

Final Report
Region One Steep Slope Logging Cost Inquiry

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Introduction

The Forest Industry Research Program at the University of Montana's Bureau of Business and Economic Research (BBER) is under contract to collect information on new forms of harvesting and yarding used on steep slopes in the Northern Region of the USDA Forest Service (R-1). R-1 has approved the use of several types of these systems as proposed from industry. With the transition certain, ultimately the USDA Forest Service needs to know the efficacy of these systems to evaluate the value of standing timber. Due to the infancy of this steep slope harvest transition, cost estimates may be premature; however, understanding the current prevalence and diversity of these systems in R-1 would be beneficial.

Objective

Forest and timber sale managers in R-1 have expressed a need for more information on the use and costs associated with alternative logging systems for steep slopes, including the use of tethered logging equipment and "shovel logging." This information will aid the development and delivery of the Region's timber program, by improving the knowledge of the use and costs associated with these systems as alternatives to traditional cable logging operations on steeper slopes. The objective of this work was to provide R-1 with additional cost information that is relevant to tethered systems' use on R-1 lands and surrounding ownerships.

Methods

The study was a scoping exercise to assess costs and how the industry is using this technology in place of traditional technologies on steep slopes. Limited local/regional data appear to be available, but BBER researchers used a combination of data sources, including: existing literature, presentations, interviews and on-site visits with logging contractors, equipment operators, and equipment dealers to learn about the use of, investment in, and costs and production rates associated with these alternative logging systems for steep slopes. BBER also discussed the use of and requests for alternative steep slope equipment use with Forest Service timber personnel in R-1.

BBER visited active sites (timber sales) where tethered logging and shovel logging was being used on Forest Service (FS) and Idaho Department of Lands (IDL) sales. During the site visits, BBER collected information regarding 1) site and stand conditions (e.g., trees per acre, slope, etc.), 2) types and quantities of timber products removed (sawlog volume, non-sawlog volume), 3) logging productivity (e.g., loads per day or hour, tons per day or hour, yarding distance traveled), 4) type of equipment and number of workers, and 5) total costs per day or hour and costs per thousand board feet or ton. For a specific list of data collected see Appendix 2 and Appendix 2A.

Literature Reviewed

Using tethered logging systems is a relatively new form of harvesting and yarding timber in Montana and North Idaho. The use of tethered logging equipment has a more extensive history in the Pacific Northwest and in other countries. This history leads to a significant bibliography of information (Ecoshare 2020).

Sites Visited

BBER contacted several operators and landowners in Montana, Idaho, and Oregon (Appendix 1). BBER visited six sites, five in Idaho and one in Montana. Four sites were active FS timber sales and two sites were active IDL timber sales. The FS projects were 1) Greenhorn Stewardship on the Nez Perce Clearwater NF, 2) Cedar South on the Lolo NF, 3) Lone Cabin Stewardship on the Idaho Panhandle NF, and 4) Roundhouse Timber Sale on the Idaho Panhandle NF. The IDL projects were 1) Lion Edge located near Priest Lake, ID and 2) Benton South Cedar Salvage located near Headquarters, ID. The six sites offered a variety of geography, species composition, logging systems used, ownerships and silvicultural treatments.

Sites Visited and Logging Equipment Used

Appendix 2 and 2A display the information collected at each site. The following is a site-specific summary of the information collected. Individual logging firm cost data will not be reported given confidentiality issues. This ensures continued participation from the logging industry in these types of efforts.

Greenhorn Stewardship: The Greenhorn project is located on the Palouse District of the Nez Perce Clearwater NF east of Moscow, ID. The project is estimated to harvest approximately 700 acres with 17 million board feet (MMBF) of sawtimber and non-sawtimber harvested (USDA various years). Idaho Forest Group (IFG) purchased the project, and Danielson Logging was the logging contractor. The sale consisted primarily of Douglas-fir and grand fir sawtimber. The project appraisal consisted of approximately 80 percent skyline yarding and 20 percent ground-based yarding. The FS estimated skyline yarding cost was \$48 per ton.

BBER visited the site in August 2020. BBER spent the day observing the harvest operation in multiple units. Danielson Logging crew was interviewed during the visit. Danielson requested to use tethered logging on the skyline units and was granted permission. On this Unit, Danielson Logging was using a bar saw/processor head harvester tethered to a Caterpillar excavator and a shovel/excavator tethered to a Caterpillar excavator. The yarding distance on this unit was approximately 1,000 feet. They indicated using tethered logging systems for the last 3 to 4 years.

Cedar South: The Cedar South project is located on the Superior District of the Lolo NF. The project is estimated to harvest approximately 730 acres with 8 MMBF of sawtimber and non-sawtimber harvested (USDA 2022). Thompson River Lumber purchased the project and Jared Fitchett Logging was the logging contractor. The sale consisted of approximately 70 percent sawtimber and 30 percent non-sawtimber. Lodgepole Pine was the primary sawtimber species. The project appraisal consisted of approximately 75 percent skyline yarding and 25 percent ground-based yarding. The FS estimated skyline yarding cost was \$43 per ton.

BBER visited the site in October 2021. BBER spent the day observing the harvest operation in one-unit X. Fitchett Logging crew was interviewed during the visit. Fitchett Logging requested to use tethered logging and was granted permission. On this Unit, the logging contractor was using a Ponsse cut-to-length harvester tethered to a John Deere excavator and a Ponsse forwarder tethered to a John Deere excavator. The maximum forwarding distance was 1,000 feet. They indicated they were relatively new to using tethered logging systems.

Lone Cabin Stewardship: The Lone Cabin project is on the Fernan District of the Idaho Panhandle NF just north of Coeur d'Alene, ID. The project is estimated to harvest approximately 330 acres with 6 MMBF of

sawtimber harvested (USDA 2022). IFG purchased the project and R&R Logging was the logging contractor. The sale consisted of 100 percent sawtimber. Grand fir was the primary sawtimber species removed. The project appraisal consisted of approximately 87 percent skyline yarding and 13 percent ground-based yarding. The FS estimated skyline yarding cost was \$43 per ton.

BBER visited the site August 1, 2022. BBER spent the day observing the harvest operation in Unit 33. R&R Logging was interviewed during the visit. R&R requested to use tethered logging on the skyline units and was granted permission. On this Unit, R&R Logging had a Caterpillar 552 harvester with bar saw/processing head tethered to a Caterpillar 330D excavator sitting on the road. This unit was yarded with a shovel tethered to the excavator on the road in the narrow section of the unit; a cable yarder had been used further down the road in a (wider/deeper) portion of the unit already completed. They indicated using tethered logging systems for the last three years.

Roundhouse Timber Sale: The Roundhouse project is on the St. Marie's District of the Idaho Panhandle NF east of Coeur d'Alene ID. The Roundhouse project is a large project harvesting 1,122 acres providing approximately 23 MMBF of sawtimber and non-sawtimber (USDA 2022). Approximately 94 percent of volume is sawtimber and the remaining volume was non-sawtimber. IFG was the winning purchaser and Ben Smith Logging of Missoula, MT was the logging contractor. Lodgepole pine was the primary sawtimber species removed. The project appraisal consisted of approximately 70 percent skyline yarding and 30 percent ground-based yarding. The FS estimated skyline yarding cost was approximately \$48 per ton and ground-based yarding cost was \$31 per ton.

BBER visited the site on August 2, 2022. BBER spent the day observing the harvest operation in multiple units. Ben Smith logging crew was interviewed during the visit. The logging contractor requested using tethered logging on the skyline units and was granted permission. The tether operating in this unit was a modified excavator with a Summit tethering system. They indicated using tethered logging systems for approximately six months.

Lion Edge Timber Sale: The Lion Edge is an IDL project north of Priest Lake, ID. The Lion Edge project consists of 174 harvest acres and 2.9 MMBF of sawtimber harvested (IDL 2022). The grand fir-hemlock-subalpine fir species group was the primary sawtimber species removed. The project appraisal consisted of approximately 70 percent ground-based yarding and 30 percent ground-based yarding. The IDL estimated skyline yarding cost was \$93.50 per thousand board feet (MBF) and ground-based yarding cost was \$41.50 per MBF. An additional \$59 per MBF is involved in harvesting, processing and loading costs for a total appraised stump to loaded truck cost of \$152.50 for the skyline units (IDL 2022).

BBER visited the site on August 15, 2022. BBER spent the day observing the harvest operation in one unit. IFG purchased the sale and Shane Blood Logging was the logging contractor. Shane Blood Logging requested using tethered logging on the skyline units and was granted permission. On this Unit, Shane Blood Logging had used a tethered harvester and tethered grapple skidder to harvest the unit. The harvester and grapple skidder were tethered to a Caterpillar excavator that had been modified to serve as the anchor machine. They indicated using tethered logging systems for the last three years.

Benton South Cedar Salvage: The Benton South Cedar Salvage project is east of Headquarters, ID. The project is a fire salvage project harvesting approximately 9 MMBF of high value western red cedar and Douglas-fir sawtimber (IDL 2022). The site slope of the unit visited was extremely steep, approximately 80 percent slope. The prescription was a salvage clearcut removing approximately 40 MBF per acre. IDL

appraised the project to be 70 percent skyline and 30 percent ground-based yarding. The total appraised stump to loaded truck cost was approximately \$195 per MBF (IDL 2022).

BBER visited the site on August 17, 2022. BBER spent the day observing the harvest operation in multiple units. IFG purchased the sale and Todd Cleveland Logging was the logging contractor. On the tethered unit visited the logging contractor was using two dangle-head harvesters tethered to Caterpillar 336F excavators fitted with a Summit tether system. A Tigercat grapple line machine was used to yard the logs to the landing. The maximum yarding distance on this unit was 1,200 feet. Todd Cleveland Logging is a large Idaho logging contractor with extensive experience using tethered systems.

What We Learned

The six sites visited and the six contractors interviewed offered BBER with a cross section of site, equipment, ownership, and operator experience variability. The information collected does not allow us to precisely estimate tethered logging costs, but does provide improved understanding of how tethered logging fits into the existing cable and ground based equipment cost structure.

The following summarizes the seven important factors that were identified from the interviews conducted. Some of these factors are interrelated but they will be discussed independently.

What is a Tethered Operation: Tethered yarding systems consist of a cable winch mounted on a piece of “anchoring” equipment located on a road or landing area, with the other end of the cable attached to an operating piece of equipment (e.g., harvester, skidder) downslope in the stand. On the sites visited, the tethered systems were used in a variety of ways. We observed harvesters, yarders, shovels, and cut-to-length machines tethered to excavators or dozers, but mostly excavators. The excavators were either modified excavators or specifically designed machines from manufacturers, such as Ponsse. The operators were very creative in how the tethering was used. We observed the use of tethers on steep slopes where skyline systems are traditionally used and on slopes where ground based systems are typically used.

Safety: The safety of the choker setters and hand fallers on steep slopes was a major concern to all the operators interviewed. Of course, the safety issue directly impacts costs via workmen compensation insurance costs the operators pay. The logging contractors also indicated the concern of the health and welfare of the employee. Many of the employees had worked for the contractors for many years and were considered family members. Given the long-term tenure of these relationships the contractor and the employees had personal relationships that went beyond work. The contractors were willing to invest in machinery to secure the safety of employees especially if the contractor could remain competitive in the marketplace.

Labor Availability: The logging operators indicated that their workforce is aging and close to retirement age. We have heard this issue discussed in other forums. There is also the issue of the available labor pool willing to endure the incredibly strenuous work required in the woods. These positions are well compensated, but this does not increase the labor pool. Given this situation, the contractor must resort to investing in the equipment needed to complete the logging jobs that exist in today’s marketplace. These investments are very significant because a new tethered machine costs about \$1 million, and there is uncertainty about the amount of work available to generate the cash flow needed to pay the bank note.

Site and Harvesting Features: Tethered logging equipment and the typical cable operation are impacted by the same site and harvesting features. Examples of these factors are 1) volume per acre harvested, 2) number of leave trees remaining in the unit, 3) placement of temporary roads and skid trails, 4) types of soil (rocky versus highly erodible, 5) silvicultural prescription, and 6) experience of the operator.

All these features impact costs. The more volume harvested per acre decreases the tethered logging costs per unit volume. The more leave trees that the equipment must operate around increases the turnaround times from the stump to the landing, increasing costs. Several of the operators mentioned that skidding/yarding trail placement is especially important in the tethered operation. Skidding/yarding trail placement should not exceed 600 to 800 feet apart to be most efficient for tethering the harvester and yarder. Also, several of the operators suggested that they be allowed to determine skidding/yarding trail location since they have a better understanding of how their tethered system works. The types of soil appear to impact the tethered system. Excessively rocky or fine-grained, loose soils decrease harvester and skidder traction which can increase costs and soil impacts. Finally, the experience of the operator impacts costs. The use of tethered logging systems is relatively new in Montana and Idaho. With a range of several months to several years of experience, contractors and the operators need time to build the skill sets needed to maximize the efficiency of their tethered system(s).

Tethered Operation Costs: This study was not designed to precisely estimate tethered logging costs. The main objective was to gather quantitative and qualitative information regarding tethered logging systems. In several situations the operator did not know their costs given the use of the equipment was relatively new to them. In other situations, the operator knew their costs but did not want to share the information given the confidential nature of the information. Given these issues we can share relative information regarding fixed versus variable costs, fuel usage, labor savings, and cost ranges.

Fixed versus Variable Costs: The operators who knew their costs indicated that fixed versus variable costs were approximately 40 percent fixed costs and 60 percent variable costs. This is very similar to the typical cable yarding operation (Miyata, 1980). Fixed costs include bank payments, equipment insurance, and workers compensation insurance; and variable costs include fuel, labor, and maintenance costs.

Fuel Usage: The operators indicated that fuel usage, in general, was very similar to the typical cable yarding system. However, fuel usage was dependent on the type of equipment that was tethered. An operator surveyed indicated that the anchor used less fuel (worked at a lower engine revolution per minute) when the harvester was tethered in comparison to having the skidder/yarder tethered. The anchor had to provide more assistance when the skidder/yarder was attached with a load of logs.

Labor Savings: Tethered logging systems use few workers. In one situation the logging contractor stated that on that site there would be four to five additional workers needed using the typical cable operation. This can represent a 25-50 percent decrease in crew size using a tethered harvesting system in place of hand-fallers and choke-setters needed with traditional cable systems. Needing fewer workers and the labor shortage mentioned earlier gives the tethered system a major advantage over traditional cable yarding in the future.

Cost Range: As indicated earlier, site specific costs will not be reported. In all cases, the operators requested permission to use tethered logging systems and that permission was granted by the land management agency. In all cases, the operators were not given an appraisal

cost adjustment by either the FS or IDL. In all cases, the operators were willing to operate the sale based on the original yarding costs. Several operators indicated that a tethered logging operation using a tethered harvester and skidder/yarder would have costs in the range of the typical cable yarding system. These statements were made by operators with varying degrees of experience using tethered systems. Based on these statements and willingness to operate the sales based on the cable-based appraisal costs, indicates that the tethered system and the traditional cable system have similar cost ranges. Given labor shortages and safety issues, the tethered systems appear to be more viable than traditional cable systems in the future.

Mobilization Costs: All operators indicated that moving tethered logging equipment to and from the site was costlier in comparison to cable yarding operations. Tethered equipment is much heavier and requires low boy transportation equipment and forest bridges that can hold the added weight. And there are more pieces of equipment used at a site that require transportation.

Soil Impacts: Less soil compaction and displacement were mentioned as a benefit for using tethered systems but was not the main reason given by contractors/operators for adopting tethered logging systems. Safety and labor availability were their primary reasons. Several operators indicated that on rocky and loose soils where the machine is searching for traction, the tethered system may cause more soil compaction or soil displacement and rutting in comparison to traditional cable yarding systems. The operators need to be aware of the potential issue and change their operations accordingly. Having minimal or acceptable impacts on soil resources should be a major consideration in approving the use of tethered systems in lieu of traditional cable yarding on steep slopes.

The Future: Several operators indicated that tethered logging is the wave of the future. Because of labor and safety issues as well as flexibility, tethered systems will be the preferred steep slope system used in Montana and Idaho. Once the equipment becomes more widely available and used operating costs will be more accurately known.

Summary Points

- Tethered systems can effectively replace skyline/cable yarding systems on steep logging sites.
- Relatively few logging contractors are currently using tethered systems in Montana and Idaho, but the number could increase as the technology evolves and gains acceptance.
- The main reasons mentioned by logging contractors for using tethered systems are increased safety for workers and the need for fewer workers compared to traditional cable logging.
- Tethered systems are flexible in their configurations and use, using new and/or retrofitted ground-based equipment. However, both new and re-fitted equipment are expensive to purchase and maintain.
- Mobilization costs are higher with tethered systems than cable/skyline because more and heavier equipment is used.
- In general, costs of tethered logging appear to be similar to cable/skyline for operating on the same types of sites with similar prescriptions. The trade-off for logging contractors is higher equipment-related costs but lower labor costs with tethered versus cable/skyline.

Literature Cited

Ecoshare, 2020.

<https://ecoshare.info/projects/central-cascade-adaptive-management-partnership/synthesis-papers-tools/tethered-logging-bibliography/>

Miyata E.S. 1980. *Determining fixed and operating costs of logging equipment*. GTR NC-55. U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota

Morgan, Todd and Hayes, Steve. 2009, 2011, 2013, 2015, 2017, 2019 and 2021. Logging & Hauling Cost Studies. http://www.bber.umt.edu/FIR/F_Logging.asp

USDA Forest Service. Various years. Appraisal Form 2400-17 for specified timber sales. USDA Forest Service, Northern Region Timber Appraisal System.

Idaho Department of Lands Timber Sale Information. <https://web.idl.idaho.gov/timbersale/search.aspx>

Appendix 1: Field Visits and Contacts

The following table identifies the firms and individuals contacted. A subset of these firms was visited during the Fall of 2020 through the Summer of 2022. Region 1 of the USDA Forest Service provided BBER with Forest Service sites (or FS contacts) that were using or planning to use this technology. Those sites are identified Private wood products were also contacted in several states regarding projects using tethered logging.

Steep slope logging contacts.

Contact	Affiliation
Alan Harper	Idaho Forest Group
Eric Nave	Idaho Forest Group
Mike Lilly	Idaho Forest Group
Jerry Anderson	Hancock Oregon
Barry Dexter	Stimson Idaho
Tyler Roady	Potlatch Idaho
Shawn Keogh	Idaho Logging Association
Paul McKenzie	Stoltz Lumber
Bryan Larango	MT Loggers Assoc.
Scott Ketchum	Hancock Idaho
Tom Schultz	Idaho Forest Group
Dan Castillo	Lolo / Bitterroot NF
Ben Feiro	Lolo / Bitterroot NF
Rob Tomczak	Idaho Panhandle NF
Kaitlyn Bowman	Idaho Panhandle NF

David Haupt	Region 1, Regional Office, Forest Management
Dave Hattis	Region 1, Regional Office, Forest Management

Appendix 2: Field Data Collection Instruments

UNIT OBSERVATIONS SHEET												Project: _____				
SITE SPECS	STATE	SITE #	COUNTY	DATE	OWNERSHIP	FELLING	SKIDING	YARDING	DELIBING	MERCH. LOC.	# PRODUCTS	TREE SPECS	SAWLOG TOP "	VENEER TOP "	PULP TOP "	OTHER TOP
	XX	XX	XX	XX/XX/XX	XX	XX	XX	X	XX	X	X		XXX	XXX	XXX	XXX
SALE NAME: _____ CONTACT INFO: _____												LAT/LONG GPS: _____				
OWNER NAME: _____																
SITE #/COUNTY: _____ ACREAGE & VOLUME OF UNIT: _____												LOGGING CONTRACTOR: _____				
HARVEST PRESCRIPTION												# crew on unit: _____				
Clear		CUT	LEFT			VPA	CUT	LEFT					BBER CREW: _____			
Seed		TPA				VPA							LINE/SITE CHARACTERISTICS			
Shelter		TPA				VPA							EXTERNAL YARD DISTANCE	SLOPE	ELEVATION	ASPECT
Thin		TPA				VPA										
PRESCRIPTION NOTES:																
EQUIPMENT NOTES																
FUNCTION	MAKE				MODEL				EQP. COST							
Felling																
													SOIL ERODIBILITY			
Skidding													High			
													Moderate			
Yarding													Low			
													PRODUCTIVITY			
Anchoring													LOADS PER DAY	LOAD VOL TONS MBF	HOURS PER DAY	LOGS PER DAY
Processing																
Loading																
GENERAL NOTES												COST				
												Per ton				
												Per MBF				
												Per day				
PRODUCTS				PRIMARY SPECIES CODES				DISPOSITION OF RESIDUE								
Sawlogs								Used for other products (chips, biomass etc.)								
Veneer logs								Scattered and broadcast burned								
Houselogs								Scattered for nutrients								
Pulp logs				AVG DBH				Piled and burned								
Other Note:								Other: Note								

Appendix 2A:

Site & Landowner: _____ **Operator:** _____ **Date:** _____

COST RELATED QUESTIONS

1. What are your daily total costs for the tethered operation?
2. What are the factors that impact costs?
3. What proportion of your daily total costs are variable vs fixed costs?
4. What proportion of the total cost is tied to fuel consumption?
5. What are the site factors that impact costs?

PRODUCTION RELATED QUESTIONS

6. How many loads per day are you producing on this site?
7. What impacts your loads per day production?
8. What piece of equipment limits your production?
9. What is different operationally with tethered:
 - a. Move in/out?
 - b. # people, availability of operators, training/skills needed?
 - c. Up/down time or maintenance?
 - d. Max slope you operate on?

New vs. retro-fitted equipment – which pieces, costs?

Other operators using tethered equipment?