



Departemen
Kehutanan dan Perkebunan



NATURAL RESOURCES
MANAGEMENT PROGRAM

Principles and Practices for Forest Harvesting in Indonesia



July 1999

Technical Report

**Principles and Practices
for Forestry Harvesting
in Indonesia**

July 1999

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FOREWORD

These Principles and Practices for Forest Harvesting in Indonesia (P&Ps) have been developed to provide a uniform basis for forest harvesting practices in the Production and Limited Production Forests of Indonesia. The document provides details on principles relating to improved timber harvesting for reducing environmental and social impacts.

The P&Ps serve as an expression of Indonesia's commitment to sustainable forest management (SFM). It is intended that they be adopted by timber harvesting companies and local communities, with appropriate modifications to reflect local circumstances.

Through the development of forestry and environmental legislation, as well as forest policies, Indonesia has provided strong support for SFM. The ability of Indonesia to implement SFM will be enhanced by the adoption of this document and complementary measures for implementing and assessing adherence. It is important to point out that in order to contribute to SFM, the P&Ps must be supported by policies based on fundamental principles of sustainable resource use. These policies must be implemented through an effective legislative and regulatory framework that enables and encourages appropriate forest management practices. Such a framework should include a forest land use planning hierarchy, based on stakeholder participation, and covering national, regional and site-specific levels.

The development of these P&Ps is consistent with the principles of SFM as outlined in the Code of Practice for Forest Harvesting in Asia-Pacific and by the United Nations' Intergovernmental Forum on Forests (IFF) of which Indonesia is a member.

The P&Ps provide detailed principles for improving the way natural forests are harvested to minimise adverse environmental and social impacts and to ensure a viable residual stand. They provide the standards for WHAT is involved in planning and implementing harvesting activities in natural forests and why certain operations should be undertaken. The establishment of standards for harvesting operations is fundamental to the development of Guidelines for Reduced Impact Logging, which provide the mechanism for HOW the standards will be applied in the field.

While the P&Ps are comprehensive, they contain only standards which have been implemented or can be undertaken operationally in the forests of Indonesia. Many of the practices specified may not be undertaken immediately, but with training and education of all stakeholders involved, the principles will be better understood to form the cornerstone of sustainable forest management in Indonesia.

The contents of the P&Ps are based on practical and efficient harvesting operations undertaken in tropical forests and from research results in forest hydrology, engineering and ecology.

ABBREVIATIONS

%	Percent
APFC	Asia Pacific Forestry Commission
APHI	Association of Indonesian Forest Concessionaires
cm	Centimetres
DBH	Diameter at Breast Height (1.3 m)
FAO	Food and Agriculture Organisation
FMC	Flexible Trail Machine
FOPS	Falling Object Protection Structure
GIS	Geographic Information System
GOI	Government of Indonesia
GPS	Global Positioning System
IFF	Intergovernmental Forum on Forests
ILO	International Labour Organisation
IPF	Intergovernmental Panel on Forests
ISO	International Standards Office
ITTO	International Tropical Timber Organisation
m	Metres
MIS	Management Information System
mm	Millimetres
MoFEC	Ministry of Forestry and Estate Crops
P&Ps	Principles and Practices for Forest Harvesting in Indonesia
ROPS	Roll Over Protection Structure
SFM	Sustainable Forest Management
UNCED	United Nations Conference on Environment and Development

Table of Contents

	Page No.
Foreword	i
Abbreviations	iii
1. Background	1
1.1 Purpose	1
1.2 Scope and Coverage	2
1.3 Implementation	3
1.4 Stakeholder Roles in Implementation	3
2. Training and Education	5
2.1 Forest Harvesting Competency Based Requirements	5
2.2 Minimum Standards of Competence	6
3. The Need for Forest Planning	8
3.1 Planning Hierarchy	8
4. Forest Harvest Planning	10
4.1 Site Specific Forest Use Planning	10
4.2 Planning Levels	10
4.3 Amendment to the Plans	14
4.4 Planning Staff	14
4.5 Plan Approval Process	14
4.6 Geographic Information Systems and the Planning Process	16
5. Guidelines for Planning the Zoning of Exclusion Areas	17
5.1 Zoned Exclusion Areas	17
5.2 Management of Exclusion Areas	17
5.3 Buffer Zones	18
6. Harvesting Planning Guidelines for Transportation and Watercourse Crossings	23
6.1 Roading	23
6.2 Watercourse Crossings	33
6.3 Log Pond and Wharf	38
6.4 Quarries	40
7. Pre-harvest Field Preparation	42
7.1 Tree Marking	42
7.2 Locating Log Landings and Skid Trails	43
7.3 Skid Trails	46
8. Harvesting Operations	52
8.1 Supervision of Operations	52
8.2 Harvesting	53
8.3 Log Preparation	56
8.4 Extraction Systems	57
8.5 Log Storage and Transportation Systems	60
8.6 Weather Limitations on Harvesting	62
8.7 Log Scaling and Measuring	65
8.8 Log Ownership	66
8.9 Monitoring and Evaluation of Harvesting Operations	66
8.10 Post-harvesting Activities	71
8.11 Completion of Operations	73

9. Harvesting Equipment Maintenance, and Servicing	75
9.1 Moving Equipment.....	75
9.2 Workshop Facilities.....	75
9.3 Toxic Waste.....	75
9.4 Main Fuel and Oil Storage.....	75
9.5 Field Servicing and Maintenance	76
9.6 Refuse Disposal.....	76
10. Camp Hygiene.....	77
10.1 Camp Design Plans	77
10.2 Water Supply.....	77
10.3 Waste Disposal.....	77
10.4 Domestic Waste Water	77
10.5 Refuse Disposal.....	78
10.6 Water Ponding.....	78
10.7 Additional Facilities	78
11. Safety	79
11.1 Protective Clothing and Safety Equipment Requirements.....	79
11.2 Equipment Safety Requirements	79
12. Fire Precautions.....	83
12.1 Operational Requirements.....	83
12.2 Chainsaws and Machines	72
Glossary.....	85
References	91

Appendices

Appendix 1: Conversion Table for Slope Measurements.....	93
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Figures

Figure 4-1:	Planning System Structure.....	11
Figure 4-2:	Example of Operational Planning Map	15
Figure 5-1:	Stream Buffer Exclusion Areas	19
Figure 5-2:	Gully Buffer Strips	21
Figure 5-3:	Waterway Buffer Zones.....	21
Figure 5-4:	Classification of Watercourses	22
Figure 6-1:	Road Location and Drainage	26
Figure 6-2:	Road and Spur Road Drainage Construction.....	29
Figure 6-3:	Major and Minor Road Construction.....	30
Figure 6-4:	Removal of Temporary Bridges to Minimise Impact on Stream Flow	32
Figure 6-5:	Cross-drain System.....	32
Figure 6-6:	Temporary Bridge.....	35
Figure 6-7:	Timber Bridge.....	36
Figure 6-8:	Soil Covered Timber Bridge.....	36
Figure 6-9:	Culvert Construction	37
Figure 7-1:	Log Landing Location	43
Figure 7-2:	Log Landing Construction.....	44
Figure 7-3:	Log Loading on Corded Landing.....	445
Figure 7-4:	Skid Trail Construction	49
Figure 7-5:	Skid Trail Cross-drain Construction.....	50
Figure 8-1:	Directional Felling and Skid Trail Location	54
Figure 8-2:	Tree Feller Escape Routes	55
Figure 8-3:	Tree Felling Technique.....	56
Figure 8-4:	Log Cross-cutting	57
Figure 8-5:	Monitoring and Evaluation Procedure.....	68
Figure 8-6:	Evaluation of Harvesting Operations - Forms 1 and 2.....	69
Figure 8-7:	Harvesting Completion Certificate	74
Figure 9-1:	Removal of all Refuse from Harvesting Areas	76
Figure 11-1:	Safety Equipment	80
Figure 11-2:	Safety Equipment for Chainsaws.....	81
Figure 11-3:	Guide to Protective Clothing	79

1. Background

The demands on the natural forests in Indonesia to provide a range of goods and services are increasing. There are many external factors influencing how these forests are managed, including demographic changes, changing land use requirements, drought and fire. As a consequence, concern has been raised over whether the demand for forest products from these forests can be met in a sustainable manner, given the increase in demand and the reduction of the forest resource.

Concern for Indonesia's forests and their capacity to maintain environment values while producing timber and non-timber products in perpetuity has been highlighted following the recent drought and subsequent fires in 1997/98. During this period, large areas of forest and forest land were burnt.

Indonesia is a member of the International Tropical Timber Organisation (ITTO) which has adopted a multifaceted approach to sustainable forest management, through the introduction of the "Year 2000 Objective". This objective was a call for all internationally traded tropical timber to be sourced from sustainably managed forests by the year 2000. Indonesia is endeavouring to implement in its Production Forests, ITTO Guidelines for Sustainable Management of Natural Tropical Forests through codes of practice and reduced impact logging guidelines.

In 1995, the Intergovernmental Panel on Forests (IPF) was established by the United Nations Commission on Sustainable Development to follow up the UNCED recommendations on sustainable forest management. Indonesia is a member of the IPF which in 1997, was succeeded by the Intergovernmental Forum on Forests (IFF). One particular recommendation of the IPF was a call for the development of voluntary codes of practice for forest management activities including timber harvesting.

1.1 Purpose

The purpose of the Principles and Practices for Forest Harvesting in Indonesia (P&Ps) is to provide:

- an expression of Indonesia's commitment to sustainable forest management;
- support for maximum economic contribution from the forest with an emphasis on timber harvesting;
- an active tool that supports sustainable forest management;
- a uniform guide to improved harvesting practices;
- support for Ministry of Forestry and Estate Crops, concessionaires, co-operatives and rural communities seeking guidance for improved forest harvesting practices;
- minimum guidelines for forest harvesting activities consistent with the principles of sustainable forest management, which can be audited using criteria and indicators for ecolabelling and forest certification;
- support for recognition and respect for "*adat*" rights;

- support for the protection of sites of cultural, historical, archaeological, geomorphological, biological and spiritual significance;
- guidelines for conservation measures for flora and fauna within Production and Limited Production Forests;
- guidelines for the maintenance of forest regeneration and species diversity;
- support for promoting forest productivity;
- support for improvement of the health and safety of forest workers.

1.2 Scope and Coverage

The Principles and Practices for Forest Harvesting in Indonesia provide standards which will allow Production Forests to be harvested economically with minimal adverse impact on the forest environment. They are designed to balance improved profitability with protection of environment and social values. Implementation of the P&Ps through reduced impact logging guidelines will ensure that important resources are protected during timber harvesting operations, and that the benefits of harvesting to communities, industry and to the nation are maximised.

1.2.1 Harvesting

Sustainable harvesting principles apply across all harvesting activities.

- The principles for harvesting are consistent with those developed by ITTO and the Food and Agriculture Organisation (FAO) and include:
 - commitment to long term sustainable provision of products and services;
 - maintenance of environmental integrity in harvesting planning and implementation;
 - consultation on all issues with all affected stakeholders including those recognised under *Adat* Law;
 - comprehensive harvest planning;
 - effective implementation and control of harvesting operations with predetermined guidelines and benchmarks;
 - thorough post-harvest assessment and communication of results to the planning team and to harvesting personnel;
 - development of a competent and properly trained and motivated workforce.
- Harvesting is a major practical silvicultural tool where professional foresters' inputs can be provided to ensure the permanence of the forest resource.
- While it is recognised that non-timber forest products are also important, the harvest of non-timber forest products requires additional special consideration. These specific considerations can be best addressed through the development of principles and practices for the harvesting of non-timber forest products.

1.3 Implementation

These Principles and Practices for Forest Harvesting in Indonesia provide sets of standards on harvesting timber in natural Production Forests. These P&Ps concentrate on “what the standards are in a forest harvesting operation” rather than how to apply these standards in the field.

These Principles and Practices for Forest Harvesting in Indonesia should be implemented by undertaking the following:

- Development of Guidelines for Reduced Impact Logging (RIL).
- Training for all those to be involved from manager to machine operator.
- Effective management to:
 - maintain future resource use options;
 - maintain biodiversity and regeneration processes;
 - ensure economic returns are maximised while protecting environmental and social values.
- Improved resource management to provide stability to industry, local populations and Indonesia’s economy.

1.4 Stakeholder Roles in Implementation

1.4.1 Government

- Provide policies, legislation, implementation mechanisms, staff, education and training, resources and encouragement
- Provide sustainable use and management of forest, land and water resources, on all classes of land for the benefit of all of society.
- Facilitate training and funding for implementation with donors.
- Assist local communities in implementing the principles of SFM.
- Assist the timber industry to implement sound harvesting practices.
- Develop operational mechanisms at Provincial/District level (*Dinas Kehutanan*) to facilitate implementation of the P&Ps through Guidelines for Reduced Impact Logging.
- Evaluate and approve harvesting plans.
- Monitor and evaluate harvesting operations for compliance with the harvesting contracts and the Principles and Practices for Forest Harvesting.
- Enforce compliance with legislation and harvesting agreements.

1.4.2 Industry and Forest Managers

- Prepare harvesting plans in consultation with forest owners and/or Provincial Forest Offices.
- Implement effective and safe operations, while protecting the environment.
- Optimise the benefits to society and the company.
- Train and employ local community members to increase the level of skills that can be used in the future

1.4.3 Local Communities

- Prepare harvesting plans in consultation with NGOs and Provincial Forest Offices.
- Implement effective and safe operations.
- Implementing the principles of SFM.
- Assist the contractors to implement sound harvesting practices.
- Use their resources wisely in a way that will maintain options for future development and so provide for their long-term benefit.
- Maintain the capacity of the forest resource to supply community needs.
- Protect neighbouring and downstream resources.
- Make use of local authority (provincial/ district government) expertise.
- Identify multiple use needs of all forest-based villagers.

1.4.4 Non-Government Organisations

- Provide education and promotion of the P&Ps to communities and others.
- Assist with ensuring P&Ps compliance, monitoring and auditing procedures.
- Training of local communities and forest based villages in forest management.
- Assist local communities in preparing community based forest management plans and their implementation.
- Support the training and awareness of the legal basis and regulatory framework for community based forest management.

2. Training and Education

The objective of training and education is to ensure that all persons who are engaged in forest planning, harvest planning, and harvesting operations are competent in the use and maintenance of equipment and to carry out the assigned tasks. It is also necessary to ensure that people responsible for particular tasks understand the requirements of those tasks.

2.1 Forest Harvesting Competency Based Requirements

Skills and training needs assessments along with the development of minimum competency standards for forest harvesting operations should be undertaken prior to the implementation of the P&Ps. Properly trained staff or workers with the necessary competencies for undertaking forest harvesting and associated activities work more safely and effectively. This leads to more efficient work practices with less downtime due to injury and machinery breakdowns.

Training should involve the following:

- Development of competencies, levels and standards for timber harvesting in Indonesia;
- Competency-based training programmes developed and implemented as
 - train-the-trainer,
 - operator, supervisor level;
- Study tours and executive style training and information and awareness to policy makers and senior executives;
- Training and awareness training for middle level managers.

Training should be undertaken to ensure competencies in the following areas.

2.1.1 Planning and Survey

- Understanding the Principles and Practices for Forest Harvesting in Indonesia and its requirement for:
 - long and short term planning, operations and monitoring, and need of Geographic Information System (GIS);
 - watercourse class recognition and buffer zones;
 - road location, alignment and construction;
 - skid trail location, alignment and construction;
 - navigation techniques and equipment (compass and Global Positioning System).
- Surveying, inventory and mensuration.
- Tree identification.
- Aerial/ satellite photography and interpretation.

- Accurate maps.
- Road design and survey.
- Watercourse crossing location and construction.
- Correct marking and recording of survey information.
- Stakeholder consultation.

2.1.2 Equipment Operation and Maintenance

- Understanding by staff of the requirements of the Principles and Practices for Forest Harvesting in Indonesia and their individual tasks.
- Certification of skills and competencies from a recognised training institution for equipment operators (for chainsaws, boats, harvesting and transport machines) based on standards approved by MoFEC and APHI.
- Specific competencies in safe work practices as indicated in ILO Code of Practice on Safety and Health in Forest Work.

2.1.3 Harvesting and Associated Procedures

- All staff engaged in harvesting and associated procedures are competent to meet the needs of their position, including:
 - species identification
 - determining accurate log length and diameter measurement and assessing defect allowance;
 - tree and log marking requirements;
- Certification of all log scalers based on standards approved by MoFEC and APHI.
- Harvesting monitoring and post-harvest evaluation.
- MoFEC, APHI, companies, communities and training institutions should agree a target date and an appropriate mechanism for certification or attainment of competence of all machinery and equipment operators.

2.2 Minimum Standards of Competence

- It is desirable that minimum competency standards be developed for each of the following vocations:
 - supervisors should be able to supervise field survey crews, harvesting and skidding operations and monitoring and evaluation;
 - forest harvesting planners should be able to plan for efficient harvesting operations;
 - machine operators (loaders, skidders), tree fellers should be able to undertake their work efficiently;
 - log scalers should be able to scale logs and record correctly;

- truck drivers, railway operators, helicopter pilots, skyline operators, boat and barge operators should be able to operate machines in an efficient and safe manner;
- safety officers should have the necessary skills to implement their work.

3. The Need for Forest Planning

Forest planning will assist in the sustainable management of forests and land resources, and provide for stakeholder participation in the planning process. Planning also provides protection of areas identified as significant for conservation and identifies areas suitable for forest harvesting while ensuring proper and equitable returns to stakeholders based on sustained productivity.

3.1 Planning Hierarchy

Planning must be carried out at a range of hierarchical levels (country / regional / site specific) to ensure that the process is acceptable to all stakeholders. These P&Ps concentrate on the site-specific level.

Forest land-use planning will identify the most desirable management practices which ensure that areas are managed sustainably. Site specific forest use planning ensures that the particular forest is designated for its most appropriate use according to specified criteria. In Indonesia, this is the designation of forests into forest functional categories.

3.1.1 Forest Land Use Planning

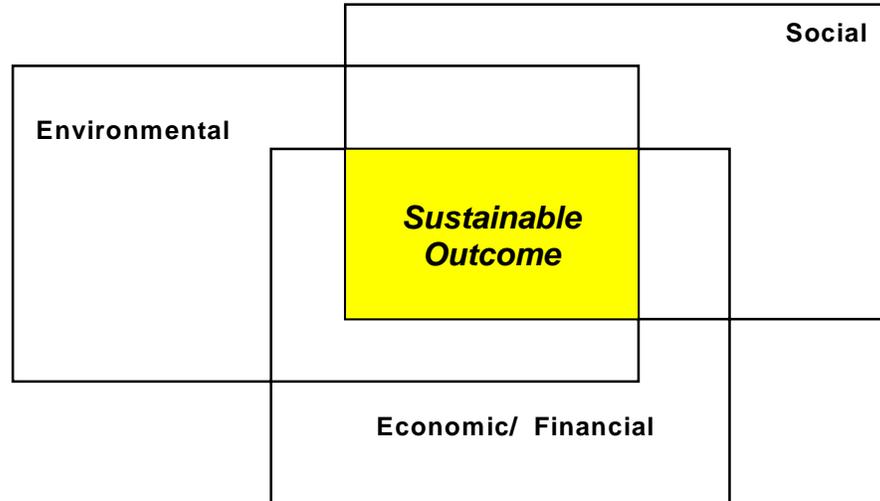
At the forest level, sustainable forest management should involve consideration of three aspects which are crucial to its implementation.

These aspects are:

- Ecological:
- Economic/ financial
- Social

The three aspects can be viewed as three layers superimposed upon each other simultaneously, with the common area defining what is possible, relevant and sustainable.

This condition is shown as follows:



To do this, participation from stakeholders representing each area of interest is essential, as is input/guidance from persons who are independent of the issues.

Initial planning for forest use should identify specific issues which are relevant to local user groups. It is important to incorporate any previous land use planning or site capability information. This will lead to options for future use of the area developed on sound land use planning principles.

As an important part of the planning process, the forest benefits of sustainable land management as well as the costs of poor land management practices in economic and environmental terms need to be explained to stakeholders. These benefits should:

- present communities / co-operatives with a range of options for sustainable management of particular areas, including the conservation of particular forests;
- clearly present the consequences of using land or forests beyond their capacity for sustained production.

4. Forest Harvest Planning

Forest harvest planning is required to develop comprehensive strategic and operational planning mechanisms which ensure that forest values will be protected during harvesting. It also provides responsible use of land and forest resources for the maximum benefit of all stakeholders by taking account of the socio-economic and environmental impacts on the area. This approach assists in the provision of efficient, cost effective and environmentally responsible means of harvesting timber.

4.1 Site Specific Forest Use Planning

- Forest land use decisions should be documented in the concession agreement and in the forest harvesting plan.
- Forest planners should determine the availability of both cadastral and physical land classification information which could include:
 - Physical land classification
 - contours/slope,
 - soil classes,
 - drainage patterns,
 - forest type and distribution.
 - Cadastral land classification
 - cadastral boundaries (HPH areas),
 - Forest Functional Categories (revised based on field conditions).

Most of this spatial information can be adequately displayed as maps, which should be accurate, “geo-corrected” (for GPS use and for inclusion in Provincial Land Use Plans) and at a scale that provides sufficient detail for the purposes required.

Planning information, combined with consultation with stakeholders, should be used to identify suitable areas for production and conservation. Where this is unavailable, a combination of field checking, aerial photo interpretation/satellite imagery and data interpretation will refine details for the planning process.

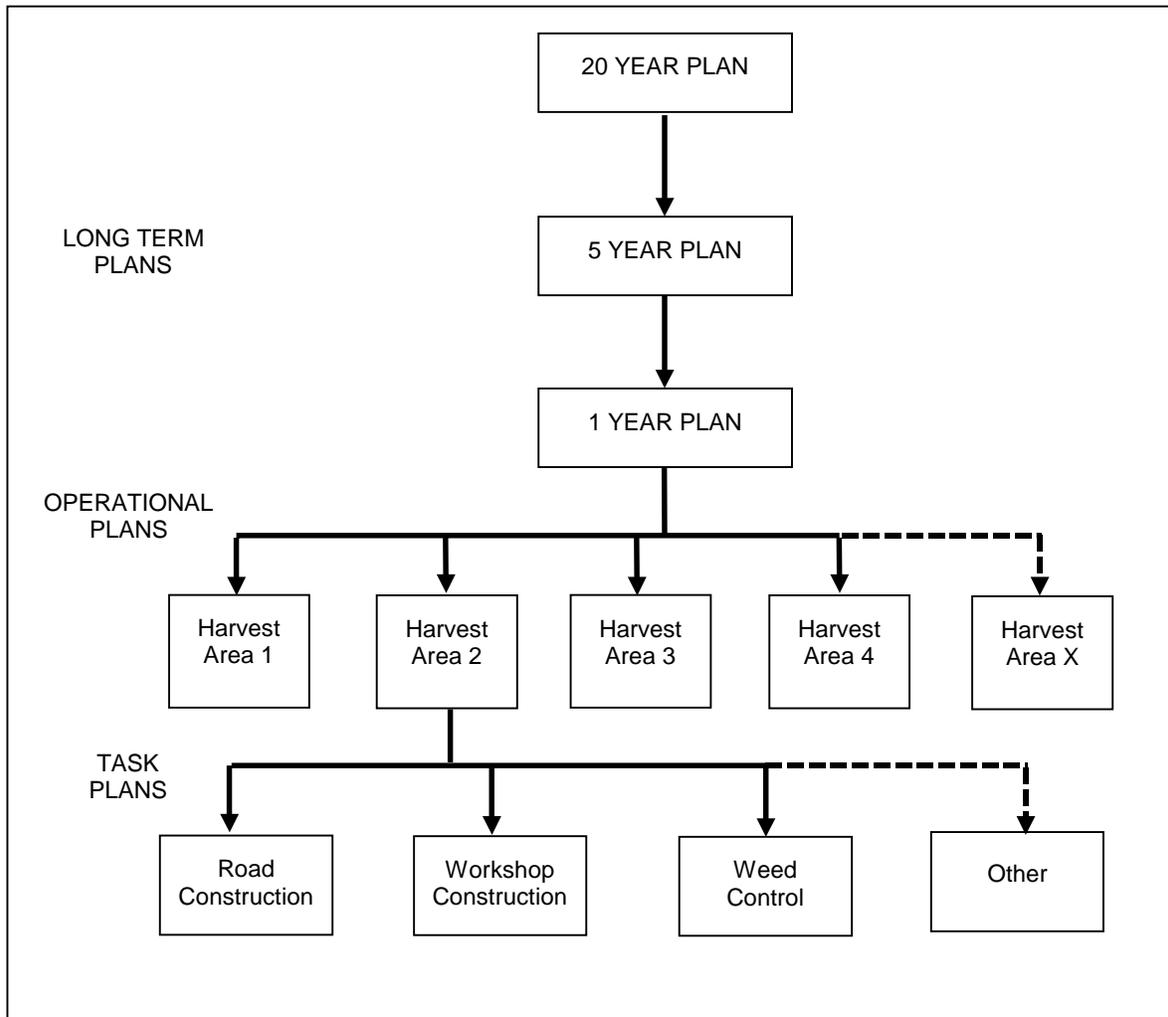
It is essential for areas of timber concessions to be unambiguously delineated on accurate maps. These maps must be part of the concession agreement.

4.2 Planning Levels

Planning for forest harvesting is a multi-tiered process often comprising three levels (Figure 4-1). These levels are:

1. Long term planning
2. Operational planning
3. Task planning.

Figure 4-1: Planning System Structure



4.2.1 Long Term Planning

Long term or strategic plans are broadscale plans which are based primarily on available information. They are a guide to future activity for all operations. Because of the timescale involved, they are subject to change. More than one plan can be used to allow planning across a range of time periods. Long term plans must be known and understood at all management levels, including the logging camp manager. Additionally, these strategic plans must provide the basic orientation for operational plans. The long term plan should include, yet not be restricted to:

- identification of areas to be reserved for biodiversity conservation;
- community land use needs and requirements;

- identification of areas to be reserved within proposed harvest areas (e.g. watercourse protection);
- the future harvest areas and an approximate time schedule for harvesting;
- the approximate size and boundaries of each harvest area;
- the approximate volumes and types of wood to be produced from each harvest area;
- future roading requirements to access harvest areas;
- the approximate road locations and standards of road required;
- monitoring standards to ensure adequate rehabilitation of the site.

4.2.2 Operational Planning

Operational plans are developed for each individual harvest area, based mainly on a site assessment. They should include maps of the harvesting block (coupe) showing a detailed plan of the activities to occur form the main element of the operational plan (Figure 4-2).

Major points covered in the Operational Plan include:

- accurate maps based on GIS developed for the concession showing physical and cadastral features;
- harvest area (approx. size 100 ha) location and boundaries which should follow topographic or natural features;
- areas excluded from harvesting through prescriptions for flora and fauna protection, water quality protection, or other identified reasons;
- silvicultural prescriptions to be adopted for different forest types if available;
- method of tree marking selection and protection;
- volume of wood to be removed by species and size class;
- location, design, construction, maintenance and closure of roads, landings, log ponds and skid trails to minimise disturbance to forest, soil and water resources.

4.2.3 Task Planning

Task planning is undertaken by the concessionaire / communities and details responsibilities of staff and how the work is to be undertaken. It is appropriate that task plans be prepared after the operational plan has been developed.

Once the plans are developed by the concessionaire/contractor enterprise, the plans should be submitted to the Provincial Forest Office for approval.

4.2.4 Planning Procedure

The following table details the recommended requirements for each planning level.

Planning Procedure

	Long Term Planning	Operational Planning	Task Planning
Needs	1:100,000 - 1:25,000 scale base maps are often appropriate Aerial photographs, satellite images Land ownership boundaries Contour information, watercourses Future development plans Prior land classification	<1:10,000 scale maps are often appropriate The operational plan is a more detailed version of a section of the Annual Plan Deals specific harvest areas Inventory (usually 100% intensity)	<1:5,000 scale maps often appropriate Short-term plan for a particular job, e.g. road construction. Job marked in the field Briefing of operators by their supervisor Input from local supervisory staff from Provincial Forest Office
Inspection requirements	Low intensity, e.g. aerial inspection, ground inspection of key points.	Ground inspection to define operational details such as excluded area boundaries, watercourses, roads, major skid trails and log landing locations.	Intensive ground inspection Operators <u>must</u> inspect the area before starting the harvesting
Detail shown on the map	Boundary of licence Key points (e.g. log ponds) Broad roading plan with major roads Areas previously harvested Current operations Future operations and order in which coupes will be logged NOTE: These details are subject to change at the operational planning stage when more detailed ground inspections are made	Contours Boundary of operation Excluded areas Designated watercourses and buffers Land tenure boundaries Key points (e.g. log ponds) Detailed roading plan for the harvest area; Major skid trails and skid direction; Minor skid trail pattern and direction; Log landings Watercourse crossings (Sites where operations do not adhere to the P&Ps	Plan shows the whole operation Critical aspects are highlighted for discussion
Details of written plan submitted with the map	Compliance with current planning guidelines Proposed silvicultural system for harvesting Location and design details for log pond construction Design for any new camps	Period for which the plan applies Species to be harvested Anticipated volumes and net area Details of, and reasons for, any deviations	Specifications for the job must be explained to operators - construction standard - felling direction - rehabilitation work - special considerations, e.g. buffer zones
When is the plan submitted?	20 years and 5 years	At least 3 months before operations in a particular area	Just prior to commencement.
Who sees the plans? (stakeholders)	Community representatives Forest Department (head office and local supervisory staff) Provincial Forest Office Camp Manager Production Manager Surveyors	Community representatives Camp Manager Production Manager, surveyors The Provincial Forest Office immediately responsible for the operation will inspect the Operational Plan in the field with the company/ community representative	Operators for specific tasks, e.g. road construction, felling, skidding
Who approves the plan?	Provincial Forest Office	The responsible Provincial Forest Office may approve Operational Plans provided that they are in line with the intent of the approved Long Term Plan. <u>Decision is given following field inspection.</u> Departure from the intent of the Plan require the approval of the Provincial Officer	The Forest Planning Team of the concessionaire/communities Decision given following field inspection

4.3 Amendment to the Plans

Should any major changes in relation to the fundamental approach be required, to either the long term or operational plans, then details of the process to be undertaken for the proposed change should be resubmitted to the Provincial Forest Office.

Stakeholders are to be advised of approved departures from the plan.

4.4 Planning Staff

The following table details recommendations for staff for effective forest planning.

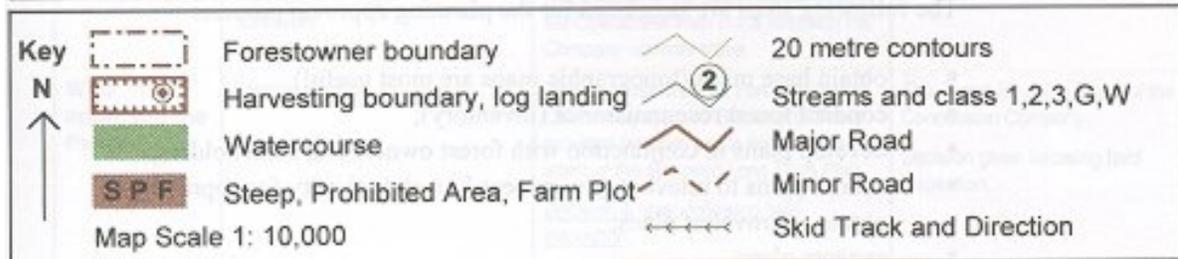
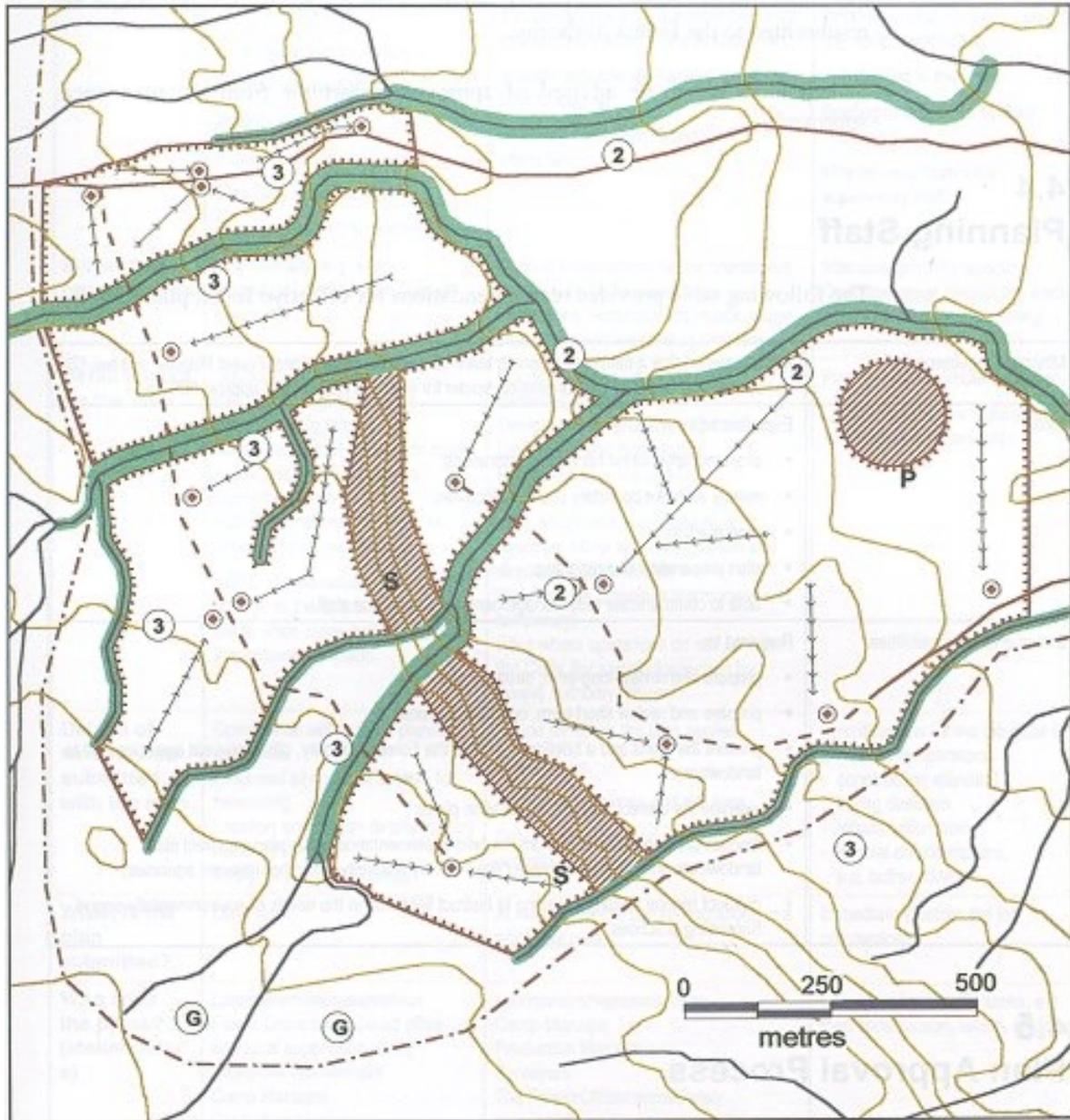
Minimum requirements	It is suggested that a minimum planning team consist of a professional Forest Planner and two (2) assistants, employed by the concession holder for areas consisting of approx. 500 ha.
Skills	Experienced in: <ul style="list-style-type: none"> ▪ planning large forest harvesting operations; ▪ survey skills for boundary and road location; ▪ mapping and map reading; ▪ plan preparation and reporting; ▪ able to communicate with management and operations staff.
Duties and responsibilities	Required to: <ul style="list-style-type: none"> ▪ prepare and review long-term, strategic plans; ▪ prepare and review short-term, operational plans; ▪ present the plans and a briefing to staff of the Provincial Forest Office, other relevant agencies and to landowners; ▪ oversee the correct field implementation plans; ▪ discuss problems which arise from the field implementation of the plan with field staff, landowners and representatives of the Provincial Forestry Office and other relevant agencies; ▪ conduct regular training sessions to instruct field operatives in the needs of environmentally sound harvesting practice.

4.5 Plan Approval Process

The following steps are suggested for the planning approval process:

- obtain base maps (topographic maps with appropriate contour intervals are most useful);
- conduct forest inventory;
- develop plan in conjunction with communities and other stakeholders;
- submit plan to Provincial Forest Office for approval;
- plan approved;
- plan executed.

Figure 4-2: Example of Operational Planning Map



4.6 Geographic Information Systems and the Planning Process

Many companies and institutions in Indonesia are now developing the capability to use a Geographic Information System (GIS) and computer aided mapping for small and large scale harvesting operations. Acquiring and developing this information and technology can be undertaken in a number of ways. The recent trend in forest practice is to develop complete Management Information Systems (MIS) which provide the framework for all levels of planning. GIS is the basic tool for such an approach.

4.6.1 Mapping Systems

Generally a GIS is developed which can hold physical (e.g. contours, drainage patterns), cadastral and administrative (e.g. concession boundaries) land classification information. A GIS is best described as a series of referenced map layers that record spatial data including contours and harvest boundaries. Associated with the spatial data are point attributes which include species, age and management history.

Information can be collected from:

- past records/maps;
- aerial photos and satellite imagery;
- ground survey.

The GIS can then be used to retrieve data required for planning. This can then be used to generate forest management and harvesting maps at a range of scales and containing different information depending on the planning required. Maps prepared in this manner can be used as part of the overall GIS or MIS for the company or community.

4.6.2 Forest Management Maps

Forest management maps should show the relevant information required for a particular planning decision. They should be developed at the appropriate scale for a given purpose. The maps developed should be appropriate to be included with the Provincial Spatial Planning objectives and should therefore be “corrected” to ensure compatibility. Maps prepared in isolation will not aid in the sustainable development of the provincial resources.

4.6.3 Inventory

An inventory should be undertaken to assess the forest and determine the volume and species available for harvest. This information allows planners to match required wood types and volumes with cutting areas. Inventory information should also be linked to GIS systems. This will provide a means of monitoring harvest levels and to refine the inventory estimates in other areas.

5. Guidelines for Planning the Zoning of Exclusion Areas

Guidelines for determining areas to be zoned for exclusion from harvesting are important to identify and protect such areas within Production Forests. The implementation of these zones will reduce downstream impacts on people and resources.

Maintenance of biodiversity, soil and water quality is of primary importance in flora and fauna conservation. Conservation of biodiversity is dependent on the maintenance of habitat, enhancing opportunities for regeneration of cut-over areas and by linking areas excluded from harvesting to allow genetic interchange. This may be achieved in the following ways:

- setting aside reserves within production areas large enough to maintain viable populations of plants and animals;
- retaining areas of unlogged forest to maintain habitat diversity. These areas should connect patches of forest as corridors which will not be logged;
- retaining habitat trees in production areas where appropriate for wildlife;
- representation of forest types to be adequately reserved in conservation forests;
- databases on the distribution of plant and animal species within forest areas are also useful for benchmarking purposes.

5.1 Zoned Exclusion Areas

Areas will be excluded from harvesting in Production Forests as follows:

- declared Protected Areas under any national or provincial statutes;
- areas of cultural importance;
- declared areas of ecological or scientific importance, including coral reefs, lagoon islands, swamps, wetlands, mangroves and special forest watersheds;
- areas that exceed specified altitude or slope limits;
- areas specified under legislation or regulations for local community land use practices, including the protection of village/ town water supply catchments.

5.2 Management of Exclusion Areas

Areas excluded from harvesting are to be managed as follows:

- no trees to be felled within areas not to be logged or their buffer zones;

- machine access is prohibited except where watercourse crossings are permitted. Where permitted, access must be by the shortest possible distance;
- if a tree has been felled inadvertently into a watercourse, all debris is to be removed without disturbance to the watercourse bank;
- no earthworks, or spoil from earthworks, is to fall within a designated area not to be logged or its buffer zone;
- no harvesting debris is to be pushed into areas excluded from forest harvesting;
- trees should be felled away from buffer zones and watercourses where possible.

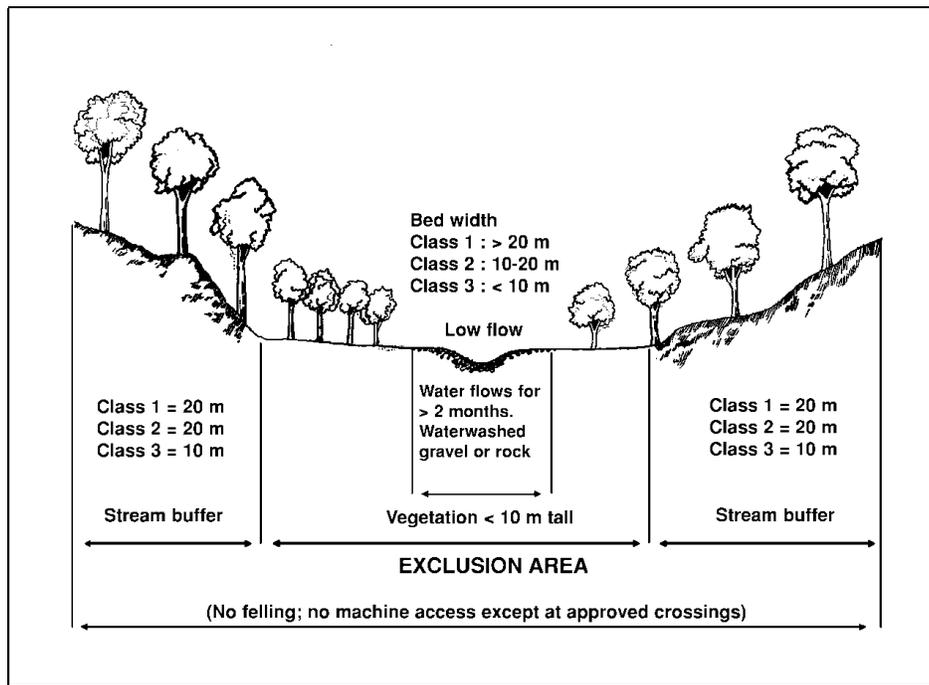
5.3 Buffer Zones

Buffer zones are areas nominated for protection and are to be managed as follows:

- protected areas and associated buffer zones are required irrespective of whether or not the feature is identified on available maps.
- field inspection is an important and necessary part of harvesting operations to determine protection areas and buffer zones.
- buffer zones are excluded from harvesting as follows:
 - cultural areas including village areas, gardens;
 - shorelines, lagoons, lakes and water storage areas;
 - landslip areas;
 - designated watercourses¹. (This is the area from bank to bank of normal flush season flow Figure 5-1);
 - specific wildlife habitats and areas containing endangered species.

¹ Defined in Section 5.3.1

Figure 5-1: Stream Buffer Exclusion Areas



Buffer zone protection can be categorised as follows:

Area	Minimum required buffer zone protection
Cultural areas	Buffer of 30 m
Buffers around: <ul style="list-style-type: none"> ▪ Lakes ▪ Lagoons ▪ Shoreline ▪ Water storage areas 	<p>The buffer width is measured from the high water mark or edge of the mangrove vegetation if this occurs above the high water mark. The minimum width depends on slope:</p> <ul style="list-style-type: none"> ▪ where slope is <17%, buffer width = 50 metres ▪ where slope is > 17%, buffer width = 100 metres <p>The only exceptions are:</p> <ul style="list-style-type: none"> ▪ for a log pond, where the buffer may be reduced to 50 metres ▪ for a wharf, associated log pond and ship loading area projection to the seaway where vegetation may be cleared to the water's edge for the width of the wharf, to a maximum of 100 metres.
Landslip areas	The area of the landslip, the landslip spoil and the catchment of the slip and spoil.
Designated watercourses (Defined in Section 5.3.1)	<p>Retain vegetation on both sides of the watercourse.</p> <p>Delineation of the buffer zone will start where the vegetation is 10 metres high or greater.</p> <ul style="list-style-type: none"> Class 1 Stream – 30 metres each side Class 2 Stream – 20 metres each side Class 3 Stream – 10 metres each side Gullies – merchantable trees may be felled; extraction equipment is not permitted within 10 metres of either side Waterways (catchment area 2 ha) – merchantable trees may be felled; extraction equipment is not permitted within 5 metres of either side

5.3.1 Buffer Zones for Watercourses

The following table provides definitions of different watercourse terms used in forest harvest planning.

Watercourses	<p>Zones which receive and conduct concentrated overland flow for some period in most years. Flows may be permanent or periodic.</p> <p>Watercourses include streams, gullies and waterways and classes are defined in terms of permanency of flow, bed material, width and bank slope.</p> <p>The high bank of a watercourse is the level which water reaches during normal season peak flows, and may include a flood plain area. This adjacent flood plain area may be a swamp or stream meander.</p>
Streams	<p>Streams are those watercourses where water flows for more than 2 months in most years. The beds are generally characterised by the presence of clean, water-washed stone, gravel, or exposed bedrock materials.</p> <p>Class 1 streams – width of the stream-base = more than 20 metres</p> <p>Class 2 streams – width of the stream-base = 10 to 20 metres</p> <p>Class 3 streams – width of the stream-base = less than 10 metres</p>
Gullies	<p>Gullies are steep-sided channels.</p> <p>The slope of at least one bank exceeds 25%</p> <p>Depth of the bank adjacent to the bed is 30 cm or more.</p> <p>The beds of gullies are soil or covered with bark, branch and leaf litter.</p> <p>Vegetation may be growing.</p> <p>Water will flow for less than 2 months in most years.</p>
Waterways	<p>Drainage lines with a catchment of approx. 2 ha One side < 25%</p>
Swamps	<p>Swamps have surface water present for 6 months or more of the year.</p>
Designated watercourses	<p>These are all classes of streams where vegetation buffers are to be marked in the field before harvesting commences.</p>

Buffer zones and crossing points for designated watercourses, as shown in Figures 5-2 and 5-3, should be:

- shown on logging plans;
- approved in the field by a Provincial Forest Officer before operations commence.

The suggested process for classifying watercourses is provided in Figure 5-4.

Figure 5-2: Gully Buffer Strips

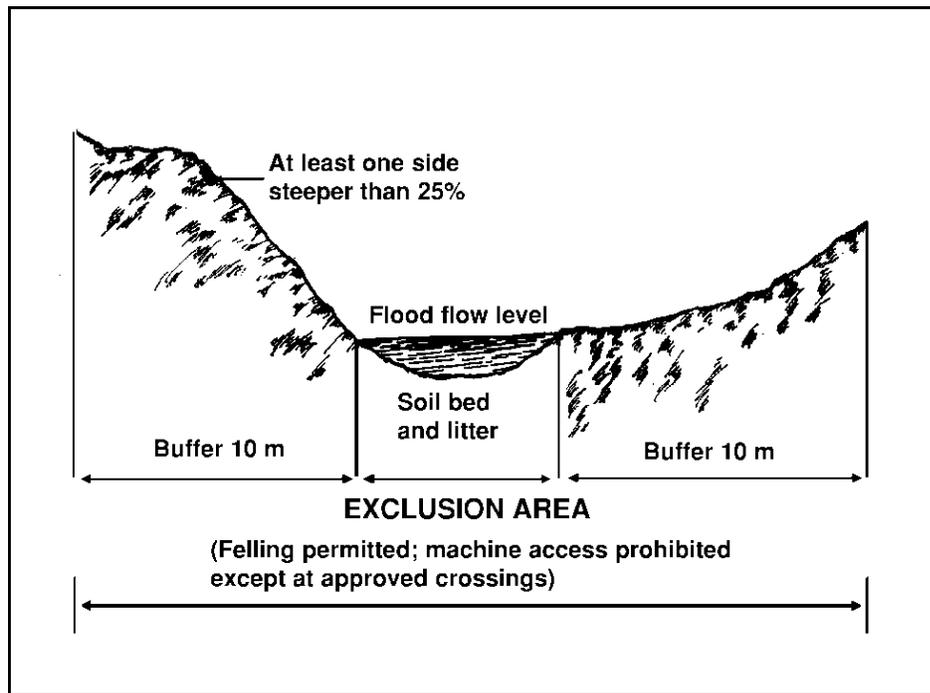


Figure 5-3: Waterway Buffer Zones

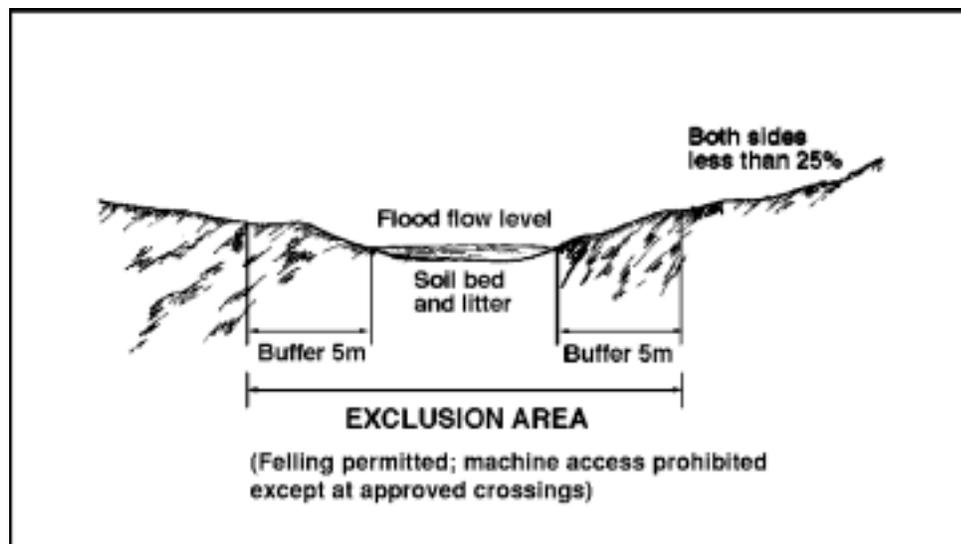
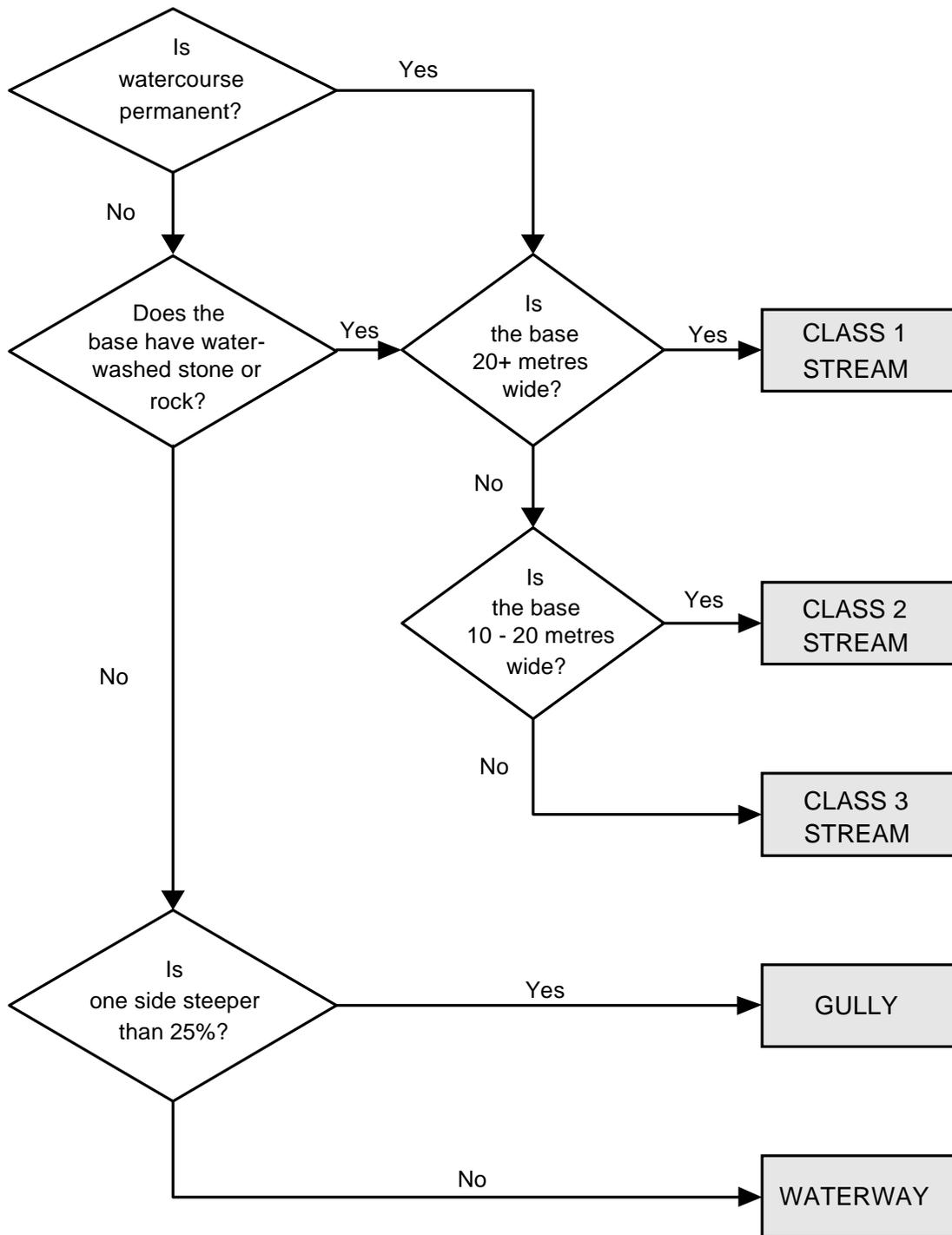


Figure 5-4: Classification of Watercourses



6. Harvesting Planning Guidelines for Transportation and Watercourse Crossings

Guidelines for transportation and watercourse crossings for safe and economical extraction systems are required to minimise the loss of productive forest area, and to minimise disturbance to excluded areas and sedimentation of watercourses. They are also designed to provide and maintain good surface and side drainage during and after construction of roads, and other construction sites.

Regardless of the type of harvest system used, pre-planning of the log extraction system and transportation will result in lower costs and less environmental and social disturbance than without effective planning.

6.1 Roding

6.1.1 Road Classification

Major roads

Major roads are those that are designed to carry trucks with large log volumes (as a guide, 2,500 m³ or more per week averaged over the logging operation).

Minor roads

Minor roads are those that are designed to carry trucks with moderate log volumes (as a guide between 1,000 and 2,500 m³ per week averaged over the time that they are in operation).

Spur roads

Spur roads are those that are designed to carry trucks with small log volumes (as a guide less than 1,000 m³ per week averaged over the time that they are in operation).

6.1.2 Road Design

Location

Roads should be designed in locations according to the following:

- The Provincial Forest Officer must approve the roadline, location and standard prior to commencement of construction;
- No earthworks, or soil spill falls into watercourse buffer areas.(Figure 6-1);
- Minimise the number of watercourse crossings;
- Balance cuts and fills to minimise transport of road construction material;

- Roads in swamp forests are inappropriate in most cases, so temporary railway systems (or other similar low impact transportation systems) located on a grid pattern should be planned for log extraction.

Areas to avoid

Areas where roading should be avoided are:

- areas excluded from harvesting (if unavoidable);
- locations which require box cuts;
- areas subject to flooding;
- steep and unstable areas;
 - gullies,
 - swamps and mangroves,
 - wetlands/watercourses,
 - conservation/reserve areas.

Suggested maximum side slopes

- 50%.²

Suggested maximum batter slopes

- 100%.

(This will be on moderately stable soils.)

Road grade specification

Road class	Preferred maximum allowable grade (%)	Preferred maximum adverse grade (%)	Preferred maximum length at maximum grade
Major road	10	8	1000 m
Minor road	15	10	750 m
Spur roads	18	12	600 m

- Steeper grades (up to 20%) for short sections (maximum 500 m) would be acceptable if this reduces the soil disturbance from road construction.
- Any two sections of road at absolute maximum gradient should be separated by 100 m of level or lower gradient.

² Slope conversion table is provided in Appendix I.

Road widths

Suggested maximum road widths are:

	Gravel Surface	Compacted Clay Surface
Major road (2-way)	10.0 m	15.0 m
Major road (1-way)	6.3 m	11.0 m
Minor road	6.0 m	7.3 m
Spur road	5.0 m	6.0 m

Road off-trailing

Curve widening will be required on corners to allow for off-trailing of trailers. Recommended road curves and widening of corners to allow for off-trailing on all road classes are:

Off-trailing on curves (metres vs. radius of curvature) based on a vehicle with overall length of 14 m

Radius (m)	25	30	40	50	60	75	100	150	200
Off-trailing	1.65	1.20	0.95	0.80	0.70	0.55	0.40	0.35	0.20

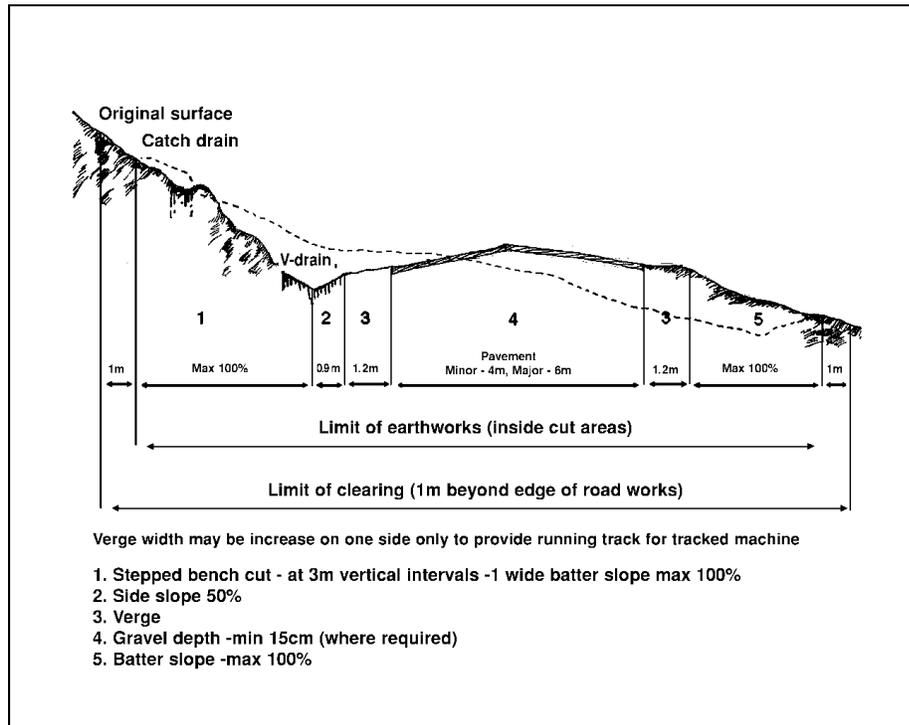
NOTES: Additional width is required in each lane, i.e. a two-lane road requires a total widening to the roadway width of twice the tabulated value.

Road curves

- Fit road curves to the topography.
- The minimum radius of the curve is related to visibility and the speed of vehicles travelling on the road. These variables are shown in the following table.

Design speed	30 kph	50 kph	80 kph
Minimum radius (use may require signs)	25 m	30 m	55 m
Desirable minimum radius	35-75 m	75-120 m	140-300 m
Minimum sight distance required	30 m	64 m	120 m
Meeting sight distance	50 m	100 m	220 m

Figure 6-1: Road Location and Drainage



6.1.3 Road and Spur Road Construction

Timing of construction

- Preliminary roadline clearing should be undertaken well ahead of final construction in any one site.
- Major and minor roads are to be completed well before logging commences.
- Construction is not to commence more than 12 months before harvesting.

Survey requirements

- Survey and mark the centreline of roads and spur roads on the ground using the defined specifications.
- Locate obligatory control points.
- Locate log landings.

Roadline development

- All merchantable stems are to be felled and extracted along the road alignment.
- All clearing debris is to be heaped and burnt within the area of roadline (or roadside log landing if this is included in the harvesting plan).
- Organic debris should not be used as fill.
- Soil heaps, berms and debris stockpiling along roadside is prohibited.

Temporary roads

- These are roads constructed to allow machinery to gain access to an area ahead of the main construction activity.

They are not generally permitted. Their location and justification should be discussed in the harvesting plan. A field inspection by the Provincial Forest Officer is suggested before approval is considered.

- Where a temporary road is approved, it should be:
 - sited so as to avoid felling trees greater than 30 cm dbh;
 - less than 4 metres wide;
 - stabilised and cross drains constructed immediately after use has been completed.

Road and spur road drainage

SPACING

- Drain all roads to minimise sediment production. Road drains should be constructed as follows:
 - at changes of slope;
 - within 50 metres of watercourse crossings;
 - additional drains to meet the maximum spacing requirement.
- Side drains which are adjacent to roads which have been box-cut should have rock bars at half the maximum drain spacing.

Indicative drain spacings are as follows:

Centreline gradient (%)	Maximum drain spacing (metres)	
	Unstable Soil	Stable Soil
0-15%	40	60
15-20%	20	40
20-25%	10	20
25%+	-	15

It is suggested that roads not be built with grades exceeding 18%. Maximum grade for logging trucks is about 23%.

DRAINAGE

The following suggestions are made to promote suitably drained roads and spur roads.

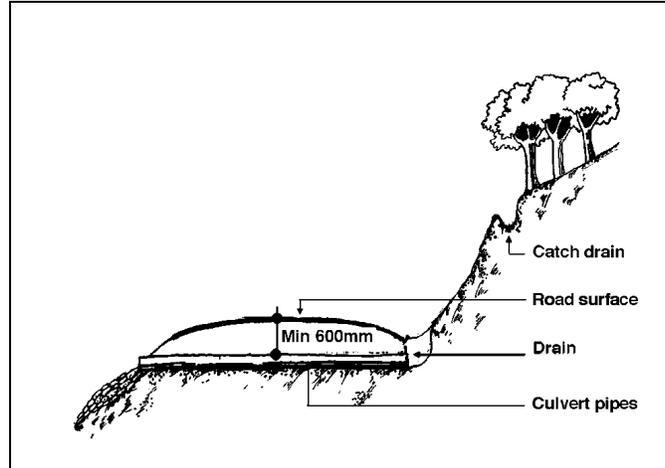
- Convex road surface should be maintained at all times.
- The installation of and minimum earth fill over culvert pipes should be in accordance with manufacturer's guidelines, e.g. 600 mm for reinforced concrete or metal pipe.
- Culvert pipes should be a minimum of 600 mm below the apex of the road surface at the time of construction (Figure 6-2).
- Culvert pipes should be laid on a grade of between 1% and 3% to minimise silting up of the pipes and excessive scouring at the discharge end.
- Side drainage for table drains. Side drain grade is 1-3%.
- Where high water flow velocities are expected in high and very highly erodible soils, drains may require special treatment such as lining with stones, concrete, grass etc to reduce scouring.
- Where unacceptable erosion of a road cutting face is likely, catchdrains should be constructed along the top sides of the cuttings to collect surface run-off. Such drains should be gently graded and/or protected against scouring particularly in the more erodible soils.
- Table drains should be dish-shaped and constructed to a minimum depth of 300 mm below the level of the top of the formation at the outer edge of the shoulder.
- Adequate provision will be made at culvert inlets and outlets to minimise erosion being caused by flow entering or discharging from the drain.
- Adequate provision of sumps or silt traps will be made to prevent siltation and blocking of culverts in high and very highly erodible soils.

DRAIN OUT-FLOW

- Drains are not to enter watercourses directly, but should be diverted into surrounding vegetation at least 50 m before a watercourse.
- Drains must have stable outlets, protected by vegetation or by rock or log barriers, particularly in fill areas.

Figure 6-2:
Construction

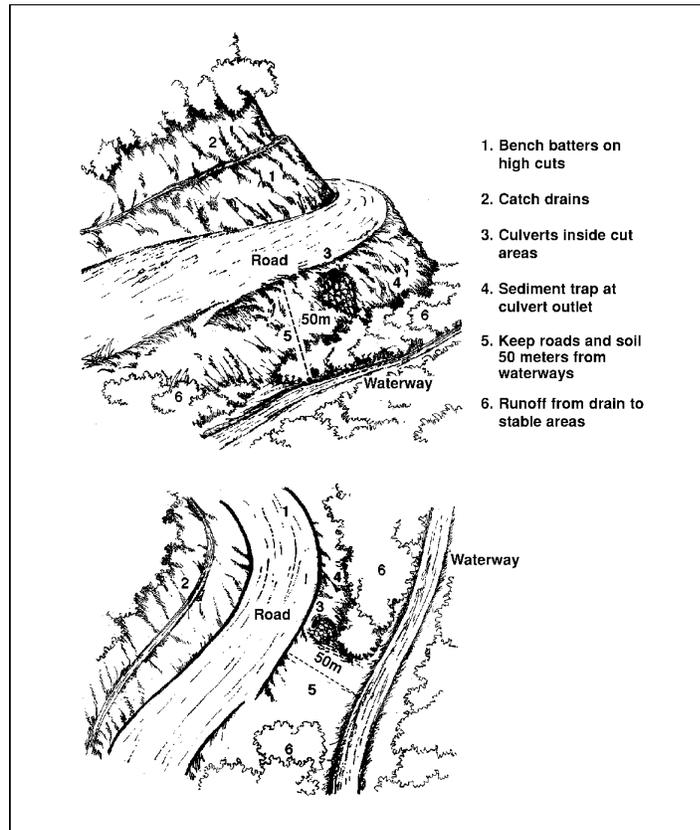
Road and Spur Road Drainage



Major and minor roads

- Roads are to be located on elevated areas wherever possible to minimise side cutting, width of clearing and drainage problems.
- If side cutting is necessary, cuts are to be formed as shown in Figure 6-3.
- Where side cutting is not necessary, earthworks should be limited to the width of the pavement plus verge and table drains on either side. Approval must be received before felling and clearing commences.
- Surfacing material to be either coral, crushed rock, compacted clay or gravel.

Figure 6-3: Major and Minor Road Construction



Spur roads

- Spur roads are to be located on ridges wherever possible to minimise side-cutting and drainage problems.
- Side-cuts should be constructed as shown in Figure 6-3.
- Where side-cutting is not necessary, the width should not exceed that specified for the travel surface.

Revegetating cut and fill areas

Revegetation should be undertaken and can be carried out using a range of measures such as cereal cover crop (e.g. rice, millet), grass or seed of fast growing shrubs or trees immediately after construction.

Limits to road construction

- Wet weather restrictions apply with machines not to be used in wet weather.
- Road construction should not occur during the wet season.

Road maintenance

- All drains, pipes, culverts and bridges are to be kept open at all times. They are to be inspected thoroughly and repaired before the onset of the wet season/monsoon and during periods of heavy rainfall.
- Removal of soil from the surface of roads, except during initial construction, is not permitted.
- Road surface maintenance should be performed as needed. Crossfall and road shape should be maintained to allow effective drainage.
- Good surfacing gravel should not be pushed to the road edge or into drains.

Road closure and rehabilitation

- Consultation with local stakeholders should be conducted prior to deciding on road closure.
- All feeder roads approved for closure should be decommissioned and rehabilitated to prevent vehicle access.
- Remove log culverts and temporary bridges to allow unobstructed waterflow (Figure 6-4).
- The road surface should be maintained intact so the road can be reopened when required.
- Cross-drains (Figure 6-5) should be installed at the following density.

Road gradient	Space between drains
0-3%	Nil required
4-14%	120 m
15-20%	80 m

Figure 6-4: Removal of Temporary Bridges to Minimise Impact on Stream Flow

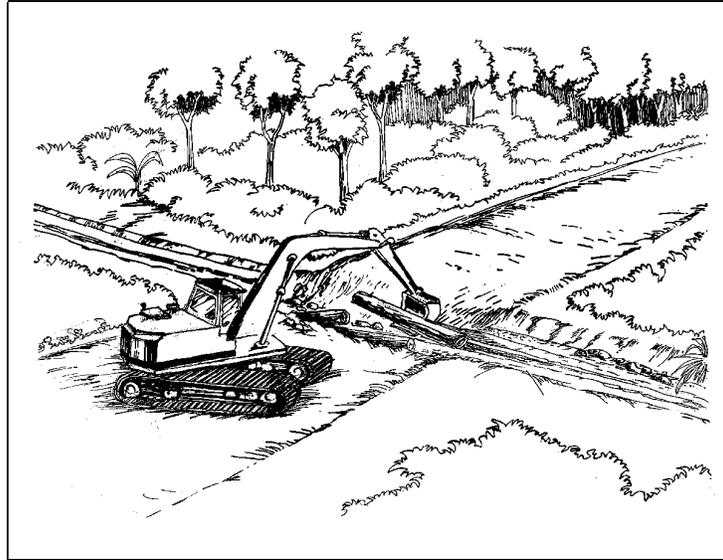
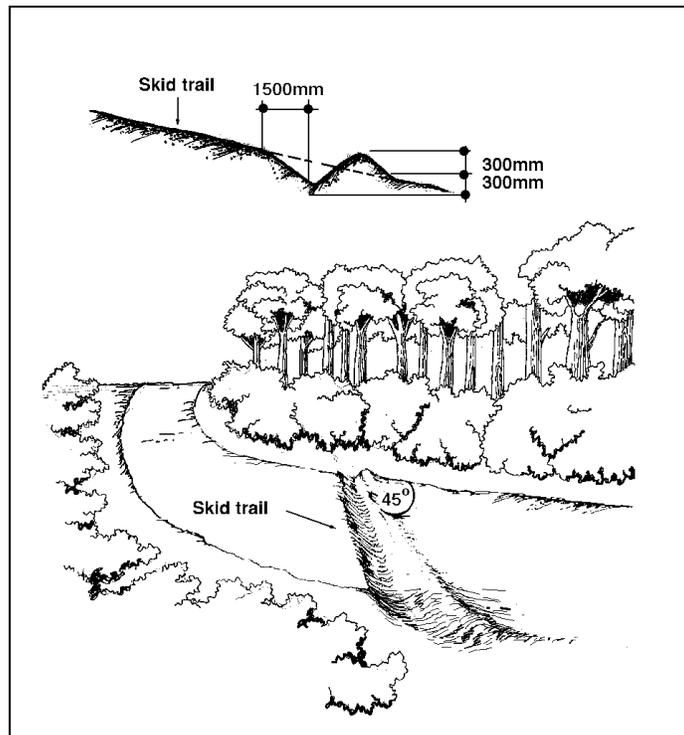


Figure 6-5: Cross-drain System



6.2 Watercourse Crossings

Watercourse crossings are designed to provide permanent bridge or culvert crossings, constructed with durable materials over all watercourses crossed by roads which will be retained for harvesting. They also provide temporary bridges or crossings where roads will be decommissioned after harvesting and to restrict disturbance to watercourses and surrounding buffer areas necessary for crossings.

6.2.1 Types of Crossings and Uses

Bridges

Bridges should be used for road crossings on all Class 1, 2 and 3 streams (except where fords are acceptable). They may also be used to cross other watercourses.

Culverts or pipes

Culverts or pipes should be used for crossing gullies and waterways (if bridges are not used). FAO Watershed Management Field Manual Guide 13/5 provides details for culvert sizes.

Fords/low level crossings

Fords and low level crossings are acceptable when:

- bank height of the watercourse is less than 1 metre;
- depth of normal waterflow across the ford is less than 0.5 metres;
- approaches to the stream are less than 5° (10%);
- the bed is solid (gravel or stone), with rock accumulation downstream.

Log clusters with earth fill

Log clusters with earth fill should not be permitted for any watercourse in any situation.

6.2.2 Construction of Watercourse Crossings

Location

The location of all watercourse crossings is to be inspected and approved by the Provincial Forest Office prior to construction. The chosen location of the watercourse crossing should:

- be at right angles to the stream alignment;
- select crossing points which;
 - are immediately downstream of straight and stable watercourse sections;
 - have easy high bank access;

- do not require deep box cuts;
- require minimum alteration or disturbance to the high bank;
- have stable beds.

Temporary crossings

- Temporary crossings are permitted to allow equipment involved with the construction of the watercourse crossing to cross to the other side.
- Width of temporary crossings should be limited to 4 metres.
- The temporary crossings are to be made on the final crossing alignment, so as to reduce disturbance to watercourse banks and buffer vegetation (Figure 6-6).

Permanent crossings

- Permanent crossings must be of a size to allow wet season flood flows to pass without damage to the crossing or its foundations.
- The height from the stream bed to the bottom of the bridge deck must be at least equal to the height of the high bank.
- Crossing width must be at least equal to 80% of the width of the watercourse measured from high bank to high bank.
- Water crossings should be single lane.

Earthworks

- Excavators should be used where possible for the construction of all watercourse crossings. Manual labour should be supplemented as appropriate.
- Earthworks should be carried out so as to prevent soil entering the watercourse. No soil is to be used or placed past the high bank without first having erected and secured a suitable barrier.
- Road construction within the buffer area should be by end-haul.
- All spoil should be removed to outside the buffer areas or placed in road fills where possible.
- Watercourse buffer vegetation should be retained to the edge of the crossing.

Foundations

- Bridge and culvert foundations are to be located on stable materials.
- The foundations are to be excavated to a solid base and not formed by pushed material.

Construction

- No machinery will operate in the watercourse during construction.

Bridges

- Approaches must have a straight and level alignment for a minimum of 10 metres either side.
- Decks to be constructed of durable sawn timber, or other non-erosive material (e.g. clean rock fill). Soil fill or soil covering is not permitted unless the timber deck is completely covered with material such as geotextile and has protection beams on both sides.
- All parts of the bridge must be well anchored to prevent their washing away.
- The stream banks adjacent to the bridge, on both the top and bottom sides, must be stabilised using wings of durable logs, stone pitch, timber or other equivalent construction (Figure 6-7 and Figure 6-8).

Figure 6-6: Temporary Bridge

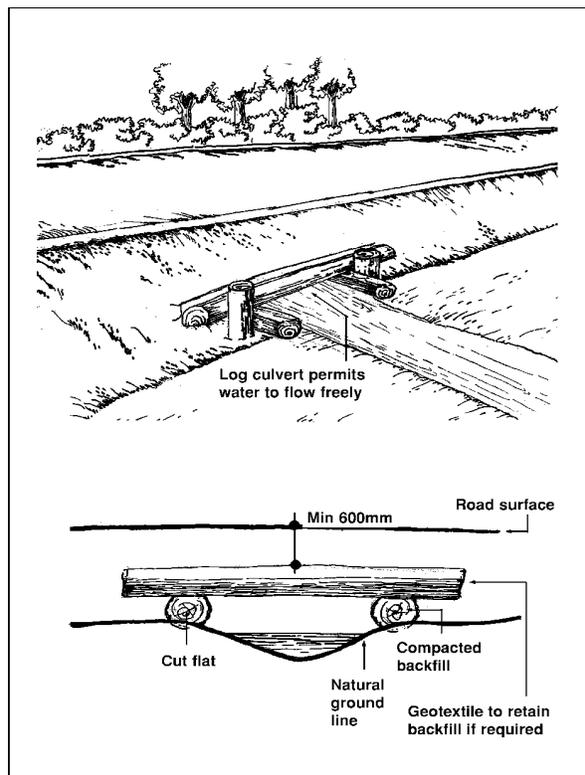


Figure 6-7: Timber Bridge

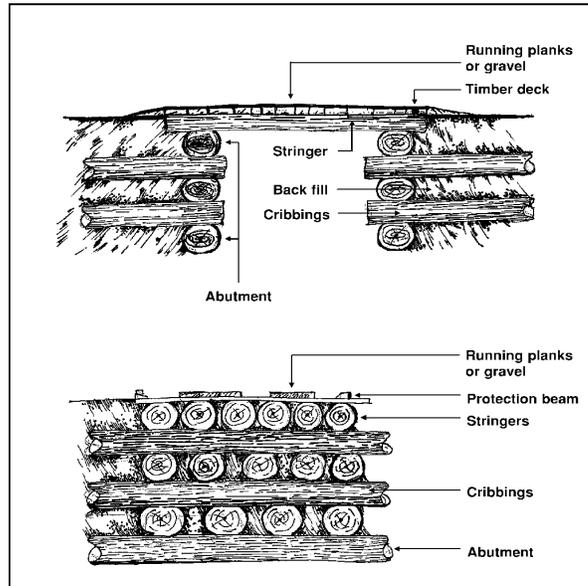
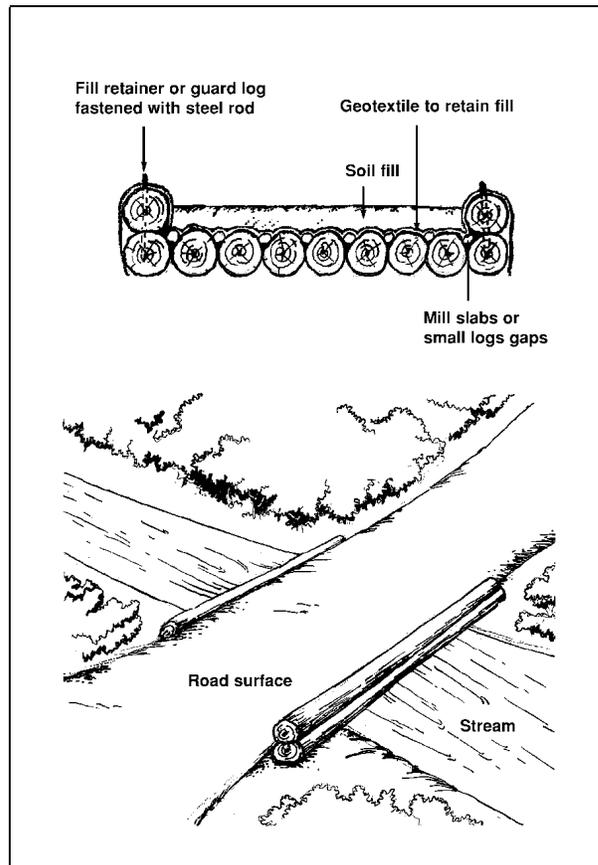


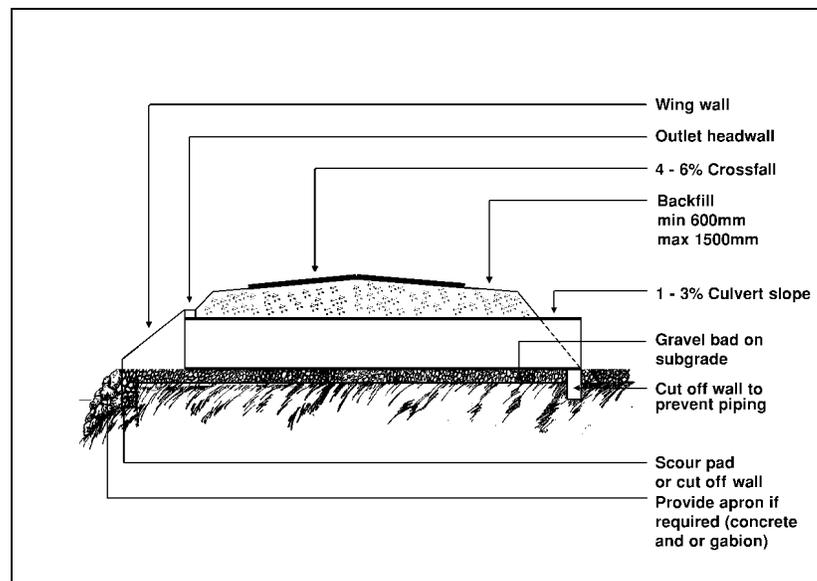
Figure 6-8: Soil Covered Timber Bridge



Culverts and pipes

- May have earth fill, but must have stable abutments constructed to the level of the running surface to prevent spoil entering watercourse.
- Scour pads (structure to minimise erosion) should be provided at culvert exits. They should be used if higher energy water flow is likely to occur (Figure 6-9).
- All culverts should have a cut-off wall to prevent erosion under the pipe.
- The head and outlet walls should be stabilised with log or stone pitched walls.
- Culvert gradients should be 1-3%.
- Use of log culverts is discouraged and logs should only be used for culverts on temporary roads.
- If log culverts are used, geotextile or another retaining mechanism should be used to retain backfill.

Figure 6-9: Culvert Construction



Fords/low level crossings

Low level crossings should:

- Minimum earth movement occur to reduce the impact on the stream bed;
- Built level to allow water to flow;
- Upstream debris deflectors should be constructed above the crossing to deflect debris which cause scouring above the crossing;
- Deposited gravel to be removed and used for roading material in the vicinity of the crossing;
- Protection from scouring below crossing should be provided unless the bed is solid gravel or stone.

Silt traps

- Silt traps are to be provided at the four corners of bridges and culverts.
- Silt traps should be cleaned regularly.

6.3 Log Pond and Wharf

The size of the log pond and wharf area should be minimised but allow for the efficient processing and shipping of logs, with least adverse impact on the aquatic environment. The areas should be located and constructed to minimise log degrade and to prevent log off-cuts from entering watercourses or the sea.

6.3.1 Location

- A log pond and wharf loading ramp plan, showing the location and construction specifications should be submitted to the Provincial Forest Office prior to construction.
- Gently sloping areas (up to 6%) are preferred for log ponds to promote drainage.
- Construction of log ponds by fill reclamation areas below low water mark will only be considered where:
 - there is no alternative;
 - construction and operation will not damage the adjacent aquatic environment; and
 - drainage water is directed away from the sea.
- Locate wharf loading facilities to provide the best and most direct access for log ship barges. Deep-water ports are preferred to reduce the cost and disturbance associated with barging operations.
- Retain a 50 metre buffer area between the log pond and the shoreline (or mangrove vegetation) or a watercourse.

- Clearing of shoreline or river frontage vegetation (including mangroves) is limited to that necessary to construct the wharf and associated log storage area. A maximum frontage of 100 metres is desirable.

6.3.2 Timing of Construction

- Construct the log pond and wharf in dry weather.
- Excavators should be used where possible for construction to minimise disturbance to surrounding environment.

6.3.3 Design

Log pond

- Log pond areas are to be well drained. Spoon drains (3-4 metres wide and 30 cm deep), constructed at a maximum interval of 40 metres will channel runoff to vegetated outlets. The maximum slope of spoon drains should be 1-3%.
- The major crossing points of drains are to be gravelled to a depth of 30 cm. The gravel is not to restrict the flow of water along drains. Where gravel is not available, crossing points are to be corded so that the top of the cording is level with the base of the drain.
- Drains are not to directly enter water bodies. Water must be filtered by a designated filter strip.
- Log and waste storage areas between the drains are to be elevated with a crossfall of 4-6% and at least 1 m above high tide level.
- Fuel storage areas should be bunded and located at least 50 m from the high tide mark.

Wharf

- Construct using clean gravel fill only. Soil material should not be used.
- The loading face of the wharf is to be a wall construction with a top log. Walls may be constructed of round timbers, rock or other material able to prevent slumping of wharf fill into the sea. All timbers are to be secured to prevent their falling into the sea. Only durable timber species should be used.

6.3.4 Maintenance

- Drains are to be kept open at all times.
- Silt traps are to be cleaned regularly.
- Log storage areas and the surface of the wharf are to be kept elevated by applying gravel or coral as required.
- Earthworks and other rehabilitation are required to bring existing facilities to these standards.

6.3.5 Decommissioning of Log Ponds and Wharves

- The drainage system should prevent storm-water runoff from the site entering watercourses or the ocean, without first passing through a filter strip. Cross drains may be required.
- All stream beds should be restored to allow unimpeded flow of water.
- All waste, waste oil and fuel must be removed from the site.

6.3.6 Barging/Beach Loading

Location

- The location should minimise damage to the shoreline;
- Machinery should not be required to enter the water.

Design

- Adequate drainage, similar to that for log ponds must be installed.
- If damage from vehicles is to occur on the waterline strip, then cording should be installed.

Decommissioning/Rehabilitation

- The drainage system should prevent storm-water runoff from the site entering watercourses or the ocean without first passing through a filter strip. Water bars may be required.
- All stream beds must be restored to allow unimpeded flow of water.
- All refuse, waste oil and fuel must be removed from the site.
- Cording should be removed from the waterfront.

6.4 Quarries

Quarries are constructed to provide appropriate material for road/landing/log pond surfacing and should be constructed with minimum disturbance to forest and watercourses.

6.4.1 Bedrock or Gravel from Dryland Deposits

- Quarries should be located within production forest areas where possible.
- Extraction of gravel and rock materials from road cutting areas during the formation of the road is preferred to the development of large quarries.
- Proposed quarries within areas excluded from harvesting require the inspection and approval of the responsible Provincial Forest Officer.

River gravel

- Obtain the approval from the Provincial Authorities if for use in concession areas.
- River gravel should only be used where quarry rock material is not available.
- River gravel or rock will only be taken from deposited fans in wide rivers.
- Gravel or rock is not to be excavated from incised streams.

6.4.2 Reef Material from Marine Areas

- Dead reef material should only be used as the impacts of dead reef coral mining are less than those involved from other sources.
- Dead coral will only be taken from areas dedicated to wharf construction or ramps.
- Gravel should be used if available.
- If the reef area is within a declared fish breeding ground or habitat area, the approval of other authorities should be obtained where this is a legal requirement.

6.4.3 Quarry Management

- All commercial trees should be harvested on the proposed quarry area.
- Drains should be constructed around the uphill side of the quarry to prevent runoff entering the area. The drains are to direct all runoff away from the quarry and are to direct water to vegetated areas where possible.
- The base of the quarry is to be drained at all times. Drains must not directly enter watercourses.
- Overburden including topsoil and organic debris should be stockpiled for spreading in the quarry surface when operations are completed. Runoff is not to pond in the stockpiled area.
- The face of the quarry is to be stable at all times.
- Blasting operations are to be carried out by certified personnel. Strict public safety measures are to be followed at all times with signs and guards posted at safe distances to prevent entry to the danger zone during blasting operations.

6.4.4 Quarry Rehabilitation

- Rehabilitation should occur progressively as quarry areas are no longer used.
- Removed overburden should be replaced followed by topsoil and organic matter.
- The site should be replanted/resown with trees, shrubs or a cereal crop.

7. Pre-harvest Field Preparation

The pre-harvest forest operations are designed to mitigate the impacts on biodiversity, soil and water quality and improve the production of forests through appropriate silvicultural prescriptions and the maintenance of a viable residual forest stand.

Operations undertaken by the harvesting company (concessionaire or community) must not commence in a harvest area prior to signing of the Operational Plan/Harvesting Agreement by both the Supervising Provincial Forest Officer and the Company/Community Supervisor. This should only occur after:

- a joint field inspection of the area;
- all buffer zones are marked to the satisfaction of the Supervising Provincial Forest Officer;
- the contents of the Operational Plan have been discussed and are understood by the Company/Community Supervisor.

NOTE: The Company/Community Supervisor should be a person who will be present and responsible for the operations on the harvest area during the time that operations are in progress.

7.1 Tree Marking

Tree marking is designed to ensure only appropriate trees are harvested, a practice that is consistent with maintaining a vigorous and viable residual forest. The practice will maintain species composition, assist to minimise canopy openings and the introduction of light demanding weed species.

7.1.1 Selecting Trees for Harvest

- Where it is desired to promote the growth of commercial species, the size of an individual canopy opening in any one position should be minimal.
- The number of trees per hectare selected for harvesting will depend on tree the silvicultural system (cutting limits /need for seed trees etc.) developed for the particular forest type and stand condition.
- Select only those trees that will provide logs suitable for processing. These must be of a suitable species and have the minimum specified log length.
- Before felling operations commence, harvesting operations staff, including supervisors, tree marking staff and chainsaw operators must:
 - have copies of tree marking rules;
 - understand how they are to be applied.

7.1.2 Selecting Trees for Retention

- Where desirable species are present in the sub-merchantable category:
 - identify, protect and retain sufficient numbers of stems to ensure a viable residual stand;

- Potential Crop Trees (PCTs) should be marked for retention according to silvicultural prescriptions;
- apply silvicultural prescriptions approved by the Ministry of Forestry and Estate Crops.
- Where desirable species do not exist in sufficient numbers, retain the original number and ensure that sufficient quality seed trees are preserved to provide for sustained regeneration.

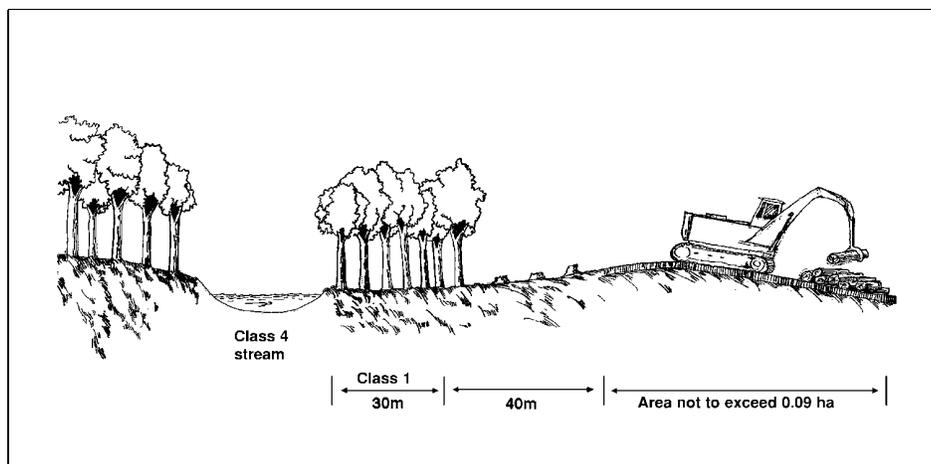
7.2 Locating Log Landings and Skid Trails

Log landings and skid trails should be located appropriately, with landings to be minimised to prevent sedimentation of watercourses. Log landings and skid trails should be stabilised following cessation of the harvesting operations.

7.2.1 Log Landing Location

- Landings are to be located:
 - outside areas excluded from harvesting;
 - at least 40 metres from the edge of buffer zones (Figure 7-1);
 - at sites which suit skidding pattern and direction;
 - to balance site disturbance with skid distance;
 - in dry areas on ridges or benches or in areas which are easy to drain;
 - in areas of low slope to reduce the amount of side cutting;
 - located on ridges to promote up hill skidding to disperse surface water runoff into surrounding vegetation (Figure 7-2).
- Roadsides may be used if:
 - this reduces earthworks; and landing areas and roads can be drained adequately.
- The location of all log landings must be shown on the harvesting plan.
- The Provincial Forest Officer may approve additional landings.

Figure 7-1: Log Landing Location



7.2.2 Log Landing Size

- Log landing size applies to the working surface of the landing and does not include area for log storage.
- The size of log landings includes:
 - the total area of disturbance, including cut and fill batters;
 - half the road width if the landing is constructed at the roadside.
- Suggested maximum log landing size is 900 m².

7.2.3 Log Landing Construction

- Landings will be located so that mud and debris do not enter watercourses.
- Landings should be located so that free drainage occurs at all times. Ideally, log landings should be located on gently sloping elevated areas.
- Split level landings may be used to reduce excavation. Safety must be paramount in design of split level landings as often found with Skyline Yarding Systems.
- Mark boundaries of the landing including cut and fill areas.
- Remove all merchantable trees.
- Construct and maintain landings to prevent the ponding of water.
- Drains must empty on to stable vegetated areas.
- Where the landing is to be used in wet weather, it should be “corded” using small logs of unmerchantable species (Figure 7-3).

Figure 7-2: Log Landing Construction

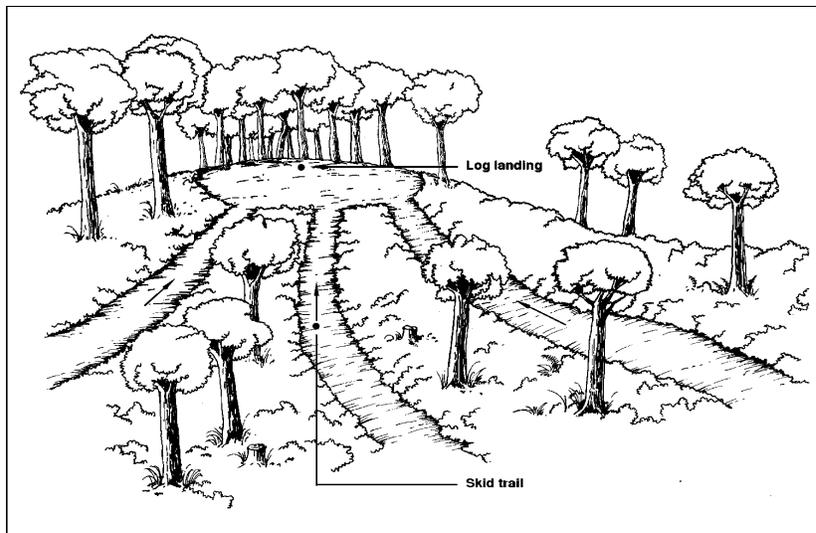
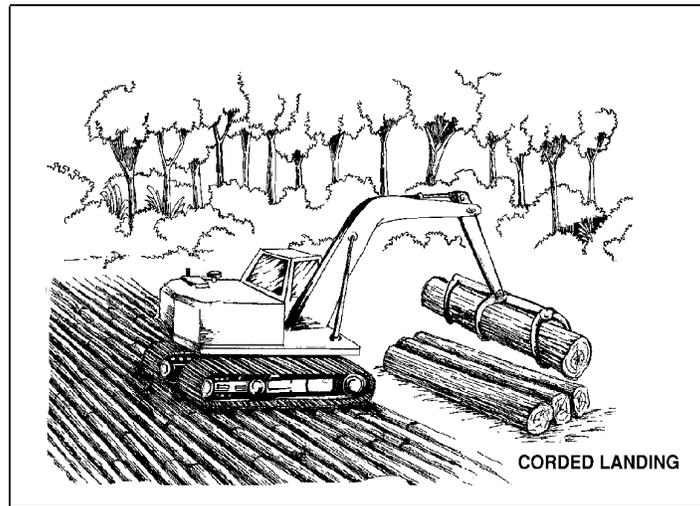


Figure 7-3: Log Loading on Corded Landing



7.2.4 Log Landing Operations

- Landings should not be bladed off to keep them operational without the approval of the relevant Provincial Forest Officer.
- Debris and waste heaps are to be:
 - placed so as not to restrict drainage of the landing;
 - stored away from standing trees;
 - more than 10 metres from drainage areas.
- Soil and vegetation debris are to be kept separate.

Landing Rehabilitation

- Landings should be restored so that proper drainage occurs to reduce soil erosion and runoff.
- If corded, cording should be removed.
- Landings should be either drained to promote natural revegetation or replanted with a cover crop and/or:
 - ripped at 90° to the drainage direction;
 - ripped radially;
 - a berm should be constructed around the landing.
- Bark and landing debris should be dispersed evenly across the landing to assist in stabilisation.
- The site should be cleaned of non biodegradable material and all solid waste removed, including oil/fuel drums and wire rope.

Skidding to landings

- Skid trails usually approach landings from below to avoid directing runoff of water to the landing.

Limits on Operation

- Avoid the use of logging equipment on saturated soils to minimise erosion, water ponding, mixing and compaction of the soil and minimise adverse effects on water quality.
- Avoid hauling on wet, rutted roads to reduce excessive turbid runoff which may adversely affect water quality.
- A complete closure of forest operations including hauling should be considered in extreme conditions where there is risk of environmental damage.
- The number of skid trails and depth of rutting should be minimised.
- High intensity skidding traffic will be confined to planned trails, which should be located on high ground, so they drain naturally.

7.3 Skid Trails

Skid trails should minimise the area covered and be constructed to minimise soil disturbance. They should minimise damage to watercourses and minimise the number of crossings.

Skid grades should be less than 20%.

7.3.1 Classes of Skid Trails

Major skid trails

Major skid trails will have more than 10 passes of the skidding machinery along each trail. Their construction may require minor earthworks. They will usually be located along ridges so as to enhance drainage.

Minor skid trails

Minor skid trails will have less than 10 passes of the skidding machinery along each trail. Their construction does not require earthworks. Litter is to be maintained on the surface of the trail (Figure 7-4).

7.3.2 Uphill or Downhill Skidding

- Skidding direction should where possible, be carried out uphill.
- Skid trails are based upon assessment of the following factors:
 - road and landing location (upper slope, lower slope);
 - watercourse crossings (to be minimised);

- potential damage to soil caused by skidding machinery (minimise);
- safety;
- large size logs are likely to cause less soil damage when pulled uphill with butt of the log raised;
- soil type and conditions will affect machine traction and therefore skid direction.

7.3.3 Winching

- Logs are to be winched for the maximum distance possible, to reduce the length of soil disturbance associated with skid trails.
- Winches should be fitted to all machines with a minimum length of wire of 30 m (18-28 mm diameter).
- Chokers and wire slings to be used for skidding to reduce damage to winch ropes.

7.3.4 Skid Trail Design

- Skidding in areas excluded from harvesting (other than at defined watercourse crossing points) should not be permitted.
- Location of landings should be undertaken prior to the location of skid trails.
- Locate skid trails:
 - away from waterways and unstable areas;
 - on spur lines where possible, to allow good drainage;
 - to avoid damage to retained trees;
 - a sacrificial tree which is to be removed can be used to protect retained trees.
- Watercourse crossing points for major skid trails are to be shown on the harvesting plan and approved by the Provincial Forest Officer. An increase in the number of watercourse crossings will require the approval of the Provincial Forest Officer following a field inspection.
- Where major skid trails must cross slopes, the angle of the skid trail to the contour should not exceed 45 degrees.
- Advisable maximum slope for side cutting is 50%.
- Advisable maximum allowable grades for skid trails are:
 - Major skid trails 25%
 - Minor skid trails 45% (D7 controllable limit).
- Cording of some or all of the length of major skid trails may be required.

7.3.5 Survey Requirements

- Major skid trail locations should be inspected and marked in the field prior to their construction and according to the Harvesting Plan.
- Departures from the planned alignment which involve increased side cutting or increased watercourse crossings, are to be referred to the Provincial Forest Officer for approval before construction.

- Skidder and chainsaw operators are to identify and inspect the proposed skid trail locations prior to commencing construction.

7.3.6 Skid Trail Construction

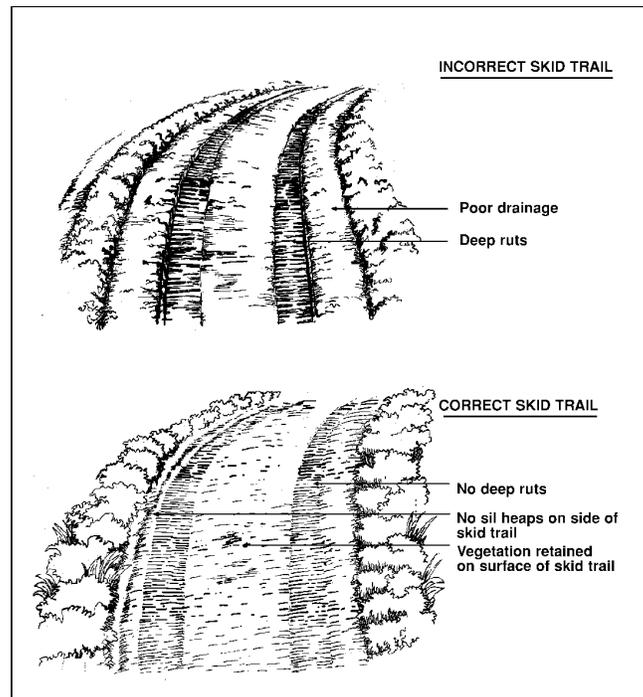
- Major skid trails are to be constructed close to the start of felling operations.
- Minor skid trails should be marked prior to harvesting to assist the cutter to determine the direction of felling. Minor skid trails should be constructed after felling.
- No blading if slope is less than 25%.
- Construct skid trails in dry weather.
- A maximum skid trail width of 4 metres for all skid trails (width of blade) is suggested.
- Avoid side cutting for construction of major skid trails.
- Side cutting is not permitted for minor skid trails.
- Side cut skid trails should have an out-slope of 2-6%.
- Box cuts should not be permitted.
- Berms on the outside edges should not be permitted.
- The radiuses of curves are to be large enough to prevent damage to retained trees and regeneration unless a sacrificial tree is used.
- Drainage should be carried out as required to prevent a build-up of running water.

7.3.7 Skid Trail Rehabilitation

As soon as skid trails are no longer required for harvesting, proper drainage, using cross-drains should be installed.

- Cross-drains should be constructed to divert water away from the skid trail (Figure 7-5).
- The distance between cross-drains should be decreased as the:
 - gradient of the skid trail increases;
 - soil erodibility increases;
 - during wet season harvesting;
 - in areas of higher rainfall.

Figure 7-4: Skid Trail Construction

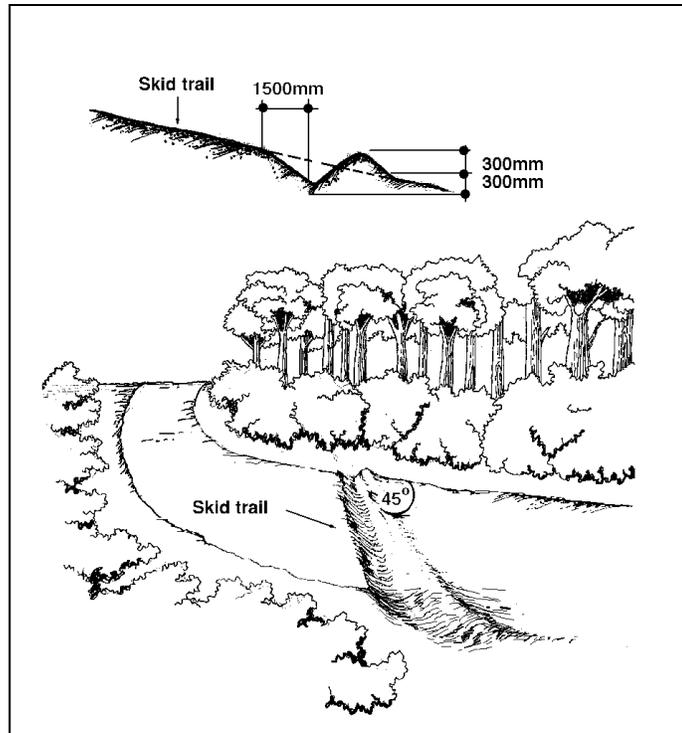


7.3.8 Cross-drain Spacing for Skid Trails

- Any watercourses inadvertently diverted into skid trails must be restored to their original course.
- Seriously rutted skid trails should be restored by backfilling in addition to the construction of cross-drains.

Slope	Maximum Cross drain Spacing
0-4%	Nil
5-9%	100 m
10-19%	60 m
20-24%	20 m
25%+	15 m

Figure 7-5: Skid Trail Cross-drain Construction



7.3.9 Watercourse Crossings

Location

- Major skid trail crossings should be shown on the harvesting plan, and approved in the field by the Provincial Forest Officer.
- Skid trails should not cross Class 1, 2 or 3 streams.
- Select crossing points on waterways in places where:
 - bank slope is less than 18% (preferably less than 9%);
 - the bed is firm.
- Skid trails should cross watercourses at right angles.
- Temporary crossings are to be provided for gullies or waterways if water is flowing at the time of operation.

Construction

- Construct crossings in dry weather.
- Width of the crossing is to be less than 4 metres. Buffer vegetation is not to be otherwise disturbed.

- Use unmerchantable logs for the crossing where appropriate.
- Abutments and approaches are to be higher than the stream banks.
- Cording of the approaches to the crossing may be required within 2 metres of the high bank.
- Soil is not to be pushed:
 - past the high bank;
 - into watercourses;
 - onto the top of the crossing.

Removal

- Crossings should be removed in dry weather. Crossing material is to be placed more than 10 metres from the high bank.
- Removal must not disturb the watercourse banks.

Limits to construction

- Wet weather restrictions apply with no machines used in wet weather.
- Crossings should not be constructed during wet periods.

8. Harvesting Operations

Forest harvesting operations should be implemented to prevent the entry of soil or turbid water into watercourses and to minimise ground disturbance and traffic in the area to maintain the productive and regenerative capacity of the forest. The operations should be undertaken effectively and efficiently and adopt and maintain appropriate safety standards at all times by ensuring that competent and experienced supervisory staff direct all harvesting operations.

8.1 Supervision of Operations

The supervision of harvesting operations should be undertaken by competent and experienced staff who will provide on-the-job guidance and training to personnel responsible for undertaking their tasks. These supervisors should also inspect harvesting operations regularly to ensure they are being carried out safely and in accordance with the harvesting agreement, P&Ps and company requirements.

8.1.1 Frequency of Inspections

The company/community supervisor should inspect each operation on a regular basis and check compliance with the P&Ps. Any non-conformance with guidelines should be acted on immediately.

8.1.2 Skills of Supervisory Staff

- Experienced in the planning and supervision of harvesting operations.
- Working knowledge of the Long Term and Operational Plans and P&Ps.
- Ability to communicate clearly with all harvesting crews, other company staff, Provincial Forest Office personnel and resource owners.
- Working knowledge of all elements of a harvesting operation including occupational health and safety of the workers, machine operation, maintenance schedules and basic repairs.
- Possession of current first aid knowledge as indicated in the ILO Code of Practice on Safety and Health in Forest Work.

Duties and responsibilities

- Direct involvement in all levels of pre-harvest planning.
- Train and familiarise personnel with:
 - the operational and safety requirements of sound logging practice;
 - company requirements in relation to the harvesting operation.
- Co-ordinate harvesting operations.
- Direct supervision of harvesting operations to ensure compliance with:
 - Principles and Practices for Forest Harvesting in Indonesia;
 - Long Term and Operational plans; and
 - ILO Code of Practice on Safety and Health in Forest Work.

- Maintain and submit accurate records as required by the Provincial Forest Office, company/community and other relevant agencies.
- Render first aid if required.
- Arrange rapid evacuation to hospital of any injured worker if required.
- Liaise with Provincial Forest Office staff, Planning Officer of the company or local communities, other forest and land management agencies with responsibilities for the proper conduct of aspects of harvesting operations.

8.2 Harvesting

Harvesting should be undertaken to maximise the recovered log volume and value and to adopt safe practices. The operation can be assisted by felling trees to minimise damage to retained stems and regeneration, assist log extraction, minimise damage to the log and avoid disturbance to exclusion areas.

Harvesting can commence when:

- the operational plan has been signed by the Provincial Forest Office and company/community;
- major skid trail location is known and marked prior to felling;
- tree marking, where silvicultural prescriptions require, has been completed;
- all operators are familiar with the harvest area and discuss the operational plan with the forest supervisor.

8.2.1 Tree Felling

Testing tree soundness

- Trees suspected of being unsound should be tested before felling.

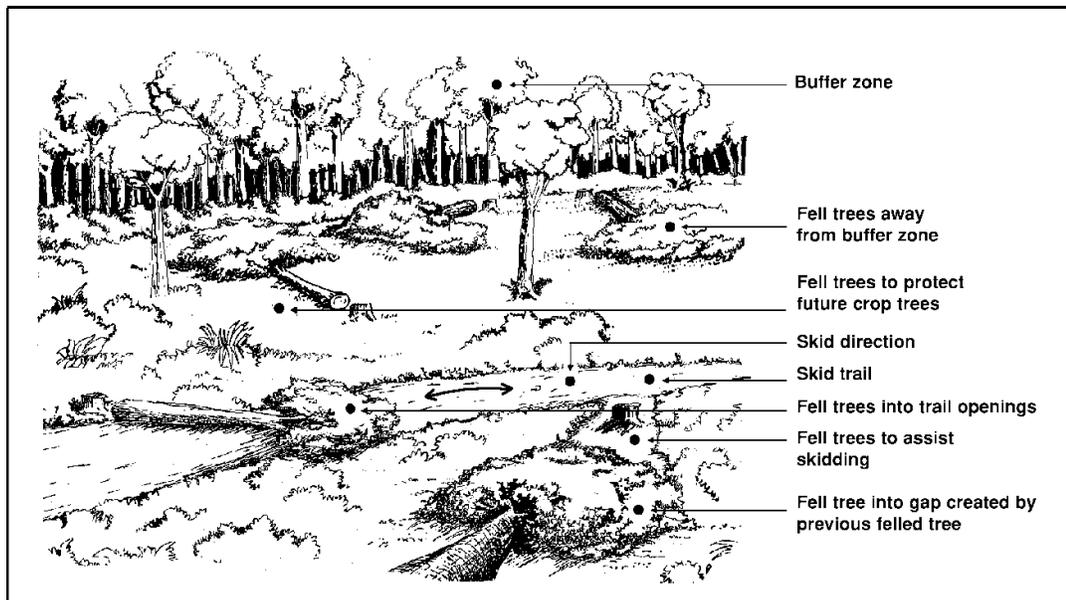
Directional felling

- Directional felling involves marking trees with a predetermined felling direction and is required to:
 - minimise damage to standing trees which comprise next cutting cycle, and the felled tree;
 - assist log extraction and minimise ground disturbance (Figure 8-1);
 - avoid disturbance to buffer areas, watercourses and exclusion areas; and
 - prevent trees from hanging-up during felling.

Preparation

- Plan the direction in which to fell the tree to facilitate extraction and reduce damage to potential crop trees.
- Make sure that there are no dead limbs or “hung-up” branches.
- Cut any vines still attached to the stem or trailing from the canopy. Vine cutting is best undertaken a year prior to harvesting.
- Clear two alternative escape routes away from the tree to be felled (Figure 8-2).
- Clear shrubs and saplings away from the base of the tree to provide an adequate working space.
- Tree fellers are not obliged to fell any tree that they feel is unsafe to fell.

Figure 8-1: Directional Felling and Skid Trail Location



Felling

- Scarf and back-cut properly (Figure 8-3).
- Retain hinge wood.
- Use wedge where appropriate.
- Once cutting of a tree is started, that tree must be felled.

Stump height

- Stump height should be as low as practicable (<30 cm is preferable) to maximise merchantable volume.
- Stump heights over 30 cm are acceptable where:
 - butt defect is obvious, the tree can be cut immediately above this defect; or
 - a buttress exists (and it is not appropriate to trim), the tree may be cut immediately above the buttress.

Using machines to assist felling and remove hung-up trees

- The use of machines to pull trees while they are being cut is prohibited.
- Machines, fitted with international standard roll-bar protection, are preferable to use to dislodge hung-up trees.
- Hung-up trees are to be removed before any more trees are harvested. If they cannot be removed immediately, the area is to be well marked to signal the danger to other people.
- Using other trees to knock a hung up tree down is not permitted.
- Adopt ILO Code of Practice on Safety and Health in Forest Work.

Limitations

- Adverse weather restrictions apply and trees should not be cut in very windy or wet weather.

Figure 8-2: Tree Feller Escape Routes

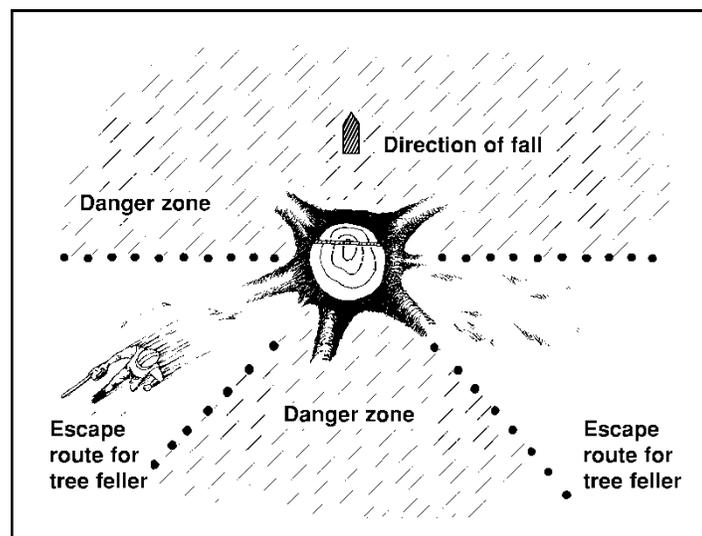
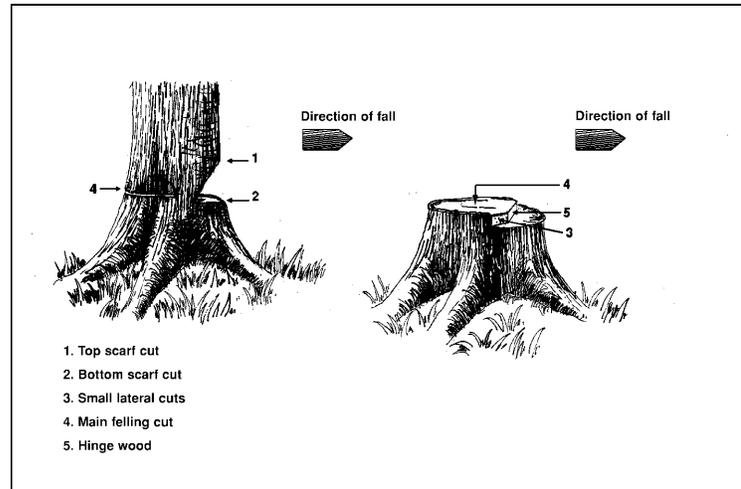


Figure 8-3: Tree Felling Technique



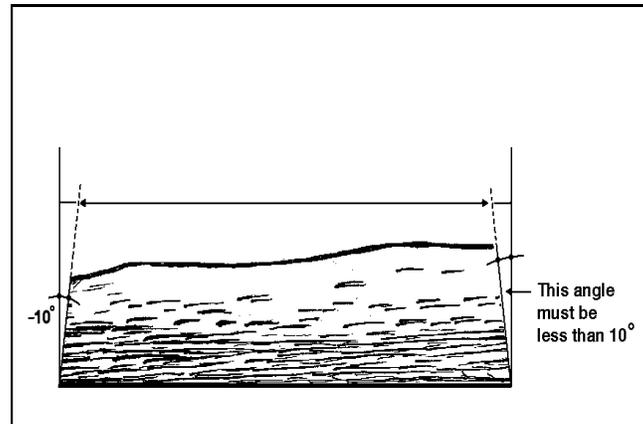
8.3 Log Preparation

The preparation of the log should be undertaken to maximise log value and to minimise cross-cutting on log landings or log ponds.

8.3.1 Cross-cutting and Debranching

- Completely cross-cut (bucking) logs so that splitting does not occur when the log is moved during skidding.
- Cross-cut boles and tops to obtain the maximum volume, consistent with highest value of saleable logs.
- Trim all buttress flutes and side branches flush with the main stem to:
 - gain maximum log quality and volume; and
 - reduce soil disturbance and assist skidding.
- Ensure that cross-cuts are no more than 10° from vertical (Figure 8-4).
- Use log nails or **S** nails on log ends to avoid end splitting and to maintain quality.
- Logs should be cut at appropriate lengths to avoid skidding damage to the residual stand.
- Log lengths must take account of processing equipment requirements.

Figure 8-4: Log Cross-cutting



8.3.2 Cross-cutting Safety

- Cutters should not stand on the trunk when the tree is being cross-cut.
- Attention should be paid to log tension while cutting logs and if necessary, the cutter should make a cut on the compression side to reduce the tension before making the final cut.
- Avoid using the tip of the chainsaw cutter bar as this can cause “kickback”.
- Use an appropriate wedge to avoid the chain from saw jamming in the log.
- Avoid making the final cut while standing on the lower side of a tree if it is lying on a slope.
- When making the final cut always stand on the compression side of the log.
- Beware of overhead hazards.

8.4 Extraction Systems

Extraction systems should be implemented to reduce soil compaction by use of low ground pressure equipment, minimise the area disturbed, and damage to the residual stand, watercourses and buffer zones. During the operations, appropriate safety standards should be implemented at all times.

To provide assistance in matching extraction systems to various sites, slopes and soil types the following information is provided:

		SLOPE CLASS			
		0-15%	15-35%	35-60%	60+%
S O I L E R O S I O N	LOW	C1-5	C1-5	C1, C5, C6	C5, C6
	MODERATE	C1-5	C1-5	C1, C5, C6	C5, C6
	HIGH	C2-5	C2-5	C5, C6	No Logging
	VERY HIGH	C2-5	C5	No Logging	No Logging

- C1 Crawler Tractor
- C2 Skidder/Forwarder
- C3 Flexible Track machines (FMC)/ Low Ground Pressure Tractors
- C4 Draught Animals/ Human Beings
- C5 Helicopter
- C6 Skyline Yarding System

8.4.1 Mechanical Skidding

- Tractor blades should be raised or removed when travelling and skidding.
- Pushing soil on skid trails < 25% slope, other than that permitted for construction, is to be avoided.
- Retain vegetation litter along trails.
- Reverse along skid trails towards the log, wherever this can be done safely.
- Use winches to pull trees to skid trails from stumps.
- Lift the end of the log off the ground, to avoid soil damage due to log drag. Logging arches will assist with this action.
- Avoid damage to soil and standing trees and regeneration along skid trail edges. Sacrificial trees may be used to minimise damage.
- Cross-cut long logs to reduce skidding damage.
- Skidding should not be undertaken within 10 metres of road cuttings or other banks which are more than 2 metres high or in areas excluded from logging, watercourses, except at approved and properly constructed crossing points
- Swamps or wet areas should not be accessed by skidding activities except at approved crossing points.

8.4.2 Helicopter Logging

- Be pre-planned at the Operational Planning stage.
- Comply with the appropriate government legislation.
- Use experienced operators.
- Have well defined procedures to minimise damage and maximise safety.
- Have an effective communication system between aircraft and ground.
- Fell undergrowth trees to prevent the long line snagging as it is being lowered.
- Avoid felling future crop trees.
- Fell dead spars and other hazards prior to extraction as the rotor downwash, or contact with the extracted log, can dislodge crowns and dead spars.

Helicopter requirements

- A direct visual operation control window.
- A lifting cradle with an on board weighing system.
- A long line with electronic release hooks at both ends, which are operated by the pilot's controls.
- A long line with 4 times the breaking strength of the helicopter lifting capacity.

Personnel requirements

- All personnel working in the vicinity of the helicopter should be familiar with the safety rules that apply when working around helicopters.
- Helmets with ear-muffs or chin straps, high visibility vests and steel capped boots must be worn by all personnel.
- To reduce the chance of injury, ground crews must work on the upslope side of felled logs, i.e. start working from the top of the slope and work downslope.

8.4.3 Skyline Yarding

Requirements

- To minimise damage to the harvesting area and retained trees.
- Minimise the area of disturbed and compacted soil.
- Implement and maintain safety standards at all times.

Planning

- Skyline yarding systems are appropriate extraction systems for selection harvesting on steep sites (40% or more).
- Skyline cable system should be considered for an area where 90% of the slope is over 40°.
- On steep sites watercourse buffer widths are to be interpreted as horizontal distance.

Operational guidelines

- Logs must be fully suspended across any buffered watercourse (i.e. stream or gully) or exclusion area.
- Cables may be pulled through buffers but cannot be dragged horizontally to the angle of pull.
- To reduce ground disturbance:
 - maximise log lift;
 - maximise spar height;
 - use intermediate supports; and
 - reduce log size or number of logs per pull.

8.5 Log Storage and Transportation Systems

Log storage and transportation systems should aim to reduce log stockpiles and to remove logs from the forest as soon as possible in order to minimise decay and insect attack. The loading and transportation of logs should also be undertaken in a safe manner.

8.5.1 Log Storage

- Stockpile logs at well drained roadside landings, accessible in wet weather.

Inspection

- Inspect logs and apply appropriate control measures if insect or fungal attack is observed.

Limitations

- Avoid stockpiling logs for more than 2 months.
- Avoid stockpiling logs in cyclone/monsoon prone sites prior to the onset of the wet season where applicable.
- Wet weather restrictions on the operation of landings apply as outlined in Sect. 8.6.

8.5.2 Water Transport

- Logs with high density should be allowed to dry out if possible to reduce weight to facilitate water transportation.
- Logs tied together in rafts to be secured adequately to avoid loss and damage to other vessels on the waterway.
- Barge sinker logs if possible to reduce excessive use of non-commercial buoyant species.
- As organic matter increases oxygen demand and causes pollution, depositing log off-cuts and bark in rivers should be avoided.
- Soil damage to river banks at loading ponds should be minimised.

8.5.3 Road Transport

- Excavators should be used for loading logs where possible.
- Trucks must not be loaded in excess of their design capacity.
- Side stanchions on trucks must be vertical after loading.
- All loads are to be secured with at least 2 approved load binders. Each log must be secured by at least 1 approved log binder.
- Protruding limbs or trailing material must be removed before the truck departs the loading point.

Transportation

Logging equipment can assist loaded trucks to:

- Move from the landing to the road; and
- Climb steep sections of road constructed according to an approved harvesting plan.

Trucking

- Observe posted speed limits and maximum (tare) weights for roads.
- The load should be checked regularly during transportation.

Unloading

- Check that the side stanchions are secure before removing log binders.
- All logs are to be removed by loaders or grapple excavators where possible.
- All people other than the loader operator are to stay at least 20 metres from the truck during unloading.

8.6 Weather Limitations on Harvesting

Harvesting should be avoided during periods when weather conditions cause high safety risk to personnel and machines. Ground operations should cease when conditions are so wet as to cause long lasting damage to the soil and water values of the forest.

- The responsibility for defining when weather conditions restrict harvesting operations lies with the on-ground supervisor/manager.
- Operating when conditions are excessively wet causes extreme damage to soil and water. It is also inefficient and often dangerous. Areas most likely to be workable in wet weather are those with less than 25% slope on stable soil types.
- Felling should cease when:
 - wind strength prevents accurate and safe directional felling;
 - ground conditions are too slippery to allow the chainsaw operator to move safely and quickly away from the falling tree;
 - rivers are too low in the dry season to permit water transport of logs.

Skidding and/or road construction

- Skidding and road construction should cease when soils are saturated and muddy water or mud is flowing down a skid trail for more than 10 metres;
- Blading of mud or soil should only be undertaken if necessary to continue skidding (the affected section of the skid trail must not be by-passed by opening up a new skid trail or road); or when
 - soils are rutted to a depth of more than 30 cm below the original ground level over a section of 10 metres or longer;
 - water is ponded on the surface of the log landing in any area which is being worked;
 - trucks cannot move unassisted along the roads because of slippery conditions;
 - muddy water or mud runs in wheel ruts, which are more than 10 cm below the road surface, for a length greater than 50 metres;
 - operations must cease if no suitable areas are available;
 - if the Provincial Forest Officer provides a provisional completion certificate.

Provisional Harvesting Certificate

- A Provisional Harvesting Clearance Certificate can be provided by the Provincial Forest Officer if operations are to be temporarily relocated. This may be due to:
 - weather limitations for example; or
 - additional roading construction requirements.

Harvest area clearance

- A provisional harvesting clearance should only be issued if there are no identified breaches of the P&Ps.
- Any breaches must be rectified prior to issuing of a clearance.
- Skid trails and landings should be drained prior to departure from the harvesting area.

Recommencement of operations

- Operations should only recommence when ground conditions permit operation without causing damage described above.

Extending operations on log landings and skid trails

- Use excavators where possible.
- Cording may be undertaken to extend operations in wet weather.
- If the cording sinks to the original rutted depth, operations should cease.

EXAMPLE ONLY
HARVESTING CLEARANCE CERTIFICATE

8.7 Log Scaling and Measuring

Log scaling should be undertaken in a manner which ensures all logs are measured accurately and that measurements are recorded to facilitate their checking as they form the basis for payments to owners.

8.7.1 Logs Scaling

- Prime responsibility for accurate measurement rests with the Contractor with the purchaser providing an auditing system.
- The Company/ Community representative should accompany the purchaser's representative for log measurements. Independent recording of log measurement by owners is encouraged.
- The District Forest Officer may attend and/or evaluate log measuring procedures during inspections.
- Logs must be measured before or when they reach the log landing. These measurements are the official records for the purpose of log volume and pricing calculations.
- Logs meeting the minimum specifications, but left in the forest should also be measured and charged (stumpage).
- Remeasurement of all, or a sample of logs at the landing or at the log pond will be done as part of District Forest Officer monitoring procedure. Minimum requirements for recording of log measurements are:
 - owner brand and District Forest Officer brand where appropriate;
 - an individual number for each log and tree marking number;
 - log length;
 - log quality, grade, species;
 - log diameter(s).
- Use sequential numbering.
- Avoid duplication of numbers.
- For the purpose of payment, other records may include:
 - owner identification;
 - identification of cutter/ skidder/ hauler;
 - lines showing position of diameter measurements.

8.7.2 Log Tally Sheets

Log tally sheets, approved by the District Forest Officer must be used to record log measurements.

8.7.3 Log Identification

- Log markings must be sufficiently durable to last at least until logs are loaded for export or processed.

8.8 Log Ownership

8.8.1 Ownership of Logs

- Legal arrangements between the parties to harvesting must specify precisely when log ownership is transferred. For example, specify the time of payment, or specify that log ownership is transferred when the licence agreement is signed.
- Following this transfer, the logs are owned by the purchaser.

8.8.2 Payment for Logs

- Legal agreement between the parties involved in harvesting must specify precisely the point and time of payment for logs and other forest products.
- Payment must be made for all commercial logs felled, irrespective of whether or not they are removed from the forest unless specific exemption is given for particular uses, for example:
 - logs are used in road construction (this will occur only if no suitable non-commercial durable logs are available);
 - logs are provided to contractors for their own use;
 - logs are used for logging camp construction and maintenance (non-commercial logs should be used in preference.)

8.9 Monitoring and Evaluation of Harvesting Operations

Monitoring and evaluation of the harvesting operation should be undertaken for compliance with the Principles and Practices for Forest Harvesting in Indonesia and as a tool for improving the quality of future planning and implementation of harvesting operations.

8.9.1 Evaluation of Harvesting Operations

- Formal evaluation of operations will be done by staff of the District Forest Office (Figure 8-5).
- Self regulation by logging companies to check their compliance with the Principles and Practices and monitoring of performance is recommended.

8.9.2 Timing of Evaluations

- District Forest Officers will evaluate operations at each inspection.
- Maximum time between evaluations is to be 3 months. Inspection at 1-month intervals is preferable.
- If the evaluation results in a suspension of operations, a further field evaluation will be carried out to confirm that all the work is completed to the required standard, before the suspension will be lifted.

8.9.3 Evaluation Procedures

- All evaluations will require ground inspection.
- The District Forest Officer is to be accompanied by a representative of the company/community and other authorities as appropriate.
- Preliminary evaluations may be undertaken from small format photography/satellite images of logging areas which have been flown since the last inspection. Assessments of operations from photography are to be checked in the field.
- Areas inspected and evaluated will include a representative sample of:
 - current harvesting operations;
 - areas completed since the last inspection;
 - areas where the company was directed, at the previous inspection, to do further work.
- During the inspection, all areas of non-compliance with the P&Ps or the harvesting contract are to be explained to the company/community representative.
- The company/community representative is requested to sign the evaluation form as a true record of the inspection (Figures 8-6).

8.9.4 Evaluation Inspections

- Copies of the evaluation are to be forwarded to:
 - head office of the District Forest Office (or regional offices);
 - other relevant government agencies;
 - representatives of local populations;
 - the company/community.

Figure 8-5: Monitoring and Evaluation Procedure

SAMPLE ONLY

Monitoring and Evaluation Procedure

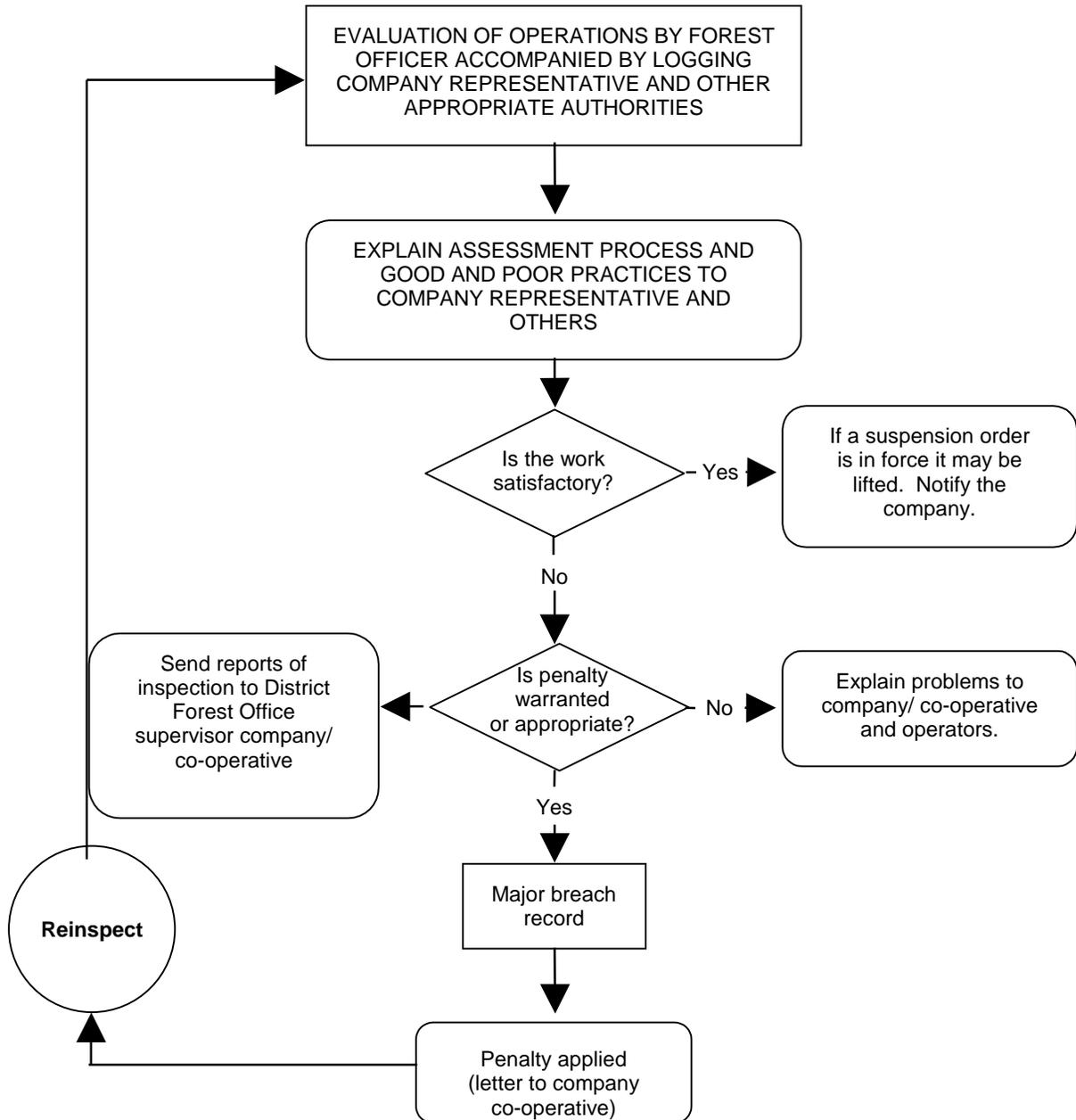


Figure 8-6: Evaluation of Harvesting Operations - Forms 1 and 2

EXAMPLE ONLY

HARVEST OPERATIONS EVALUATION - FORM 1

Procedure:
 Assess and score operations as indicated on the evaluation form. If only part of the operation is to be inspected, choose areas randomly. Make sure that the assessment represents all areas of operation.
Attach additional pages of comments if required.

Company/ Community

Results of previous inspections:

DATE	MARK

Mark for this inspection

Comments by the inspecting District Forest Officer:
 Operations HAVE / HAVE NOT improved since the last inspection. The major problems are:

Is major breach action necessary? YES / NO

Signed: Dated:

Comments by harvesting company/ community representative:

Signed: Dated:

Comments by District Forest Officer:
 I SUPPORT / DO NOT SUPPORT the action recommended by the inspecting officer because:

Signed: Dated:

ACTION TAKEN

EXAMPLE ONLY- FORM 2

Date: _____ Place: _____ Forest Officer: _____ Company Rep.: _____

CODE (1)	ACTIVITY (2)	NO. OF OBSERVATIONS (3)	MARKS DEDUCTED PER BREACH (4)	TOTAL MARKS (5)	CUM MARK (6)
STARTING MARK					100
1.0	PLANNING	(one coupe)			
1.1	Harvesting plan (at the detailed coupe level) has not been completed in accordance with the Principles and Practices. Harvest operations must not commence or must be immediately suspended if the Operational Plan has not been signed by the Supervising Forest Officer and the Company Supervisor.				
1.2	Exclusion areas ((Special Management Zones including buffer strips) not demarcated in the field prior to operations commencing.		0		
1.3	Contractor and where possible the Forest Officer has not discussed the plan with cutters and plant operators.		-5		
MARK FOR PLANNING = TOTAL COLUMN 5					
2.0	ROADING (Assess lengths of approximately 100 m)	3 lengths			
2.1	For each length not located as per harvesting plan.		-5		
2.2	For each length with clearing beyond 30 m at widest point (40 m where gravel not available).		-3		
2.3	For each length with side cuts on slopes exceeding 30 degrees.		-3		
2.4	For each length not drained in accordance with P&Ps and plan.		-5		
2.5	For each watercourse crossing not constructed to harvesting plan.		-5		
2.6	For each unmetalled (or uncompacted if no gravel available) length.		-4		
MARK FOR ROADING = TOTAL COLUMN 5 DIVIDED BY 3					
3.0	LANDINGS (Assess 3 landings)	3 landings			
3.1	For each landing not located as per harvesting plan.		-5		
3.2	For each landing not properly drained and more than 0.25 ha.		-3		
3.3	For each landing with 20+ m of skid trail that drains onto it.		-3		
3.4	For each landing in an excluded or filter area.		-6		
MARK FOR LANDINGS - TOTAL COLUMN 5 DIVIDED BY 3					
4.0	EXCLUSION AREAS (Assess 3 lengths of filter strips, 3 historical sites)	3 lengths; 3 sites			
4.1	For each length not located according to harvesting plan.		-5		
4.2	For each length with trees felled within it.		-5		
4.3	For each length with trees felled into it.		-2		
4.4	For each length with unauthorised machine entry.		-5		
4.5	For each historic site damaged.		-5		
MARK FOR EXCLUSION AREAS = TOTAL COLUMN 5 DIVIDED BY 3					
5.0	SKIDDING (Assess length of approximately 100 m)	3 lengths			
5.1	For each skid trail not marked and located as per harvesting plan.		-5		
5.2	For each trail which has been bladed after initial construction.		-4		
5.3	For each length with blade damage to watercourse banks or soil pushed into a watercourse or filter area.		-5		
5.4	For each length with clearing beyond 5 m at the widest point.		-4		
5.5	For each inadequately drained skid trail.		-4		
5.6	For each length with logs driven to the skid trail (which could have been broken out with the winch).		-3		
5.4	Damage to PCTs. In residual stand	based on trees only	-1		
5.5	Marked trees harvested.	based on trees only	-1		
5.6	Damage to trees on skid trail	based on trees only	-1		
MARK FOR SKIDDING = TOTAL COLUMN 5 DIVIDED BY 3					
ASSESSMENT TOTALS = MARK FOR PLANNING + ROADING + LANDINGS + EXCLUSION AREAS + SKIDDING					

OBSERVATIONS AND CONCLUSIONS:

8.10 Post-harvesting Activities

Post-harvest activities are carried out to encourage forest regeneration and protection for other environmental values. The activities are also required in order to leave the forest in a safe condition (any tree hang-ups should be removed) and to prevent deterioration of downstream soil and water values.

8.10.1 Skid Trails and Spur roads

Temporary crossings

- Remove all temporary crossings using an excavator where practicable.
- Avoid disturbance to the watercourse banks and buffer zones.
- Place material at least 10 metres from the watercourse.

Skid Trails

- Do not increase the width of trails by blading material from the side in order to cover the trail surface.
- Place cross-drains:
 - at changes in slope;
 - within 10 metres of a watercourse;
 - at other locations so that the spacing between cross-drains is equal to or less than the maximum allowed.
- Cross-drains are to have:
 - a bank height of at least 30 cm and a batter length of 1.5 m;
 - the bank is to be accompanied by a cut into the surface of the trail;
 - a crossfall of 1-3%;
 - an angle of 45° to trail alignment;
 - a stable vegetated disposal area, log barriers or scour pads.
- Box cuts are to be avoided if possible, but are to have earth dams (water bars) constructed at a spacing equal to or less than the maximum allowed for cross drains. The bank height is to be equal to the depth of the cut.

8.10.2 Log Landings

- Rip log landings with tractor at right angles to the drainage direction, or construct a berm around the landing and/or replant with a forest growing crop of grass, or shrubs.
- Remove or bury waste.
- Stabilise the batters of cuts and fills. Drain all areas where water may pond to stable disposal points and not directly into watercourses. The grade of drains is to be 1-3%.

8.10.3 Watercourses

Remove any harvesting debris which have entered buffer zones and/or designated watercourses.

8.10.4 Roads

Permanent crossings

- Check all bridges and culverts, including decking foundations and side walls. They must be secure and safe.
- Any debris which has been pushed into the watercourse must be removed by excavator or by hand.
- Water must be able to flow freely beneath the bridge.
- Clean all silt traps.

Formation

- Road formations are to be in good condition. There are to be no ruts in the surface.
- Crossfall is to be 1-3%.
- Surface grading and compaction may be required to ensure the road is in a stable and well drained condition.

Side drainage

- All table drains, side drains and cross-road drains are to be in a good working condition. Surface grading may be required.
- Soil, vegetation or other material which would obstruct waterflow is not to remain in road drains.

8.10.5 Quarries and Borrow Pits

- Remove or bury all rubbish.
- Stabilise steep cuts:
 - batters should be less than 100% slope;
 - cuts more than 3 m high should be stepped at 3 m vertical intervals.
- Regrade the drain on the uphill side and make sure that runoff cannot enter the quarry or borrow area and is diverted to a stable disposal point.
- Drain the surface of the quarry if water is likely to pond. These drains must empty to stable disposal areas.

8.10.6 Log Ponds and Wharves

- All material that can be used by the local community is to be stockpiled free of soil.

- Drainage within the log pond and on the wharf is to be put in good working order such that water will not pond for extended periods of time.
- The road to the wharf is to be drained to prevent runoff reaching the sea.
- Removal of all log debris (bark and log ends) from the wharf.

8.10.7 Refuse Dumps

- Fill in the dumps level with the surrounding areas to prevent water ponding.
- Compact the fill to prevent settling.

8.10.8 Camp Areas (base and field)

- Remove all refuse.
- Drain all areas where water is likely to pond. Drains should not empty directly into water bodies.
- The area should be left in a clean and tidy condition (removal of all temporary buildings and machinery).

8.11

Completion of Operations

- Upon completion of rehabilitation work, a Harvesting Completion Certificate or Provisional Harvesting Clearance Certificate should be issued by the supervising District Forest Officer. Until this is submitted, harvesting operations should not commence in another area.
- A Harvesting Completion Certificate should only be issued when the Officer is satisfied that all requirements of the P&Ps have been fulfilled (Figure 8-7).

Figure 8-7: Harvesting Completion Certificate

EXAMPLE ONLY

This certificate is made consequent upon agreement dated _____ between _____ (the Company/Community) and the _____ District Forest Officer.

WHEREAS

The Company/Community has notified the District Forest Officer that it has completed operations within the land covered by the above agreement with effect from _____.

We the undersigned have inspected the said land to check that the Company/Community has satisfactorily carried out its obligations under the said agreement. In particular, we have established:

1. That all streams and watercourses have been cleared of obstructions, dams, temporary culverts etc.
2. That all skidding trails on slopes have been water barred and drains led off at no greater than the frequency detailed in the Principles and Practices.
3. That all landings have been ripped and/or replanted to break up the soil compaction and topsoil has been spread evenly back across the disturbed areas.
4. That all merchantable timber felled by the Company/Community has been extracted and paid for.
5. That all oil, chemical or similar pollutants have been removed and all rubbish has been satisfactorily disposed of.
6. That all quarries, pits, and gravel extraction areas have been restored to a safe environmentally acceptable condition and that any areas of stagnant water created by operations around working areas have been filled or drained.
7. That a thorough final maintenance has been carried out on all roads. Those roads to be closed have been water barred and temporary crossings removed. Those roads to be retained have been properly drained and left in good working condition.
8. That all royalties, penalties, compensation or other payment due under the agreement have been duly received.

THEREFORE IT IS HEREBY AGREED:

That the Company/Community is released from further obligation or benefit under the said agreement save as follows:

1. The Company/Community will retain the right of access along the roads from _____ to _____ and shall retain the obligation to maintain these roads as provided in the said agreement until _____.
2. (Insert any other retained obligations)

Harvest area/number: _____

Signed by: _____ (The District Forest Officer)

Signed by: _____ (The Company/Community Representative)

Date: _____

9. Harvesting Equipment Maintenance, and Servicing

During harvesting operations, it is imperative for efficient logging that machinery be in sound and safe working condition, to prevent pollution of water resources and to prevent the introduction of weed species and pathogens to new operating areas. This will be facilitated by maintaining a clean and tidy harvesting operation.

9.1 Moving Equipment

- All equipment is to be washed thoroughly before it is moved to a new operation area to prevent the spread of weeds, pests and disease.
- Fuel or oil spillage is to be avoided during transportation.

9.2 Workshop Facilities

- Site at least 50 m from any water body or watercourse.
- Drainage from workshop areas should be diverted into collecting / settling ponds.
- Non-toxic solid waste should either be removed or buried and covered with at least 0.5 m of soil.

9.3 Toxic Waste

- The use of toxic substances is to be minimised and wherever possible biodegradable substitutes used.
- Toxic materials include spent hydraulic and refrigeration fluid, oil, fuel (petrol, diesel), workshop wastes, oily water separator sludge and residues, industrial cleaners, paints and resins, preservatives (including timber treatment chemicals), distillates, lubricants, insecticides, and biocides.
- Toxic materials are to be collected in containers securely sealed and preferably returned to municipal/township disposal areas, returned to the manufacturer or buried in an appropriate waste pit.
- Where onsite burial of toxic materials and their containers is the only alternative, the location of the pit should be clearly indicated (including signs in all the local languages), and the pit securely fenced.
- All waste pits are to be covered with at least 0.5 m of soil and located at least 100 m from maximum inundation by water and at least 1 m above maximum groundwater height.

9.4 Main Fuel and Oil Storage

- Locate main fuel and oil storage:
 - in a well drained area at least 50 m from any watercourse; and
 - no closer than 100 m to village areas.

- Bunds (preferably concrete mounds) with a capacity of twice (x 2) the storage capacity must be provided around the storage.
- Drains are to be directed to a closed, stable and flood free disposal pit, at least 50 m from a watercourse or water body.
- Where main fuel storage must be located on a wharf, they should be:
 - located as far away from the sea as the fuel pumping lines permit;
 - fitted with a proper, leak-proof bund, which in the event of a spill is able to be pumped to a disposal pit at least 50 m from a water body.

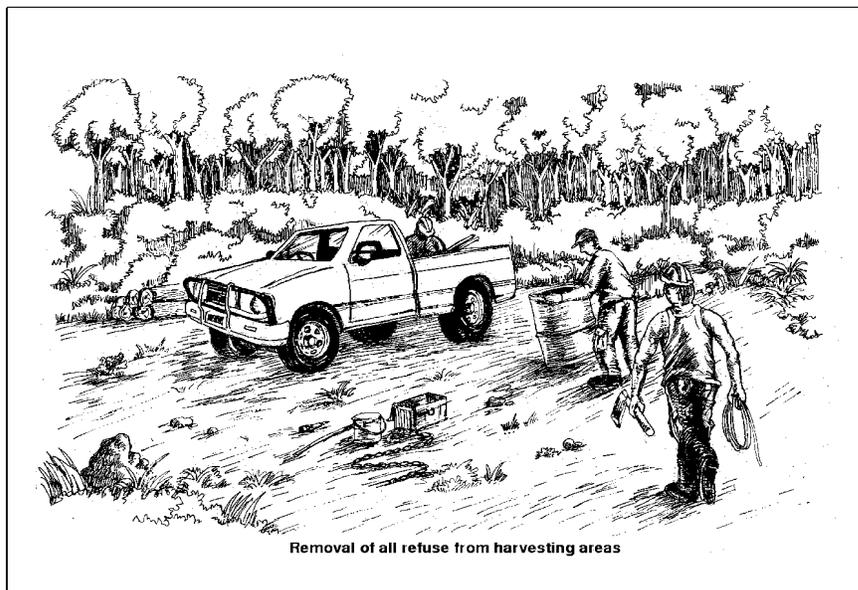
9.5 Field Servicing and Maintenance

- Field fuel tanks, refuelling points and maintenance areas are to be located:
 - in well drained areas such as landings or road junctions;
 - outside areas excluded from harvesting;
 - more than 50 m from a watercourse.
- Prevent spillage during refuelling.
- Sump oil is not to be dumped in the harvesting areas. It should be collected and removed to the main disposal facility.

9.6 Refuse Disposal

All solid waste should be placed in a refuse pit and buried as soon as harvesting in the coupe is completed.

Figure 9-1: Removal of all Refuse from Harvesting Areas



10. Camp Hygiene

The ILO Code of Practice on Safety and Health in Forest Work provides sound guidelines on camp hygiene and should be consulted.

10.1 Camp Design Plans

- Hygiene requirements should meet or exceed the ILO Code of Practice on Safety and Health in Forest Work standards in all existing and new camp areas.
- Detailed site plans are to include designs for sewage, water supply, waste water and waste disposal for new camp areas proposed for construction or expansion in that year.
- Camps to be designed to prevent pollution.
- Location of permanent camps to be shown in Long Term Plan.

10.2 Water Supply

- Camps must be supplied with potable water obtained from running streams, rainwater or wells.
- Water storage tanks should be properly screened to prevent the breeding of mosquitoes.

10.3 Waste Disposal

- Pit toilets should not be located within 100 m of surface water bodies used for drinking water supplies.
- Sewage should be discharged so it does not enter:
 - the catchment of drinking water supplies/intakes;
 - into a stream;
 - into the ocean at any point where it may cause a health risk to camp personnel or nearby communities.
- All drains are to be covered.

10.4 Domestic Waste Water

- Direct to a disposal area more than 20 m from the nearest building.
- All drains are to be covered.

10.5 Refuse Disposal

- Provide refuse disposal areas:
 - in pits which are above the water table;
 - where runoff water cannot enter;
 - at least 50 m from any water body or watercourse.
- Cover refuse with soil to a depth of 30 cm, at least once per week.

10.6 Water Ponding

Camp areas are to be well drained so that water does not pond and create mosquito breeding areas.

10.7 Additional Facilities

- Additional facilities in camps should include:
 - medical;
 - educational;
 - recreational; and
 - spiritual, where appropriate.

11. Safety

Forest harvesting safety is designed to provide safe and healthy working conditions for all personnel and to provide and maintain safe working equipment for all personnel in accordance with international standards.

The ILO Code of Practice on Safety and Health in Forest Work, which provides sound guidelines on clothing and equipment, should be consulted.

11.1 Protective Clothing and Safety Equipment Requirements

- A first aid kit in a suitable airtight and dust proof container should be provided and located close to where harvesting crews are working.
- Basic first aid training should be provided to all crew members of each working group according to ILO Code of Practice.
- All harvesting personnel to be provided with and wear:
 - steel capped footwear;
 - high visibility jacket (red or orange colour).
- Chainsaw and harvesting operators are to be provided with and wear:
 - safety helmet of International Standards Office (ISO) standard or equivalent;
 - ear muffs/defenders which are capable of providing hearing protection for sound at over the 100 decibel level (dB); and
 - leg protection made from cut-resistant materials (e.g. chainsaw chaps, leg piece).
- Workshop operators are to be provided with and wear:
 - protective clothing, ear defenders, eye protection and gloves (when handling chemicals) as appropriate for the equipment being used (Figure 11-1);
 - respirators are required when painting and using industrial fluids.

11.2 Equipment Safety Requirements

- Safety requirements should comply with Part III of the ILO Code of Practice on Safety and Health in Forest Work.
- All chainsaws (Figure 11-2) held directly by hand should have at least one of the following securely attached:
 - rigid-type hand guard;
 - functional chain brake;
 - interlocking throttle
- Chainsaw exhaust systems must direct the fumes away from the operator and conform to the chainsaw guidelines for the dry season.

- Chainsaw tool kit should be provided for corrective and preventive maintenance.
- Harvesting and roading equipment require:
 - regular maintenance to achieve registered road worthy standards and a safety sticker;
 - Roll Over Protection Structure (ROPS) and Falling Object Protection Structure (FOPS) cab or frame conforming to international standards securely mounted with high tensile nuts and bolts specified in fitting instructions;
 - securely mounted seat and seat belt conforming to international standards;
 - rear of cab or frame fitted with protective wire mesh;
 - reversing alarms on machines;
 - securely guarded pulleys, shafts, belts and fan blades;
 - positive, non-returning engine stopping device which is accessible from normal operating position and clearly marked with operating instructions;
 - first aid kit;
 - suitable fire extinguisher firmly fixed and easily retrievable;
 - exhaust system fitted with a spark arrestor at times of high fire risk.
- All staff must be trained to follow safe working practices in the use and operation of all plant, equipment or substances they may handle or use.
- All staff must wear appropriate safety clothing. The following table provides a guide on protective clothing adapted from the ILO Code of Practice on Safety and Health in Forest Work provide sound guidelines on camp hygiene and should be consulted (Figure 11-3).

Figure 11-1: Safety Equipment

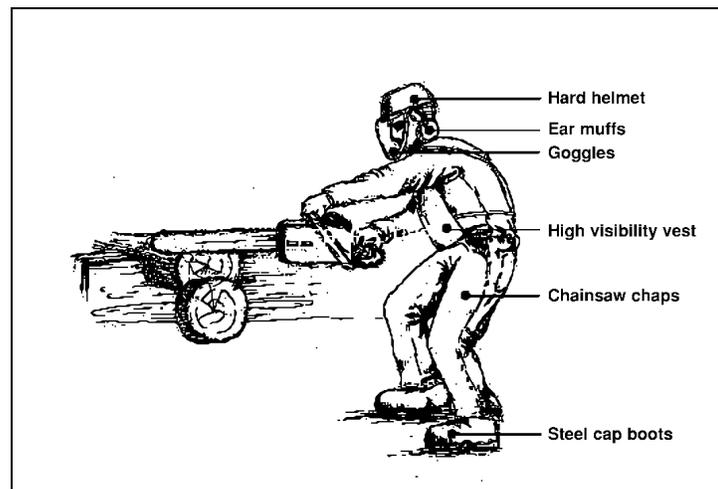


Figure 11-2: Safety Equipment for Chainsaws

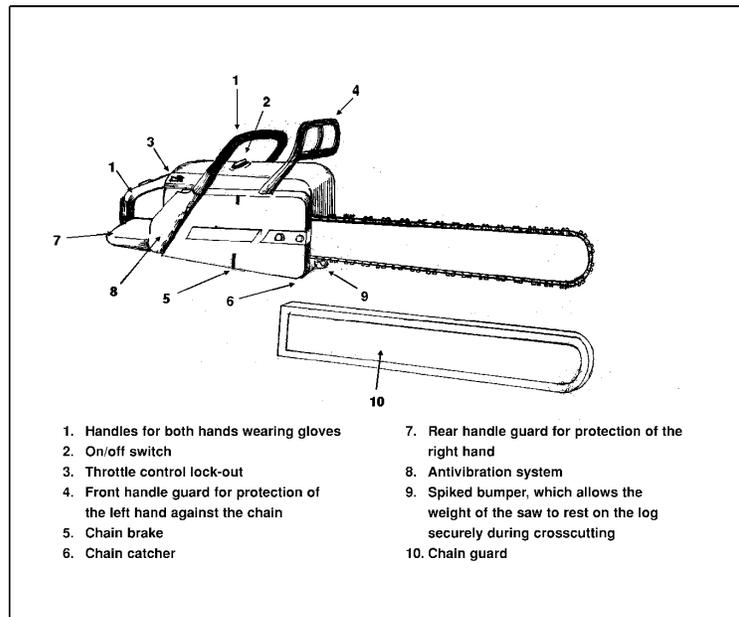


Figure 11-3: Guide to Protective Clothing

Part of body to be protected	Foot	Leg	Trunk, arms, legs	Trunk	Hand	Head	Eye	Eye/face	Hearing
Appropriate Equipment	Safety boots or shoes	Safety trousers	Close - fit clothing	High visibility clothing	Gloves	Safety helmet	Goggles	Visor (mesh)	Ear muffs
Operation									
<i>Felling</i>									
Hand Tools	✓		✓	✓	✓	✓			
Chainsaw	✓	✓	✓	✓	✓	✓		✓	✓
Mechanised	✓		✓	✓		✓			✓
<i>Debarking</i>									
Manual	✓			✓	✓				
Mechanised	✓		✓	✓	✓	✓	✓		✓
<i>Extraction</i>									
Manual	✓			✓	✓	✓	✓		
Chute	✓			✓	✓	✓			✓
Animal	✓			✓	✓	✓			
<i>Mechanised</i>									
Skidder	✓		✓	✓	✓	✓			✓
Forwarder	✓		✓	✓	✓	✓			✓
Cable crane	✓		✓	✓	✓	✓			✓
Helicopter	✓		✓	✓	✓	✓	✓		✓
<i>Stacking/loading</i>									
	✓		✓	✓	✓	✓			✓
<i>Tree climbing</i>									
Chainsaw	✓	✓	✓	✓	✓	✓	✓		✓
No chainsaw	✓					✓			

Source: Adapted from ILO Code of Practice on Safety and Health in Forest Work

12. Fire Precautions

Fire precautions are required which conform to the relevant legislation regarding fire prevention associated with harvesting operations. They should be designed to reduce the incidence of forest fires and damage to forest or other areas through escape of fire.

12.1 Operational Requirements

- In times of high fire risk the Provincial Forest Officer or other authority, should be informed.
- Reference should be made to Sections 706-732 of the ILO Code of Practice on Safety and Health in Forest Work.
- Operations should cease if conditions become extreme.
- Machinery must be clear of surplus oil and accumulations of vegetative material around surfaces which will become heated.
- Refuelling should only be carried out where no flammable materials are within 3 m of the machine. This also applies to any welding activity.
- No fire must be left unattended in the forest.
- Fires for cooking or any other purposes shall only be lit when an area of 3 m radius has been cleared of flammable material around the fire.
- All fires must be completely out before leaving a harvesting area.
- Training in regard to fire risk and control should be provided for workers.
- Fire suppression equipment should be provided in areas of high fire risk.

12.2 Chainsaws and Machines

All chainsaws and machines should be fitted with functioning fire screen/spark arrestors prior to the fire season.

GLOSSARY

Abutment	End support for bridge, culvert or similar structure.
Adverse grade	Grade up which a loaded log truck must travel.
Annual plan	Plan of harvesting for one year's operation.
Back-cut	The final cut involved in felling a tree. The back-cut should be higher than the scarf.
Batter	Inclination or shape of side slope of walls, banks, cuttings.
Berm	Heap of soil associated with the side of a road or skid trail.
Biodiversity	The range of species of plants and animals and biological processes in an ecosystem.
Borrow pit	An excavation outside the limits of road construction for obtaining fill used for roadway construction.
Buffer zone	Area of vegetation retained around a sensitive area or site. Harvesting and disturbance is excluded from these areas.
Butt	The stump end of a log.
Buttress	A ridge of wood that develops in the angle between a lateral root and the base of a stem to provide lateral root stability to the stem.
Cable logging	Any haul system using a machine with powered drums, spars, blocks, wire rope and butt rigging to haul logs from the felling site to the landing. Also called Cable Yarding System.
Cadastral	This term refers to land extent, value or boundaries.
Camber	The amount of crossfall on a road.
Canopy gap	A break in the leaf canopy of a forest. Gaps permit light to reach the forest floor. The amount of light is an important factor in forest regeneration, particularly in rainforests.
Catch drain	A drain constructed above a batter to prevent erosion of the batter.
Catchment	The area which yields run-off water to a given point.
Chain brake	A safety device on a chainsaw designed to stop the chain in the event of a kickback.
Chaps	Chainsaw chaps are safety trousers which are cut resistant and contain material designed to protect against chain saw cuts.
Clearfelling	Felling and removal, of all or nearly all commercial trees.
Competency	A concept that focuses on what is expected of a person in the workplace rather than on the learning process. It embodies the ability to transfer and apply skills and knowledge to new situations and environments.
Conservation area	Areas protected from harvesting by legislation.
Cording	Laying of suitable logs, bark or vegetation on the soil to separate

	machine tyres or trails from direct soil contact.
Cross-cut	Cutting through a felled log. Also called bucking .
Cross-drain	Drain constructed across a trail to divert water to a stable disposal area.
Cultural area	Area of social, cultural, historical or anthropological importance to indigenous populations. Includes villages, gardens and sites which are culturally sensitive.
Culvert	A channel or conduit carrying water across a road.
Cutting cycle	In selection (polycyclic) harvesting systems, the planned number of years between successive harvests on an area of forest. The harvesting activity occurs at the end of the cutting cycle. It is also referred to as felling cycle .
Designated watercourses	Those required to be marked on harvesting plans. They include all classes of streams and gullies where vegetation buffers are to be marked and retained.
Directional felling	Felling a tree in a particular direction.
Drilling	Inserting a vertical cut into the stem with a chainsaw to determine the presence of internal defect. Defect is indicated by discoloured sawdust or soft wood.
End haul	Excavation and removal of spoil to another site. End haul is used where side casting of material is not appropriate.
Endangered	Flora and fauna species in danger of extinction.
Exclusion area	Area which is excluded from harvesting.
Felling jack	Tool inserted into the backcut during felling to provide leverage to force the tree to fall in a particular direction.
Flute, fluting	Supporting buttresses at the base of some species.
Forest officer	Employee of the forest agency or other agency authorised, under the relevant legislation, to administer forest regulations.
Formation width	The width of a road, excluding batters.
Future crop trees	Trees which will provide merchantable timber in the future. See Potential Crop Trees (PCT).
Geographic information system	A computerised mapping system and database which uses layers to store information which can be retrieved as required.
Geotextile	A material sheet placed on road surfaces to assist in drainage and road stabilisation.
Guard log	Log along the outside of bridge, above the main stringer logs to prevent gravel from falling from the bridge into a watercourse.
Gully	Gullies are steep-sided channels. The slope of at least one bank exceeds 15°. Depth of the bank adjacent to the bed may be 30 cm or more. Vegetation may be growing in the gully bed.
Habitat tree	Tree used primarily for animal dwellings.

Harvesting contract	Legal agreement negotiated between landowners (State, private or customary) and harvesting companies for the harvesting of forests.
Harvesting debris	Broken logs, branches, vines or other tree material created as a result of felling and skidding.
Harvesting supervisor	Company officer responsible for the management of harvesting operations in the field.
Haul roads	Trails linking roads and landings and used for haulage of logs on trucks. May also be called a spur trail.
Head wall	A retaining wall at the inlet end of a culvert.
Hinge wood	The quantity of wood remaining between the scarf and back-cut during tree felling.
Hung-up tree	A tree which has not completely reached the ground following cutting.
Integral arch	An extension to the winch of a harvesting tractor which gives lift to one end of the log.
Landing	Area where logs are stored prior to transport to the log pond.
Log cluster	Group of 3 or more logs placed in a triangular fashion to act as a culvert.
Log pond	Main storage area for logs awaiting shipment or processing.
Log scaling	Measurement of logs for the purpose of determining volume.
Logging arch	See integral arch .
Main road	A permanent or semi-permanent road carrying large volumes of timber.
Management information system	A computerised system used for the management of a forest enterprise. Often a geographic and mapping component using GIS is included.
Operational plan	Plan providing precise details of harvesting proposals, including location of roads, landings and skid trails. Operational plans usually cover relatively small areas.
Outlet wall	Retaining wall placed at the outlet end of a culvert.
Out-slope	Sloping the surface of a trail to shed water to the downhill side.
Permanent road	A road which will be maintained after harvesting is finished.
Planning officers	Company officers responsible for the planning of harvesting operations.
Plantation	A forest crop or stand raised artificially by sowing seed or planting seedlings or clones raised in a nursery.
Potential crop trees	These are the stems which make up the residual stand and form the basis of subsequent cutting cycles.
Production forests	Forests which are being managed for the production of wood and other products on a sustainable basis.

Protected forests	Forest areas which are excluded from harvesting for any reason.
Protection zone	Area of forest excluded from harvesting in an operational plan.
Reduced impact logging guidelines	These are mechanisms by which principles and practices for harvesting are implemented with particular emphasis on protecting soil, water and forest stand values.
Regenerating forests	Forests which have been disturbed and altered from their natural state but are growing back towards the natural state.
Regeneration	Seedlings of tree species.
Road crown	The shaping of a landing, road or trail so that it is higher in the centre than the outside, allowing water to drain to the sides.
Rotation	The planned number of years between the formation or regeneration of a crop of trees and the time when the same crop is felled.
Saddle	A low point on a ridge or spur.
Scarf	Two cuts to remove a wedge usually made to assist directional felling. Often called an “undercut”.
Sediment trap	See silt trap .
Selection harvesting	Harvesting systems in which crop trees are removed based on a cycle of felling entries that occur more frequently than one rotation based on cutting limits or other criteria.
Shoreline	Limit of high tide; limit of mangrove growth.
Shoulder	See verge .
Side cast	Pushing material to the side, usually during road or trail construction.
Side drain	Drain which diverts water from a table drain.
Sight distance	The distance along a road or trail that a driver can see other objects (usually other vehicles).
Silt trap	Hole dug to catch sediment in run-off water flowing in drains. Log or rock bars may also be used.
Skid trail	Trail along which a log is pulled by a tractor.
Skidding	The pulling of logs from the felling point to a landing.
Skyline yarding system	A cable yarding system which makes use of a heavy wire rope (the skyline) which is stretched between two spars (or spar trees) and used as a trail for a skyline carriage.
Stakeholders	Individuals or groups of individuals who have an interest in, or an impact on, the outcomes of a decision as well as groups or individuals dependent to some degree on the outcome for their personal or institutional goals.
Strategic plan	Long term plan which provides broad description of future harvesting and forest management.
Stream	Watercourse where water may flow for more than 2 months in most years. The beds are generally characterised by the presence of clean,

water-washed stone, gravel, or exposed bedrock materials.

Sustainable forest management	The process of managing permanent forest land to achieve one or more clearly specified objectives of management with regard to the production of a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity and without undue undesirable effects on the physical and social environment. (Definition of ITTO)
Swamp	Area of land where surface water is present for 6 months of the year.
Table drain	The drain parallel to and at the side of a road.
Task planning	Undertaken by the harvesting company and details particular jobs such as construction of a landing.
Temporary crossing	A watercourse crossing which will be removed after harvesting.
Tree crown	Leaves and branches which make up the top of the tree.
Understorey	That part of the forest vegetation growing below the forest canopy.
V-drain	“V”-shaped table drain.
Verge	The part of the road construction continuous and flush with the pavement on either side. It is generally only used by passing vehicles but may be used for travel by trail machines.
Water bar	See cross-drain .
Water body	Surface water area such as a lake, lagoon or ocean.
Watercourse	Defined line that receives and conducts concentrated overland flow for some period in most years. Flows may be permanent or periodic. Watercourse includes a stream, a gully and a waterway. Classes are defined in terms of permanency of flow, bed material, bed width and side slope.
Wedge	A high impact plastic or aluminium wedge driven into the back-cut to assist directional felling.
Winch rope	Flexible wire rope used to winch logs towards the skidding tractor.
Wing wall	Side walls provided at a culvert or bridge to retain road fill material.

References

APFC (1998) Code of Practice for Forest Harvesting in Asia-Pacific. Asia-Pacific Forestry Commission 1998.

Dykstra, D.P. and R. Heinrich (1996), FAO: Model Code of Forest Harvesting Practice, Rome, 1996.

FAO (1994), Forest Codes of Practice. FAO Forestry Paper 133.

FAO Watershed Management Field Manual FAO Guide 13/5.

ILO (1997), Code of Practice on Safety and Health in Forest Work. Meeting of Experts on Safety and Health in Forest Work, Geneva, 1997.

ISO (1997), Additional relevant International Organisation for Standardisation (ISO) Standards not presented in the ILO Code of Practice on Safety and Health in Forest Work, 1997 are as follows:

No.	Title
ISO 11161	Industrial automation systems - Safety of integrated manufacturing systems - basic requirements 1994.
ISO 13860	Machinery for forestry - Forwarders - terminology and specifications (Draft) 1997.
ISO 13861	Machinery for forestry - Wheeled skidders - terminology and specifications (Draft) 1997.
ISO 13862	Machinery for forestry - Feller bunchers - terminology and specifications (Draft) 1997.
ISO 6531	Machinery for forestry - Portable chain saws - vocabulary 1982.

South Pacific Forum (1995), Code of Conduct for Logging of Indigenous Forests in Selected South Pacific Countries, September 1995.

APPENDIX 1

Conversion Table for Slope Measurements *

SLOPE CORRECTION TABLE																
Degree	Percent %	Distance (m)														
		1	2	3	4	5	6	7	8	9	10	20	30	40	50	100
1	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
2	3.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03
3	5.2	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.04	0.05	0.07
4	7.0	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.05	0.07	0.10	0.12
5	8.7	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.08	0.11	0.15	0.19
6	10.5	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.11	0.16	0.22	0.27
7	12.3	0.01	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.07	0.07	0.07	0.15	0.22	0.30	0.37
8	14.1	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.10	0.19	0.29	0.39	0.49
9	15.8	0.01	0.02	0.04	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.12	0.25	0.37	0.49	0.62
10	17.6	0.02	0.03	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.15	0.15	0.30	0.46	0.61	0.76
11	19.4	0.02	0.04	0.06	0.07	0.09	0.11	0.13	0.15	0.17	0.18	0.18	0.37	0.55	0.73	0.92
12	21.3	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.17	0.20	0.22	0.22	0.44	0.66	0.87	1.09
13	23.1	0.03	0.05	0.08	0.10	0.13	0.15	0.18	0.21	0.23	0.26	0.26	0.51	0.77	1.03	1.28
14	24.9	0.03	0.06	0.09	0.12	0.15	0.18	0.21	0.24	0.27	0.30	0.30	0.59	0.89	1.19	1.49
15	26.8	0.03	0.07	0.10	0.14	0.17	0.20	0.24	0.27	0.31	0.34	0.34	0.68	1.02	1.36	1.70
16	28.7	0.04	0.08	0.12	0.15	0.19	0.23	0.27	0.31	0.35	0.39	0.39	0.77	1.16	1.55	1.94
17	30.6	0.04	0.09	0.13	0.17	0.22	0.26	0.31	0.35	0.39	0.44	0.44	0.87	1.31	1.75	2.18
18	32.5	0.05	0.10	0.15	0.20	0.24	0.29	0.34	0.39	0.44	0.49	0.49	0.98	1.47	1.96	2.45
19	34.4	0.05	0.11	0.16	0.22	0.27	0.33	0.38	0.44	0.49	0.54	0.54	1.09	1.63	2.18	2.72
20	36.4	0.06	0.12	0.18	0.24	0.30	0.36	0.42	0.48	0.54	0.60	0.60	1.21	1.81	2.41	3.02
21	38.4	0.07	0.13	0.20	0.27	0.33	0.40	0.46	0.53	0.60	0.66	0.66	1.33	1.99	2.66	3.32
22	40.4	0.07	0.15	0.22	0.29	0.36	0.44	0.51	0.58	0.66	0.73	0.73	1.46	2.18	2.91	3.64
23	42.4	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.79	0.79	1.59	2.38	3.18	3.97
24	44.5	0.09	0.17	0.26	0.35	0.43	0.52	0.61	0.69	0.78	0.86	0.86	1.73	2.59	3.46	4.32
25	46.6	0.09	0.19	0.28	0.37	0.47	0.56	0.66	0.75	0.84	0.94	0.94	1.87	2.81	3.75	4.68
26	48.8	0.10	0.20	0.30	0.40	0.51	0.61	0.71	0.81	0.91	1.01	1.01	2.02	3.04	4.05	5.06
27	51.0	0.11	0.22	0.33	0.44	0.54	0.65	0.76	0.87	0.98	1.09	1.09	2.18	3.27	4.36	5.45
28	53.2	0.12	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.17	2.34	3.51	4.68	5.85
29	55.4	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1.25	2.51	3.76	5.02	6.27
30	57.7	0.13	0.27	0.40	0.54	0.67	0.80	0.94	1.07	1.21	1.34	1.34	2.68	4.02	5.36	6.70
31	60.1	0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.29	1.43	1.43	2.86	4.28	5.71	7.14
32	62.5	0.15	0.30	0.46	0.61	0.76	0.91	1.06	1.22	1.37	1.52	1.52	3.04	4.56	6.08	7.60
33	64.9	0.16	0.32	0.48	0.65	0.81	0.97	1.13	1.29	1.45	1.61	1.61	3.23	4.84	6.45	8.07
34	67.5	0.17	0.34	0.51	0.68	0.85	1.03	1.20	1.37	1.54	1.71	1.71	3.42	5.13	6.84	8.55
35	70.0	0.18	0.36	0.54	0.72	0.90	1.09	1.27	1.45	1.63	1.81	1.81	3.62	5.43	7.23	9.04
36	72.7	0.19	0.38	0.57	0.76	0.95	1.15	1.34	1.53	1.72	1.91	1.91	3.82	5.73	7.64	9.55
37	75.4	0.20	0.40	0.60	0.81	1.01	1.21	1.41	1.61	1.81	2.01	2.01	4.03	6.04	8.05	10.07
38	78.1	0.21	0.42	0.64	0.85	1.06	1.27	1.48	1.70	1.91	2.12	2.12	4.24	6.36	8.48	10.60
39	81.0	0.22	0.45	0.67	0.89	1.11	1.34	1.56	1.78	2.01	2.23	2.23	4.46	6.69	8.91	11.14
40	83.9	0.23	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.34	4.68	7.02	9.36	11.70
41	86.9	0.25	0.49	0.74	0.98	1.23	1.47	1.72	1.96	2.21	2.45	2.45	4.91	7.36	9.81	12.26
42	90.0	0.26	0.51	0.77	1.03	1.28	1.54	1.80	2.05	2.31	2.57	2.57	5.14	7.71	10.27	12.84
43	93.3	0.27	0.54	0.81	1.07	1.34	1.61	1.88	2.15	2.42	2.69	2.69	5.37	8.06	10.75	13.43
44	96.6	0.28	0.56	0.84	1.12	1.40	1.68	1.96	2.25	2.53	2.81	2.81	5.61	8.42	11.23	14.03
45	100.0	0.29	0.59	0.88	1.17	1.46	1.76	2.05	2.34	2.64	2.93	2.93	5.86	8.79	11.72	14.64

* Working example: If the horizontal distance shown on a map is 30 m and the slope is 15° or 26.8%, the actual distance required to be measured on the ground is 30 m + 1.02 m, or 31.02 m.