REPORT OF THE
VIRGINIA DEPARTMENT OF FORESTRY ON

Feasibility of Helicopter Logging in the Commonwealth

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 18

COMMONWEALTH OF VIRGINIA
RICHMOND
1991

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The Honorable L. Douglas Wilder
Governor of Virginia
and
The General Assembly of Virginia

The report transmitted herewith is pursuant to House Joint Resolution No. 201 of the 1990 Session of the General Assembly of Virginia. The Resolution requested the Department of Forestry to study the feasibility of helicopter logging in the Commonwealth and submit the report to the 1991 Session of the General Assembly.

Respectfully submitted,

James W. Garner
State Forester

EXECUTIVE SUMMARY

Pursuant to 1990 House Joint Resolution No. 201, the Virginia Department of Forestry was requested "to study the feasibility of helicopter logging in the Commonwealth."

During the course of the study the Department examined (1) the volume of timber necessary to operate helicopter logging; (2) types and sizes of helicopters used or needed for an operation and their availability; (3) the cost-effectiveness of helicopter logging compared with cable and traditional logging; and (4) the relative environmental benefits of helicopter logging.

The following study results relate to Virginia and the eastern United States unless otherwise noted (see Appendix C and D for methods, processes and examples).

(1) Helicopter logging in Virginia and the eastern United States is more expensive than cable or traditional logging.

(2) Generally, helicopter logging has been economically justified in special situations such as hurricane Hugo damaged forests, in experimental operations by large wood using companies, and on property where high value timber species are removed prior to selling the land.

(3) Cable logging is more expensive than traditional logging and has occurred mostly on U.S. Forest Service timber sale areas where strict controls dictate this type operation.

(4) The environmental impact of helicopter logging is low due to reduced road building and skidding activity.

Introduction

House Joint Resolution No. 201 (see Appendix A) requested the Virginia Department of Forestry to conduct a study of the feasibility of helicopter logging in the Commonwealth.

The request was generated from environmental concerns that the Commonwealth reduce soil erosion and maintain water quality (paragraph 4 of Resolution No. 201). Recognizing the importance of the forest products industry to Virginia is also an important part of the Resolution (paragraphs 1,2,3 of Resolution No. 201). If helicopter logging is determined to be economically feasible and have relatively greater environmental benefits, the technique could give Virginia's wood industry the competitive edge in some market areas.

The wood manufacturing industry is a large and important business in Virginia (Ref. 1). It contributes over $4 billion annually to the state's economy and accounts for 1 of 6 manufacturing jobs. The industry employs over 60,000 people in 7 pulpmills, 380 sawmills, 9 veneer plants and over 500 secondary manufacturing plants. The industry purchases over $150 million of timber annually from landowners to harvest and manufacture into products. Any improvement in the overall system of harvesting, transporting, and processing wood would benefit the industry and the Commonwealth.

Methods of logging commercial forests in Virginia have been dictated by the free market conditions since colonial times. Animals and wagons did the job until the steam engine and railroads entered the picture in the 1800's. After WW II cleated tractors came to the woods, and with farm-type rubber-tired tractors, provided a system of moving logs from the stump to landings. By the early to mid-1960s, rubber-tired skidders had become the principal method of skidding, especially, in flat and rolling terrain. Cleated tractors were the dominant vehicle in the steeper areas. By the mid to late 1970's, rubber-tired skidders were used in practically all areas, with cleated tractors being used primarily for road building and logging on the steepest of slopes. This method considered traditional logging.

New methods of logging have been tried as environmental concerns increase and timber supplies decrease. Cable logging was used in the east on private property in the 1970's during a tight timber supply period. This system is still in use on U.S. Forest Service property where the terrain is very steep, in aesthetically sensitive areas and in remote areas too isolated for traditional logging techniques.

In Eastern coastal areas companies are trying a combination of cables and mats to log swampy areas. Helicopters have also been tried in unique situations. However, traditional logging remains the preferred system to supply timber for the wood industry.

Study Method

The two geographical areas in the state where helicopter logging most likely would occur are the Coastal Plain area (swampy and wet conditions) and the Moun

tain area (steep terrain) (Fig. 1). These two areas were studied to obtain data and information relative to the Resolution.

Information and cost data were obtained by visiting logging sites, personal and telephone contacts, and correspondence.

There are academic studies suggesting how to calculate logging costs and evaluate environmental impacts. Due to time and funding constraints, the method used for this study was direct contact with on-going operations. Generally the logging systems have no set method for determining costs and each logging operation is negotiated separately; therefore, real costs are difficult to generate. A range in logging costs was the general data obtained. Environmental impact information was derived using the same method. Personal knowledge of logging systems for all three situations (helicopter, cable, and traditional logging) was used to develop conclusions and recommendations.

Conclusions

Contacts with various companies and individuals performing logging operations provided information for this report. The study provided data to answer the four main points requested by the Resolution:

1. **Volume of timber necessary for cost efficiency -**

   Since the majority of helicopter logging operations have occurred in the western United States the only written minimum volume figure was provided by the Helicopter Loggers Association (Appendix B, "Helicopter Timber Sale Preparation Video Script"). The accepted minimum timber volume in the western U. S. is 2.5 million board feet. Discussions with companies in Virginia, North Carolina, and South Carolina that have tried helicopters or examined the possibility of helicopter logging stated:
   "Helicopter companies would like to have at least 5 million board feet to log in an area (could be in a fairly large geographical area - Virginia and North Carolina). They require at least 1 million board feet for any specific location and prefer as few log concentration landings as possible. Turn- around times of less than 3 minutes from stump to landing and back are necessary for daily production quotas of 50-100,00 board feet." Many other factors associated with helicopter logging are covered in the script.

VIRGINIA

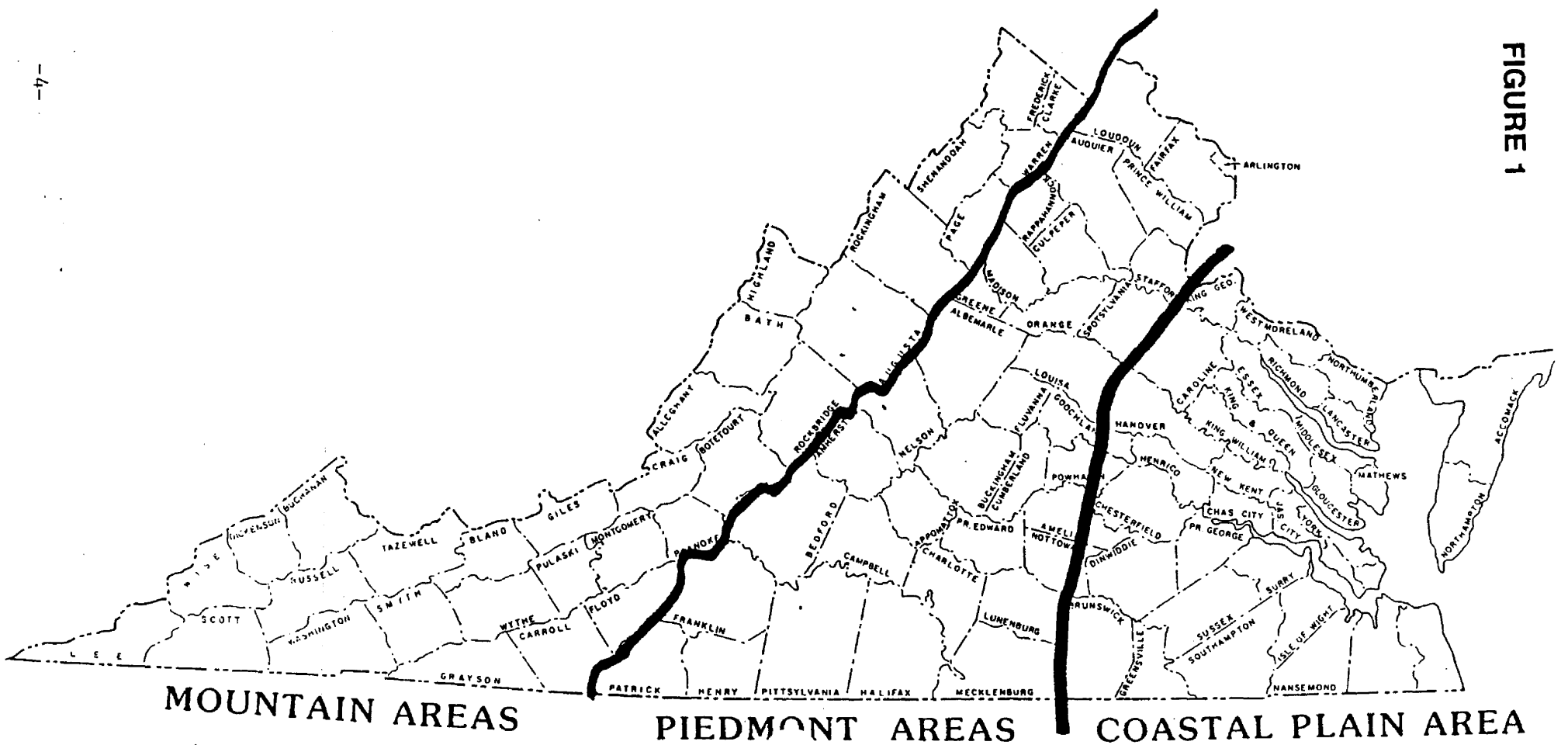

FIGURE 1

2. **Types and sizes of helicopters needed, as well as their availability:**

Helicopters used for logging are listed below (Appendix A):

Helicopter	Maximum Payload Pounds	Average Production (truckloads/day)
Hiller 12-E	1,200	
Jet Ranger	1,200	
Bell 205	5,000	6-10
Sikorsky S58	5,000	15-20
Bell 214	8,000	20-25
Boeing Vertol 107	11,500	25-30
Super Puma	9,900	25-30
Sikorsky S61	11,000	25-30
Sikorsky S64	20,000	40-50

In the east, except in areas affected by hurricane Hugo, the principal machine used has been the Boeing Vertol 107. The Bell 205 has been used in a few situations, but its limited payload makes it a less desirable machine in most cases. The Vertol 107's hourly charge is $2,200 while the Bell 205 costs $1,500. The economic advantage of the Vertol 107 is obvious. Availability of helicopters for logging is limited because most companies specializing in this type of logging are located on the West Coast.

3. **The cost-effectiveness of helicopter logging when compared with cable logging and traditional logging -**

Data was gathered for two of Virginia's geographical areas where helicopter logging would most likely occur (Fig.1). Companies contacted gave a range of cost(s) per thousand board feet based on individual tract characteristics and other factors. On some logging jobs, major road building may be a separate contract and additional expense. Costs shown include delivery of logs to the mills.

Table 1. Logging Cost Per Thousand Board Feet

Logging Type	Coastal Regions	Mountain Region
Traditional	$ 60 - 75	$ 90 - 135
Cable	$ 100 - 150	$ 150 -200
Helicopter	$ 220 - 225	$ 230 +

4. **The relative environmental benefits of helicopter logging -**

Generally, helicopter logging creates less site disturbance than cable or traditional logging because fewer roads and skid trails are needed. However, using existing equipment, pre-planning and proper implementation or use of Best Management Practices (Ref. 2), traditional logging can effectively be used to harvest the majority of Virginia's timber with minimum environmental impact. Sensitive areas which cannot be harvested by traditional means without unacceptable site disturbance should be logged using cable or helicopter systems.

Recommendations:

1. Cable or helicopter logging should be recommended on sensitive areas which cannot or should not be logged by traditional means without unacceptable site disturbance.

2. A pilot project should be undertaken in order to obtain cost data and determine more specifically the criteria necessary for some helicopter logging in Virginia.

Appendix A - Resolution No. 201
Appendix B - Helicopter Timber Sale Preparation
Video Script - "An Introduction to Helicopter Logging" Appendix
Appendix C - Logging Methods and Processes
Appendix D - Example of Cable Logging

References

(1) "Virginia's Forests - Our Commonwealth" - Virginia Department of Forestry

(2) Forestry Best Management Practices for Water Quality in Virginia - Virginia Department of Forestry - 1989

1990 SESSION

LD4196462

HOUSE JOINT RESOLUTION NO. 201

Offered January 23, 1990

Requesting the Department of Forestry to study the feasibility of helicopter logging in the Commonwealth.

Patron—Giesen

Referred to the Committee on Conservation and Natural Resources

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WHEREAS, the forest products industry contributes $4.2 billion annually to the economy; and

WHEREAS, there are 600 loggers, seven pulp and paper mills, and over 100 sawmills in Virginia; and

WHEREAS, the forest products industry provides over 135,000 jobs in the Commonwealth, and some branch of the industry is located in every Virginia locality; and

WHEREAS, the forest products industry has long been concerned with water quality and soil erosion issues, both environmentally and aesthetically; and

WHEREAS, helicopter logging is relatively new to the Eastern United States, the only such operation currently located in Alabama; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the Department of Forestry is requested to study the feasibility of helicopter logging in Virginia. The study shall include, among other things, (i) the volume of timber necessary for cost efficiency; (ii) types and sizes of helicopters needed, as well as their availability; (iii) the cost-effectiveness of helicopter logging when compared with cable logging and traditional logging; and (iv) the relative environmental benefits of helicopter logging.

The Department shall complete its work in time to submit its findings and recommendations to the Governor and the 1991 Session of the General Assembly as provided in the procedures of the Division of Legislative Automated Systems for processing legislative documents.

Official Use By Clerks	
Agreed to By The House of Delegates	**Agreed to By The Senate**
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with amendment ☐	with amendment ☐
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Clerk of the House of Delegates	Clerk of the Senate

APPENDIX C

LOGGING METHODS AND PROCESSES

Traditional Logging - **Uses bulldozers for road building, chainsaws and/or mechanical felling equipment, rubber tired or cleated tractors for skidding logs to landing, trucks for transporting logs to mills.**

1. Build main haul road(s).
2. Select & develop log landing area.
3. Fell trees (may require bucking into logs in woods).
4. Skid logs to landing (may require building skid trail(s)).
5. Load logs onto trucks.
6. Transport to mill.

Cable Logging - **Same as traditional logging except a machine with cables draws logs to the landing (uses less road building). Can be used on steep slopes or flat terrain.**

1. Build main haul road(s).
2. Select & develop log landing area.
3. Fell trees (may require bucking into logs in woods).
4. Use cable system to bring logs to landing (no other roads - usually).
5. Move trees by skidder or tractor to bucking and/or loading-site (close by).
6. Load trucks.
7. Transport logs to mill.

Helicopter Logging - **Same as traditional and cable logging except logs lifted to landing by helicopter (less road building and site disturbance).**

1. Build main haul road(s).
2. Select & develop log landing area.
3. Fells trees (may require bucking into logs in woods).
4. Lift logs by helicopter and move to landing.
5. Cut logs into desired lengths and load onto trucks.
6. Transport logs to mill.

APPENDIX B

HELICOPTER TIMBER SALE PREPARATION VIDEO
"An Introduction to Helicopter Logging"

A training video for the planning, design, layout, and administration of helicopter timber sales. 41 minutes.

Prepared by: USDA - Forest Service
Region 6, Timber Management
Portland, Oregon

and

Helicopter Loggers Association
Wilsonville, Oregon

February 18, 1988

HELICOPTER TIMBER SALE PREPARATION VIDEO

HISTORY - The first trail of helicopters in logging was in Scotland in 1956. This initial operation, along with numerous other experimental programs in Russia, Canada, and Norway through the late 50's and 60's showed that logging with a helicopter had potential. The first US Forest Service timber sale with helicopter was on the Plumas NF in California purchased by Erickson Lumber Co. of Marysville California and logged by Columbia Construction Helicopters of Portland Oregon. This initial commercial venture proved that vertical logging was indeed an economic reality.

Since that first sale in 1971, the helicopter logging industry has logged approximately 4 billion board feet. That's enough wood to build over 360,000 homes. The industry has a current capacity to log 1 billion board feet per year. This capacity included all Forest Service regions as well as other public and private lands.

DESCRIPTION - Helicopter logging operations are highly mobile and fast moving with daily production rates up to 50 truck loads per day depending on aircraft and timber sale design. Different sized ships are currently used in logging covering a range of payloads. Payload for each ship varies depending on temperature and altitude. Helicopters used for logging are listed below:

Helicopter	Maximum Payload (pounds)	Average Production (truckloads/day)
Hiller 12-E	1,200	
Jet Ranger	1,200	
Bell 205	5,000	6-10
Sikorsky S58	5,000	15-20
Bell 214	8,000	20-25
Boeing Vertol 107	11,500	25-30
Super Puma	9,900	25-30
Sikorsky S61	11,000	25-30
Sikorsky S64	20,000	40-50

The S-64, S-61, and BV-107 account for most of the helicopter logging currently being done. These ships are large and powerful. Specifications are listed below:

	S-64	S-61	BV-107
Length	88'6"	72'10"	83'4"
Width	72'	62'	50'
Height	25'5"	17'	17'
Wheel base	19'9" wide 24'5" long	13' wide 23'5" long	14'5" wide 24'9" long
Cruising speed	95 knots	120 knots	120 knots
Fuel capacity	1345 gallons	500 gallons	350 gallons
Shaft horsepower	4500/engine	1500/engine	1500/engine

FUEL LOAD AND FLYING TIME - Helicopters can carry enough fuel to fly for 1 to 2 hours. However, to maximize efficiency of the logging operation, the fuel cycle is usually reduced to 40-60 minutes.

YARDING CYCLE - The helicopter yarding cycle consists of four elements:

1) hook
2) fly in
3) unhook
4) fly out

CREW - A helicopter logging operation usually requires from 13 to 31 personnel. These include:

Felling crew:	5-10 fellers and buckers
Yarding crew:	3-4 pilots, 4-6 men on woods crew (choker setters and hookers)
Landing crew:	2 loader operators, 3 landing chasers
Maintenance crew:	4 maintenance personnel
Supervisory personnel:	1 woods boss, 1 felling boss

SPECIAL PRODUCTS - Ships with lift capacities less than 6,000 pounds are sometimes used for yarding logs, but they are usually used for:

1) removal of special products such as cedar shake bolts
2) hauling chokers and personnel to support the larger ships
3) heli-torching
4) spraying

WHEN AND WHERE TO CONSIDER HELICOPTER LOGGING - It is appropriate to consider helicopter logging in the following areas:

Environmentally sensitive areas: The helicopter is particularly valuable when considering environmentally sensitive areas. These include high-use recreational areas, special wildlife habitat areas, SMU's, politically sensitive areas, archeological sites, sensitive landscapes, and problem soils areas.

Catastrophic damage areas: Fire, insect epidemics, and disease. The ability of the helicopter to produce large volumes of logs quickly, means that damaged timber can be salvaged quickly before it deteriorates. This capability provides a means to limit insect epidemics by removing infested trees thereby interrupting the insect life cycle. Fore example, the S-64 can produce 40-50 truckloads of logs daily, the S-61 and Boeing Vertol can each produce between 20-30 loads per day.

Areas previously considered uneconomical due to scatter volume: This includes isolated blow down which is not readily accessible by conventional logging.

Inaccessible areas: This includes areas considered too costly for conventional logging, due to high road construction and maintenance costs. The helicopter provides an alternative for timber harvest without access roads. Another example of an inaccessible area would be timber such as you see here, unreachable by conventional systems, due to these rock bluffs.

Areas where a less expensive logging system will not meet resource management objectives.

"I've worked with the forest industry for more than forty years. During that time I've used most of the logging systems. The last sixteen I've worked with the helicopter logging system in development and utilization. When this tool is used properly, there can be immediate and long term benefits. But we should be careful not to use it where another system can be more economical and still meet environmental concerns." (Steve Martin, Helicopter Loggers Association)

PLANNING CONSIDERATIONS - An integrated area analysis and logging plan for an entire drainage or other logical area encompassing the sale should be developed as part of the timber sale planning process. The logging plan is an essential link between the sale planning team, appraiser, administrator, and the logger. The final logging plan is documented in the logging feasibility report. It is the vehicle that provides the link between the decisions that were made and documented in the timber sale Environmental Assessment and the timber sale contract which legally governs the logging activities that are carried out on the ground.

"In analyzing a particular area for timber harvest, an important step is to determine which logging/transportation system or systems can meet resource management objectives. After this has been done, the planner must determine economic tradeoffs of the alternatives. When comparing the logging costs of conventional systems with those of a helicopter, it is important to consider more than merely a comparison of the yarding costs for the first entry. For example:

1) Many times when comparing the cost of necessary road construction and cable yarding costs to helicopter yarding costs and no road construction, the comparison indicates that helicopter yarding is the least cost method to access the area. However, if the first entry pays for the roads, future stand management activities and entries to adjacent stands can be accomplished at a reduced cost. The planning team must therefore consider the long term benefit of the road.

2) In a two-story stand with a releasable understory if a cable system would require clearcutting and the helicopter system could leave an adequately stocked stand, the cable logging costs and all regeneration costs must be compared to the helicopter logging cost. Here we should also make an analysis of the future stand management possible with both systems. Some factors to consider here are fire hazard reduction, site preparation, pre-commercial thinning, etc.

3) There is a misconception that once we log an area with a helicopter, we have dedicated it to helicopter management forever. This is not always the case. For example, sometimes an overstory removal cut with a helicopter could be the appropriate first entry and the second entry could be to clearcut with cable system. For another example, in a shelterwood cut, the first entry could be skyline logged with a slack pulling carriage, and the final removal accomplished by helicopter, and the third entry could be done by skyline. All this could be accomplished to the same landings.

4) Fire hazard reduction, if necessary, is usually more expensive with the helicopter.

5) In cases the total costs of both systems are equal, and there are no built in advantages to either system, the FS will probably receive a higher bid for stumpage if a cable system is used. This is because there is more competition of cable sales.

So, if in the early planning stages if appears that (1) the helicopter is the most economical system or (2) the helicopter is the only logging system that is capable of meeting the resource management objectives, then we continue our general economic analysis considering such factors as minimum and maximum sale volumes.

MINIMUM SALE VOLUME - For most areas in the Pacific NW excluding Canada and Alaska 2.5 MMBF is a good rule of thumb for a minimum sale volume. This is only about 3 to 3.5 weeks work for a Sikorsky S61 or a Boeing Vertol, or about 2 weeks work for a Sikorski S64. On occasion smaller sales will sell, but there is a risk of loosing sale preparation costs.

MAXIMUM SALE VOLUME - Maximum sale volume should be determined by the local economy. For example, an extreme case would be in a community with only one local mill with an annual cut of 30 MMBF. A 15 MMBF helicopter sale in this area could obviously reduce volume for local loggers, and possibly by beyond the mill's ability to unload 25-45 truck loads per day. In this type of area, a 3-5 MMBF helicopter sale would be more desirable from a socioeconomic standpoint.

This size sale could possibly be logged when other logging is off season. This can then create a positive economic effect on the community.

Positive economic effects which can result from a helicopter sale are as follows: (1) provides timber which is otherwise unobtainable (2) provides some work for local people such as log truckers, fellers, woods crews, etc. (3) local merchants have an influx of 25-50 people who are active in the local economy." (Jim Neal, Helicopter Loggers Association)

MIXED LOGGING SYSTEMS - Mixing logging systems in the same sale can be accomplished with careful design. The helicopter industry both purchases sales and contract logs. So whatever fits best with the local economy and meets the resource management objectives should guide the decision as long as there is sufficient volume for each system to be financially viable. For example, a 5 MMBF cable sale with a 500 MBF helicopter unit may not be feasible for either a helicopter company or a local purchaser to buy.

UNIT LOCATION SIZE AND SHAPE - Location of units in respect to landings will be considered first. There has been considerable energy spent on finding maximum yarding distances. The fact is that the helicopters currently used for logging can carry enough fuel to fly approximately two hours at 90 knots. But the average product value of most our timber dictates that in most cases the weighted average yarding distance should be under one mile. The maximum uphill elevation difference from the centroid of the unit volume to the landing should be less than 1000 feet and the maximum downhill elevation difference should be less than 2000 feet. When the direct flight grade (100* elevation difference/average yarding distance) would exceed 25%, an adjustment is appropriate to reflect a more accurate yarding distance. The following equation can be used for the adjustment in this case:

AVERAGE YARDING DISTANCE adjusted = ELEVATION DIFFERENCE/.25

Now let's consider the location of units with respect to other units. Units may be scattered throughout different drainages as long as there is at least 500 MBF coming to each landing with an average weighted yarding distance of less than one mile. There are exceptions to this guide when there are several landings in close proximity for flexibility or when timber quality and value is exceptionally high.

Finally we will consider the size and shape of units. The helicopter does not care how big or what shape a unit is. One 40 acre square clearcut verses ten four-acre odd-shaped units does not affect the operation of the helicopter. The biggest additional expense comes from felling small scattered units where additional directional felling effort is needed to keep trees within the unit, and where walking time between the units is increased.

LANDINGS - Three types of landings must be considered in planning a helicopter sale. These include: log landings, service landings, and helispots.

LOG LANDINGS - Log landings should be located so that there is at least 500 MBF within an average weighted yarding distance of one mile of each landing. All other factors being equal, if there is a landing on the ridgetop and one in the valley bottom, approximately 1/3 will go uphill, and the bottom 2/3 will go downhill. This is mainly due to faster flying times and slightly larger turns when flying downhill.

Normally, the shorter the flying distance, the less the yarding cost. However, such items as wind direction, fog, snow, and available landing space, etc. can also affect costs. The

ideal situation is for the sale planner/logging specialist to find landing locations which make the sale operable, and then allow the operator the flexibility to utilize additional landing locations which meet resource management objectives.

Helicopter log landings normally require about one acre for a safe, efficient operation. This size usually fulfills OSHA requirements for helicopter landings which are: (1) the landing drop zone shall not be less than 125 feet from the loading or decking area. (2) The landing drop zone shall be at least twice the nominal length of logs to be landed.

Unlike cable and tractor landings, helicopter landings normally must accommodate two loaders. A wheel loader is normally used to keep the drop zone from plugging while either a second wheel loader or a grapple loader loads trucks. Variable affecting helicopter landing size include:

1) Amount of volume coming to the landing
2) Amount of slash coming to the landing
3) Nominal log lengths
4) Number of log sorts
5) Average number of logs per turn
6) Flight path approach

If a one-acre flat exits for a landing, there are many ways to restore it following logging, or it may be preserved for future sale activity. This beach on Rimrock Lake in the Wenatchee National Forest was used as a log landing for approximately 3 MMBF. Erickson Skycrane removed the stock ramps, put 15 inches of gravel on this paved parking lot, and logged approximately 4 MMBF to this trailhead to the Marble Mountain Wilderness Area on the Klamath National Forest several years ago.

When a full acre is not available for a landing, there are other options which are operable and which meet OSHA requirements such as: (1) Two or three smaller landings in the immediate vicinity can be used simultaneously. In this case the loaders are split up. Logs are dropped at one landing while loading occurs at another. (2) When it is possible to temporarily close a road, the road bed and existing turnouts can be used for a drop zone. A grapple loader follows to load trucks.

When a road is unnecessarily designated to be kept open in the timber sale contract, flexibility concerning its use for landing logs is lost unless the timber sale contract is modified after the sale had been awarded.

Flight path approach to each landing must be considered. A vertical descent to land logs should be avoided. A flight path must sometimes be cut through surrounding trees. Flight path clearing areas are best decided upon by the sale administrator and the purchasers representative after the flight path has been established. OSHA requirements for helicopter landing approach path is as follows: The approach to the landing shall be clear enough to prevent tree tops from being pulled into the landing.

Helicopter log landings should not exceed a 5-6% grade. A grade of at least 1-2% assists with drainage if necessary. Near streams, settling area for runoff water may be required.

Dust abatement is necessary on most landings. Water has proven to be the best for both economic and environmental reasons.

Although nearly all helicopter log landings are on land, it is possible to land logs in water. Floating chokers are recovered by boom boats.

SERVICE LANDINGS - Service landing are needed for the purpose of maintaining and fueling the logging helicopter and support ship. OSHA requires a separate helicopter service landing as follows: "Separate areas shall be designated for landing logs and fueling the helicopter."

The service landing should be as close to the log landing as possible to reduce the flight time with no payload.

The service landing must normally be 1/4 to 1/2 acre in size, depending on ship size and terrain, to be large enough to accommodate the following equipment and to allow sufficient rotor blade clearance:

1) Logging helicopter
2) Service van
3) Generator
4) Fuel storage (usually 10,000 gallons)
5) Fire equipment
    a. 1,000 gallon water bucket
    b. Fire tool box and trailer
6) Small support ship
7) 2-3 support vehicles
8) Watchman's trailer (may be off landing)

The service landing can be shaped in a variety of ways. There must be a flat spot large enough to accommodate the helicopter's wheel base and to provide rotor blade clearance. See dimensions for various ships.

Dust abatement is provided by placement of clean gravel on the actual landing pad, and water as needed.

LANDING DESIGNATION - Sufficient helicopter log landings and service landings should be designated on the Sale Area Map and included in the Sale Area Boundary to operate the sale. Bidders and the purchaser then have a clear understanding of maximum flying distances involved.

HELISPOTS - Helispots are normally located within the cutting units when needed on the sale to transport crews. Usually there location, size, and flight path clearing are decided by the sale administrator and purchaser's representative.

SILVICULTURAL PRESCRIPTION - The helicopter can be used effectively for any silvicultural prescription that is financially viable, and that does not require scarification during yarding. Helicopter logging considerations for each of the even-age silvicultural prescriptions are as follows:

Regeneration cuts:

Clearcutting - Advantages 1) The helicopter has the advantage of being able to operate small odd-shaped clearcuts at nearly the same cost as large contiguous clearcuts.

Disadvantages

1) In an uneven aged stand, or a mixed species stand, a clearcutting prescription can increase the logging cost and decrease the average product value to an unacceptable or inoperable level.
2) Slash disposal requirements can render an entire sale financially infeasible.
3) Site preparation costs may be more expensive of financially infeasible due to inaccessibility of the unit and due to the lack of scarification.
4) Pre-commercial and commercial thinning may not be financially feasible due to inaccessibility.

Seed-tree and shelterwood

Advantages 1) The helicopter has the capability of saving the understory in most 2-3 age stands where conventional systems cannot. There are may cases where the helicopter has removed up to 30 MBF per acre in one entry and left an adequately stocked understory. This allows us to:

1) Practice even-age timber management where clearcutting is unacceptable.
2) Alleviate expensive regeneration costs including slash disposal, site preparation, and planting.
3) Reduce risk of regeneration failure due to harsh site or brush invasion.

Disadvantages

1) It must be realized that the annual growth may be less than we could attain by clearcutting because the regenerated stand may achieve acceptable growth, but may be less vigorous than a planted stand.

Intermediate cuts:

Commercial thinning - Commercial thinning with a helicopter is physically possible, but the product value usually in not high enough to make it financially feasible.

Special treatments for visuals, soils, etc:

"A typical example of where helicopter logging would be helpful in sensitive areas would be those situations where we have very steep topography and highly erodible soils, where removal of some trees would not be detrimental but the means of yarding these trees could be damaging to the soil, and in this case the helicopter provides a means to do that.

In visually sensitive areas where we want to maintain some tree cover and at the same time have the opportunity to utilize some of the value in the timber volume that has accumulated there, the helicopter would allow us to partially remove the trees and still retain and acceptable visual setting." (Ralph Jaskowski, USFS Silviculturist)

In deciding which silvicultural prescription, or combination of prescriptions to use, we must consider:

1) resource management objectives
2) logging costs
3) product value
4) slash disposal and site preparation costs
5) future management

We severely limit the helicopter's potential to accomplish resource management objectives if we insist on using conventional criteria and parameters.

In environmentally sensitive areas, it must be realized that if our choices are to helicopter log or not manage the timber resource at all, certain tradeoffs may be appropriate. For example, a special treatment which meet visual or soil resource management objectives may be appropriate even though the timber resource cannot be intensively managed. These areas may be intentionally managed for less productivity.

"It seems like it is a perfectly viable option to use the helicopter to treat sensitive areas and not necessarily practice the most intense timber management that we are capable of doing in other areas. There are many silvicultural regimes which would benefit the stand, would capture some of the volume that we've grown on the area, but not necessarily practice the intensive tree farming that would give maximum timber production. What we have to recognize is if we are going to do less than the maximum technical timber management that we know how to do, we are making trade-offs; we are buying something by trading off and we are giving up something. If we are giving up timber growth, we need to look at our approved plans and see whether the area actually calls for maximum timber production. If

the managing for less than maximum timber production is acceptable within the overall plans that we have, then there are many types of moderate intensity or low intensity regimes that can be used and still maintain a good productive forest on the site."(Ralph Jaszkowski, USFS Silviculturist)

LOGGING COST - Many times a sale planning team can design a sale which would appraise out with normal profit only to have the timber marking crew destroy or damage the financial viability of the sale. Timber marking crews must understand the limitations and cost variables affecting helicopter logging. For example, marking scattered trees which neither make an efficient turn nor meet the silvicultural objective only increases logging costs. The use of optional areas have been used successfully in marginal areas.

OPTIONAL AREA CONCEPT - In marginal timber or when average weighted yarding distances exceed one mile, it may be appropriate to designate some of the units with longer flying distances as "timber subject to agreement" C2.11#, 2400-6 timber sale contract. Utilization specifications are listed separately in A-2, 2400-6 contract, and may be different than other included timber not subject to agreement. Fore example, on this map, areas within the sale area boundary, but outside of the unit boundaries could be optional areas.

UTILIZATION SPECIFICATIONS - Utilization specifications stated in the timber sale contract effect the financial viability of timber sale offerings. Generally, the smaller the DBH, DIB top diameter, and minimum piece size, the lower the value and the higher the logging cost.

FELLING - The biggest difference between cutting for a helicopter sale is that: (1) All cuts must be bucked clear off so that the helicopter can lift the log. (2) Sometimes more short logs are cut which tend to roll more easily.

WILDLIFE TREES - The helicopter can usually leave more wildlife trees standing than conventional systems because: (1) cables are not strung through the unit that whip up against standing trees. (2) The choker setter can "tag chokers together allowing a safe distance from the standing wildlife tree when logs are removed. Contract flexibility must be allowed to permit the Purchaser to fell wildlife trees hazardous to operations.

CONTRACT ADMINISTRATION - In contract administration, the pre-operations meeting is especially important in helicopter sales. This is because helicopter sales are fast paced operations which often take place in environmentally sensitive areas. Sale administrators must get out on the ground when the cutting starts. There could be 1-2 million board feet cut per week on a helicopter sale. Also, because of the cost of helicopter time, it would save money and time to conduct helicopter water bucket tests during lunch time, which is helicopter down-time. Now for more on contract administration, here's Bill Case:

"There's some extra fire requirements on helicopter sales that are not normally required: fire buckets, a different radio system that we need to be aware of when we're using aircraft. We also need to be aware that even though we'd like to, we

can't ride on helicopters or any other aircraft unless they've been certified by our regional office aviation fire management department, and of course the FAA gets involved in this too. Both the pilot and the aircraft need to be carded. Just the fact that there's a helicopter there doesn't make it available to use.

There's some safety aspects that we also need to be aware of; and they are dealing primarily with out on-the-ground areas of operation. We need to wear high-visibility vests when we're out there on the ground and hard hats; we got these so that we can be seen. We need to stay clear of flight paths. We need to be aware--from the public stand-point--of flight paths over roads, lakes, recreation areas, etc. We may need to restrict access to the public and in this pre-op meeting we can find out some of those things that are needed." (Bill Case, USFS)

SAFETY - Safety is a basic consideration in the design, operation, and administration of timber sales. Safety considerations for helicopter sales should include: landings, felling, hooking in partial cuts and near wildlife trees, sale administration activities, public view points and travel paths, communications, flight paths over highways, roads, power lines, improvements, rivers, lakes, and irrigation channels. Many of these considerations are addressed in state logging safety codes, OSHA, and FAA regulations.

"All rotor-craft external load operations are conducted in accordance with the provisions of Federal aviation regulation #133. These cover the helicopter and its rigging down to the bottom hook. In a logging operation, all operators must operate in accordance with this regulation. The regulation covers aircraft, pilots, flight crew, and the company, or the operator. All external load operations must be conducted in such a way that they present no hazards to persons or property on the ground. Flights in the vicinity of roads, powerlines, and other improvements have been made successfully, but should be evaluated on a case by case basis by the sale designer.

One other thing that I think affects safety and operations by helicopters doing external load operations is the attitude of the helicopter operator. Every reputable operator is deeply concerned about safety. I think they look at every project they do and give safety primary concern. I think it's a concern that exceeds the economic concern. Nobody wants to do anything that's going to cause damage to persons or property. They don't want to do anything that's going to reflect on the industry because the helicopter is a highly visible machine and anything that happens as a result of sloppiness or unsafe practice reflects badly on the entire industry, and it's a small limited industry that is affected disproportionately by this sort of thing." (George Warren, Chief Pilot, Columbia Helicopters).

COST AND APPRAISAL - "USFS direction concerning appraising helicopter sales is stated in the Timber Sale Appraisal Handbook, 2409.22. A special appraisal procedure is currently used for sales meeting the following criteria:

1. Helicopter volume of at least 2.5MMBF
2. Elevation of sale under 5,000 feet
3. Cutting prescriptions where volume removed is over 50%
4. Limited y.u.m. requirements (The appraiser should refer to the standard helicopter appraisal procedure for removal of cull logs or piling of unutilized material.)
5. The unit centroids are, if downhill yarding is planned, under 2,000 feet of elevation form the landing, if uphill yarding is planned, under 800 feet of elevation format the landing.
6. The average helicopter DBH (weighted by volume) is over 20 inches and taper is not excessive. Region Five in California is working on a system to adjust the special appraisal procedure when this particular criteria is not met.
7. Landing sizes meet the standards described in Timber Sale Preparation Guide for Helicopter Logging.
8. Average yarding distance are between 1700-6600 feet.
9. Scaling defect is 20% or less.

The standard appraisal procedure should be used for helicopter sales not meeting these criteria. Occasionally, it is appropriate to use both appraisal procedures in the same sale.

If cost appears unusually low with the special appraisal procedure, the appraiser should confirm that taper is not excessive and that marking for turn efficiency has been accomplished." (Fred Sprenger, USFS)

Many factors affect helicopter logging, preparation, and administration costs. These include:

1. yarding distance
2. utilization specifications
3. silvicultural prescription
4. slash treatment
5. defect
6. ripping - Ripping is required when minimum length pieces exceed the lift capacity of the helicopter. Minimum log length of 17 feet (includes 1 foot of trim) should be used for helicopter design purposes.
7. Cost of layout: There is as much flexibility in the actual layout cost of a helicopter sale as there is in every other cost associated with this logging system. The following variables affect these costs:

   (1) Do we have to run road locations and yarding profiles first to see if a cable or skyline system will work?

   (2) Is the cutting unit and sale area easy or difficult to

access by sale planning and layout personnel?
(3) Must cut or leave trees be individually painted, or will special contract wording designating size, species, and type of tree suffice?

8. Administration - More time per week must be spent administering the helicopter sale because of the rapid rate of operation.
9. Planting and regeneration - Planting and regeneration costs can be higher or lower for the average cable sale depending on accessibility and silvicultural prescription.
10. Precommercial thinning - Precommercial thinning costs may be higher if units are not easily accessed by crews.
11. Commercial thinning - Low product value currently means financial infeasibility with the helicopter.
12. Felling - Felling costs tend to be higher on helicopter sales because of increased waling time to scattered or inaccessible units. More partial cutting on steep slopes tends to occur in helicopter sales which increases costs.

FUTURE OF HELICOPTER LOGGING - Now, here is Clive Wittenbury to discuss the future of helicopter logging:

"There is a new heavylift technology that combines heavy lift helicopter technology with lighter-than-air, and that's why we call them hybrids. As you can see by this picture, the hybrid no longer looks like the old helicopter. It combines a balloon, rather like the Goodyear blimp with rotating wings. The particular machine you are looking at is called a cyclocrane and has been developed by Aerolift from Oregon.

Several hybrid development programs have been supported by the US Forest Service and by private industry during the last five years." (Clive Wittenbury, Erickson Aircrane)

This has been an introduction to helicopter logging, presented by the US Forest Service and the Helicopter Loggers Association. We hope it will be useful in the planning, design, layout, and administration of a helicopter sale. Now, here is a list of references for further study:

REFERENCES FOR FURTHER STUDY -

Timber Sale Preparation Guide for Helicopter Logging
Timber Sale Appraisal Handbook, FSH 2409.22
State safety codes
FAA regulations
OSHA
Timber sale contracts (current and closed)
Timber Sale Administration Handbook, FSH 2409.15

Comments or questions relating to this training video can be addressed to:

Helicopter Loggers Association
POB 206
Wilsonville, OR 97070
503-678-1222

USDA - Forest Service
Region 6, Timber Management
POB 3623
Portland, OR 97208
503-221-2954

APPENDIX C

LOGGING METHODS AND PROCESSES

Traditional Logging - **Uses bulldozers for road building, chainsaws and/or mechanical felling equipment, rubber tired or cleated tractors for skidding logs to landing, trucks for transporting logs to mills.**

1. Build main haul road(s).
2. Select & develop log landing area.
3. Fell trees (may require bucking into logs in woods).
4. Skid logs to landing (may require building skid trail(s)).
5. Load logs onto trucks.
6. Transport to mill.

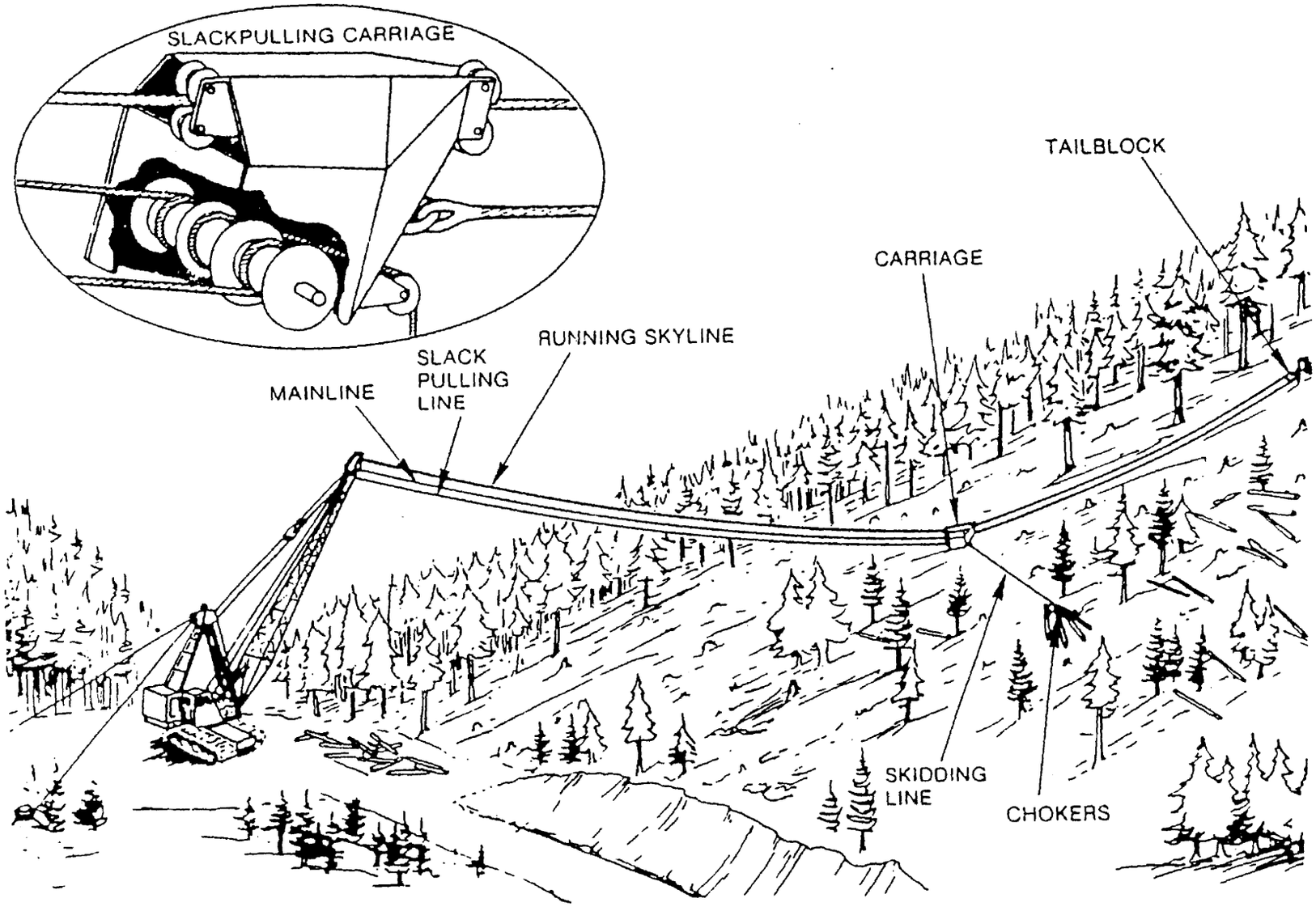
Cable Logging - **Same as traditional logging except a machine with cables draws to logs to the landing (uses less road building). Can be used on steep slopes or flat terrain.**

1. Build main haul road(s).
2. Select & develop log landing area.
3. Fell trees (may require bucking into logs in woods).
4. Use cable system to bring logs to landing (no other roads - usually).
5. Move trees by skidder or tractor to bucking and/or loading site (close by).
6. Load trucks.
7. Transport logs to mill.

Helicopter Logging - **Same as traditional and cable logging except logs lifted to landing by helicopter (less road building and site disturbance).**

1. Build main haul road(s).
2. Select & develop log landing area.
3. Fell trees (may require bucking into logs in woods).
4. Lift logs by helicopter and move to landing.
5. Cut logs into desired lengths and load onto trucks.
6. Transport logs to mill.

NOTE - SYSTEM USED FOR UP SLOPE AND DOWN SLOPE SKIDDING.



RUNNING SKYLINE CABLE SYSTEM

APPENDIX D