KINGDOM OF CAMBODIA

Nation Relegion King

Ministry of Agriculture Forestry and Fisheries
Forest Administration

FIELD GUIDE IN REDUCED IMPACT LOGGING IN CAMBODIA

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ITTO-FA Project on
Training in Reduced Impact
Logging (RIL) in Cambodia
PD 65/01 Rev. 2 (i)

DECEMBER 30. 2003

PREFACE

The Royal Government of Cambodia (RGC) through the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Forestry Administration (FA) has prepared and approved its National Code of Practice for Forest Harvesting in July 1999. It was completed with technical support from FORTECH, an Australian firm, and funded by the World Bank (WB). The Code was consistent with the government's policy of promoting the implementation of improved forest management practices, including reduced impact logging (RIL), as well as the International Tropical Timber Organization (ITTO) Year 2000 Objective on Sustainable Development.

In addition, the Forest Concession Management Planning Manual (2001) with support from the Asian Development Bank (ADB) and the World Bank (WB) has provided the technical guidelines that promote the RIL practices. The planning manual has been based on scientific researches on forest management and widely accepted by the government through the FA, including the donor community, NGOs and the private sector. The next logical step therefore is to introduce the Code to concerned stakeholders through education and awareness program to provide corresponding shift in strategies to efficiently and effectively implement the National Code and the RIL practices on the ground.

In the pursuit of its mandate, the FA continuously explore opportunities to work with international and local organizations in order to implement sustainable forest management-related programs and projects. Along this line, the ITTO has approved the FA's project, entitled, "Training in RIL in Cambodia under PD 65/01 Rev. 2 (I), and being implemented for two (2) years starting October 2002. One of the project outputs is to produce and publish an operational manual for RIL by adapting the existing sustainable forest management guidelines and procedures in the country.

In this regard, the ITTO-RIL project has compiled and drafted this document, which we termed as ***"Field Guide in Reduced Impact Logging (RIL) in Cambodia"*** through the efforts of its advisers, national consultants and staff spearheaded by Dr. Antonio C. Manila of Japan Overseas Forestry Consultants Association (JOFCA). It is hoped that this document would prove useful to all concerned stakeholders working in the field levels through their concerted efforts to implement sustainable forest management, particularly the RIL practices throughout the country.

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Head
Forestry Administration

ACKNOWLEDGEMENTS

This *Field Guide in RIL in Cambodia* is a compilation of lecture notes, experiences gained and lessons learned in the practice of sustainable forest management in the country. The documents have been provided by the four (4) National Consultants, as authors of the said Guide, of the ITTO-FA Project, with the intention of collating these documents and producing an operational manual on RIL in Cambodia.

The Guide has been edited and compiled by Dr. Antonio C. Manila of Japan Overseas Forestry Consultants Association (JOFCA) as the International Expert of the ITTO-FA Project. The documents/lecture notes have been organized and translated from Khmer dialect to English language and vice versa through the kind assistance of Mr. Det Seila, the Project Assistant of ITTO-FA Project. It is hoped that this field Guide will be used by various stakeholders, including " Forestry and Wildlife Training Center ", which was established by the support of Japan International Cooperation Agency (JICA).

On behalf of the FA under the able leadership and support from its Director General, Mr. Ty Sokhun, we wish to express our profound appreciation for the assistance received and patience encountered by the International Tropical Timber Organization (ITTO), without its financial support this document would have not been completed. Special mention is extended to its Executive Director, Dr. Manuel Sobral Filho and Dr Hwan Ok Ma, Projects Manager, Forestry Industry, ITTO and a member of the Project Technical Committee (PTC) of this RIL-Cambodia project.

MR. CHANN SOPHAL
Project Manager
RIL Project

TABLE OF CONTENTS

Sighs and abbreviation used in the text

OLI :	Operational Level Inventory
dbh :	Diameter at Breast Height
NTFP	Non Timber Forest Products
FA	Forestry administration
GPS	Global Positioning System
GIS	Geographical Information System

LIST OF FIGURES

APPENDICES LIST

LIST OF TABLES

1. INTRODUCTION

This operational manual or termed as *"Field Guide"* in reduced impact logging (RIL) is aimed at providing foresters, forest technicians and forest managers in the government and private sectors, particularly those working in the field levels, with technical procedures and guidelines for adapting and applying the sustainable forest management practices in Cambodia. A common set of procedures and guidelines has been designed and provided for all production forests in the country.

The guidelines and procedures cover the major phases of forest

- Pre-harvesting activities;
- Harvesting operations; and
- Post-harvest activities.

In 1992, the government decided to introduce private industrial concessions as the main instrument of commercial forest management, with the concerned forestry agency, such as the Department of Forestry and Wildlife (FA) regulating the use of the forest resources. The above guidelines and procedures covering the major phases of forest management are applied in all production forests, and being followed by the forest concession holders.

To further strengthen the capacities of human resources involved in the implementation and regulation of the existing forest management guidelines and procedures, it is important to introduce the Cambodian Code of Practice for Forest Harvesting to concerned stakeholders through education and awareness program to provide corresponding shift in strategies to efficiently and effectively implement the Code and the RIL practices on the ground.

The objective aim to provide a reduce impact logging procedure as well as a forest management tools in implementing for Forest Administration and stakeholders in Cambodia.

2. PRE-HARVESTING ACTIVITIES

2.1- Operational Level Inventory

In this manual, we are going to define
- the needs in data (parts 2 and 3)
- the general inventory design (parts 4 and 5)
- and finally the detailed operational procedures

The inventory and the data analysis is done by the concessionaire. FA is involved in tree selection and harvesting planning, done by the concessionaire. The ground truthing is conducted by the FA.

This document has been prepared according to the planning manual and the Code of Practice, and based on the methodology already applied by the concessionaires.

This manual have been prepared by the Department of Forestry and Wildlife with the Technical Assistance of the Forest Concession Management and Control Pilot Project funded by the World Bank.
The objectives of OLI are:

- to assess the harvestable resource for the first cutting cycle Coupe (one year)
- to allow the preparation of the Annual Coupe Plan and the Detailed block plans (cf. Planning Manual and Code of Practice) and especially the demarcation on map of the blocks
- mapping of the Coupe, in order to plan the activities on the Coupe (harvesting, roads and bridges, non-harvestable areas...) : repartition of the resource, constraints (rivers, swamps, slopes, rocks...), human activities, site of social interest...

Data analysis and annual Coupe plans must be submitted by the concessionaire to the FA by 31 August.

2.2. Data to be collected (Minimum requirements)

Harvestable Trees:
- within Group 1, Group 2 and Group 3
- with diameters upper than the new Minimum Diameter decided by the medium-term (compartment) plan
- diameter, species, quality will be recorded for each tree:,.
- a number will be allocate to each tree, and marked either on the map and on the stem of the tree.

Trees to be protected: for seeding, for harvesting in the next cutting cycles, for social interest (NTFP, cultural or religious importance), in the buffer zones, protected species

Topographic features: watercourses, gullies, waterways, confluent, swamps, areas of wet soils, rock outcrops, crest lines

Site of religious, cultural or recreational importance (someone from the local populations must be involved).

All the information required defining buffer zones and protected areas planned by the "code of practice".

Slopes: in order to define the steep areas and to draw the 10 meters contour interval, the data on digital terrain modeling will not be sufficient

Tracks of NTFP harvesting on trees

Existing roads and skid trails, water course crossings

All the data have to be located on plan (on the tally-sheet) to allow the edition of a map.

Consequence: all these features have to be locate relatively one to the other but also in the absolute. So GPS data are required.

2.3 Inventory design

The methodology proposed is quite the same as the one implemented by the concessionaires (before the suspension of the harvesting activities). It has be improved in order to fulfil all the requirements provided by the "code of practice".

2.3.1 Introduction

It is a 100% inventory, concerning the entire harvestable area of the Coupe.

The fieldwork is done in 3 stages, because it is absolutely impossible to do inventory, tree selection (especially for trees inside the buffer zones or if the maximum number of trees to harvest is reached) and harvest planning (demarcation of road, skid trails, buffer zones...) at the same stage. For the tree selection and harvest planning, it is necessary to use a precise map with trees, natural features and constraints and all the existing infrastructure.

1 – stage 1:
Demarcation of plots, with transects.
GPS recording, to locate transects and plots.

2 – stage 2: inventory:
Inventory of the trees, with mapping (on the field) of the trees, the topographic features, existing infrastructures. All the trees that fulfil the harvesting requirements are numbered, with continuous series for each block.

3 – stage 3: tree selection and harvest planning
After an analysis of the data allowing the edition of resource maps on the Coupe and the demarcation of the blocks. At this stage:

- the harvestable trees will be definitively selected and marked,
- protected trees will be marked,
- the roads, skid trails and water courses crossings will be mapped and demarcated on the field

It is better to carry out the inventory very soon after the plot demarcation. The tree selection shall be carried out later, to prepare the Block plan. A FA representative is involved only in that stage and not in stage 2 (inventory).

The planning process is illustrated by the Appendix 5

2.3.2 Inventory area

The Operational Level inventory is conducted on the entire harvestable area of the coupe, as defined by the Compartment Plan (Five-year working plan). For example, if the deciduous forest is non-harvestable according to the compartment plan, the inventory is not conducted on this forest type.

Every year, the Inventory stage must be finished on the entire Coupe before the beginning of the harvesting. The tree marking is conducted in order to prepare the Detailed Block Plan. This Detailed Block Plan "*must be prepared by the concessionaire and approved before harvesting operations can commence in a block*" .

2.3.3 Transects and size of the plots

Different kinds of transects are demarcated on the field (see Figure 1 and Figure 2)

- main transects demarcate rectangles of 1000 metres by 1500 metres (150 hectares)
- secondary transects demarcate inventory plots of 100 metres by 500 metres (5 hectares)
- inventory transects are used by the measurers, they are facultative

Figure 1: design for the main and secondary transects

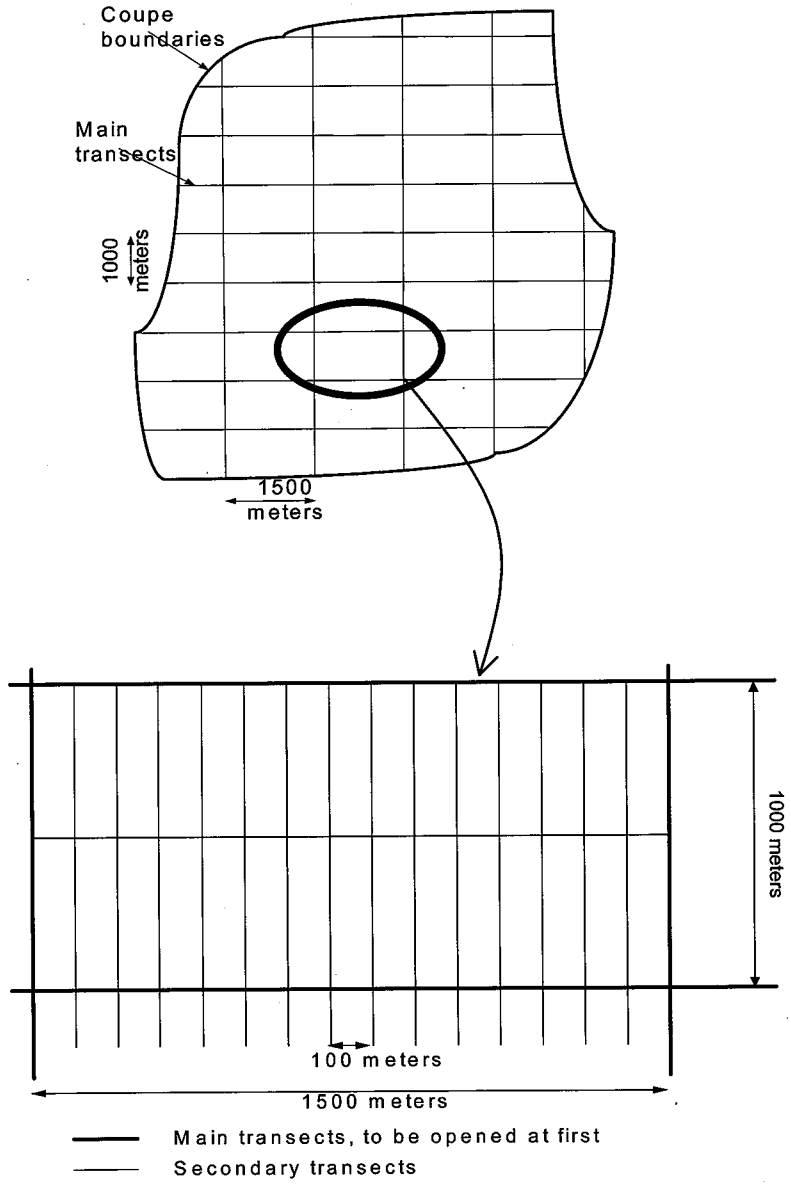
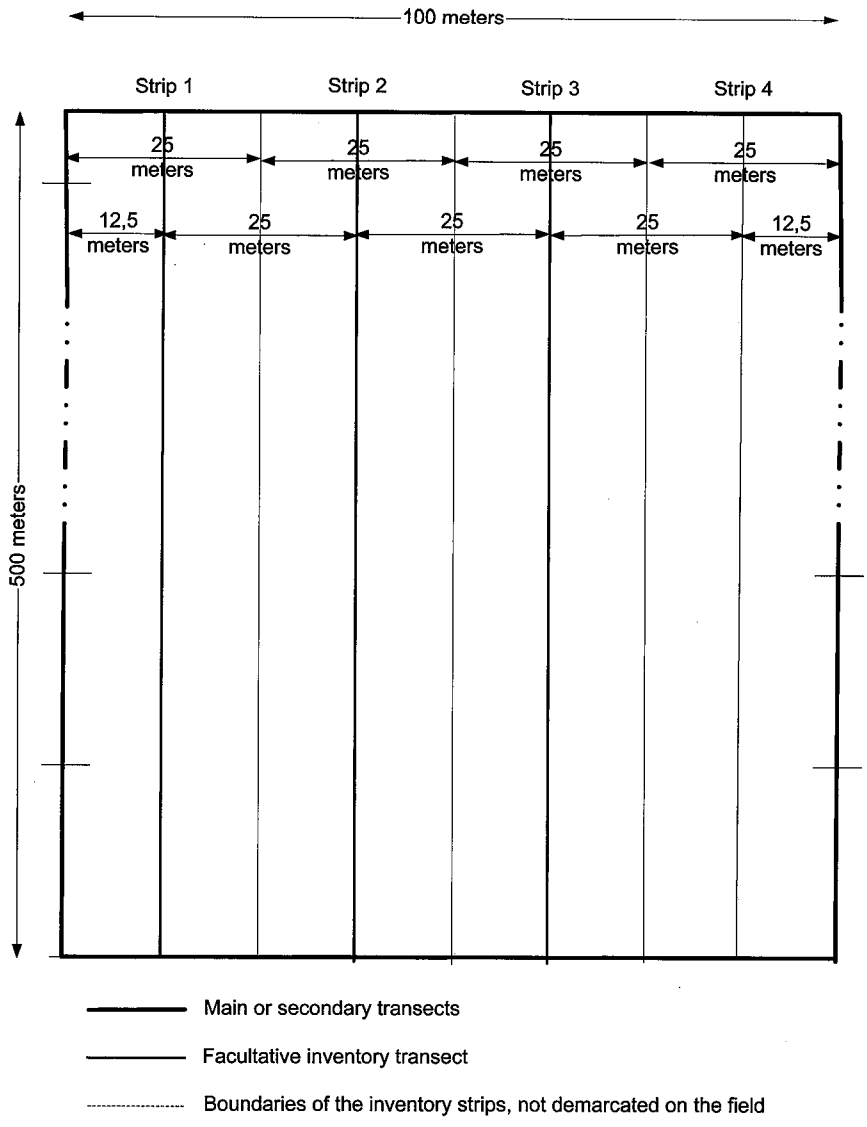


Figure 2: design for the inventory transact, facultative



2.4 PREPARATION OF THE TRANSECT PLAN ON A COUPE

Directions of the transects must be only North-South and East-West. The inventory strips can be directed East-West or North-South (inventory direction).

The transect plan (see example in Figure 3) is prepared on a map, on a scale of 1:25.000 to 1:50.000. Data provided by the Compartment plan are used for this map : water-courses, roads...The transect plan can be prepared for several Coupes or an entire compartment.

The rules for transect identification are:

- letters for main transects and secondary transects perpendicular to the inventory strips,
- numbers for main and secondary transects parallel to the inventory strips
- no number for inventory transects

The chaining is continuous in both direction, from an origin point, to the end of a transect. X and Y are the distances chained (in latitude and longitude) from the origin. The origin point is located at the southwest and outside the Coupe so that X and Y are always positive. One on the 2 co-ordinates is constant all along the transect.
On the example illustrated by Table 1 and Table 2, the inventory strips are oriented East-West. Main transects are highlighted in grey.

Table 1: X-Co-ordinate for main transects and secondary transects parallel to the inventory strips (distance between transects: 100 metres)[1]

Transect	X
0	0
1	100
2	200
3	300
4	400
5	500
6	600

[1] If the inventory strips are oriented North-South, this table is valid for the Y-co-ordinate

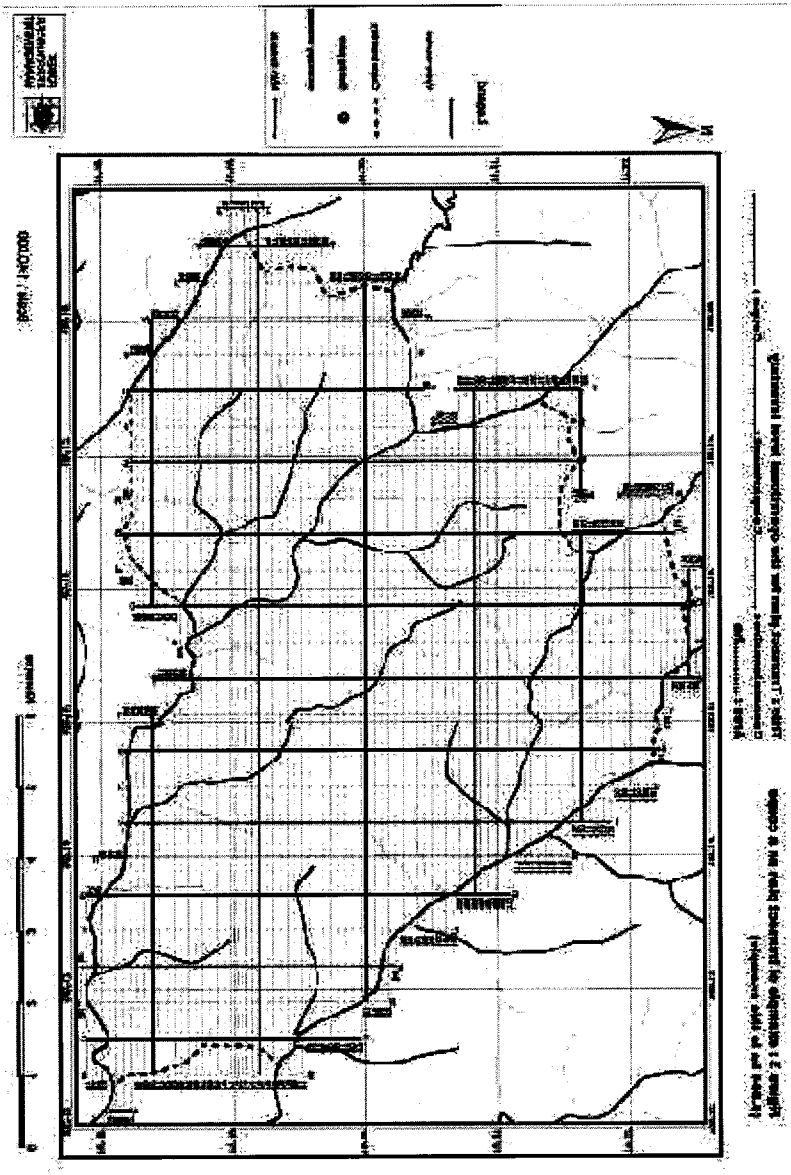
7	700
8	800
9	900
10	1 000
.....	.....
15	1 500
.....	.....

Table 2: Y-Co-ordinate for main transects and secondary transects perpendicular to the inventory strips (distance between transects: 500 metres)[2]

Transect	Y
A	0
B	500
C	1000
D	1500
E	2000
F	2500
G	3000
H	3500
I	4000
J	4500
K	5000
L	5500
.....	.....
A'	13 000
.....	.....

[2] If the inventory strips are oriented North-South, this table is valid for the X-co-ordinate

Figure 3: example of transects plan on a Coupe



2.5 TRANSECT DEMARCATION

There are 3 types of transects: the main transects are cleared first, so that the secondary and the inventory transects can be adjusted on them on each crossing. For the chaining and the identification of the transects, information are provided by the transect plan.

A signboard is set up at the starting point on the coupe (starting point of the first transect to be cleared), with compartment number, coupe number and area and UTM coordinates.

2.5.1 Main transects

The starting point of the first main transect is located as far as far possible in the middle of the Coupe and on a road. The point is found on the field with a GPS or with the map, without any requirement on accuracy.

2.5.1.1 Clearing

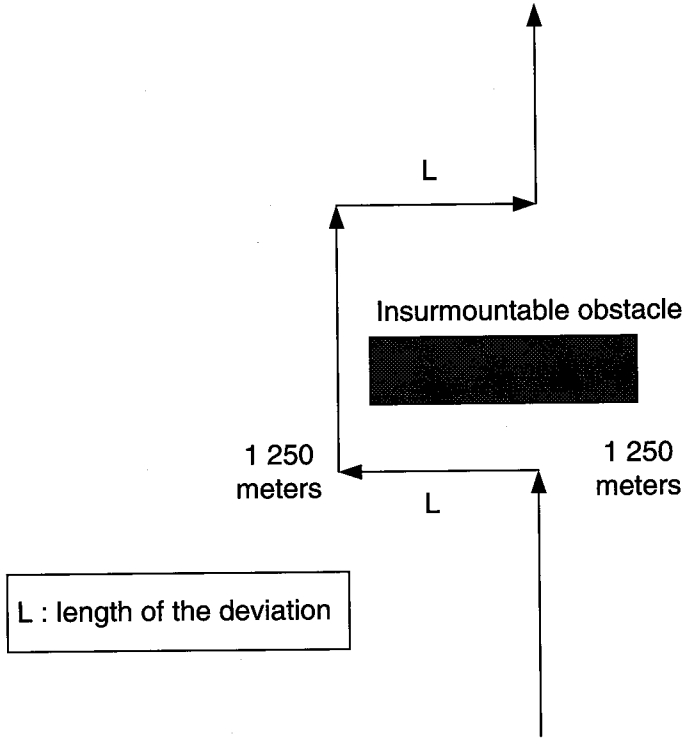
The transects width is at least 1 metre, in order to be visible several months after their demarcation (during the inventory and during the tree selection).

2.5.1.2 Directions

Azimuths are measured with a compass, with an accuracy of a half-degree. They are corrected by the local declination (difference between geographic azimuth and magnetic azimuth).

If the transect crew comes up against an insurmountable obstacle, and the transect can not be continued according to the planed direction, a deviation is created, as explained in the Figure 4.

Figure 4: Deviation in case of insurmountable obstacle



2.5.1.3 Chaining and slope corrections

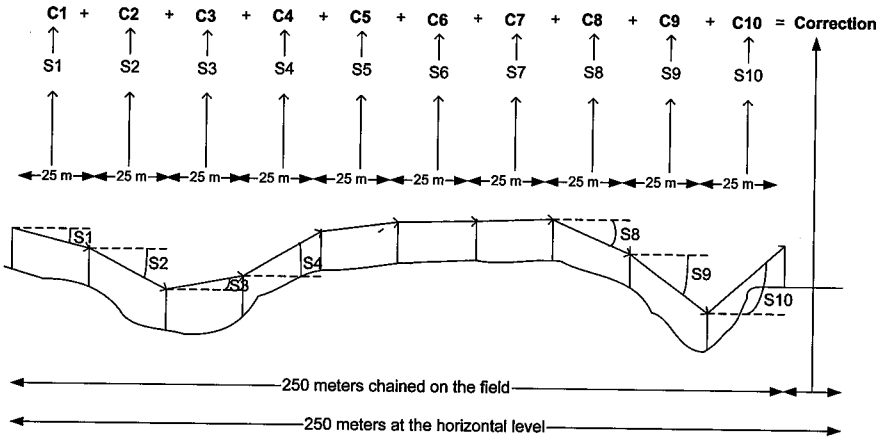
The chaining is made with a cable 25 metres long, in continue from the origin to their end (from 0 to x metres to the east or to the north).

The clearing and chaining could be done backward.

Slope correction is required only if the slope is greater than 10%. The purpose is that the length must be measured on an horizontal level.

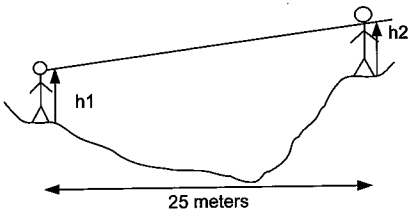
The procedure to apply is to measure the slopes and add the correction required at the end of each 250 m length transect line (see Figure 5). The values of the length to be added are given by Appendix 3 and are calculated on the transect tally-sheet.

Figure 5: procedures to apply for slope correction



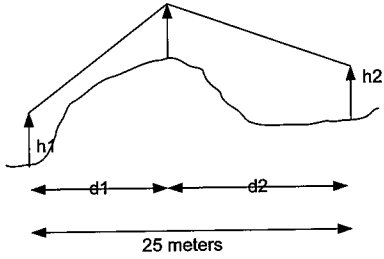
For i=1 to 19 ; Ci = 25 * ((√(Si²+1)) - 1) , where Si given in %

2.5.1.4 Poles



Aiming along the same way as chaining

Aiming to the same height at the starting and the ending points : h1 = h2



If aiming is impossible along the chaining way

Aiming in two stages

Total correction = d1 * coeff 1 + d2 * coeff 2

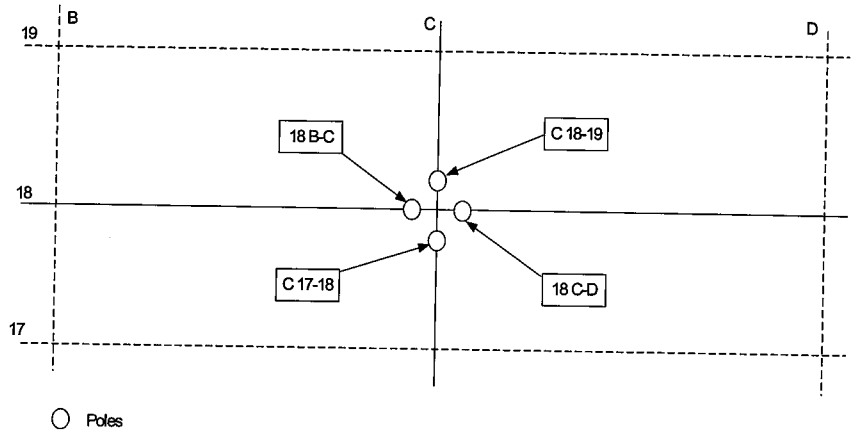
coeff to be read in the correction table for 1 meter chained

Poles will be put every 25 metres on the transect. The following features are written on each pole: number of the transect and total distance from the transect starting point (X or Y co-ordinate): for example **T 18 – 1325 m**. As far as possible, it is better to use living trees for poles.

Poles are put on the crossings with roads and watercourses, with the same specifications.

At the beginning of each plot (every 500 metres), 2 plates will be hammered on a tree, indicating the numbers of the concerned transect and the numbers of the 2 transects before and after (see Figure 6).

Figure 6: Identifications to be put on the poles on each transect crossings



2.5.2 Secondary transects

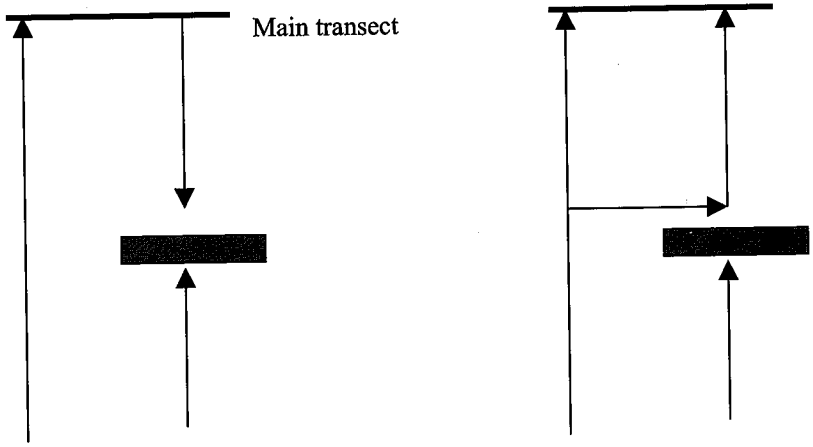
Only the differences with the main transects are indicated below.

The clearing is lighter, but the poles must be visible during several months.

Azimuths are measured with a compass, with an accuracy of one degree, so that the total deviation at the end of each 500 metres long line is lower than 10 metres.

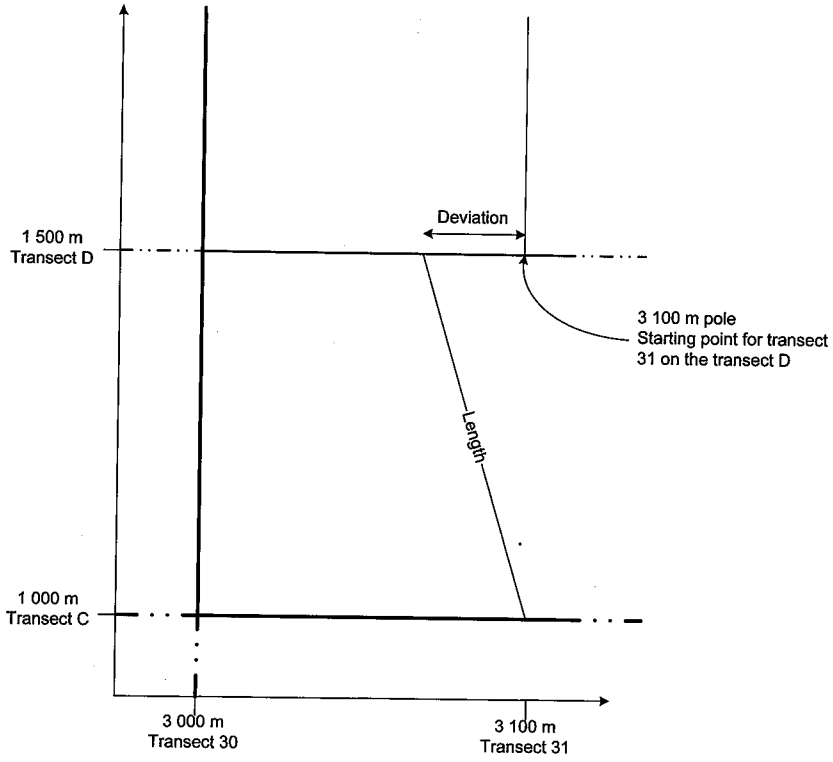
If the transect crew comes up against an insurmountable obstacle, and the transect can not be continued according to the planed direction, either the end of the transect is opened backward, or a perpendicular transect is open from a nearby transect (see Figure 7).

Figure 7: procedures to be applied in case of insurmountable obstacle



No slope is measured and the distances are not corrected. At the junction with a main transect, there is an adjustment in order to continue the secondary transect from the right pole (see example in Figure 8).

Figure 8: adjustment of the secondary transects on the main and perpendicular transects



If the deviation is higher than 15 metres or if the real length of the secondary transect (between 2 main or perpendicular transect) is higher than 550 metres, the transect must be started again. The deviation and the real length of the transects are noted down on the transect tally-sheet.

2.5.3 Plots on the boundaries

In case the transect is ending on a natural feature (water-course) or a road at the Coupe boundary:

- if this boundary can be crossed, the transect is continued, in order to demarcate entire plots (500 x 100 metres), as explained in Figure 9. In this case, all the Coupe area is

included in rectangular plots. Consequently, as soon as the Coupe boundary cross the last transect, another transect as to be opened.

- if the boundary can not be crossed, some supplementary transects can be created between the existing transect, each 100 metres in both directions. Supplementary transects in inventory direction are identified by numbers, as normal secondary transect in inventory direction. Supplementary transects perpendicular to the inventory direction are identified by the letter of the near transect (south or east) and a number (see Figure ***10***).

It means that the transect plan has to be adapted on the field.

Figure 9: transect and plots to be demarcated near a boundary, which can be crossed

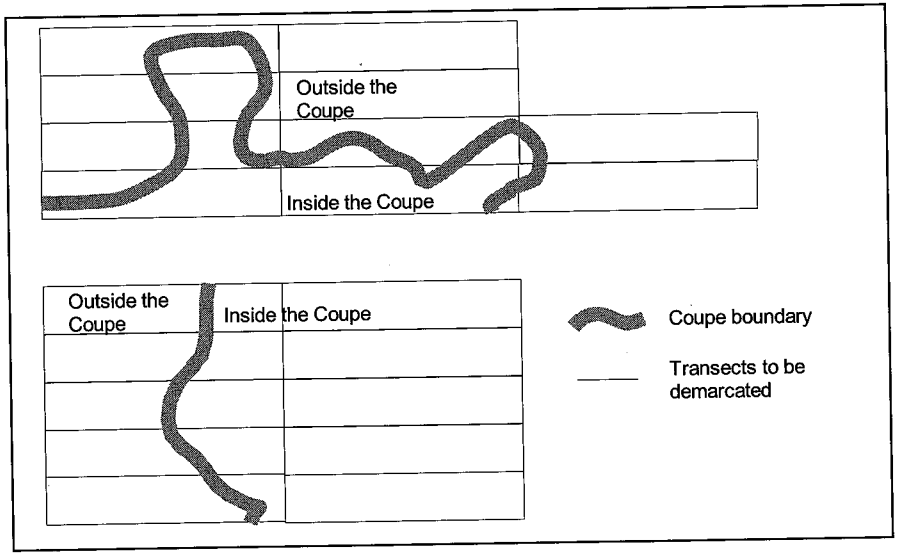
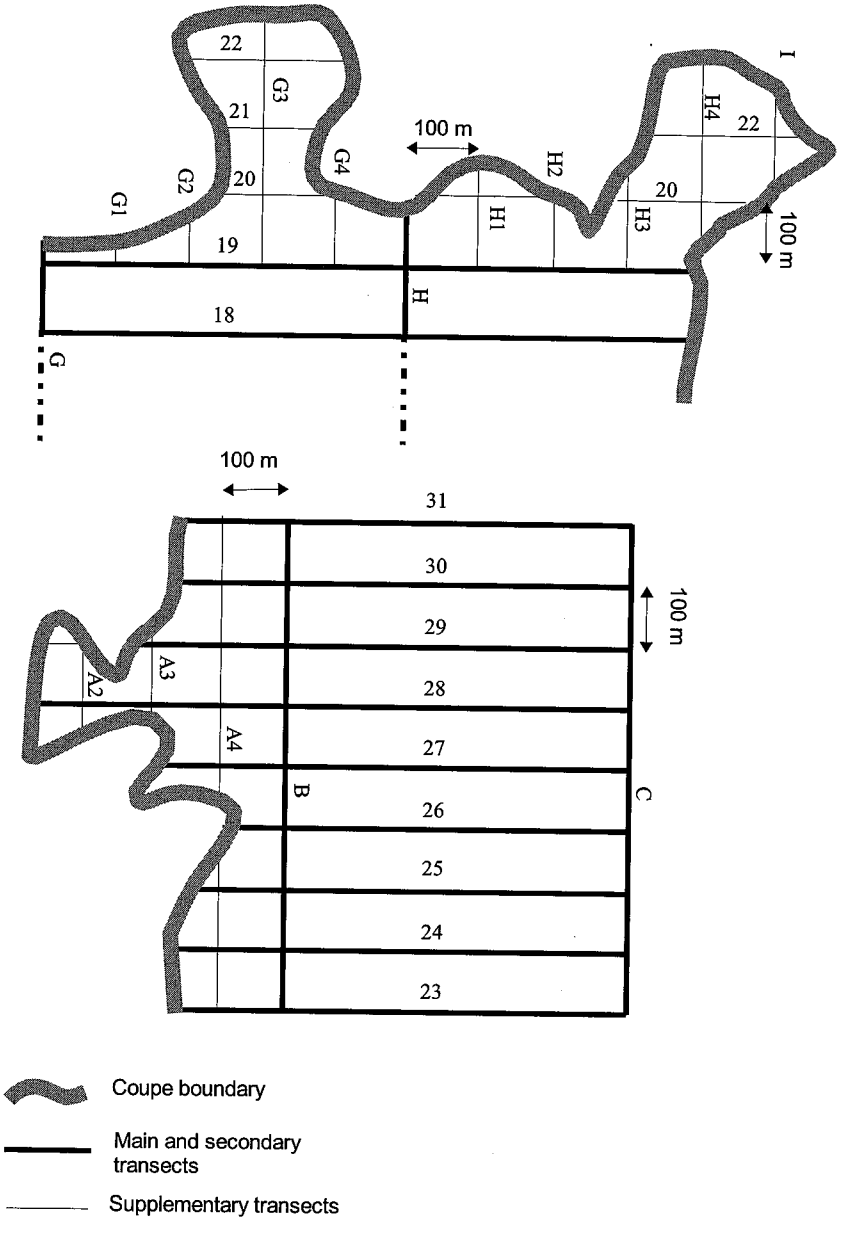


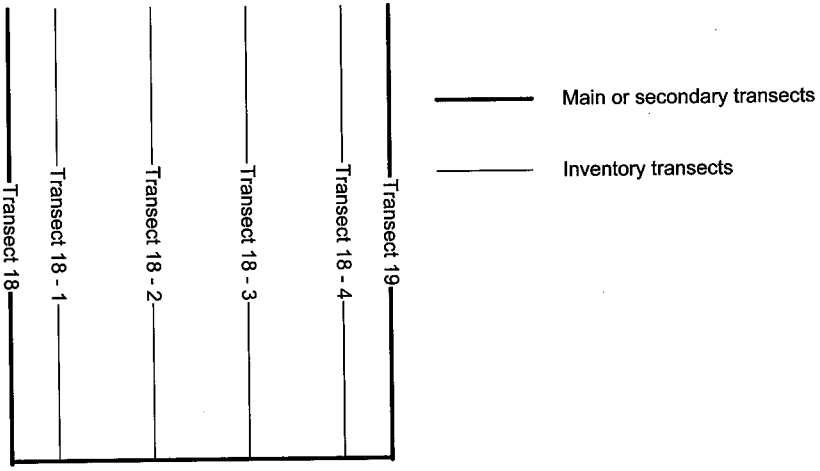
Figure 10: transect and plots to be demarcated near a boundary which can not be crossed



2.5.4 Inventory transects

They are facultative. They are opened in the axis of the 25 metres wide inventory strips, in order to facilitate the progress of the measurers. There is no requirement on their width or the poles to be put. Their identification is clearly different from the other transects: for example, they are identified by 2 numbers (see example in Figure 11): number of the secondary transects located at the east or at the south and number of the measurer (1 to 4).

Figure 111: example for the identification of inventory transects



2.5.5 Tally sheets for the transect

The 3 models for tally-sheets are provided in Appendix 1:

- Tally-sheet for the main transects
- Tally-sheet for the secondary transects
- Tally-sheet for GPS data

The transect tally-sheets are filled in from the bottom to the top, in order to have the same displays in the field and on the tally-sheet.

Distances of transect crossings are noted down in the right row for secondary transects for example: Transect 18 (518 m) X Transect B (1795 m). In this example, the errors are 18 meters on transect 18 length and 5 meters of deviation for crossing on transect B.

For main transects, distances of crossings are noted down as observation.

Deviation on main transects are also explained as observation.

2.5.5.1 Plot identification (on the 2 transect tally-sheets)

- Concession
- Compartment number
- Number of the Coupe
- Number of the transect
- Distances from the transect starting point (in metres) The unused row is crossed out. For the secondary transects demarcated backward (to the South or to the East), the right row is used and the left one is crossed out.
- Azimuth followed with the compass

2.5.5.2 Crew and inventory identification (on the 2 transect tally-sheets)

- Name of the crew leader
- Date at the time of the measurement

2.5.5.3 Slope on the transect (only for the main transects)

The average slope is measured for each 25 metres long transect lines. The slope corrections for 25 metres and the total for 250 metres are calculated.

2.5.5.4 Higher slope (on the 2 transect tally-sheets)

This slope is measured only if it is higher than 27% (15°), in the direction where it is the highest, at each 25 metres pole. The value is noted down and the slope direction is indicated with an arrow, with the arrowhead to the highest.

2.5.5.5 Vegetation (on the 2 transect tally-sheets)

Only the main vegetation types that can affect the forest management are noted down. They are recorded all along the transect, the transition distance is clearly noted down (see example in Appendix 1). The following codes are noted down on the tally-sheet.

- Swamps (Sw)
- Water-body and flooded area (WB)

  Mangrove forest (MF)
- Bamboo (B)
- Agricultural land (AL)
- Wood and shrubland (WS)
- Grassland (G)
- Wet land (WL)
- Regrowth (RG)
- Plantation (Pl)
- Deciduous forest (DF)
- Evergreen or semi-evergreen forest (EF)

2.5.5.6 Topographic features (on the 2 transect tally-sheets)

See Figure 19 for mapping conventions.

2.5.5.7 Post harvesting tracks (on the 2 transect tally-sheets)

See Figure 19 for mapping conventions.

2.5.5.8 GPS data (on the GPS tally sheet)

GPS data are recorded: at the beginning of the main transects, and at each crossing between 2 main transects, at the end of main transects, at each crossing between a transect and a road

2.5.6 Transect Crews

The indicative composition of the crew and the tasks of each worker are given by Table 3 for the main transects and Table 4 men for the secondary and inventory transects.

Table 3: Main transects crew composition

Position	Tasks
Crew leader	- supervise the team - fill the transect tally-sheet
Compass operator	- measure the azimuth with the compass
Chaining operator	- chain the transect, put the poles and all the marks
Forest labourers	- lay down the transect - assist in clearing, cutting of poles...

Table 4: Secondary and inventory transect crew composition

Position	Tasks
Crew leader	- chain the transect, put the poles and all the marks - supervise the team - fill the transect tally-sheet
Compass operator	- measure the azimuth with the compass
Forest laborer	- lay down the transect - assist in clearing, cutting of poles...

The expected yield is 2,5 to 3,5 kilometers a day for the main or the secondary transects

2.6 INVENTORY

2.6.1 Plot identification

The name of the plot is constitute by the names of the 4 transects around. For example, the plot demarcated by the transects 16, 17, J and K is named 16-17-J-K (see Figure 15).

2.6.2 Organisation of the work

Before beginning the inventory, the crew leader

- Reports on a map the main information of transect tally-sheet: transects (with their real length), water-courses, roads and other infrastructures
- Copies on his inventory tally-sheets the information provided by the transect tally-sheets.

The concessionaire delineate on map the provisional blocks (less than 150 ha and based as far as possible on natural boundaries and existing roads), that can be adapted by the crew leader on the field. The block numbers (roman numerals) are also written on the map (see Figure12, page 26).

The inventory crew works in a plot of 500 metres x 100 metres, demarcated by 4 transects. The 4 measurers are distributed in the plot width, so that each of them can inventory a 25-metre strip (see Figure 16):

- Measurer 1: strip 1 between 0 and 25 metres
- Measurer 2: strip 2 between 25 and 50 metres
- Measurer 3: strip 3 between 50 and 75 metres
- Measurer 4: strip 4 between 75 and 100 metres

All these measurers walk on the same line (perpendicular to the inventory direction). Measurer 1 and 4 can read the distances on the lateral transect. When a measurer arrives on a feature to be mapped (tree, watercourse...), the crew stops, the measurer inform the crew leader of the feature characteristics and of his number: for example "measurer 1, Kerning, 60 cm dbh, quality A, tapped for resin". If necessary, the measurers between them repeat the information. The crew leader also repeat the information, to insure the measurer he has been well heard and gives the number to be put on the tree (for removable trees). The assistant or a measurer announces the distance on the lateral transects. Then the crew-leader filled his tally-sheet and the measurers can move forward.
The tree numbers follow a different series in each block. The inventory can be conducted.

- Block by block, inventorying only the parts of each plot located inside the block

- or plot by plot : a entire strip is finished before beginning the next one, the crew can cross the block boundary and the crew leader has to change series.

However, only one tally-sheet is filled in for each plot, even if it is covering several different blocks (see Figure 14).

Figure 12: example of Coupe map with the provisional block boundaries

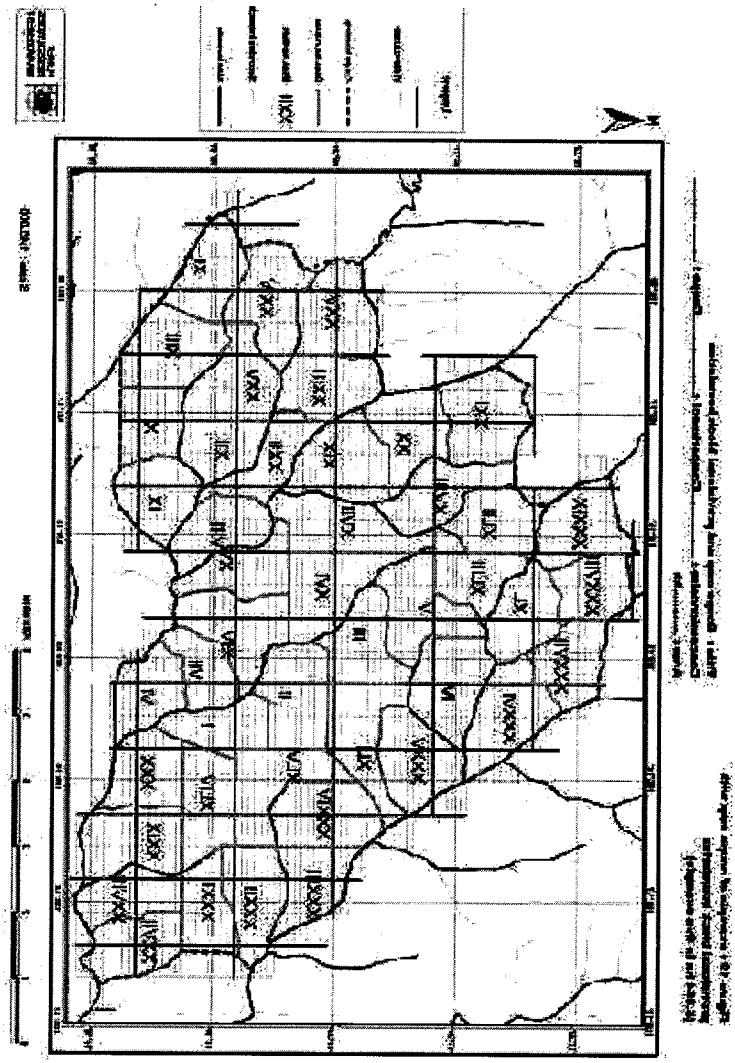


Figure 13: two options for inventory

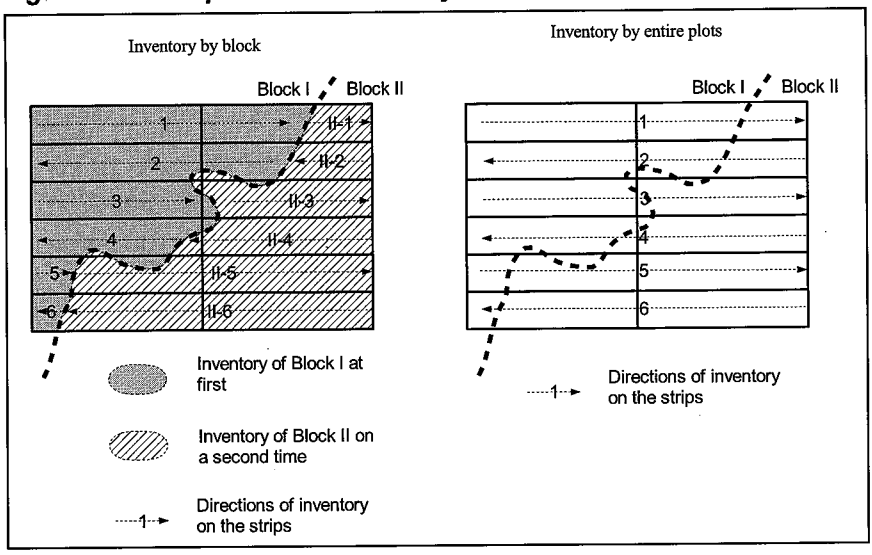
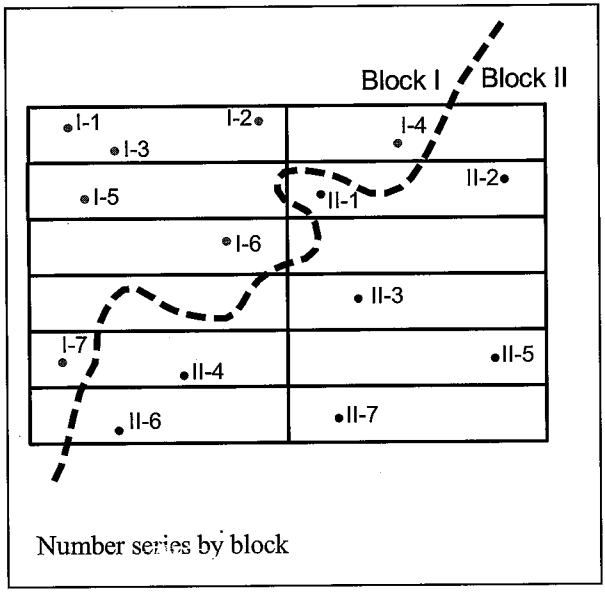


Figure 14: Tree numbering by block



The features taken into account are:

- Trees and tracks of NTFP harvesting
- Water-courses

✓ Streams, with classification in accordance with the "code of practice" (Figure 9, or see Appendix 4 of this manual), width of vegetation < 10 m tall on each side, confluent

✓ Gullies, gully heads, sources, waterways (see "code of practice", Figure 9),

✓ Lakes, water storage areas, with indication of the bufferzones required (50 or 100 metres), in accordance with the Code of Practice (Figure 7, or Appendix 4 of this document)

- Other topographic features : swamps, areas of wet soils, rock outcrops, crest lines, steep areas (slope upper than 27%), very steep areas (slope upper than 58%), landslip areas (and spoils)
- Site of religious, cultural or recreational importance (someone from the local populations is involved).
- Information to define the bufferzones and protected areas (mapping, but no demarcation on the field).
- Slopes : in order to define the steep areas, the data on digital terrain modeling will not be sufficient
- Block boundaries and block numbers
- Existing roads and skid trails, water-courses crossings, landings
- Specific forest types : swamps, mangrove forests, bamboo's, agricultural lands, wood and shrub lands, grasslands, wet lands, Regrowth, plantation

If there is a doubt, the measurer specifies the relative position of 2 items: for example, the tree is before the watercourse, inside a swamp area...

For plots located at the Coupe boundary, where transects cross this boundary, only the area located in the Coupe is inventoried, unless if the other part of the plots is the Coupe to be inventoried for the next year. In this case, all the plot is inventoried.

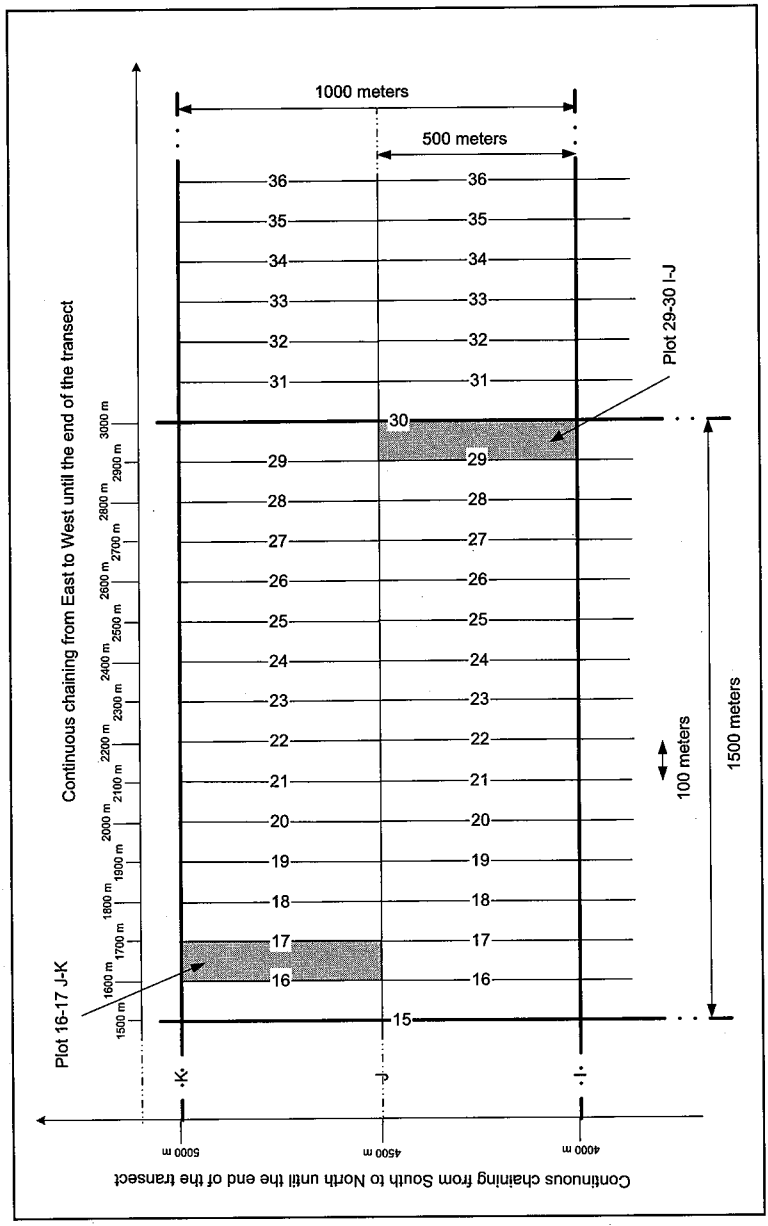
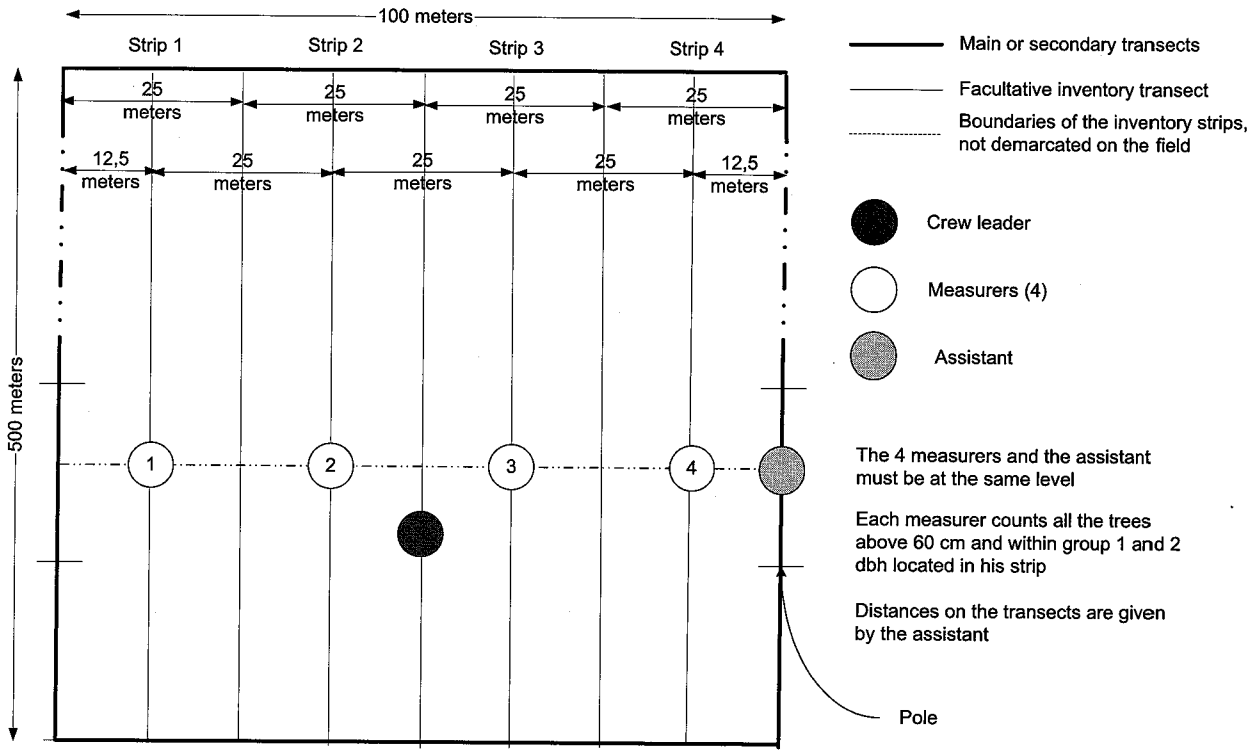


Figure 15: example for the chaining of the transects, the identification of the transects and the plots

Figure 16: organization of the crew



2.6.3 Trees taken into account

All the trees with diameter upper than the new Minimum Diameter decided by the medium-term (Compartment) plan, within species from Group 1, 2 and 3 are inventoried. Species from group 4 (non-commercial) are not inventoried.

The Groups are specified by the Compartment Plan by each concessionaire:

- Commercial Group 1 (CG1): Keruing and Mersawa: high commercial values species
- Commercial Group 2 (CG2): Species of commercial interest in the short or the medium term: the concessionaires should choose for this group species which have already been harvested, species that can been sold but under the profitability level for the moment, abundant species with good technological properties...
- Commercial Group 3 (CG3): Species of commercial interest in the long term: the concessionaires should put in this group all the species with good conformation and big diameters (above 50 cm), even if they never have been harvested.

The FA provides and updates a list of the name species to be used (see Appendix 2).

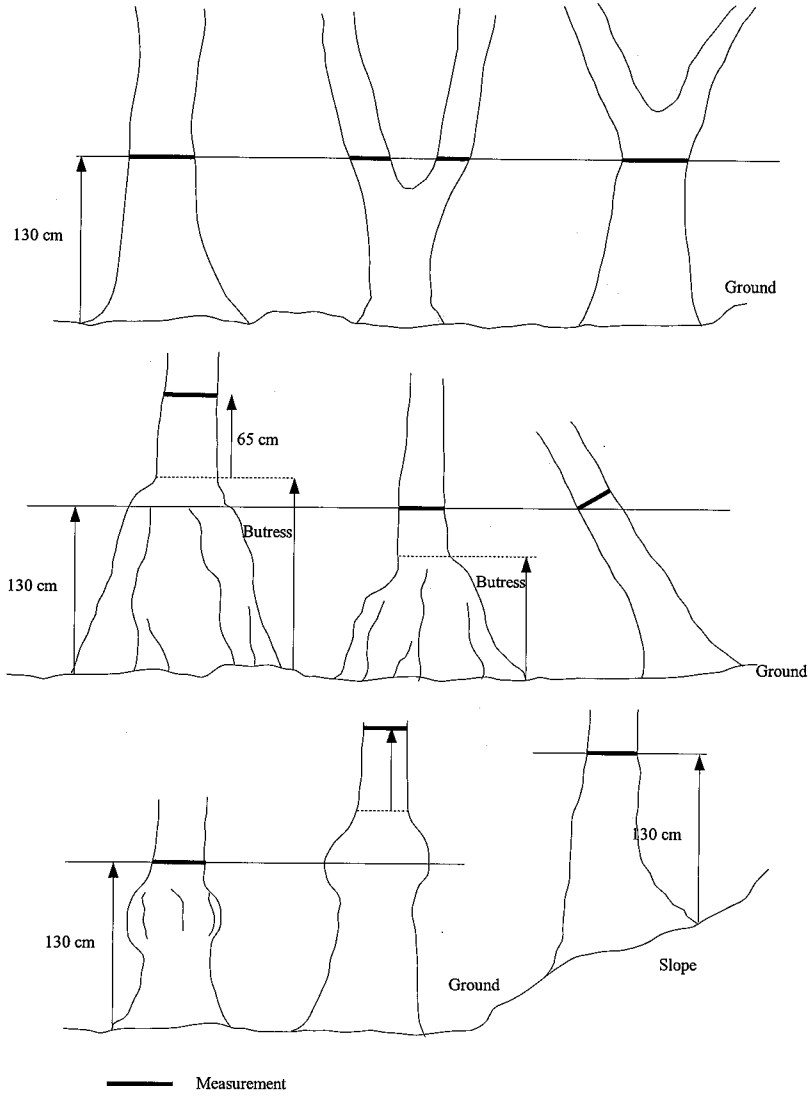
2.6.4 Measurement of diameters

Diameters are measured over bark at 1.3 m above ground or 0.65 m above buttress to nearest cm. The measurement conventions are given in Figure 17.

Diameters are measured with a tape graduated in diameter, which has to be perfectly perpendicular around the stem. If the measurement level is very high, the "measurer" must climb in order to reach it.

Diameters of trees near the interval limits must be checked.

Figure 17: conventions for diameter measurements



2.6.5 Assessment of tree quality

The quality of each tree is assessed: for each tree, one of he 3 quality categories is given.

Quality A: trees that can provide a log without any important default, at least 6 metres long.

Quality B: trees that can provide a log, at least 6 metres long, with a small default, that can be processed.

Quality C: trees that can not provide a log usable in sawmills or veneer industries, because of a lot of defaults

The acceptable defaults for qualities A and B are to be defined precisely by each concessionaire. After that the requirements on quality for each species are defined: for some species, only quality A can be harvested (for example, for veneer industries) and for others, both qualities A and B can be harvested and processed.

2.6.6 Tree marking and numbering

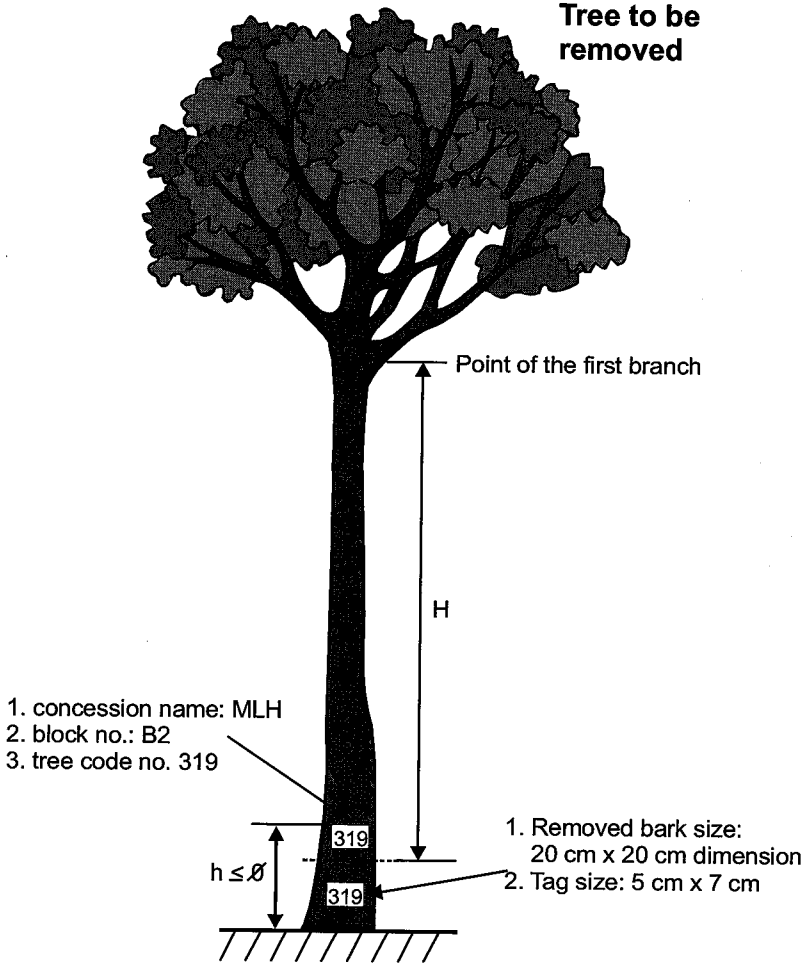
All the removable trees, that fulfil the harvesting requirements on quality, diameter and species, are numbered, with the following rules:

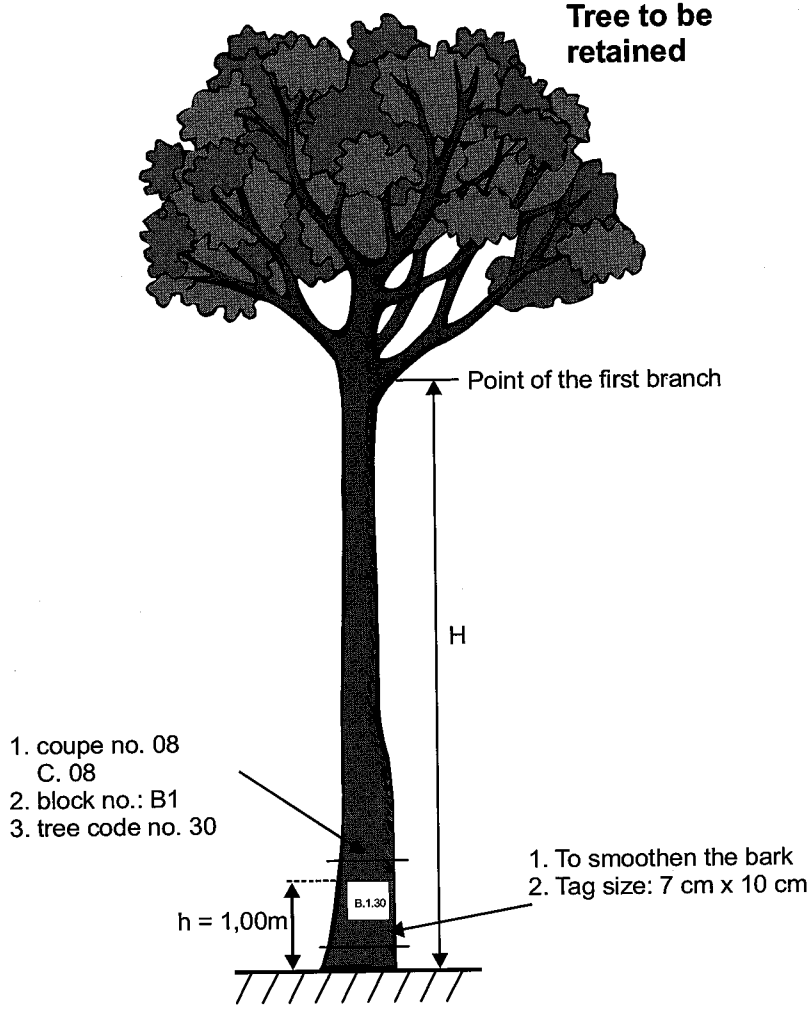
- One continuous series of numbers for each block (from 1 to x) see Figure 14.
- the inventory number is written on the tally-sheet plan and table
- the number of the tree is put on the stem using paint or strips, on a temporary basis. They will be replaced by plates hammered on the stem for the selected trees.

Non removable trees are painted with a red strip, about 1,30 m high on the stem. Their number is not marked on the stem.

2.6.6.1 Tree marking techniques/methodology

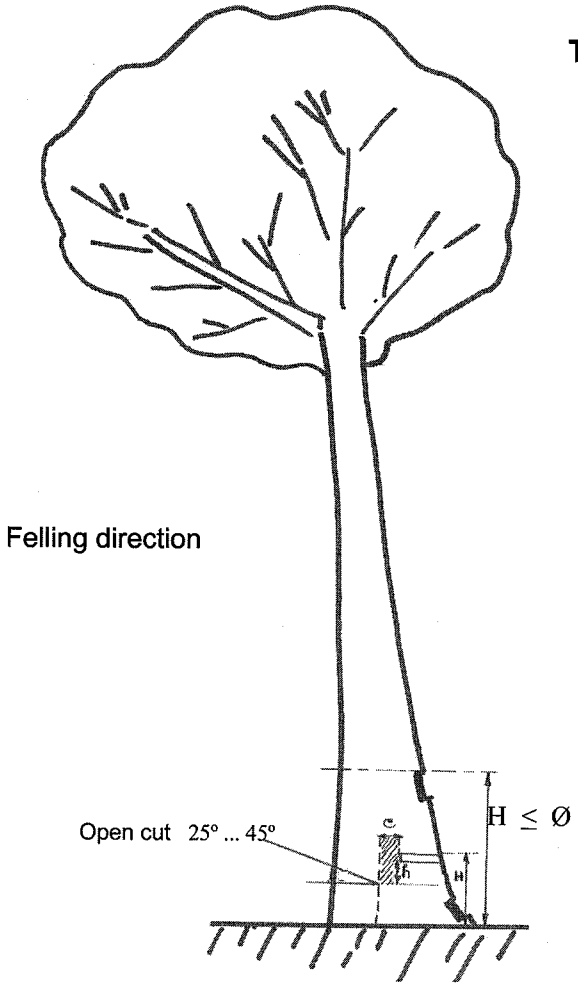
Felling direction is needed and is required to be identified on the ground. These felling direction is located opposite the open-cut or back cut. The felling direction is affected and directly related to the following situations, such as tree crown structure, exiting regeneration and slope of the ground or forest floor.




Tree to be retained
Point of the first branch
H
1. coupe no. 08
C. 08
2. block no.: B1
3. tree code no. 30
1. To smoothen the bark
2. Tag size: 7 cm x 10 cm
B.1.30
h = 1,00m

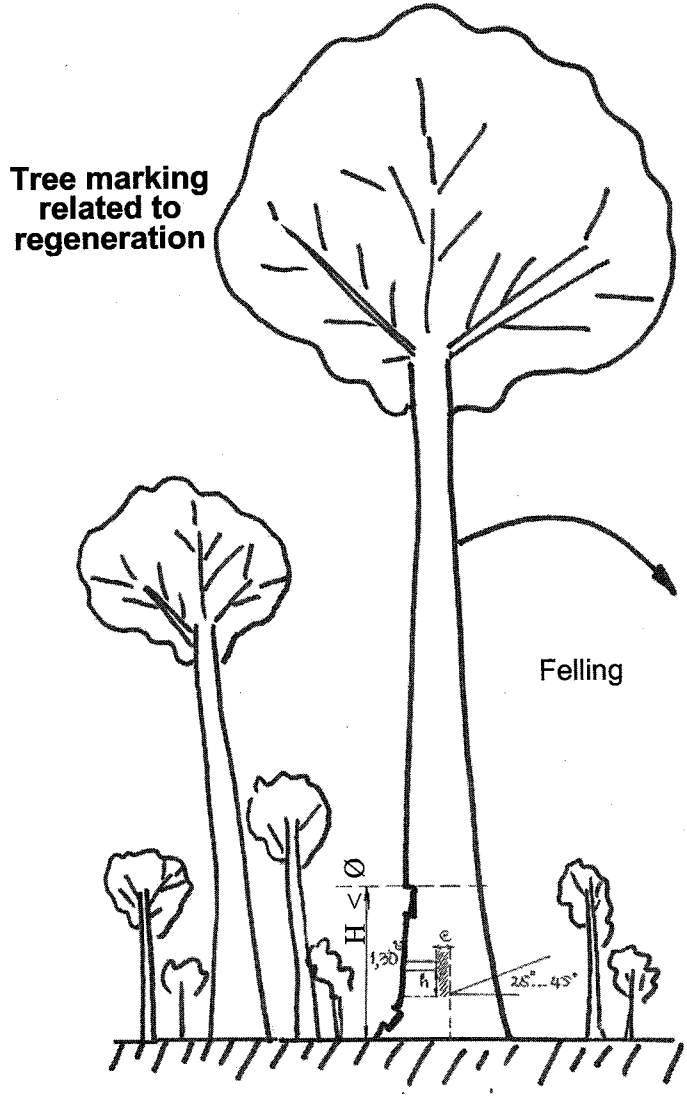
2.6.6.2 Tree marking related to crown structure

Based on the crown structure, the felling direction should follow the lean of the tree crown. This also allow a good position for the chainsaw operator as it easier to see the tag after felling operations.



2.6.6.3 Tree marking related to the regeneration

Felling direction should be appropriate in order to avoid damage to existing commercial regeneration or reproduction and remaining trees or residuals in the forest.

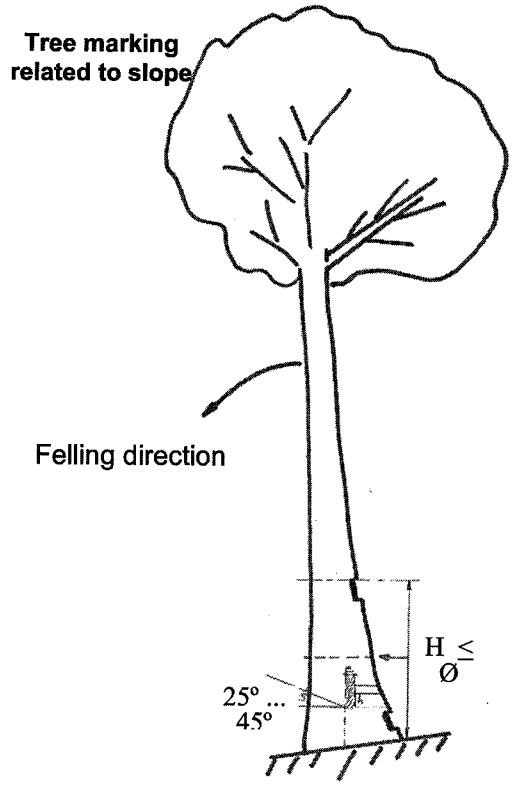


2.6.6.4 Tree marking related to slope

In gentle or moderate slopes, the felling direction should be generally downhill. The tag should be placed at the up-hill slope of the tree. This makes it easier to see the tag and prevent occurrence of accidents during felling operations.

In steep slopes, avoid felling downhill as the felled tree may slide along the slope causing severe damages to residue trees and ground vegetetion. In suchcases, felling directions shou ;d be more or less parallel to the contour.

In all cases, directional felling should be aimed at felling the tree into gaps with fewer residue trees thereby causing the least damage, and towards the skidding trails to reduce skidding distances.

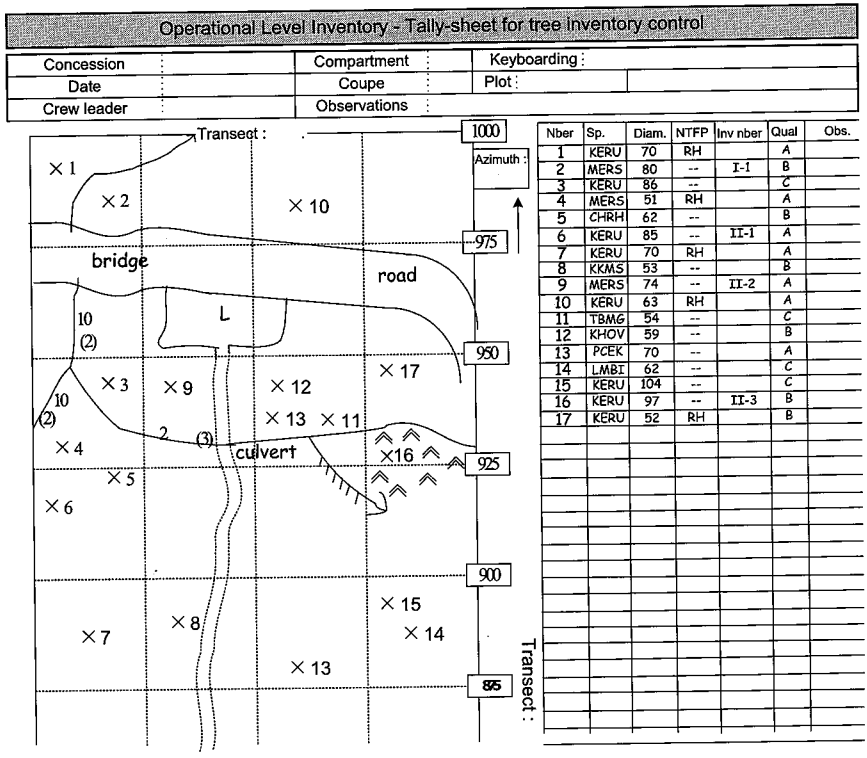


Felling direction related to slope

2.6.7 Inventory tally-sheet

A tally-sheet correspond to a half plot, 250 m x 100 m and 2 tally-sheets are required for each plot. The tally-sheet model is provided in the Appendix 1 and an example of filled-in tally-sheet in

Figure 18: Example of a filled-in tally-sheet



Nber	Sp.	Diam.	NTFP	Inv nber	Qual	Obs.
1	KERU	70	RH		A	
2	MERS	80	--	I-1	B	
3	KERU	86	--		C	
4	MERS	51	RH		A	
5	CHRH	62	--		B	
6	KERU	85	--	II-1	A	
7	KERU	70	RH		A	
8	KKMS	53	--		B	
9	MERS	74	--	II-2	A	
10	KERU	63	RH		A	
11	TBMG	54	--		C	
12	KHOV	59	--		B	
13	PCEK	70	--		A	
14	LMBI	62	--		C	
15	KERU	104	--		C	
16	KERU	97	--	II-3	B	
17	KERU	52	RH		B	

2.6.7.1 Plot identification

On heading:

- Concession
- Compartment number
- Coupe number
- Number of the plot

On the plan:

- Azimuth followed with the compass, in the arrow direction
- Names of the transect around the plot
- Distances on these transects, in the rectangle on the transects
- Name of the "measurers", at the bottom of the plan

2.6.7.2 Crew and inventory identification

- Name of the crew leader
- Date at the time of the measurement

2.6.7.3 Measurements on the trees

- Number of the tree on the plan, given by plot (used for keyboarding and digitalization).
- Species code, following the list provided by FA (see Appendix 2)
- Diameter (see title 2.6.4,)
- Quality (see title 2.6.5,)
- Number given to the trees, following a continue series in the block. So, each tree can be clearly identified.
- NTFP: The field "NTFP " has to be filled up for each tree. If tracks of harvesting are observed on the tree, the code of the product is written in the "NTFP harvesting" field. If there is any track on the tree, a dash is written in the field.

- Observation : for example :
  tree located in a swamp area (Sw A) tree located in a steep area (St A), with slope higher than 27% tree located in a site of religious, cultural or recreational importance (Soc)

Other observation possibles are entire written

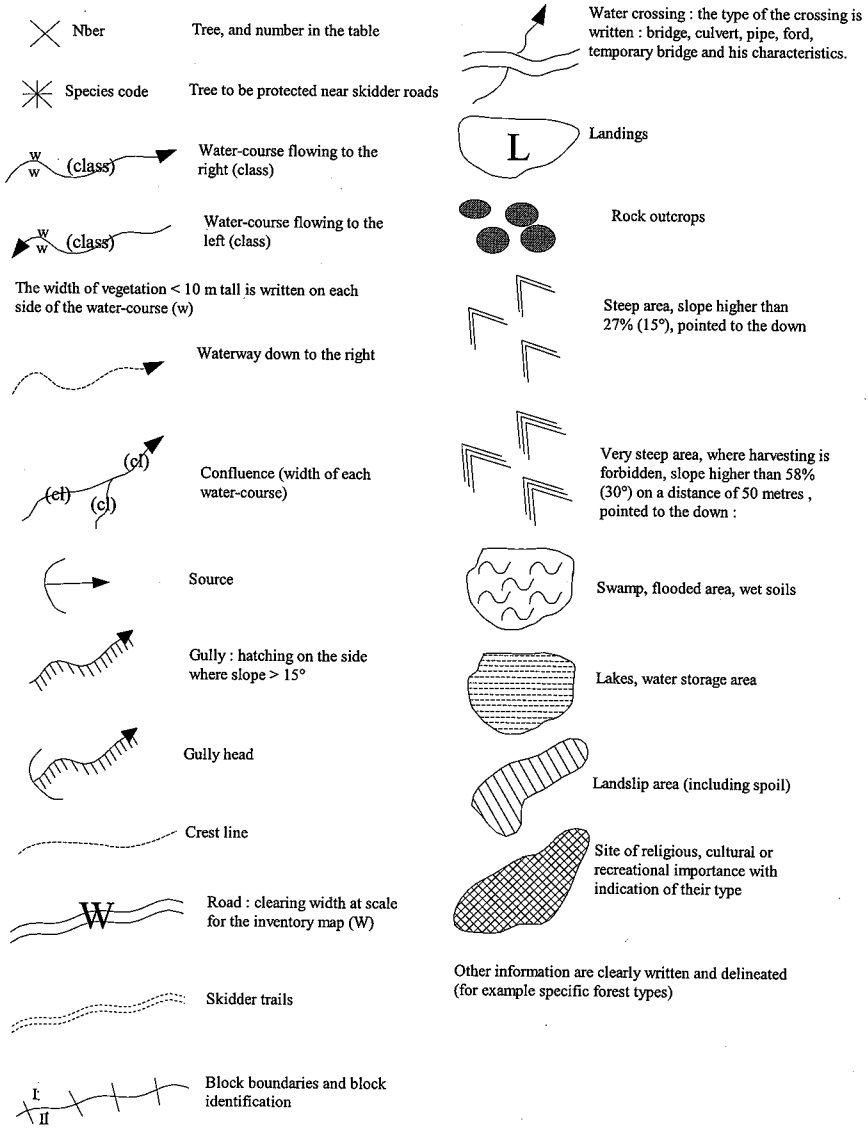
2.6.7.4 Mapping

All the trees and features listed in title 2.6.2 (page 244) are located on the plan. For this location, the crew leader uses the information given by the workers: the number of the measurer indicates the strip and the poles on lateral transect indicate the row of the plan. In each 25 m x 25 m square, the features are located relatively one to another. The relative accuracy of the mapping must be lower than 25 metres in each direction.

Block boundaries are drawn and the numbers of blocks on each side of the boundary are written on the plan.

The mapping of topographic features and the harvesting tracks follows the conventions provided by Figure 19. Specific forest types (see list in title 2.6.2, page 244) are delineated and the code of the type (see title 2.5.5.5 page 22) is noted down

Figure 19: Conventions for the topographic features mapping



2.6.8 Inventory crew

The indicative composition of the crew and the tasks of each worker are given by Table 5.

Table 5: Inventory crew composition

Position	Tasks
Crew leader	- supervise the team - fill the inventory datasheet
Measurers	- identify the tree species, measure the diameters, assess the quality, put the numbers on the tree
Measurer assistant	- announces the distances on the lateral transect

The organization of the crew on the field is illustrated by Figure 16.

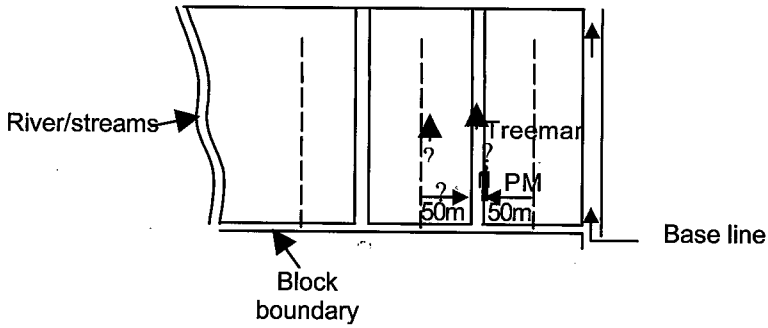
2.6.8.1 Transect preparation group : composed of six (6) persons

- 1 compass man : as Team Leader
- 3 persons as brushers
- 2 laborers one is the painter, the other is putting the tag and determine the distance between the trees

2.6.8.2 **Tree marking group: composed of nine (9) persons,** divided into two (2) small groups, including a Team leader positioned between the transect line and recording the data in the tally sheets (see figure bellow)

- ✯ Left-side team has four (4) members
  - 1 person measures the DBH, look for the trees and identify the species
  - 2 persons puts/place the tags and paint the trees
- 1 person undertakes clearing of the cutting zone.

- ✯ Right-side team has four (4) members, with the same dut as the left-side team



2.6.8.3 **Coupe and block boundary**
delineation group composed of six (6) persons, with their work assignement shown below :

- 1 person – as the team leader ;
- 1 person – as the compass man, who gives the direction of the line as the coupe and block boundaries
- 3 persons – as brushers, who cut the vegetation /brushes along the coupe and block boundaries
- 1 person – as laborer, who paints the coupe and block boundaries

The difference between the coupe and block boundaries is only on the color of the paint, i.e. red color paint for coupe boundary and yellow color paint for block boundary.

2.7 TRANSECT AND INVENTORY DATA ANALYSIS, PREPARATION OF THE INVENTORY MAPS FOR THE TREE SELECTION CREW

Data analysis is explained in the document "Guidelines for analysis of inventory data".

During this analysis, the blocks are demarcated on the map, according to the "code of practice" (title 2.3., page 4), based as far as possible on natural boundaries and infrastructure. A Coupe level map is prepared, on a 1:25.000 scale, in accordance with the Code of practice and the Guidelines for review Operational Forest Management Plan. The standard legend used for this map is provided by Figure 20. This legend has been adapted from "Code of practice, figure 4)[3].

An inventory map is prepared for each block, on a 1:2500 scale[4] showing all the features recorded during the inventory.

The harvestable trees (complying with requirements on species, minimum diameters and quality) are symbolised by a circle (with size depending on the diameter), the other ones by a cross, the code of the species is indicated for each tree and the inventory number is indicated for removable trees.

The protected areas and bufferzones are approximately delineated on this map, but trees near their boundaries have to be checked.

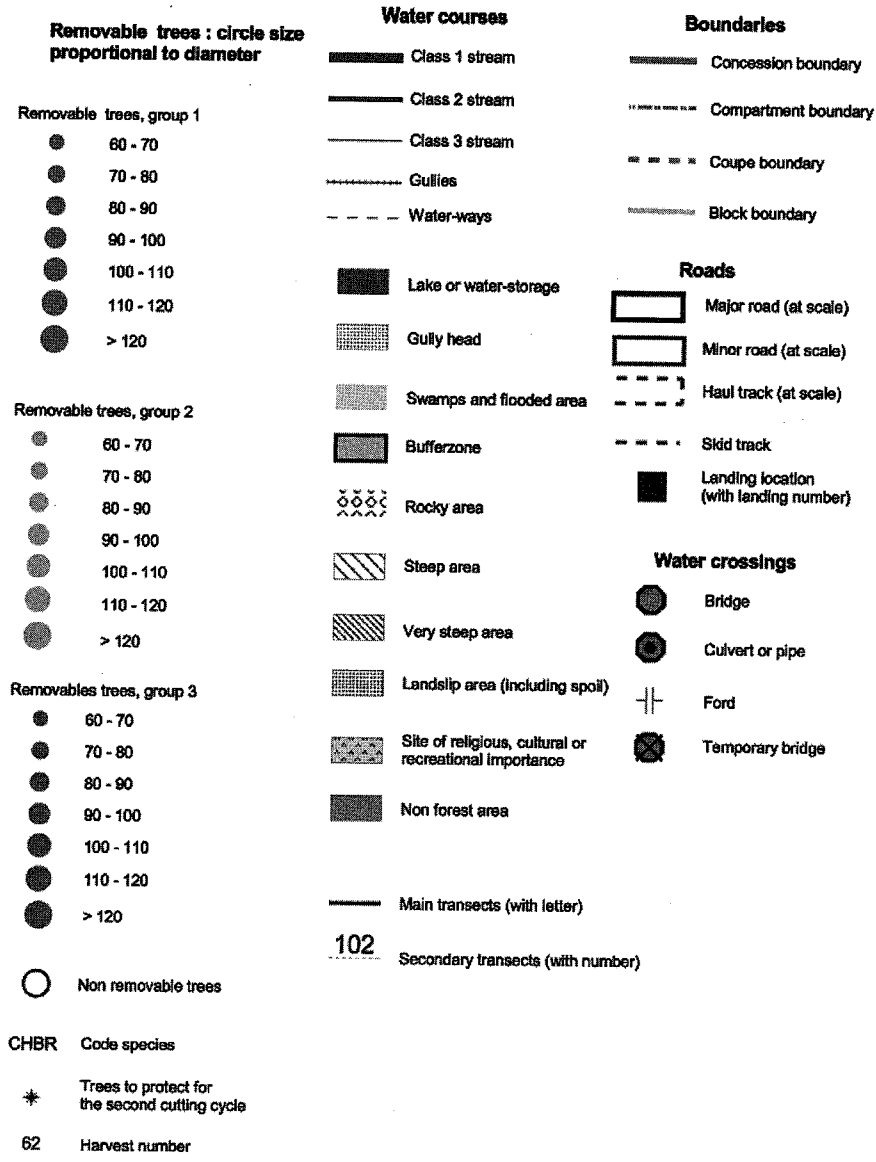
One copy of this map is provided to the FA with the annual Coupe plan.

Another copy is provided to the tree selection crew, with the rules for tree selection and harvesting plan for the block: maximum number of tree to be removed, protected areas, specifications for water-crossings, complements to provide for mapping.

[3] Some codes, that seems to be inappropriate have been improved

[4] This very big scale is required because of the important number of information to show, for example, between 9 and 15 trees / ha (i.e. almost 1 tree / cm^2 on the map)

Figure 20: Standard legend for Coupe level and block level maps



2.8 TREE SELECTION AND HARVEST PLANNING

The crew, with the help of the inventory map:

- Select the trees to be harvested, according to the Annex 7 of the planning manual (Tree marking procedures)
- Plan the harvesting operations: major roads, secondary roads, haul tracks, skid trails, water crossings, location of the landings, according to the "Code of practice"
- Put the inventory number on the trees (with plates)

The inventory is conducted by blocks. All the data are written on the inventory map.

With these data, the pre-harvesting map is prepared, at a scale between 1:2.500 and 1:5.000[5], showing the trees to be harvested with their numbers, the topographic features, the roads, skid trails and water-crossings, the protected areas. This map is attached to the detailed block plan, according to the "code of practice", title 2.4.

A file is established for each block, made up of all the maps (inventory, pre-harvest, post-harvest) and data of inventory and harvesting.

2.8.1 Tree selection and marking

All the harvestable trees (circles on the map) are found again on the field. For each tree, the crew leader decides if it has to be removed or to be kept, according to the "Tree marking procedures", and the harvesting rules for the block.

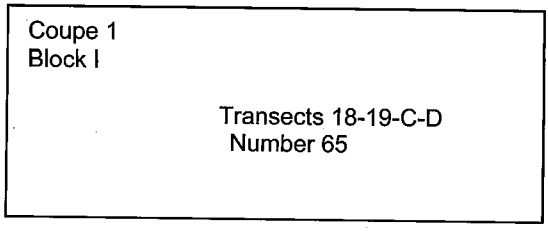
The data collected during the inventory can be corrected: diameter, quality, location of features, complement on map. The corrections are written on the map. If a tree can not be found again, it is crossed out on the map. If the tree location was wrong, the real location is indicated with an arrow from the first location to the real one.

2 plates hammered on the stem: 1 about 1,30 m height and one near the ground (in order to stay on the stump after felling). On this plot are written: the block number and inventory number and possibly indications on transects around. The plate sizes are 5 cm x 7 cm.

---

[5] the 1:10.000 scale planed by the "code of practice" does not seem to be appropriate, because there are a lot of information to show on the map.

Figure 21: example of plate hammered on a tree



The new retention trees (removable trees finally not selected) are painted with a red strip. The reason of their retention is written on the map, according to the following rules:

- Bad quality: the new assessed quality is written on the inventory map
- Diameter lower than the minimum cutting diameter: the new measured diameter is written on the inventory map
- Location in a buffer zone (BZ), a swamp area (Sw A), a steep area (St A), a buffer zone (BZ), a site of religious, cultural or recreational importance (Soc)
- Trees tapped for resin (Res)
- Seed source in a gap without regeneration (SS)
- Risk of excessive opening in the canopy (CAN)
- Tree required for the future harvest cycle, if the maximum number of removable trees is reached

Other possible observations are entire written.

2.8.2 Harvesting planning

2.8.2.1 Harvesting Design

When all the harvestable trees have been found, the crew leader decides the roads and skid trails layout and the landing locations, according to the code of practice.

The rules to follow for the road layout are:

1 - to reduce the total length of skidding, by going as far as possible through the harvestable stands

2 - to adapt the length of the road to the average volume to be harvested.

3 - to reuse the existing roads as far as possible

4 -To optimize the geometry: the radius of all horizontal curves is maximized, road grades are kept to a minimum.

5 - to fulfil all the other requirements provided by the "code of practice", and figures 11 to 14, (see Appendix 4).

The rules to follow for the choice of landing location are provided by the "code of practice" .

The rules to follow for the design of the skidding trail layouts are the following, according to the code of practice:

1- to reduce the impact on stand (length of the trails), the percentage of the block covered by skid tracks should be less than 20%.

2- to avoid completely the buffer zones, protected areas, steep areas where slope is upper than 58% (30 degrees), and rocks,

3- to avoid swamps, wet-soils, waterways, and unstable areas and prefer spur lines where possible

4 - to avoid the slope upper than 27% (15 degrees) on major skid tracks

5- to avoid the unneeded successions of climb up and climb down. Up- hill skidding is preferred.

6- to design open angles for the curves (135° minimum)

7- to reuse the existing skidder trails as far as possible

8- to avoid or to reduce the number of water-crossings and chose an adequate location for them (see Code of Practice)

9- to avoid as far as possible to damage the trees for next cutting cycle

10- to allow winching at the maximum distance possible

Trees to be protected near the skidder trails (trees for the next cutting cycle) are marked on the field (with tapes or paint) and on the map (asterisk and species code).

2.8.2.2 Marking

Layouts are clearly demarcated on the field (with a transect, tapes, poles, or paint), with different marks for roads and skidder roads, in accordance with the code of practice (Figure 4).

Each landing is numbered, the number is written on the inventory map and on a signboard.

2.8.2.3 Mapping

Roads and skidder trails are drawn on the inventory map, included in the block plans. The symbols to be used are provided by the Figure 19. The roads are drawn at scale, as wide as their clearing wide, according to the "code of practice", title 5., page 17.

High slopes, upper than 10% along roads and upper than 20% along skidder trails are indicated by 2 arrows, with the slope value.

These data are recorded on the database and the operational block map is edited (see example in Figure ***22***).

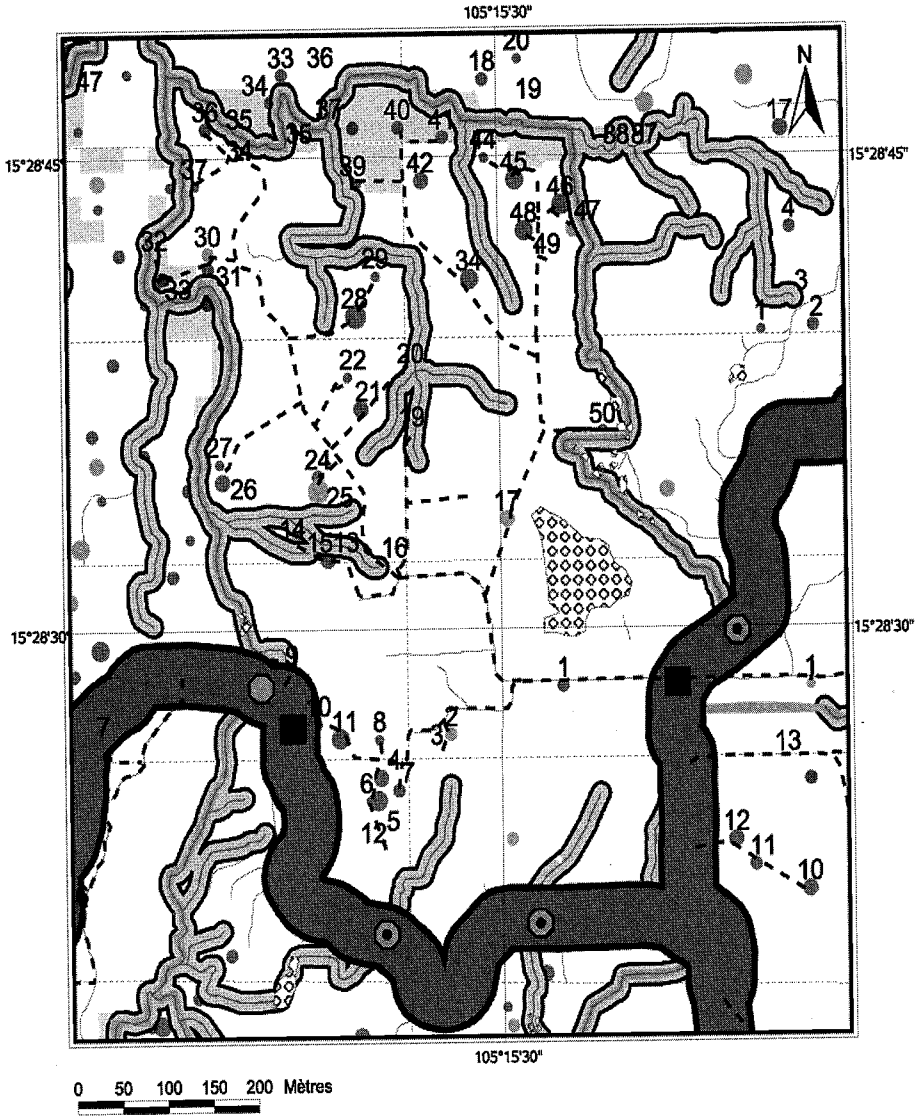
2.8.3 Tree selection and harvesting plan crew

The indicative composition of the crew and the tasks of each worker are given by Table 6. One FA representative is involved in this stage.

Table 6: Tree selection and harvesting plan crew composition

Position	Tasks
Crew leader	- supervise the team - fill the inventory map - select the tree to be removed - design the roads and skidder trails layout and the landings location
FA representative	- control the compliance with Guidelines and code of practice
Workers	- find the harvestable trees - verify the diameters and qualities - mark the layouts

Figure 22: Example of operational block map



2.8.4 Materials and equipment

From the annual operations plan, the quantity of wood raw materials and the number of equipment can be appropriately determined following the timely procedures. This is done to avoid too much entry of machinery and thereby prevent destruction of the remaining forest resources.
Besides determining the quantity of wood raw materials, the types of machinery's can also be selected or determined for harvesting areas during operational period.

Example:

Determining the number of machinery's for harvesting plan:
8.564,863 cu.m

$$\textbf{No. of Chainsaw} = \frac{8.564{,}863 \text{ cu.m}}{35 \text{ cu.m/day} \times 20 \text{ days/mo.} \times 3 \text{ mos.}} = 4 \text{ chainsaws}$$

where - 8.564,863 cu.m annual yield
- 35cu.m/day : estimated capacity of chainsaw per day
- 20 days/mo. : working days per month
- 3 months : duration of felling operations (Jan., Feb., March)

Number of skid track machines
Determining the number of machinery's for harvesting plan: 8.564,863 cu.m

$$\textbf{No. of skid track machine} = \frac{8.564{,}863 \text{ cu.m}}{20 \text{ cu.m/day} \times 20 \text{ days/mo.} \times 4 \text{ mos.}} = 5 \text{ machines}$$

Every machinery and equipment to be used in the harvesting area should have a permit through an identification sticker from the FA.

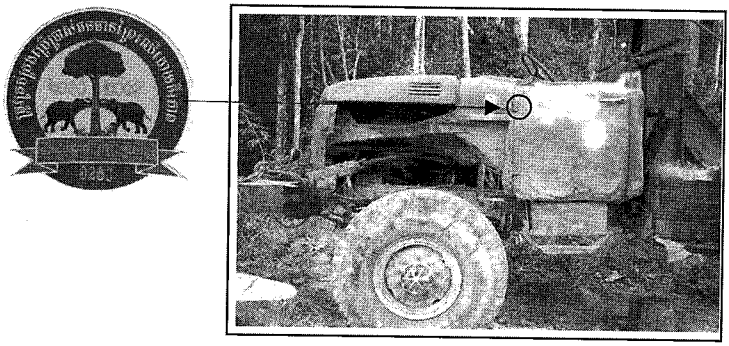
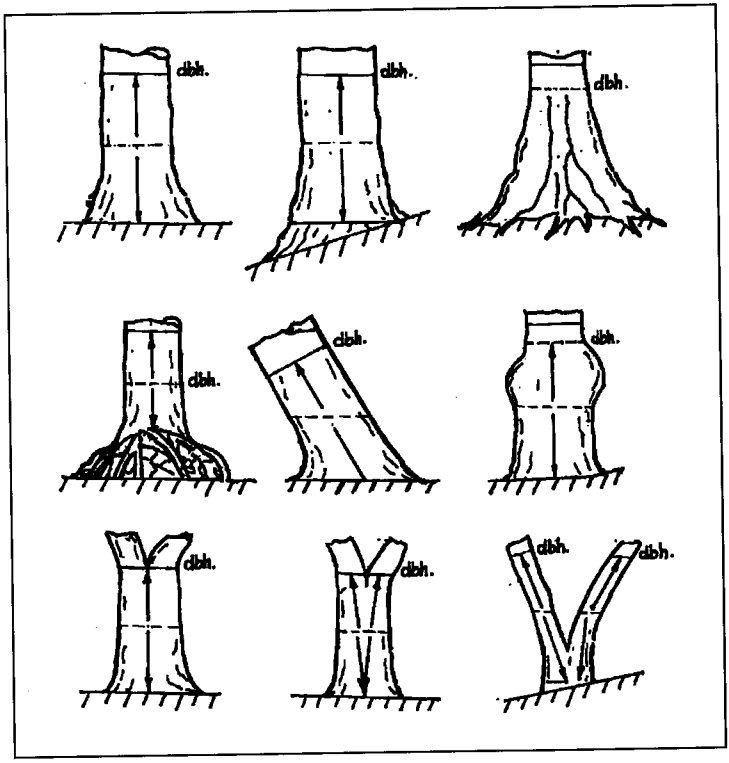


Photo No. 5. A truck with FA sticker

2.8.5 Tree measurement guidelines and methods

2.8.5.1 Guidelines and parameters of measurement

The parameter measured in a standing tree is its diameter at breast height (DBH) at 1.30 m, or immediately above the highest buttress if the buttress is higher than 1.30 m, with the use of a diameter tape in the following guidelines (see figures below):



a. level surface (ground) ;
b. sloping ground ;
c. buttressed trees ;
d. stilt roots ;
e. leaning trees ;
f. defective/diseased trees ; and
g. forked trees.

2.8.5.2 Determination of stem form quality

To idetermine or identify the stem quality, the following guidelines should be followed :

Quality A - straight stem, without damage within and outside the stem;

Quality B - stem, with little damage and with curvature of less than 50%

Quality C - stem, with little damage and with curvature of more than 50%

2.8.5.3 Standing tree volume computation

In general, the formulae for calculating standing tree volume are the following :

D : diameter at breast height (DBH at 1.30 m), units in cm.
V : volume, units in cubic meter (m^3)

♦ **Dipterocarp Species**

- D : 40-49 cm $Vol.= 0.121 + 92.174 \times 10^{-5} \times D^2$
- D : 50-59 cm $Vol.= 0.121 + 97.596 \times 10^{-5} \times D^2$
- D : 60-69 cm $Vol.= 0.121 + 103.018 \times 10^{-5} \times D^2$
- D : 70-79 cm $Vol.= 0.121 + 105.729 \times 10^{-5} \times D^2$
- D : ≥ 80 cm $Vol.= 0.121 + 108.440 \times 10^{-5} \times D^2$

♦ **Non-dipterocarp Species**

- D : 40-49 cm $Vol.= 0.226 + 73.625 \times 10^{-5} \times D^2$
- D : 50-59 cm $Vol.= 0.226 + 78.375 \times 10^{-5} \times D^2$
- D : 60-69 cm $Vol.= 0.226 + 83.125 \times 10^{-5} \times D^2$
- D : 70-79 cm $Vol.= 0.226 + 85.500 \times 10^{-5} \times D^2$
- D : ≥ 80 cm $Vol.= 0.226 + 90.250 \times 10^{-5} \times D^2$

2.8.6 Forest road systems and construction

The planning and construction of forest harvesting roads is a major and expensive operation that is critical to the orderly flow of logs. In tropical environments, road development has to contend with difficult terrain and high and protracted rainfall. Traditionally, logging roads have tended to use high impact construction methods featuring wide clearing widths, major earthworks and relatively crude construction standards. The justification for such practice has commonly been on the basis of economic and operational needs. Poorly located, constructed or maintained roads are inefficient and can cause major soil and water hazards with serious implications to affected communities, which may be of distant from the site of the actual road.

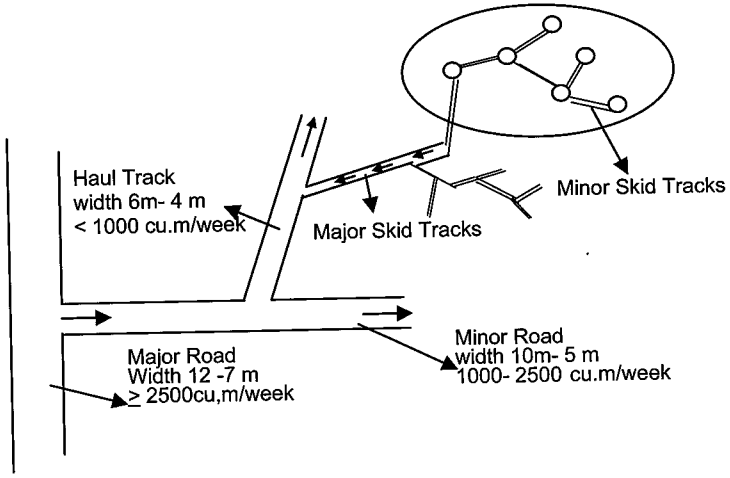
2.8.6.1 Classes and design of roads

Three (3) classes of roads are described in the Code:

1. Major Roads, which will carry, log volumes of 2,500 m^3 per week (averaged over the logging operation),

2. Minor Roads, which will carry, log volumes of between 1, 000 and 2,500m^3 per week (averaged over the time that they are in operation),and

3. Haul tracks, which will carry log volumes of less than 1,000m^3 per week.



The design and construction standards to be applied will be decided before construction. This must be done in consultation with the Department of Forestry and Wildlife, Provincial Planning Authorities and represen-tatives from local communities.

ROAD WIDTH SPECIFICATIONS

Road Class	Carriage width	Formation Width	Clearing Width
Major Road	7m	12m	equal to height of forest each side of center line
Secondary Road	5m	10m	20m (total)
Haul Tracks	4m	6m (or as required)	10m (total)

2.8.6.2 Road location and surveys

Locate roads in the following:

⇒ in areas of low side slopes,

- so that no earthworks or soil spill falls into watercourse buffer areas,
- to minimize the number of watercourse crossings,
- to balance cuts/fills, and

⇒ on spur limes wherever possible to minimize side cutting and width of clearing.

Areas to avoid:

⇒ all areas excluded form logging, however, where construction is unavoidable and has been approved by the Forest Officer, use end hauling, i.e. full bench cutting with no side cast of spoil,

⇒ locations which require box cuts,

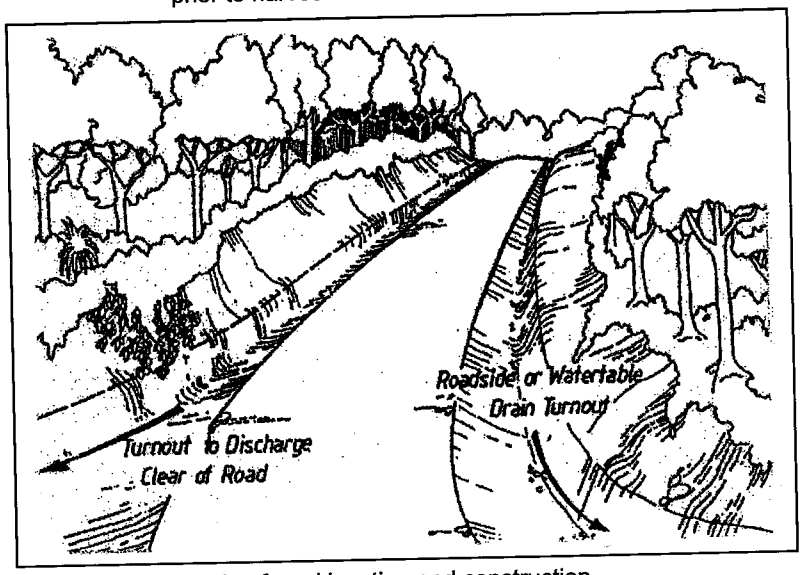
⇒ areas subject to flood flows, and

⇒ villages, houses and gardens (where possible).

2.8.6.3 Road construction

Timing of construction

- Inspection and approval of the location, by the Forest Officer, is required before construction commences;
- Major and minor roads are to be completed before logging commences;
- Construction three (3) months in advance of logging is required unless adequate compaction has been achieved during formation and surfacing;
- Construction is not to commence more than 12 months prior to harvest.

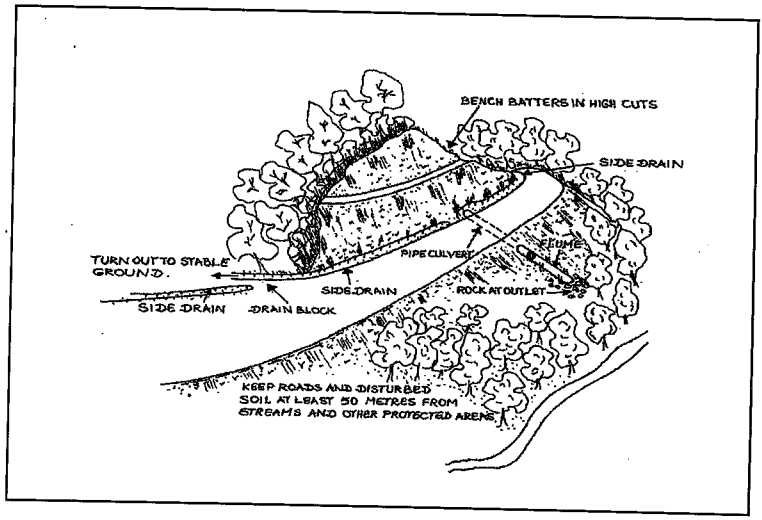


Example of road location and construction

2.8.6.4 Road maintenance

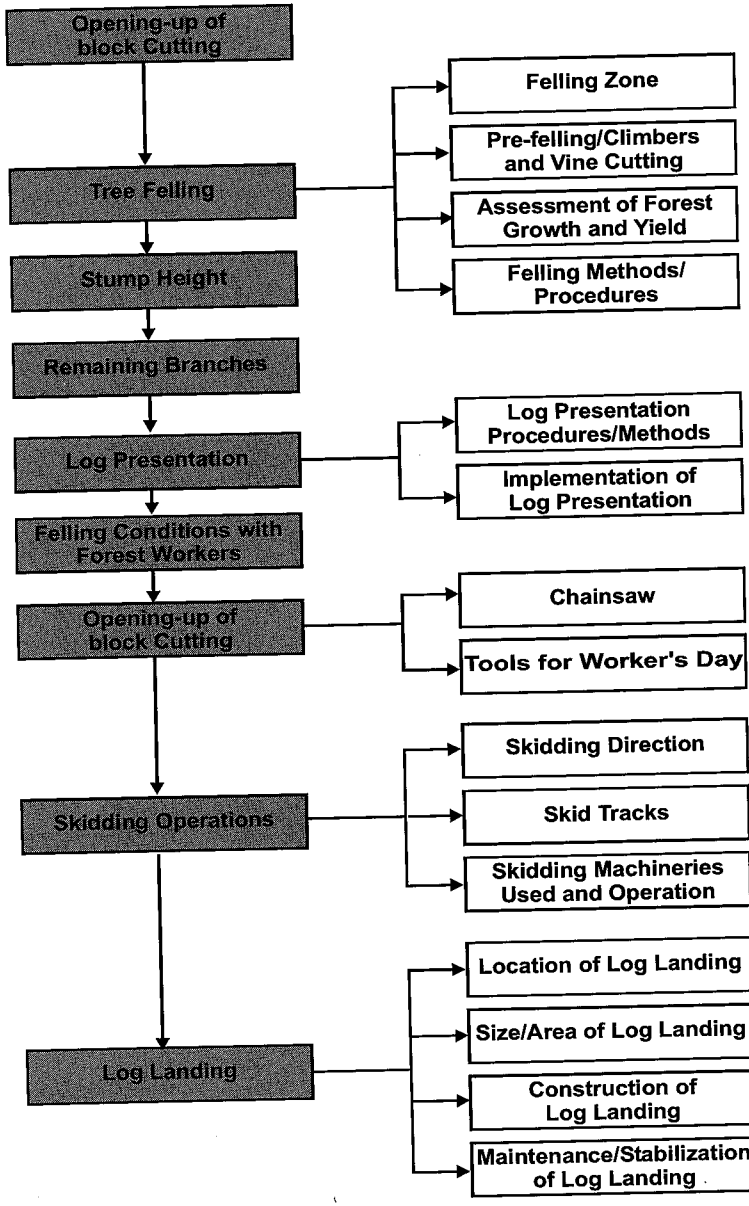
- Road surfacing material in Cambodia is usually laterite gravel excavation from pits located along road-side within the clearing width of the road. Used pits should either be re-filled (deep pits) or drained (shallow pits). In certain situations, due to unavailability of laterie or gravel on site, excavation pits may have to be located along another road far away from the road to be surfaced or maintained;

- Laterite surfacing (or other approved surfacing material) is required on all arterial or major roads.
- If wet season access is required, surfacing with laterite is necessary.
- Road surfacing is also required on the following situation:
  - ⇒ Where local communities or Government agencies have negotiated its inclusion as part of the logging contract, and
  - ⇒ Within 15 meters of the approaches on both sides of bridges.
- All road drainage works and subgrade preparation must be completed before surfacing commences.
- Minimum compacted laterite (or gravel) thickness is 200mm
- Laterite deposits can generally be located within economic haul distances of the road, however, only good quality laterite should be used (i.e. with a low plasticity and a high concretionary nodule or gravel concentration).
- Laterite or gravel should be compacted at optimum moisture content using standard compaction equipment to achieve the required densities; and
- The structural strength (and hence service life) of laterite pavements (especially low quality laterite) can be improved by the use of lime, cement or chemical stabilization



Example of road location and construction

HARVESTING ACTIVITIES



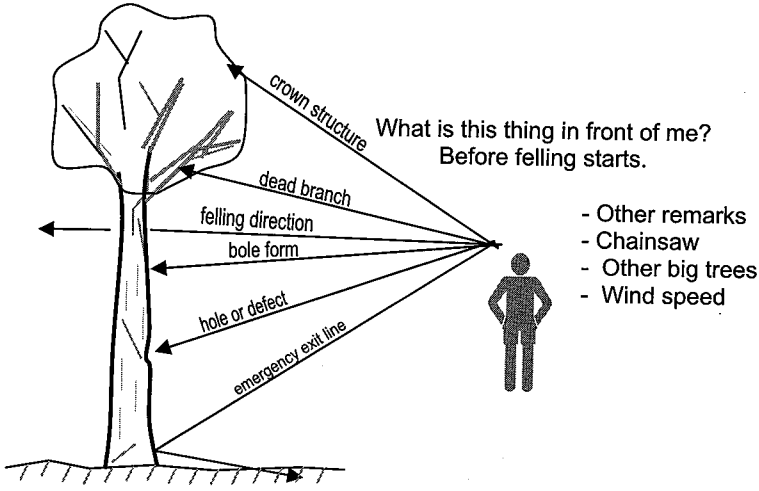
3. HARVESTING ACTIVITIES

3.1 Opening-up of cutting blocks

In annual coupe with too many cutting blocks, the forest concessionaires are allowed to open only two (2) blocks at a time and should coincide with the number of skidding machines permitted for the annual harvest using the computation method described in Section 2.3.3. The other cutting blocks can be opened only after the monitoring and evaluation activities conducted by Forest Officers on the 2 blocks previously opened as well as in accordance with the Code of Practice.

3.2 Tree Felling

Tree felling is a very delicate and dangerous activities conducted within the forest. It is, therefore important to identify and follow strictly the procedures in implementing tree felling activities, such as the techniques in open cut, felling cut, the felling directions, including the environmental working conditions and the use of safety equipment.

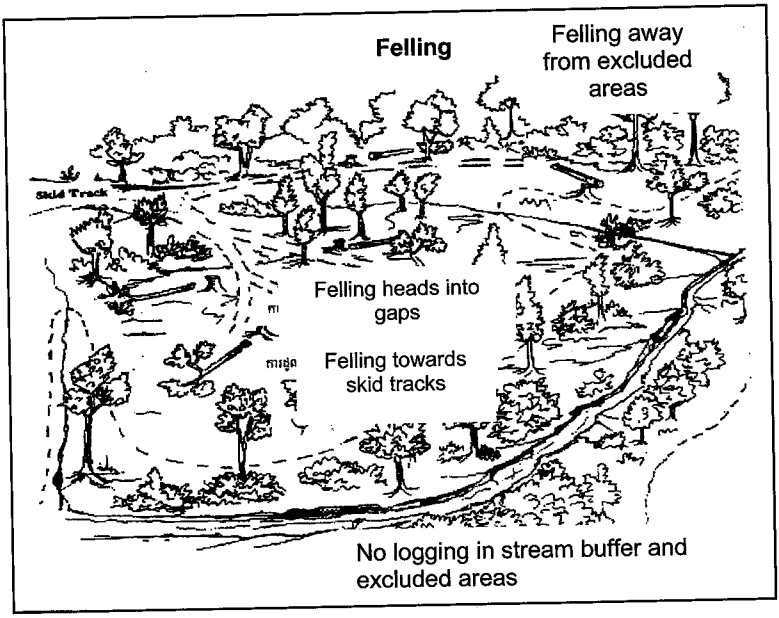


Trees to be removed have the following characteristics and locations:

- Trees located 50 m from rivers/stream banks and slope less than 30;
- Trees located 20-30 m from the banks of intermittent creeks/streams; and
- Felling direction should not be towards the streams and other water sources.

3.2.1 Felling zones – located only in the following designated areas:

- in allowable harvestable areas;
- inside the opened block; and
- in areas without soil erosion (slope less than 30 degrees)



Example of good felling patterns

3.2.2 Pre-felling/climbers and vine cutting

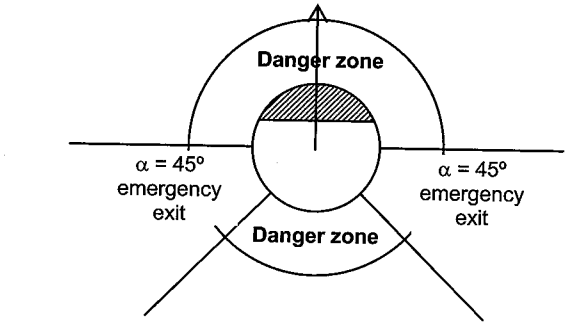
- To look around and observe the forest conditions before felling activities:
  - Identify properly the direction of fall for every tree to be removed during tree marking activities. The preferred direction of fall is indicated by fixing the tags on the opposite side of the open cut so that the tag on the felled stem faces upwards. However, the tree marking teams can only suggest the general direction of fall. The final decision should be made by the tree cutter ;

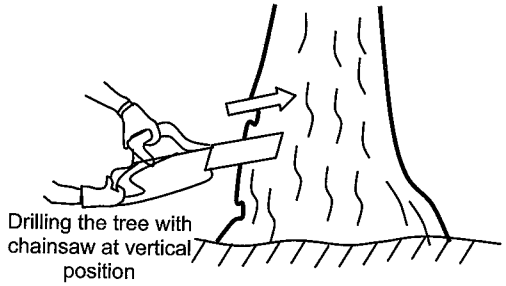
- Trees to be removed should have no big dead branches as these branches can damage other trees nearby, including forest workers during felling;
- Vines and climbers that intertwine the marked tree for removal with other nearby trees should be cut during the tree marking activities, and NOT during felling operations. The vines and climbers should be cut at the base of both the tree marked for removal as well as those at the base of the nearby reserve trees whose climbers and vines are intertwined with the tree to be removed. This is to allow the cut climbers and vines to die before tree cutting/felling activities so that they break-off easily and not pull other trees or damage the crown of other nearby trees;

- Provision of two (2) emergency exits during felling with 45 bearing (please see figure below).

- Testing of soundness of the trees to be removed:

  - Trees suspected of being unsound or defective inside should be tested before felling, i.e. by knocking on the wood or by drilling a chainsaw vertically to the tree. If the unsound or defective tree cannot produce at least one (1) merchantable log, then that tree should be left standing.





Drilling the tree with chainsaw at vertical position

Photo No. 6. Testing the tree for soundness

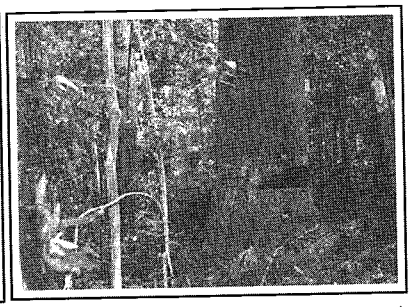


Photo No. 7. Under cut / Open cut and Felling of tree

3.2.3 Assessment of forest stand growth and yield

In some cases, the results of periodic forest inventories are used to estimate forest stand growth rates specific to the coupe and to determine how the timber stands in its compartments develops over time.

The activity should be done following the procedures as shown below:

- Forest inventory design and fieldwork is done as part of the pre-harvest inventory.
- The main requirement is that plot centers are clearly marked to ensure that periodic measurements are done at exactly the same place to make it likely that the same plot of land is measured each time. Plot center markers should therefore be made from materials that can last at least to the next inventory (e.g. five years in the case of pre-harvest inventories made in the same area every five years).
- Another requirement is that pre-harvest inventory records are kept well organized and preserved. The most important data to keep is the volume of each plot.
- Forest stand growth can then be estimated as the average difference between successive volume measurements with the pre-harvest inventory plots as the sampling units. For example, if a plot was measured in 2000 and re-measured in 2005, growth is estimated as the difference between the two successive plot volumes divided by the time of interval of 5 years, expressed in terms of cubic meters per hectare.

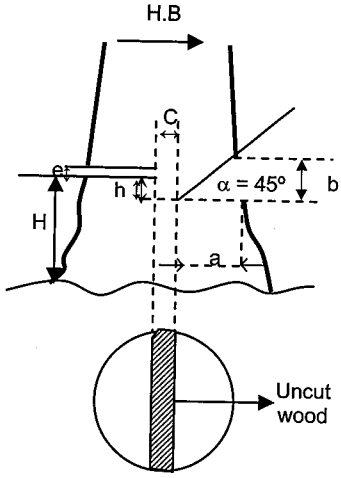
3.2.4 Felling methods/procedures

Every tree has its own directional fall because of its own canopy structure and form, with tree crowns leaning heavily or slightly on one side.

3.2.4.1 Under cut / Open cut

Open cut should have a bearing of 25°- 45°, and the length of cut is 1/4 or 1/3 of the DBH and parallel with the directional fall:

- Objectives of the under cut / open cut:
  - To monitor the direction of fall as we wanted it that way; M
  - To reduce destruction or minimize damage to residual trees and regeneration or reproduction;
  - To fell the trees in open areas; and
  - To make it easier for skidding activities.



- HB: directional felling
- uncut wood for holding C = 1/10 D
- length of open cut:
  - a = 1/4 D straight stem/bole
  - a = 1/3 D leaning stem parallel to felling direction
  - a = 1/5 D leaning stem opposite felling direction
  - b = (1/10 ... 1/8) . D
  - e = 4...6 cm
  - h = (1/10...1/12) . D (please see figure beside)

- Uncut wood for holding :
  - It is a small uncut wood section for holding break off, and equal to C = 1/10 D.
- Purpose of the uncut wood section for holding:
  - To provide easier means of monitoring the felling direction and keep that felling direction as much as possible;
  - To prevent damage to the felled trees during felling operations; and
  - To prevent the trees from falling into the wrong direction

Photo No. 8. Stump height and Log presentation

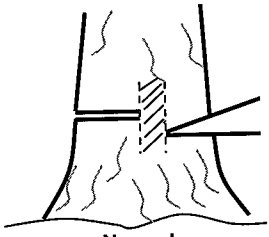
Photo No. 9. Wrong way of directional felling

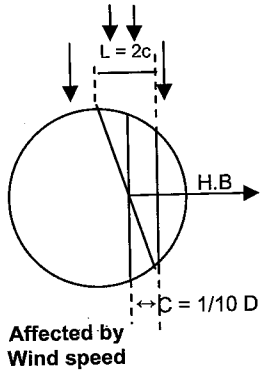
3.2.4.2 Felling cut/back or cut procedures

- The felling cut /back cut is located opposite the under cut/ open cut;
- It is straight and higher than the open cut, h = (1/10 ... 1/12) DBH; and
- when the uncut wood section breaks off, the breaking sound signals the tree cutter to withdraw the chainsaw and quickly move safely away along the safe exit corridor.

3.2.4.3 Objectives of felling direction

- To prevent damage on existing regeneration and residuals in the forest;
- To avoid destruction/damage that may be inflicted on adjacent big trees;
- To provide easier ways to undertake skidding activities; and
- To prevent damage to the buffer zone and special management areas.





With leaning tree & canopy form on one side

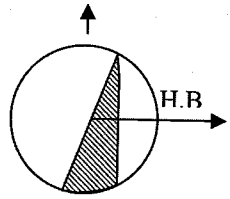


Fig. 1

Wind direction on one side

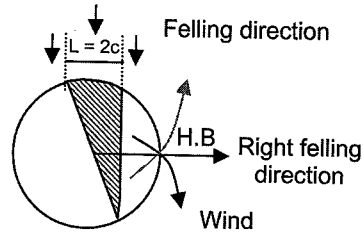


Fig. 2

Wind direction opposite the crown canopy

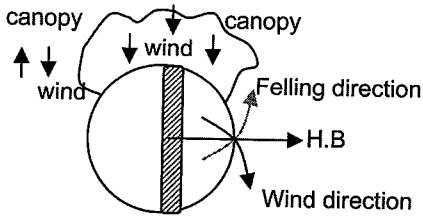


Fig. 3

Wind direction parallel to crown canopy

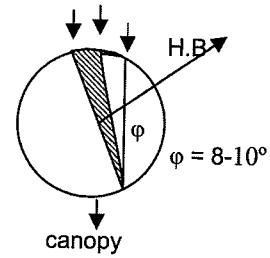


Fig.4

Figures 1 & 2 : These show the uncut wood in triangle form in order to keep the felling in the right direction;

: L = 2C is obtained due to wind direction or canopy;

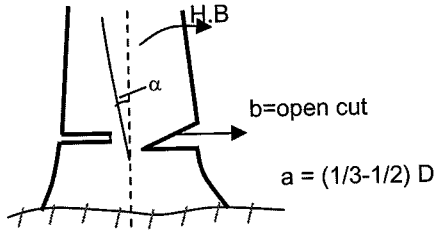
Figure 3 : Normal standing tree;

Figure 4 : In case the canopy and wind are the same, the uncut wood is also triangular form, but the angle becomes u φ = 8-10°

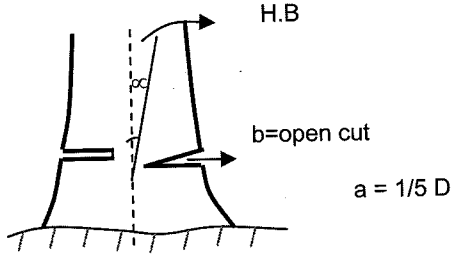
The angle φ is created to help in felling in the right direction

Some Important Notes:

★ If the tree canopy is leaning opposite of the felling directions, the angle produced is = 10°, and the open cut area is much bigger in size.

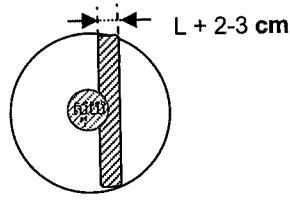


★ If the canopy and the felling direction are the same, the open cut area is smaller in size.



★ If the angle produced is greater than (> 10°) and also opposite the felling direction, the use of tractor or crane is required, or just follow the natural lean of the tree for felling direction.

★ In case of defective trees with holes or diseased area, the natural felling direction is followed and the uncut wood for holding is about L + 2-3 cm (see figure below).



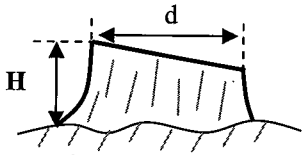
3.3 Stump height

- Stump height must be very short to increase wood volume recovery and maximize wood utilization;
- Stump height should not be higher than 30 cm (see Code of Practice, 6.1.6)

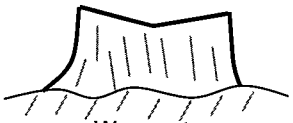
- keep it low to the ground to increase the log volume;
- cutting must be less than the DBH above ground level on the high side, except in the following situations:
  - when butt defect is obvious, the tree can be cut immediately above this defect; or
  - where a buttress exists, the tree may be cut immediately above the buttress.

Advantages of stump heights:

- Some tree species produce coppicing from stumps or roots, and therefore the chainsaw operator should follow the following:
- the chainsaw teeth must always be sharp;
- the remaining stumps must have smooth and slanting surface ends.

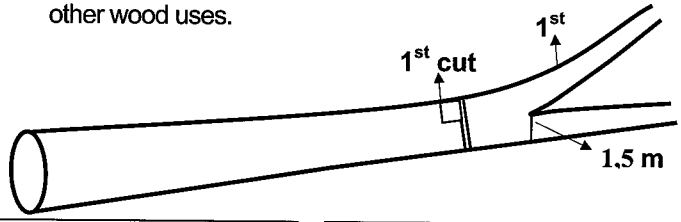


Slanting surface


Wrong stump surface

3.4 Remaining branches

- After felling, the felled tree is cut on the first branch to form a log;
- It is necessary to cross-cut at the first branch in a straight line;
- The remaining branch of 1,5 m and above can be used further for other wood uses.



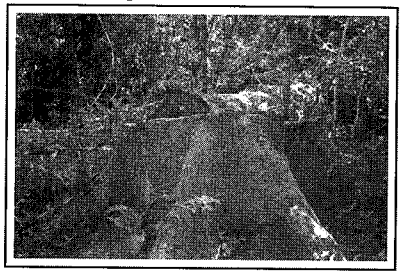


Photo No. 10 Appropriate Stump Height

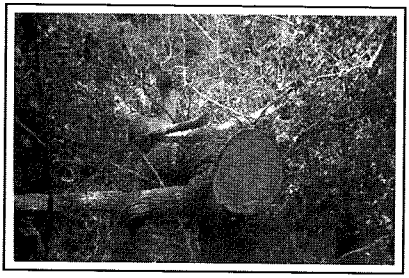


Photo No. 11 Appropriate Remaining Branch

3.5 Log presentation

The objectives of log presentation are as follows:

- Obtain the maximum log value possible from felled trees; and
- Present logs well and eliminate illegal cross-cutting at log landings or the log pond.

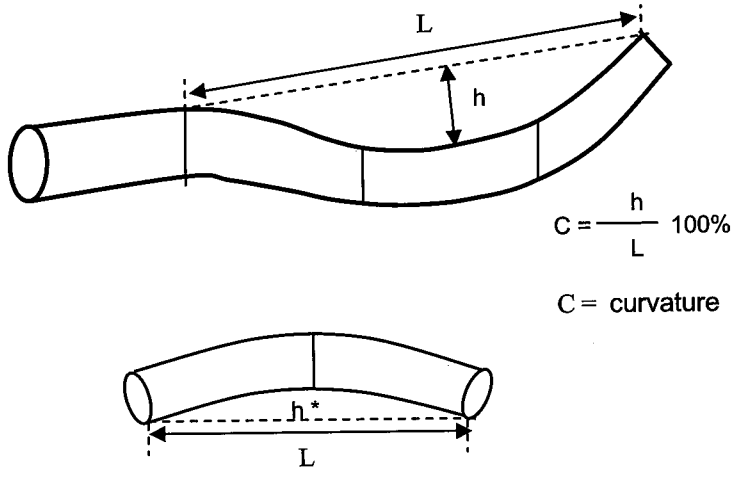
Log presentation depends mainly on tree species length, log quality, which can be divided into sections of:

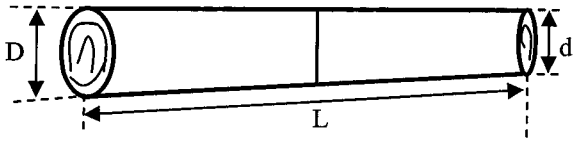
- 2 m
- 2 - 6,5 m
- 6,5 m and above.

3.5.1 Log presentation procedures/methods

In log presentation procedures, one must consider the wood-processing requirement, including the presence of natural defects such as holes, curvatures and taper of the bole.

- logs must be cut into smaller sections, even if it does not comply with the wood raw material requirements, since smaller log sections can still be used in other wood processing plant.
- Cross-cut logs and tops to obtain the maximum benefits from the wood utilization.



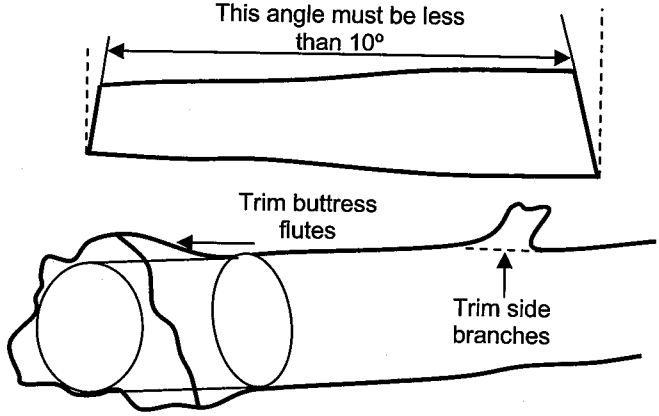


$$C = \frac{D-d}{L}$$

T = Taper form

3.5.2 Implementation of log presentation

- It should be done after felling in order to prevent and avoid damages during skidding activities;
- Crosscut boles and tops to obtain 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.



- Do not stand on the trunk of the tree being crosscut;
- Be ready to step back quickly if the log being cut starts to roll;
- Avoid making the final cut while standing on the lower side of a tree if it is lying on a slope; and
- When making the final cut always stand on the compression side of the log.

3.6 Felling conditions with forest workers

Felling activities should be stopped at once on the following conditions:

- When there is heavy rain during, the previous nights and days with fog;
- When there is strong wind, which can affect the directional felling; and
- When the soil is too muddy and its affects mobility and transport.

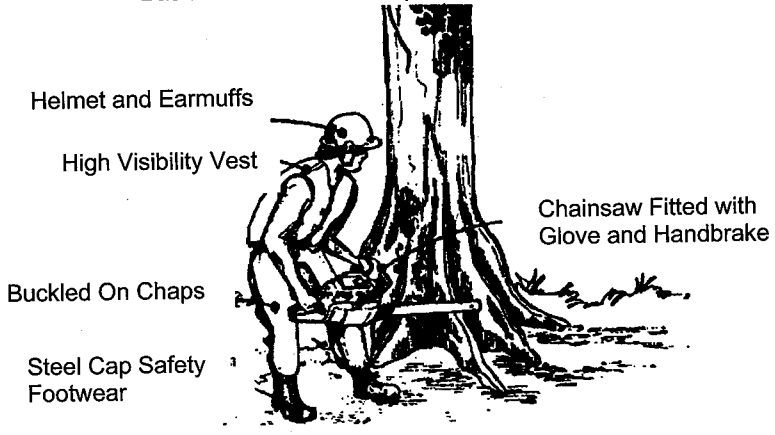
3.7 Safety in working conditions

3.7.1 Chainsaw

- Chainsaws should be cleaned before switching on, with clearly marked positive on-off switch and its machines are properly checked for better running conditions;
- It should have special hand gloves and fitted with handbrake; and
- It should have a tool kit for corrective and preventative maintenance.

3.7.2 Tools for workers' safety

- Helmet and earmuffs;
- Specially-designed plasticized eyeglass and special clothes;
- Steel cap safety footwear and Buckled on chaps; and
- Basic first-aid kit for occupational safety purpose.



Chainsaw operators must be trained and use well maintained safety equipment

3.8 Skidding operations

Skidding operations start from the stumps location to the first landing or temporary log yard.

- It should ensure the following conditions :
- Ensure the safety of location and avoid damage to remaining trees and regeneration;
- Minimize the area of disturbed and compacted soil. Skidding area is less than 20% of the harvesting area; and
- Preserve watercourse banks and buffer zones.

3.8.1 Skidding directions

- Before opening up the skid trails, a pole or stick is placed in advance to determine the skidding distance and guide the felling activities in order to avoid damage and other vegetation.
- Major skid track should be straight, where many trees can be felled.
- There are two (2) types of skidding related to soil conditions:

3.8.1.1 Up hill skidding direction

Up hill skidding is preferred because:

- run-off is spread to vegetated areas;
- the number of watercourse crossings is usually less ;
- roads are located further away from the watercourses;
- gives more control over skidded logs, especially in wet conditions.

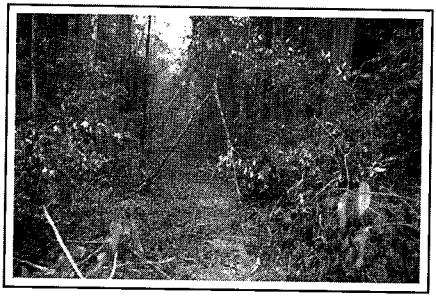


Photo No. 12 Skidding road

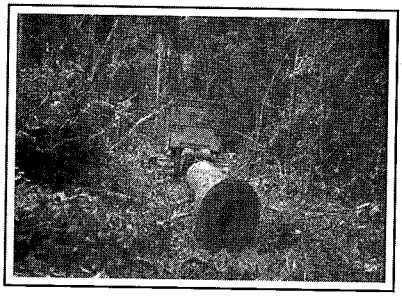
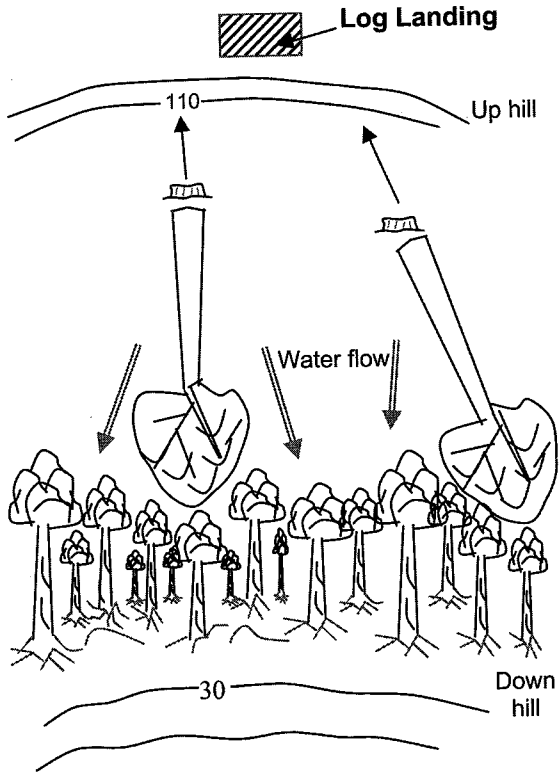


Photo No. 13 Log skidding using tractor with winch



3.8.1.2 Down hill skidding direction:

Down hill skidding may be approved the Forest Officer where

- road density can be shown to be less;
- areas required for log landing are less;
- large size logs will cause extreme damage when pulled uphill; and
- soil conditions prevent good traction by logging machinery..

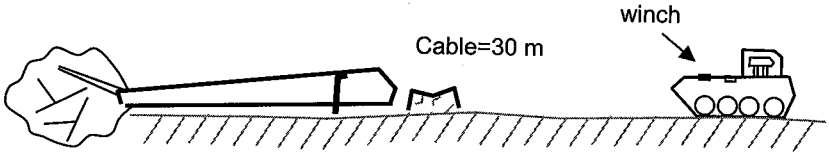
3.8.2 Skid tracks

- Skidding road should be established as much as possible with very few branches within one block, thus, maintaining productive forest area.
- Skidding track should be used :

- to reduce soil damage along the skidding tracks;
- to avoid damage to watercourses; and
- to use low skid track grades.

- **Log skidding with winch:**

  - Log skidding using winches are used in long distances, rather than with tractor causing heavy damage or destruction;
  - Winches should be appropriately used by heavy machines, with cables of good quality with minimum length of 30 meters.



3.8.2.1 Major Skid Tracks

It is characterized as follows:

will have more than 10 passes made along each track;

their construction may require minor earthworks; and

will usually be located on spur lines.

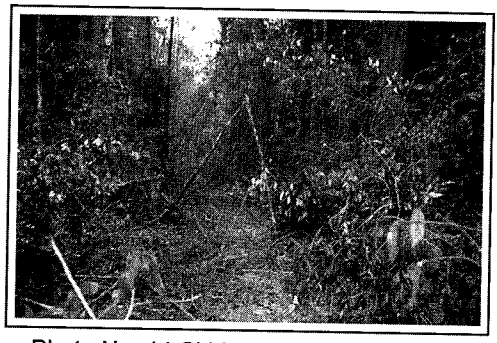


Photo No. 14 Skid track in cutting blocks

3.8.2.2 Minor Skid Tracks

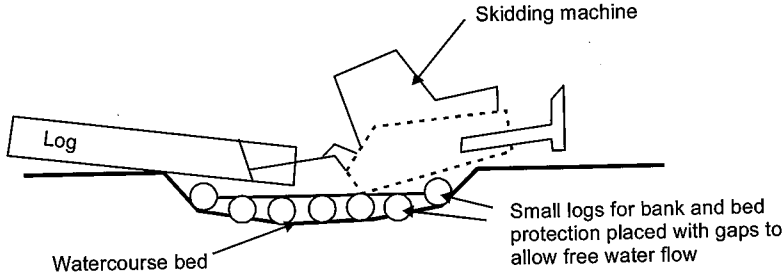
It is characterized as follows:

- will have less than 10 passes made along each track;
- their construction does not require earthworks; and
- litter/logging debris to be maintained on the surface of the track.

3.8.2.3 Skidding design

- Skidding trials should avoid watercourse crossings as much as possible. Where it is not possible to avoid, all permitted watercourse crossing must be sited where the banks and beds are stable solid rock or large gravel's;

- All permitted watercourses crossing with earth banks and beds must be reinforced by placing small logs parallel to the water flow. The log bed reinforcement will prevent or reduce bank and bed disturbance. The log bed must be removed immediately after completion of skidding



- Locate the position of landings before deciding the location of skid tracks

- Locate skid tracks:

  - away from waterways and unstable areas;
  - on spur lines where possible, to allow good drainage; and
  - to avoid damage to retained trees.

3.8.2.4 Timing of skid track construction

- Major skid tracks are to be constructed within one (1) month prior to the start of felling operations;

- Minor skid tracks must be marked prior to logging to assist the cutter/feller to determine the direction of felling, however, they may be constructed after felling.
- Departures from the planned alignment which involve increased side cutting or increased watercourse crossing, are to be referred to the Company Planning Officers. The new alignment may be authorized if it conforms to the Code of Practice. Other cases are to be inspected by the concerned Forest Officer before construction

3.8.2.5 Skid track construction

- Vegetation should be hand cut;
- Construct skid tracks in dry weather
- Maximum width is 4 meters for all skid tracks;
- Where possible, avoid side cutting of major skid tracks;
- Side cutting is not permitted for minor skid tracks;
- Side cut skid tracks must have an outward cross-fall of 1^{o} - 3^{o};
- Box cuts are not permitted;
- Berms on the outside edges are not permitted; and
- The radiuses of curves are to be large enough to prevent damage to retained trees and regeneration.

3.8.2.6 Skid track rehabilitation

- All disturbed areas must be reinstated; and
- Natural surface drainage must be restored with temporary erosion protection installed as required. Cross drains are to be constructed if required.

3.8.3 Skidding machineries used and operations

Techniques for skid tracks operations should include the following:

- Ensure the use of low ground pressure equipment and machineries;
- Minimize the area of disturbed and compacted soil;
- Avoid damage to remaining trees and regeneration; and
- Preserve watercourse banks and buffer zones.

3.8.3.1 Skidding machine characteristics

- Equipment that can reduce damage to the forest during logging is preferred. This includes:

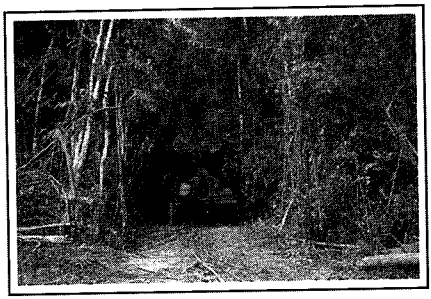


Photo No. 15 Log transport from the cutting blocks

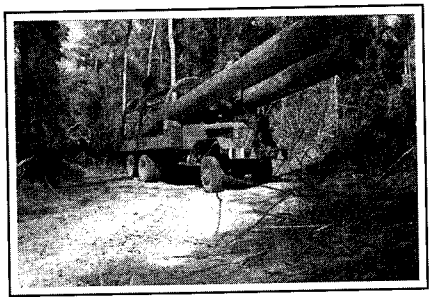
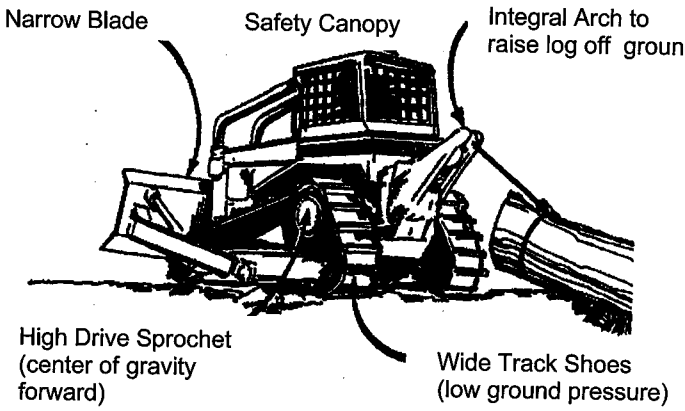


Photo No. 16 Skidding and transportation (with GMC)

- Dozers fitted with bull blades of a width no greater than outside track width;
- Track machines fitted with wide tracks;
- Rubber tired machines fitted with wide high flotation tires; and
- Machines with integral or logging arches.

3.8.3.2 Skidding machine practices

- Keep the blade up when traveling and skidding;
- Pushing of soil on skid tracks, other than that permitted for construction, is prohibited;
- Retain vegetation litter along tracks;
- Reverse along skid tracks towards the log, wherever this can be done safely;
- winches to minimize the need to drive right to the log;
- Head or butt haul to minimize the tractor traveling distances;
- Lift the end of the log off the ground, to avoid soil damage due to log drag. (Logging arches will help this action); and
- Avoid damage to standing trees and regeneration along skid tracks.



Schematic diagram showing the specifications for skidding machines

3.9 Log landing

Log landing is designed to ensure that

- Work is done in accordance with the harvesting plan;
- Small log landings are used to ensure the loss of productive forest areas;
- Log landings are managed to prevent sedimentation of watercourses; and
- Log landings are stabilized after use.

3.9.1 Location of log landing

- Landings are to be located:
  - outside areas excluded from logging;
  - at least 40 m from the edge of the buffer zones;
  - at sites which suit skidding patterns and direction;
  - to balance site disturbance with skid distance;
  - in dry areas on ridges or benches;
  - in areas which are easy to drain; and
  - in areas of low slope to reduce the amount of side cutting.

- The minimum distance between landings will be determined by
  - the terrain found within the block;
  - the stocking density within the forest; and
  - the type of skidding machines being used.

- Roadsides may be used if
  - this reduces earthworks; and
  - landing and road can be well drained.
- Landing locations are to shown on the logging plan, and inspected by the Forest Officer before construction;
- Forest Officer may approve additional landings (if requested after field inspection)

Photo No. 17. Log landing near major skid track

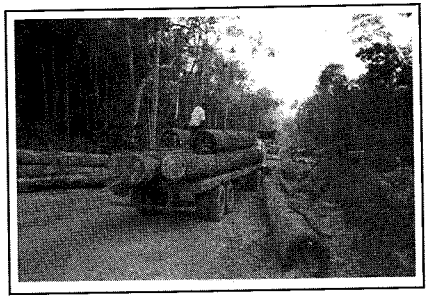


Photo No. 18 Log landing along the main road

3.9.2 Size/area of log landing

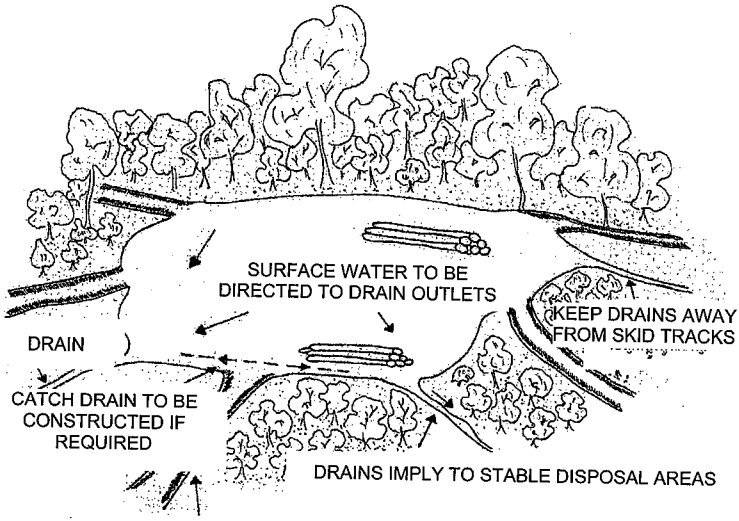
- The size of landings includes:
  - the total area of disturbance, including cut and fill batters, and
  - half the road width if the landing is constructed at the road-side.
- Landings must occupy less than one (1) percent of the logged area;
- Maximum landing size is 2,000 square meters.

3.9.3 Construction of log landing

- Mark the boundary of the landing cut and fill areas;
- Remove all merchantable trees; and
- Debris and waste heaps are to be:
  - placed so as not to restrict drainage of the landings
  - stored away from landing trees; and
  - more than 10 m from drainage area

- Soil and vegetation debris are to be kept separate;
- Heap debris and burn (if necessary) within the landing ar
- Split level landings may be used to reduce excavation;
- Batter cuts and fills and stabilize with suitable planting;

PLAN OF TYPICAL LANDING



Log landing location

- Construct and maintain landings to prevent the pounding of water; and

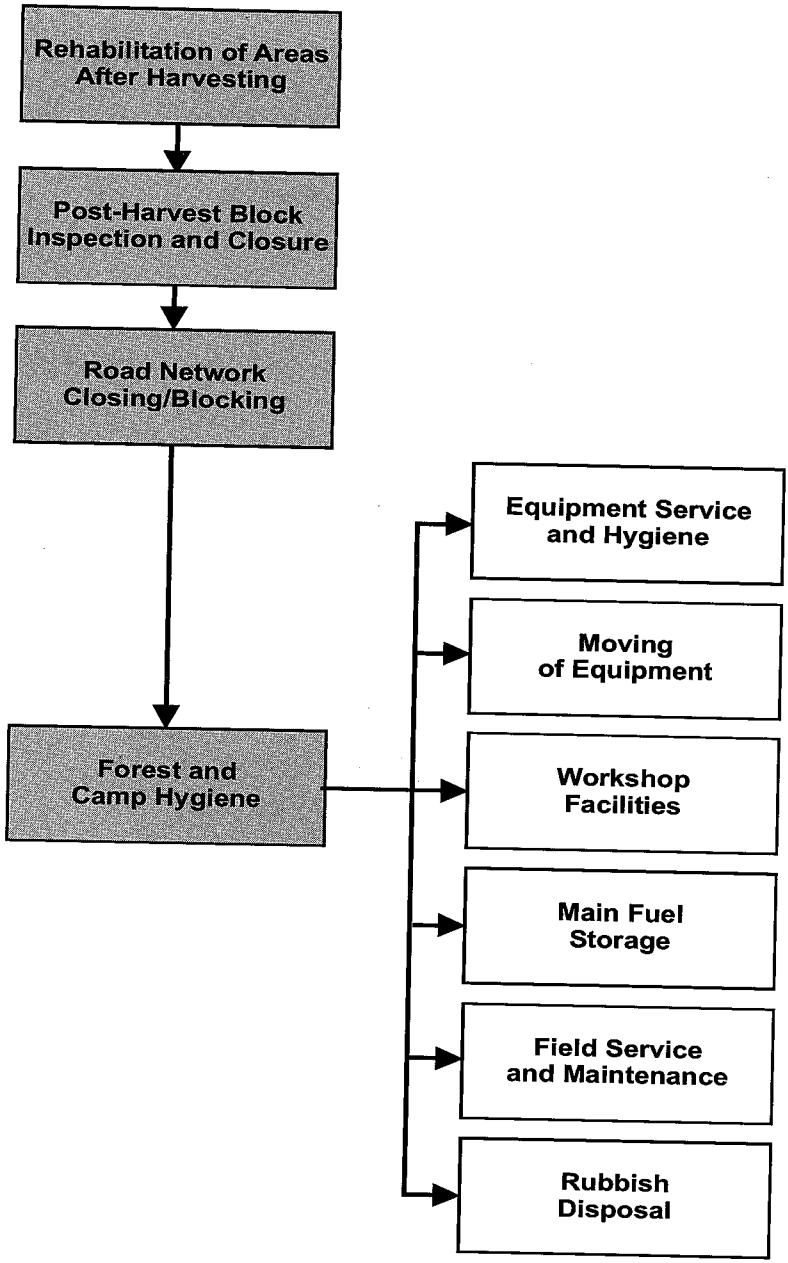
- Provide ring drainage (if required) to prevent surface pounding. Drains may empty on the stable vegetated buffer strips.

3.9.4 Maintenance/stabilization of log landing

- Landings should be replanted with suitable cover crops, such as ground creepers and/or fast-growing species. In order to reduce unnecessary new openings, most old logging roads, landing and main skid tracks are to be used again for the next cutting cycle. As such, it is not advisable to plant commercial trees requiring longer years to mature and with the same areas to be used again for the same purposes;

- If corded, cording must be removed;
- Landings should be replanted with merchantable species;
- Landings should ripped at 90 degrees to the drainage direction;
- Bark and other logging debris should either be burnt or distributed evenly through the harvest area; and
- The site should be cleaned of all rubbish, including oil/fuel drums, wire rope, used batteries and plastic containers/bottles

POST HARVEST ACTIVITIES



4. POST-HARVESTING ACTIVITIES

4.1 Rehabilitation of areas after harvesting

The rehabilitation of the forest after harvest, the improvement of the composition and productivity of the growing stock and the continuous protection of the forest and conservation of its biodiversity are important activities that ensure the sustainability of forest management. The result of these activities is a healthy forest that can continue to deliver the products and services of forest management.

These activities include:

- Timber stands improvement (TSI) – providing growing space and favorable growth requirements for the preferred species within the secondary forest stand, which is conduced 5-10 years after logging operations;
- Assisted natural regeneration (ANR) – assisting the growth and development of preferred species in sub-marginal or open areas;
- Enrichment planting (EP) – planting of preferred or indigenous tree species in inadequately stock secondary forest areas to enrich stand composition and density.

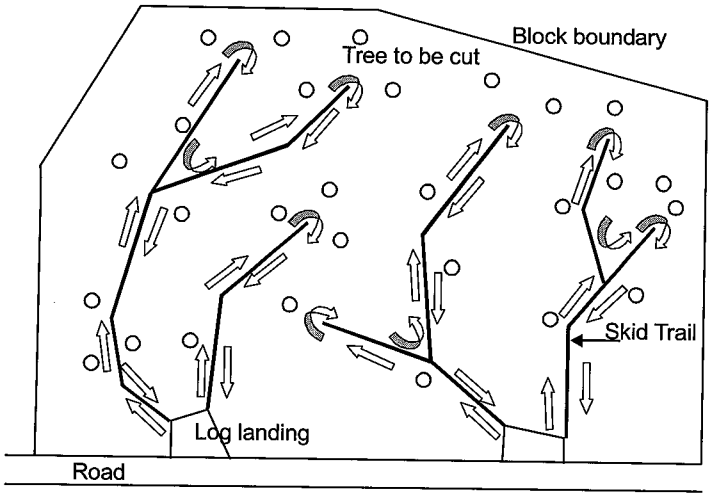
Photo No. 20 Cutting of Climbers and Vines
After harvest operations

4.2 Post-harvest block inspection and closure

The harvesting operations must be knowledgeable and experienced, and should be given opportunities to learn on-the-job, particularly from their mistakes. As such, it is important for harvesting operations to accompany the post-harvest inspection teams during field visits and inspections so that mistakes and errors can be pointed out and shown to them for further improvement in the implementation of the Code of Practice as translated in the Field Guide.

Block inspections should be carried out systematically along the skidding tracks arising from each log landing. If the inspection commences from the right corner of the block, the inspectors should walk along the first skid track and walk the whole length of the track observing and assessing only the right side. As the inspectors reach the end of the track, the turn and walk back observing and assessing the right side. Then the same process and sequence is repeated for all other skid tracks until the whole block is completely inspected.

If the inspection commences from the left corner, then the inspectors should only pay attention to the left side all the way in, and again pay attention to the left side all the way out. A schematic diagram below illustrates how this should be done.



Legend:
⟹ Inspection route

4.3 Road network closing/blocking

The Code sets guidelines for stabilization of logging areas after harvesting and if fully implemented will:

- Prevent further deterioration of the logged-over area and down stream soil and water values; and
- Leave all rehabilitated areas in a clean and tidy condition.

Permanent crossings

- Check all bridges/culverts, including decking foundations and sidewalls. They must be secure and safe.

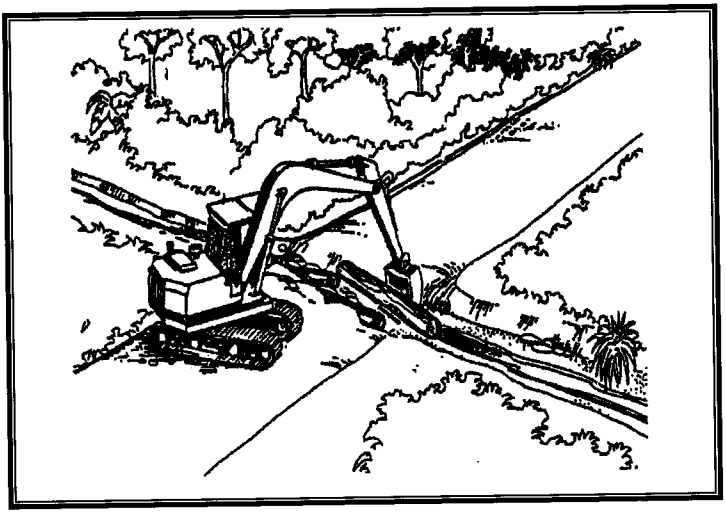
Photo No. 19 Blocking of road with filling materials

Photo No. 21 Cutting/Cleaning of logging debris

- Debris must be removed from watercourse by excavator or by hand;
- Water must be able to flow freely beneath the bridge; and
- Re-open all the silt traps.

Temporary crossings

- Remove all temporary crossings using an excavator:
  - avoid disturbance to the watercourse banks and bufferzones; and
  - place material at least 10 m from the watercourse.
- Closed roads and tracks with debris and filling materials.



The use of excavator to remove temporary crossings

4.4 Forest and Camp Hygiene

4.4.1 Equipment, maintenance, servicing and hygiene

The Code sets guidelines for forest and camp hygiene and if fully implemented will:

- Prevent pollution of water resources;
- Prevent introduction of non-endemic species and pathogens to new operating areas
- Maintain a tidy operation.

4.4.2 Moving equipment

- All equipment is to be washed thoroughly before it is moved to, or from, areas that are specifically quarantined, to prevent the spread of weeds and disease.
- Fuel and oil spillage is to be avoided during transport.

4.4.3 Workshop facilities

- Locate at least 50 m from any water body or watercourse;
- Drainage from workshop areas is not permitted to directly enter watercourses;
- Provide sullage pits for fuel and oil waste;
- Sullage pits must be constructed so that:
  - ⇒ they are above the water table;
  - ⇒ run off water does not enter the pit;
  - ⇒ they are stable and safe; and
  - ⇒ they are at least 50 m from a watercourse or water body.
- Provide safe disposal areas for solid workshop wastes.

4.4.4 Main fuel and oil storage

Locate:

⇒ in a well drained area; and
⇒ no closer than 100 m to village areas.

- Bunds (preferably concrete) with a capacity of twice (2x) the storage capacity must be provided around the storage area;
- Drains are to be directed to a closed, stable and flood free sullage pit, at least 50 m from a watercourse or water body;
- Spillage of fuels during re-filling or fuel transfer is to be avoided;
- Storage at least 50 m from a water body or watercourse is preferred; and
- Where main fuel storage areas must be located adjacent to rivers, they are:

⇒ to be located as far away from the water as the fuel pumping lines permit; and
⇒ to be fitted with a proper, leak-proof bund, which in the event of a spill is able to be pumped to a sullage pit at least 50 m fom a water body.

4.4.5 Field servicing and maintenance

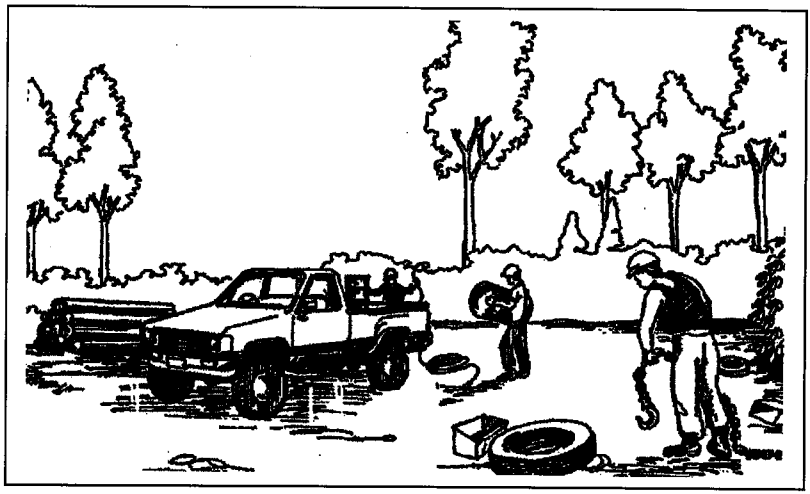
- Prevent leakage of the fuel and oil reserves;
- Field fuel tanks, re-filling points and maintenance areas are to be located:

⇒ in well drained areas such as landings or road junctions;
⇒ outside areas excluded from logging; and
⇒ more than 50 m from a watercourse.

- Prevent spillage during re-fueling;
- Sump oil is not to be dumped in the logging area; and
- All sump oil is to be collected and removed to the main sullage disposal facility.

4.4.6 Rubbish disposal

- Discarded machinery is to be removed from the logging operation area to the base camp; and
- All rubbish is to be placed in a rubbish pit and buried as soon as logging in the block is finished.

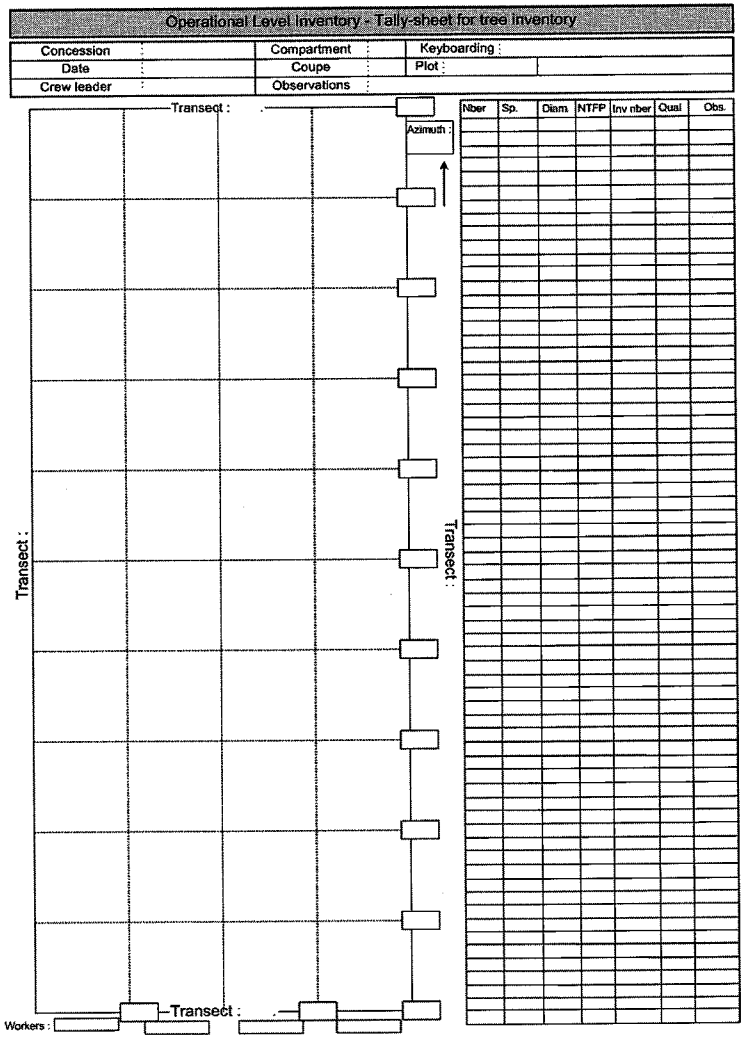


Remove all rubbish from field and campsites

Appendix 1

Models of the Tally-Sheets

➢ Inventory



➢ Main transect

Operational Level Inventory - Tally-sheet for main transect			
DFW			
Concession :		Azimuth :	Date of keyboarding :
Compartment :		Transect :	
Coupe :		Observations	
Crew leader :			
Date :			

Distance	Vegetation	Topography and post-harvesting tracks	Slope[1] (%)	Correction for 25 m	Correction for 250 m	Higher slope (%)	Slope correction on 25 meters	
							Slope (%)	Correction (m)
.000								
.975							10	0.12
.950							11	0.15
.925							12	0.18
.900							13	0.21
.875							14	0.24
.850							15	0.28
.825							16	0.32
.800							17	0.36
.775							18	0.40
.750							19	0.45
.725							20	0.50
.700							21	0.55
.675							22	0.60
.650							23	0.65
.625							24	0.71
.600							25	0.77
.575							26	0.83
.550							27	0.90
.525							28	0.96
.500							29	1.03
.475							30	1.10
.450							31	1.17
.425							32	1.25
.400							33	1.33
.375							34	1.41
.350							35	1.49
.326							36	1.57
.300							37	1.66
.275							38	1.74
.250							39	1.83
.225							40	1.93
.200							41	2.02
.175							42	2.12
.150							43	2.21
.125							44	2.31
.100							45	2.41
.075							46	2.52
.050							47	2.62
.025							48	2.73
.000							49	2.84

[1] Slope (%) : slope in the transect direction

➢ Secondary transects

Operational Level Inventory - Tally-sheet for secondary transect			
DFW			
Concession		Azimuth	Date of keyboarding
Compartment		Transect	
Coupe		Observations	
Crew leader			
Date			

Distances[1]		Vegetation	Topography and post-harvesting tracks	Higher slope (%)	Transect crossings
.000	.000				
.975	.025				
.950	.050				
.925	.075				
.900	.100				
.875	.125				
.850	.150				
.825	.175				
.800	.200				
.775	.225				
.750	.250				
.725	.275				
.700	.300				
.675	.325				
.650	.350				
.625	.375				
.600	.400				
.575	.425				
.550	.450				
.525	.475				
.500	.500				
.475	.525				
.450	.550				
.425	.575				
.400	.600				
.375	.625				
.350	.650				
.325	.675				
.300	.700				
.275	.725				
.250	.750				
.225	.775				
.200	.800				
.175	.825				
.150	.850				
.125	.875				
.100	.900				
.075	.925				
.050	.950				
.025	.975				
.000	.000				

[1] The unused row is crossed out

➢ GPS recording

Operational Level Inventory - Tally-sheet for GPS recording			
DFW			
Concession	:	Units (degree, minutes, seconds / decimal degrees / UTM...)	:
Compartment	:	Observations	
Coupe	:		
Crew leader	:		

Date	GPS reference	Location description (Transect, distance, plot, water-course, road, bridge...)	X	Y	Accuracy (....)

GPS reference : name of the point recorded in the GPS.
The accuracy unit has to be indicated between parenthesis.

Appendix2

LIST OF SPECIES

SPECODE	Local-Name	SPEC-Gr	ROY_CLASS	COMM-Gr	Dip/NonDip
ACSA	ACH SAT	7	NONCLASS	NonCommercial	Non-Dip
ADCH	ACHDERK	7	NONCLASS	NonCommercial	Non-Dip
AKSL	AN GKEA SEL	7	NONCLASS	NonCommercial	Non-Dip
AMBB	AMBENG BEK	7	NONCLASS	NonCommercial	Non-Dip
AMCN	AMBENG CHAN	7	NONCLASS	NonCommercial	Non-Dip
AMPI	AMPIL TOEUK PREY	7	NONCLASS	NonCommercial	Non-Dip
ANCH	ANGKOCH	7	NONCLASS	NonCommercial	Non-Dip
ANKB	AN GKEA BOS	7	NONCLASS	NonCommercial	Non-Dip
ANKM	A NGKOT KHMAU	5	LUX	Commercial	Non-Dip
ANKN	AN GKANH	6	LUX	NonCommercial	Non-Dip
ANKT	AN GKAT TMAAT	6	FIRST	NonCommercial	Non-Dip
ANOM	ANGKRANG PHNOM	6	NONCLASS	NonCommercial	Non-Dip
ANRD	ANGRE DEK	7	NONCLASS	NonCommercial	Non-Dip
APEN	APH EAN	7	NONCLASS	NonCommercial	Non-Dip
ATES	ATES	7	NONCLASS	NonCommercial	Non-Dip
ATNG	A TEANG/ROTEANG	6	THIRD	NonCommercial	Non-Dip
ATSR	ANNTUNG SOR	7	NONCLASS	NonCommercial	Non-Dip
ATTT	ATITH/NEANG PHOR EK	5	SECOND	Commercial	Non-Dip
BADM	BAK DERM	6	NONCLASS	NonCommercial	Non-Dip
BAKG	BAN GKANG	6	NONCLASS	NonCommercial	Non-Dip
BAKK	BAN GKONG KENGKONG	7	NONCLASS	NonCommercial	Non-Dip
BAKP	BAKP AO	7	NONCLASS	NonCommercial	Non-Dip
BBOK	BOR BORK	7	NONCLASS	NonCommercial	Non-Dip
BDNG	BAKD ORNG	6	NONCLASS	NonCommercial	Non-Dip
BELY	BELOY	6	FIRST	NonCommercial	Non-Dip
BENG	BEN G	5	LUX	Commercial	Non-Dip
BKSV	BAN GKEOU SVA	6	NONCLASS	NonCommercial	Non-Dip
BNKO	B AG KHEOU	6	THIRD	NonCommercial	Non-Dip
BOPR	BO PROEUK	7	NONCLASS	NonCommercial	Non-Dip

BRCH	BROR CHOK	7	NONCLASS	NonCommercial	Non-Dip
BSNK	BOSNEAK	5	FIRST	Commercial	Non-Dip
BTIL	BATPHTIL	7	NONCLASS	NonCommercial	Non-Dip
BYPV	BAY POU VAING	6	THIRD	NonCommercial	Non-Dip
CABB	CHAM BAK BARAING	7	NONCLASS	NonCommercial	Non-Dip
CASA	KHCHOENG	6	THIRD	NonCommercial	Non-Dip
CCHB	CHOEUNG CHAB	6	LUX	NonCommercial	Non-Dip
CHBG	CHHOETEAL BANGKOUY/NEANGDENG	NonCommercial	SECOND	Commercial	Dip
CHBK	CHAM BAK	5	NONCLASS	Commercial	Non-Dip
CHBR	CHHOETEAL BRENG	NonCommercial	SECOND	Commercial	Dip
CHCK	CHHOENG CHKER	7	NONCLASS	NonCommercial	Non-Dip
CHEK	CHANG ENG SEK	7	NONCLASS	NonCommercial	Non-Dip
CHHA	CHHAR	7	NONCLASS	NonCommercial	Non-Dip
CHHU	CHHOM POU PREY	7	NONCLASS	NonCommercial	Non-Dip
CHKG	CHEUNG KRORVAING	7	NONCLASS	NonCommercial	Non-Dip
CHKM	CHHOEU KHMAV/NEANG KHMAV	5	LUX	Commercial	Non-Dip
CHKO	CHOEUNG KO	5	NONCLASS	Commercial	Non-Dip
CHKP	CHUNGKONG PHON	7	NONCLASS	NonCommercial	Non-Dip
CHKR	CHAN KRASNA	5	THIRD	Commercial	Non-Dip
CHKU	CHEUNG KRAPEU	7	NONCLASS	NonCommercial	Non-Dip
CHLK	CHHLIK	5	FIRST	Commercial	Non-Dip
CHLS	CHORNLOS	7	NONCLASS	NonCommercial	Non-Dip
CHMC	CHHAM CHHA	5	SECOND	Commercial	Non-Dip
CHMI	CHHOETEAL MOSAU	NonCommercial	SECOND	Commercial	Dip
CHMK	CHAMRIEK	6	NONCLASS	NonCommercial	Non-Dip
CHNA	CHANG NANG	7	NONCLASS	NonCommercial	Non-Dip
CHNO	CHNOK	7	NONCLASS	NonCommercial	Non-Dip
CHNY	CHORNY	6	NONCLASS	NonCommercial	Non-Dip
CHOV	CHOV	7	NONCLASS	NonCommercial	Non-Dip
CHPL	CHHOE PHLOEUNG	6	NONCLASS	NonCommercial	Non-Dip
CHPS	CHHOETEAL PREUS	7	NONCLASS	NonCommercial	Non-Dip
CHRH	CHORCHONG	3	SECOND	Commercial	Dip
CHRK	CHRAKENG	6	NONCLASS	NonCommercial	Non-Dip

CHRM	CHANG KONG ROMEANG	6	NONCLASS	NonCommercial	Non-Dip
CHRS	CHREIS	6	LUX	NonCommercial	Non-Dip
CHTP	CHAN TOUM PEANG	5	THIRD	Commercial	Non-Dip
CHTR	CHHOETEAL CHHNGAR	NonCommercial	SECOND	Commercial	Dip
CHTU	CHNOK TROU	7	NONCLASS	NonCommercial	Non-Dip
CHUT	CHORNG UOR THMAT	6	THIRD	NonCommercial	Non-Dip
CKTM	CHEK TUM	6	THIRD	NonCommercial	Non-Dip
CREY	CHREY	6	NONCLASS	NonCommercial	Non-Dip
CRMS	CHRASMAS	3	SECOND	Commercial	Dip
CTES	CHORNTESPLOUK	7	NONCLASS	NonCommercial	Non-Dip
DAKD	DANG KEAP KDAM	7	NONCLASS	NonCommercial	Non-Dip
DCSP	DONCHERM	5	FIRST	Commercial	Non-Dip
DGPR	DANGKEABPROEUS	7	NONCLASS	NonCommercial	Non-Dip
DKOR	DONGKOR	6	NONCLASS	NonCommercial	Non-Dip
DKPO	DOKPO	7	NONCLASS	NonCommercial	Non-Dip
DNKY	DOUNKAY	7	NONCLASS	NonCommercial	Non-Dip
DOKM	DOK MEY	6	NONCLASS	NonCommercial	Non-Dip
DRDV	DORNG DAV	7	NONCLASS	NonCommercial	Non-Dip
DYKL	DEY KHLA	5	NONCLASS	Commercial	Non-Dip
DYSP	DEY SAMPOCH	7	NONCLASS	NonCommercial	Non-Dip
EPSH	EYSEIPHSAM SRACH	7	NONCLASS	NonCommercial	Non-Dip
HISN	HAISANH/NGAYSANG/CHA NSAR	6	LUX	NonCommercial	Non-Dip
HUDN	HOUN DAN/MOREASPREOUPHNOM	5	LUX	Commercial	Non-Dip
KACL	KACHEAL	7	NONCLASS	NonCommercial	Non-Dip
KAKU	KAKHUCH	7	NONCLASS	NonCommercial	Non-Dip
KANA	KANA	7	NONCLASS	NonCommercial	Non-Dip
KANE	KANER	7	NONCLASS	NonCommercial	Non-Dip
KANT	KANTOUT PREY	7	NONCLASS	NonCommercial	Non-Dip
KAOM	KANGSENGPHNOM	6	NONCLASS	NonCommercial	Non-Dip
KATG	KATOUNG	7	NONCLASS	NonCommercial	Non-Dip
KAYK	KA YOUK	7	NONCLASS	NonCommercial	Non-Dip
KBAL KRORLORNG		7	NONCLASS	NonCommercial	Non-Dip
KBDA	KANCHOEU BEY DACH	7	NONCLASS	NonCommercial	Non-Dip
KBDK	KBAL DERK	7	NONCLASS	NonCommercial	Non-Dip

KBKK	KROBAO KHEK	7	NONCLASS	NonCommercial	Non-Dip
KCAS	KCHAS	6	NONCLASS	NonCommercial	Non-Dip
KCHP	KA CHIEP	7	NONCLASS	NonCommercial	Non-Dip
KDAG	KANN DEANG	6	NONCLASS	NonCommercial	Non-Dip
KDCE	KANDAB CHANG ET	7	NONCLASS	NonCommercial	Non-Dip
KDCH	KDURCH	6	NONCLASS	NonCommercial	Non-Dip
KDCK	KDOR COMBROK	7	NONCLASS	NonCommercial	Non-Dip
KDOL	KDOL	6	THIRD	NonCommercial	Non-Dip
KES	KES	6	FIRST	NonCommercial	Non-Dip
KHLG	KHLONG	NonCommercial	SECOND	Commercial	Dip
KHMA	KHANNMA	7	NONCLASS	NonCommercial	Non-Dip
KHNH	KHNHE	7	NONCLASS	NonCommercial	Non-Dip
KHOS	KHOS	7	NONCLASS	NonCommercial	Non-Dip
KHOV	KCHOV/KAMLENG	4	SECOND	NonCommercial	Dip
KHTN	KHTING	7	NONCLASS	NonCommercial	Non-Dip
KHVG	KHVENG	7	NONCLASS	NonCommercial	Non-Dip
KKAL	KALKAL	7	NONCLASS	NonCommercial	Non-Dip
KKCM	KONG KANGCHHMOL	6	THIRD	NonCommercial	Non-Dip
KKDK	KOKI DEK	4	FIRST	NonCommercial	Dip
KKGN	KONG KANGNHY	6	THIRD	NonCommercial	Non-Dip
KKKK	KALAP	7	NONCLASS	NonCommercial	Non-Dip
KKKS	KOKI KHASAC	4	SECOND	NonCommercial	Dip
KKLG	KBAL KRORLORNG	7	NONCLASS	NonCommercial	Non-Dip
KKMS	KOKI MOSAU	3	FIRST	Commercial	Dip
KKOM	KONG KANGPHNOM	6	NONCLASS	NonCommercial	Non-Dip
KKPN	KOKI PHNONG\KAMNHAN	3	SECOND	Commercial	Dip
KKTM	KOKI THMOR	4	FIRST	NonCommercial	Dip
KLIG	KLING	7	NONCLASS	NonCommercial	Non-Dip
KLNG	KLOUNG	7	NONCLASS	NonCommercial	Non-Dip
KLPO	KLENG POR	7	NONCLASS	NonCommercial	Non-Dip
KMPR	KOMPENG REACH	5	THIRD	Commercial	Non-Dip
KMPT	KOM PERT	7	NONCLASS	NonCommercial	Non-Dip
KNAL	KNALL	7	NONCLASS	NonCommercial	Non-Dip
KNAY	KNAY MORN	7	NONCLASS	NonCommercial	Non-Dip

KNDL	KANNDOL	6	THIRD	NonCommercial	Non-Dip
KNPR	KHNOR PREY	6	THIRD	NonCommercial	Non-Dip
KODK	KORNDORK	7	NONCLASS	NonCommercial	Non-Dip
KOKH	KON KHMOM	7	NONCLASS	NonCommercial	Non-Dip
KOMT	KOKTMAT	7	NONCLASS	NonCommercial	Non-Dip
KOMY	KO MOUY	7	NONCLASS	NonCommercial	Non-Dip
KORK	KORK	7	NONCLASS	NonCommercial	Non-Dip
KOTT	KORTHET	7	NONCLASS	NonCommercial	Non-Dip
KRAG	KRANG	6	NONCLASS	NonCommercial	Non-Dip
KRAK	KRORCHORK ANDERK	7	NONCLASS	NonCommercial	Non-Dip
KRAS	KREAS	6	THIRD	NonCommercial	Non-Dip
KRAY	KRAY	5	NONCLASS	Commercial	Non-Dip
KRBO	KRORBAO	6	THIRD	NonCommercial	Non-Dip
KREG	KROENG	7	NONCLASS	NonCommercial	Non-Dip
KREL	KROEL	5	LUX	Commercial	Non-Dip
KREM	KROR EM	7	NONCLASS	NonCommercial	Non-Dip
KRKO	KRORKORS	5	FIRST	Commercial	Non-Dip
KRLA	KRORLANH	6	FIRST	NonCommercial	Non-Dip
KRMN	KROR MOURN	7	NONCLASS	NonCommercial	Non-Dip
KROH	KROCH PREY	7	NONCLASS	NonCommercial	Non-Dip
KRON	KRONG	6	NONCLASS	NonCommercial	Non-Dip
KRPM	KRORNHOUNG	5	LUX	Commercial	Non-Dip
KRSR	KRORNG SOEUR	7	NONCLASS	NonCommercial	Non-Dip
KRUS	KHOES REOUS	7	NONCLASS	NonCommercial	Non-Dip
KRVN	KRORVANN	7	NONCLASS	NonCommercial	Non-Dip
KRYS	KRAY SAR	5	THIRD	Commercial	Non-Dip
KTIT	KTITH	7	NONCLASS	NonCommercial	Non-Dip
KTOM	KHTOM	6	NONCLASS	NonCommercial	Non-Dip
KWAV	KHVAO	6	SECOND	NonCommercial	Non-Dip
LGNG	LO NGIENG	6	THIRD	NonCommercial	Non-Dip
LMBI	LUMBOR	3	SECOND	Commercial	Dip
LORT	LORT	7	NONCLASS	NonCommercial	Non-Dip
LORV	LOR VEA	7	NONCLASS	NonCommercial	Non-Dip
LOVG	LORVING	7	NONCLASS	NonCommercial	Non-Dip

LRLT	LORLOT	7	NONCLASS	NonCommercial	Non-Dip
MADN	MADEHN	7	NONCLASS	NonCommercial	Non-Dip
MAKG	MAK BREING	6	NONCLASS	NonCommercial	Non-Dip
MAKP	MAK PRANG	6	NONCLASS	NonCommercial	Non-Dip
MAKU	MAK KLOEU	6	NONCLASS	NonCommercial	Non-Dip
MASK	MEYSAK	5	FIRST	Commercial	Non-Dip
MDAS	MADEHN MEAS	7	NONCLASS	NonCommercial	Non-Dip
MMAG	MOR MANG	7	NONCLASS	NonCommercial	Non-Dip
MNPR	MEAN PREY	6	NONCLASS	NonCommercial	Non-Dip
MTYK	MLOUTRAYOUK	7	NONCLASS	NonCommercial	Non-Dip
NENS	NEANG SAR	6	NONCLASS	NonCommercial	Non-Dip
NGOK	NGOK	7	NONCLASS	NonCommercial	Non-Dip
NHAM	NHAM	7	NONCLASS	NonCommercial	Non-Dip
NIV	NIV	7	NONCLASS	NonCommercial	Non-Dip
NNON	NEANG NOUN	5	LUX	Commercial	Non-Dip
ONLK	ONLOK PHOR EM	7	NONCLASS	NonCommercial	Non-Dip
PAGA	PA NGAB	7	NONCLASS	NonCommercial	Non-Dip
PAGS	PA NGES	7	NONCLASS	NonCommercial	Non-Dip
PANG	PANG	6	NONCLASS	NonCommercial	Non-Dip
PCEK	PHCEK	3	FIRST	Commercial	Dip
PECH	PECH CHANGVA	7	NONCLASS	NonCommercial	Non-Dip
PHDK	PHDEAK	Commercial	SECOND	Commercial	Dip
PHLG	PHLANG	7	NONCLASS	NonCommercial	Non-Dip
PHMA	PHNERK CHMA	7	NONCLASS	NonCommercial	Non-Dip
PHNO	PHNOM PHNERNG	7	NONCLASS	NonCommercial	Non-Dip
PHNV	PHNHEAV	6	NONCLASS	NonCommercial	Non-Dip
PHON	PHAONG	6	THIRD	NonCommercial	Non-Dip
PHOR	PHOR	7	NONCLASS	NonCommercial	Non-Dip
PHUT	PROR HOUT	6	NONCLASS	NonCommercial	Non-Dip
PLNG	PLOV NEANG	7	NONCLASS	NonCommercial	Non-Dip
PLOG	PLUOUNG	7	NONCLASS	NonCommercial	Non-Dip
PLOK	PLONG KEOV	7	NONCLASS	NonCommercial	Non-Dip
PLON	PLONG	6	NONCLASS	NonCommercial	Non-Dip
PLOR	PLOR	7	NONCLASS	NonCommercial	Non-Dip

PLPH	PLOV SOMPOUCH	7	NONCLASS	NonCommercial	Non-Dip
PMVG	PROMOY VIENG	7	NONCLASS	NonCommercial	Non-Dip
PNAG	PHNEANG	6	NONCLASS	NonCommercial	Non-Dip
PNGS	PHNGEAS	6	NONCLASS	NonCommercial	Non-Dip
PNKP	PHNEK PREAP	7	NONCLASS	NonCommercial	Non-Dip
PNOM	PON ORMBORK	7	NONCLASS	NonCommercial	Non-Dip
POBY	POPUOL BAY	6	NONCLASS	NonCommercial	Non-Dip
POCH	POUCH	7	NONCLASS	NonCommercial	Non-Dip
POCV	PON SVAR	6	NONCLASS	NonCommercial	Non-Dip
POKH	POPEA KHE	6	NONCLASS	NonCommercial	Non-Dip
PONR	PONG RO	6	NONCLASS	NonCommercial	Non-Dip
POPL	PO PLEAR	7	NONCLASS	NonCommercial	Non-Dip
POUN	POUN	7	NONCLASS	NonCommercial	Non-Dip
PPEL	POPEL	4	FIRST	NonCommercial	Dip
PPPR	POPLEA PRUES	7	NONCLASS	NonCommercial	Non-Dip
PPTH	POPULTHMOR	6	NONCLASS	NonCommercial	Non-Dip
PPUL	PHNEL/POPOUL	6	FIRST	NonCommercial	Non-Dip
PPVK	POPOULVAK	7	NONCLASS	NonCommercial	Non-Dip
PRDL	PRAM DOMLENG	5	THIRD	Commercial	Non-Dip
PREL	PREAL	7	NONCLASS	NonCommercial	Non-Dip
PRLO	PRO LOUP	5	NONCLASS	Commercial	Non-Dip
PRNG	PRING/KRORB BEK	5	THIRD	Commercial	Non-Dip
PROM	PROMAT KHLAKMOM	7	NONCLASS	NonCommercial	Non-Dip
PROM	PROUM	7	NONCLASS	NonCommercial	Non-Dip
PRPN	PREAS PHNOV/SOMBOK KROHOM	6	NONCLASS	NonCommercial	Non-Dip
PRUS	PROUS	6	THIRD	NonCommercial	Non-Dip
PYPK	PHKAI PROEK	6	FIRST	NonCommercial	Non-Dip
RAIT	RAING TOEK	6	NONCLASS	NonCommercial	Non-Dip
RANG	RAING	7	NONCLASS	NonCommercial	Non-Dip
RINM	RAING PHNOM	4	FIRST	NonCommercial	Dip
ROCG	ROM CHORNG	7	NONCLASS	NonCommercial	Non-Dip
RODL	ROMDOUL	7	NONCLASS	NonCommercial	Non-Dip
ROKA	ROKA	6	NONCLASS	NonCommercial	Non-Dip
ROML	ROMLEANG	7	NONCLASS	NonCommercial	Non-Dip

ROTY	ROMENGTHA NGE0Y	7	NONCLASS	NonCommercial	Non-Dip
ROVN	ROVIENG	7	NONCLASS	NonCommercial	Non-Dip
RPCK	ROMPEAT CHROUK	7	NONCLASS	NonCommercial	Non-Dip
RUNG	ROUNG	6	NONCLASS	NonCommercial	Non-Dip
SABL	SAMBOUR LOVENG	6	NONCLASS	NonCommercial	Non-Dip
SADA	SANDA	7	NONCLASS	NonCommercial	Non-Dip
SAHA	SANG HA	7	NONCLASS	NonCommercial	Non-Dip
SAND	SANDAN	7	NONCLASS	NonCommercial	Non-Dip
SANK	SANG KE	7	NONCLASS	NonCommercial	Non-Dip
SARG	SAM RONG	6	NONCLASS	NonCommercial	Non-Dip
SAVP	SANGVA PICH	7	NONCLASS	NonCommercial	Non-Dip
SBMS	SAMBOUR MEAS	6	NONCLASS	NonCommercial	Non-Dip
SBTS	SAMBOUR TES	7	NONCLASS	NonCommercial	Non-Dip
SDAV	SDAV	6	NONCLASS	NonCommercial	Non-Dip
SDEY	SDEY	6	FIRST	NonCommercial	Non-Dip
SEMN	SEMORN\ ROL	7	NONCLASS	NonCommercial	Non-Dip
SKPL	SLAKRORPOUL	7	NONCLASS	NonCommercial	Non-Dip
SKRM	SOKROM	5	FIRST	Commercial	Non-Dip
SLCH	SLA KCHEY	7	NONCLASS	NonCommercial	Non-Dip
SLEN	SLENG	6	NONCLASS	NonCommercial	Non-Dip
SLET	SLOEK LO ET	7	NONCLASS	NonCommercial	Non-Dip
SLNG	SOM LEANG	7	NONCLASS	NonCommercial	Non-Dip
SMCH	SMACH	6	THIRD	NonCommercial	Non-Dip
SME	SME	6	FIRST	NonCommercial	Non-Dip
SMKB	SMA KRABEY	6	THIRD	NonCommercial	Non-Dip
SMPN	SAM PONG	5	THIRD	Commercial	Non-Dip
SNAY	SNAY	6	NONCLASS	NonCommercial	Non-Dip
SNOL	SNUOL	6	NONCLASS	NonCommercial	Non-Dip
SOPI	SOPHY	7	NONCLASS	NonCommercial	Non-Dip
SOUY	SOURY	6	NONCLASS	NonCommercial	Non-Dip
SPOR	SOM POR	6	FIRST	NonCommercial	Non-Dip
SPPY	SPEOU PREY	6	NONCLASS	NonCommercial	Non-Dip
SPTK	SPEOU TEK	6	NONCLASS	NonCommercial	Non-Dip
SRAL	SRAL	5	SECOND	Commercial	Non-Dip

SREG	CHHKER SRERNG	7	NONCLASS	NonCommercial	Non-Dip
SRKM	SRAKOM	6	SECOND	NonCommercial	Non-Dip
SRKR	SROL KRAHAM	5	SECOND	Commercial	Non-Dip
SRLO	SRORLAO	5	FIRST	Commercial	Non-Dip
SRMO	SRORMOR	7	NONCLASS	NonCommercial	Non-Dip
SROL	SROL SAR	5	SECOND	Commercial	Non-Dip
SVAK	SVAY SVAK	6	NONCLASS	NonCommercial	Non-Dip
SVCT	SVAY CHANTI	6	NONCLASS	NonCommercial	Non-Dip
SVPT	SVAY PONGTRONG	6	NONCLASS	NonCommercial	Non-Dip
SWPR	SVAY PREY	5	THIRD	Commercial	Non-Dip
SYCR	SVAY CHAM REANG	5	THIRD	Commercial	Non-Dip
TAPL	TAPIL	7	NONCLASS	NonCommercial	Non-Dip
TAUR	TAOUR	5	THIRD	Commercial	Non-Dip
TBEG	TBENG	3	SECOND	Commercial	Dip
TBOT	TABORT	7	NONCLASS	NonCommercial	Non-Dip
TENG	TENG	7	NONCLASS	NonCommercial	Non-Dip
TEPI	TEP PHIROU	5	NONCLASS	Commercial	Non-Dip
THME	THMEAS	7	NONCLASS	NonCommercial	Non-Dip
THNO	THNOT PRENG	7	NONCLASS	NonCommercial	Non-Dip
THNR	THNONG KROHORM	5	LUX	Commercial	Non-Dip
THNS	THNONG SOR	5	LUX	Commercial	Non-Dip
THTR	THMENH TREY	7	NONCLASS	NonCommercial	Non-Dip
TKOV	TKOV	6	NONCLASS	NonCommercial	Non-Dip
TLOK	THLOK	6	THIRD	NonCommercial	Non-Dip
TMAK	TLERM ANNDERK	7	NONCLASS	NonCommercial	Non-Dip
TNIV	TAONIV	7	NONCLASS	NonCommercial	Non-Dip
TOLP	TOUNLORP	6	NONCLASS	NonCommercial	Non-Dip
TOUK	TOUK	7	NONCLASS	NonCommercial	Non-Dip
TPOG	TOM POUNG	6	NONCLASS	NonCommercial	Non-Dip
TRAC	TRACH	NonCommercial	SECOND	Commercial	Dip
TRAG	TRANG	6	NONCLASS	NonCommercial	Non-Dip
TRBL	TROR ORL	7	NONCLASS	NonCommercial	Non-Dip
TRCU	TRA BEK CHOU	7	NONCLASS	NonCommercial	Non-Dip
TREL	TREAL	7	FIRST	NonCommercial	Non-Dip

TREN	TRA MENG	6	THIRD	NonCommercial	Non-Dip
TRLT	TRORLAT	4	SECOND	NonCommercial	Dip
TRMN	TRORMOUNG	6	THIRD	NonCommercial	Non-Dip
TROG	TRORNG	7	NONCLASS	NonCommercial	Non-Dip
TRSK	TRORMOUNGSEK	6	FIRST	NonCommercial	Non-Dip
TRSK	TRORSEK / TRAMKANG	7	NONCLASS	NonCommercial	Non-Dip
TRTM	TRORP TOM	5	THIRD	Commercial	Non-Dip
TRYA	TROR YAK	7	NONCLASS	NonCommercial	Non-Dip
TRYG	TROR YING	5	LUX	Commercial	Non-Dip
TRYG	TROR YORNG	7	NONCLASS	NonCommercial	Non-Dip
TTPY	TOTIM PREY	7	SECOND	NonCommercial	Non-Dip
TTRV	TATRAV	5	LUX	Commercial	Non-Dip
UNKN	UNKNOWN	7	UNKN	NonCommercial	Non-Dip
VEAY	VEAY	7	NONCLASS	NonCommercial	Non-Dip
VOEG	VOENG	7	NONCLASS	NonCommercial	Non-Dip
WYNG	VOR YONG	6	FIRST	NonCommercial	Non-Dip
YEAM	YEAM	7	NONCLASS	NonCommercial	Non-Dip
YOUK	YOUK	7	NONCLASS	NonCommercial	Non-Dip

Appendix 3

Slope correction for 25 metres

Slope (%)	Lentgh to add for 25 metres (m)
10	0.12
11	0.15
12	0.18
13	0.21
14	0.24
15	0.28
16	0.32
17	0.36
18	0.40
19	0.45
20	0.50
21	0.55
22	0.60
23	0.65
24	0.71
25	0.77
26	0.83
27	0.90
28	0.96
29	1.03
30	1.10
31	1.17
32	1.25
33	1.33
34	1.41
35	1.49
36	1.57
37	1.66
38	1.74
39	1.83
40	1.93
41	2.02
42	2.12
43	2.21

Slope (%)	Lentgh to add for 25 metres (m)
56	3.65
57	3.78
58	3.90
59	4.03
60	4.15
61	4.28
62	4.42
63	4.55
64	4.68
65	4.82
66	4.95
67	5.09
68	5.23
69	5.37
70	5.52
71	5.66
72	5.81
73	5.95
74	6.10
75	6.25
76	6.40
77	6.55
78	6.71
79	6.86
80	7.02
81	7.17
82	7.33
83	7.49
84	7.65
85	7.81
86	7.97
87	8.14
88	8.30
89	8.47

44	2.31
45	2.41
46	2.52
47	2.62
48	2.73
49	2.84
50	2.95
51	3.06
52	3.18
53	3.29
54	3.41
55	3.53

90	8.63
91	8.80
92	8.97
93	9.14
94	9.31
95	9.48
96	9.66
97	9.83
98	10.00
99	10.18
100	10.36

Slope correction for 1 meter

Slope (%)	Lentgh to be added for 25 meters (m)
10	0.005
11	0.006
12	0.007
13	0.008
14	0.010
15	0.011
16	0.013
17	0.014
18	0.016
19	0.018
20	0.020
21	0.022
22	0.024
23	0.026
24	0.028
25	0.031
26	0.033
27	0.036

Slope (%)	Lentgh to be added for 25 meters (m)
56	0.146
57	0.151
58	0.156
59	0.161
60	0.166
61	0.171
62	0.177
63	0.182
64	0.187
65	0.193
66	0.198
67	0.204
68	0.209
69	0.215
70	0.221
71	0.226
72	0.232
73	0.238

28	0.038
29	0.041
30	0.044
31	0.047
32	0.050
33	0.053
34	0.056
35	0.059
36	0.063
37	0.066
38	0.070
39	0.073
40	0.077
41	0.081
42	0.085
43	0.089
44	0.093
45	0.097
46	0.101
47	0.105
48	0.109
49	0.114
50	0.118
51	0.123
52	0.127
53	0.132
54	0.136
55	0.141

74	0.244
75	0.250
76	0.256
77	0.262
78	0.268
79	0.274
80	0.281
81	0.287
82	0.293
83	0.300
84	0.306
85	0.312
86	0.319
87	0.325
88	0.332
89	0.339
90	0.345
91	0.352
92	0.359
93	0.366
94	0.372
95	0.379
96	0.386
97	0.393
98	0.400
99	0.407
100	0.414

Appendix 4

Figure 7: Minimum bufferzones requirements

Description of Site	Minimum bufferzones Required
Cultural areas	Spiritual Sites, Gardens, etc – bufferzones with greater then the dominant tree height to be retained between the boundary of the site and the edge of the harvesting operations. Village areas – Minimum bufferzones width of 100 meters between the Village and the of harvesting operations.
Buffers around: .Lakes .Shorelines .Water storage areas	The bufferzones width is measured from the high water mark or the edge of the mangrove vegetation if this occurs above the high water mark. The minimum width depends on slope: .where slope is <17.6 % , bufferzones width = 50 meters. .where slope is >17.6 % , bufferzones width =100meters. Exceptions may occur where specific access to the water's edge has been incorporated into the Harvesting Plans, and approval for this access has been granted.
Landslip Areas	The bufferzones must include the landslip, the landslip spoil and the catchment of the landslip and spoil.
Watercourse Reserves (See Section 4,5 and Figures 8,9 & 10 for Watercourse Definition)	Retain vegetation on both sides of the watercourse. Bufferzones will be measured horizontally away from watercourses, from a point where the vegetation reaches a height of 10 meters or more. Class 1 Streams — 30 meters each side Class 2 Streams — 20 meters each side Class 3 Streams — 10 meters each side **Gullies** — **merchantable trees may be felled, however, extraction equipment is not permitted within 10 meters of either side.** Waterways — merchantable trees may be felled, however, extraction equipment is not permitted within 10 meters of either side.

Figure 9: Stream classification method

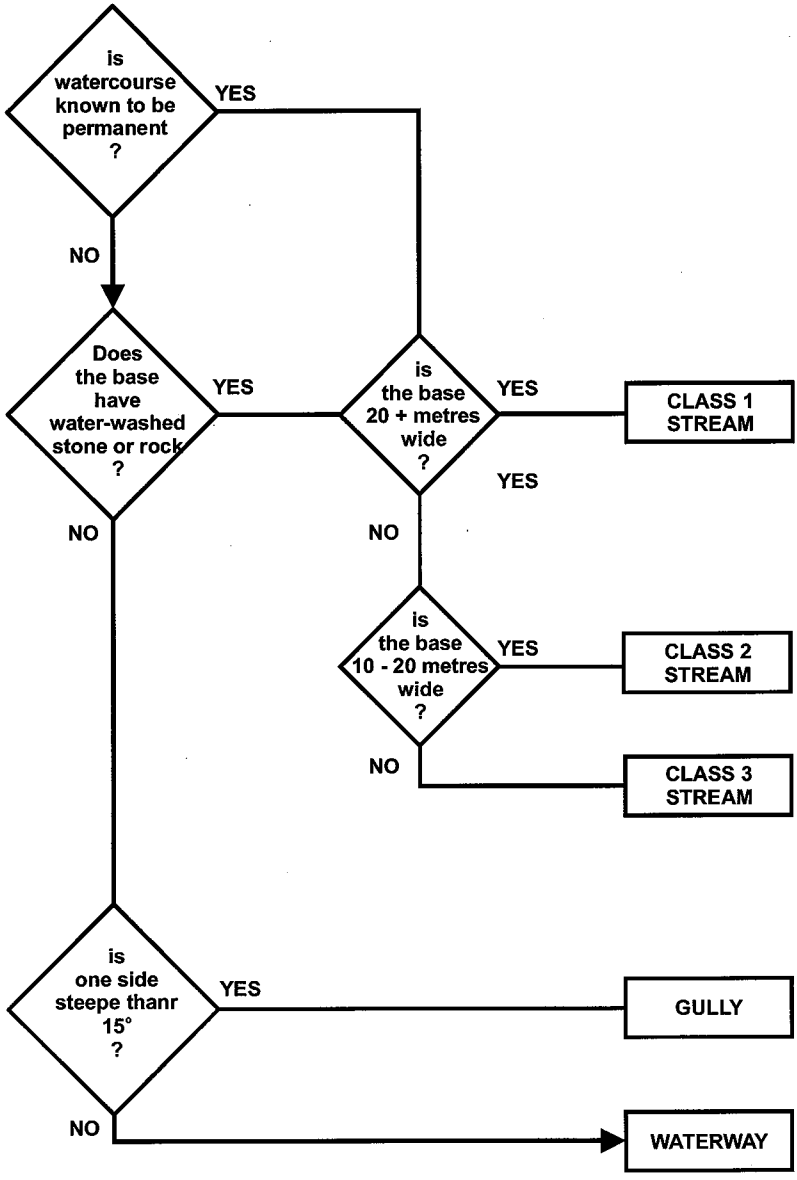


Figure 10: Watercourse definition

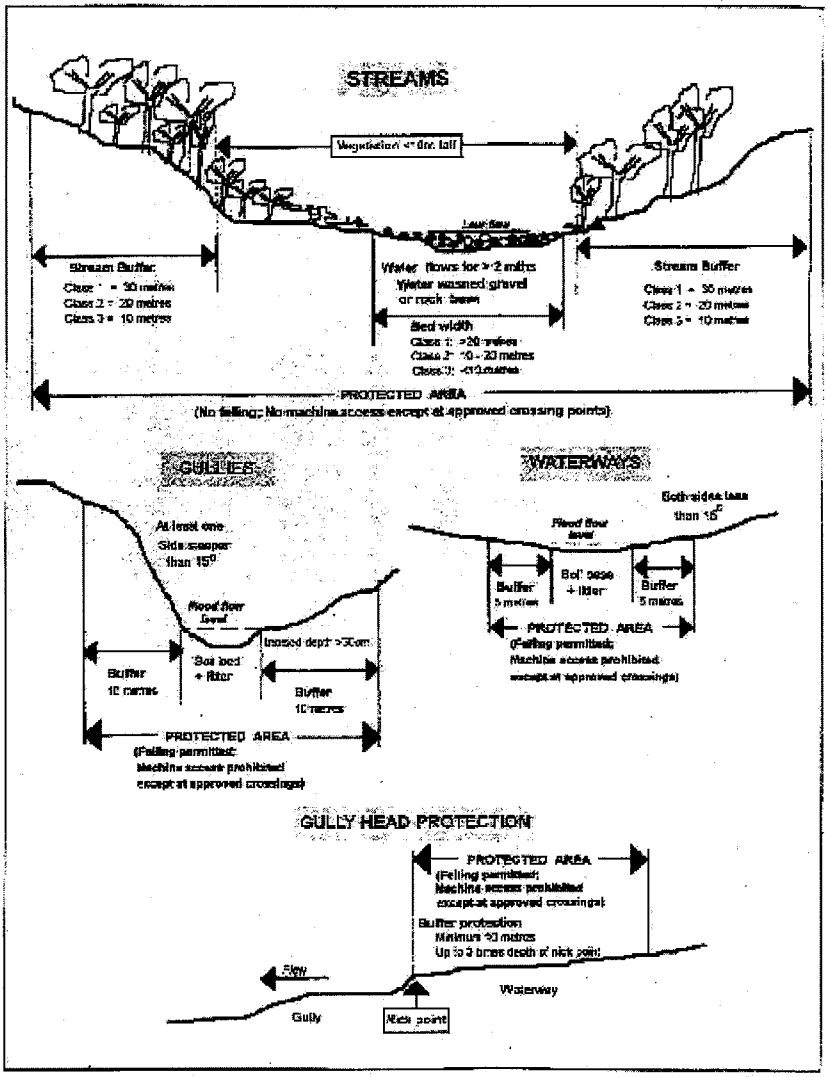


Figure 11: Road grade specifications

Road Class	Preferred maximum allowable grade degrees	Preferred maximum adverse grade degrees	Preferred maximum length at maximum grade
Major Road	10.5 %	5°	100m
Secondary Road	14.1 %	6°	750m
Haul Tracks	17.6 %	7°	600m

Notes:

- Steeper grades (up to 12°) for short sections will be acceptable if this reduces the disturbance from road construction.
- Any two sections of road at absolute maximum gradient must be separated by at least 100m of level or low gradient.

Figure 12: Road width specifications

Road Class	Carriageway Width	Formation Width	Clearing Width
Major Road	7m	12m	equal to height of forest each side of centre line
Secondary Road	5m	10m	20m (total)
Haul Tracks	4m	6m (or as required)	10m (total)

Notes:

- Curve widening will be required on corners to allow off- tracking of trailers.
- An additional width to allow for travel by track machine (if required) may be approved following an inspection by the Forest Officer.

Figure 13: Road off - tracking specifications

Off-tracking on curves (meters vs radius of curvature) based on vehicle with an overall length of 14m									
Radius (m)	25	30	40	50	60	75	100	150	200
Off-tracking (m)	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 width of twice the tabulated value.

Figure 14: Road curve specifications

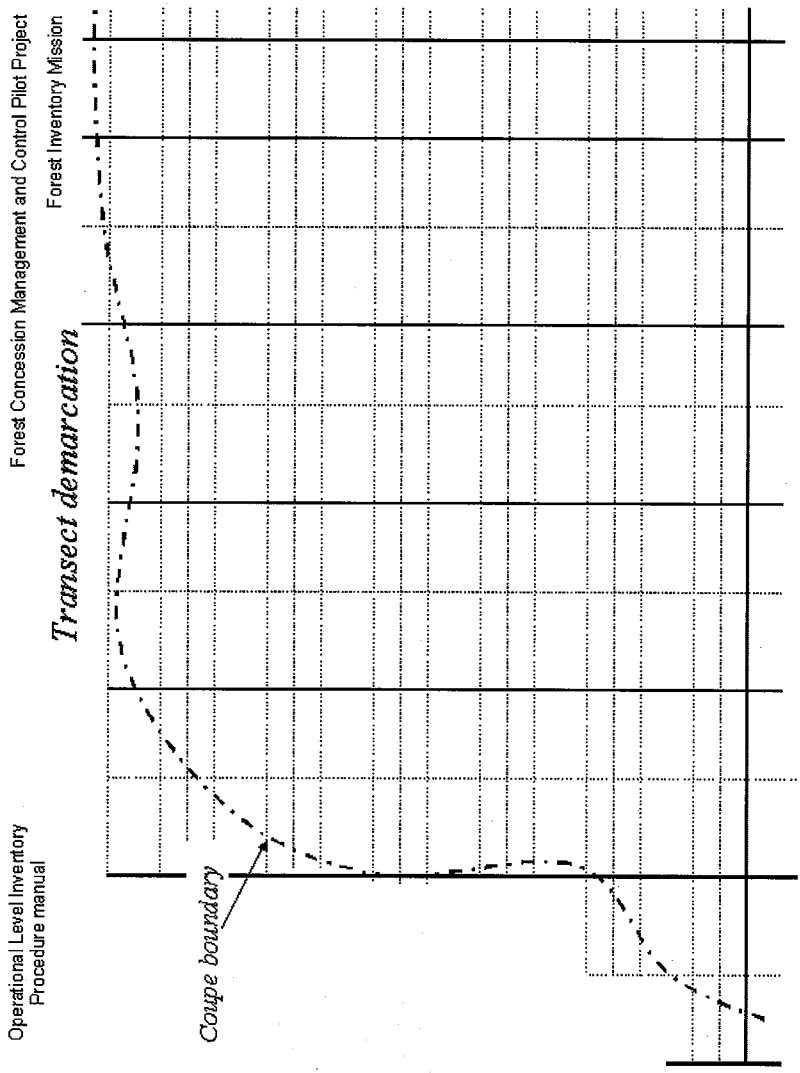
Specifications	Design Speed		
	30 kph	50 kph	80 kph
Minimum Radius (use may require signs)	25m	30m	55m
Desirable Minimum Radius	35-70m	75-120m	140-300m
Minimum Site Distance Required	30m	64m	120m
Minimum Site Distance Required	50m	100m	220m

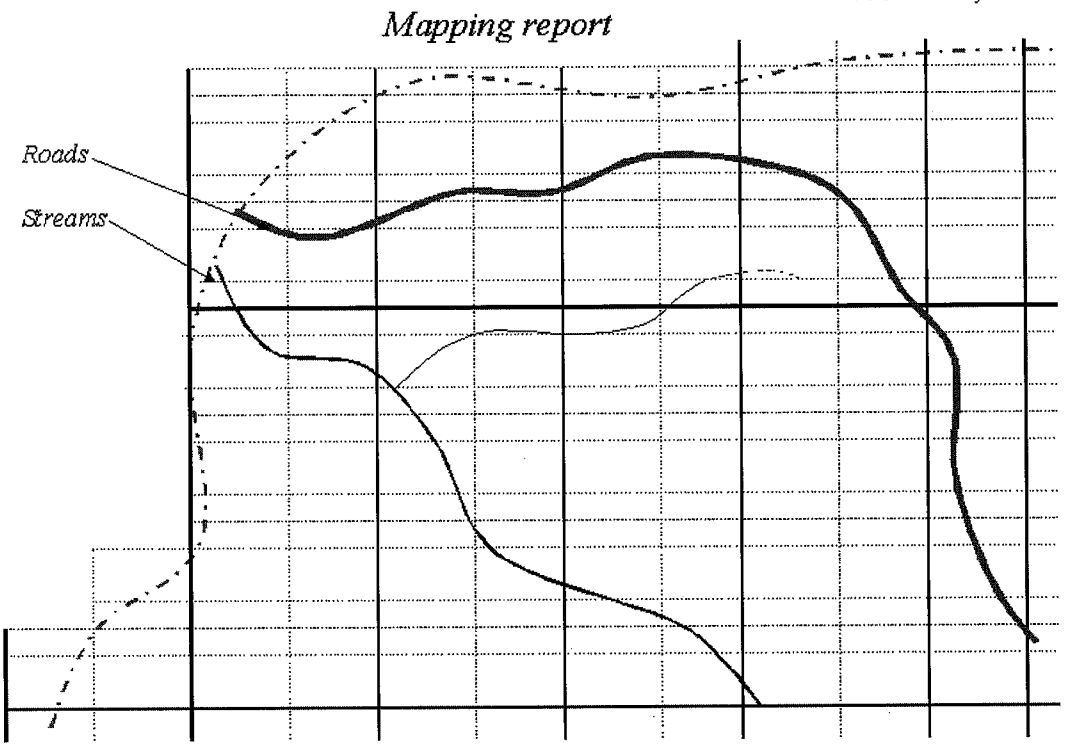
Notes:

- Fit curves to the topography.
- The minimum radius of the curve is related to visibility and the speed of vehicles travelling on road.

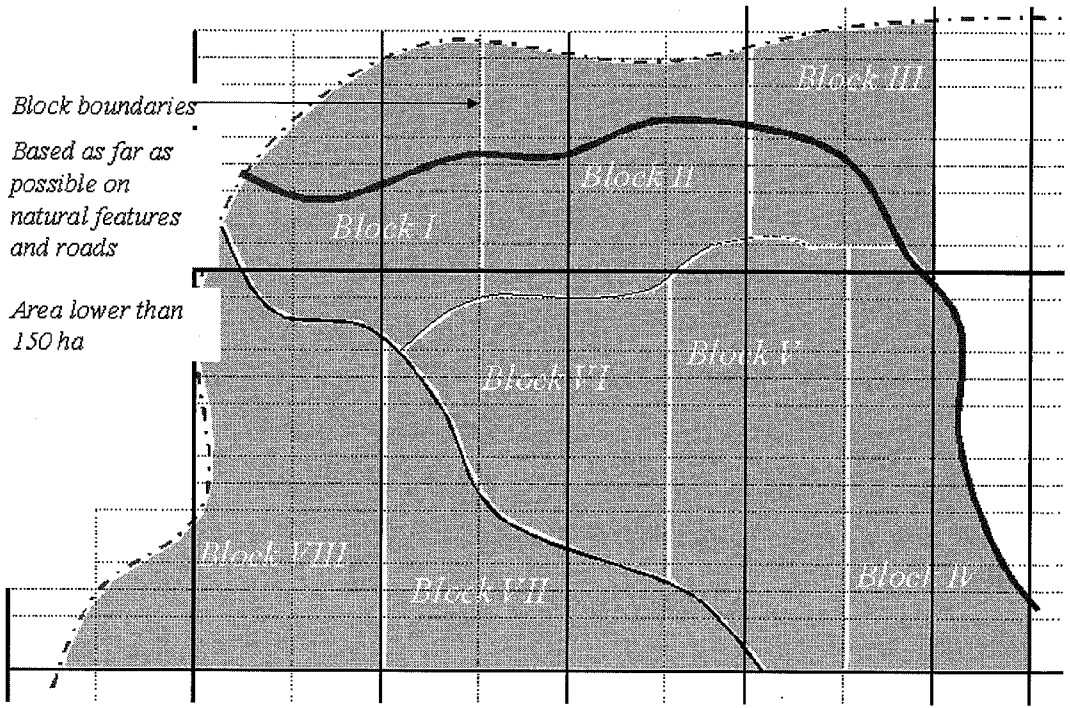
Note: All occasions where proposed roads will breach these design criteria are to be show and discussed
in the logging plan. They must be inspected by the Forest Officer prior to approval.

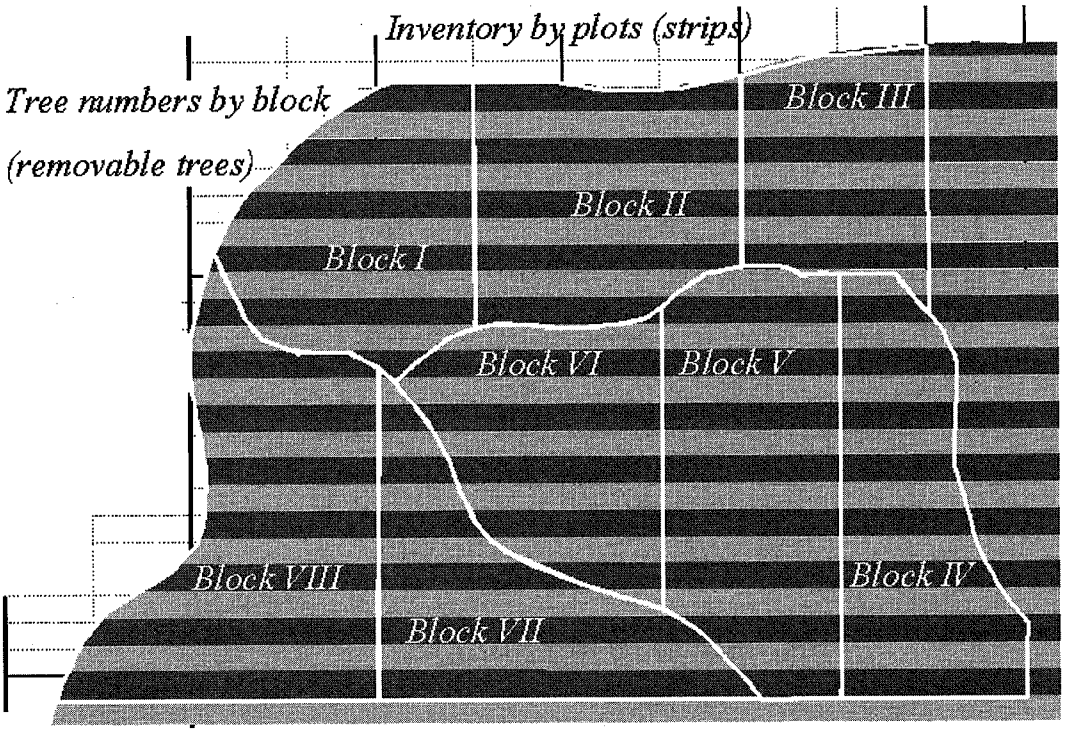
Appendix5

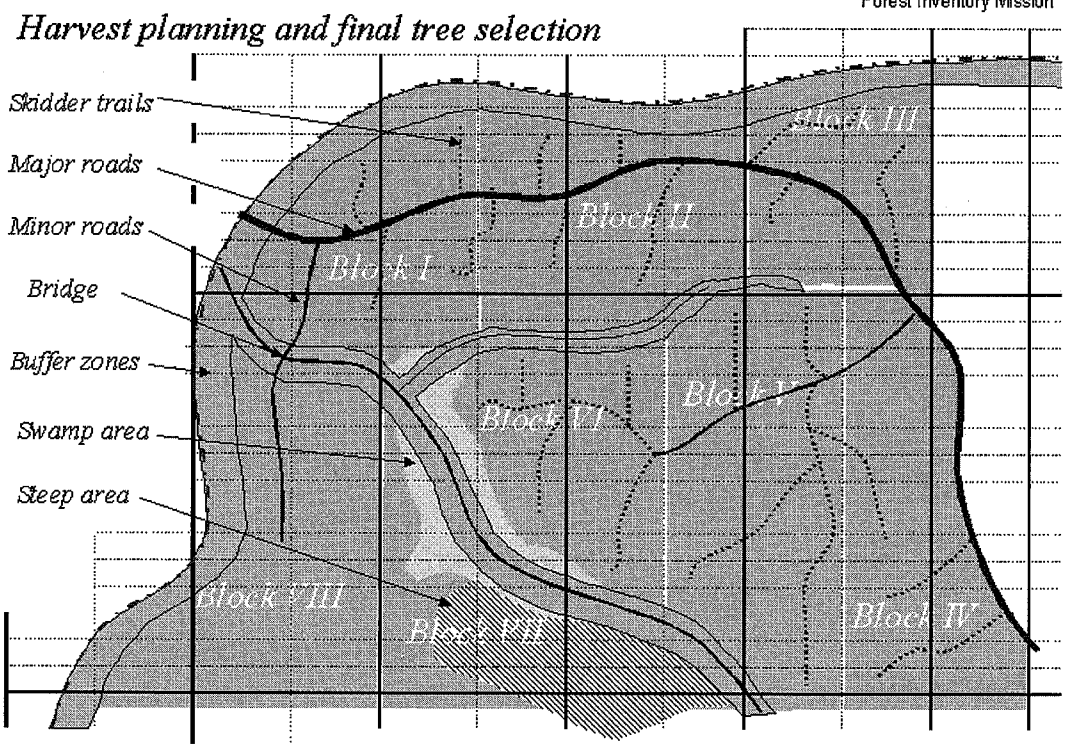

Forest Concession Management and Control Pilot Project
Forest Inventory Mission
Transect demarcation
Coupe boundary
Operational Level Inventory
Procedure manual


Mapping report
Roads
Streams

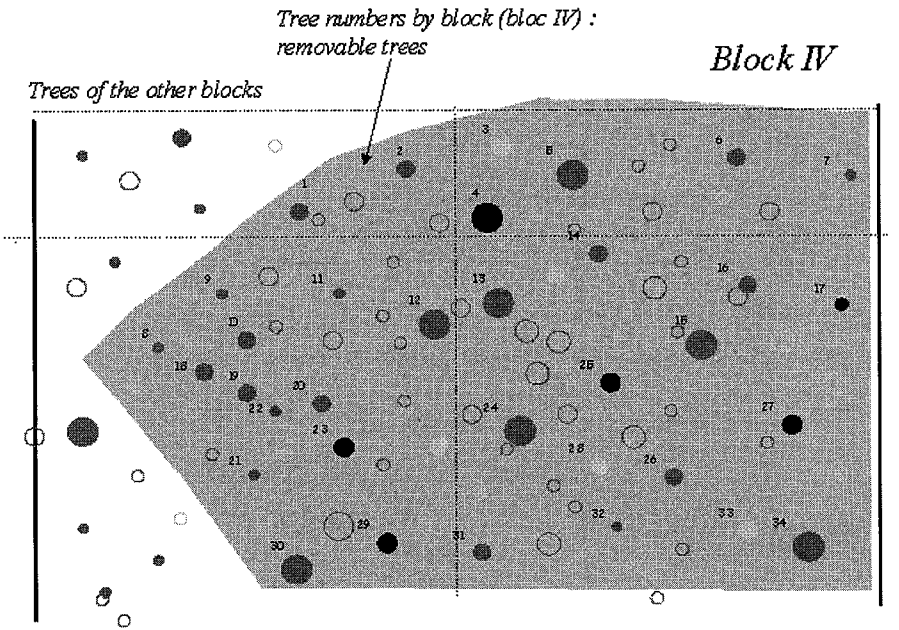
Provisional block delineation




Inventory by plots (strips)
Tree numbers by block
(removable trees)
Block III
Block II
Block I
Block VI
Block V
Block VIII
Block IV
Block VII


Harvest planning and final tree selection
Skidder trails
Major roads
Minor roads
Bridge
Buffer zones
Swamp area
Steep area
Block I
Block II
Block III
Block IV
Block V
Block VI
Block VII
Block VIII

Inventory : trees > 50 cm dbh, Groups 1 to 3



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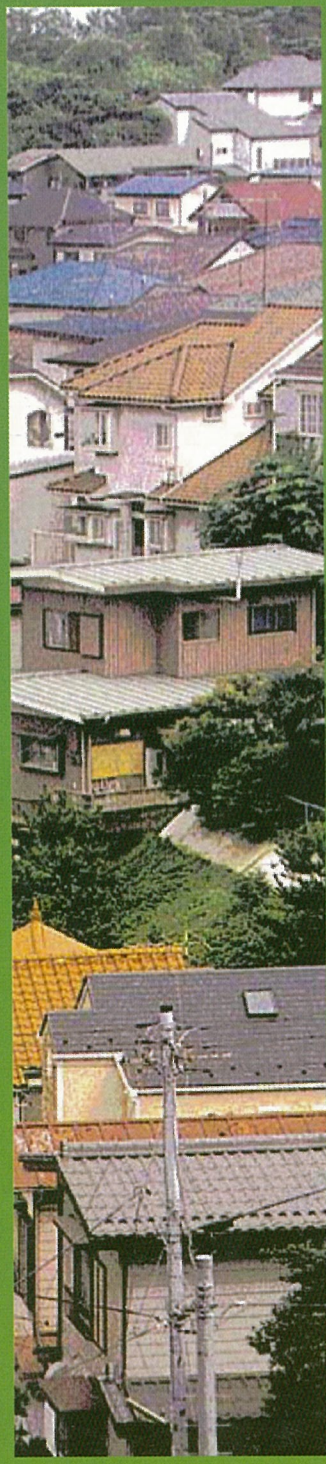
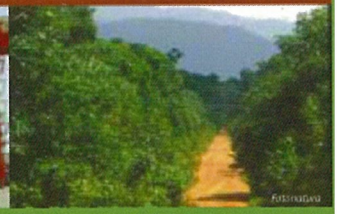


Windows of opportunity



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