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FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA

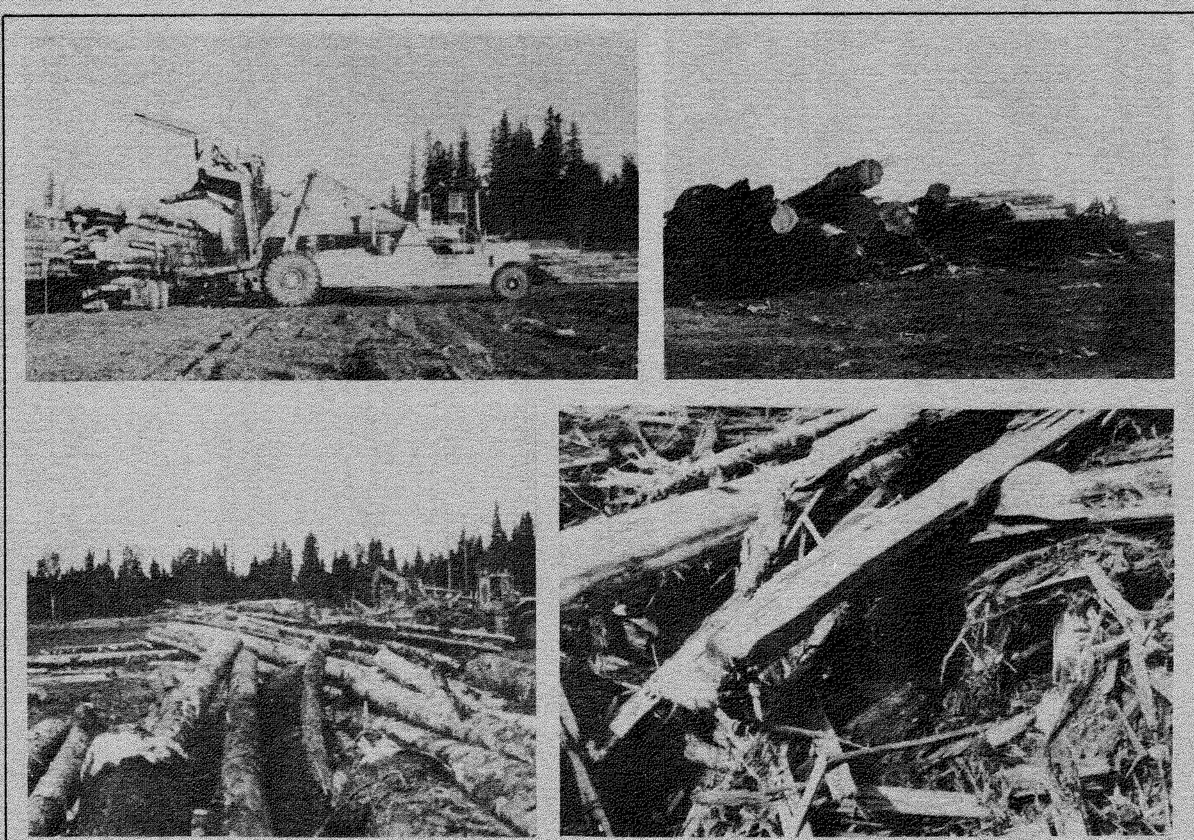
INSTITUT CANADIEN DE RECHERCHES EN GÉNIE FORESTIER

Technical Report NO. TR-14

May 1977

Log-Sort Yard Debris: Composition And Source

Donald G. Smith



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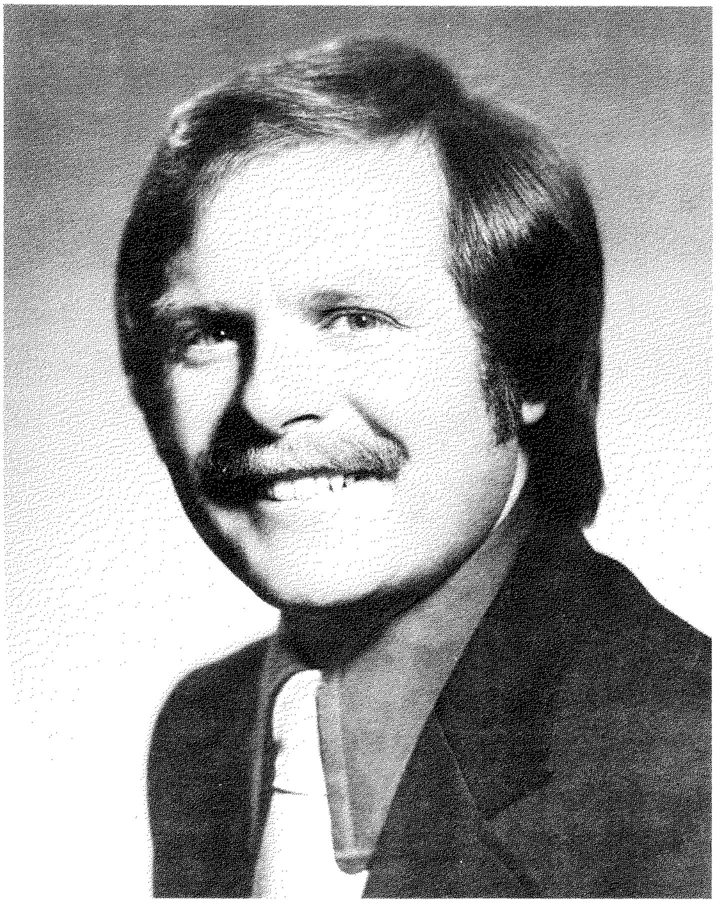

D.G. Smith received his M.Eng. (Transportation) from Carleton University in 1971. From 1971 to 1975 he was employed as a transportation consultant in private industry. In 1975, he joined FERIC in Vancouver, British Columbia, to work on transportation and materials handling projects.

He is a Registered Professional Engineer in both Ontario and British Columbia.

SUMMARY

Five log-sort yards in British Columbia were examined in order to estimate the quantity, composition and sources of log yard debris.

Results indicated that the space volume of yard debris is approximately 5% of the solid wood volume of log throughput. Overall, the proportions of water, bone-dry organic and inorganic material were approximately equal. However, the proportion varied substantially by size class. The fraction of debris less than 2 inches (5.1 cm) in size (longest dimension) contained approximately 80% of the total weight of inorganic material. No single operational change could significantly reduce the volume of debris. Rather, woods practices, mechanical log handling and remanufacturing in the yard would all require careful scrutiny to reduce debris.

Physical separation of the large-sized material from the accumulated debris, and water washing of road dirt from trucks and logs before entering the surfaced yard are two relatively simple procedures which could improve the manageability of yard debris. The feasibility of employing these procedures may be the subject of future study by FERIC.

SOMMAIRE

Les débris laissés sur cinq jetées de triage en Colombie Britannique furent le sujet d'une étude pour en déterminer la quantité, la composition et la provenance.

La quantité, en volume, de ces débris représentait environ 5% du volume de bois solide acheminé vers ces jetées. Dans l'ensemble, le volume d'eau était à peu prés égale à celui des matériaux organiques et inorganiques anhydres. La proportion des débris plus petits que 2 pouces (5.1 cm) (sens de la longueur) contenait approximativement 80% du poids total des matières inorganiques.

Suite aux observations préliminaires de cette étude, il est permis de conclure que le volume de débris pourrait être sensiblement réduit si toutes les dimensions du problème étaient considérées, c'est-à-dire le mode d'extraction des bois, la manutention mécanisée des billes et les opérations de transformation sur ces jetées.

Le lavage des camions et des billes avant leur arrivée sur les jetées et l'enlèvement de plus gros matériaux des débris accumulés seraient aussi des correctifs qui pourraient être apportés.

FERIC considère présentement une analyse plus poussée de ces correctifs.

INTRODUCTION

Logs harvested in coastal British Columbia have traditionally been sorted and stored in water. Increased concern about the environmental impact of waterborne debris, coupled with the water losses of expensive logs, have induced many operations to shift sorting and bundling operations to facilities on land. Here, bark, branches and broken pieces of wood mix with the dirt and gravel on the yard during the mechanical handling of the logs. This debris, steadily accumulating in the yards, creates a serious disposal problem.

Burning log yard debris has shown little success to date. Unsorted piles are virtually impossible to ignite during wet periods and hazardous during dry periods. Special burners may be somewhat more effective, but will be costly to operate, will require frequent clean-out to remove unburnt fractions, and probably will not entirely escape criticism from nearby communities.

Landfill with debris is the subject of increasing Pollution Control Board regulation. Leaching of bark solutes necessitates a site with minimal ground water flow. Suitable locations are scarce and usually distant from the yard, with consequent high transportation costs to dispose of the refuse.

In response to industry requests to assist in its efforts to reduce, utilize or dispose of sort yard debris, FERIC began to assemble reliable quantitative information concerning the debris problem. Initial research included

Typical log-sort yard debris: bark, broken wood and rock mixed due to mechanical log handling. (Piece size indicated by hard hat.)

Unsorted log-yard debris consumes landfill space rapidly.

investigation of:

1. the volume of debris generated as a function of yard throughput;

2. the composition of the debris by size class and nature (organic, inorganic, water); and,

3. the sources of debris, such as manufacturing in the yard, woods practices, and mechanical handling.

STUDY METHOD

To encompass a range of conditions, five yards were investigated (see Table 1) which varied as to volume of annual throughput, purpose (storage, hot sorting), surfacing material (dirt, gravel, pavement), and location (log species, piece size, and climate).

The volume of debris generated was estimated from company records where available. In addition, short-term volume estimates were made of debris removed by truck.

Debris composition was sampled by a procedure developed in cooperation with the Western Forest Products Laboratory[1]. Three size classes were considered: Small, Intermediate and Large, measuring less than 2 inches (5.1 cm), 2 inches to 12 inches (5.1 cm to 30.5 cm), and greater than 12 inches (30.5 cm) respectively, in the largest dimension. All of the Large material was removed from previously weighed sample loads and placed in individually weighed categories. Approximately one-cubic-foot (0.03 m^3) samples randomly chosen from the remaining material were further screened into the Small and Intermediate classes, dried to determine the water content and burned to determine the ash and inorganic content.

The large material was categorized by source, i.e., bark, limbs, broken wood, tops/butts, cull and rock. These reflect the local impact of species, woods practices, mechanical log handling and remanufacturing.

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[1] The sampling technique, outlined by Dr. W.G. Warren, involved unbiased selection of bucket samples throughout the yard area, successive sorting by size classes and by categories, determination of undried weights of each, and retention of subsamples for subsequent laboratory analysis.

Table 1. Log-Sort Yard Characteristics.

Yard Number	Region	Major Species[1]	Surface	Function
1	East Coast Vancouver Island	Western Hemlock Douglas Fir Amabilis Fir Western Red Cedar Yellow Cypress	Asphalt	Sorting
2	Southern Interior B.C.	Engelmann Spruce Alpine Fir Douglas Fir Lodgepole Pine	Soil	Storage Remanu-facturing
3	Southern Interior B.C.	Engelmann Spruce Lodgepole Pine	Soil	Storage Remanu-facturing
4	Northern Vancouver Island	Western Hemlock Western Red Cedar Amabilis Fir	Partial Asphalt	Sorting
5	Southern Interior B.C.	Engelmann Spruce Alpine Fir Douglas Fir Lodgepole Pine	Soil & Gravel	Storage

[1] Refer to Appendix II for complete scientific names.

RESULTS

Little quantitative information was previously available as to the volumes of debris generated at the various locations. A load count at a coastal yard indicated a generation rate of approximately 170 cubic yards (130 m^3) per operating day, while a southern Vancouver Island yard removed an average of 300 loads per month. On the average, approximately 185 cubic yards (141 m^3) of debris accumulated for every 1,000 cunits (2,830 m^3) of logs handled. This is equivalent to 5 cubic feet (0.14 m^3) space volume of debris per 100 cubic feet (2.8 m^3) of solid wood log volume handled in the yard, or 5 percent, disregarding the different forms of volume measurement.

While quantity is normally estimated on a volume basis, the sampling to determine composition was more conveniently conducted on a weight basis. As indicated in Table 2, 56% by weight of the debris sampled was less than 2 inches (5.1 cm) in size while only 18% was greater than 12 inches (30.5 cm). The larger pieces, however, were seen to cause the greatest problems in handling and transporting the debris.

From Table 3 the overall proportions by weight of water, inorganic and bone-dry organic material were approximately equal. However, the proportion of water and inorganic material varied substantially by size class. The Small fraction had a high inorganic content which accounted for 80% of the total inorganic weight of the entire sample, making it unsuitable for boiler fuel without treatment. The Large fraction was almost all green wood, but the bone-dry organic component accounted for only 11% of the total sample

Table 2. Piece Size Distribution[1]
(Percent)

YARD NUMBER	SIZE CLASS[3]		
	% SMALL	% INTER-MEDIATE	% LARGE
1	40.4	42.1	17.5
2	68.0	14.9	17.1
3	83.2	8.2	8.6
4	52.8	22.6	24.6
5	84.0	6.3	9.7
Average:[2]	56.0	26.3	17.7

Note:

1) Percentage based on wet weight of total sample.

2) Averaged by weight.

3) Size classes:

Small - less than 2 inches (5.1 cm)

Intermediate - 2 inches to 12 inches (5.1 cm to 30.5 cm)

Large - greater than 12 inches (30.5 cm)

Table 3. Sample Composition[1]

YARD NUMBER	SIZE CLASS[4] SMALL % ORG.	SMALL % INORG.	SMALL % WATER	INTERMEDIATE % ORG.	INTERMEDIATE % INORG.	INTERMEDIATE % WATER	LARGE % ORG.	LARGE % INORG.	LARGE % WATER	TOTAL SAMPLE % ORG.	TOTAL SAMPLE % INORG.	TOTAL SAMPLE % WATER
1[3)]	22.7	5.8	11.9	25.8	0.5	15.7	10.9	0.0	6.7	59.4	6.3	34.3
2	16.6	36.0	15.4	4.9	6.7	3.3	11.2	0.1	5.8	32.7	42.8	24.5
3	17.9	52.1	13.1	4.1	2.4	1.8	5.3	0.6	2.7	27.3	55.1	17.6
4[3)]	12.3	21.1	19.3	7.1	7.8	7.8	14.7	0.5	9.4	34.1	29.9	36.5
5	24.3	44.5	15.3	3.4	1.5	1.4	5.9	0.7	3.0	33.6	46.7	19.7
Average[2]	16.2	25.4	14.3	11.8	6.1	8.4	11.0	0.4	6.4	39.0	31.9	29.1

Note:
1) Percentages calculated on total wet weight basis.

2) Averaged by weight.

3) Yard Number 1 was paved, yard number 4 was partially paved.

4) Size classes: Small - less than 2 inches (5.1 cm)
Intermediate - 2 inches to 12 inches (5.1 cm to 30.5 cm)
Large - greater than 12 inches (30.5 cm)

weight. Although this class had only minimal inorganic content, the presence of the occasional large rock would severely limit its use for hogging or chipping.

The surfacing material of the yard was seen to be a significant factor affecting the debris composition. The most noticeable impact was the reduction of the inorganic content of the Small fraction to 6% for the paved yard as compared to 36%-52% for unpaved yards.

While the source of the Small and Intermediate sized material could not be determined, Table 4 summarizes the composition of the Large fraction, which constituted 17.7% of the total 73,310 pounds (33,253 kg) of sample debris. Tops and butts on the average accounted for 5.3% of the total debris. However, the proportion of tops and butts varied substantially between yards. In one yard conducting upgrading, an average of 13% of the debris was tops and butts while in another, which employed a worker to remove usable wood (see Appendix I), they represented only 3%. Branches and cull logs brought to the yard accounted for only 3.8% of the total debris. Broken wood and bark accounted for 8.2% of the total. Large rocks contributed only 0.4% to the total weight.

Table 4. Percentage[1] Breakdown of Sample Components Greater than 12 inches (30.5 cm) in Largest Dimension.

Yard Number	Sample Number	Tops & Butts %	Branches %	Cull Wood %	Broken Wood %	Bark %	Rock %	Total %
1	1	0.0	2.2	0.0	6.2	7.6	0.0	16.1
	2	0.0	3.3	0.0	2.4	6.0	0.0	11.7
	3	1.4	5.0	1.1	10.6	6.7	0.0	24.7
2	1	12.4	0.5	0.0	3.9	0.3	0.0	17.5
	2	5.8	0.6	0.0	1.3	0.0	0.2	7.8
	3	33.9	0.9	0.3	7.4	0.0	0.0	42.4
3	1	0.7	1.4	0.0	4.1	1.8	0.6	8.6
4	1	3.1	3.1	7.5	20.6	0.4	0.7	35.5
	2	3.6	1.3	0.0	9.2	0.6	0.7	15.3
	3	0.0	1.5	10.0	9.8	1.3	0.0	22.7
5	1	0.9	3.3	0.0	2.7	0.1	0.0	7.0
	2	6.2	4.1	0.0	1.5	0.0	1.8	13.6
Average[2]		5.3	2.0	1.8	6.8	1.4	0.4	17.7

[1]Percentage calculated on total wet weight basis.

[2]Averaged by weight.

CONCLUSIONS

The investigation of the debris generated at log sort yards under varying conditions indicated:

1. Each cunit (2.8 m^3) of log input generated about 5 cubic feet (0.14 m^3) of unsorted debris. For a yard handling, for example, 100,000 cunits (283,168 m^3) of logs per year, this translates into 18,500 cubic yards (14,144 m^3) of material for disposal.

2. No single operational change will significantly reduce the volume of debris generated in all log yards. Pavement reduced the total inorganic content and re-manufacturing increased the volume of large pieces.

3. The most suitable debris disposal technique depends upon the size class of the material. No simple technique is suitable for unsorted debris. The Small fraction has a high proportion of inorganic material and water. It is easily loaded and transported, thus is amenable for landfill, but is very difficult to burn. The Large size class is difficult to handle, inefficient to transport and takes much space in the fill. The high wood content makes it more suitable for burning or salvage. A rugged separator could be effectively employed to remove the Large material. Once separated, each segment could be directed to the most suitable disposal means.

4. The 6% inorganic content (by weight) of the fines from the paved yard suggests that a significant amount of dirt is carried into the yard on the trucks and logs.

A high pressure water washer could effectively remove this accumulated road dirt from the trucks and logs before they enter the yard.

This study has not solved the problem of debris disposal from land log sort yards. Rather it has identified the composition and source of the debris. It is unlikely that anything can be done to reduce the volume of debris accumulating in the yards; current trends towards full-tree logging and increased remanufacturing in the yard may increase the debris volume. It is also unlikely that any single disposal technique will be developed to dispose of unsorted debris. The high inorganic and moisture content of the Small size material makes it difficult to burn, and it has no potential value other than landfill. On the other hand, the Large material will burn and offers considerable potential for salvage as hog fuel or as minor forest products.

FERIC plans to investigate methods for sorting debris (a preliminary step to hogging) and will search for ways to further utilize this material.

APPENDIX I

The following is a list of observed log sort yard debris management practices:

- ground stabilization fabric used to help reduce spring mud;
- front end loader used to separate large pieces from the accumulated debris;
- full-time worker employed to salvage all material from the debris suitable for chips, hog fuel or firewood;
- portable chipper used in sort yard to chip large pieces of wood debris;
- contractor salvaging firewood, posts, shake blanks and other minor products from debris.

APPENDIX II

The following is a list of the scientific names of the major species noted at sort yards during the course of the survey.

Alpine Fir	*Abies lasiocarpa* (Hook.) Nutt.
Amabelis Fir	*Abies amabilis* (Dougl.) Forbes
Douglas Fir	*Pseudotsuga menziesii* (Mirb.) Franco
Engelmann Spruce	*Picea engelmannii* Parry
Lodgepole Pine	*Pinus contorta* Dougl.
Western Hemlock	*Tsuga heterophylla* (Raf.) Sarg.
Western Red Cedar	*Thuja plicata* Donn
Yellow Cypress	*Chamaecyparis nootkatensis* (D. Don) Spach