Soil Disturbance after Logging in British Columbia 1991 Results

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by

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SUMMARY

1. **Compliance with current guidelines** on Low and Moderate sensitivity sites was over 90% (Figure 1). On High sensitivity sites compliance ranged from 80% on winter logging, to 25% on summer logging.

2. **Season, slope steepness and terrain uniformity were correlated with differences in detrimental skidding disturbance,** as expected. Skidding disturbance increased with increasing slope steepness, was higher on summer vs. winter logged sites, and increased on non-uniform terrain types (Figure 2).

3. For winter logged sites, **average detrimental disturbance** ranged from 6.7 - 9.4% on 0-15% and 16-30% slope classes, respectively. Summer logged blocks ranged from 10.6 - 16.1% on the same slope classes (Table 3).

4. **Average landing area on non-roadside treatment units was 3.4%.** Landing area decreased slightly with increasing slope, and landings were slightly larger on summer than winter logged sites (Figure 3). Seventy-two percent of surveyed landings were less than 4% of Treatment Unit area.

5. **Average total disturbance** was calculated as the sum of landings, detrimental skidding and light disturbance. On slopes less than 30% total disturbance averaged 46.6% on summer logging, and 28.3% on winter logging (Figure 5). Total disturbance measures total machine traffic on a logged area, and is a conservative estimate because it does not include area in mainline or spur roads.

6. Impressions in the "1", "2", "3" and "4" categories accounted for approximately 1/2 of detrimental skidding disturbance (Figure 6).

7. Three moderately sloped sites (>30%) logged in winter using designated skidroad layout had detrimental skidding disturbance of less than 7.5%. Two of the 3 were on complex terrain.

8. Additional sampling is needed on sites with slopes steeper than 30%. Ninety-nine of the 116 blocks surveyed were on slopes less than 30%.

Acknowledgements

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Within the forest regions site selection was co-ordinated by Blair Wood (Cariboo), Bob Mitchell (Kamloops), and Mike Curran (Nelson). Thanks to the many surveyors who completed the field work.

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Soil Disturbance after Logging in British Columbia: 1991 Results

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1.0 INTRODUCTION

This report summarizes soil disturbance survey results for 116 Interior sites. This work was done to facilitate a review, by the Interior Forest Harvesting Council's Technical Advisory Committee, of the Interim Harvesting guidelines for Interior sites. The objectives of this review were to: 1) measure soil disturbance levels resulting from well planned and executed ground based harvesting, and 2) determine which combinations of terrain and harvesting systems resulted in acceptable levels of soil disturbance.

The Interim Harvesting Guidelines for Interior sites recognize two major categories of soil disturbance: 1) severe disturbance resulting from the construction of landings and unapproved haul roads, which may represent permanent deletions from the productive forest land base, and 2) ground based skidding disturbance, such as skidtrails and bladed skidroads. Maximum limits on disturbance were based on the inferred productivity loss in each disturbance category. Landings and unapproved haul roads were restricted to 4% of the Net Forested Area. The limit for ground skidding disturbance varied from 0% for Very High sensitivity sites, to 5% for High Sensitivity sites, and 15% for Moderate and Low sensitivity sites.

When the Interim Harvesting Guidelines were published in 1989, there were limited data quantifying soil disturbance levels for specific harvesting systems and terrain conditions where logging was well planned and executed. Consequently, the guidelines were released with a recommendation that post-harvest soil disturbance surveys be conducted for 2 years, and that a database of soil disturbance survey information be established. Approximately 260 soil disturbance surveys were completed in the first 2 field seasons following the introduction of the guidelines. However, the majority of these surveys were not useful for evaluating the feasibility of the proposed guidelines because they were carried out on sites where there was a perceived problem in the way logging was conducted. As a result, many of these sites had levels of detrimental disturbance in excess of the proposed guidelines.

To gain an improved understanding of the levels of timber harvesting related soil disturbance that are achievable, given good logging practices on a range of terrain conditions, soil disturbance surveys were conducted on selected benchmark sites. These benchmark sites were considered to be examples of ground skidding operations where the planning and execution of logging was average or better, according to current practice in the industry. Cable harvesting operations were not included in this sample because previous surveys had indicated that soil disturbance after cable harvesting was consistently below the maximum allowable levels.

The results presented in this report have been used by the Interior Forest Harvesting Council's Technical Advisory Committee to review the Interim Harvesting Guidelines . These results can also be used to define target soil disturbance levels in Pre-Harvest Silvicultural Prescriptions (PHSP's). In evaluating target disturbance levels, it is essential that the specific combination of season of logging, terrain conditions and harvest system be considered because soil disturbance levels are strongly dependent on the combination of all 3 factors.

Frontline Forest Research, Nelson, B.C., [2] Ministry of Forests, Research Branch, Victoria, B.C.

2.0 METHODS

2.1 Site Selection and Description

Site selection was conducted by Ministry of Forests' District staff, Ministry of Forests' soil scientists, and by several licensee foresters. Sites were selected as benchmark examples of good planning and execution of logging using current practices. **Not all combinations of Site Sensitivity, slope class and logging system are equally represented;** 99 of the 116 sites sampled were on slopes less than 30%. Sample size according to key site and logging system attributes is summarized in Table 1.

To ensure consistency in survey results, each participating surveyor was required to take a soil disturbance measurement training course, and standardized field recording forms were provided. In addition to collecting soil disturbance information, a summary of site characteristics, harvest system attributes, and comments on the planning and execution of logging were recorded.

2.2 Soil Disturbance Classification and Survey Methods

Surveys were completed using the standard gridpoint-intercept method outlined in the manual for "Measuring Soil Disturbance Following Timber Harvesting[3]". Soil disturbance was assessed in the categories outlined in Table 2.

2.3 Definitions

The use of the term **detrimental disturbance** in this report follows the current definition in the soil disturbance guidelines, which includes: landings, unapproved haul roads, and skidding disturbance that is either a bladed structure or an impression in the category of "1", "2", "3" or "4" (Table 2). **Detrimental skidding** disturbance refers to skidding disturbance from a bladed structure or an impression deeper than 5 cm. **Total disturbance** was defined as the sum of detrimental disturbance, and Light disturbance (category "L", Table 2). Total disturbance includes both detrimental and non-detrimental disturbance that results directly from machine activity.

For the purpose of this study, **treatment units (TU's)** were defined as homogeneous areas within a cutblock that were uniform with respect to all of the following 3 factors: season of logging, harvesting method, and site sensitivity rating. Only a few of the surveyed cutblocks had more than 1 treatment unit.

2.4 Data Summary and Compliance Assessment

The data were summarized according to terrain and harvest system attributes that were found to be significant using tabular and graphical analyses. Results are reported only for those attributes that were correlated with soil disturbance levels, and for selected attributes that are used in the classification of site sensitivity.

Compliance with the proposed soil disturbance guidelines was assessed in 2 ways: **actual compliance** for a specific treatment unit was determined by comparing measured detrimental disturbance to the maximum allowable level stated in the guidelines for the actual site sensitivity of the treatment unit. The proportion of sites in actual compliance with the guidelines was tabulated by season of logging and site sensitivity.

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[3] Curran, M.C. and S.R. Thompson. 1991. Measuring Soil Disturbance Following Timber Harvesting. Land Management Field Guide Insert #5. Ministry of Forests, Victoria, B.C.

Projected compliance was determined using cumulative frequency distributions for selected combinations of slope class and season of logging. For each combination of slope class and logging season, the frequency distribution identified the proportion of sites with detrimental disturbance equal to or less than a specified level, irrespective of site sensitivity. These distributions were used to project the effect of alternative soil disturbance limits on levels of compliance.

3.0 FACTORS DETERMINING SOIL DISTURBANCE

3.1 Landing Disturbance

- Average landing area on 102 treatment units was 3.4% (Table 4)[4]. Winter landings were smaller than summer landings: 2.9% vs. 3.7% (Figure 3 and Table 4).
- The debris component of landings on 0-15% slopes was measured on a subsample of 27 sites. For this sub-sample, **landing area without debris averaged 2.2%** (Table 5). Where significant debris piles were present, they represent 37.2% of total landing area on average. The same proportion cannot be assumed for all landings because in many cases debris piles were so small that they were not measured.

3.2 Skidding Disturbance

Detrimental Skidding Disturbance

- **Season, slope steepness and terrain uniformity[5] were correlated with differences in detrimental skidding disturbance.** Skidding disturbance increased with increasing slope steepness, was higher on summer vs. winter logged sites, and increased on non-uniform terrain types (Table 6). All 3 factors were statistically significant (p=.10) using an analysis of covariance model with slope as the covariate (Appendix 1).
- On slopes less than 30%, skidding disturbance was consistently higher on complex terrain, irrespective of season (Figure 2 and Table 6). Too few sites were sampled on slopes over 30% to interpret trends.
- Skidding disturbance increased with slope. A 1% increase in slope corresponded to a 0.21% increase in detrimental skidding disturbance, irrespective of season or terrain uniformity (Figures 7 and 8, Appendix 1).
- Designated skidding resulted in low levels of detrimental skidding disturbance. Designated skidroad systems on slopes in the 31-45% range resulted in detrimental skidding disturbance levels less than 7.5% on 3 treatment units logged in winter (Figure 8 and Table 7). Terrain was complex on 2 of the 3 sites and unknown on the third.

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[4]Landing area was inconsistently recorded on the 12 roadside Treatment Units, therefore they were not included in the summary.

[5]Terrain uniformity was classified as uniform or complex. The definition of complex terrain was not the same as that used in the Displacement Hazard key. Treatment units were classified as complex if they met **any one of three conditions:** 1) more than 1 watercourse or gully per 100 meters, or 2) terrain classified as broken in the Displacement Hazard key, or 3) terrain with a hummocky surface shape modifier.

Table 2 Soil disturbance classification*

OBJECT	CODE	DESCRIPTION		
Skidroad*	**R**	Skidroad cutbank or running surface		
	B	Skidroad berm/sidecast (counted to points where it is continuously 5 cm deep in mineral soil; 15 cm in woody debris).		
Skidtrail		**Soil type**	**Depth criteria[a] (Into Mineral Soil)**	**Disturbance type counted**
	L	All	< below criteria	Light machine traffic disturbance not meeting below criteria for 1, 2 or 3. Includes deposits of mineral soil or woody debris not associated with an intact skidroad berm/sidecast, or not meeting the depth requirement for "B".
	1	Cohesive	5-10 cm	High Impact Machine Traffic Wheel/track impressions and rutting
	2	Cohesive	>10 cm	High Impact Machine Traffic Wheel/track impressions and rutting
	3	Non-cohesive sandy[b]	>15 cm	High Impact Machine Traffic displacement
		(Into Organic Layer)		
	L	Organic	< below criteria	Light Machine Traffic disturbance not meeting below criteria for 4
	4	Organic	>20 cm	High Impact Machine Traffic rutting
Other	**O**	Other types of disturbance (e.g., Traversed disturbance such as landings; also for log-butt or windthrow disturbance and slash accumulation piles; **Light skidder disturbance should be recorded as "L", above.)**		
Undisturbed	**–[c]**	**Undisturbed** (Includes **light** forest floor disturbance not attributable to Light Machine Traffic ["L"].)		

A forest floor with no mineral soil exposed or any impression from machine travel. Also includes surfaces beneath stumps or large coarse fragments, or natural bedrock surfaces. If an assessment beneath slash or large logs is possible, then it is made. Otherwise, these surfaces are recorded as undisturbed.

**Note:* *Bladed areas on skidtrails greater than 1.5 m x 1.5 m wide and 5 cm deep are counted as skidroads.*

[a] Based on maximum depth of cross-section (see Fig. 7). Bladed areas not meeting the skidroad criteria above (1.5m x 1.5m wide and 5 cm deep) are evaluated as skidtrail disturbance

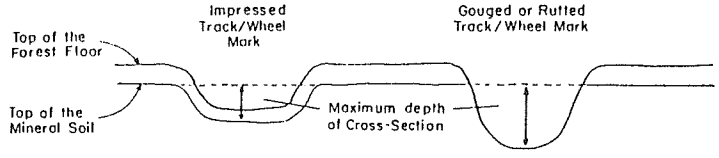
[b] "Non-cohesive sandy soils" have a very weak moist cast that is non-sticky and will not form a moist worm ≤ 4 mm (i.e. S. LS, and some coarse SL textures). For more information refer to Soil Texture Key FS238.

[c] A "–" is used for undisturbed so that these can appear as a horizontal line on the survey form.

KEY IDENTIFICATION CRITERIA

Skidroads — bladed, usually with no stumps on the running surface.

Skidtrails — non-bladed, with stumps often present on running surface



* from: Curran, M.C. and S.R. Thompson. 1991. Measuring Soil Disturbance Following Timber Harvesting. Land Management Field Guide Insert #5. Ministry of Forests, Victoria, B.C.