Session 4
Paper (b)

LANDING LAYOUT AND DESIGN - A MEANS TO REDUCE HAULING DELAYS

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INTRODUCTION

Landing layout and design can have a major effect on the amount of delay time to the hauling cycle that occurs in cable logging operations. If it is possible to reduce hauling delays then it is possible to improve efficiency and productivity. By seeking a means to reduce hauling delays, we are seeking a means to increase productivity.

At this point I would like to refer to a paper entitled "Productivity and Logging" that was presented to last year's 'Business of Logging' seminar by John Dey.

Briefly quoting from that paper:

1. "Productivity is the key to a profitable, successful business and understanding productivity is the first step".

2. Productivity = Output/Input = Results Achieved/Resources consumed.

"It is not a measure of production or output but rather a measure of how well resources are combined and utilised to accomplish specific desirable results" ...... "It looks so simple but the result is meaningless ...... unless we compare it with some target or expectation".

3. "Productivity growth will involve change - it will take you out of your comfort zone and it won't be easy ......"

There are three main areas where opportunities exist to improve productivity.

They are as follows:

1. Methods and Equipment
   - Introduce new methods and equipment.

2. Utilisation of Resources Capacity
   - Balance operation factors.

3. Performance Levels
   - The People Factor

I will look primarily at areas 1 and 2 in this paper although area 3 is an essential part of the overall equation.

Before we start looking at major changes to landing design and layout, let us compare some New Zealand logging operations with some in the United States, Pacific North West.

PACIFIC NORTH WEST vs NEW ZEALAND LOGGING OPERATIONS

A comparison between Pacific North West and New Zealand landing parameters was undertaken (Williams, 1989 in prep.) using the results of surveys of New Zealand operations by Alistair Twaddle (1984) and Keith Raymond (1987) and Dallas Hemphill's Pacific North West survey (1987).

A total of 135 landings were sampled in this analysis. Of the original 135 operations, the top ten operations from all New

Zealand, New Zealand hauler and the Pacific North West were selected for analysis.

A. The top ten New Zealand operations were selected on the following basis:

1. Production per scheduled 8 hour day > 177 tonne/day (lowest of Pacific North West top ten operations).

2. Ratio of production (tonne/day) vs tree size (tonnes) > 82 (lowest ratio for Pacific North West top ten operations).

3. Number of Log Sorts > 4.

4. Ratio of number of log sorts vs landing size (Ha) > 15.3 (minimum required to select ten operations).

B. The top ten New Zealand hauler operations were selected on the following basis:

1. Production > 101 tonne/8 hour day.

2. Number of log sorts > 4.

C. The top ten Pacific North West operations were selected on the basis of highest production/8 hour day.

No significant difference in average tree size or average number of log sorts was evident between the top ten New Zealand operations and the top ten Pacific North West operations.

No significant difference in production (8 scheduled hours per day) was evident between the top ten overall New Zealand operations and the Pacific North West top ten operations, however the New Zealand top ten hauler production was significantly lower than the top ten Pacific North West hauler production (see Figure 1).

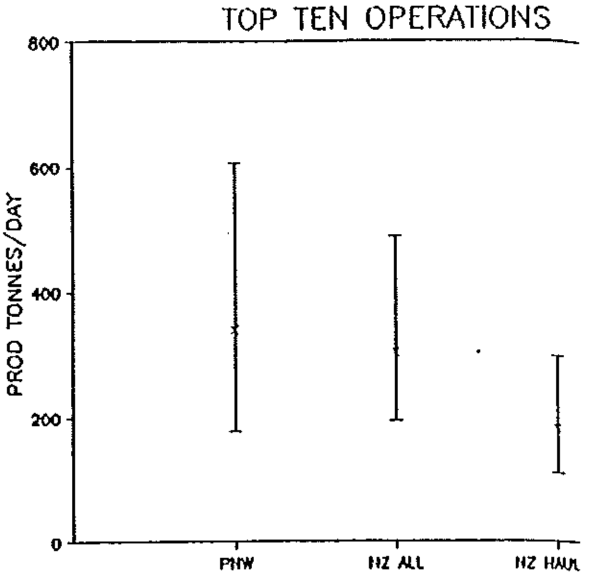

Figure 1
Production vs Operation

The Pacific North West land size was found to be significan smaller than both the New Zeal hauler and overall New Zeal operations (see Figure 2).

Given the obvious operat parameter similarities between Zealand and the Pacific No West, it is important to note major operational differences tween the two regions' operatio The three most obvious differen are:

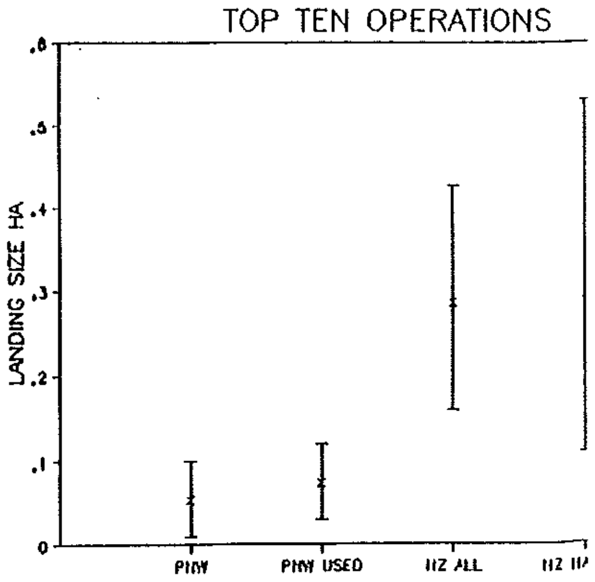

Figure 2
Landing Size vs Operation

(1) New Zealand's predominance of tree length hauler operations vs log length and the Pacific North West,

(2) Pacific North West predominant use of large hydraulic knuckleboom loaders that are generally not limiting to logging system production, and

(3) Truck scheduling in the Pacific North West that is generally controlled by the loader driver.

:he analysis and comparison of New (land and Pacific North West ›perations shows that it is pos- ;ible to maintain high production ›ith relatively high numbers of .og sorts on small landings. It .s essential, however, to ensure hat logging and transport systems nd equipment are matched to main- ain overall productive ef- 'iciency.

hould we in New Zealand, look urther into log length or partial og length processing at the stump nd the extended use of high apacity hydraulic knuckleboom oaders? I will leave you to nswer that question. Hopefully he information presented in the (of this paper should help you ›.mulate your answer.

he Pacific North West examples rovide us with a target or expec- ation on which to base our roductivity improvements.

ANDING SYSTEMS AND LAYOUTS

iere are two basic types of andings:

- Single stage landings where logs or trees are landed by the cable system, processed, sorted, stacked and loaded out from the same landing.

  Two stage landing where logs or trees are landed by the cable system and are then moved by a secondary skidding machine to a separate landing for final processing, sorting, stacking and load-out.

Single stage landings will be covered in this paper.

A. **Tree Length Landings**

(i) RTFEL (Rubber tyred front end loader)

- log processing under the ropes. (See APPENDIX 1 for landing layout).

Advantages:

- Proven system
- Minimises handling
- Loader available to assist in unstropping etc.

Disadvantages:

- Skiddies must work under ropes. This can only be done safely while the lines are stationary during log hook-up. Interference to the hauling cycle occurs while logs are being processed by the skiddies in the chute.
- Landing area must be sufficient to work the loader, form stockpiles (generally around the landing perimeter) and load trucks.
- Difficult to load directly from the chute.
- The loader can become limiting to system production in wet conditions.
- Limited ability to utilise unformed area adjacent to formed landings for stockpiling.

(ii) RTFEL

- Two stage with loader to processing area (see APPENDIX 2 for landing layout).

Advantages:

- Skiddies can work away from the ropes i.e. minimum skiddy caused hauling cycle delays.
- Skiddies can be better utilised as they are not directly constrained to the hauler cycle with their work patterns.

Disadvantages:

- Increases handling.
- Increases landing area required.
- Chute cannot be cleared easily while trucks are being loaded.
- Processing area must be far enough away from the chute to enable easy loader access to both the chute and processing area.
- Skiddies are not in the immediate vicinity of the chute for unhooking.
- The loader can become limiting to system production in wet conditions.
- Limited ability to utilise unformed area adjacent to formed landings for stockpiling.

(iii) <u>ROPE CRANE</u>

- No heel.
- Log processing under the ropes (see APPENDIX 3 for landing layout).

Advantages:

- Proven system.
- Minimises log handling.
- Can operate on smaller landings than RTFEL's.
- Can work more difficu ground conditions th RTFEL's.

Disadvantages:

- Requires access and swi space between stockpile
- Can only handle a limit number of log sorts d to limited mobility.
- Interference to the ha cycle as for (i) above.
- Skiddies can only wo safely under stationa ropes.
- The loader has a limit ability to load direct from the chute.

(iv) <u>HKL</u> (Hydraulic Knucklebo Loader)

- Grapple on dipper arm.
- Log processing under t ropes (see APPENDIX 3 f landing layout).

Advantages:

- Generally as for (ii above but track mount machines have bett mobility and hence bett ability to sort and sta larger numbers of l types.
- Ability to utilise u formed area adjacent formed landings f stockpiling.

Disadvantages:

- Generally as for (ii above but track mount machines have bett mobility and hence a more able to lo directly from the chute

(v) <u>HKL</u>

- Live Heel boom

- Two stage with loader to processing area (see APPENDIX 3 for landing layout).

Advantages:

- There is no need to work under the ropes and therefore minimum skiddy caused hauling delays occur and hence productive potential is enhanced.
- A very small landing area is required due to the ability of the loader to radial stack and the diminished need for access and swing area.
- Minimal loader repositioning is required as trucks can be loaded over the back from the same position that the chute is cleared from and the same position most of the stacking is done from.
- The ability to load direct from the chute or processing area.
- Better skiddy utilisation due to less constraints from the hauling cycle on work patterns.
- Ability to utilise unformed area adjacent to formed landings for stockpiling.

Disadvantage:

- A larger loader is required to handle end heeling of logs with consequent high capital cost.

. Log Length Landings

i) RTFEL (see APPENDIX 1 for landing layout).

Advantages:

- Little or no processing is required to be done on the landing, under the ropes.
- No work under the ropes means skiddy caused hauling delays are minimised and skiddies have a safer work environment.
- Logs are able to be loaded direct from the chute.

Disadvantages:

- Landing size required is dependant on the number of log types cut and landing perimeter available for stockpiling.
- Wet ground conditions may limit cable system production.
- Limited ability to utilise unformed area adjacent to formed landings for stockpiling.

(ii) ROPE CRANE (see APPENDIX 3 for landing layout)

Advantages and Disadvantages:

- Generally as for B.(i) above but the loader may become limiting to cable system production at high production levels and with high numbers of log sorts.

(iii) HKL (see APPENDIX 4 for landing layout)

- The difference between no heel and live heel equipped machines are largely the same as for tree length operations as outlined above.

Advantages:

- Generally as for B.(i) above with the following additions:

- Ability to sort and stack multiple log sorts on very small or wet or marginal ground condition landings.

- If the correct sized loader is chosen it should very rarely become cable system production limiting.

Disadvantage:

- High capital cost of large machines.

The examples outlined don't represent all the possible operation combinations available but constitute a reasonably comprehensive sample. As can be seen from the examples outlined, a change of landing design or layout to reduce hauling delays generally requires a change or modification of landing machinery or processing system. As outlined by the previous speaker in this session, loader selection and design is another very important factor to consider in the total cable logging system.

The reduction of hauling delays generally requires the setting up of a logging system that is limited only by the hauler's capacity to 'pull wood'. The system should not be limited by the skiddies ability to 'make logs' or the loader's capacity to sort, stack and loadout. With this concept fresh in our minds we should look more closely at some of the systems and layouts outlined above and select those that have potential to meet those requirements.

Log processing under the ropes has potential to cause substantial hauling delays so we should select alternative systems. The list of potential systems if we exclude the processing under ropes examples has shrunk to examples; A.(i), A.(iv), A(v), B.(i), B.(ii) and B.(iii).

Any system that contains potential production limiting factors apart from the hauler is susceptible to hauling delays caused by the limiting factor. Ground or weather conditions can limit the performance of RTFEL's. If we look at our edited list of system examples, the best remaining options after allowing for ground or weather limited systems are A.(v), B.(ii) and B.(iii). If the productive capacity of the loader is likely to be limiting at high production levels we are left with A.(v), the tree-length HKL-live heel and B.(iii), the log length HKL-live heel as the landing systems that have the greatest potential to minimise hauling delays.

If landing area is limited the log length/HKL-live heel system is best suited because of the short log lengths to be landed. This system has been well tested in the US Pacific Northwest where productivity is considerably higher than in most comparable, current New Zealand cable operations, (Williams, 1989), (Hemphill, 1987). The tree length/HKL-live heel system with a suitable radial stack, separate processing area layout has potential as a hauling delay reducing system.

Duggan (1989) carried out a trial with an 009 Madill hauler to compare an RB30 rope crane, a Cat 966 RTFEL with log processing in the chute and a HKL-live heel Sumitomo LS4300 two staging to a separate processing area out from under the ropes.

Table 1 summarises the results in terms of hauling delay effects.

Both the loaders that handled wood processed in the chute recorded similar levels of hauling cycle delays. A 10% increase in productivity was achieved by processing logs away from the landing chute. The productivity increase was found to be related to production level and at high production levels (300 tonne/day), a 17% increase was indicated using the HKL/live heel system with processing away from the landing chute.

An operation costing comparison based on the LIRA costing format was completed on the system

Table 1 : Landing Caused Hauling Delays by Loader Type

Processing Site	Processing in the Landing Chute		Processing in a separate area
Loader Type	Rope Crane	Wheeled Loader	Heelboom Loader
Cycle time (min) op del incl.	8.27	8.27	8.27
Landing interference (min)	0.96	0.87	0.09
Total cycle time (min)	9.23	9.14	8.36
Daily Productivity (tonnes)	224	224	247

systems studied. The results are summarised in Table 2.

The Secondhand rope crane showed the lowest daily cost but the unit cost of wood was only marginally less than the HKL/live heel loader system assuming the 10% recorded productivity differential (see Table 1). A safer working environment was achieved by processing away from the landing chute.

Table 2 : Unit Cost by Loader Type

	CREW CONFIGURATION		
	Hauler and Rope Crane (Secondhand)	Hauler and Wheeled Loader (New)	Hauler and Heelboom Loader (New)
Daily Cost	$3000	$3220	$3400
Production (tonnes)	224	224	247
Unit Cost ($/tonne)	$13.39	$14.37	$13.76

Landing layout and design in conjunction with suitable methods and equipment can have a significant affect on the productivity of cable logging systems. A reduction in hauling delays can result in a direct increase in the available time for production. If the introduction of new systems and equipment indicates a growth in productivity, taking into account all inputs and outputs, serious consideration should be given to investing in a change to a better new system.

It is possible that a change of system may result in lower short term profits but it is also possible that the longer term result is higher overall productivity and possibly better flexibility.

The Madill 009/Sumitomo trial briefly outlined above, indicates overall productivity gains can be achieved in tree length cable operations, provided landing layout and equipment is matched to system production.

The Pacific Northwest examples indicate efficient operations centred around log length systems incorporating large heelboom hydraulic loaders and loader operator controlled truck scheduling.

It is not the purpose of this paper to specifically recommend or dismiss any particular landing systems, but to indicate factors that influence landing system productivity and to encourage investigation of systems that may reduce hauling delays and hence enhance productivity growth.

CONCLUSIONS

It is important to look at a cable logging operation system as a complete system, that to operate efficiently must balance system factors from extraction through landing operations to trucking. In reality the most efficient landing layout or system is useless if the overall system is limited by for example truck scheduling.

Productivity growth must rema our main aim in any cable loggi system. We should continually ir vestigate and assess potenti method or equipment changes, ir cluding landing layout and desig that may improve productivity. W should also aim to fully utili the resources required to run cable logging system to balanc labour, machinery and capital ir puts in an efficient way. Finall we should aim to train and er courage a motivated workforce t operate and further develop through use, efficient systems.

Landing layout and design is or of many factors that can influenc cable hauling productivity. It i important that we continuall monitor and investigate potentia system improvements, measure ou performance and compare that per formance with achievable produc tivity targets.

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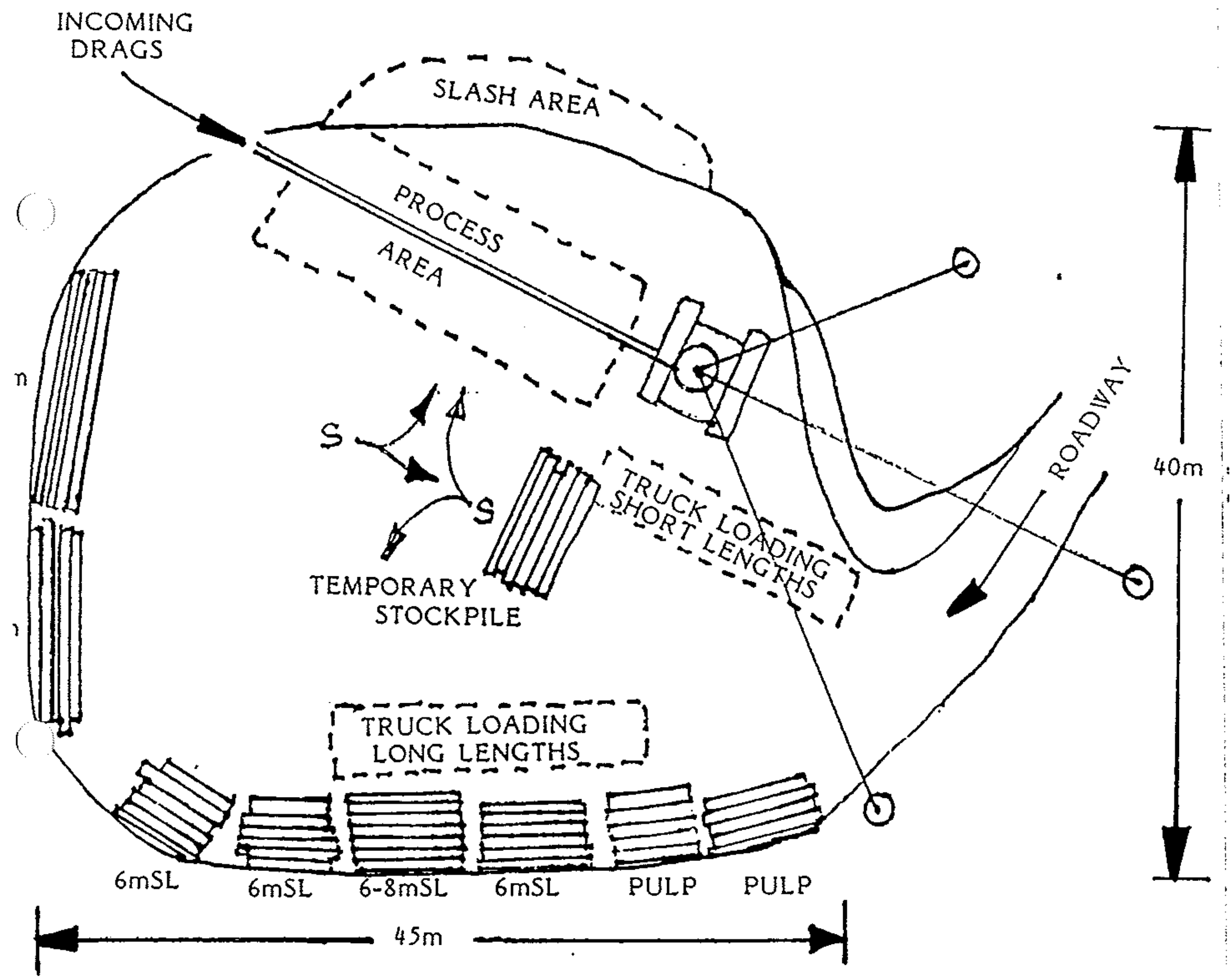
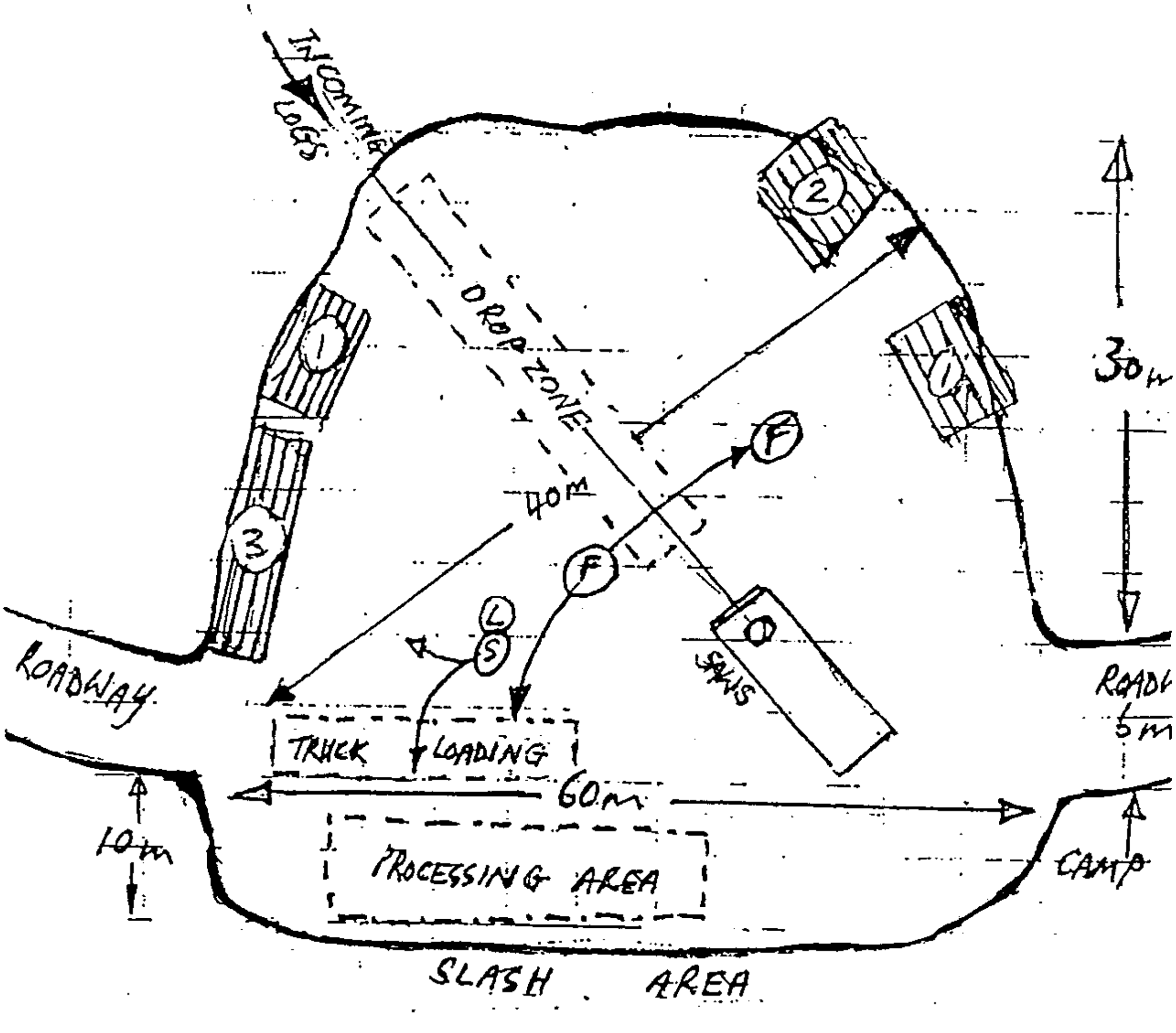
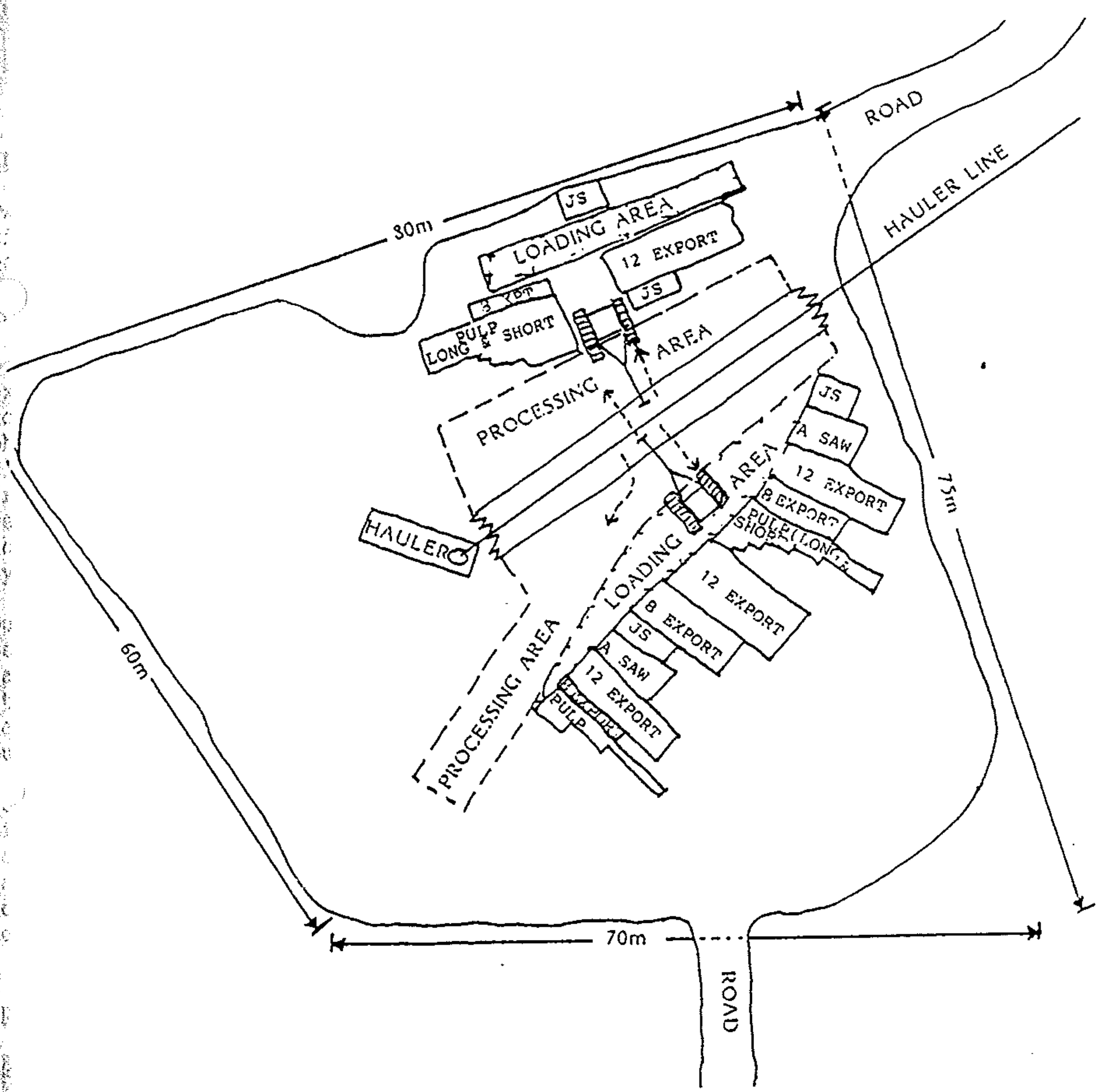
LANDING LAYOUT : HAULER/WHEELED LOADER





INCOMING LOGS
DROP ZONE
2
1
1
3
30m
40m
F
F
L
S
SAWS
ROADWAY
TRUCK LOADING
60m
10m
PROCESSING AREA
CAMP
SLASH AREA

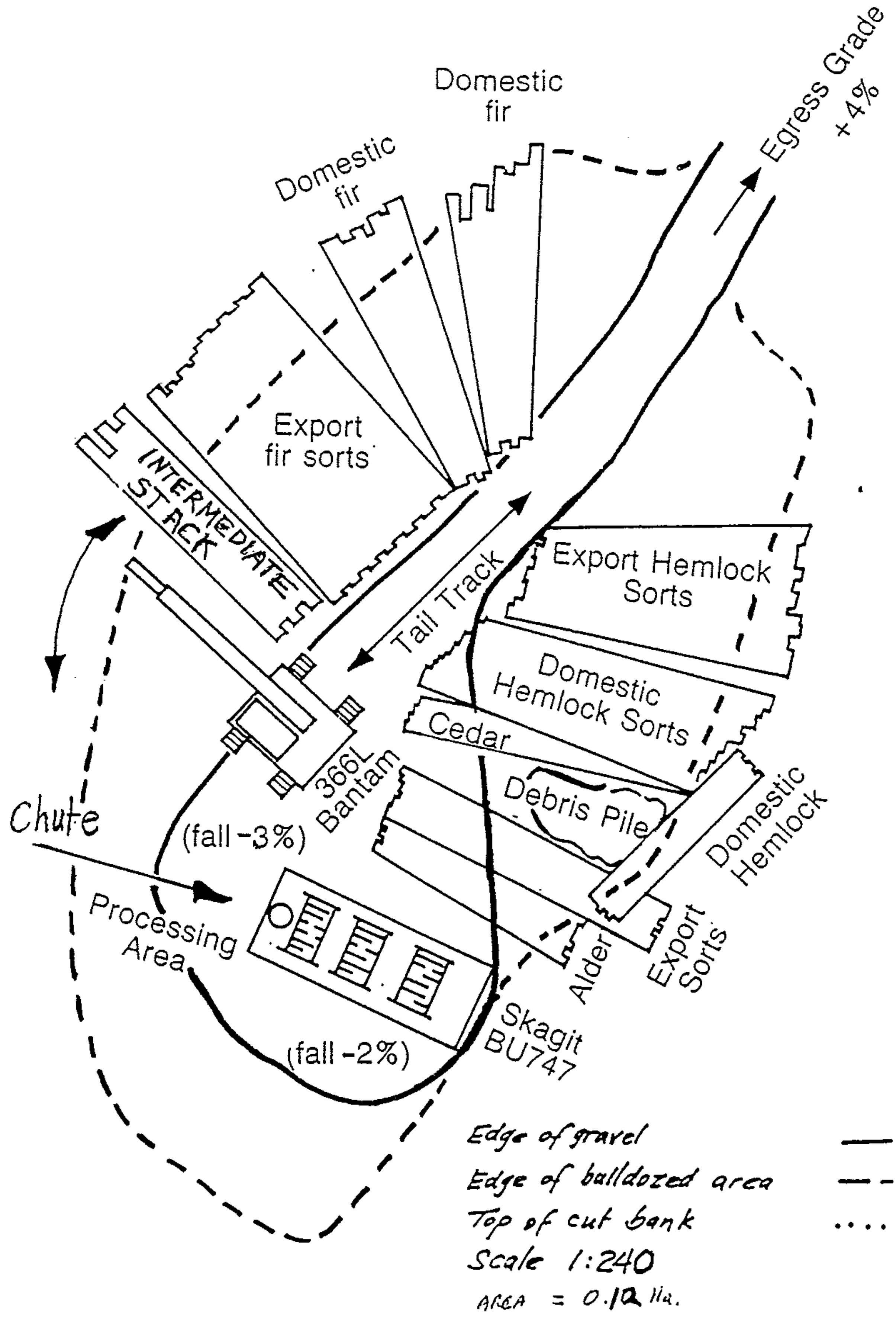
LANDING LAYOUT : HAULER/KNUCKLEBOOM LOADER



TOTAL AREA = 0.53 ha

UTILISED AREA = 0.25 ha

APPENDIX 4



Domestic fir
Domestic fir
Egress Grade +4%
Export fir sorts
INTERMEDIATE STACK
Tail Track
Export Hemlock Sorts
Domestic Hemlock Sorts
Cedar
366L Bantam
Debris Pile
Domestic Hemlock
Chute
(fall -3%)
Processing Area
Alder
Export Sorts
Skagit BU747
(fall -2%)
Edge of gravel
Edge of bulldozed area
Top of cut bank
Scale 1:240
AREA = 0.12 ha.