S O F T W O O D L O G G I N G S T U D Y N O. 10

Thinnings Extraction - Western Australia

Timber Supply Economics,
Forestry and Timber Bureau,
Canberra.

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THINNINGS EXTRACTION - WESTERN AUSTRALIA

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THINNINGS EXTRACTION - WESTERN AUSTRALIA

Softwood Logging Study No.10

SUMMARY

This report, compiled at the request of the West Australian Forestry Department, concerns the extraction of thinnings from the Nannup and Grimwade plantations.

The recommendations made are :

(i) that slopes of up to 20° be thinned when stem volume is adequate for tree length extraction. This will involve delaying thinning for one to two years.

(ii) that road haulage should initially be in billet lengths but that haulage in tree lengths should be envisaged,

(iii) that slopes of greater than 20° be thinned by cable system and that this thinning be delayed until the stand is at least 20 years of age,

(iv) it is suggested that small areas on very steep slopes should be heavily thinned to waste to obtain some indication of the effect of such treatment on the stability of the remaining stand.

(v) the use of a truck mounted loader is recommended for Grimwade. Because of the short road haul distances this unit would be operating under ideal conditions and a marked reduction in costs is anticipated.

NANNUP PLANTATIONS

1. Introduction

Stand and Site Conditions - The first plantings of P.radiata were established at Nannup in 1956 and the current acreage is now approximately 4100. The sites in general are highly productive but poor stem form has resulted in a reduced merchantable yield. The terrain is steep, 38% of the current planting being on slopes of greater than 20°. As much of the plantation is on old grazing land the forest floor is generally clear of hardwood logs, etc.

During 1966 several plots were thinned, one to two years ahead of schedule, to obtain some indication of the likely yields (Appendix I). The yields per acre were 1100 cubic feet* for the S.Q.II stands and 790 cubic feet for the S.Q.III stands. Average merchantable volume of the removed trees (3.1 cubic feet) was low.

Annual Cut - Estimations of the annual cut of first and second thinnings are given in Table 1, Appendix II. However this assumes that all of each age class can be thinned to schedule; in fact the steepness of the terrain will prevent the scheduled thinning of a varying proportion of each year's plantings. Table 2 of Appendix II gives the approximate area and the proportion of each age class that is established on the readily accessible slopes of less than 20°. Although an accurate estimate of the likely yield cannot be obtained by reducing the volume

yields/

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* all volumes cubic feet, true measure over bark

yields given in Table 1 by the proportion of inaccessible (slopes greater than 20°) terrain (Table 2) it will afford an indication of the likely scale of operations in the first few years.

Market - The present market for thinning is at Busselton, some 40 miles away. Case logs down to four inches diameter and in eight foot lengths will initially be the only product.

Specific Problems - The problems related to this particular forest can be summarised as follows :

(i) Steepness. Most of the plantation is established on slopes of greater than 10° and 38% of the planted area is steeper than 20°.

(ii) Merchantable volume. At present a market exists for case material only and combined with the poor stem form this will result in a low merchantable volume per stem.

(iii) The frequent occurrence of high road banks prevents the location of landings at reasonably spaced distances.

(iv) The scale of operations in the first years will be such as to restrict the capital outlay for sophisticated loading equipment.

2. Recommendations

Thinning Prescription.

Slopes less than 20° - The data recently obtained from thinning plots (Appendix I) indicates that at 10 years of age the merchantable volume removed per stem will be very low if thinnings are done according to the present prescription. To permit the commercial thinning of the maximum possible area of plantation it is recommended that the first thinnings be delayed by at least two years.

The range of S.Q. is quite limited (S.Q.II to IV account for 98% of the successful plantings in 1956) and there is some merit in thinning by age class rather than S.Q.

It is appreciated that other factors influencing management will affect the decision to modify the present thinning schedule, but the delaying of the first thinning is strongly recommended, at least until such time as a pulpwood market is available as this should increase the volume yield by as much as 30%.

Slopes greater than 20° - On such slopes a cable system is currently the only economical means of extracting timber. For it to operate economically a minimum volume per acre of approximately 1200 cubic feet and a minimum stem volume of nine cubic feet is required. It is therefore unlikely that these stands will be thinned before they are 20 years old.

Infrequent heavy thinnings (say at 20 and 30 years of age) would probably be more profitable than clear fellings, depending on the market, and it is suggested that a small experimental area be heavily thinned to waste by removing at least half the standing volume, to note the effect on stand stability of such treatment. It would probably be necessary to do this in a stand at least 18 years old for the results to be significant.

Logging Methods.

Slopes less than 20° - Two alternative methods are possible depending on whether (i) thinning is delayed until a merchantable stem volume of four cubic feet is available or (ii) if first thinnings proceed as scheduled.

(i) If a merchantable stem volume approximately four cubic feet is available tree length extraction is recommended. This stem volume could be achieved by delaying the first thinning or if a market for particle board material occurred.

Extraction tracks not less than 12 feet wide should be located at approximately 55 foot intervals, straight up and down the slope. Felling should be directed to give a herring-bone pattern. The plunge bow type chain saw can help to achieve this (Figure 1). A half tracked tractor and winch is recommended for snigging (Figure 2).

At the roadside landing the tree lengths should be docked to billet lengths and stacked into a frame with a set capacity of 50 cubic feet. Bundles should be formed by tying with a Gerrard wire tying device and on steep slopes where high road banks occur, the bundles can be rolled down the bank for loading.

Loading of the bundles may be done by 'blitz'. Where the road banks dow not allow easy loading the 'blitz' should carry the bundles along to a suitable loading bay prior to the road truck's arrival.

Advantage should be taken of the excellent roads which will allow semi-trailers to be used for road haulage.

(ii) Thinnings carried out as scheduled. Under these circumstances the yield per stem of case wood would be too low for economical tree length extraction. The half tracked tractor would be suitable to pull a small sled (Figure 3) which would also act as the unit measure (50 cubic feet) and a former for wire tying. The bundles can be tied at the roadside and tipped out of the sled and down the road bank ready for loading.

Slopes steeper than 20° - On such slopes a light skyline system will probably be used when sufficient stem volume is available. This rig can be used to log either uphill or downhill; the maximum span of 10 chains will permit a maximum road spacing of about 20 chains. Thinnings will be extracted in tree lengths and probably docked at the landing. Roads should be so located as to minimize the height of banks.

Equipment

Felling - Plunge bow cutter bars on lightweight chain saws are suggested. They are available for Homelite, McCulloch and Stihl saws. The lightweight saw is particularly recommended in view of the steep slopes and the plunge bar permits the faller to control the direction of the trees more readily.

Skidding - (i) M.F.135 or equivalent tractor fitted with Svetlund half tracks. Available from Massey-Ferguson (Australia), contact Mr.Bourne, of Products Planning Division, Devonshire Road, Sunshine, Victoria.

(ii) Nell-Eco double drum winch and skidpan. Available from R.M.Nell and Co., 70 Wayo Street, Goulburn, N.S.W.

(iii) Counter weight at front of tractor - approximately 250 lbs.

(iv) Safety Canopy. Not essential but recommended - it is also available from Nell.

(v) Rigging.

Winch rope 1½" circ. 6 x 19 construction Seale pattern regular lay of best plough steel and with a hemp core.

Chokers - ¾" mild steel chain approximately four feet long with 2½" diameter ring on one end (Figure 5).

Sliding Choker Hooks. These can readily be made up in your plant workshop; details are given in Figure 6.

Docking and Bundling (i) Conventional chain saw

(ii) Gerrard wire tying equipment

(iii) Bundling frame or sled (Figure 3)

Loading - 4 x 4 'blitz' with loading jib

Road Haulage - Semi-trailer preferably with bogie drive

3. Discussion

Thinning Regime - The present prescription calls for the extraction of first thinnings at 11 years of age for S.Q.II stands, at 12 years for S.Q.III, 13 years for S.Q.IV and 15 years for S.Q. V. This parallels South Australian practice. There are, however, two important differences that affect the economics of such a treatment. In South Australian the terrain permits truck access to the stump and this is estimated to add at least $1.50 per 100 cubic feet to the stumpage value. Secondly, their market for pulpwood could increase the merchantable volume by as much as 30%. New Zealand data (Appendix III) which would appear to be applicable, indicates a 20% increase in volume with a reduction of small end diameter from four to three inches for a d.b.h.u.b. of 6.5". This would be about the average d.b.h. for the stems removed during the scheduled first thinnings at Nannup. The poor form of these stands will add to the waste material.

If thinnings are delayed approximately two years the first commercial thinning can be carried out over a wider range of terrain as extraction in tree lengths is possible and this may be done on slopes ranging from 20° favourable to 15° adverse; billet length extraction is limited to a range of slopes from 15° favourable to 10° adverse.

It is also suggested that the thinning could be done on the basis of age class rather than S.Q. The range of S.Q. is comparatively narrow, at least for the 1956 planting, which is as follows :

S.Q. II	10%
S.Q. III	49%
S.Q. IV	36%
S.Q. V	3%
failed	2%

Extraction -

Snigging - The half tracked agricultural tractor is considered to be a particularly suitable unit for the extraction of first thinnings at Nannup because of its ability to operate over a wide range of topography (approximately 15° adverse to 20° favourable). This tractor's performance has been established at Oberon, New South Wales, under similar conditions to those at Nannup. Alternatives could include horses or small crawler tractors. The former have not been considered suitable because of the rate of expansion anticipated with this operation (Appendix II) and the comparatively long snig distances necessary because of the road banks. Horse snigging production falls off rapidly with distance. Although the crawler tractor is capable of operating over a wide range of terrain, its somewhat higher capital outlay and operating costs are not offset by a proportionate increase in production.

Tree Length or Billet Wood ?

Whether the material should be extracted from stump to roadside in tree lengths or billet lengths is, however, more contentious. Because of the poor stem form road haulage in billet lengths is probably necessary while case logs only are being produced. Therefore there will be no great cost or production advantage in extracting them in tree lengths, (Appendix IV) but other factors affecting management favour tree length extraction.

The following is a brief resume of the points for and against tree length extraction for this particular plantation :

(i) An average merchantable stem volume of not less than about 4.0 cubic feet is desirable for the extraction of tree lengths. Scheduled thinnings will yield a merchantable stem volume of less than this figure.

(ii) There will be little difference in production rates between the two methods as the material must be cut into billets for loading and haulage.

(iii) Damage to the remaining stems is somewhat higher with tree length logging than billet wood on level terrain. At Oberon the comparable figures are 2% of the remaining trees damaged in billet extraction of billet wood, compared to 8% damaged with tree length extraction. On the steeper slopes the damage with tree length extraction would be comparable with that caused by billet extraction.

(iv) Some waste material will accumulate at the landings if the thinnings are extracted in tree lengths and docked at the landing.

(v) With tree length extraction the docking into billet lengths and the manual handling of billets is removed from the steep slopes and done on the comparatively level landings, thereby increasing production and reducing the accident hazard.

(vi) The second and subsequent thinnings will be extracted in long lengths, therefore the use of the tree length system for first thinnings will permit the same equipment and pattern of access tracks to be used for all operations.

(vii) Thinnings can be extracted in tree lengths over a wider range of topography than in billet lengths.

It is considered that the extraction of tree lengths will afford access to a considerable proportion of the Nannup plantation that would be inaccessible to a billet length operation. For this reason it is suggested that the initial operation should be based on the extraction of tree lengths to landing. Should the extraction of billet wood prove desirable on the easier terrain the same tractor could be used, the only additional cost being that of constructing a sled.

Bundling and Loading

The bundling of 7'3" billets is standard practice in A.P.P.M.'s first thinning operation in north west Tasmania and it is designed to overcome the same problems as encountered at Nannup, specifically, high road banks and a considerable road haulage distance. The added cost of wire tying is approximately 45 cents per 100 cubic feet or about 2% of the cost of landing wood at Busselton. As loading and unloading costs (estimated at about $2.40 per 100 cubic feet for loose wood) will be reduced by at least 25%, the cost of bundling is easily recovered. The movement of wood in the log yard of the mill is also simplified if the billets are in bundles.

Wire tying could be avoided where the banks are low and the 'blitz' could gain access to the landing by utilising a re-usable strap such as used by A.P.M. Forests Pty.Ltd. in Gippsland (Figure 4), and loading by passing the sling around the bundle, removing the strap and loading the loose wood on to the truck. However, unloading the truck would be much faster if the wire ties are employed and initially it is suggested wire tying be used for all phases of the operation.

An alternative method of avoiding the problem of road banks would be to cut snig tracks along the tops of road banks to permit the tractor to snig to accessible landings. The disadvantages of this system are that the tractor would have difficulty leaving this track to enter the forest because of the side cut and secondly, the length of many of the roadside banks would necessitate very long snig distances.

In the initial stages of the operation a 'blitz' jib should be used to load the road trucks. This avoids hauling a truck-mounted loader the considerable distances involved and also avoids committing the haulage to one particular truck. The loader would not be used enough to justify a 'Hiab' mounted on an independent truck being used for loading only.

Where the banks are high wire tied bundles can be carried by the 'blitz' along the road and stacked awaiting the return of the prime mover.

Haulage

Road haulage will be the major cost item in this logging operation. For this reason the operation should be planned to take advantage of the excellent road network to permit access for the maximum size haulage unit that is practical. This would probably be a standard bogie drive semi-trailer.

GRIMWADE PLANTATION

The logging operations in this forest include the extraction of a range of thinnings, yielding case wood and saw logs.

The terrain is undulating and 15° would rarely be exceeded.

The current operation includes truck to stump extraction of first thinnings and the loading of eight foot wood by hand. Saw logs from the later thinnings are extracted and loaded by 'blitz' on to an eight ton truck.

The difficulties appear to be (i) the hand loading of first thinnings, (ii) the rather high maintenance cost of operating 'blitzes' and (iii) the need for a 'blitz' to be located in the bush, the mill and the rail siding.

Extraction from stump to roadside by tractor is recommended. An M.F.135 or equivalent tractor with winch, 13 x 24 tyres and tyres chains would log most of the terrain. Hourly production would range from 150 cubic feet for first thinnings to 350 cubic feet for third thinnings.

With such short road hauls, approximately two miles from forest to mill, the truck-mounted hydraulic grab (e.g. Hiab) would be ideal to load case and saw logs. One forward control truck with such a loader could readily handle the present cut - including the haulage of sawn timber to the rail siding. Similar units working in the A.C.T. are hauling 1500 cubic feet per day with a lead distance of 25 miles. The estimated cycle time for 400 cubic feet payload would be :

Travel time to and from compartment (average 2 miles)	=	30 minutes
Loading and unloading	=	60 "
Total cycle time	=	90 "

Therefore the average daily log input of approximately 775 cubic feet could be handled in two trips per day or three hours.

Assuming a recovery of 45% of the o.b. log volume, one trip per day would haul the sawn timber to Kirup. Estimated cycle time is three hours.

Such an operation would mean loading an eight ton truck to capacity. If greater flexibility is required to accommodate a fluctuating demand, this could be achieved by either using a truck with a bogie drive to increase payload, or by using the truck fitted with the loader to load logs on to a conventional truck when the added production is required.

Although road haulage costs are increased due to the reduced payload (a Hiab weighs approximately 17 cwt) this is of little importance where haulage distances are short and the truck spends most of the time loading and unloading. The following is a daily cost comparison of the two systems :

Present Method

One eight ton truck and two men at 24 + (10 x 2)$ per day	=	$44 per day
One six ton " " " " at 18 + (10 x 2)$ " "	=	$38 " "
Three 'blitzes' at $8 each per day	=	$24 " "
Total daily cost	=	$106 per day

Truck Mounted Loader

One eight ton truck and one man at 30 + 10 $ per day	=	$40 per day
One tractor, winch and operators at 11 + 10 $ per day	=	$21 " "
Total	=	$61 per day

In practice, the plant used with the present method is not operated to capacity but even if a proportion of the cost of the second truck is deducted, the cost advantage still favours the truck fitted with a loader.

The main features of the recommended operation are reduced operating costs, the elimination of manual handling of logs and a reduced accident hazard.

15/9/66
CHK

6 x ¼ acre thinning plots established in Compartment 9 Folly.* Planting on contour in ploughed lines spacing 8' x 8'

Plot No.	Site Quality	Stocking per acre	Number stems marked	Number of misses	Number left standing	Number taken off outrows	Stocking after thinning	Stocking after extraction rows	Mechanical marking	Lds.as thinnings	Lds. from outrows	No.of trees per load	Loads per acre
1	III	648	43	51	61	7	272	244	4 out 7	3	1	12.5	16
2	III	664	83	10	68	5	292	272	4 out 7	4½	½	17.6	20
3	II	704	82	15	79	6	316	292	4 out 7	4½	¾	16.7	21
4	II	656	84	5	75	6	300	276	6 out 11	5	¾	15.6	23
5	III	668	46	46	75	4	300	284	3 out 8	2½	1¼	13.4	15
6	III	644	50	36	75	12*	300	292	2 out 5	2	1	20.6	12
Average	3.2	664	65	27	72	7	297	277	4 out 8	3.6	.88	16.1	17.8
Av.for S.Q.II		680					308	284		4.75	.75	16.2	22
" " S.Q.III		656					291	273		3	.94	16.0	15¾

* This was caused by 3 outrows running through plot.

1. Average stem volume 5.57 c.ft.
   Range 1.29 to 9.01 cu.ft.
2. Average Merch.stem volume = $\frac{50}{16.1}$

   = 3.1 cu.ft.

* Data provided by W.A. F.D.

Table 1.

Total Volumes Available as First and Second Thinnings.

Assuming the total area is thinned to schedule.*

Year of Thinnings	Volume Cubic Feet o.b.
1967	37,500
68	237,500
69	460,000
70	530,000
71	665,000
72	770,000
73	750,000
74	939,000
75	1,220,000
76	1,327,500

* Data provided by the West Australian Forests Department

Table 2.

Plantation Areas and Accessible Areas (Acres)

Year of Planting	Total area	Accessible Area /	Percentage Accessible
1956	300	230	77
57	450	150	33
58	420	290	69
59	650	330	51
60	630	400	64
61	160	130	81
62	380	310	83
63	280	210	75
64	190	110	58
Total	3460	2160	62

/ Accessible areas are those of less than 20° as indicated by the contour maps Milward sheets 1 and 2, Folly-Lindsay sheet 1, and Lewana sheets 2 and 3.

3 In. Top Vol. as a Percentage of a 4 in. Top Vol. for Mean D.B.H. of Stand

D.B.H. Units	D.B.H. DECIMAL									
	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
	Percentage									
5	171.7	163.6	156.8	151.2	146.3	142.2	138.6	135.4	132.7	130.2
6	128.0	126.1	124.3	122.7	121.3	120.0	118.8	117.7	116.6	115.7
7	114.9	114.1	113.3	112.7	112.0	111.4	110.9	110.4	109.9	109.4
8	109.0	108.6	108.2	107.9	107.6	107.3	107.0	106.7	106.4	106.2
9	105.9	105.7	105.5	105.3	105.1	104.9	104.7	104.6	104.4	104.3
10	104.1	104.0	103.8	103.7	103.6	103.5	103.4	103.3	103.2	103.1
11	103.0	102.9	102.8	102.7	102.6	102.6	102.5	102.4	102.4	102.3
12	102.2	102.2	102.1	102.0	102.0	101.9	101.9	101.8	101.8	101.7
13	101.7	101.7	101.6	101.6	101.5	101.5	101.5	101.4	101.4	101.4
14	101.3	101.3	101.3	101.2	101.2	101.2	101.2	101.1	101.1	101.1
15	101.1	101.0	101.0	101.0	101.0	101.0	100.9	100.9	100.9	100.9
16	100.9	100.8	100.8	100.8	100.8	100.8	100.8	100.7	100.7	100.7
17	100.7	100.7	100.7	100.7	100.7	100.6	100.6	100.6	100.6	100.6
18	100.6	100.6	100.6	100.6	100.5	100.5	100.5	100.5	100.5	100.5
19	100.5	100.5	100.5	100.5	100.5	100.4	100.4	100.4	100.4	100.4
20	100.4	100.4	100.4	100.4	100.4	100.4	100.4	100.4	100.4	100.4
21	100.4	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3
22	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3	100.3
23	100.3	100.3	100.3	100.3	100.2	100.2	100.2	100.2	100.2	100.2
24	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2
25	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2
26	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2
27	100.2	100.2	100.2	100.1	100.1	100.1	100.1	100.1	100.1	100.1
28	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1
29	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1
30	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1	100.1

PROGRAMME FOR C.A.V.BARY, F.R.I.

Estimated Production Rates. Man-Minutes* per 100 cubic feet

	Billet Length	Tree Length	
		Docking at roadside	Haulage in tree lengths
Cutter	190	110	110
Tractor Operator	45 /	55	55
Docking and Stacking ≠	-	70	-
Bundling	15	15	-
Total	250	250	165

* Man-minute - based on a competent and experienced cutter working on contract or piece-work rates.

/ Assisting to load and operating tractor to haul out sled.

≠ Docking and stacking at roadside for tree length operation.

FIGURE 1. PlungeBar Type Chain Saw. An aid to directional felling.

FIGURE 2. An M.F. 35 Tractor and half tracks turning on a 23° slope.

FIGURE 3. A Nell double drum winch fitted to a standard M.F. 35.

FIGURE 4. Sliding hook and chain choker as used for tree length extraction.

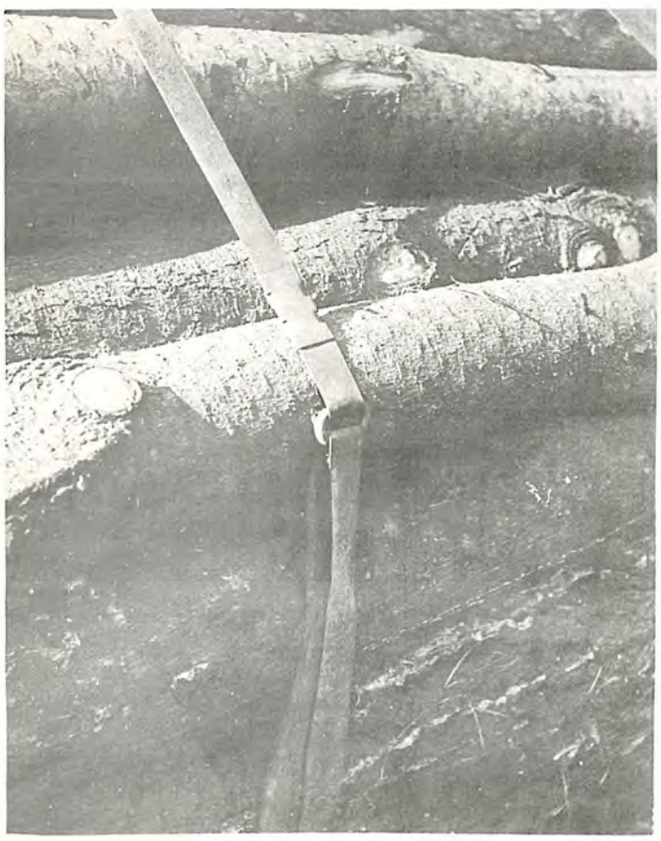

FIGURE 5. Reusable strap for bundling pulpwood (A.P.M. Forests Pty. Ltd.).

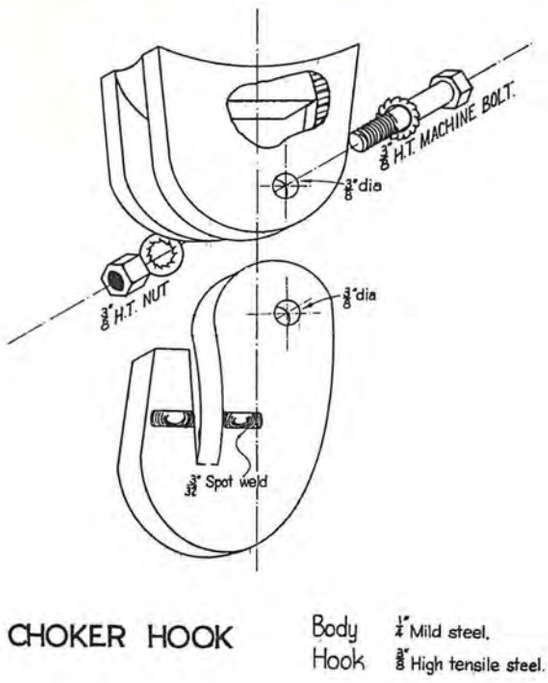

FIGURE 6. Drawing of Choker hook.

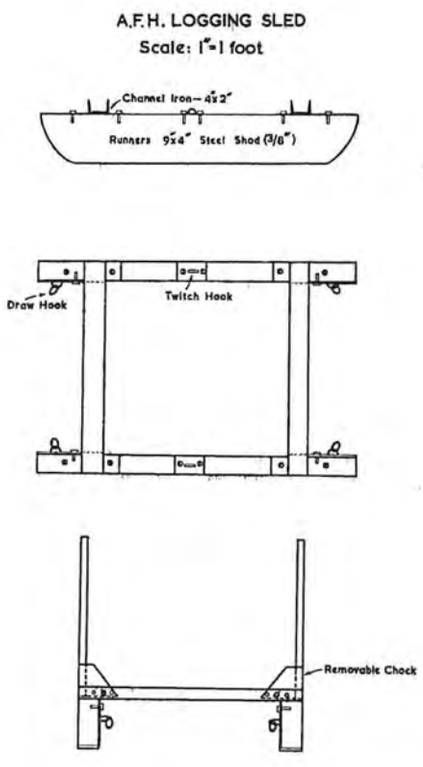

FIGURE 7. Drawing of Pulpwood sled.