FORESTRY DEVELOPMENT ASSOCIATION

Irish Thinning Protocol

A complete step by step guide to the requirements and implementation of thinning systems in Ireland

Funded by the Forest Service of the Department of Agriculture and Food
under the National Development Plan 2000-2006

NDP NATIONAL DEVELOPMENT PLAN

Forest Service

THE DEPARTMENT OF AGRICULTURE & FOOD
AN ROINN TALMHAÍOCHTA AGUS BIA

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Table of Contents

List of Figures

List of Tables

Foreword

Mary Wallace TD
Minister of State
Dept of Agriculture &
Food

Private landowners, mainly farmers, now account for the vast majority of new planting in Ireland. The nature of these plantations creates new and unique challenges for the forest industry.

It is in all our interests to gain the maximum financial benefit possible from these plantations and to improve the quality of the timber produced at final harvest. This initiative by the Forestry Development Association in developing a thinning protocol responds directly to these imperatives and I am pleased that my Department was able to provide the necessary funding to develop the Protocol and bring it through to publication.

The Protocol will be of benefit to all farm forest owners, but I believe it will be of particular benefit to farmers with small forest holdings where co-operation between owners will be important. Small farm plantations need innovative and practical solutions to the problems of economy of scale and this Protocol maps the way forward.

I saw the procedures being tested on the ground myself in a pilot thinning project in Castlecomer, Co. Kilkenny and I know that the protocol was subjected to the most rigorous assessment before publication. I believe this Protocol can act as an industry template for the sustainable management of farm forests right across Ireland.

I thank the Forestry Development Association for their initiative in conducting this project and I am sure that the final publication will make a significant contribution to the enhancement of Sustainable Forestry Management in Ireland.

Mary Wallace

Mary Wallace TD.
Minister of State at the Department of Agriculture and Food

Background to Thinning Protocol:

"Time waits for no man" is an old saying and this is a useful adage for us to bear in mind in the world of farm forestry. Many farm forest sites are now fast approaching first thinning stage. Among the reasons for this are that in many cases the land used for farm forestry is of high productivity or a high yield class. Forest crops on such land will therefore need to be thinned earlier in order to maximise the potential timber volume which can be harvested from the forest stand over the crops rotation. Research has shown that the timing of thinning and the management of volumes removed are inextricably linked to the potential profits to be gained from the enterprise. First thinning is of particular importance since this sets the scene for future volume growth and the setting of a thinning cycle. Also, thinning early in unstable sites can greatly reduce the occurrence of windthrow.

In order to benefit from the significant area of privately owned forest which is currently growing in Ireland we need to be able to market it. It is not feasible to sell timber without measurement of the timber and the provision of an adequate harvest plan.

Preparatory works do not end with the measurement of timber volumes and a harvest plan. There are other areas of vital importance including infrastructural requirements and transport haulage distances. These are covered within this protocol and practical solutions to problems together with advice on the availability, value and utilisation of relevant grants are provided.

Thinning volumes removed from small sized forest holdings can pose challenges for successful marketing of timber and will also affect the profitability of the harvesting operation. This protocol strongly encourages owners to pool their resources, wherever possible, to benefit from economies of scale in every area of the thinning program. This both enhances the presentation of the sale and segregates it into quantities suited to buyers needs.

Forest owners should ensure adequate harvesting roads and inspection paths are in place well in advance to begin the work of marketing and harvesting timber from thinnings. Both of these are essential to the successful marketing of timber. At present a grant is available to help fund the costs of roading. Unless these operations are carried out, reliable estimates of volume cannot be assessed and also it may not be possible to get the harvest machinery to the site or the felled timber from the plantation. This would make the sale of the timber virtually impossible. With the correct infrastructure and marketing tools forest owners will be able to generate the best profits possible from their enterprise.

This project was undertaken by the Forestry Development Association Co-Op in collaboration with the Irish Timber Growers Association and funded by the Forest Service of the Department of Agriculture and Food under the National Development Plan 2000-2006.

1.0 Introduction

Plantation forests are traditionally planted at close spacing (highly stocked). This is due to the fact that single trees planted in isolation tend to produce heavy side branching and poorly shaped and knotty stems. Close spacing:

- Leads to the promotion of good clean stems with reduced side branching and therefore smaller sized knots (In conjunction with pruning systems such plantations produce relatively knot free timber which may command a premium in the future);
- Ensures that, despite natural wastage and diseased and damaged stems and the removal of poorer quality trees that there remains sufficient quality stems to produce a valuable final crop; and
- Ensures the suppression of vegetation, which would otherwise hold back tree growth.

What is thinning?
Thinning is the removal of trees at intervals over the rotation of the forest crop thereby concentrating volume growth on the remaining better spaced, better quality stems. Thinning increases the overall timber revenue by increasing the volume of sawlog produced as well as providing an interim income for the owner. Larger, high quality trees attract significantly higher prices as they are less expensive to harvest and yield significantly higher value end products. Thinning also enables the application of the best silvicultural practices to the crop and aids pruning and other operations.

When to thin?
Yield class, or more simply top height can be used to indicate when thinning operations should commence (this is described in more detail within the protocol). For example for Sitka spruce planted at 2 m spacing with a yield class of 22, the standard first thinning age is nineteen years or a top height of 12 m. Leaving aside other considerations crops of a high yield class are thinned earlier. Many farm forests with high yield classes are now at the age for first thinning. It is therefore important that forest owners are aware of and have access to relevant up to the minute information on the requirements for sustainable thinning.

This ‘THINNING PROTOCOL’, is a working document which outlines the step-by-step process which will be required to undertake and complete each type of thinning operation on normal production conifer sites; from the initial preparation of the site, the administration and management of the operation, the marketing and sales procedures and post sale strategies.

The Protocol incorporates copies of the relevant documentation relating to thinning operations and clear instructions for using them. A flowchart is incorporated at the end of section one. The flowchart provides guidance for a forestry owner or forest manager in organising the marketing and harvesting of thinnings from a forest.

The information presented in the protocol includes:

- Presale infrastructure information;
- Marketing information - actual and anticipated;
- A sales and harvesting system;
- On-site monitoring procedures; and
- Post-sales procedures

1.1 Thinnings - Opportunities and Challenges

The COFORD publication, '*Forecast of Roundwood Production from the Forests of Ireland 2001-2015'* (Gallagher and O'Carroll, 2001), forecasts that annual roundwood production from Irish forests could reach 5 million m^3 by 2015 from a current production output of circa 3.6 million m^3 (see figure 1 below). The bulk of this increase is due from privately owned forests. This report is indicative of the potential timber resource available here in Ireland. The challenge is ensuring this resource will be managed in a manner that will meet the demands of the downstream processing and wood energy industries in Ireland.

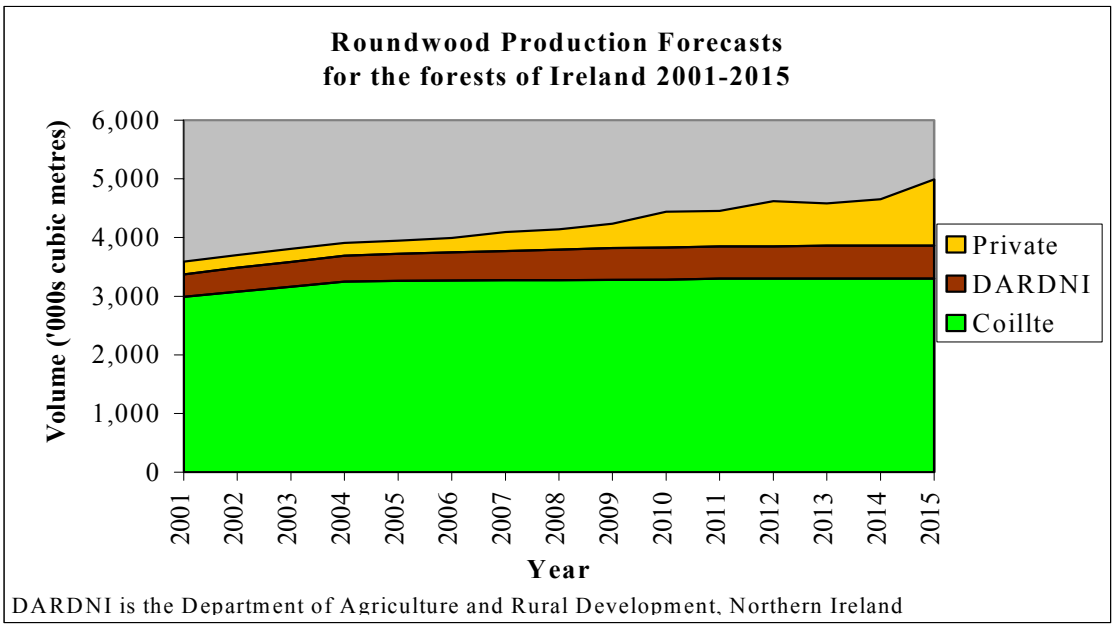

Figure 1: Combined Roundwood Production Forecasts 2001-2015
Reproduced with permission from COFORD Report entitled 'Forecast of Roundwood Production from the Forests of Ireland 2001-2015' (Gallagher and O' Carroll 2001).

This protocol will enable private forest owners to take advantage of the opportunities presented by these projections.

1.2 Sustainable Forest Management (SFM)

All thinning operations should be carried out within the ethos of SFM. Sustainable forest management has been given several definitions. One definition is:

"The practice of meeting the forest resource needs and values of the present without compromising the similar capability of future generations."

In essence SFM is the incorporation of management practices, which take regard of the social, environmental and financial aspects of forest management in a holistic manner. The diagram below outlines the interaction between these aspects and the achievement of SFM through the incorporation of all three.

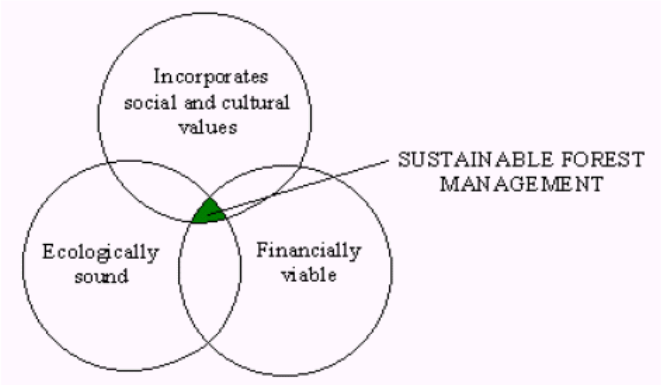

Figure 2 Interaction of Social, Economic and Environmental Aspects of SFM

1.2.1 SFM Implications for Harvest Operations

The harvesting of forests on a sustainable basis to meet environmental, economic, social and cultural needs have specific implications for harvest management operations:

- The principle of quality management leading to quality products should be implicit, so that the user requirements of the various forest customers are recognized and met;
- Good forest practice must be associated with: a healthy environment and the need for water and soil quality; an archaeological, heritage and cultural presence; nature conservation; landscape conservation and enhancement; and recreational features. The particular needs of rural communities must also be respected;
- The health and vitality of forests must be protected and maintained, with management oriented towards pest and disease control and good practice in relation to the avoidance or minimization of fire and windthrow damage;
- Forest operations should not damage the future viability of the forest;
- Forest practice must be backed by strong and ethically based professional, education and training programs. These will provide sound advice and will help to ensure that forest operations are carried out safely, efficiently and with minimal risk to the environment;
- Transparency and a high level of communication between the forest authority, owners, managers, operators, users and all stakeholders is essential; and
- A monetary return for the forest owner.

Sources of information used within the protocol are included in the bibliography section.

1.3 Co-operation between Forest Owners

Co-Operation between forest owners can be a major factor in achieving a successful thinning operation. Forest owners are encouraged to co-operate in group thinning schemes and early participation in such a scheme is important for its success. Co-operating from an early stage allows for the possible grouping of resources and potential grant funds to the mutual benefit of forest owners. In the first instance a forest owner should approach his forest holding neighbours to discuss the potential for cooperation. If forest owners are members of an agricultural or forestry co-operative they should also approach their local co-op contact person in relation to such co-operation. This would be particularly applicable in the case of forestry co-ops. All forest operations can then benefit from economies of scale.

The protocol contains a case study of a project that private forest owners can co-operate on. The case study is an actual operation carried out by a group of forest owners based in County Kilkenny. The group carried out a joint harvesting program. The case study includes the procedures used, any legal issues dealt with, full listings of associated costs and the price paid for timber.

The fieldwork formed an integral part of the project and a thinning demonstration was advertised locally and held on site during the harvesting operations. At the demonstration, co-op members and interested parties, were presented with an overview of thinning from the initial crop assessment stage to the sale of timber and the on site harvesting and extraction.

There are certain issues to be addressed between forest owners in co-operating on various operations; such issues might include the signing of a legal contract to ensure all party's interests are adequately protected within the harvesting agreement. Other issues include rights of way roading, brashing, crop assessment volume estimates and the marketing, sale and management of thinnings.

1.3.1 Benefits and Advantages of Co-operative and Other Thinning Groups

- Where there are many individual growers with small and scattered blocks of woodland ready for thinning, it is often difficult to get contractors interested in harvesting such areas and the price is likely to be unattractive to the grower. The purchaser has the upper hand and can pick and choose while the grower is at the mercy of the market. To safeguard their interests and profitability, the grower needs to gain market advantage. One of the better ways of achieving this is to join other growers in a Co-operative setup or by grouping together with a service provider.

- A Co-op or professional forestry company/consultants will have knowledge of purchasers and contractors and will have ready access to industry wide market prices and requirements and can thus assist in obtaining better returns for growers

- Most growers lack forest management and marketing skills and the expertise to maximise returns from their woodland. Within a Co-op or other group structure they will have all the back up and support that is required.

- Co-ops and other professional forestry service providers will have the benefit of professional foresters working on their behalf.

- Co-ops and other professional forestry service providers will ensure that proper forest harvesting and environmental guidelines and code of best practise will be adhered to.

- Using the Co-op or group structure, prices are negotiated from a position of strength

- Small areas grouped and marketed for thinning are more saleable and also more attractive to contractors due to economies of scale.

- Working through the co-op or other structures, growers can obtain steady and profitable financial returns and develop strong markets. The advantage for purchasers and contractors on the other hand is reliability, and control of supply, from secure and stable suppliers.

- Harvest road grants and felling licences can be organised through the Co-op or other service providers.

- Utilising an inventory of its members'/client's woodland resource, a Co-op or other group structure can carry out strategic market planning.

- The Co-op or other group structure can ensure only highly skilled and fully insured contractors observing all Health & Safety guidelines are involved in thinning their member's crops.

- A co-operative or other group structure will co-ordinate and supervise the harvesting and transport of timber to suppliers, contracting with loggers as required. It may assume responsibility for ensuring that harvesting occurs in accordance with prescribed forestry practices.

- A Co-operative or other group structure can actively explore markets for various grades and species of timber and other types of timber products.

- A central role of a co-operative or other professional service providers involved in thinning is in making sales and negotiating contracts between suppliers and buyers.

1.3.2 Use of Co-Ops outside of Ireland

The use of forestry Co-Ops is global and many countries operate successful Co-Operative systems that we can emulate. Some excerpts of Co-Ops successfully operating in Australia, Holland, Canada and the USA are located in appendix 10.13.

1.4 Thinning Organisational Flowchart

Figure 3, below is a thinning organisational flowchart outlining the stages of planning involved in a thinning operation in a step by step manner. The chart is an indicator of the management that should be carried out at different stages of the crop development through to the balancing payments of a completed harvest operation. Indicators for each stage of crop development are in *italics* in the left-hand column. For each step in the flowchart the relevant sections of the Thinning protocol are included in brackets.
The flowchart is merely an indicator of the steps involved and people are encouraged to read the document thoroughly in order to get a complete picture of the thinning management process.

YOUR FOREST	ACTION REQUIRED
Canopy Closure ***-lower branches dead up to 2m*** ***-ground vegetation suppressed*** ***-trees approx. 7 m in height***	**1.** Create access paths in plantation (2.0, 2.1, Fig. 4) **2.** Assess growth rate and estimate age of first thinning and thinning cycle (3.0, 3.1)
Approximately four - five years before recommended age of first thinning ***-tree height approx. 7m***	**1.** Assess infrastructural requirements and apply for relevant Forest Service grant – roading etc. (2.1-2.2.1 & 8.2) **2.** Apply for felling licence (2.5.1, 10.3) **3.** Consult with local authority with regard to new entrances (2.2)
Approximately three years before recommended age of first thinning ***-tree height approx. 9m***	**1**. Construct harvest roads, laybys, or bellmouth where required **2**. Install further inspection paths as required. (2.0-2.21)
Recommended first thin year ***-tree height approx. 10 - 12 m***	**1**. Carry out volume assessment (3.0-3.4) **2**. Assess market conditions – market sale (5.0-5.6) **3.** Draw up harvest plan (4.0) **4**. Consult with public authority regarding use of public road where required (2.3) **5**. Consult with persons with ROW (2.4)

Before thinning commences

1. Sales contract agreed and signed
(6.1)
2. Harvest plan agreed and signed
(4.0-4.6 &10.8)
3. Site hazard and risk assessment
completed. (4.7 &10.7)
4. Safety signage in place
(2.5.3 & 4.1)
5. Insurance clearance received
(2.5.4)
6. Machinery operators aware of site sensitivities and all FS Guidelines and Requirements
7. Buffer zones in place for archaeological sites, waterways etc.
8. Weight docket system in place
(6.2, 10.11 & 10.11.1)

During thinning operations

1. Monitor thinning quality and harvesting operations
2. Take volume measurements
3. Ensure urea applied
4. Monitor load removal
5. Ensure compliance with all FS Guidelines and Requirements and Code of Best Forest Practice
(6.3 &6.5)

After thinning completed

1. Ensure all timber removed from site before machine leaves
2. Finalise volumes removed from site to sawmill
(7.2)
3. Ensure site left in an acceptable manner (7.3)
4. Invoice buyer/settle payments
(7.2)

Figure 3: Thinning Organisational Flowchart

SECTION A : Pre-thinning Requirements

2.0. Introduction

In order to implement a successful thinning operation there are a series of requirements which must be undertaken. These requirements include the provision of an adequate infrastructure system. This involves all the necessary road construction, construction of adequate bell-mouth entrances and turning areas. It also includes pre-thinning crop assessments and initial crop access operations such as the cutting of inspection paths (brashing). The following section provides information on all of these requirements and the relevant application forms and field sheets etc. can be found in the operational toolkit and appendices sections. Forest owners are reminded of the benefits of co-operation and the need to seek professional advice on issues or procedures they are unfamiliar with.

2.1 Access

- Good access into a forest is a vital in preparing for first thinning. Harvesting machinery, personnel and timber lorries must be able to access a site efficiently and safely.

- The first step is to cut **inspection (brash) paths** throughout the plantation to allow for initial crop assessment. Paths should be brashed to 2m height parallel to each other and at approx. 100 m apart. Lines should also interconnect for easy access (see figure 6.pg 26). Brashing is a straightforward practical chore which the forest owner can either carry out him/herself using a short handled pruning saw or employ a fully qualified and insured contractor using specialised chain saws.

- Adequate Bell mouth entrances or lay-bys should be constructed on all sites adjoining public roads. These may be grant aided by the Forest Service;

- Local Authorities must be consulted for all new entrances and exit points or old entrances to be widened onto public roads;

- All entrances to be sufficiently wide to facilitate all vehicles entering/turning into the forest;

- An articulated lorry requires twice the turning space as a lorry and trailer. The minimum width of all entrances, corners and turning points should therefore be 7m;

- At all times it must be possible for vehicles to remain on the carriageway and they should not have to drive on the soft verge at any time – a minimum road width of 3.4 m is therefore recommended; and

- Access points should remain locked or adequately secured so as to prevent the theft of timber. For larger plantations forest barriers (similar to those seen in Coillte owned forests) can be erected. For smaller plantations it may be sufficient to have locked farm gates in good working order.

2.2 Infrastructure and Roading

Good roading infrastructure is essential to the success of thinning operations. Currently there are Forest Service grant schemes available for the construction of forest roads, bell mouth entrances and other infrastructure requirements. Carefully planned forest roads will ensure adequate parking areas/lay-bys, well-positioned stacking areas, adequate turning areas and will include a schedule for road maintenance.

Forest infrastructure should be developed with minimal environmental disturbance. Firstly it is important to identify if the forest lies within or contains any or all of the following:

- An area identified as being environmentally sensitive in a County Development Plan;
- A part or whole of a Special Area of Conservation (SAC), Special Protection Area (SPA) or proposed Natural Heritage Area (pNHA);
- Aquatic zones;
- An area within 6 km upstream of a Freshwater Pearl Mussel Catchment area;
- Archaeological sites and monuments; and
- Important habitats retained for biodiversity purposes.

Secondly consultation with the relevant statutory bodies and local stakeholder groups could include the following:

- The relevant Regional Fisheries Board;
- The relevant Local Authority;
- National Parks and Wildlife Service;
- The Heritage Service; the National Monuments and Historic Properties Service of Dúchas The Heritage Service; and
- Other relevant bodies, non-government organisations and the local community.

Note: The above mentioned consultation process will be automatic when a roading application is submitted to the Forest Service. However, an owner may have the means and experience to construct the forest road without grant aid. It is in such cases that the owner must satisfy themselves in relation to the above.

Finally inspect the area and prepare a map which should include the following:

- The boundaries of the forest;
- Any existing forest road and track network, including associated structures such as landings, turntables and bridges and any utilities etc;
- All environmental features of the area, including all aquatic zones, known archaeological sites and monuments, and other areas of biodiversity;
- The location of any buffer and exclusion zones located within the area where operations will be prohibited or restricted;
- Areas, which are deemed unsuitable for road construction, due to, for example, potentially high erosion risk or difficult terrain.

2.2.1 Applications for Forest Roading/Bellmouth Grant

Forest Road Grant approval must issue from Forest Service before work commences on a grant aided site. All applications require the following:

- Road Application form signed by applicant, approved forester and engineer/surveyor where applicable;
- Location Map: discovery 1:50000;
- Roads map or copy of Certified Species Map with roads label and lengths of road and area served outlined (Harvesting roads marked in blue). Where certified species map is unavailable, supporting inventory data is required;
- Copy of current Biodiversity Map; and
- Engineer's specification where relevant.

Following site inspection by Forest Service Inspector written approval may issue.

Road construction should be completed well in advance of the planned harvesting operation in order to allow the road to dry out and settle. It is recommended that road planning begin within **five** years of first thinning schedule in order to facilitate a minimum of one to two years settling and drying out.

Harvest road construction is governed by the Safety, Health and Welfare at Work (Construction) Regulations 1995.

The following conditions should be applied to road construction operations

- Construction should be stopped during periods of high rainfall.
- Cut-off drains should be constructed to a flat gradient at least 5 m back from the upper edge of the road formation, to avoid erosion.
- Ensure that roadside drains do not intercept large volumes of run-off from higher ground.
- Ensure roads are constructed with regard to best practice. Roadside drains must never discharge directly into aquatic zones.

2.3 Public Road Assessment

This is an important issue in the planning of forest harvesting. It is important to assess the condition of local public roads as these must bear the weight of timber loads and be able to support the traffic servicing thinning operations. Maximum weight limits for haulage must also be adhered (section 2.5.5). Secondary roads may be of poor standard, narrow, have low/narrow bridges located along the desired route or have soft verges and dangerous/narrow bends. Significant shortcomings that will affect the transport of timber must be identified and brought to the attention of the relevant Local Authority.

- Public roads are the responsibility of the National Roads Authority (NRA) or Local Authority and governed by the Road Act 1933;

- If upgrading works are to take place in the vicinity during thinning operations consult with the Local Authority to assess the best haulage routes;

- There should be no carrying over of soil or debris onto public roads. Keep roadside drains and culverts free of logs, debris and obstructions;

- No loading must take place on public roads without prior consultation with and written permission from the Local Authority.

The level of consultancy required with the local roads engineer varies from county to county. It is advisable to consult with a professional forester on roading issues.

Before timber is removed from the forest photographs and notes should be taken of the public roads surrounding the forest as an aid to forest owners in the event that a dispute may arise with the local roads authority.

2.4 Rights of Way (ROW)

A right of way is the privilege of someone to pass over land belonging to someone else. Some points on use of right of ways during harvesting include:

- Liaise with all those with access to ROW of intention to harvest. Establish the type of ROW. Is it on foot, for stock or all purpose;

- Establish suitable timing of operations (time of year), e.g. very important where twice daily milking occurs or where farm crop sowing and harvesting operations are taking place using the same route;

- If possible try to direct haulage route away from ROWs or keep use to a minimum;

- All damage to ROW must be repaired at the end of the harvesting operation; and

- It is essential that all Rights of Way are identified and incorporated into any agreement between co-operating forest owners and other land users.

2.5 Legal Requirements

It is essential that forest owners meet all legal requirements before and during the thinning operation. The main legal requirements to be fulfilled are outlined below.

2.5.1 Felling Licence Application

Landowners are required under the Forestry Act, 1946, to give notice of an intention to fell trees and effectively to seek permission to fell trees from the Forest Service, Department of Agriculture and Food through the application for Felling Licences.

- Two different types of felling licences exist. A General Felling Licence (GFL) is issued for a period of two to five years where a management plan exists for the plantation. In exceptional cases this period may be extended to ten years. **A GFL should be applied for in thinning operations**. In some cases a harvest plan may be acceptable for a successful GFL application. A Limited Felling Licence (LFL) should be applied for where special considerations or constraints arise in relation to State bodies, Fisheries and Local Authorities. The period during which a LFL is active is fixed by law at two years.

- GFL application forms can be obtained from the Forest Service and should be returned directly to the Felling Section of the Forest Service. Application

forms for a LFL are available from any Garda Station, as well as from the Forest Service and may be returned to either. Details such as number of trees to be felled or area for thinning and other information should be included in the felling licence application, as indicated on the forms.

- It is standard practice that within 3 weeks of submitting the LFL application, the applicants for LFLs will receive a prohibition notice from the Gardai, prohibiting the applicant from felling the trees in question. Sometime later a Forest Service inspector will inspect the trees and make recommendations. Subsequently a Felling Licence may be issued if deemed appropriate by the Forest Service. This approval will also be based on submissions from relevant authorities consulted during the process.

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- All areas clearfelled under a General Felling Licence must be replanted which is a legal obligation that passes to each successor - in - title to/occupier of the land in question. A Limited Felling Licence also contains a restocking condition and this is also a legal obligation that passes to each successor - in - title to/occupier of the land in question. There are also differences in other legal aspects of each type of felling licence.

- Penalties apply to breaches of the Felling Licence Legislation.

2.5.2 Safety Statement

The landowner, contractor, consultant forester and forestry company require an up to date safety statement. A safety statement is a company's written programme for managing health and safety. More information on safety statements can be found on the Health and Safety Authority website www.hsa.ie.

2.5.3 Signs

Appropriate signage must be erected at access points, around the harvest area and surrounding areas to inform the public of potential danger due to harvesting operation (See 4.1). Figure 4 below illustrates examples of signage suitable for use in forestry operations.

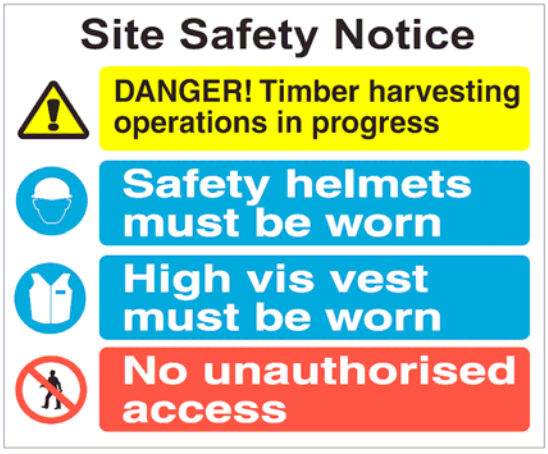

Figure 4 Harvesting Signage.

2.5.4 Insurance

With all operations, appropriate insurance cover is essential. Therefore, it is advisable to verify all necessary insurance is held by those involved in any aspect of the thinning operation. (See table 1 below).

Table 1: Insurance Requirements in Thinning Operations

Insurance Type	Definition	Required by	
Public Liability	General term for any liability brought against the insured by a third party or member of the public.	Landowner Contractor Subcontractor Consultant	
Employer Liability	A liability that may be imposed on an employer if an employee is injured in the course of his/her employment	Any person/company directly employing staff.	
Professional Indemnity	A liability brought against a professional for any errors and/or omissions during the course of a contract.	All those with professional qualifications, operating a business i.e. forestry consultants and companies.	A minimum insurance of €325,000 is recommended by the Society of Irish Foresters.

Public liability insurance is required by consultants where they are issuing instructions directly to contractors i.e. they are taking on the role of the landowner (see table 2 below).

2.5.5 Weight Restrictions on Haulage

The **current** maximum legal weight laden for an articulated vehicle consisting of a two axle tractor unit with a three axle semi-trailer (commonly used in forestry) is 42 tonne. However after, 1 January 2008, the maximum legal weight laden for such a vehicle will be 40 tonne (Anon. 2003). Further details on the legal limit for haulage of different type vehicles are available from the Department of Transport.

It is vital that this is adhered to. Overloading not only causes damage to public roads but to the internal forest road. Serious over-loading is also a health and safety issue. Some sawmills may have a policy of not paying for timber on lorries over the legal weight limit. Weight restrictions in relation to haulage of timber can vary from **county to county** and this should be clarified with the county engineer before haulage or harvesting begins.

2.6 General Health and Safety Guidelines on Harvest Sites

During all forestry operations the general duties of the Safety, Health and Welfare at Work Act, 1989 and the Safety, Health and Welfare at Work (General Application) Regulations, 1993 must be met.

Listed below (table 2) are those responsible for onsite Health and Safety. More detail on Health and Safety on harvest sites can be found in section 4.0 (The Harvest Plan).

Table 2: On Site Health and Safety – Who is Responsible?

Role	Definition	General Duties
Landowner	The person or company in control of the land in which the work takes place.	**1.** Manage activities of the overall forest environment for health and safety. **2.** Collect information regarding potential hazards on and around the harvest area and pass on to the forestry works manager. **3.** Ensure work on a harvesting or related site does not affect the health and safety of other people.
Forestry Works Manager (FWM)	The person or company who commissions work on the site.	**1.** Use the information from the landowner to prepare an outline risk assessment for the harvest area. **In certain circumstances the FWM can take on responsibilities of the landowner.** **2.** Select experienced contractors with relevant health and safety provision. **3**. Liaise with contractors regarding health and safety procedures for contractors working on and visiting the site. **4.** Liaise with the landowner **5.** Monitor health and safety on the site.

All roles are interchangeable and one may take on more than one role in the course of a thinning operation. In many circumstances the FWM will take on responsibilities of the landowner. This will depend on the agreement/contract the landowner has with the forest manager and/or contractor.

SECTION B: Crop Assessment, Pre-sales Measurement and Harvest Planning

3.0 Crop Assessment and Pre-sales Measurement

The initial crop assessment and pre-sales measurement are key factors in the success of harvest planning and thinning operations. The timing and method of first thinning has a significant effect on all subsequent harvest operations. The number of trees to be felled is dependant on a number of factors, all of which should be ascertained through initial crop assessment and pre-harvest measurement.

Pre-sale measurement of the crop is necessary for several reasons. The main reason is to produce an estimate of the quantity of timber available for sale and therefore an indication of value. Another equally important reason is the need to ensure adequate thinning controls to increase the total yield of timber over the rotation. Failure to implement an adequate system for controlling the volume removed as thinnings can result in over-cutting and under-cutting of the crop, which in turn may effect the cumulative volume production over the rotation.

Forest owners should seek professional advice when considering harvest planning. A good harvest plan is essential for implementing a safe, efficient thinning operation that will benefit the crop in the longterm.

Ideally, planning for harvesting should begin at the establishment phase through the formulation of a Forest Management Plan. However, in many cases harvest planning usually begins later in the life-cycle when the crop is approaching first thinning.
Such a plan should include:

A. Terrain classification and the recording of geological, environmental, archaeological and management features.
B. Site classification, in terms of soil type, aspect and exposure. These help to predict crop growth potential and the selection of management regimes, allocating and scheduling of thinning and final felling systems.
C. Harvest planning. This should take into account future extraction routes, loading areas, roads and harvest methods/equipment.

Adequate planning and crop assessment are equally important for small forest holdings as for larger plantations. Small plantations are described as having areas in the 1-9 ha range. In Ireland there are many forests, which fall into this category. These small plantations require a significant amount of planning to ensure economic harvesting. However this should not be seen as a unique situation as many countries in Europe have plantations of a similar size and these are harvested efficiently due to good planning and crop assessment.

3.1 Initial Crop Assessment

Timing of first thinning is of crucial importance as it largely determines the ultimate quality of the crop. It is carried out at a stage when canopy openings do not incur serious risks of windthrow. However, maximum site damage can occur at this time, if the operation is not carried out carefully. A forest stand will not normally be thinned unless it is judged to be adequately stocked (see section 3.3).

Assessment usually takes place when the crop has reached thicket stage i.e. no gaps between trees and usually occurs at approx. 9 m in height or when the lower branches are dead up to 2 m. Access for site assessment should be maximised by brashing parallel paths at approx. 100 m apart, i.e. every 50th line of trees, and stiles should also be erected at suitable entry and exit points.

It should be noted that brashing can take place at any stage once the crop has reached thicket stage i.e. canopy is closed. Early crop assessment can provide the forest owner with a considerable advantage in future planning.

Measurements taken at this time will determine age of first thinning, thinning cycle and approx. age of final clearfell. All forest operations can then be planned around this assessment.

Areas of poor growth, inadequate drainage or unfavourable ground conditions, which may not be included in first thinning, are mapped at this stage.

During the initial crop assessment anything that might devalue a sale should be noted and these include:

- Crooked/knotty trees/species mix;
- Windblow;
- Edge trees;
- Suspicion of foreign objects in trees (nails/wire);
- Weak/unthrifty/bare sections; and
- Pest/Disease/Previous mechanical damage to stems.

Other areas to consider at this stage are potential products i.e. stake, pulp, pallet and sawlog. Harvest operational requirements such as stacking areas and loading/maintenance areas and arrangements for taking down transmission and ESB cables

3.1.1 Crop Suitability Options

Most forest crops will benefit from the implementation of a thinning operation. However, there are certain particular site or crop conditions, where the risks of carrying out harvest operations, outweigh advantages. These factors include:

- Sites which are inherently unstable due to soil or location;
- Sites with poor drainage or persistent water logging;
- Stands which are ‘drawn up’ or etiolated due to delayed first thinning;
- Stands that are currently damaged or diseased;
- Sites that are inaccessible, e.g. severe slopes;
- Stands with abnormal spacing/ stocking levels; and
- Stands with a high level of exposure to wind.

All of the site factors mentioned above can increase the risk of windblow/windthrow after thinning. Windblow is the name associated with the overturning or uprooting of trees due to wind (usually the root plate remains intact). This can happen when trees are removed from the canopy, leaving the remaining trees vulnerable for the next three to five years while the canopy re-closes. In some cases the use of machinery on these sites that leads to rutting and sinking, increases the risk of windthrow on the site. Timing of harvesting, where practical, to drier seasons can aid in the reduction of rutting and soil damage.

Other factors, which may affect crop suitability for thinning, include:

- Provision of access:
  Adequate access is essential. Restricted access can reduce the value of the crop and in extreme cases prevent a sale (see section 2.1 on Access above)

- Terrain:
  Terrain can be classified on the basis of three factors: ground conditions (soil bearing capacity); ground roughness (the presence of obstacles which obstruct machine operation) and slope. The terrain can be classed using table 3 below

Table 3: Ground Classification Criteria (Source: Code of Best Forest Practice)

Ground Condition	Ground Roughness	Slope
Good (1)	Even (1)	Gentle (<8^{o}) (1)
Average (2)	Uneven (2)	Intermediate (8^{o}-14^{o}) (2)
Poor (3)	Rough (3)	Steep (>14^{o}) (3)
Very Poor (4)		

From the above table a site classified as 3, 2, 3, would have poor soil bearing capacity, be uneven and have a steep slope. Machinery should be chosen to suit the site and conditions present.

- Damage or disease:
  Sale of crops with a high percentage of damage or disease will be difficult and price will also be greatly reduced. Damage can be caused by insects, mammals or fungi and viruses.

- Protected or sensitive areas

- Unrecorded archaeological sites

General Rule – only a crop capable of reaching a top height of 18 m should be thinned.

3.1.2 Age of First Thinning

Age of first thinning can be ascertained from an initial crop assessment. The earliest age at which a crop is considered suitable for thinning without incurring a loss in cumulative production is called the standard thinning age. As well as age, height is an important indicator of first thinning and in general thinning can occur at approx. 10 - 12 m. However many other factors affect the time of first thinning.

Factors affecting the age of first thinning are:

- Species: shade-tolerant species can survive and grow under greater levels of crown competition and shade and so for stable sites a later first thinning is more acceptable for them than for light-demanding species;
- Initial spacing: the closer the spacing the earlier the first thinning will be required;
- Growth rate (yield class): the faster the growth rate of the stand, the earlier the first thinning will be needed;
- Desired thinning intensity or thinning yield: the greater the intensity or yield desired, the later the first thinning;
- Financial and marketing considerations: factors to consider include the smallest acceptable load, overall harvest volume and the price for small roundwood;
- Windthrow risk of the site;
- Distance to markets; and
- Potential co-operative or group sales with neighbouring forest owners.

Standard thinning ages for the most common conifer crops planted at 2m x 2m spacing can be found in table 4 below. These standard ages are based on Yield Class (YC) which is a term used to describe a crops rate of growth or volume increment. This is based on a crops mean annual increment (MAI), which can be determined from a crops top height and its age in years since planting (known as General Yield Class). The units of measurement are m^3/ha/yr.

Table 4: Standard* First Thinning Ages for Common Conifer Crops (source: Forestry Commission Field Book 2)

	YC							
Species	**24**	**22**	**20**	**18**	**16**	**14**	**12**	**10**
Sitka spruce	18	19	20	21	22	23	25	27
Norway spruce		21	22	23	25	26	29	31
Douglas fir	16	17	18	19	20	22	24	27
Japanese/ Hybrid larch						15	16	18
European larch							18	20
Scots pine						22	24	27
Lodgepole pine						20	22	25

***Note some crops may have a higher YC than is covered in the above table. In many situations in Ireland thinning should take place before the age outlined above.**

It should be noted that thinning might not necessarily take place at these ages and might take place before this age. Thinning of high YC crops should be organised before the age to lower the subsequent risk of windblow on certain sites. This is especially relevant to many new plantations where YC of 24+ have been recorded. Early thinning is strongly recommended in some sites with windthrow risk. Only in

very unusual circumstances should thinning take place after the above indicative ages. Where a thinning is delayed it will need to be heavier in order to return the stand to the correct growing stock level. However if the thinning has been considerably delayed it is not always possible to do this in one operation due to the possibility of loss of cumulative production or stand instability.

3.2 Initial Crop Assessment and Pre-sales Measurement Procedures

Initial crop assessment and pre-sale measurement utilise **systematic random sampling** to estimate the pre-sale data that usually include:

- (1) Stocking or Stems per hectare;
- (2) Diameter at breast height (dbh); and
- (3) Top height

The main and second species in the sub-compartment are also recorded. The intensity of assessment in the initial crop assessment will generally be less than in the pre-sales measurement.

3.2.1 Sampling

Divide the crop into units with similar characteristics i.e. age, species etc. These units are then known as subcompartments. This is known as stratification. These subcompartments may resemble the units on the original afforestation map. Each unit is then managed separately for the purposes of inventory and management work. The crop can then be sampled i.e. a small section of the subcompartment is measured which is representative of the entire subcompartment of the forest.

Systematic random sampling (appendix 10.1) should be employed throughout the forest to ensure a representative section of the forest is sampled.

The number of sample plots for which pre-sale data are collected is dependant on plantation size and crop uniformity, as outlined in Table 5. In general the more plots taken the more accurate the assessment will be.

Table 5: **Number of Sample Plots Required**

Area of plantation (ha)	Uniform crop	Variable crop
0.5 - 2	2-6	3-8
2 - 10	3-8	4-12
Over 10	4-10	4-16

There are several methods of taking plots. Listed below is a common method utilised in first thinnings where a dense canopy is present and no extraction racks have been created. Plots are taken along the inspection paths due to the inaccessibility of dense crops.

Measure the distance in metres between five rows of trees (since trees are planted 2 m apart this should be approximately 10 m). Divide this figure into 100 (if you want a .01/ha plot; divide into 50 to give .02/ha plot) to give the length along the inspection path you will need to measure e.g.
Distance across five rows = 9.6 m
Distance along inspection path = 10.4 m (see figure 5 below)

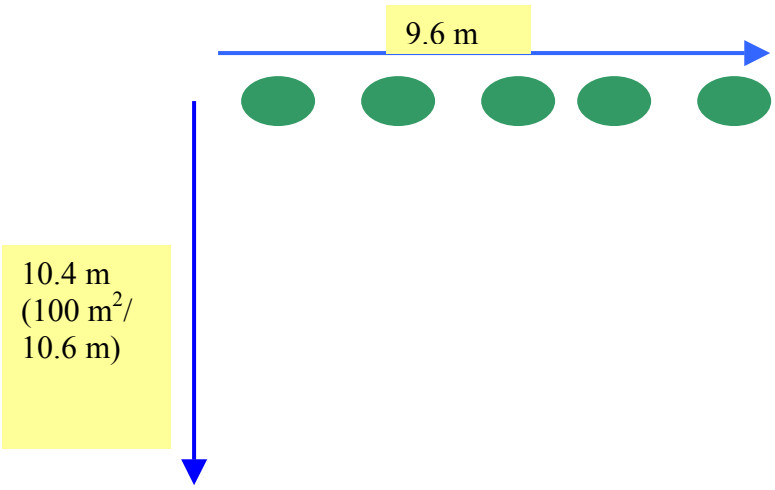

Figure 5 Plot Layout in First Thinning
(For second and subsequent thinning plot layouts see appendix 10.2).

(1) Stocking (number of trees/ha) Assessment
Plots should contain at least 7-20 trees. Borderline trees within plots should be classed as half a tree. In first thinnings count all the trees in the two rows either side of the inspection path. The reason you measure across five rows but only count the trees in four rows is to allow for the one metre either side of each of the outer rows which must be included to give a full plot (the 2 m space between each row must be included in your measurement).
Example:
0.01/ha plot
Number of trees counted in plot = 24
Number of trees / ha = 2400 (24/0.01)

(2) DBH Measurement (cm)
The diameter at breast height (dbh) is measured in cm using a specialised rounded down dbh tape or by using an electronic callipers which electronically measures the DBH of each tree and can calculate an average DBH.

Callipers are used to measure trunk diameter directly. With callipers, it is best to take two measurements with trunk diameter at right angles to one another and use the average.

Several conventions apply for dbh measurement:

- Trees should be measured for girth at a point on the tree 1.3 m above ground level;
- The tape must be kept taut and at right-angles to the stem of the tree;
- Where trees are on sloping ground, measurements are taken at 1.3 m from ground level on the upper side of the tree;
- When the tree is leaning measurements are taken 1.3 m from ground level on the under side of the tree parallel to the axis of the stem;
- On mounded or ploughed ground the measurement is taken 1.3m from the root collar or present ground level, whichever is higher;
- Where a swelling occurs at 1.3 m above ground level measurement is taken from the point below the deformity where the swelling is smallest;

- Where the stem forks below 1.3 m measure each limb separately and record separate trees. Where the fork is above 1.3 m treat the stem as one tree and measure below the fork where the diameter is smallest; and
- Measurements should be free of branches, ivy, loose bark, moss etc.

The dbh of each tree **over 7 cm** in the plot should be recorded. The mean DBH can be calculated for each subcompartment using the following formula (using a calculator with a square root key):

- Square each DBH
- Add all the squared values
- Divide by the number of trees measured for DBH
- Calculate the square root which is the mean DBH

This is the **quadratic mean**, the diameter corresponding to the mean basal area tree, and is different to the arithmetic mean.

Generally the more DBH measurements taken the more accurate the assessment of mean DBH will be (assuming the measurements are representative). The amount of DBH measurements required to give an adequate estimation of both the current DBH and the DBH of the trees, which will be removed in thinning will be in the region of 40-100+ (depending on the size of the plantation or plot for thinning within a plantation) a guideline would be:

Table 6: Guideline for the No.of DBH's Required in a Uniform Crop

Area/ha	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**>7**
No. of DBH's	40	50	60	70	80	90	100	100

As well as recording the dbh in the plot, diagonals can be taken through the plantation, to ensure a representative sample and sufficient numbers are recorded. These can follow the inspection paths as shown in figure 6 below.

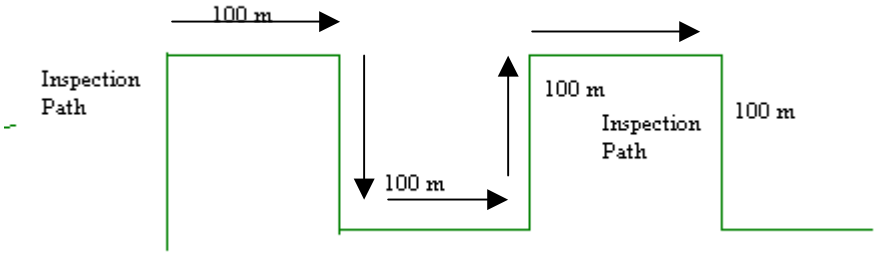

Figure 6 Systematic DBH Sampling

(3) Top Height Measurement:
Top height is defined as the average total height of the 100 trees of largest DBH per hectare. Top height is measured using a suitable device such as a Hypsomoter or Clinometer (there are also laser height finding devices available).

The measurement is taken from two points (the bottom of the stem and the very top of the tree). To measure top height in a pure stand it is common practice to take the height of the tree with the largest DBH within each of the plots measured using the system as outlined above. The number of top height trees to be measured will equate to the number of plots required in table 5. In mixed stands the number will depend on the percentage mixture with a general requirement for the same number of main crop trees as outlined above but less of the second or third species will need to be measured.

3.3 Timing of Thinning

With the above parameters it is now possible to calculate whether the stand should be thinned immediately or not. A stand is not generally considered ready to thin unless it is fully stocked. This can be assessed either by a visual inspection or through the assessment of threshold basal area. The term basal area (BA) is used throughout the next section and is described as:

- The *basal area* (BA)(m^2) of an individual tree is classified as the overbark cross-sectional area of the stem at breast height.
- *Basal area* per hectare is classified as the sum of the basal area of all trees in one hectare.

Basal area is calculated as follows:

(1) Stems/ha = 800
(2) Mean DBH = 27 cm
(3) Top Height = 16 m

Actual BA = mean DBH^2 x 0.00007854 x Stems/ha
45.8m²/ha = 27² x 0.00007854 x 800 =

BA can also be assessed using a specialised piece of equipment called a relascope (more information on relascopes can be found in the British Forestry Commission publication "Forest Mensuration, Booklet 39).

Using the top height parameter and species for each subcompartment the **Threshold** basal area can be obtained for that subcompartment (Table 7). If the calculated/actual BA is equal to or greater than the value shown in the threshold BA then the stand can be considered fully stocked and fit for thinning e.g. 35 m^2 is the threshold BA for Sitka spruce crop with top height 16 m. Therefore if this crop has a basal area > 35 m^2 it is fit to be thinned.

Table 7: Threshold Basal Areas of Commonly Planted Conifers for Fully Stocked Stands (source: Forestry Commission Field Book 2)

Species	**Top Height (m)**											
	10	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**30**
Sitka spruce	33	34	34	35	35	36	37	38	39	40	42	
Norway spruce	33	33	34	35	36	38	40	42	44	46	49	
Douglas fir	28	28	28	29	30	31	32	34	35	37	40	
Japanese/Hybrid larch	22	22	23	23	24	24	25	27	28	29	-	
European larch	23	22	22	22	23	24	25	27	28	30	-	
Scots pine	26	26	27	30	32	35	38	40	43	46	-	
Lodgepole pine	33	31	31	30	30	31	31	32	33	34	-	

(If height measured is between the above ranges i.e. 11m interpolation should be used to find threshold BA)

3.3.1 Timing – Environmental Considerations

There may be environmental considerations i.e. protected species nesting/breeding periods etc. in relation to timing of thinning. Please refer to the forest service harvesting guidelines.

3.4 Volume Calculation

The volume to be removed during thinning (thin volume) can be assessed using basal area.
Firstly two concepts need to be introduced

(1)Thin DBH: The Thin mean DBH is the DBH of the stems to be removed in thinning. It is important to assess this separately as the average dbh per tree of thinnings will normally be less than the DBH of the crop before thinning. For a guide use the DBH of the trees before thinning and minus a set figure from this. The set figures would usually be:
First thinning –2 (e.g if mean DBH is 16 then thin DBH would be 14)
Second thinning –2 (as above)
Subsequent thinnings –3 (as above).
Alternatively only the dbh of the trees thought to be removed in the thinning could be measured and averaged.

(2)Form Height: is the product of the mean height of the stand and the crop form factor. This figure is found to be closely related to the top height of the stand, and by assessing top height, form height can be assessed. There are two form heights (a) thinning form height and (b) main crop form height (for thinning form heights see appendix 10.5)

The procedures for using this method in order to assess BA in first thinning is outlined below (calculation methods for second and subsequent thinnings can be found in appendix 10.4):

Estimations for first thinning can be done on a percentage of stems removed basis with removal of between 25% and 33% of the stems the norm. Thin volume is estimated as follows:

Thin diameter = 17 – 2 = 15
BA = 15^2 X 0.00007854 = 0.0176
Top height = 11m
Form height (from table) = 4.13
Thin mean volume = 0.0176 X 4.13 = 0.073
Thin stems per hectare = (2,200 stems – 25%) = 550
Thin volume = Thin mean volume (0.073) X Thin stems per hectare (550) = 40 m^3

Important note: these calculations will give volume estimates however these volumes may vary on consultation with forestry professionals, timber purchasers or harvest contractors due to site conditions or other factors.

Other methods for volume assessment include:

- Tariff measurement; and
- Abbreviated tariff measurement.

The selection of a suitable measurement method generally relies on several factors, which include:

- Available resources;
- The value of the timber;
- Potential cost of measurement methods;
- The ownership of the timber;
- The quantity and variability of the sale;
- Potential precision of measurement method; and
- Sale type

Further information on tariff measurement including the abbreviated tariff measurement system can be found in Timber Measurement Manual , Purser, P., 2000.

These pre-sale measurements are vital as they will allow the forester to ensure that the forest is not over or under thinned.

3.5 Dynamic Yield Models

The tables and models referred to so far in the text are based on British Forestry Commission Models. These models have been derived from research plots in Britain over a number of decades. While the growth conditions in Ireland are similar to those in Britain, these yield models may not always be accurate for Irish forests. Also, they have only been developed for certain management regimes and do not allow for flexibility within the management regime.

Models, known as 'Dynamic Yield Models', have been developed for forests grown in Ireland. Based on the stand parameters collected during pre-sale measurement i.e. stocking, average dbh, top height, species and age, these PC based models predict roundwood production more accurately than the static management regime of the Forestry Commission yield tables. Also forests can be 'grown' into the future, using the models. The Dynamic Yield Models allow greater flexibility within management regimes and also incorporate timber price considerations. The models are currently available for Sitka spruce, Norway spruce and Douglas fir with more models currently in production. The Dynamic Yield Models can be ordered from COFORD (the Council for Forest Research and Development).

4.0 The Harvest Plan

The harvest plan includes a description of the operation, measures to minimize environmental disturbance and covers all aspects of harvesting on the ground from fuelling areas to haulage routes. The best way to present a harvest plan is by using maps accompanied by a description of all the relevant information and environmental issues. When compiling the harvest plan efforts must be taken to assess where the area to be harvested lies within or contains any of the following areas:

- An area identified as being environmentally sensitive in a County Development Plan;
- Part or whole of a Special Area of Conservation (SAC), Special Protection Area (SPA) or proposed Natural Heritage Area (pNHA);
- Aquatic zones;
- An area situated within 6 km upstream of a Freshwater Pearl Mussel catchment area;
- Archaeological sites and monuments; and
- Important habitats retained for biodiversity

When constructing a harvest plan one should ensure the following are consulted for practical advice where initial inspection highlights any important environmental issues relevant to the particular body:

- The relevant Regional Fisheries Board;
- The relevant Local Authority;
- National Parks and Wildlife Service;
- The National Monuments and Historic Properties Service of Dúchas The Heritage Service;
- Other relevant bodies including non-government organizations and the local community.

The operational harvest plan should address the following:

- Legal requirements, e.g. felling licence conditions (felling licence number should also be given);
- The felling parameters such as intended volume for removal, tree sizes/stocking etc. and the chosen thinning cycle;
- Allowable types of felling machine to be used, related to site and terrain class;
- Extraction system and extraction machine type to be used, related to site and terrain class;
- Timing/weather constraints on operational schedule;
- The need for ancillary structures, e.g. temporary bridges, sediment traps, rafts for boggy ground;
- A contingency plan for emergencies, which should include location of an oil spillage kit, should be present on site at all times; and
- Stacking heights (timber Stacks should be less than 2 – 3 m in height dependant on timber product).

The harvest plan should include:

- A good map of the area with marked boundaries of the harvest area and any geographical, environmental of archaeological features;

- Existing transport routes, including public and forest roads, loading bays, turn tables;
- Location of dwellings, transmission lines, monuments, important habitats, water pipes and rights of way;
- The location of areas of potentially high erosion risk;
- The location of machine maintenance, refueling and repair areas and storage areas for fuel, motor oil, lubricants and chemicals. These must be on dry, elevated sites at least 50 m from the nearest aquatic zone;
- Location of potential temporary measures such as temporary bridges, sediment traps and rafts for boggy ground;
- Location of extraction routes, marked with green or red arrows to signify direction of extraction, planned to avoid all buffer and exclusion zones and kept to a minimum on steep slopes; and
- Additional features, which may present difficulties or require particular attention when harvesting, e.g. landscape considerations.

Provision should be made within the plan to ensure that the **harvest managers, machine operators and haulage companies** are aware of the need for the following procedures to be applied on all harvest sites before and during harvest operations.

4.1 Safety Signage

For all harvest operations adjoining public roads, appropriate warning signs should be in place to alert the public. These signs should warn of harvesting operations taking place and lorries entering and leaving the site. Warning signs should also be placed within the forest, particularly if it is used for recreation. These signs should include those mentioned above and signs to warn of dangers of climbing timber stacks (see also section 2.5.3).

4.2 Brash Mats

The harvest plan should contain instruction for the creation and maintenance of brash mats on all machine routes. Foliage removed during harvesting and laid in a path is known as a 'brash mat'. Used correctly these can help to reduce the quantity of compaction and rutting to the soil as well as erosion and sedimentation. On sites where the bearing capacity of the soil is low, specify prompt extraction to ensure that fresh brash is available for extraction machinery.

4.3 Suitable Machinery for the Site

Harvest machinery must be suitable for the operation. The choice of machinery will depend upon the choice of harvesting system, the ground bearing capacity and the nature of the terrain. Other factors affecting choice of machinery includes:

- Environmental considerations;
- The forest road network; and
- Machine availability and cost.

Conditions on the machine type, permitted load size and the possible use of flotation and traction aids should be included in the harvest plan. Many forest sites can be unsuited to heavy harvesting machinery due to area, soil type wetness etc. and therefore machines with weights in excess of 14-16,000kg may not be suitable for thinning operations. Size of harvest machinery is also a factor. Many excavator bases

fitted with harvesting heads may be unsuited to thinning due to factors such as low ground clearance, width and damage from tracks.

4.4 Machine Passage on Forest Roads

It is important that no forwarding or ground haulage operations should take place on either forest or public road surfaces. There should also be no carrying over of soil or debris onto public roads. Roadside drains and culverts must be kept free of logs, debris and obstructions. Machine repair and maintenance operations, which have the potential to lead to a pollution incident, should only be carried out at appropriate locations, and the procedures designed to limit potential environmental damage should be adopted.

4.5 Safety Procedures

Harvest planning should incorporate the following safety procedures:

- Operator safety must be a priority at all times. Guidelines, rules and safety instructions must be strictly observed;
- A written site hazard and risk assessment should be carried out by the forest owner, manager or contractor (appendix 10.7);
- Employ suitably trained, qualified and experienced operators;
- The appropriate personal protective equipment for the operation must be worn at all times, up to industry standard and replaced regularly. Appropriately stocked first aid kits should be readily available either on the machine or at a central point on the site e.g. machinery operators car;
- Equipment should be properly used and maintained with all refuelling points and all maintenance operations carried out at least 50 m away from the nearest watercourse;
- There should be a clear understanding among all operators of the thinning system to be imposed and tree categories to be removed;
- Directional felling should be understood and used in relation to terrain;
- All operators should have emergency contact telephone numbers on site for all relevant agencies (doctor, hospital, fire-brigade etc.)All serious accidents must be reported to the Health and Safety Authority;
- Timber Stacks should be less than 2 – 3 m in height dependant on product;
- All operators involved in felling and extraction must carry adequate insurance; and
- Contractors should have an up-to-date safety statement that should be provided to all those working on the site.

A copy of a typical harvest plan can be found in appendix 10.8

4.6 Choice of Thinning System

There are several thinning systems to choose from with the two broadest types of systems being:

- Systematic and
- Selective

Systematic thinning involves removing trees based on a predetermined pattern, and is often used in the initial thinning of a stand. A typical systematic thinning would be the removal of every fifth row (i.e. 1 in 5). Such thinnings can be either manual or mechanical and can follow a range of designs, including line thinnings and chevron thinnings. Types of line thinning, including chevron and herringbone thinning, only benefit trees directly adjacent to the lines removed. For example, where a line thinning would take out 1 line in 5, the trees in the centre row of the four rows left standing are not released from competition. Line thinning is also indiscriminate as far as which trees are removed. Thus, a proportion of the most vigorous trees may be removed which can affect yields. However line thinning is required where machinery is being used to open up interconnecting lines for access.

Selective thinnings, as the name suggests, involves removing trees on the basis of criteria relating to size, quality or their position in the canopy.

It is common practice to mix systematic and selective systems in first thinnings. In this case a row would be removed to allow access (generally called an extraction rack) and poor or undesirable stems are removed from either side of the rack. This system increases growing space for the remaining high quality stems. This type of thinning termed rack or line plus selection is commonly carried out by removing 1 line in 7 and selecting trees for removal from the three remaining rows either side of the rack (see figure 7 below). This system allows access into the crop for machinery and the racks are then used in second and subsequent thinnings.

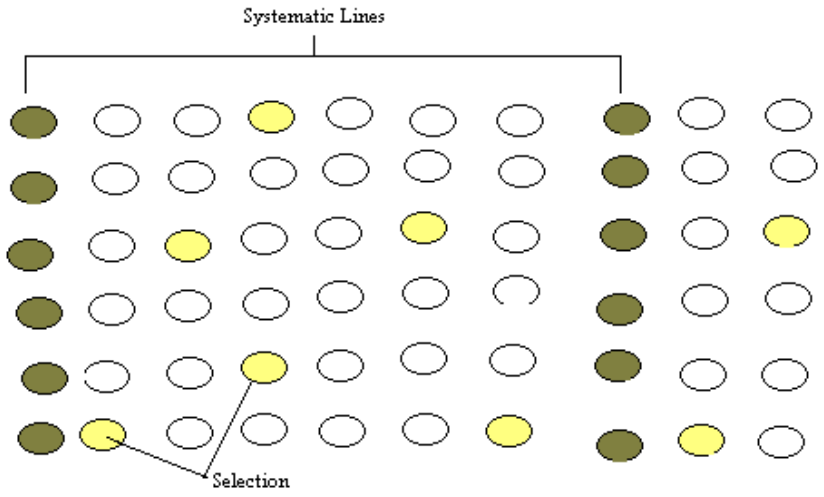

Figure 7 Rack and Selection Thinning- 1st Thinning

In high value crops at final clearfell stage, it may be worthwhile to do a pre-clearfell thinning where all trees below 17 cm are removed.

It should be noted that in mixtures where a nurse species has been used it is predominately the nurse species that is removed during thinning. This is most common in conifer-broadleaf mixtures.

4.7 Site Hazard and Risk Assessment

As part of the harvest planning process it is necessary to carry out a site hazard and risk assessment inspection. Findings of these assessments should be recorded on the harvest plan. Potential hazards would include:

- ESB lines: contact the ESB in order to arrange for dangerous power lines to be made safe before harvesting begins;
- Steep banks: and ravines should be identified on maps and also on the ground by marking adjacent trees or with the use of high visibility tape to ensure that the edge of the bank is easily identifiable to machine operators; and
- Roadside harvesting: the local authorities should be contacted and agreement on the road control system to be implemented should be sought in writing if possible.

Also Eircom lines, persons with ROWs, important bird nesting sites, mass paths and pipe lines for local water mains, gas etc should be identified in the risk assessment. A sample site hazard and risk assessment can be found in appendix 10.7.

SECTION C Marketing, Harvest Management and Post Sale Procedures

5.0 Timber Marketing

Timing of thinning to take advantage of good market prices is essential in order to enhance the value of your plantation. It is wise to be well informed on current market conditions. Ireland has nine large sawmills, five of which can process approximately 200,000 cubic metres or more per annum. There are also numerous smaller sawmills in the country, along with three major pulpwood mills. Also alternative markets such as wood energy and fire-wood are emerging, increasing local market options to forest owners. There are different types of sale systems, means of sale and methods of sale, with different combinations of each possible e.g. one could sell timber standing, on a sale by weight system by tender or one could sell timber standing, on a tariff system, with a negotiated sale. Before putting the measured timber on the market it is important that:

- All necessary roadwork's, inspection paths and styles should be in place;
- Stacking and loading areas should be clearly marked;
- Areas for chemical, fuel and equipment storage should be clearly marked; and
- Arrangements for taking down transmission and ESB cables, if necessary, should be made.

5.1 Sales Systems

There are a number of different sales systems that may be employed in the sale of timber:

a. Sale by Tariff;
b. Sale by Weight ; and
c. Sale on a Volume/Weight basis.

a. Sale by Tariff

The tariff system is a timber measurement system used to assess the volume of standing timber in the sale lot. It is accurate when carried out to a high standard. Timber is then sold based on the estimated standing volume. Tariff measurement is time consuming and expensive due to the accuracy and measurement intensity required. Therefore, it is only generally used to assess high value crops and is not economic in first thinning crops.

The advantage of this system is that as the selling price is agreed prior to harvesting, it generally promotes good harvesting and site clearance practices. From the point of view of the grower, monitoring of timber removed will be reduced. Other than the high cost of using the tariff system, the main disadvantage is that it is not always attractive to processors as the onus is on them to assess the accuracy of volumes calculated and to monitor timber security. Also poor measurement technique may result in a loss of revenue for either the grower or purchaser. As the tariff system has become less favoured by purchasers it is now less frequently employed.

b. Sale by Weight

For this system each load of timber is measured as it crosses the weighbridge and the quantity of timber is then expressed in tonnes. Value of the sale is then based on the

total weight of timber crossing the weighbridge. A unit value (value per tonne) for this timber should be previously agreed between vendor and purchaser. This may be based on the initial crop assessment. Lorries are weighed on entering and exiting the mill and the net timber weight is calculated. Sale by weight is a relatively inexpensive sales system, as it requires less intensive field measurement procedures. It is therefore appropriate for use in first thinnings. The main disadvantage is that the weight of timber can vary greatly between time of felling and weighing at sawmill/processor. Also only the timber which crosses the weighbridge is quantified. Factors, which affect the weight of timber, are:

1. Time between weighing and felling;
2. Site type;
3. Log type;
4. Forest Management;
5. Species;
6. Climate;
7. Season; and
8. Log handling.

It is essential that all timber is monitored closely and removed from the site promptly to prevent drying out and weight loss. For roadside or delivered sales, all timber should be stratified into product type before weighing takes place e.g. pulp, pallet or sawlog and a separate field-sheet kept for each stratum[1]. Net weight for each stratum is calculated at the end of the sale, to give the total net weight. The value of the sale is based on this figure. Data may also be logged on an electronic device or computer and saved for later reporting. An adequate ongoing forest site monitoring and security system is vital when employing this sales system. A weight/docket monitoring system is outlined in appendix 10.10.

c. Sale on a Volume/Weight Basis

This system protects the forest owner against any delay between felling, processing, extraction and haulage dates. Volume/weight measurement involves the weighing of every load of timber from a sale, similar to the sale by weight system above. A volume/weight factor or ratio is then applied to assess the volume of timber in the sale. Samples are taken systematically throughout the course of the sale to assess the volumes in various loads and the number of samples taken is dependant on the predicted volume to be felled. Each species and log type will have different volume/weight factors. Therefore estimated quantity of each species and log-type (stratum) is required to apply the appropriate number of samples (sampling fraction). A separate recording sheet is kept for each stratum. The volume of timber is calculated using a volume/weight conversion factor for each stratum. Total volume is found by adding each stratum. The value of the sale is based on this volume.

This can be a highly accurate method of timber volume assessment. However, it requires a manned weighbridge, usually at the sawmill/processor, and a relatively high level of expertise. As with the sale by weight system, good monitoring of harvesting, extraction and removal of loads from the forest is also essential.

5.2 Means of Sale

- *Standing*

The sale is sold to a contractor/sawmiller/boardmill as standing trees and the purchaser is then responsible for harvesting, extracting and delivery of the timber.

[1] Sample field sheets can be found in the following publication Purser. P, 2000 Timber Measurement Manual. COFORD

- *Roadside*

The timber is felled, cross-cut and extracted to roadside, where it is then sold. It is the responsibility of the buyer to remove the timber from the forest. This option requires a medium level of input – but entails additional upfront costs to the owner.

- *Delivered*

The timber is felled, cross-cut, extracted and then delivered to the buyer. Organisation, management and monitoring of a delivered sale is very intense as all aspects from measurement and harvesting to haulage are undertaken by the owner or his/her manager. This option has a high level of input – entails high upfront costs to the owner.

5.3 Method of Sale

- *Electronic Auction*

Details of the sale i.e. estimated volume, average tree size, average dbh and number of stems are posted, at regular intervals on a computer system , website or emailed to potential purchasers. Processors have a defined time period to view the sales before making a bid. Bidding will close on a stated date/time and highest bid usually buys the sale. This electronic method is typical of many Coillte sales. Currently ,other than through Coillte, no such facility exists for private growers.

- *Tender*

Details of the sale i.e. volume, average tree size, average dbh and number of stems are circulated to a wide range of potential buyers, who are invited to tender for the sale. The tenders are received by an agent/owner by a set date. The highest tender is usually accepted. Also the reputation of the buyer and previous references/experiences should be considered when accepting a tender. It may be wise to accept a slightly lower bid where high quality thinning can be assured.

- *Negotiated Sales*

The sale is carried out by direct negotiation with potential purchasers. Local processors, sawmills, contractors etc. can be approached to buy part of or the entire sale. This may work well in small lots where access or the distance from market makes transport uneconomic for a wider range of purchasers.

5.4 Method of payment

The basis for standing sales can be one price for the entire lot, a single unit price per cubic metre or tonne or a price per cubic metre or tonne for each category of log i.e. pulpwood, stakewood, boxwood or sawlog.
The basis for roadside or delivered sales will normally be based on a price per tonne or cubic metre for each category of log. A percentage of the estimated value of the sale should be paid upfront as a deposit before felling begins. After this, payments may be made at regular intervals based on the volume of timber removed. In a sale by weight system, the weight of timber removed is based on records from the weighbridge.

5.5 Forestry Taxation and VAT Issues

The occupation of woodlands in the State, managed on a commercial basis and with a view to the realisation of profits is exempt from income taxes for individuals and corporations subject to section 17 of the Finance Act 2006. Section 17 of the Finance

Act 2006 has introduced a provision to limit the use of 'specified reliefs' by certain high income individuals for tax years 2007 and following, where these specified reliefs exceed €250,000. The provision is complicated and may apply in a limited number of cases where woodland profits are involved (O'Hegarty, 2007).

VAT must be charged at a rate of 21% on timber sales by individuals or companies registered for VAT and in the case of farmers not registered for VAT, a farmer's rate of VAT can be applied.

These details are liable to change and annual updates can be found in the current ITGA Forestry and Timber Yearbook. It is recommended that forest owners consult with an approved forester or an accountant or tax consultant on income tax and VAT issues.

5.6 Alternative Markets -Wood energy[2]

The sale systems, means and methods listed above refer for the large part to timber for sale to mills for the traditional methods of processing. With recent developments in the sustainable energy programme in Ireland, most notably the introduction of grants for wood pellet and wood chip boilers through the Greener Homes Scheme[3], wood-energy is becoming a viable alternative market for forest thinnings. This is especially true in areas where distance to market makes haulage of small diameter timber uneconomic.

5.6.1 Wood Energy Products and Supply

Timber can be processed in three different ways when supplying to the energy market:

- Logs – tree lengths are cut in 0.5 to 1 metre length logs;
- Pellets - made from a mixture of sawdust and wood shavings, ground to a fine powder, dried and pressed into short sticks; and
- Chips – trees are processed and fed into machines that can 'chip' the trees to a desired size and quality.

The product used depends on the user's requirements, storage facilities available, size and type of boiler and scale of operation. In most cases, unless specialised equipment is purchased, forest owners will be restricted to producing logs and chips.

The products may be used in the forest owner's home (it is estimated that 1 hectare of thinnings can heat a home for a year) but in many cases a contract may be set up between a forest owner or group of forest owners to supply a local school, hotel, industry etc.

Three contract options exist:

- **Fuel/Wood Supply**: This is a simple supply contract where a forest owner or group of forest owners agree to supply chips for a boiler to a specified size and moisture content. The boiler owner owns and maintains the boiler and buys in the chips to supply the heat requirement;
- **Heat Supply Contract**: A forest owner or group of forest owners agree to supply an annual heat requirement based on kilowatt hours (kWh). Payment is based on heat delivered plus maintenance. Supplier must supply specified chips or carry any additional costs. The forest owner generally carries out boiler maintenance. Can be a joint venture with a boiler supplier and forest owner; and
- **Energy Supply Company (ESCo):** Forest owners form a joint venture with boiler suppliers to supply a boiler and fuel, deliver heat requirement and maintain the boiler. The bill is then based on heat used plus capital cost of boiler.

Energy content is the general basis for sale of wood-fuel. There are no general specifications for wood-energy and it is advisable that an acceptable range should be agreed by contract. Two methods are recommended for calculation of wood energy content:

- 1. Net Calorific Value – Giga joules per tonne (kWh /t)

[2] Proceedings of COFORD conference'Forest Energy 2006', Tullamore Court Hotel, Tullamore Co.Offaly, 12/12/06.

[3] www.sei.ie/index.asp?locID=756&docID=-1 5/1/2007 2:45 pm

- 2. Energy Density – kilowatt hours per cubic metre.

Trading woodfuel by energy content requires agreed measurement procedures based on measurement of weight, moisture content and bulk density. For further information on the calculation of woodfuel energy content is available in 2005 the COFORD publication 'Wood for Energy Production).
Current harvesting machines employed in Ireland for conventional forest use can be easily adapted to use wood energy harvesting systems e.g. feller-buncher. In terms of chipping machinery there is no impediment to the use of the same machinery employed across Europe for chipping harvested thinnings for wood energy in Ireland.

5.6.2 Moisture Content and Wood Chip Quality

The quality and moisture content of timber fuel used in boilers is dependant on the size of the wood-fuel boiler. In general large industrial boilers can burn wood with higher moisture content and can utilise larger wood chips than smaller domestic boilers. European specifications for wood-fuels, CEN/TS 14961, now govern wood-fuel quality.

5.6.3 Research in Ireland

Extensive research into thinning and chipping systems for wood energy was carried out in 2006 over a range of broadleaf and conifer sites in Ireland. The project entitled Forest Energy 2006 was carried out jointly by Waterford Institute of Technology, COFORD and Teagasc (footnote 2).
The County Clare Wood Energy Project, is aiming to develop a market for wood energy in Co. Clare by supporting and encouraging local businesses to switch to wood energy heating systems and facilitating farm forest growers in County Clare to work together to supply the wood energy, in the form of woodchip. This model is one that may be repeated for future schemes in similar areas around the country[4]. The findings of both projects will be invaluable in the development of economically viable wood-fuel markets in Ireland.

[4] Anon, 2006 Wood Energy from Farm Forests – A Basic Guide, Teagasc

6.0 Management of Harvest

Harvest planning, pre-sale measurement and timber marketing must be followed up with high quality harvest management. Correct management of harvesting will ensure the crop is thinned in the optimum manner, thus ensuring maximum return from the forest over its life-cycle.

6.1 Sales Contract

Employing well thought out contracts which include details of the following will ensure the interests of both the vendor and purchaser are protected:

- vendor and purchaser contact details;
- details of vendor's agent;
- Compliance with felling licence conditions;
- the land on which harvesting will take place and accompanying map with harvesting plan;
- date of agreement and deadline date for completion of harvesting and extraction;
- 'caveat emptor' clause-the buyer must satisfy himself as to the details and quality of the sale;
- payment procedures- number and date of payments, conditions governing payment such as volume or weight of timber felled, repercussions of late or non-payment;
- Despatch procedures, number of days between felling, extraction and haulage - especially important in a sale by weight as timber will dry out if left on-site, blue-stain can also effect pine if left for a period in damp conditions;
- provision for delay in completion date of harvesting and transport of timber due to weather and unforeseen circumstances;
- conditions under which contract may be terminated by vendor;
- health and safety conditions and responsibilities as governed by the Code of Practice for Managing Safety and Health in Forestry Operations;
- environmental control in relation to the Code of Best Forest Practice Ireland and Forest Service Guidelines and Requirements;
- felling protocol; stumps cut as low as practicable, urea application on all cut stumps immediately, trees felled inwardly, felling procedures close to public roads and/or dwellings;
- insurance - the purchaser must ensure that the harvest area and all personnel, contractors and sub-contractors are fully insured and documentation presented as proof;
- extraction protocol - use extraction routes as indicated on harvest plan, use of brash mats, where extraction is suspended due to bad weather provisions can be made for extended contract where necessary ;
- responsibility for damage to trees - any damage to trees during the term of the contract is at the risk of the buyer;
- felling outside harvest area penalties for felling outside of agreed harvest area;
- access to harvester volume output information by vendor;
- specify that all remaining lop and top, butt ends etc. are the property of the vendor;

- responsibility for damage and repair of damage to site - outline those responsible for damage caused, in majority of cases liability will lie with buyer, a minimum amount of wear and tear is acceptable and
- include a copy of site hazards map, site risk assessment, health and safety guidelines, emergency contact numbers and pollution control plan.

The above points will help ensure good harvesting, completed on time. By implementing systems for monitoring volume of timber felled, extracted and delivered to the mill, any potential pilferage can be prevented. It is important all personnel operating on the site are aware of the above issues and have a copy of the harvest plan and sale detail.

6.2 Ongoing Monitoring and Supervision

- A management presence on the site will help improve compliance with harvesting plan and contract and improve control procedures.

- The manager should liaise with the machinery operators on a regular basis as operators are the people to the fore of the thinning operation;

- The owner and local manager should monitor the harvesting. Where the owner lives a distance from the property employing a caretaker living in the locality will aid in monitoring of the operation and can be invaluable in the event of unexpected events;

- The owner/manager should monitor compliance with all contractual and felling licence and also all environmental guidelines and requirements, Code of Best Forest Practice and ensure that all health and safety regulations are fully complied with.

- If there are water-ways or aquatic zones on site ensure that relevant buffer zones are maintained and no drains are allowed to discharge directly into waterways. Freshwater Pearl Mussel requirements must be complied with in relevant areas.

- Put in place a weight docket system (see appendix 10.10);

- Request harvester printout of cut volumes by product;

- Compare harvester printouts and weight dockets received i.e. carry out a stocktake;

- Where specific products are cut for a roadside sale or delivered, it may be sensible to carry out random measurements of lengths;

- Marking of timber with paint or an identifiable substance can aid in the monitoring of timber removal. For very high value timber using an individual stamp may be justified;

- Also compare the estimated timber volume to the volume received by the saw-mill/buyer. Factors, which may influence the difference, are time, weather or timber that has not yet been extracted;

- Ensure all weigh bridges used are certified;

- Ensure all stumps are sprayed or painted with a 20% solution of urea with added dye immediately after felling to prevent the spread of fomes (*Heterobasidium annosum*) or butt rot disease;
- Ensure all trees are cut as low as possible to ensure the optimum amount of sawlog is extracted; and

- Ensure all timber has been extracted and removed before machines leave the site.

6.3 Damage

- *Soil damage*
  Foliage removed during harvesting and laid in a path is known as a 'brash mat'. Used correctly these can help to reduce the quantity of compaction and rutting to the soil as well as erosion and sedimentation. Repeated travelling of paths can also result in ground damage. These issues should be addressed in the harvest plan. In wet weather tracks on wheeled machines will help reduce sinking and damage by increasing surface area.

- *Tree damage*
  'Barking' is the removal of bark from standing trees and is usually caused by machinery. This can lead to disease and/or insects entering the tree, leading to long term damage. By using the correct sized machinery for the site and careful harvesting barking can be kept to a minimum.

- *Water*
  Water-ways are extremely sensitive to pollution. Therefore it is essential that all harvesting is carried out in accordance with the Forestry and Water Guidelines and where applicable the Forestry and Freshwater Pearl Mussell Guidelines. Machinery operators should always carry a pollution control kit for use in the event of oil or fuel spillage.

In the event of excessive ground damage, barking or pollution event harvesting should be suspended.

6.4 Timber Sales Recording Procedures

- Record start and finish date of harvest operation.

- Record all timber removed from the site (see appendix 10.11).

- Record all downtime on the site i.e. machinery breakdowns.

On the thinning protocol sites the owners played a large part in the recording and monitoring of load removal.

6.5 Thinning – Monitoring and Control

- Machine operators should be aware of the optimum volume of timber to be removed per hectare. Plots should be taken at intervals to ensure that the optimum amount is harvested (too little is better than too much). By taking these measurements the operator can establish if too much or too little timber is being removed and adjust the harvesting accordingly. These plots should be recorded and available for inspection by the manager. This will ensure extra trees are not taken. On the thinning protocol sites plots were marked to show the intensity of thinnings and trees to be removed before thinning began. These plots were viewed by the buyer and the harvesting contractor and agreed onsite before harvesting commenced.

- Managers should also take sample plots of the harvested area while on site to verify that the appropriate timber volume is being harvested.

- Harvester operators are skilled in the removal of inferior stems, however it is wise to monitor the size of tree felled to ensure that thinning selection is as agreed.

- Inspection plots should be laid out and measurements taken as described in section 3.2.

- The volume can be calculated as described in section 3.3 and 3.4.

- The volume removed during thinning, calculated as volume before thinning less the volume remaining after thinning should not greatly exceed the volume stated in the sale detail.

- This monitoring of harvesting during the operation aids in the prevention of over-thinning and identifies problems early in the operation, rather than afterwards when it is too late.

7.0 Post Sale Inspection and Further Silvicultural Treatments

There are several procedures and treatments, which must be considered post sale. The following section outlines these and gives recommendations as to the requirements of such treatments and procedures.

7.1 Post Harvest Calculations

After the harvest operation has been completed it is important to assess the remaining crop volume and stocking rates. Plots should be taken to assess post thinning stocking rates (this should be done by following the procedures outlined in sections 3.2 - 3.4).

The post harvest stocking level is very important to ensure that the thinning hasn't been excessive and therefore reducing the capacity for the crop to respond to the thinning. Over thinning leads to a loss of production as the trees attempt to respond to the excessive space left. The remaining trees must expand to fill the space before the correct level of competition is again achieved and the sites capacity is once again attained.

It is also important to assess the DBH of the remaining crop to ensure the thinning has resulted in an increase in tree size. Increases in the DBH of the crop post thinning should normally be:

- First thinning 2cm
- Second thinning 2cm
- Subsequent thinning 3cm

The comparisons of pre-sale and post sale measurements taken in the three sites involved in the thinning protocol can be compared in appendix 10.9. These tables highlight the ease with which thinning control can be implemented.

The other calculations to be carried out and information to be collated after the harvest are:

- Total volume removed;
- Total payments for timber;
- Costs incurred in the sale/harvesting; and
- Net thinning income/expenditure.

7.2 Balancing Payments

Once all harvested timber has been removed from site and all dockets (where appropriate) for these removals collected and matched to corresponding weight dockets then all outstanding payments (or refunds) should be made. It is essential to ensure prompt receipt of weighbridge tickets in order to assess the final payment to be received.

7.3 Post Harvest Inspection

Post harvest inspection should include an assessment of the need for the following:

- Road repairs;
- Drain repairs;
- Removal of any temporary structures which were erected to facilitate harvesting;
- Removal of any hazardous compounds and residues left over from harvesting operations; and
- Water management -issues include inspection of water-ways to ensure no drains are discharging directly into water-ways.

7.4 High Pruning[5]

The purpose of high pruning is to produce a stand of conifers, which have 6 metres of a branch/knot free stem. This should result in an increase in quality and value of the crop.

Stands suitable for high pruning must fulfil the following criteria:

- Selected trees within the stand must be capable of increasing their mean diameter by a factor of 2.5 (this is usually trees of between 14-18cm dbh);
- Crop age will be in the region of 13-22 years old i.e. time of first thinning or before. This is yield class dependant.;
- The stand should be of yield class 14 or higher;
- The stand must have a low risk of wind blow and be stable; and
- A minimum area of 0.4 ha applies.

The operation should include the following:

- Pruning of a minimum of 500 stems/ha;
- Removal of all branches on selected stems to a height of 3.5 m (1st lift); and
- Removal of all branches on the selected stems to a height of 6 m (2nd lift carried out two to four years after 1st lift).

It should be noted that many high yield class crops may have surpassed the diameter size to be eligible for the pruning grant before first thinning has taken place.

[5] Due to the change in the forestry programme under the 2007-2013 Rural Development Regulation, details of a pruning grant, if any, for this period will not be known until the programme is approved at European Union level in 2007.

SECTION D: Financial information

8. 0 Introduction

The costs and returns from harvesting operations are based on a number of factors including, site access, location, productivity and volume to be removed. Site type, haulage distances and timber quality must also be considered. In this section we include some information on costs for timber harvesting/extraction and silvicultural operations and operations such as harvest planning, crop assessment, marketing and measuring and post harvest assessments. The costings are largely based on the fieldwork carried out on the thinning protocol sites.

8.1 Planning Logistics of Thinning Protocol Sites

Costings for the Pilot Thinning Protocol project undertaken in three forests under different ownership are employed in this section. The profiles of the sites thinned as part of the fieldwork for this Thinning Protocol can be summarised as in table 8.

Table 8 Thinning Protocol Site Description

Site	Planting Year	Yield Class (m^3/ha/yr)	Total Forest Area (ha)	Harvest Area (ha)	Average Tree Size (m^3)
1	1991	24	2.4	2	0.065
2	1990	24	12	7	0.092
3	1989	24	4.4	3.2	0.082
				12.2	

The location map of the sites can be seen below in figure 8. The close proximity of the sites in relation to each other is clearly shown here.
The three sites were assessed two years previous to harvesting. The decision to market and manage thinning of these areas together in 2006 was taken based on this initial crop assessment, the proximity of sites to each other and agreement between the forest owners.

Site 1 ★

Site 2 ★

Site 3 ★

Figure 8 Location Map of Thinning Protocol Sites
Note site markers are indicatory only and are not proportional to actual site area.

8.2 Infrastructure Requirements

Roading costs will depend largely on a site-by-site analysis of underlying soil type, slope, etc. The current Forest Service grant funds up to 80% of the maximum costs of the forest road construction but forest owners should note that 20% of costs would be borne by the owner (see pouch at end of manual). A harvesting road can be applied for when the crop is within 5 years of thinning and the application is as outlined in section 2.2.1.

In some cases the forest owner may have the means and expertise to develop the infrastructural requirements themselves. In some cases this may make more economic sense. For example table 9 summarises the infrastructure requirements of the three Thinning Protocol sites, overall costs to the owners and any grants received.

Table 9 Infrastructural Requirements and Costs of Thinning Protocol Sites

Site	Infrastructure Required	Total Forest Area (ha)	Infrastructure Grant Aided by FS	Own Labour used?	Cost per hectare[6]	Comment
1	1 x Layby	2.4	No	Yes	316.80	
2	2 x Layby	12	No	Yes	66.86	
3	1 x Turning Bay	4.4	Yes	No	114.27	20% of 88 metres @€28.57

It is clear from the table above that generally the greater the forest area the lower the roading costs per hectare.

8.3 Harvest Planning and Crop Assessment

Professional costs for harvest planning and crop assessment will depend largely on the area, age and volume of the timber to be harvested. Generally prices for greater areas and volumes will be cheaper per unit area due to economies of scale. As outlined earlier this is an area in which co-operation can benefit the forest owner as forest management on a large scale is likely to lead to a reduction in overall costs to growers. Costs for such operations may be quoted for in several different ways. These are likely to be either flat costs for the creation of a harvest plan and physical measurement of timber and report on volumes of species etc. or by percentage of the sale revenue received which is generally linked to an overall harvest planning, crop volume assessment and marketing/sales package.

In the case of the thinning protocol sites the annual fee for membership of the co-op covered the cost of the initial crop assessment. The cost of the harvesting was covered by an agreed percentage of the overall value of the sale. This is explained in more detail in section 8.7 below.

[6] Roading cost per hectare based on the overall area of plantation

8.4 Assortments

Timber in Ireland is usually sold on a shortwood system. In other words it is felled delimbed and cut to various lengths or size assortments in the forest. Size assortments are various categories of timber, specified by length, or diameter, or both and are produced through crosscutting of a tree. Prices for different assortments can vary greatly. Prices for standing timber and different assortments can be gained from several sources. These sources include:

- ITGA Forestry & Timber Yearbook and website www.forestryyearbook.ie;
- ITGA website www.itga.ie;
- ITGA newsletters "Irish Timber Grower"; and
- ITGA Comiled prices on the Forest Service website www.agriculture.gov.ie/index.jsp?file=forestry/pages/forest_service.xml

Standard assortments lengths are typically as described in Table 10 below.

Table 10: Standard Assortments (Source Purser, P., 2000)

Assortment type	Typical size range
Stake/Pulp	Top diameter 7 – 13cm Length 1.5 – 3.8m
Pallet Wood (boxwood)	Top diameter 14 – 19cm Length 2.4 – 3.7m
Sawlog	Top diameter 20cm+ Length 3.7m+

Other assortments could include full tree lengths and variable tree lengths containing Pulp, Stake, Boxwood and occasionally small sawlog.

Prices for assortments will depend on a variety of factors including:

- Site (slope, soil type, wetness);
- Accessibility;
- Volume;
- Extraction distance;
- Quality of timber;
- Haulage distance; and
- Species

Thinning, harvest and extraction prices will depend on the factors outlined above.
The pilot sites for the thinning protocol were sold standing. That is the owners received an overall price per tonne (€8.25) for all products based on the average tree size over the three sites. The buyer then cuts the products as desired. In this case the buyer was responsible for the cost of harvesting and haulage of timber from the site. This reduced the risk to the owner, as the buyer dealt directly with, and issued payment to, the harvesting and haulage contractors. Also the onus for providing a harvesting contract, harvest management, insurance requirements and associated matters rests with the buyer rather than the forest owner in the case of a standing sale. The forest owner must always ensure that the contractors hold all relevant insurances while on site (see section 2.5.4).

8.5 Marketing of Timber on Thinning Protocol Sites

A letter was circulated to perspective timber buyers in July 2006 along with details of the sale and a tender reply form.

The prospective buyers were given 3 weeks to view the sale before the closing date for the tender reply. Contact details for a co-op representative were supplied in the sale cover letter and perspective buyers contacted this representative in order to view the sale.

The successful tender was contacted following the closing date for tender reply and a date agreed for an onsite meeting to sign contracts, agree harvest plans and carry out the required health and safety measures. All relevant documentation was sent to the buyer prior to this meeting for review and the forest owners were supplied with copies.

8.5.1 Sale Contract

As outlined in section 6.1 a sale contract between buyer and vendor is essential. Similarly a contract may be drawn up between forest owners when selling timber together in one sale lot. In the case of the Thinning Protocol sites a verbal agreement existed between the owners of the three forests in relation to the sale.

8.6 Post Sales Inspection and other Silvicultural Treatments

Post sales inspection fees can be either part of the agreed contract for payment of harvest management or a set fee to be paid after the harvest is completed. The post sales inspection should include a thorough assessment of any remedial operations required such as reinstatement of roads, removal of temporary structures and checking of adherence to harvest planning i.e. no evidence of pollution events, no evidence of storage of chemicals/fuels near watercourse. The post inspection should also include checks of post thin DBH and stocking levels to ensure the thinning operation has resulted in an increase in DBH and that stocking levels are in line with those projected at harvest measurement stage (the details of the post-sale inspection for the three sites used in the thinning protocol pilot study are in appendix 10.9). The fee for these inspections should be similar to the fees for pre-harvest inspections operations or charged as an overall percentage of the final sale value (see section 8.7 for costings in protocol sites). Other silvicultural treatments commonly include high pruning. Pruning operations may be grant aided[7]. The grant may cover costs for pre-approval application, form 2 application and the actual operation as explained earlier in section 7.4.

8.7 Cost of Thinning in Protocol Sites.

The sites used in the thinning protocol received a price per tonne for the thinnings for the overall sale .The management cost, which included harvest planning, marketing of timber, management of harvest and post-sale inspection, was calculated and charged on the basis of an overall percentage of total income received. The owners were also charged the annual co-op subscription membership fee. Table 11 gives the exact figures for the harvest operation on the thinning protocol sites.

[7] Due to the change in the forestry programme under the 2007-2013 Rural Development Regulation, details of a pruning grant for this period will not be known until the programme is approved at European Union level in 2007.

It is important to note that the cost of harvest management on the three Thinning Protocol sites was subsidised by funding received from Forest Service, Department of Agriculture and Food. Future group thinning sales carried out by the co-op will be on a larger scale, with a higher percentage of income charged, as cost of management on small areas is uneconomic for both the co-op and the forest owners.

It is also important to recognise that the forest owners received a large amount of information in the form of newsletters, field days and yearbooks for their co-op membership fee.

Table 11 Income and Expenditure per Site per Hectare for Thinning Protocol (VAT exclusive)

	Site 1	Site 2	Site 3
1.Price/tonne received in Thinning Protocol (€)	8.25	8.25	8.25
2.Volume per hectare (tonnes)	49.27	71.74	66.5
3.Gross Income per hectare	406.47	591.85	548.63
4. Management Fee per hectare [8](5%)	20.32	29.59	27.43
5. Roading Costs	316.80	68.86	114.27
6. Co-Op Membership Fee [9]	224.44	44.89	122.42
5.Net Income per hectare (3-(4+5+6))	**-155.09**	**448.51**	**284.51**

It is clear from the above table that the greater the area of forest the greater the profit per hectare for the owner. In the case of site 1 a loss was incurred but the first thinning is an essential step in producing high quality saw-log that will be profitable in the future.
It is also worth noting that the smaller plantations would have incurred much higher costs and possibly received a lower price had they not been thinned in the group situation.

8.8 Conclusions and Alternative Options

As is apparent from the above, the forest owner has many options with regard to the sale of thinnings. The co-op or group marketing of thinnings has definite advantages with regard to economies of scale.
Regardless of the management or marketing structures in place, well managed and aptly timed thinning operations are essential to achieve a high quality final crop of timber, and to optimise the financial return during the life-cycle of the crop.
Planning of thinning operations is essential from an early stage in crop development in order that the forest achieves its maximum social, environmental and economic potential.

[8] The management fee per hectare included the time spent onsite showing the sale, monitoring the thinning, liaising with harvesting team and harvest manager, final calculations and post-sale inspections. As noted in previous text this cost was largely subsidised by Forest Service funding of the Thinning Protocol project.
[9] The membership fee for three years i.e. 2004, 2005 & 2006 were used to calculate membership fee as inventory was carried out on the sites in 2004. The costs for 2004 & 2005 were compounded forward to 2006 to show a true cost for the harvesting operation. An interest of 5% per annum was utilised. Membership fee per annum was based on the overall forest area for the individual.

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SECTION E: Appendices

10.1 Systematic Random Sampling

Two forms of sampling are recognised- random and systematic. Random implies all individuals and all groups of a given number of individuals in a population have an equal chance of being selected (Hamilton, 1975). In the systematic method samples are taken according to a predetermined system. Therefore a combination of both is desired when sampling a forest.

A grid system can be used to identify sample points on the map before carrying out the inventory.(see figure 6 below) This helps to reduce bias in the field. The use of a grid to identify sample points is known as area frame sampling (MacSiurtain, 2005) Points can then be located in the field using distance measurements, a map and compass.

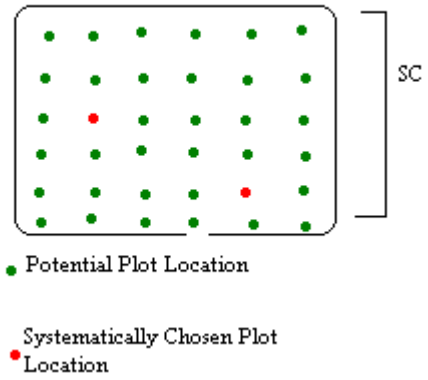

Figure 9 Grid Sampling of SC

The method shown above is just one that can be employed to ensure sampling is representative and without bias.

10.2 Second and Subsequent Thinning Plot Layouts

Rectangular & Square Plots -

In second and subsequent thinning when racks have been created in the crop (normally every 7th row) plots can be taken across these racks.

Plots are generally taken from the middle of one rack across to the middle of the adjacent rack.

Procedure:

Measure from the middle of one rack across to the middle of the adjacent rack (in standard spacing this should be approximately 14 m) ensuring you are measuring square across the rack (if you are unsure you are square you can create a 3,4,5 right angle triangle). Divide the distance into 100 (again this is for a 0.01/ha plot). Measure down the rack the required distance counting all the trees between the two racks.

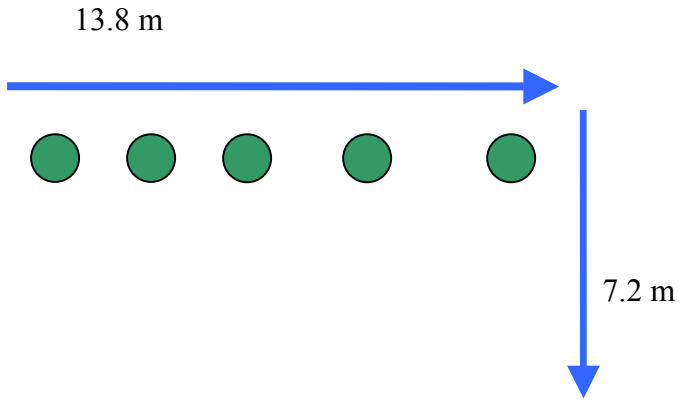

Figure 10 Plot Layout in Second and Subsequent Thinnings (rectangular)

Example:
0.01/ha plot
Distance across two racks = 13.8 m
Distance along racks = 7.2 m
Number of trees counted between two racks = 16
Number of trees a ha = 1600 (16/0.01)

Diamond plots -
Diamond shaped plots of 50 m^2 can also be used. These are most practical when the extraction racks cannot be clearly seen. Diamond shaped plots should be laid out using two intersecting 10 m tapes. The tapes should intersect at right angles at 5 m along the tape length. As standard, only the trees within the plot boundaries are counted.

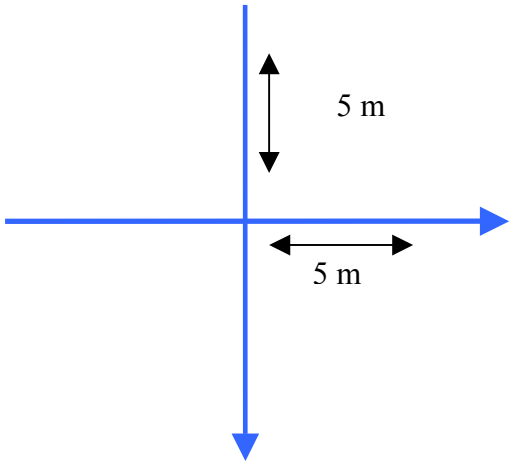

Figure 11 Plot Layout in Second and Subsequent Thinnings (diamond)

Subsequent thinnings
In subsequent thinnings, where rows may no longer be obvious, diamond, square or rectangular plots can be used. However if rows are still obvious the rectangular method is often the most practical method to use.

10.3 Sample General Felling Licence Application Form
F. A. 4.

An Roinn na Mara agus Achmhainní Nádúrtha
Department of Agricu1ture and Food
(Forest Service - An tSeirbhís Foraoise)

FORESTRY ACT. 1946

Section 49

APPLICATION FOR A GENERAL FELLING LICENCE

I. Christian name (in full) and surname of the owner of the land the subject of the application (USE BLOCK CAPITALS).

.....

2. Full postal address of the owner

.....

..... Phone .....

3. Details as to the land:-

Area	Townland(s) in which situated	County	Nature of ownership i.e. whether land is freehold, subject to Annuity, etc.	Total area of woodlands on the land

4. Total area of woodlands falling into the following classifications:-

Type of woodlands	1 -25 years	26 - 50 years	51 -75 years	76 years and over	Various Ages
Conifers					
Broad leaved trees					
Mixed Woods					

5 Details as to felling and planting operations carried out on the land:-

DURING THE LAST YEAR				DURING THE LAST TEN YEARS			
Area or number of trees Felled	Species	Area or number of trees Planted	Species	Area or number of trees Felled	Species	Area or number of trees Planted	Species

6. Area of scrub or cleared land not replanted after felling:-

.....

7. Name(s) of Garda Síochána sub-district(s) in which land is situated:-

.....

8. Purpose for which a general felling licence is required:-

.....

9. Details as to felling and planting operations which it is proposed to have carried out and the period required for completion of same (this should **be submitted on a separate report with a map showing the proposed felling area).**

I hereby apply for a general felling licence in respect of the holding detailed at 3 above **(in accordance with the felling and replanting programme attached).**

Signature *: .....

* If the signatory is not the owner of the land the subject of the application, it should be here stated on what authority he signs on behalf of the said owner:-

.....

10.4 Basal Area Calculation Second and Subsequent Thinnings

Second thinning:

Volume to be removed = BA to be removed x Form Height

BA to be removed = Actual measured BA – Threshold BA + *4 m²*
e.g 41 m² - 35 m² + *4 m²*
= 6 m² + *4 m²*
= 10 m²

Volume to be removed = Basal area to be removed x Form height
Volume = 10 m² X 6.30 (from appendix 10.5 (SS with Top height 16))
10 m² x 6.30 = 63.0 m³

Subsequent thinning:

The procedure is the same as for second thinning except + *2 m²* (instead of + *4 m²*)

Maximum and minimum volume to be removed

A simple check to ensure that the volume removed is not excessive or too low is to use a guide as to maximum and minimum BA to be removed.

Second thinning: Max BA to be removed = 12m²/ha, Min BA to be removed = 6m²/ha

Subsequent thinning: Max BA to be removed = 10m²/ha, Min BA to be removed = 4m²/ha

10.5 Thinning Form Height Table (source: Forestry Commission Field Book 2)

Top Height	Species Sitka spruce	Norway spruce	Douglas fir	Jp/Hybd larch	Euro larch	Scots pine	Ldgpole pine
8.0	2.83	2.52	2.22	2.35	1.70	2.26	2.72
8.5	3.04	2.74	2.43	2.63	1.97	2.50	2.94
9.0	3.26	2.97	2.64	2.91	2.25	2.75	3.17
9.5	3.48	3.19	2.85	3.19	2.52	2.99	3.40
10.0	3.69	3.42	3.06	3.47	2.79	3.23	3.63
10.5	3.91	3.64	3.28	3.75	3.07	3.47	3.85
11.0	4.13	3.87	3.49	4.03	3.34	3.71	4.08
11.5	4.34	4.09	3.70	4.31	3.61	3.95	4.31
12.0	4.56	4.32	3.91	4.59	3.89	4.19	4.53
12.5	4.78	4.54	4.12	4.87	4.16	4.43	4.76
13.0	5.00	4.77	4.33	5.15	4.43	4.67	4.99
13.5	5.21	5.00	4.54	5.43	4.70	4.91	5.21
14.0	5.43	5.22	4.75	5.71	4.98	5.15	5.44
14.5	5.65	5.45	4.96	5.99	5.25	5.40	5.67
15.0	5.86	5.67	5.18	6.27	5.52	5.64	5.89
15.5	6.08	5.90	5.39	6.55	5.80	5.88	6.12
16.0	6.30	6.12	5.60	6.83	6.07	6.12	6.35
16.5	6.52	6.35	5.81	7.11	6.34	6.36	6.57
17.0	6.73	6.57	6.02	7.39	6.62	6.60	6.80
17.5	6.95	6.80	6.23	7.67	6.89	6.84	7.03
18.0	7.17	7.02	6.44	7.95	7.16	7.08	7.26
18.5	7.38	7.25	6.65	8.23	7.44	7.32	7.48
19.0	7.60	7.48	6.86	8.52	7.71	7.56	7.71
19.5	7.82	7.70	7.07	8.80	7.98	7.80	7.94
20.0	8.03	7.93	7.29	9.08	8.26	8.05	8.16
20.5	8.25	8.15	7.50	9.36	8.53	8.29	8.39
21.0	8.47	8.38	7.71	9.64	8.80	8.53	8.62
21.5	8.69	8.60	7.92	9.92	9.08	8.77	8.84
22.0	8.90	8.83	8.13	10.20	9.35	9.01	9.07
22.5	9.12	9.05	8.34	10.48	9.62	9.25	9.30
23.0	9.34	9.28	8.55	10.76	9.89	9.49	9.52
23.5	9.55	9.50	8.76	11.04	10.17	9.73	9.75
24.0	9.77	9.73	8.97	11.32	10.44	9.97	9.98
24.5	9.99	9.96	9.19	11.60	10.71	10.21	10.20
25.0	10.21	10.18	9.40	11.88	10.99	10.45	10.43

10.6 Field Measurement Form

SC No.							
Area (ha)							
Productive Area (%)							
Species							
Plot Size (ha)							
Plot Number							
DBH 8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
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29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
No. Measured Trees							
No.Trees /ha							
Mean DBH (cm)							
Slope ^{O}							
Top Height (m)							

10.7 Sample Site Hazard and Risk Assessment Form

HAZARD INDENTIFICATION - RISK ASSESSMENT

OPERATION _____ LOCATION _____ ACTIVITY_____

HAZARD	CONSEQUENCE	RISK			CONTROLS	PERSON(S) RESPONSIBLE	RESULTANT RISK
		SEVERITY	LIKLIHOOD	NO. OF PEOPLE AFFECTED			

ASSESSMENT COMPLETED BY _____ SEEN BY _____

DATE _____ DATE _____

10.8 Sample Harvest Plan

PART A **HARVESTING SITE PLAN** **Version 1**

Forest: _____ **Property:** _____ **PO No:**_____
Date:_____
Harvest Type **1** ☐ **2** ☐ **S** ☐ **C** ☐ **P** ☐ **W** ☐

Felling Plan Rack Only ☐ Rack & Selection ☐ Selection Only ☐ Rack & Chevron ☐
Full Face ☐
Special Considerations: Archaeology Yes ☐ No ☐ Fisheries Yes ☐ No ☐
Recreation Yes ☐ No ☐ Transmission Lines Yes ☐ No ☐
Other Considerations:_____

Harvesting: Agreed output per week**:**_____**m^3** **Gang size Max:**_____ **Measurement Method:**_____
Start Date:_____ **Completion Date:**_____

Harvest From:_____ am to_____ pm **Days** _to_____(incl)

Thinning Control: Data Attached Yes ☐ No ☐

Agreed Equipment:_____

Person responsible for opening and closing barriers :_____

Removals: Start Date: _____Completion Date: _____Double Handling Required Yes No

Removal From: _____am to_____pm **Days** _____to_____(incl)

Agreed Truck Types: Artic ☐ Rigid ☐ Rigid and Trailer ☐

Person responsible for opening and closing barriers:_____
See Part 2 of Harvesting Site Plan Map for the designated transport route

I hereby agree to carry out the harvesting operation in accordance with the conditions as laid down in Plan.

Vendor:_____**Harvesting Mgr:**_____**Purchaser:**_____

Date: _____**Date:**_____**Date:**_____

PART B **HARVESTED SALES ONLY** **Measurement method for payment**_

Product Specification	Pulpwood		Stakewood		Small Sawlog		Large Sawlog		Other	
	L (m)	TD	L (m)	TD	L (m)	TD	L (m)	TD	L (m)	TD
Harvested Sales Only										

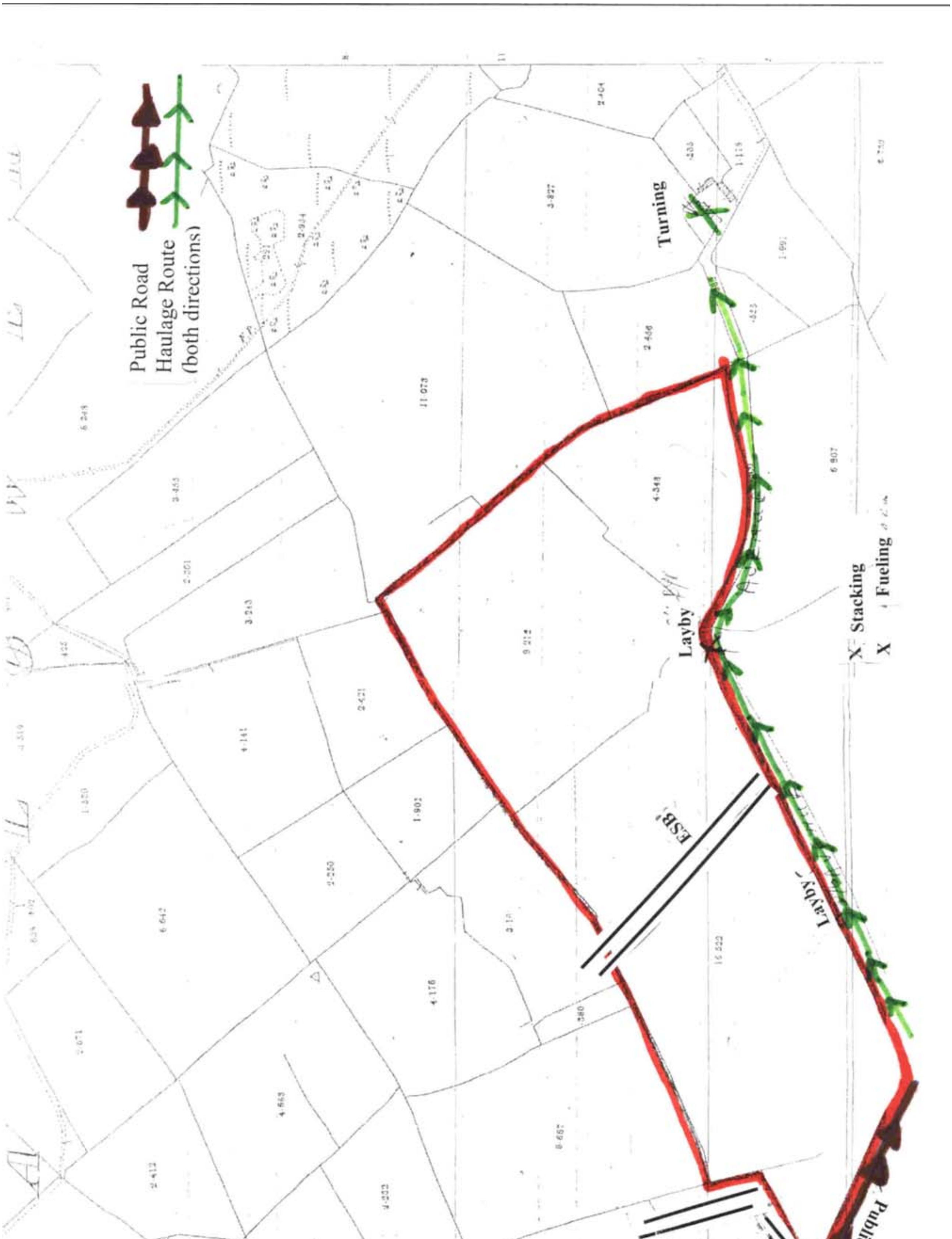
I hereby agree to carry out the Harvesting operation in accordance with the conditions as laid down in the Harvest Site Plan.

Signed: _____**Date:** _____**Signed:** _____**Date:** _____
(Contractor) (Harvesting Manager)

PART C

Agreed Action: I am/ am not satisfied with harvesting operation.
_____
_____

Vendor:_____ **Harvesting Mgr:**_____ **Purchaser:**_____
Date:_____**Date:**_____**Date:**_____


Public Road
Haulage Route
(both directions)
Turning
Layby
X Stacking
X Fueling
ESB
Layby
ESB
Public Road

10.9 Thinning Control Measurement Data Thinning Protocol Sites

Site 1:

Pre Thin Data		Thinning Data		Post Thin Data (Forecast)		Post Thin Data (Actual)
DBH	16.5	**DBH**	14.2	**DBH**	17.3	16.8cm
Stems	2260	**Stems**	676	**Stems**	1584	1560
Basal Area	48.3m^2	**Basal Area**	10.7 m^2	**Basal Area**	37.6 m^2	34.5 m^2
Height	11.7m	**Ave. Stem Volume**	0.065			
Threshold Basal Area	34m^2	**Volume / ha**	44			

Accuracy = 4.12%

Site 2:

Pre Thin Data		Thinning Data		Post Thin Data (Forecast)		Post Thin Data (Actual)
DBH	17.6	**DBH**	15.4	**DBH**	18.4	17.7 cm
Stems	1823	**Stems**	543	**Stems**	1280	1559
Basal Area	44.3	**Basal Area**	10.1 m^2	**Basal Area**	34.2 m^2	38.36 m^2
Height	12.2 m	**Ave. Stem Volume**	0.092			
Threshold Basal Area	34m^2	**Volume / ha**	50			

Accuracy = 3.07 %

Site 3:

Pre Thin Data		Thinning Data		Post Thin Data (Forecast)		Post Thin Data (Actual)
DBH	18.4	**DBH**	16.3	**DBH**	19.2	18.6cm
Stems	1894	**Stems**	585	**Stems**	1309	1669
Basal Area	50.3m^2	**Basal Area**	12.2 m^2	**Basal Area**	38.1 m^2	45m^2
Height	11.5	**Ave. Stem Volume**	0.082			
Threshold Basal Area	34 m^2	**Volume / ha**	48			

Accuracy = 4.25%

10.10 Sample Weight Docket System Outline

The Purchaser shall notify the Vendor's agent before each and every entry onto the site(s). There shall be no entry onto the property for the purpose of removing roundwood, without a properly completed Forest Docket having first been placed in a designated docket box **prior to loading** which authorises the designated party and vehicle, to enter onto the property for the purpose of removing roundwood. Unless otherwise agreed with the Vendor or his agent, entry to the property shall only be permitted between 8.30am and 5pm Monday to Friday.

All Forest Dockets shall be specific to this sale and supplied by or agreed with the Vendor and shall contain the following information:

- Docket Number – each docket shall be numbered in sequence prior to insertion into docket box.
- Date of Load Removal
- Time of Load Removal
- Vehicle Registration Number
- Drivers Name
- Single or Double load
- Estimated tonnage
- Destination of Timber

The corresponding weight tickets/dockets showing the above compatible forest docket numbers for reference shall be forwarded to the Vendor on a weekly basis every Monday for all loads removed in the previous week.

10.10.1 Sample Docket

Forest Docket

Notify for collection of loads:

Section A: To be completed on ARRANGING COLLECTION of load

Docket Number: _____

Forest Name:

Vehicle Registration Number:_____

Drivers Name:_____

Single **(S)** or Double **(D)** load:_____

Estimated Tonnage:_____Tonnes

Destination:_____

Section B: To be completed by DRIVER at arrival on site for lodging into Docket Box before loading

Time of Arrival:_____ Date:_____

Drivers Signature:.....

Section C: To be completed at WEIGHBRIDGE and attached to weight ticket/docket and returned to above address

Weight Ticket/Docket No: _____ NET Weight:_____Tonnes

Signed on behalf of Sawmill: ..... Date:

NOTE: At least 3 copies of each Forest Docket to be made;
One copy with Sections A & B completed should be lodged into the docket box on site before loading and the second copy with Sections A, B & C completed should be **returned to:**

with corresponding weight Ticket/Docket attached each following Monday.

10.11 Load Removal Record Sheet

Forest		Location		Forester/Company	

Date	Time	Docket Number	Vehicle Registration	Product*	Net Weight**

***The product type will only be recorded where there is a separate price per m^3 for each product type.**
**** Net weight is that recorded on the official weighbridge docket.**

10.12 Excerpts of Co-ops Successfully Operating in Australia, Holland, Canada and the USA

Tony Gill who is the founder of several Co-Operatives in Australia has highlighted several market conditions, which are required for successful primary producer groups which are:

- There has to be an agreement as to price; a meeting point at which one party is willing to sell and the other willing to buy. It is this price fixing mechanism that creates a market where transactions can take place because agreements are being made. Many factors influence price agreement but the basic consideration on either side is to make a profit. The seller needs to sell at a price that makes production profitable for them; the buyer needs to buy at a price on which they can make a profit. To that extent the motivations of each are at once the same, but also antagonistic. The producer is seeking the highest price they can obtain and the buyer the lowest.

- Prices will be influenced by the relative bargaining strengths of buyers and sellers. If there are urgent financial or other reasons for sellers to sell or if supply levels are high and demand low, the advantage lies with the buyers. If the contrary is the case, the advantage lies with the sellers. If there are a lot of small sellers and few buyers, the advantage will lie with the buyers.

- Prices offered and accepted can be substantially influenced by information, or perhaps more importantly lack of it, as to prices available at markets in other places.

Other examples of co-operative forestry at work are:

- The Sustainable Woods Cooperative is based in southern Wisconsin west of Madison. The organization is about three years old and has 120 members representing over 20,000 acres of privately owned land. All members must manage their land under a plan that has been certified as sustainable. There are several consulting foresters involved in the forest management. The co-op currently has a small sawmill and solar dry kiln, and the objective is to manufacture lumber for builders and other customers who specify hardwood products from certified sustainable forests. The Sustainable Woods Cooperative represents the most sophisticated type of operation. A co-op could be organized simply to market logs or stumpage and does not necessarily have to be based on certified sustainability. Co-op members need to consider what advantages they can create by adding value to their forest outputs or improving management of their property. Marketing of non-wood forest products through a co-operative is a possibility, for example.

- A major influence on the development of the Dutch forest co-operatives in the next few years will be the changing policy of the Dutch government towards forestry. More and more, the government has choosen to address the forest owners through the co-operatives. The role of the co-operative as an intermediate between forest owners and government will become much more prominent.

- In Canada Allex White believes that the co-op model provides a flexibility that allows for other types of businesses to operate within it, such as NTFPs and value added products, which maximize the value of each acre of land, and also retain most of the profits within the community. All of these factors make the co-operative forestry model an excellent choice for community enhancement and development, and will hopefully result in the expansion of current co-ops and the development of many new ones.

- In Finland, for example, nearly 206 landowner associations have developed across the country since 1907, providing education and consulting services for over 330,000 landowners. Some other programs that are succeeding:

- In Nova Scotia, Canada, the Athol Forestry Cooperative started in 1977 with Roy Hoeg and 11 other landowners sitting around a kitchen table and talking about how they might work together. The co-op was initially nurtured by government grants, and five years ago started a profitable forest management business that has made it self-sufficient.

- In Sweden, government incentives and a socialist culture have spurred cooperatives for everything from housing to insurance. Södra in southern Sweden was started in the 1930s by forester Gösta Eström and it's now the world's largest forestry cooperative — 34,000 forest owners, covering almost half of the private land in the lower part of the country. Södra is now so large it hardly fits the folksy "co-op" term; like any U.S. timber company it has big pulp and lumber mills and a shiny corporate headquarters. Still, each landowner- member receives assistance with forest management and PEFC certification, participates in regional workshops, buys stock and votes.

10.13 Glossary

Brashing The removal of branches up to two metres to facilitate the inspection of plantation. Takes place when crop has closed in and the lower branches of the trees are dead.

Clearfell The cutting down of all trees on an area of more than 0.25ha

DBH (Diameter Breast Height) - Diameter of the stem measured at 1.3 m above ground level

MAI (Mean Annual Increment) The average yearly (volume) increment over the rotation, calculated as the total volume production divided by the rotation age.

Thinning cycle The interval measured in years between each thinning. The thinning cycle will depend on the Yield Class of the crop with a high yield class generally resulting in a short cycle and a low yield class resulting in a longer cycle. Typical cycles are from 3 years for crops with a very vigorous growth rate, 4 to 6 years for crops with a fairly vigorous growth rate and 7 to 10 years for crops with slower growth rates.

Thinning intensity is regarded as the proportion of the crop volume removed over the rotation. It can be represented as a percentage of the maximum mean annual increment (yield class) removed. The thinning intensity can be calculated for any species if the yield class is known. The removal of 70% of the yield class each year from first thinning on is known as the marginal thinning intensity. This is estimated to be the maximum annual amount, which can be removed without reducing the crop's cumulative volume production.

Thinning yield is the actual volume removed from a stand in any one thinning. If a fully stocked stand is thinned at the marginal thinning intensity, the thinning yield is calculated as 70% of the crops yield class multiplied by the thinning cycle. The resulting volume is calculated on a per hectare basis. Therefore a crop of yield class 20 thinned on a 4 year thinning cycle would have a thinning yield of 56 m^3 per hectare (70% of 20m^3/ha/yr* 4 yrs = 56 m^3).

Thicket stage The stage after planting and before pole stage when young trees have grown up enough to form a dense thicket.

Windthrow The overturning or uprooting of trees due to wind (usually the root plate remains intact).

Yield class A classification of rate of growth in terms of the potential maximum mean annual increment per hectare of volume to 7 cm top diameter (m^3/ha/annum), irrespective of age of culmination, or of tree species.

To be put into a pouch as will require updating on a regular basis

- Sample Forest Service Application Forms- for copying

-Form 1 and Form 2 etc., pruning grants etc.

-Roading grant application forms and grant details.

-Local planning forms

-Other relevant documentation