

THE PROBLEM OF SLASH DISPOSAL CONFRONTING  
THE LOGGING OPERATOR IN THE DOUGLAS FIR REGION

by

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## INTRODUCTION

The slash disposal problem has been and is a serious question mark to the logging operator, the National forest service, and State forest agencies. Because most logging is done on private property, it comes under State control rather than the forest service, but the forest service is nevertheless quite concerned with the problem. Since a good share of the future logging will be on National lands, they are becoming more and more directly interested in the problem. In view of this and changing conditions, considerable work is being carried on by different agencies with regards to slash disposal. Most of the studies that have been made were on the pine forests and are hardly applicable to the Douglas fir region. However, several ideas and plans have resulted that can be used, as well as others under certain circumstances. Very little has been written on this subject, however, with reference to the Douglas fir region of the Pacific Northwest.

With these points in mind, I chose this subject in order to work out some possible answers to this problem. My plan is to present the problem with all its variable points and possible conditions, and then relate what is being done to abate or relieve the pressure of the problem. I also intend to present possible future developments along these same lines that are reasonable and probable, and

bring out any points that seem to adequately meet the problem as it stands.

Logging has been one of our country's major industries, since the days of the colonies, and since slash is the term given to that debris, composed of tree tops, limbs, chunks, snags, fallen trees, etc., which is left on the ground after logging, one may easily see the importance of this problem. At first it was given little thought as farmers burned and cleared the lands as fast as it was logged and in numerous places before the timber was logged, but today all this fertile land for the most part has been cleared, and the timbered lands left are very hilly and unsuited to agricultural uses in the most cases. It stands to reason that something must be done. You cannot leave the slash and forget about it as very disastrous and costly fires may result. Nor can you fire the slash and expect to help the matter without going to a considerable expense for preparation and protection measures as some very costly fires have resulted even when all possible precautionary measures were observed. Economic forces have also had a great effect upon the problem by limiting the operator as to the care he may use and forestry practices he may observe in burning his slash due to the expenditures involved.

## THE SLASH DISPOSAL PROBLEM

In a forest area as large as the Douglas fir region, embracing practically all of the acreage west of the Cascade range from the depths of British Columbia down into northern California, it is inevitable that the problems found in any phase of forest management be many and varied. Throughout the timbered areas of the world, the felling of trees is invariably accompanied by the accumulation of varying amounts of debris, which cannot be profitably used and is usually left in the woods as waste. With the possible exception of the redwood forests, there is more residual debris left from logging in the Douglas fir region than in any other lumbering section in the United States.

This accumulation of debris results from many causes. The tall, heavy trees are naturally hard to fall without suffering certain losses due to breakage and mashing of young trees. The topography, action of weather, and other natural causes which are uncontrollable, also take their toll and cause considerable debris. Wood destroying insects and fungi are found throughout the region and all infected trees having no value add that much more to the waste on the ground.

A large number of the loggers in the Douglas fir region practice clear cutting, that is, cutting everything on the area to be logged. One can readily imagine the amount of waste which will result from this practice. Other operators cut only that which they can log profitably, but a large por-

tion of the trees standing are pulled or knocked during the logging of the area. Much waste results from logging also. This varies with the ability and skill of the workmen and the requirements set up by the operators. Certain operators are very rigid in requiring an area to be logged of everything possible and even employ checkers to see that the workmen comply with the requirements. Other companies are very lax on the issue and permit great amounts of waste by leaving a large number of low grade and short logs in the woods.

Certain of these requirements are determined by economic forces acting upon the operator. He is limited somewhat by the costs of logging and the value of logs involved. Most operators make a practice of taking all logs that will pay at least the costs of logging. A good manager will, therefore, be able to use poorer logs profitably than will the poor manager; consequently, the poor manager will leave much more waste in the woods.

This accumulation of waste must have some attention and the logical answer has been "burn it". Certain advantages are attained by burning the slash and most operators have followed this practice in the past. By burning Douglas fir slash, most of the light flashy material is consumed also. The remainder is left in a condition that fungi and insects can easily finish the eradication of the wood.

The greatest advantage gained from burned slash is the low rate of spread and ease of control of any subsequent fire that may start on the area. As the flashy material is con-

sumed, any subsequent fire must move through the heavier material and as it takes a fire some time to gain much headway in such an area under normal conditions, a suppression crew can easily check its spread, and bring it under control with little difficulty.

By burning the slash area, the new stand will consist of a larger proportion of seedlings which will tend toward a more even aged stand of young timber. This is advantageous, especially if a good stocking results after the burning. For then the seedlings will compete with each other and the survivors will be the best and produce excellent timber upon maturity.

A slash fire that removes the litter and debris from the ground will leave the area in a state that will allow grass, herbs, and other plant life to flourish. This will make better forage for wild life and insure better hunting for the sportsman. Also, grazing facilities are greatly improved, and stock raising can be made quite profitable if land is so situated to make this feasible.

From the above, you may get the impression that slash burning is the correct thing to do. However, you must expect several resulting factors that are a decided disadvantage. Because of the density of the stand, there are usually a large number of snags on the area, and slash fires will not consume these as a general rule. The fire will kill the residual trees, however, and thereby create more snags. As a rule this is very important in the Douglas fir region, since there are usually a considerable amount of diseased and rotten timber

per acre that has no value and is generally left standing after logging. The snag problem presents no immediate difficulty as a rule, but when they become rotted and start falling, this extra debris on the ground again becomes a fire hazard. Also, if a subsequent fire gets into these snags, it becomes very difficult to control and presents a very hazardous task to suppression crews.

Any land from which the natural cover is removed becomes susceptible to erosion. This is especially true in the Douglas fir region, because of the steep hillsides and considerable amounts of rainfall. If the country is at all steep, the skid roads formed by dragging logs over the same route make an ideal place for gullying to take place. During a slash fire all the vegetation is usually consumed and bare soil is left. Since most slash is burned in the fall, this bare soil is exposed to the whole of the rainy season. This is especially a disadvantage, since many steep-sided hills are washed clean of all soil. It has been estimated that certain areas would require one hundred or more years to rebuild enough soil to sustain plant life where erosion has left bare rock after a fire. This is providing no further fire or erosion takes place. The above should give a good picture of the magnitude of this problem.

Along with this damaging erosion, a fire will effect the stream flow adversely. After the cover has been burned, the run-off of rain-fall is exceedingly rapid. Therefore, most streams in burned-over country are flooded during the rainy season and nearly dry during the summer draught if not entirely

dry. Many good game streams are thus ruined and watersheds spoiled. If any of these streams empty into a reservoir or other storage place for municipal or industrial use, the silt and sediment carried by these streams during the flood stage will soon fill the reservoir and create a severe handicap.

The moisture conditions of this burned-over soil is damaged severely. The rain pounds and packs the top soil quite hard and the summer dry spell will dry out the soil completely, thus leaving little nourishment for plant life during the summer. A great number of young trees that may be left or start the succeeding spring suffer greatly from sun scald.

The fire usually destroys the residual seed supply left after logging. The only source of seed for regeneration is that which was in the ground and escaped the fire or those few trees which may still be alive after the fire. In a good many instances the only source of seed is from the adjoining green bodies of timber if any. The soil is usually injured to varying extents, depending upon the heat of the fire and may take some time to recover its fertility. The big problem though is to find some way to get the seedlings started before the heavy brush and bracken fern gain control of the area. Once this happens, regeneration is much slower and the fire hazard increases rapidly until it is as high as it was before the slash was burned. The rate of spread becomes very fast, but the difficulty of control does not increase so rapidly.

Many foresters and operators contend that the logging slash should not be burned, and they have some very good

arguments to substantiate their views. They contend that the unburned slash is no more hazardous after the first few years than burned slash which has proven to be a fact in several instances.

Good reproduction is assured if the slash is not burned as the seeds in the ground and on the top, etc., left as slash are not destroyed. This is an important item as it means the entire area is subject to seeding by natural means. Also, all the residual seedlings and small saplings are left on the area. The debris covering the ground prevents quick growing brush, fern, etc., from getting a good start and shading out the Douglas fir seedlings.

By not burning the slash, most of the disadvantages claimed against slash burning are avoided and this is quite a talking point also. Of late, a large number of timbermen are admitting that non-burning of slash is the proper thing to do if it is at all feasible. On the other hand, however, there are a few great disadvantages to be overcome before it can become more practical and put into general use.

The main object of slash disposal is to abate the fire risk that is present on lands covered with logging slash. This risk and hazard is especially great in the Douglas fir region due to the excessive amount of slash and the exceedingly dry period during the summer months. Until the new crop of trees are large enough to adequately cover the area, the slash will dry out quickly and present a hazardous flashy fuel in which a fire will spread rapidly and be very hard to control.

If the slash is not burned there will be no chance for using the land for grazing purposes and wild life will find little if any forage on it. Any of the residual stand that is injured, scarred, or broken present an ideal place for insects and fungi to gain a foothold from which to attack the new stand. Also, a good many of these trees will become "wolf" trees and prevent the growth of good sound timber in their place. This does not seem very important, but when you consider the area that is non-productive and the length of time it takes for Douglas fir to become large enough for number one saw logs, it begins to look considerably different.

The above arguments, pro and con, presented were based on the assumption that the logging operators were cutting the entire stand that is merchantable. Today, we have further complications that change the picture considerably. Logging is no longer the wanton slaughter of timber lands. It is becoming more conservative and scientifically managed. Recent improvements in internal combustion engines have greatly influenced this change and seem to be replacing the steam powered units. Except for a few large companies of long standing, logging on large-scale basis is gone. Truck hauling has replaced many logging railroads. Caterpillar tractors are replacing the well-known donkey engine. The capital necessary to finance a logging operation has decreased greatly because the new machinery requires a much smaller initial investment. This means that many small stands and those with spotty timber have been opened which would never have been touched otherwise.

The improved machinery is easily adapted to sustained yield and selective logging. In fact it does better in selectively logged stands than where everything is taken. The problem of slash disposal have increased greatly thereby. State laws say that the slash must be eradicated, and to burn it usually means the destruction of all the trees that are left, many of which are young saplings in the prime of condition. Of course, a good share of them are over-matured and diseased, but if any are left it is these because of the thick fire resistance bark characteristic of old growth Douglas fir. These methods of logging do leave the logged area cut into smaller units by the truck roads and these units are further subdivided by cat trails which makes for easier fire protection. But at the same time these roads make it much easier for the public to use the forest lands for outings and therefore increase the possibilities of fire.

All of the problems that have been mentioned deal with the general aspects of the subject as a whole. In addition there are numerous local conditions which further increase the problem of slash disposal. Climatic or weather conditions probably are the most important. This varies greatly from the coast eastward to the Cascade Range. The coast area receives an excessive amount of rainfall and is also known as a fog belt. A fire in this area is not dangerous and the area in general needs few precautionary fire measures. However, the eastern slopes of the Coast Mountains, although it has sufficient rain, becomes exceedingly dry during the summer

months. Due to the plentiful amount of rain during the winter, vegetation is very dense and slash in this area creates a great hazard during the dry period. The hazard and risk increases as you go east, mainly because the length of the dry season increases also.

The many good fishing streams found in the mountains of Oregon and Washington provide a place for the sport-loving public to try their skill along these lines. This means a large number of people are in and around the forest areas every summer. Naturally, if logging slash has been left, it will be a high hazard, and the danger of fire becomes a real menace to life and property.

The actual costs involved in slash disposal cause many operators to attempt almost any means of lowering or getting away from them. State laws are such that in most cases the operator must burn or stand full liability for any damage or costs involved in fires originating on his property. In many cases this has amounted to a considerable sum. As a result the logging operator will not hold this property after he removes the timber. The usual procedure is to remove the timber, fire the slash and forget about it. This has resulted in vast acreages of denuded lands reverting to the county each year as tax delinquent property. These lands are nearly valueless and no one wants the responsibility of owning them. This has caused several counties of Oregon to be nearly bankrupt, since they have depended upon the taxes from these lands to support their administration. Higher taxes have resulted, and

in turn more property reverted as tax delinquent which means some new tax plan must be found before good forestry, especially in slash disposal, will be practiced by the logger.

## MEETING THE PROBLEM

In the past little attention was given this seemingly unimportant phase of logging. In fact, there seemed to be no problem. Timber was plentiful; fire loss was apparently negligible; and the farmers wanted the land badly; therefore, the slash was fired as fast as the timber was removed and sometimes faster. Large areas of this land were cleared and converted to agriculture. But as the timber gradually receded to the foothills and on into the mountains less and less land was wanted for farming; consequently, the operator found himself with vast acreages of burned-over land on his hands. It was apparently valueless to him, so rather than pay taxes on it, he let the property revert as tax delinquent. This is the story of slash disposal during the first years of logging in the Douglas fir region.

As the topography became rougher, the need for high-powered machinery increased. With the advent of this machinery came the wanton destruction of vast areas of timber. The machinery required 100 percent logging of the land and as a result the amount of debris left on the ground increased considerably. Labor costs increased since this type of logging required a larger percent of skilled workmen and the dangers and risks that go with logging allows common labor to command a good wage also. Because of the increased logging costs, the operators attempted to get as much as possible with the

equipment each day. This meant high-speed careless logging which resulted in a still greater amount of waste to be left on the ground.

The states then enacted laws requiring the property owners and operators to dispose of this debris, so that the fire hazard might be abated. These laws have since been amended and changed as conditions and factors proved the original laws wanting for the accomplishment of their purpose. This was especially necessary since each section of Oregon and Washington have peculiar characteristics. There are really three main sections, the coastal area, the area west of the Cascade Mountains, and that east of the Cascades, each of which are entirely different from the other and the blanket law did not prove adequate.

The slash disposal laws today, though not nearly as good as they might be, do serve the present need pretty well. They are so constructed that undue pressure is not placed upon the operator and that flexibility may be used where a competent official deems it necessary. Everyone engaged in logging or permitting logging upon his property, thereby creating a fire hazard, is obligated to dispose of the slashings or debris each year in Oregon by State law number 42-421. This law is so stated that the State forester or his representative may relieve the operator of the duty of burning his slash where in the opinion of the forester the slash does not constitute a hazard or where a more serious hazard would result from

burning.

This law states explicitly that the slash should be burned annually as it says "by burning his annual slash." Certain provisions are also made for precautionary measures that must be used in burning the slash. It states that this burning must be done at such time and in such manner and with such provisions of help as shall afford all necessary precautions against the spread of fire to other property. The area to be burned must be isolated and snags that may throw fire must be cut for a distance of two hundred and fifty (250) feet inward from the exterior boundaries of the area to be burned.

## BURNING THE SLASH

Both the states of Oregon and Washington recognize unburned slashing as a public nuisance. Oregon requires specifically that these slashings be burned annually unless exempted by the State forester. Washington does not specifically require slash burning but states that the nuisance shall be abated unless otherwise directed by the supervisor of forestry. Nevertheless, slash burning, especially during certain years, has caused a good deal of damage. Slash fires have been written up in various newspapers and other publications and as a result of the damage emphasized in some cases many people have acquired the attitude that all slash burning is bad practice. There have been many areas pointed out as having been "destroyed" by this slash burning habit. However, after considerable study and thought on the subject the conclusion has been reached that much of the damage, attributed to slash fires, resulted from improper methods, faulty objectives in the minds of those in charge of the use of fire, laxity in planning the burn, and the unscientific manner in which it was carried out. Probably the first cause for poor results obtained in the past was the lack of funds and experienced personnel, but as our knowledge of fire, fuels, and risks increases and our planning procedure is evolved we should become adept at slash disposal and so do away with many of the evils.

We have stated several times that the slash must be burned unless exempted, but nothing about when or how it should be done. Since the prime purpose of slash burning is to so treat the area that it will be as nearly immune to future fires as is economically feasible, it follows then that the sooner the burning is accomplished the greater will be the returns realized on the investment in disposal. In addition, not only is the hazard reduced at an earlier date, but several other factors operating to the detriment of proper forest management are removed.

Usually a sufficient seed supply is present after logging to splendidly restock the areas, and given reasonable success on the part of the protection force, the regeneration of logged-over lands is a certain and relatively rapid process. But too often this seed sprouts before the slash is burned and the seed abundance is nullified. It is true that the burn may be light or scattered and any viable seeds and those in the ground may later germinate and grow. The chances of an area restocking is immeasurably greater, however, where the debris is burned as soon as is practicable. With such a practice much of the seed falling on the area afterwards, will fall on freshly burned ground and germinate without danger of being consumed by an intentional fire at a later date.

As a result of the normal progress in logging, the average timber operator leaves each year an area of logged land adjacent to a bank of standing mature timber. To have the

logged land ready for restocking before this nearby block of timber is cut cannot be overemphasized. Burning in two-year units or burning in the late fall what was cut in the early spring is often disastrous to restocking. In Oregon the operator must burn the slash annually as stated by law, and this seems to be a fairly common practice in Washington. However, if it were economically feasible and weather permitting, the best plan would be to burn small blocks as soon as logged of merchantable material; thus, giving reproduction the best possible chance.

Briefly, delayed slash burning has practically the same effect as a recurrent fire, in wiping out the seed and established seedlings. Any fire, burning over logged-off lands after the reproduction has been initiated, is a decided factor in decreasing the returns from that management unit.

We have found that slash must be burned as soon as is practicable or at least once each year as is required by law in Oregon. Now tied in with this problem is when should this burning take place? In the spring or in the fall? Many people believe that one or the other is the proper approach to the time element, and it can be proved that there are several good points and several bad ones about each.

Since practically all operators agree that the main objective of all slash burning is the reduction of the fire hazard, a "clean burn" would be the ideal situation. The likelihood of getting a "clean burn" after the long summer

drought is greater than after the extended rainy season of winter and early spring, but many other points must be considered in order to understand the essence of the whole problem.

A successful fall burn will usually consume most of the debris down to mineral soil. The humus is usually entirely destroyed, and the intense heat, generated by the fire in the dry fuel, often kills seed trees of large size. Because of the low moisture content of the wood, the fire develops enormous headway and may become very difficult to control. Records of slash fires that "got away" are long and the damage costly. In fact, records show that although recent cutover lands comprise eleven percent of the total forest lands in this region, they are responsible for 57 percent of the acreage burned each year.

In a study made by Shepard in his fire insurance work he found that out of a total acreage burned in fires of fifty acres and more on State and private lands of 1,113,852 acres, those that started in unburned slash were responsible for 339,029 acres or more than the acreage burned in any other type. This would seem to indicate that to leave spring slash areas over the summer months results in great loss. On those areas subjected to high risk it would be folly to allow the slash to remain over the summer months if it could safely be burned in the spring. The danger of holdover fires as a result of spring burning may often offset any gain from promptness of disposal. In the fall heavy rains are almost certain

to follow before an extended period of dry weather; in the spring, on the other hand, they cannot be counted on and the fires often are still burning in stumps, roots and rotten logs long after the fire season is definitely present.

Spring burning finds the forest floor at the beginning of the drying-out process. A few days of drying east or northeast winds may render the flashy fuels dry in the extreme but the denser fuels are still heavy with moisture and the soil below has not as yet given up the store of water accumulated through long winter months. The result of this condition is usually an incomplete burn. This spotty removal of the flashy fuels with a killing of small woody vegetation that is not consumed, creates a much higher hazard after these dead trees and branches fall over and are covered by a new deposition of dead weeds, ferns and grass than the original slash. The greatest benefit of slash burning is, therefore, not obtained for the hazard is not lowered nearly as much as it would be by a hot fall burn, and the remains of the slash coupled with the accumulation due to the killing of the small trees and shrubs, and drying of rapidly growing annuals is in effect a greater hazard than the original. Whether the temporary lowering of hazard offsets damaging effects would have to be calculated for the individual areas. Obviously spring burning, if complete, consumes all seed deposited from the fall crop and also destroys the germinated seeds and young seedlings.

In general it would appear reasonable now to assume that fall burning is the better for all practical purposes. Now the question is how should the slash be burned. Various methods have been tried with some enjoying more success than others. Because of the vast amount of heavy debris, broadcast burning is the most favored method in the Douglas fir region. Broadcast burning means the firing of the entire slash area and allowing the fire to burn itself out. This is a speedy and usually a very efficient method of slash disposal. Because of the large quantity debris, it is also the least expensive method, and therefore, highly favored by those operators who want to get all they can from a stand as quickly as possible.

After the decision has been made to broadcast burn a slash area, certain precautions must receive careful attention. No general rule can be applied as it would vary greatly even over short distances due to the influence of the physical features of the country. Certain fundamentals remain true, however, and, if these are followed closely, no serious trouble should be forthcoming. Those in charge of the burning should maintain close contact with the Weather Bureau and keep a constant check of all local weather instruments and weather conditions. In this manner they will have the best available information of weather conditions and possible changes at all times to assist in making decisions as to how the fire should be handled at any time. It is preferable to burn the slash prior to a storm, but, as this cannot always be done, it means

the slash may have to be fired on clearing weather as soon as it is sufficiently dry to burn. In such an instance as this, any weather information is most valuable and may save considerable damage.

If possible, the slash fire should be started from six to twenty-four hours ahead of a storm. This should be initiated in the late afternoon or at night so that the bulk of the slash may be consumed before the next day in case the expected storm fails to arrive. The poorer burning conditions at night will allow the crew to hold the fire in the slash area at all danger points and thus reduce the chance of the fire getting away if the next day turns warm and dry. Irregardless, however, of these conditions, the man in charge of the slash burning must be alert at all times. He must watch air currents, drafts, winds, humidity and all of the factors which enter into the problem at the time of his decisions.

Before this area is burned, however, there are certain requirements which must be met. The area must have definite boundaries. The boundaries may be road grades, streams, or fire trails, but in each case, the slash area must have certain limitations over which the fire may be allowed to burn. The boundaries must be fixed and understood before the slash is ignited. The person or persons in charge should allow only that slash which should be disposed of to burn. It would be very poor management to allow the fire to exceed the limits of the slash area and reburn areas now stocking or down timber

not yet logged. In order to better meet any contingencies that may arise a definite plan of action should be made for the slash area in question. The personnel in charge of the burning should should know the duties and location of each man and crew at the time of firing and afterwards. Also, all fire trails that are necessary to limit the extent of the fire and to protect timber and improved property should be finished before the burning is instituted.

The actual firing should be initiated at the upper edge of the slash on the slopes and then spread in narrow belts or strips across the face of the hillside, firing the corners and sidelines in advance of the center so that the pull of the fire to the center will draw the smoke and fire away from the fire line. Plenty of time should be spent in preparing a safety belt of burned slash from 200 to 400 feet wide at the upper edges of the fire line. After this the fire can be spread out along the contours of the hillside, care being taken that part of the crew will fire a safety belt next to green timber or other danger points of the burn. High humidity or a recent rain may make firing difficult in which case a great volume of heat must be maintained. To secure this greater volume of heat, it may be necessary to fire well within the slash areas a few lines of slash running up and down the slope, so as to insure a rapid run and spread of the fire. Extreme care should be practiced when doing this, however, as it is very dangerous and may cause much trouble if it has the

slightest chance.

An adequate number of men should be provided for patrol work after the slash has been ignited. Usually by morning all of the slash on the steeper and all danger points will be burned, so that a small patrol may hold the line during the early part of the day while the remainder complete the firing within the slash area. The patrol should be heavy later in the day and continue as long as deemed necessary after which it may be varied to suit local conditions. It will be found necessary to maintain a small patrol of about two men for several days after the slash fire to watch for the possible escape of hangover fires. Fire in the Douglas fir area has a habit of holding under large logs, in stump roots, and rotten material for days and even weeks and then on a hot, dry day it will spring to life and may cause serious trouble if not stopped immediately.

As mentioned previously, the State law requires all snags to be felled at least 250 feet back from the fire line. This is a serious and important item as snags are often the cause of spot fires being set ahead of the slash fire. Although spot fires can be easily controlled under favorable weather conditions with good action of the personnel in charge, nevertheless there is always the possibility that a spot fire will go undetected; that the weather will change abruptly and a disastrous fire is the result. Also a sufficient amount of

equipment must be available to meet any emergency. All successful operators will agree that a few extra dollars spent on preventive and precautionary measures will prove to be a good investment in the long run. If there are any instances where the fire did cross the lines set as the boundaries of the burn, mop-up work should be initiated to prevent any chance of a further spread of the fire. Also the mop-up of all hold-over fires is essential if dry weather and east winds occur after slash burning.

A good deal of the information included in the above discussion on broadcast burning may also apply to burning slash in selective logging operations. To try to secure a "clean burn" on a partially cut area or to expect one fire or a few fires to spread through the entire area, consume the slash and not injure the standing trees, is not within reason. Such a policy may actually greatly increase the total hazard rather than lowering it. Selective logging operation may leave so light a slash that burning, to be effective must be done under very dry conditions, because the fire would be hard to spread. If the area is dry enough, the fire will be so hot that numerous saplings and larger trees will be killed or fire scarred. Within two or more years these trees will begin to break up and fall with a resultant hazard that is greater than the one before the slash fire. In any case, such a procedure in slash removal will inevitably

result in more resultant hazard than is necessary.

It has been found that approximately two inches of rain should precede the burning of selective slash in most of Western Oregon. This amount will not be necessary on north slopes, in the fog belt, or in some other individual areas. In Eastern Oregon one inch of rain appears to be adequate. After the necessary rain has fallen, it is a good policy to dispose of the slash as rapidly as possible, however, if the rain occurs before October 1, burning may not be advisable. The person in charge of selective slash removal has a much more difficult job as each spot of slash must be considered separately and certain pieces should not be burned at all. "Cat" trails will have a considerable influence on his judgment and damage to tree growth must be kept at a minimum. In places where large accumulations of slash afford danger of rapid spread of fire, he should construct fire lines.

Many more men are necessary for proper removal of selective logging slash than for the disposal of slash created by clear-cutting. Each spot of slash has to be lit individually. Flame throwers made of backpack cans filled with saw oil are great aids for efficient and fast burning. If the area is wet enough to prevent the harming of living trees, burning cannot be accomplished without lighting each spot of slash and the "flame thrower" makes this possible without too great a loss of time. The oil allows the fire to create enough heat so that it can burn the down material. In order

that the slash may be entirely removed before weather conditions become adverse, a fairly large force equipped with cans must work rapidly over the area.

In addition to the above discussion on slash disposal methods, there are also several special problems that may be well to mention at this time. The problem of slash in young stands from thirty to fifty years old where less than one-half of the trees are removed is very important. To remove this slash by burning usually results in killing practically all of the standing trees. If these trees are preserved, a second crop of timber can be harvested in a few years. Most of these young stands are fairly clean of underbrush; thus, where the slash is not too heavy, the best practice would be not to burn it. In any case, the future value of the young trees will make the extra cost of hazard reduction a good investment.

The "small hemlock" problem found in many stands, particularly in Washington, is another source of discussion. In these stands which have a very heavy mixture of hemlock, the logging operations do not remove any of the small material though a good share is knocked down. Since hemlock has a low value, operators have never given its protection much thought. The increasing value of hemlock for paper pulp has lead many to believe some effort should be made to save these trees that are now usually destroyed by the slash fire.

Then there is the problem of local forest types and

conditions. In the coastal "fog belt" for instance, the forest type changes from Douglas fir to mixed stands of hemlock, cedar, and spruce with a luxuriant growth of underbrush. Precipitation is extraordinarily heavy, often in excess of one hundred inches per year, and drenching fogs are of common occurrence throughout the year. This all tends to reduce the fire hazard except during those occasional few days of abnormally low humidity and east or northeast wind when the coast areas also dry out. Then the enormous growth of underbrush and forest make a fire hazard of greater importance than in most other areas. The infrequency of the fire weather in this area, however, tends to render burning of slash to reduce the fire hazard of far less value than elsewhere in the region. Aside from this fire hazard, this fog belt presents another problem. In some instances, the volume of the slash, its almost complete covering of the soil, and its slow decay (cedar especially) may so seriously interfere with the natural reestablishment of the forest as to require removal of the slash for this reason alone without even considering the necessity for doing so in order to reduce the fire hazard.

## POSSIBLE FUTURE TRENDS OF SLASH DISPOSAL

The discussion thus far has dealt with the problem as it now stands. However, from the present developments it is reasonable to assume that the coming years will see a considerable change in this problem. Science is, by no means, static, and economic forces may also bring about radical changes. As science finds new uses for wood, especially in the chemical and plastic fields, it is certain that the operators will practice closer utilization of the forest. More of the low grade top logs and short chunks may be profitably logged and thus less slash will result. Most of the operations employ various means in order to prevent careless workmen wasting any large amounts of timber in felling and bucking or logging. Probably more work along these lines at present may lessen the amount of heavy debris that is now left in the woods.

This is especially true in the Douglas fir region. The Northwest loggers have always maintained that in order to survive it is necessary to get plenty of logs and get them cheaply. The large high-speed machinery resulted and consequently much loss has resulted due to breakage and uneconomical small logs. At present there are lighter and more mobile yarding machinery on the market. These machines are designed for smaller timber and especially for work in stands of mixed sizes. Numerous operators have successfully used this machinery and many more will replace the old equipment with this

new type in the near future. Consequently, we can expect a large reduction of the amounts of logging slash left in the woods; also, a larger residual stand in a much better condition.

Prelogging and relogging are other means of reducing the waste and thereby leaving less slash. Recently a pulp and paper company, that has been developing a system of relogging the cut-over lands, made a study of the results which apparently are quite satisfactory. In a period of four months four million board feet of small logs and broken chunks were salvaged from recent logging slash. This represented about twelve percent of the original stand on the area which is a considerable amount to be left as slashing along with the unusable top, limbs, and rotten logs. This reduction of the waste along with other forms of improved managerial methods will go a long ways to reduce the amount of slash in the Northwest.

Partial cutting is becoming more and more popular in the Douglas fir region. It has come as a result of the improved tractors and motor trucks, the use of which allows the operator to successfully "high grade" the timber. A much smaller amount of slash will result and the tractor trails and truck roads allow for easier accessibility of the timber, which in turn allow protective agencies a much better opportunity to prevent fires or suppress those which may start. Protection changes are then much lower and the operator is afforded a

better opportunity to manage his cut-over lands.

In this same manner this increasing number of truck roads is making accessible numerous forest playgrounds, lakes and streams that heretofore were at the end of long horse and foot trails. More and more recreationists, vacationists, hunters, fishermen, and the like, are making use of these advantages every year. This increasing usage of forest lands make unburned land as a whole. ?

Because of the number of people who are using and enjoying the forest lands each year, many loggers and foresters are contending that other agencies beside their own should help pay the costs of protecting and managing these lands. From the face of the argument it is quite reasonable. The logger or the forester must pay all costs of presuppression and suppression of fires on their respective lands. The increased usage naturally raises their expenses without giving a bit of income. Perhaps it is reasonable to believe that the State and National governments will find some way to assist the timber owner in this matter. Better fishing and hunting facilities will naturally mean increased revenue from hunting and fishing licenses. A little help on this line will allow the timber owner to practice better forestry in removing slash, and thus the residual stand will preserve the aesthetic value found on timber lands and the public will have the opportunity of enjoying this beauty rather than looking at vast acres of denuded land that is covered with brush and blackened snags.

## CONCLUSION

I hope that the material in this paper will give one a full picture of the slash problem in the Douglas fir area, and to conclude the discussion it might be well to summarize some of the main points that have been brought out.

There is a definite need for a flexible slash-burning policy in this region. Not only flexibility in the legislation, but also in the intelligent application of that legislation. The changing methods of logging and the many variations from the general slash type preclude the use of any blanket rule or policy. Perhaps sufficient legislation to empower certain trained men to carry out a flexible policy would be a splendid thing. In such an instance these few trained men with their picked assistants could decide the policy to follow for each individual slash area. With the authority given them by the legislature, they then would be able to enforce or carry through with each policy on these different areas.

It is quite apparent from the present legislation and policies of the State forestry department that future changes will be in this direction. Better trained personnel and closer cooperation with the operators will further this system considerably. Some loggers and foresters cannot emphasize this flexibility point too much and are in agreement that it may hold the answer, at least in part, of the slash disposal

problem.

A policy which allows the burning of a splendid residual stand of young trees, sanctions the destruction and blackening of miles of forest land along highways used by tourists and the like, and the continual burning of lands adjacent to slash areas, demands a uniform slash disposal method for all slash area, and which puts the greater emphasis on methods of destruction of slash hazards and smaller emphasis on the upbuilding of forest resources cannot be to the advantage of the region. Of course, it is hard to say which should actually receive the most attention right now. Certainly we do not care to risk a serious fire with the heavy loss that may go with it, but at the same time we must think of the future value of the land and how the slash fire will affect this value. Now a flexible policy administered intelligently by trained personnel may pass judgement, based upon future values and present costs and risks, that will best apply to this particular area. Then the community and state may derive the most possible good from the forest land.

It has been determined that the rate of spread of fire on logged-over land is about four times as great on unburned as on burned land during the first year. After the first year, however, this difference rapidly decreases. By the end of the fourth year, the rate of spread of fire is about the same on either type of treated land. Any variations after the fourth year are not consistent and seem to be affected by

other causes.

Along with this same principle, the resistance to control a fire on unburned slash is about four and one-half times as great as on burned slash areas. This difference lessens quite gradually and it will take about 19 years for the resultant changes to equalize conditions. It is on this basis that most slash lands are required to be burned. The danger of fire at a later date is always great on slash areas, and the difficulty of controlling these possible future fires is a deciding factor for determining whether or not to burn a particular area.

The degree of stocking resulting from burned areas as compared to unburned areas seems to be of no essential difference in the coast areas of Oregon and Washington. In the remaining lands of the area, however there is a decided difference showing that burning is of great detriment to stocking for at least twenty years.

The slash fire that runs through areas of young immature stands usually kills the trees without consuming them and thereby defeats the original purpose of the slash fire by forming a fire hazard almost as great if not greater than the original logging slash. This destruction of immature timber has other results which are even more serious. Such losses make it necessary to start the next forest crop from seeding or planting which will greatly delay the next harvest or immensely increase the expense necessary to restock the area.

The destruction of many small areas taken as a whole will

have a serious effect upon the volume of future logging. Revenues from this source, upon which many counties are largely dependent, will be seriously diminished.

Also, with the placing of more emphasis on fish and game management it is but a matter of time until the expense of intensive protection of certain slash areas will be more than compensated for by returns from license issued which apply to fish and game fed on these areas.

Logging on a watershed area or in a recreational center offers serious complications to the problem. To prohibit such logging would not be economically sound nor would it follow the "multiple purpose" forest policy. However, to burn the cut-over land after logging would be disastrous to the watershed and would remove the recreational benefits. In such cases the gradual removal of the stand coupled with intensive protection without slash disposal by burning would probably be the best answer.

All in all, however, the slash disposal problem is not the only big problem of cut-over land management. Perhaps the problem of recurrent burning is even greater. It is a great menace to future forest industry. In some areas of the younger types of Douglas fir forests where this menace exercises the greatest influence we find the condition where, on an average, the lands are burned over every twenty or twenty-five years. Thus, the establishment of a new forest on these lands is prohibited.

Statistics show that incendiarism is the chief cause of fires in this region. An enlarged law-enforcement program, coupled with land classification and education, can correct this evil. Lumbering, though causing a small percent of the total fires is very high in the damage per fire, which points to the need of scientific rating of fire danger and efficient management of the operations of cutting and burning to hold down the hazard and resultant damage. More attention must be given to the planning and execution of necessary burning of slash and the control of risks present within the operation.

The gradual lessening of the use of fire in any shape or manner should prove a decided benefit to the region. As we educate people and perfect our law enforcement we can expect to have the number of fires drop rapidly, and as our knowledge of the possibilities and uses of hazard removal methods increases, we may well spend more time in fireproofing by the division of our management units into compartments by roads and fire-breaks. Improvements such as roads and fire-breaks will accumulate and aid in the lowering of the fire danger. Inevitably, however, we will always need to use broadcast burning on some large areas.

THE PROBLEM OF SLASH DISPOSAL CONFRONTING  
THE LOGGING OPERATOR IN THE DOUGLAS FIR REGION

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