

Harvesting Systems and Equipment in British Columbia



BRITISH COLUMBIA Ministry of Forests
Forest Practices Branch



Harvesting Systems and Equipment Part One

EQUIPMENT SELECTION

Examples, Pages 42 — 45

The handbook does not attempt to define a single “best” system for any site. Instead, it presumes that readers need to be aware of the key factors that influence the probability of achieving success with any given combination of equipment and site characteristics. Readers will then use their own judgement to evaluate the merits of the various options. The information in the handbook should be considered only as part of an overall process for equipment selection which will vary from company to company.

EXAMPLES

These examples demonstrate how information can be obtained from the handbook to help match equipment to the site. The examples have been based on hypothetical scenarios that could be encountered by industrial or agency planners.

These examples illustrate that the handbook's purpose is to identify issues and concerns, and to evaluate the risks associated with combinations of site conditions and equipment. The handbook is not meant to provide the single "correct" answer about what equipment is suited to any particular site.

Example 1: Change Harvest Season

A cutblock has been planned and approved for winter harvesting, but corporate log-flow requirements have made it important to advance the harvesting schedule, perhaps to late summer or early fall. What are the important issues that must be addressed with harvesting the cutblock earlier in the season? Will the same equipment be suitable? If not, what different equipment or operating techniques will achieve acceptable results?

The cutblock is proposed for clearcut harvesting, using typical roadside equipment comprising a feller-buncher, grapple skidders, stroke delimiters, and butt 'n top loader. The timber is small-diameter pine on rolling terrain, and the roads were laid out for a maximum of 250 m skidding. The maximum sideslope is about 30% and the soils are fine-textured. The proposed plan specifies harvesting under dry or frozen conditions.

Scan the column labelled "wheeled skidder - grapple" in Table 2 to determine what impacts could result from the proposed change to the harvesting schedule. Wheeled skidders require high soil strength, and have low to moderate ability to avoid ground disturbance, especially when the soil moisture content is high.

Figure 1
Rubber-tired skidders may be a high-risk option for non-frozen conditions unless weather conditions are favourable.



Chart 1 confirms this — operating on fine-textured soils under wet conditions is rated at risk level 6 (Table 6). Clearly, soil disturbance will be a significant concern.

The requirements and limitations of the skidding equipment will not be changed under a different harvesting schedule, so the planner must evaluate the risk of operating under non-

frozen conditions. What is the likelihood of experiencing a period of sustained dry weather when the skidders may be able to operate successfully? If the likelihood of dry weather is low, resulting in a high risk of soil disturbance, then changes to the operating techniques or equipment will be required. Information listed in the Index under "soil disturbance - compaction - skidder" and "soil disturbance - rutting" describe wide tires and devices to fit over the skidder tires to reduce their ground pressure. These devices could reduce the risk of causing soil disturbance.

However, the rubber-tired skidder remains a high-risk option even with tracks or wide tires, so alternative equipment should be considered. Clambunks, forwarders, loader-

forwarders, small-scale equipment, and horse logging are the ground-based options with greater ability to avoid ground disturbance (Table 2). The latter two options are high risk for this scenario because of their low productivity. Although the forwarder is less susceptible to high soil moisture, it could be high risk because it requires specialized trucks and mill configuration (Chart 5) that may not be available. Specialized falling and loading equipment will also be required. Clambunks (Index: clambunk) may be better suited to the soil conditions than the skidders. Loader-forwarding could be an option, but the small timber size and long skidding distances increase the risk. Flex-track skidders are also rated in Table 2 with a low–moderate ability to avoid ground disturbance, but their risk on moist, fine-textured soils is rated slightly lower than skidders (Chart 3). They may be worth considering.

Cable equipment may provide an alternative more suited to reducing soil disturbance, but higher operating costs will increase the risk. Furthermore, the yarder must be suitable for roadside operations to fit with the processing and loading equipment, eliminating highlead yarders from consideration. The small tree size eliminates large equipment, although bunching could help to reduce the risk. Adequate deflection and clearance will be critical to avoid soil disturbance (Chart 14). Rolling terrain with maximum 30% sideslopes over yarding distances of 250 m will make it difficult to achieve adequate clearance with a short yarder. Multi-span skylines could be considered.

The only alternatives to the wheeled skidder that seem viable are the clambunk skidder and the flex-track skidder. The forwarder may be viable if the corporate infrastructure supports shortwood logging.

Clearly, any equipment changes required in this scenario will be short term, and therefore must be confined to equipment that is readily available for hire. Most of the alternative equipment is capital-intensive (Table 1), and is likely to be gainfully employed and unavailable for a short-term rental. Furthermore, all the alternatives are more expensive than the original proposal — the planner must evaluate the benefit of the altered harvesting schedule with the added costs.

Example 2: Review Development Plan

As a Small Business forester for the British Columbia Ministry of Forests, you are responsible for preparing forest development plans for the Small Business Forest Enterprise Program. An area of your development plan includes a coastal cutblock where the layout contractor has proposed skyline yarding over a creek. You are unfamiliar with skyline systems, and want to ensure that the proposed harvesting will achieve all the operational and environmental objectives. What are the issues that should be addressed in your review? What alternatives should be considered?

The cutblock is located in an incised valley with sideslopes averaging about 70%, although the sideslope reaches about 100% at the higher elevations. A road was constructed about 15 years ago to harvest the timber on one side of the creek using a grapple yarder. The cutblock was reforested after harvesting, and now supports a stand of trees about 5–7 m tall. The timber on the far side of the valley was not harvested because of difficult terrain. It has numerous rock bluffs dispersed throughout the standing timber, which would result in extremely expensive road construction. A narrow band of trees left adjacent to the creek after the original harvesting has not sustained any significant amount of windthrow. A similar buffer strip is proposed for the far side of the creek. Two landings are proposed on the existing road for skyline yarding, and the maximum distance from the landings to the cutblock boundary is about 700 m.

Figure 2
Large skyline towers can suspend logs over streams providing the conditions are suitable



Table 2 indicates that the proposed large, single-span skyline will adequately address any concerns about soil disturbance, but the cross-stream yarding concerns you with the possibility of introducing debris into the stream. Will the skyline be able to lift the logs clear of the buffer strip? Chart 15 indicates that deflection is a primary consideration for large skylines, and the Index points to several areas with information about deflection. Clearly, both deflection and clearance are important, so you make a note to ask the layout contractor for representative deflection lines. You will ask about the amount of deflection, and the amount of clearance below the carriage. You also note to ask whether the trees will be yarded full-length, or will they be bucked beforehand? This will affect the required amount of clearance over the standing trees. You learned from the information under “hand-falling” and “hand-bucking” that

on-site bucking is difficult and dangerous in such steep terrain. If clearance is inadequate, you will ask what plans have been made for corridors through the standing timber.

You also notice from Chart 15 that the landing chance and anchors are critical for successful skyline operations, so you will ask about the landings (Index: landing - yarding). The original harvesting was done by grapple yarders, which do not require landings, but the skyline yarders will need landings. Will the landings encroach on the plantation, and will they have adequate space to accommodate the yarding debris? What anchors are available at the landing to hold the tower (Index: anchor - guyline), and what anchors will be required at the tailholds? Will the anchors be located at the cutblock boundary, or will they be extended above the cutblock boundary to increase deflection (Index: anchor – backspar)?

You make another note to ask the layout contractor whether alternatives to cross-stream yarding have been considered. Clearly, ground-based systems are impractical because of the steep and difficult terrain (Table 2), but you want to ensure that all the options have been considered. Alternative yarding systems would involve building a road on the other side of the creek, so you make a note to ask whether a road survey was conducted on the far side, and if so, why it was not chosen for construction. You know from Chart 10 that highlead systems are more tolerant of poor landings than large skylines, so you will ask about potential landings on the alternative road location. You also know from the Index information on “yarding - slope - downhill” that safety in the landing is a major concern.

You also consider helicopter logging. You know from Table 1 and Table 2 that helicopter extraction is more expensive than skylines, but you want to ensure that all alternatives have been explored. You know from the descriptions of helicopters (Index: helicopter) that the helicopter must be matched in size to the timber resource and that bucking the trees by weight rather than by length is important. Bucking on the steep, broken ground may be difficult. Also, landing size and safety in the landing are major concerns — you note to ask whether helicopter logging was considered, and if so, what landing location would be used.

Armed with your new knowledge about skylines, you feel more confident that you can ask pertinent questions about the proposed system, and any alternatives that were considered.

Example 3: Encounter New Operating Conditions

XYZ Forest Products had been operating in consistent timber and terrain types for more than 10 years, but is now faced with new conditions as it moves into a different area. Previously, the average cutblock had been laid out for clearcut logging with roadside processing, but the planners for XYZ realize this system is unsuitable for the new operating area. The slopes are steeper, and visual-quality objectives make large clearcuts unacceptable. Partial cutting will be required. The timber size is about the same, although the soils are generally of finer texture.

XYZ has four contractors, each producing about 120 000 m³/yr in roadside operations for a total of 480 000 m³/yr. The total cut for the operating division will be reduced to about 450 000 m³/yr, with the new area comprising about 50 000 m³/yr. One option among several being considered is to retain three contractors at their current levels, and to reduce one of the contractors to 90 000 m³/yr, working in a combination of the new and existing operating areas.

The company, and its contractors, must determine whether the equipment that was used previously will be acceptable for the new operating area.

Three of the contractors have very similar equipment: two feller-bunchers, two grapple skidders, two stroke delimiters, and one butt 'n top loader. Each of the contractors has at least one levelling-cab feller-buncher, and all of the feller-bunchers are equipped with high-speed disc saws. The fourth contractor has different equipment: two feller-bunchers, but neither have levelling cabs, one grapple skidder that is used as required, one clambunk skidder, two dangle-head processors, and a butt 'n top loader.

What is the best equipment allocation for the new area?

The new operating conditions have five critical differences: steeper terrain, finer-textured soils, partial cutting, less operating volume, and the requirement for flexibility between the new and old operating conditions. Taking these in order, Table 2 indicates that wheeled skidders are best suited to slopes less than 35%. Depending on the amount of area over 35% or over 50%, the wheeled skidders may be marginally suited or completely unsuited to the new conditions (Chart 1). Furthermore, the requirement for partial cutting makes grapple-based equipment poorly suited because of its limited reach (Index: skidder - grapple).



Figure 3
Clambunk skidders may be able to work on the steeper slopes of the new operating area.

Will the clambunk skidder be any better suited? Table 2 indicates that clambunks can work on steeper terrain and require less soil strength, but there are three major factors that make clambunks poorly suited to this situation: they are grapple-based, they are

large, and difficult to maneuver within a partial cut (Index: clambunk - partial cutting), and they require a large operating volume to make them cost-effective (Index: clambunk).

It appears that the present equipment fleet is not well suited to the new conditions. What features should the company and contractor be looking for in replacement equipment?

The steep terrain, fine-textured soils, partial cutting, and low operating volume will all be critical factors in the specification. Wheeled-based equipment may be unsuited, depending on the steepness of the terrain, even if operations could be confined to frozen or deep snowpack conditions to address the soil disturbance concerns. Track-based equipment would have better stability for improved safety. For grapple-equipped machines to work effectively, especially in partial cutting, they must be matched with suitable felling equipment (Index: skidder - grapple), which means that a zero-clearance feller-buncher with a levelling cab will likely be required (Index: feller-buncher – partial cutting). Without the appropriate falling equipment, line skidders will be required (Table 2).

Forwarders may be an option, depending on the terrain steepness, but the mill and trucking fleet must be configured to accept the different log specifications. Different felling equipment would also be required to manufacture the short logs.

Cable equipment should also be considered, but only carriage-based yarders because of the partial cutting (Table 2). With the projected volume (50 000 m³/yr), and typical daily production rates, year-round operations will be required. Costs may be prohibitive with the small trees unless feller-bunchers can be used. As before, a levelling cab will be required, but the soils must be examined carefully to ascertain if a feller-buncher can be used during the summer. Depending on the typical ground profiles and deflection, multi-span capabilities may be necessary (Chart 13, Chart 14, Index: deflection).

Processing and loading equipment must also be considered. The traditional operating area used roadside processing, but the new area will likely use landings because of the steeper terrain. The butt 'n top loaders will not be suited, although the processors can be used in roadside or landing configurations.

Lastly, the company and contractor must consider the overall effect of annual production levels. Under the scenario as presented, one contractor would be downsized to 90 000 m³ – 50 000 m³ from the new area and 40 000 m³ from the traditional operating areas. The previous equipment fleet was based on high-volume roadside logging, and will no longer be cost-effective. What equipment will be used on that area? The overall scenario seems unworkable, and should be reconsidered. The new operating area requires different types of equipment, but changes cannot be made without considering the impacts on the traditional operating areas.

As stated before, the purpose of this handbook is not to identify the single “correct” answer, but to identify issues that must be considered and how the characteristics of the various types of equipment address those issues. The preceding examples illustrate how to use the information in the handbook to improve equipment selection.