SITE IMPACTS FOR THREE INEXPENSIVE CABLE YARDERS

A thesis

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ABSTRACT

This study investigated the site impacts of three types of inexpensive cable yarders. A Koller Model K-300 with intermediate support capability and a hydraulically clamping carriage and a shop built, two-drum Idaho jammer rigged both as a ground lead with a squirrel block and as a live skyline with a nonclamping mechanical carriage were observed on three strip clearcuts and one shelterwood on two silt loam soils in northern Idaho. Change in soil bulk density, exposed mineral soil, residual slash, and residual damage to leave trees were recorded. Changes in soil bulk density for a crane mounted, single-drum jammer operating in the Idaho batholith near Smith's Ferry, Idaho were also recorded. Amount and distribution of soil disturbance and residual slash were determined and compared for the systems. Number of damaged leave trees and type of damage were recorded in the shelterwood harvest.

No significant compaction was recorded on units which were logged during dry weather in the northern Idaho units. Significant compaction was recorded on the single drum jammer site in the batholith and some portions of the shelterwood logged in wet weather. Areas where compaction was significant were yarded with the logs in full contact with the ground. Results indicated no difference in the impact of skyline and ground lead systems on dry soils.

Ground lead caused more serious compaction on moist soils. Both systems demonstrated ability to provide adequate exposed mineral soil for natural regeneration. Operations with the Koller provide the capability of controlling amount and location of exposed mineral soil by varying the amount of deflection in the skyline. There was no difference in the amount of residual slash left with either the skyline or the ground lead. Both systems produced little residual damage in the shelterwood. Most of the damage associated with the Koller was occurred on areas where the turn could not be controlled.

ACKNOWLEDGEMENTS

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INTRODUCTION

General

Cable logging has been used in the Pacific Northwest since the late 19th century. The first cable systems were steam powered. These machines, called "steam donkeys", used a horse to pull the line to the stump. Then the single drum, powered by a steam boiler, pulled the log to the landing. These systems could not control the path of the log, so it was difficult to maneuver around stumps and other obstacles. To solve this problem, loggers began to raise the cables off the ground by hanging them from blocks in trees. This provided some upward lift to the log making it easier to avoid obstacles. The height of the blocks got higher over time, eventually leading to the invention of the skyline around the turn of the century. Skylines were used extensively for yarding from steam yarders that travelled on railroad. These first skylines required a crew of 26 men and nearly seven miles of cable in order to reach 2000 feet. These systems fell into disfavor during World War II because of the high man power requirements. They were replaced in many areas by crawler tractors, which were less expensive and required less man power.

Increased concern with environmental effects of timber harvesting and decreasing land base led to renewed use of cable systems in the last 20 years. This increase has been accompanied by dramatic improvements and developments of different types of cable yarders. Cable yarders are now available in a variety of sizes and configurations.

The two main types of cable systems in common use today are known as skyline and ground lead. The main difference is that the skyline is capable of lifting some portion of the log clear of the ground, while ground lead systems must drag the log in contact with the ground. Skylines range in complexity from expensive five drum models to small two drum models. The ground lead yarders are usually less complex and less expensive. They normally use one or two drums.

Problem statement

While the effect of skyline and ground skidding on site productivity is well documented, there seems to be some disagreement on the effects and usefulness of different systems. Compaction, soil disturbance, residual tree damage and the amount of slash (residual organic debris) are all important factors in establishment and growth of planted and natural seedlings. These factors also affect productivity and residual stand value in selection cuts and thinned stands. These impacts depend on site conditions such as slope, moisture, soil type, aspect, and timber size. Very little information is available on site impacts from inexpensive cable systems or yarders with intermediate support capability.

Objectives

Because of lower timber values, increasing concern with site impacts and lack of knowledge of the site impacts of small, inexpensive and intermediate support yarders, this study was devised to assess impacts on several specific sites. The overall objective was to examine three different small yarder configurations operating in clearcuts and shelterwood units. The specific objectives of this study include:

1. An extensive review of the existing literature on the site impacts of the yarding or skidding function.
2. Determine the amount of soil compaction, disturbance and residual slash resulting from clearcut yarding with a small capacity skyline yarder using intermediate supports, a double drum Idaho jammer used as a ground lead.
3. Determine the soil compaction and soil disturbance effects of these systems in a shelterwood cut.
4. Determine amount, type and distribution of residual damage in a shelterwood cut.

5. Determine soil compaction for a single drum jammer in a selection cut.
6. Make comparisons between the systems.
7. Determine how use of an intermediate support affects site impacts.

CONCLUSIONS

When cable logging in dry weather there appears to be no appreciable compaction for the Koller yarder or the KWIK yarder. Some compaction was associated with the corridor in the Koller units, however the area impacted was limited to a five foot wide strip and amounted to approximately 1% of the area in the units. None of the units logged in dry weather were compacted significantly enough to affect productivity.

Units logged during wet weather showed areas of compaction. The ground lead yarded unit was heavily compacted in the corridors. Due to the large percent of area in corridors, there is probably enough compaction to cause a decrease in productivity. Heavy compaction on one corridor in the Koller shelterwood was probably due to a lack of deflection, which resulted in logs being yarded much like a ground lead. The higher soil moisture content during yarding resulted in more impact due to compactiom for the ground lead than for the skyline.

SOIL DISTURBANCE

All of the units except Unit 3 had an adequate percent of the area in exposed mineral soil to satisfy requirements for natural regeneration. Most deep disturbance was associated with the corridor. Unit 2 had significantly more disturbance than the other units. This was due to convex (benchy) slopes, which recquired yarding the log in contact with the ground for most of the turn and differences in residual slash accumulations.

SLASH

All the units except Unit 2 have high concentrations of slash. Slash on Unit 2 was very well distributed. There appeared to be no difference between skylines and ground lead yarding in slash concentrations. It appears that areas with more disturbance have a better distribution of slash. It is broken up and spread out by the action of the log. Tree length yarding appears to result in smaller slash concentrations due to less bucking in the woods, also the longer pieces tend to be in contact with the ground more, thus breaking up and redistributing slash concentrations.

RESIDUAL DAMAGE

Both systems demonstrated very little residual damage. Most of the wounds to residual trees were located on the bole. There was no difference in the two systems. Lack of residual damage is probably related to the fact that both systems lack power to keep logs suspended for long distances. This results in the turn being yarded in contact with the ground. The log did not whip around on inhaul and strike leave trees along the edge of the corridor. This is supported by the observation that damage was concentrated in areas where the turn could not be kept in a narrow track during inhaul, due to logs being lifted off the ground or sidehill yarding where the logs tended to slide downhill.

The KWIK rigged as a ground lead had low residual damage, but due to lack of lateral yarding capability the area yarded was limited to the corridors. The unit in this study was essentially two strip clearcuts. A two drum jammer is acceptable when managing for natural regeneration by using strip clearcuts, however due to lack of control in lateral skidding it can not be used in selection cuts.

RECOMMENDATIONS

Overall, the Koller skyline appears to be preferable to the groundlead systems in this study. When properly used the Koller showed no significant compaction on dry or wet soil. The ground lead configurations caused significant compaction on wet soils.

The Koller can create the desired amount of soil disturbance depending on site conditions. On areas where scarification is required for natural regeneration and potential erosion is not a problem, rig the tail tree low, so logs are yarded in contact with the ground. In areas where high erosion potential exists, rig the tail tree high, so logs can be flown for a portion of the turn, minimizing exposed mineral soil.

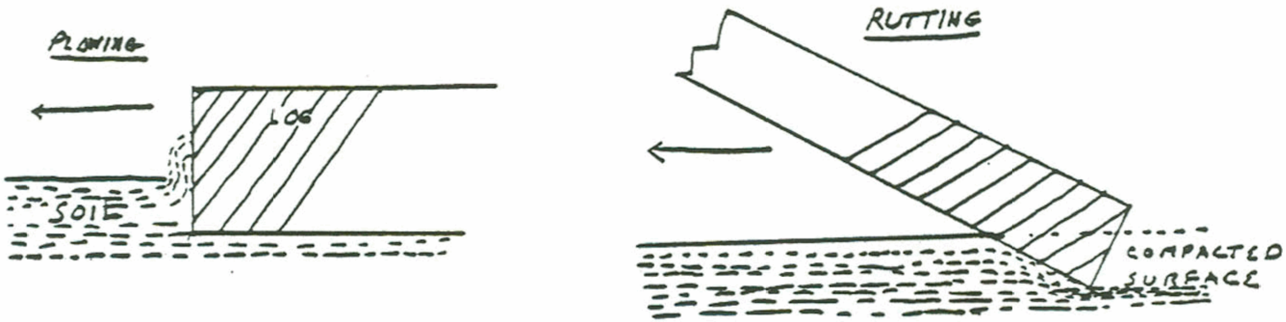
Some interesting results were drawn from this study. Due to the large amount of variation in conditions between the units, it was sometimes impossible to determine whether observed differences were due to system differences or site conditions. The main sources of variation were conditions over which man has no control, soil moisture and soil type.

This study showed that on wet soil a small skyline with inadequate deflection can cause serious compaction. Because of this information and a lack of available information on site impacts due to yarding with small skylines, a follow up study would be of great interest. This study could best be accomplished by yarding larger homogeneous units. Several areas should be chosen. The soils in this study were both silt loams. A follow up study could include sites with sand and clay soils.

Units should be large enough to be divided in half, one half should be logged with a skyline and the other with a ground lead. Logging on each half should take place as near to the same time as possible (simultaneously if it can be done safely). This would eliminate effects due to differences in soil moisture.

FIGURE 1

Diagrams of the plowing mode and the rutting mode.*



*From Cummins (1982)

Figure 2

UNIT 1

Clear Cut
1.88 acre
Ground Lead
McAllister Block

270 trees removed
51204 Bd. ft. Gross
27181 Bd. ft. Gross/Acre
189.1 Bd. ft. Gross/Tree

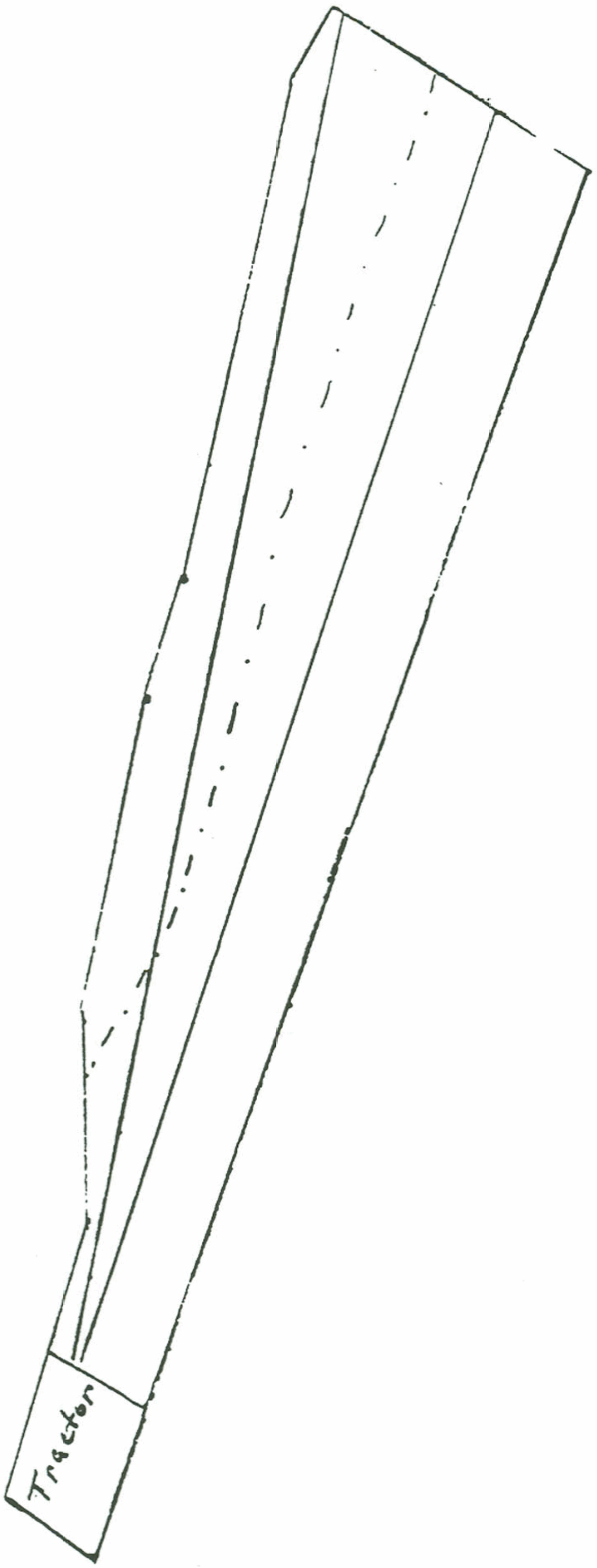
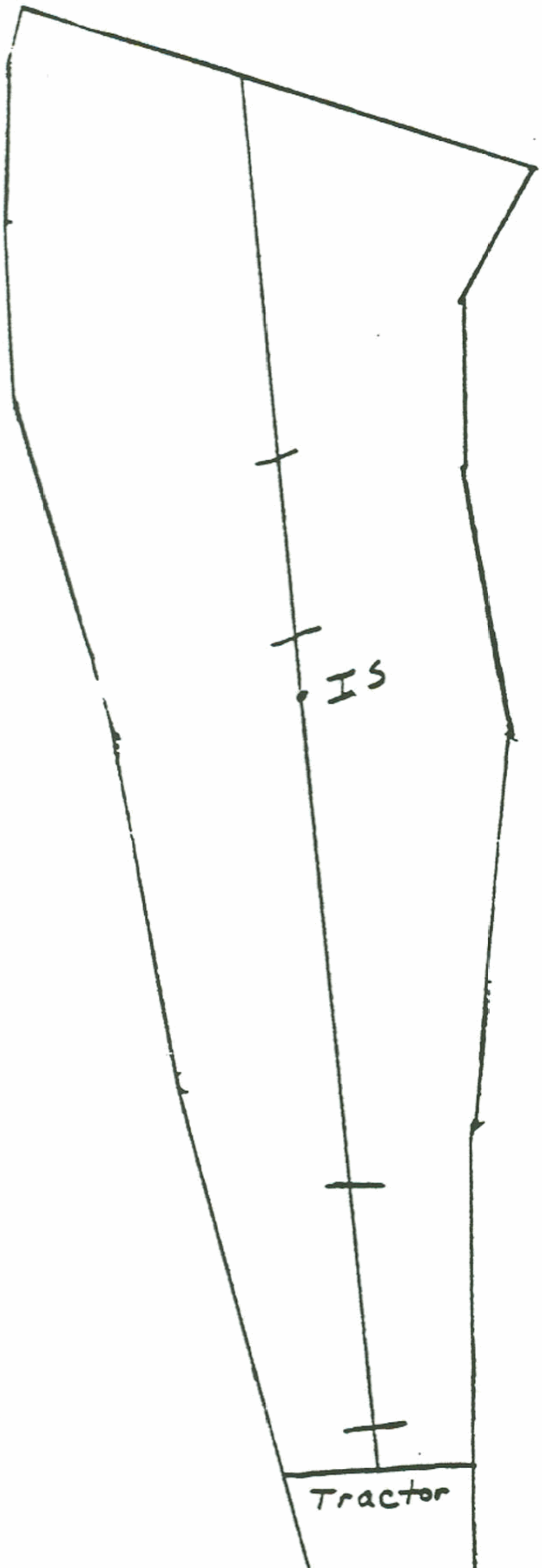


Figure 3

UNIT 2



Clear Cut
1.96 Acre
Koller intermediate support

528 trees
61460 Bd. ft. Gross
116.4 Bd. ft./Tree
31357 Bd. ft./Acre

IS = Intermediate support

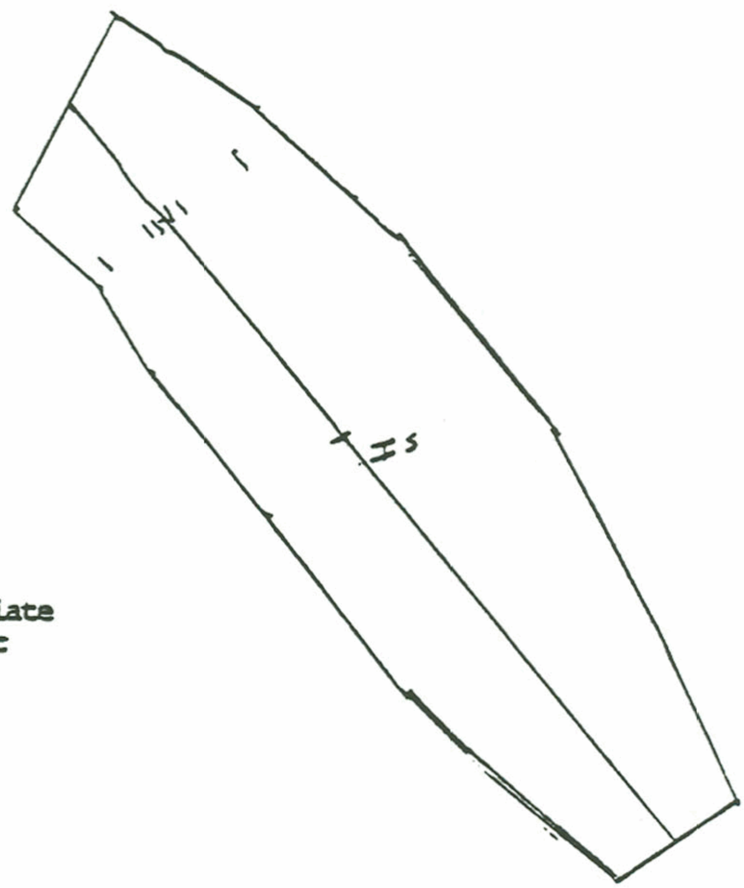
Figure 4

UNIT 3

Clear cut
1.3 Acre
Koller Intermediate
Support

405 trees
46696 Bd. ft. Gross
35920 Bd. ft./Acre
116.4 Bd. ft./Tree

Corridor
Az = 318°



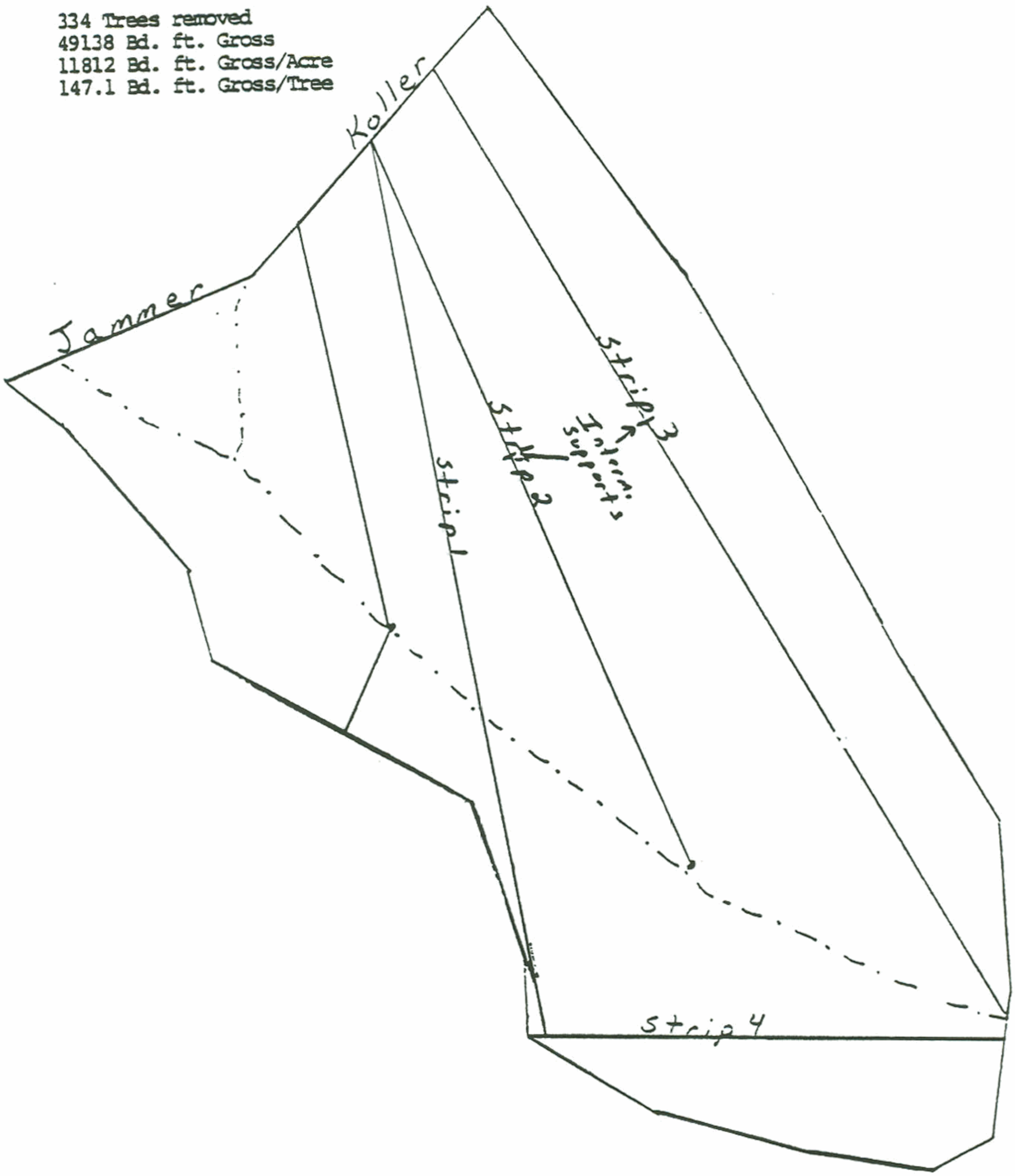
IS = Intermediate
Support

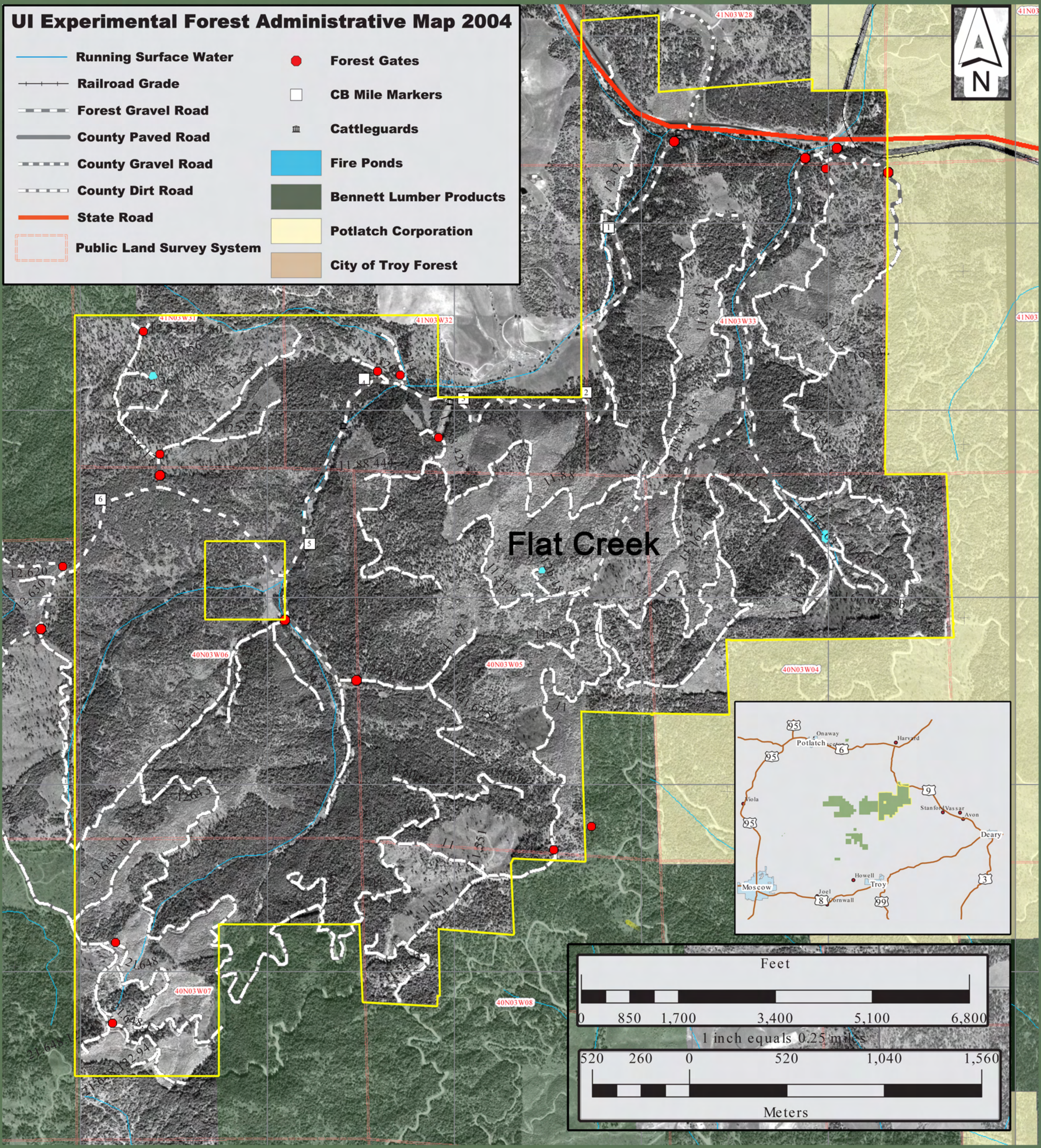
Shelterwood
41% Cut

Figure 5

Kdler = 3.5 Acre
Jammer = 0.66 Acre

334 Trees removed
49138 Bd. ft. Gross
11812 Bd. ft. Gross/Acre
147.1 Bd. ft. Gross/Tree




UI Experimental Forest Administrative Map 2004
Running Surface Water
Railroad Grade
Forest Gravel Road
County Paved Road
County Gravel Road
County Dirt Road
State Road
Public Land Survey System
Forest Gates
CB Mile Markers
Cattleguards
Fire Ponds
Bennett Lumber Products
Potlatch Corporation
City of Troy Forest
Flat Creek
Feet
0 850 1,700 3,400 5,100 6,800
1 inch equals 0.25 miles
520 260 0 520 1,040 1,560
Meters
Potlatch
Harvard
Viola
Stanford
Vassar
Avon
Deary
Moscow
Howell
Troy
Joel
Cornwall

Flat Creek

Location of Complete Research:

Author & Title: Bellitto, Michael W.
Site Impacts for Three Inexpensive Cable Yarders

University of Idaho Library:

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College of Natural Resources:

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Other Sources: