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PREDICTIONS OF FIRE BEHAVIOR AND RESISTANCE TO CONTROL

FOR USE WITH PHOTO SERIES FOR THE SIERRA MIXED CONIFER TYPE AND THE SIERRA TRUE FIR TYPE

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Abstract

This publication presents tables on the beha'vior of fire and the resistance of fuels to control. The information is to be used with the photos in the publication, "Photo Series for Quantifying Forest Residues in the Sierra Mixed Conifer Type, Sierra True Fir Type" (USDA For. Serv. Gen. Tech. Rep. PNW-95, 1979, by Wayne G. Maxwell and Franklin R. Ward).

KEYWORDS: Fire behavior (forest), fire management, fire spread.

Metric Conversion

To change	to	multiply by:
Miles per hour	kilometers per hour	1.6093
Chains	meters	20.12
Feet	meters	0.3048
Acres	hectares	0.4047

Species List

Douglas-fir	Pseudotsuga menziesii (Mirb.) Franco
fir	Abies spp.
ponderosa pine	Pinus ponderosa Dougl. ex Laws.

Timber harvest and silvicultural practices — as well as natural phenomena, such as windthrow, ice damage, and wildfire — often leave undesirable amounts of forest residues. The forest manager must set limits on the amount of residues and fire hazard that are consistent with resource management objectives.

Photo series have been published as an inventory tool to assess fuel loadings by size class in several forest types. The photos are used to translate visual images to quantities (tons per acre) so the manager can describe the residue that should be retained to meet environmental concerns and goals of a particular specialty. The photos also provide a starting point for assessing fire hazard.

This publication presents tables for predicting rate of fire spread, flame length, and resistance of fuel to control for each residue condition depicted by the photo series for the Sierra mixed conifer and Sierra true fir types (Maxwell and Ward 1979). Fire behavior estimates are based solely on measured fuel loadings in the 1/4- to 3-inch diameter range. All other inputs to a mathematical fire spread model (Rothermel 1972), including depth of fuel bed and 1-hour timelag (0- to 1/4-inch diameter) loading, are generated by assuming similarity of the fuel bed to a stylized fuel model. Packing and surface-to-volume ratios were derived by interpolation between models. Foliage and litter loadings are reflected in the 1-hour timelag fuel loading. No live or coarse (greater than 3-inch diameter) fuels are considered.

Two sets of fuel models are in widespread use for fire planning and hazard appraisal--Northern Forest Fire Laboratory (NFFL) ana National Fire-Danger Rating (NFDR) models. The NFFL models (Albini 1976) are also used for forecasting behavior of wildfire. Generally, the slash fuel models reflect an average of typical fuel conditions in Douglas-fir and ponderosa pine slash. The NFDR models (Deeming et al. 1977) differ from the NFFL series mainly in that a greater proportion of 1-hour timelag fuels are present relative to 10- and 100-hour fuels (1/4 inch to 3 inches). Packing ratios are similar, but NFFL models have more nearly optimum packing. Because of these differences, predictions for spread and intensity of fire for fuels with properties of the NFDR slash models will be slightly greater at low windspeeds--and much greater at high windspeeds--than fuels with the physical properties of NFFL slash models.

A choice between using the NFFL or NFDR series of models to represent the fuel bed in a photo from Maxwell and Ward (1979) was based on the proportion of fine fuels present and on the believability of the output on fire behavior. Residues from second-growth timber and red slash, because of a greater amount of 1-hour fuel loading, are better represented by NFDR models. Old-growth or overwintered slash has characteristics similar to NFFL models.

Rothermel's (1972) fire spread model is the basis for estimates of fire behavior. The algorithm used to estimate flame lengths for photographs judged similar to NFDR fuel models is the same used in the NFDR system. The fire spread model, however, depends on a continuous and homogeneous fuel bed, and adjustments are needed if those conditions do not prevail. Several fuel beds depicted in the photo series by Maxwell and Ward (1979) were treated by fire or mechanical crushing. Where a treatment drastically reduced depth or continuity of the fuel bed, outputs of the model were adjusted accordingly.

Tables 1-30 provide a means to quantify relative differences in fire potential between fuel beds in a manner consistent with, but more precisely than, stylized fuel models. The user should not expect predicted values to be exact estimates of fire behavior on an actual fire on a specific unit. Deviations from one-half to two times the predicted values can be expected. Even values one-fourth to four times the actual value may occur. Deviations are also possible if the fuel inventory is inaccurate or if the character of the fuel bed is substantially different from the stylized fuel model.

Spread of fire is amplified by wind and slope. Effective wind (Albini 1976) is the windspeed that alone would produce the same amplification as the combined effects of wind and slope. The tables show effective wind at midflame height. Figure 1 can be used to determine effective midflame windspeed.

Fuel moisture content is calculated by combining the three fine fuel classes so that:

Moisture content = 0.76 x (1-hour timelag moisture)
+0.18 x (10-hour timelag moisture)
+0.06 x (100-hour timelag moisture).

Fire perimeter, area, and resistance to control are also useful for fire planning. Formula and graphic aids (Fire Behavior Officer's Field Reference[1]) for determining perimeter and area are presented in appendix 1. Fuel resistance to control rating, slope, and flame length adjustment factors, and

[1] National Interagency Fire Training Center, Marana, Arizona, 1978.

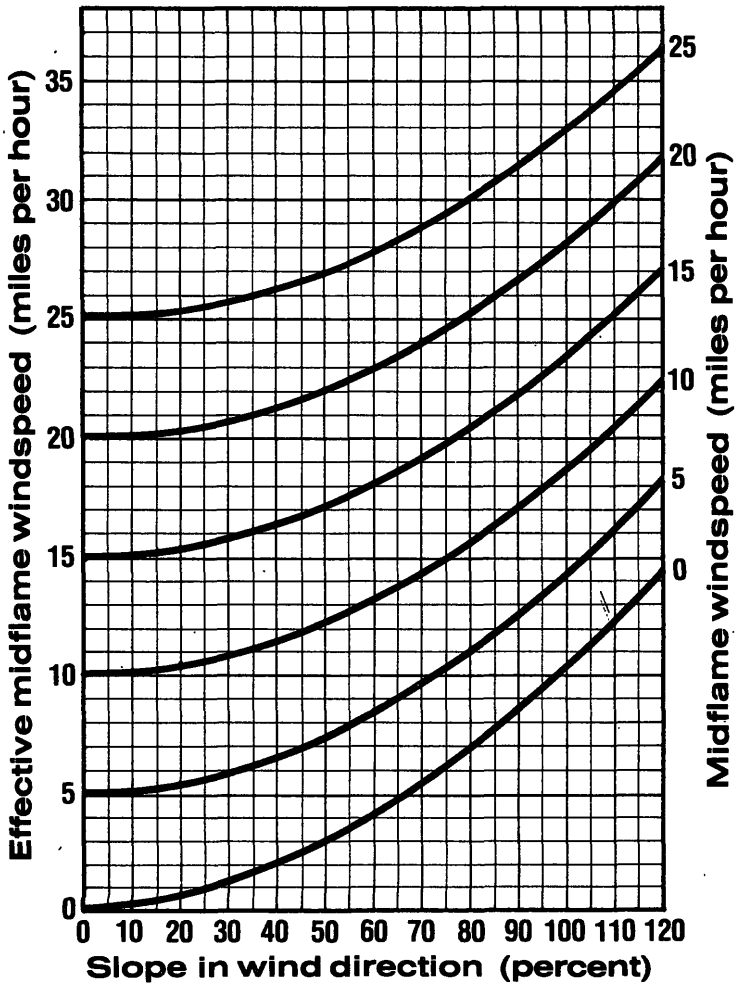

Figure 1.—Chart for determining effective windspeed from midflame windspeed and ground slope in direction of wind.

conversion of resistance to control rating values to chains per hour of line constructed by one person are presented in appendix 2.

For the approximate potential fire behavior and resistance of fuel to control for a particular area and given weather conditions, determine the following:

1. Which photo nearly matches, or which photos bracket, the area.
2. Rate of spread of fire and flame length (tables 1-30).
3. Perimeter and area of fire (from graphs and formulas in appendix 1).
4. Resistance of fuel to control (from tables in appendix 2).

For example, if the area was represented by photo 2-MC-4-RC in Maxwell and Ward (1979) and there was a 5-mi/h wind at midflame height, a fine fuel moisture of 4 percent, and the area was on a 20-percent slope, the following conditions would exist:

Effective midflame wind (miles per hour)--6
Rate of spread (chains per hour)--10
Flame length (feet)--6
Perimeter growth at 1 hour (chains)--29.3
Area at 1 hour (acres)--5.2
Resistance to suppression (chains/person-hour)--1.2

If the area was bracketed by two photos, interpolate by using the respective tables.

Literature Cited

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1976. Estimating wildfire behavior and effects. USDA For. Serv. Gen. Tech. Rep. INT-30, 92 p. Intermt. For. and Range Exp. Stn., Ogden, Utah.

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Mixed Conifer

Size Class 4

Regeneration Cut

Tables 1 through 3

(Corresponds to **Photo** Series 1-MC-4-RC to 3-MC-4-RC in Maxwell and Ward 1979)

TABLE 1--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 1-MC-4-RC

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TAELE 2--FIRE BEHAVIOR AND CONTROL INFORMATION FUR PHOTO 2-MC-4-RC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL 'MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	a	13	17	22	27	35	48	2	4	5	7	8	9	9	1 1	1 2
3	1	4	7	11	15	19	23	3G	41	2	4	5	6	7	8	8	9	1 1
4	1	3	6	10	13	17	21	26	37	2	3	4	5	6	7	8	8	10
5	1	3	6	9	12	15	19	24	33	2	3	4	5	6	4	7	8	9
6	1	3	5	8	11	14	17	22	31	1	3	4	5	5	6	7	a	9
7	1	3	5	8	11	14	17	21	29	1	3	4	5	5	6	6	7	8
e	1	3	5	7	10	13	16	20	28	1	3	4	4	5	6	6	7	8
9	1	2	5	7	13	12	15	19	27	1	3	6	6	5	6	6	7	8
10	1	2	4	7	9	12	14	18	25	1	3	3	4	5	5	6	7	8
11	0	2	4	6	a	11	13	17	23	1	2	3	4	5	5	6	6	7
12	0	2	4	5	7	10	12	15	21	1	2	3	4	4	5	5	6	7
13	0	2	3	5	6	8	1 0	1 3	1 7	1	2	3	3	6	4	4	5	6
14	0	1	2	3	5	6	7	9	1 3	1	1	2	2	3	3	3	4	4
15	0	1	1	2	3	4	4	6	8	0	1	1	2	2	2	2	2	3
16	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1

TABLE 3--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 3-MC-4-RC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	3	6	9	12	15	19	24	34	1	3	4	4	5	6	6	7	8
3	1	3	5	8	10	13	16	21	29	1	2	3	4	4	5	5	6	7
4	0	2	4	7	9	12	14	18	25	1	2	3	3	4	4	5	6	6
5	0	2	4	6	8	11	13	17	23	1	2	3	3	4	4	5	5	6
6	0	2	4	6	8	10	12	16	22	1	2	3	3	4	4	4	5	6
7	0	2	4	5	7	10	12	15	21	1	2	2	3	3	4	4	5	6
8	0	2	3	5	7	9	11	14	20	1	2	2	3	3	4	4	5	5
9	0	2	3	5	7	9	10	13	19	1	2	2	3	3	4	4	4	5
10	0	1	3	4	6	8	10	12	17	1	2	2	3	3	3	4	4	5
11	0	1	3	4	5	7	8	11	15	1	1	2	2	3	3	3	4	4
12	0	1	2	3	4	5	7	9	12	1	1	2	2	2	3	3	3	4
13	0	1	1	2	3	4	5	6	E	0	1	1	1	2	2	2	2	3
14	0	0	1	1	1	1	2	2	3	0	0	0	1	1	1	1	1	1

Mixed Conifer

Size Class 4

Partial Cut

Tables 4 Through 11

(Corresponds to Photo Series 1-MC-4-PC to 8-MC-4-PC in Maxwell and Ward 1979)

TABLE 4--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 1-MC-4-PC (PATE OF SPREAD ESTIMATES ARE ONE-HALF OF NFFL CONTINUOUS SLASH MODEL)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	1	2	3	5	6	7	9	13	1	1	2	2	3	3	3	3	4
3	0	1	2	3	4	5	6	8	11	1	1	2	2	2	2	3	3	4
4	0	1	2	3	3	4	5	7	10	1	1	1	2	2	2	2	3	3
5	0	1	2	2	3	4	5	6	9	0	1	1	2	2	2	2	3	3
6	0	1	1	2	3	4	5	6	8	0	1	1	2	2	2	2	3	3
7	0	1	1	2	3	4	4	6	8	0	1	1	2	2	2	2	2	3
8	0	1	1	2	3	3	4	5	7	0	1	3	1	1	2	2	2	2	3
9	0	1	1	2	2	3	4	5	7	0	1	1	1	2	2	2	2	3
10	0	1	1	2	2	3	3	4	6	0	1	1	1	1	2	2	2	2
11	0	0	1	1	2	2	3	4	5	0	1	1	1	1	1	2	2	2
12	0	0	1	1	1	2	2	3	4	0	0	1	1	1	1	1	1	2
13	0	0	0	0	1	1	1	1	2	0	0	0	0	1	1	1	1	1

TABLE 5--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 2-MC-4-PC (RATE OF SPREAD. ESTIMATES ARE ONE-HALF OF NFFL CONTINUQUS SLASH MODEL)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	2	3	5	7	9	11	14	20	1	2	3	4	4	5	5	6	7
3	0	1	3	4	6	8	9	12	17	1	2	3	3	4	4	5	5	6
4	0	1	3	4	5	7	8	11	15	1	2	2	3	3	4	4	5	5
5	0	1	2	4	5	6	8	10	14	1	2	2	3	3	4	4	4	5
6	0	1	2	3	5	6	7	9	13	1	2	2	3	3	3	4	4	5
7	0	1	2	3	4	6	7	9	12	1	2	2	3	3	3	4	4	5
8	0	1	2	3	4	5	6	8	11	1	2	2	2	3	3	4	4	5
9	0	1	2	3	4	5	6	8	11	1	1	2	2	3	3	3	4	4
10	0	1	2	3	4	5	6	7	10	1	1	2	2	3	3	3	4	4
11	0	1	2	2	3	4	5	6	9	1	1	2	2	2	3	3	3	4
12	0	1	1	2	3	3	4	5	8	1	1	1	2	2	2	3	3	3
13	0	1	1	2	2	3	3	4	6	0	1	1	1	2	2	2	2	3
14	0	0	1	1	1	2	2	2	3	0	1	1	1	1	1	1	1	2
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 6--FIRE BEHAVIOR AND CONTROL INFORMATION FUR PHOTO 3-MC-4-PC

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 7.--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 4-MC-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	3	6	10	13	17	21	27	37	1	3	4	5	6	b	?	8	9
3	1	3	5	8	11	15	18	23	32	1	3	4	4	5	6	6	7	8
4	1	2	5	7	10	13	16	20	28	1	2	3	4	4	5	6	6	7
5	0	2	4	7	9	12	14	18	26	1	2	3	4	4	5	5	6	7
6	0	2	4	6	9	11	13	17	24	1	2	3	3	4	4	5	6	b
7	0	2	4	6	8	10	13	16	23	1	2	3	3	4	4	5	5	6
8	0	2	4	6	8	10	12	16	22	1	2	3	3	4	4	5	5	b
9	0	2	4	5	7	9	11	15	20	1	2	3	3	4	4	4	5	6
10	0	2	3	5	7	9	11	14	19	1	2	2	3	3	4	4	5	5
11	0	1	3	4	6	8	9	12	17	1	2	2	3	3	3	4	4	5
12	0	1	2	4	5	6	8	10	14	1	1	2	2	3	3	3	4	4
13	0	1	2	3	4	5	6	7	10	1	1	1	2	2	2	2	3	3
14	0	0	1	1	2	2	3	4	5	0	1	1	1	1	1	1	2	2

TABLE 8--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 5-MC-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	9	13	17	22	27	34	4f	2	4	5	6	7	8	9	1 0	1 2
3	1	4	7	11	15	19	23	29	40	2	3	5	6	7	7	8	9	1 1
4	1	3	6	10	13	17	20	26	36	2	3	4	5	6	7	7	8	10
5	1	3	6	9	12	15	18	24	32	2	3	4	5	6	6	7	8	9
6	1	3	5	8	11	14	17	22	30	1	3	4	5	5	6	7	7	9
7	1	3	5	8	10	13	16	21	29	1	3	4	4	5	6	6	7	a
8	1	2	5	7	10	13	15	20	27	1	3	4	4	5	6	6	7	8
9	1	2	5	7	9	12	15	19	26	1	3	3	4	5	5	6	7	a
10	1	2	4	7	9	11	14	18	24	1	2	3	4	5	5	6	6	7
11	0	2	4	6	8	10	13	16	22	1	2	3	4	4	5	5	6	7
12	0	2	3	5	7	9	1 1	1 4	2 0	1	2	3	3	4	4	5	5	6
13	0	1	3	4	6	0	9	1 2	1 7	1	2	2	3	3	4	4	5	5
14	0	1	2	3	4	6	7	9	1 2	1	1	2	2	3	3	3	4	4
15	0	1	1	2	3	3	4	5	7	0	1	1	1	2	2	2	2	2
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 9--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 6-MC-4-PC
(FIRE BEHAVIUR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	5	9	14	19	24	30	38	52	2	5	6	7	9	10	10	12	14
3	1	4	8	12	16	21	26	33	45	2	4	5	7	8	8	9	10	12
4	1	4	7	11	15	18	23	29	40	2	4	5	6	7	8	8	9	11
5	1	3	6	10	13	17	20	26	36	2	3	5	6	6	7	8	9	10
6	1	3	6	9	12	16	19	24	34	2	3	4	5	6	7	7	8	10
7	1	3	6	8	12	15	18	23	32	2	3	4	5	6	7	7	8	9
8	1	3	5	8	11	14	17	22	30	2	3	4	5	6	6	7	8	9
9	1	3	5	8	10	13	16	21	29	2	3	4	5	6	6	7	8	9
10	1	2	5	7	10	13	15	20	27	1	3	4	5	5	6	7	7	8
11	1	2	4	7	9	12	14	19	26	1	3	4	4	5	6	6	7	8
12	0	2	4	6	8	11	13	17	23	1	2	3	4	5	5	6	6	7
13	0	2	4	5	7	9	11	15	20	1	2	3	4	4	5	5	6	7
14	0	1	3	4	6	8	9	12	16	1	2	2	3	3	4	4	5	6
15	0	1	2	3	4	5	6	8	11	1	1	2	2	3	3	3	3	4
16	0	0	1	1	2	2	3	4	5	0	1	1	1	1	1	2	2	2

TABLE 10--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 7-MC-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	5	9	13	18	23	28	36	50	2	4	6	7	8	9	10	11	13
3	1	4	8	12	16	20	24	31	43	2	4	5	6	7	8	9	10	11
4	1	3	7	10	14	18	22	28	38	2	3	5	6	7	7	8	9	10
5	1	3	6	9	13	16	20	25	35	2	3	4	5	6	7	7	8	10
6	1	3	6	9	12	15	18	23	32	2	3	4	5	6	6	7	8	9
7	1	3	5	8	11	14	17	22	30	2	3	4	5	6	6	7	8	9
8	1	3	5	8	11	13	16	21	29	1	3	4	5	5	6	7	7	9
9	1	3	5	7	10	13	16	20	28	1	3	4	5	5	6	6	7	8
10	1	2	5	7	10	12	15	19	26	1	3	4	4	5	6	6	7	8
11	1	2	4	7	9	11	14	18	24	1	3	3	4	5	5	6	7	8
12	0	2	4	6	8	10	12	16	22	1	2	3	4	4	5	5	6	7
13	0	2	3	5	7	9	11	14	19	1	2	3	3	4	4	5	5	6
14	0	1	3	4	5	7	8	11	15	1	2	2	3	3	4	4	4	5
15	0	1	2	3	3	4	5	7	10	1	1	2	2	2	2	3	3	3
16	0	0	1	1	1	2	2	2	3	0	0	1	1	1	1	1	1	1

TABLE 11--FIRE BEHAVIOR AND CONTROL *INFORMATION* FOR PHOTO 8-MC-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	8	12	16	21	26	33	45	2	4	5	6	7	8	9	10	11
3	1	4	7	10	14	18	22	28	39	2	3	5	5	6	7	8	9	10
4	1	3	6	9	12	16	19	25	34	2	3	4	5	6	6	7	8	9
5	1	3	5	8	11	14	18	23	31	1	3	4	5	5	6	7	7	9
6	1	3	5	8	11	13	16	21	29	1	3	4	6	5	6	6	?	0
7	1	2	5	7	10	13	16	20	28	1	3	4	4	5	6	6	7	8
8	1	2	5	7	10	12	15	19	26	1	3	3	4	5	5	6	7	8
9	1	2	4	7	9	12	14	18	25	1	2	3	4	5	5	6	6	7
10	0	2	4	6	9	11	13	17	23	1	2	3	4	4	5	5	6	7
11	0	2	4	6	8	10	12	16	21	1	2	3	4	4	5	5	6	7
12	0	2	3	5	7	9	11	14	19	1	2	3	3	4	4	5	5	6
13	0	1	3	4	6	7	9	11	15	1	2	2	3	3	4	4	4	5
14	0	1	2	3	4	5	6	9	11	1	1	2	2	2	3	3	3	4
15	0	0	1	1	2	3	3	4	6	0	1	1	1	1	1	2	2	2

Mixed Conifer

Size Class 3

Partial Cut

Tables 12 Through 19

(Corresponds to Photo Series 1-MC-3-PC to 8-MC-3-PC in Maxwell and Ward 1979)

TABLE 12--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 1-MC-3-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	2	3	5	7	9	12	15	21	1	1	2	2	3	3	3	4	4
3	0	1	3	5	6	8	10	13	18	1	1	2	2	2	3	3	3	4
4	0	1	3	4	6	7	9	11	16	1	1	2	2	2	2	3	3	4
5	0	1	2	4	5	7	8	10	14	1	1	1	2	2	2	3	3	3
6	0	1	2	4	5	6	8	10	14	0	1	1	2	2	2	2	3	3
7	0	1	2	3	5	6	7	9	13	0	1	1	2	2	2	2	3	3
8	0	1	2	3	4	6	7	9	12	0	1	1	2	2	2	2	3	3
9	0	1	2	3	4	5	6	8	11	0	1	1	1	2	2	2	2	3
10	0	1	2	3	3	4	5	7	10	0	1	1	1	2	2	2	2	3
11	0	1	1	2	3	4	4	6	8	0	1	1	1	1	1	2	2	2
12	0	0	1	1	2	2	3	4	5	0	0	1	1	1	1	1	1	1
13	0	0	0	0	1	1	1	1	2	0	0	0	0	0	0	0	0	1

TABLE 13--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 2-MC-3-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFDR MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	5	10	15	21	28	34	45	64	2	4	6	8	9	10	11	13	15
3	1	4	8	13	19	24	30	40	57	2	4	6	7	8	9	10	12	14
4	1	4	7	12	17	22	27	36	51	2	4	5	6	7	8	9	11	12
5	1	3	7	11	15	20	24	32	46	2	3	5	6	7	8	9	10	11
6	1	3	6	10	14	18	22	29	42	2	3	4	5	6	7	8	9	10
7	1	3	6	9	13	17	21	27	39	2	3	4	5	6	7	7	8	10
8	1	3	5	8	12	16	19	25	36	1	3	4	5	5	6	7	8	9
9	1	2	5	8	11	15	18	24	34	1	3	3	4	5	6	6	7	8
10	1	2	5	8	11	14	17	23	33	1	2	3	4	5	5	6	7	8
11	1	2	5	7	10	13	17	22	31	1	2	3	4	4	5	5	6	7
12	1	2	4	7	10	13	16	21	30	1	2	3	4	4	5	5	6	7
13	1	2	4	7	10	12	16	20	29	1	2	3	3	4	4	5	5	6
14	0	2	4	7	9	12	15	20	28	1	2	2	3	4	4	4	5	6
15	0	2	4	6	9	11	14	19	27	1	2	2	3	3	4	4	5	6
16	0	2	4	6	8	11	14	18	25	1	2	2	3	3	3	4	4	5
17	0	2	4	6	8	10	13	17	24	1	1	2	2	3	3	3	4	5
18	0	2	3	5	7	9	12	16	22	1	1	2	2	2	3	3	4	4
19	0	1	3	5	7	9	11	14	20	1	1	2	2	2	2	3	3	4
20	0	1	3	4	6	8	10	12	18	0	1	1	2	2	2	2	3	3
21	0	1	2	4	5	6	8	11	15	0	1	1	1	2	2	2	2	3
22	0	1	2	3	4	5	6	8	12	0	1	1	1	1	1	2	2	2
23	0	1	1	2	3	4	5	6	8	0	0	1	1	1	1	1	1	1
24	0	0	1	1	1	2	2	3	4	0	0	0	0	0	1	1	1	1

TABLE 14--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 3-MC-3-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	3	5	8	11	14	17	22	30	1	2	3	4	4	5	5	6	7
3	0	2	4	7	9	12	14	19	26	1	2	3	3	4	4	5	5	6
4	0	2	4	6	8	10	13	16	23	1	2	2	3	3	4	4	5	6
5	0	2	4	5	7	10	12	15	21	1	2	2	3	3	4	4	5	5
6	0	2	3	5	7	9	11	14	20	1	2	2	3	3	4	4	4	5
7	0	2	3	5	7	9	10	13	19	1	2	2	3	3	3	4	4	5
8	0	2	3	5	6	8	10	13	18	1	2	2	3	3	3	4	4	5
9	0	1	3	4	6	8	9	12	16	1	1	2	2	3	3	3	4	4
10	0	1	3	4	5	7	8	11	15	1	1	2	2	3	3	3	4	4
11	0	1	2	3	5	6	7	9	13	1	1	2	2	2	3	3	3	4
12	0	1	2	3	4	4	6	7	10	0	1	1	2	2	2	2	2	3
13	0	1	1	2	2	3	3	4	6	0	1	1	1	1	1	1	2	2
14	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0

TABLE 15--FIRE BEHAVIOR AND CONTROL INFORMATION FUR PHOTO 4-MC-3-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET.								
2	1	3	6	10	13	17	20	26	36	1	3	4	5	5	6	7	7	9
3	1	3	5	8	11	14	17	22	31	1	3	3	4	5	5	6	7	8
4	1	2	5	7	10	13	15	20	27	1	2	3	4	4	5	5	6	7
5	0	2	4	7	9	12	14	18	25	1	2	3	4	4	5	5	6	7
6	0	2	4	6	8	11	13	17	23	1	2	3	3	4	4	5	5	6
7	0	2	4	6	8	10	13	16	22	1	2	3	3	4	4	5	5	6
8	0	2	4	6	8	10	12	15	21	1	2	3	3	4	4	5	5	6
9	0	2	3	5	7	9	11	14	20	1	2	3	3	4	4	4	5	6
10	0	2	3	5	7	8	10	13	18	1	2	2	3	3	4	4	5	5
11	0	1	3	4	6	7	9	12	16	1	2	2	3	3	3	4	4	5
12	0	1	2	4	5	6	8	10	13	1	1	2	2	3	3	3	4	4
13	0	1	2	3	3	4	5	7	10	0	1	1	2	2	2	2	3	3
14	0	0	1	1	2	2	3	3	5	0	1	1	1	1	1	1	1	2

TABLE 16--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 5-MC-3-PC
(FIRE BEHAVIOR INFORMATTON SCALED FROM NFDR MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	5	10	15	22	28	35	46	66	2	4	6	7	9	10	11	12	14
3	1	4	9	14	19	25	31	41	58	2	4	5	7	8	9	10	11	13
4	1	4	8	12	17	22	28	37	52	2	4	5	6	7	8	9	10	12
5	1	3	7	11	15	20	25	33	47	2	3	5	6	7	7	8	9	11
6	1	3	6	10	14	18	23	30	43	2	3	4	5	6	7	8	9	10
7	1	3	6	9	13	17	21	28	40	1	3	4	5	6	6	7	8	9
8	1	3	6	9	12	16	20	26	37	1	3	4	4	5	6	7	7	9
9	1	3	5	8	12	15	19	25	35	1	2	3	4	5	5	6	7	8
10	1	2	5	8	11	14	18	24	34	1	2	3	4	5	5	6	6	8
11	1	2	5	8	11	14	17	23	32	1	2	3	4	4	5	5	6	7
12	1	2	5	7	10	13	17	22	31	1	2	3	3	4	4	5	6	7
13	1	2	4	7	10	13	16	21	30	1	2	3	3	4	4	5	5	6
14	1	2	4	7	9	12	15	20	29	1	2	2	3	3	4	4	5	6
15	0	2	4	6	9	12	15	19	27	1	2	2	3	3	4	4	5	5
16	0	2	4	6	9	11	14	18	26	1	1	2	3	3	3	4	4	5
17	0	2	4	6	8	11	13	17	25	1	1	2	2	3	3	3	4	4
18	0	2	3	5	7	10	12	16	23	1	1	2	2	2	3	3	3	4
19	0	1	3	5	7	9	11	15	21	1	1	1	2	2	2	3	3	4
20	0	1	3	4	6	8	10	13	16	0	1	1	2	2	2	2	3	3
21	0	1	2	4	5	7	8	11	15	0	1	1	1	2	2	2	2	3
22	0	1	2	3	4	5	7	9	12	0	1	1	1	1	1	1	2	2
23	0	1	1	2	3	4	5	6	9	3	0	1	1	1	1	1	1	1
24	0	0	1	1	1	2	2	3	5	0	0	0	0	3	1	1	1	1

TABLE 17--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 6-MC-3-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	2	4	7	9	12	15	19	26	1	2	3	3	4	4	4	5	6
3	0	2	4	6	8	10	12	16	22	1	2	2	3	3	4	4	4	5
4	0	2	3	5	7	9	11	14	20	1	2	2	3	3	3	4	4	5
5	0	2	3	5	6	8	10	13	18	1	1	2	2	3	3	3	4	4
6	0	1	3	4	6	8	10	12	17	1	1	2	2	3	3	3	4	4
7	0	1	3	4	6	7	9	12	16	1	1	2	2	3	3	3	4	4
8	0	1	3	4	5	7	9	11	15	1	1	2	2	2	3	3	3	4
9	0	1	2	4	5	6	8	10	14	1	1	2	2	2	3	3	3	4
10	0	1	2	3	5	6	7	9	13	1	1	2	2	2	2	3	3	3
11	0	1	2	3	4	5	6	8	11	0	1	1	2	2	2	2	3	3
12	0	1	1	2	3	4	4	6	8	0	1	1	1	1	2	2	2	2
13	0	0	1	1	1	2	2	3	4	0	0	1	1	1	1	1	1	1

TABLE 18--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 7-MC-3-PC
(FIRE BEHAVIOR INFOPMATTOM SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	9	13	18	23	28	35	49	2	4	6	7	8	9	10	11	13
3	1	4	7	11	15	20	24	31	42	2	4	5	6	7	8	9	10	11
4	1	3	7	10	14	17	21	27	37	2	3	5	6	6	7	8	9	10
5	1	3	6	9	12	16	19	25	34	2	3	4	5	6	7	7	8	9
6	1	3	6	9	11	15	18	23	31	2	3	4	5	6	6	7	8	9
7	1	3	5	8	11	14	17	22	30	1	3	4	5	5	6	7	7	9
8	1	3	5	8	10	13	16	21	28	1	3	4	5	5	6	6	7	8
9	1	2	5	7	10	13	15	20	27	1	3	4	4	5	6	6	7	8
10	1	2	4	7	9	12	14	19	26	1	3	4	4	5	5	6	7	8
11	0	2	4	6	9	11	13	17	24	1	2	3	4	5	5	6	6	7
12	0	2	4	6	8	10	12	15	21	1	2	3	4	4	5	5	6	7
13	0	2	3	5	7	8	10	13	18	1	2	3	3	4	4	5	5	6
14	0	1	2	4	5	6	8	10	14	1	2	2	3	3	3	4	4	5
15	0	1	2	2	3	4	5	6	9	1	1	1	2	2	2	2	3	3
16	0	0	0	1	1	1	1	2	2	0	0	0	0	1	1	1	1	1

TABLE 19--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 8-MC-3-PC

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

True Fir

Size Class 4

Regeneration Cut

fables 20 Through 25

(Corresponds to Photo Series 1-TF-4-RC to 6-TF-4-RC in Maxwell and Ward 1979)

TABLE 20--FIRE BEHAVIOR ANG CONTROL INFORMATION FOR PHOTO 1-TF-4-RC

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 21--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 2-TF-4-RC

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HUUR									FEET								
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
13	0	0	.	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 22--FIRE BEHAVIOR AND CONTROL INFORMATION FUR PHOTO 3-TF-4-RC
(RATE OF SPREAD ESTIVATES ARE ONE-QUARTER OF NFFL CONTINUOUS SLASH MODEL)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	1	2	3	4	5	6	7	10	1	2	2	3	3	4	4	4	5
3	0	1	2	2	3	4	5	6	9	1	1	2	2	3	3	3	4	5
4	0	1	1	2	3	4	4	6	8	1	1	2	2	3	3	3	4	4
5	0	1	1	2	3	3	4	5	7	1	1	2	2	2	3	3	3	4
6	0	1	1	2	2	3	4	5	7	1	1	2	2	2	3	3	3	4
7	0	1	1	2	2	3	4	5	6	1	1	2	2	2	2	3	3	4
8	0	1	1	2	2	3	3	4	6	1	1	2	2	2	2	3	3	3
9	0	1	1	2	2	3	3	4	6	1	1	1	2	2	2	3	3	3
10	0	0	1	1	2	2	3	4	5	1	1	1	2	2	2	2	3	3
11	0	0	1	1	2	2	3	3	5	0	1	1	2	2	2	2	3	3
12	0	0	1	1	1	2	2	3	4	0	1	1	1	2	2	2	2	3
13	0	0	1	1	1	1	2	2	3	0	1	1	1	1	1	2	2	2
14	0	0	0	1	1	1	1	1	2	0	0	1	1	1	1	1	1	1
15	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0

TABLE 23--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHDTO 4-TF-4-RC
(RATE OF SPREAD ESTIMATES ARE ONE-HALF OF NFFL CONTINUOUS SLASH MODEL)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	2	3	5	7	9	11	14	20	1	2	3	4	4	5	5	6	7
3	0	2	3	5	6	8	10	12	17	1	2	3	3	4	4	5	5	6
4	0	1	3	4	5	7	9	11	15	1	2	3	3	4	4	4	5	6
5	0	1	2	4	5	6	8	10	14	1	2	2	3	3	4	4	5	5
6	0	1	2	3	5	6	7	9	13	1	2	2	3	3	4	4	4	5
7	0	1	2	3	4	6	7	9	12	1	2	2	3	3	3	4	4	5
8	0	1	2	3	4	5	7	9	12	1	2	2	3	3	3	4	4	5
9	0	1	2	3	4	5	6	8	11	1	1	2	2	3	3	3	4	5
10	0	1	2	3	4	5	6	7	10	1	1	2	2	3	3	3	4	4
11	0	1	2	2	3	4	5	7	9	1	1	2	2	2	3	3	3	4
12	0	1	1	2	3	4	4	6	8	1	1	2	2	2	2	3	3	3
13	0	1	1	2	2	3	3	4	6	0	1	1	1	2	2	2	2	3
14	0	0	1	1	1	2	2	3	4	0	1	1	1	1	1	1	2	2
15	0	0	0	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0

TABLE 24--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 5-TF-4-RC
(FIRE BEHAVIOR INFORMATION SCALEC FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	2	5	7	10	12	15	19	27	1	2	3	3	4	4	5	5	6
3	0	2	4	6	8	11	13	17	23	,	1	2	2	3	3	4	4	5	5
4	0	2	3	5	7	9	11	15	20	,	1	2	2	3	3	3	4	4	5
5	0	2	3	5	7	9	10	13	19	1	1	2	2	3	3	4	4	5
6	0	2	3	5	6	8	10	13	18	1	1	2	2	3	3	3	4	4
7	0	1	3	4	6	8	9	12	17	1	1	2	2	3	3	3	4	4
8	0	1	3	4	6	7	9	11	16	1	1	2	2	3	3	3	4	4
9	0	1	3	4	5	7	8	11	15	1	1	2	2	2	3	3	3	4
10	0	1	2	3	5	6	7	9	13	1	1	2	2	2	2	3	3	4
11	0	1	2	3	4	5	6	8	11	0	1	1	2	2	2	2	3	3
12	0	1	1	2	3	4	5	6	8	0	1	1	1	1	2	2	2	2
13	0	0	1	1	2	2	2	3	4	0	0	1	1	1	1	1	1	1

TABLE 25--FIRE BEHAVIOR AKD CONTROL INFGRMATION FOR PHOTO 6-TF-4-RC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	8	12	16	21	25	33	45	2	4	3	6	7	8	9	10	11
3	1	3	7	10	14	18	22	20	39	2	3	4	5	6	7	8	9	10
4	1	3	6	9	12	16	19	25	34	2	3	4	5	6	6	7	8	9
5	1	3	5	8	11	14	18	23	31	1	3	4	5	5	6	7	7	8
6	1	3	5	8	11	13	16	21	29	1	3	4	4	5	6	6	7	8
7	1	2	5	7	10	13	16	20	27	1	3	4	4	5	5	6	7	8
8	1	2	5	7	9	12	15	19	26	1	3	3	4	5	5	6	7	8
9	1	2	4	7	9	12	14	18	23	1	2	3	4	5	5	6	6	7
10	0	2	4	6	8	11	13	17	23	1	2	3	4	4	5	5	6	7
11	0	2	4	6	8	10	12	15	21	1	2	3	4	4	5	5	6	7
12	0	2	3	5	7	9	11	14	19	1	2	3	3	4	4	3	5	6
13	0	1	3	4	6	7	9	11	15	1	2	2	3	3	3	4	4	5
14	0	1	2	3	4	5	6	8	11	1	1	2	2	2	3	3	3	4
15	0	0	1	1	2	2	3	4	5	3	1	1	1	1	1	1	2	2

True Fir

Size Class 4

Partial Cut

Tables 26 Through 30

(Corresponds to Photo Series 1-TF-4-PC to 5-TF-4-PC in Maxwell and Ward 1979)

TABLE 26--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 1-TF-4-PC
(RATE OF SPREAD ESTIHATES ARE ONE-HALF OF NFFL CONTINUOUS SLASH MODEL)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	0	1	3	4	5	7	8	11	15	1	2	2	3	3	3	4	4	5
3	0	1	2	3	5	6	7	9	13	1	1	2	2	3	3	3	4	4
4	0	1	2	3	4	5	6	8	11	1	1	2	2	2	3	3	3	4
5	0	1	2	3	4	5	6	7	10	1	1	2	2	2	3	3	3	4
6	0	1	2	3	3	4	5	7	10	1	1	2	2	2	2	3	3	4
7	0	1	2	2	3	4	5	7	9	1	1	2	2	2	2	3	3	3
0	0	1	1	2	3	4	5	6	9	1	1	1	2	2	2	3	3	3
9	0	1	1	2	3	4	5	6	8	0	1	1	2	2	2	2	3	3
10	0	1	1	2	3	3	4	5	7	0	1	1	2	2	2	2	2	3
11	0	1	1	2	2	3	4	3	6	0	1	1	1	2	2	2	2	3
12	0	0	1	1	2	2	3	3	5	0	1	1	1	1	1	2	2	2
13	0	0	0	1	1	1	2	2	3	0	0	1	1	1	1	1	1	1
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE 27--FIRE BEHAVIOR AND CONTROL INFORMATIUN FOR PHOTO 2-TF-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR.									FEET								
2	0	2	4	7	9	12	14	16	26	1	2	3	3	4	4	4	5	6
3	0	2	4	6	8	10	12	16	22	1	2	2	3	3	4	4	4	5
4	0	2	3	5	7	9	11	14	19	1	1	2	2	3	3	4	4	5
5	0	2	3	5	6	8	10	13	18	1	1	2	2	3	3	3	4	4
6	0	1	3	4	6	0	9	12	17	1	1	2	2	3	3	3	4	4
7	0	1	3	4	6	7	9	11	16	1	1	2	2	3	3	3	4	4
8	0	1	3	4	5	7	0	11	15	1	1	2	2	3	3	3	3	4
9	0	1	2	4	5	6	8	10	14	1	2	2	2	2	3	3	3	4
10	0	1	2	3	4	6	7	9	12	1	1	1	2	2	2	3	3	3
11	0	1	2	3	4	5	6	7	10	0	1	1	2	2	2	2	2	3
12	0	1	1	2	3	3	4	5	7	0	1	1	1	1	2	2	2	2
13	0	0	1	1	1	2	2	3	4	0	0	1	1	1	1	1	1	1

TABLE 28--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 3-TF-4-PC
(FIRE BEHAVIUR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	3	7	10	14	17	21	27	38	2	3	4	5	6	6	7	8	9
3	1	3	6	9	12	15	10	23	32	1	3	4	4	5	6	6	7	8
4	1	3	5	9	10	13	16	21	29	1	2	3	4	5	5	6	6	7
5	1	2	5	7	9	12	15	19	26	1	2	3	4	4	5	5	6	7
6	0	2	4	6	3	11	14	18	24	1	2	3	4	4	5	5	6	7
7	0	2	4	6	8	11	13	17	23	1	2	3	3	4	4	5	5	6
8	0	2	4	6	8	10	12	16	22	1	2	3	3	4	4	5	5	6
9	0	2	4	6	8	10	12	15	21	1	2	3	3	4	4	5	5	6
10	0	2	3	5	7	9	11	14	19	1	2	3	3	4	4	4	5	6
11	0	2	3	5	6	8	10	12	17	1	2	2	3	3	4	4	4	5
12	0	1	2	4	5	7	8	10	14	1	1	2	2	3	3	3	4	4
13	0	1	2	3	4	5	6	8	11	1	1	1	2	2	2	3	3	3
14	0	1	1	2	2	3	3	4	6	0	1	1	1	1	1	1	2	2

TABLE 29--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 4-TF-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	8	12	15	21	25	32	45	2	4	5	6	7	8	9	10	11
3	1	3	7	13	14	18	22	28	38	2	3	4	5	6	7	8	9	10
4	1	3	6	9	12	16	19	25	34	2	3	4	5	6	6	7	8	9
5	1	3	5	8	11	14	18	22	31	1	3	4	5	5	6	7	7	8
6	1	3	5	8	10	13	16	21	29	1	3	4	4	5	6	6	7	8
7	1	2	5	7	10	13	15	20	27	1	3	3	4	5	5	6	7	8
8	1	2	5	7	9	12	15	19	26	1	2	3	4	5	5	6	7	8
9	1	2	4	7	8	11	14	18	25	1	2	3	4	5	5	6	6	7
10	0	2	4	6	8	11	13	17	23	1	2	3	4	4	5	5	6	7
11	0	2	4	6	8	10	12	16	21	1	2	3	4	4	5	5	6	7
12	0	2	3	5	7	9	11	13	19	1	2	3	3	4	4	5	5	6
13	0	1	3	4	5	7	9	11	15	1	2	2	3	3	3	4	4	5
14	0	1	2	3	4	5	6	8	11	1	1	2	2	2	3	3	3	4
15	0	0	1	1	2	2	3	4	5	0	1	1	1	1	1	1	2	2

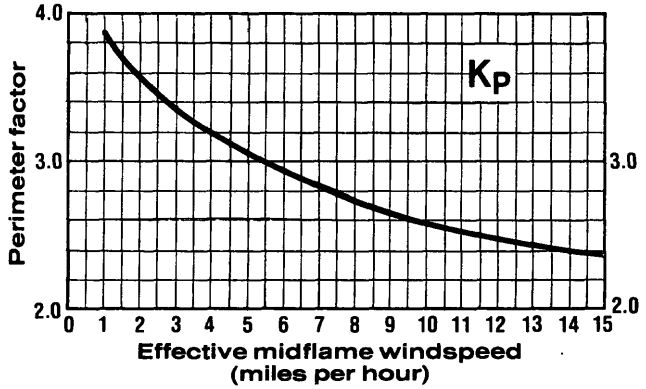
TABLE 30--FIRE BEHAVIOR AND CONTROL INFORMATION FOR PHOTO 5-TF-4-PC
(FIRE BEHAVIOR INFORMATION SCALED FROM NFFL MODELS)

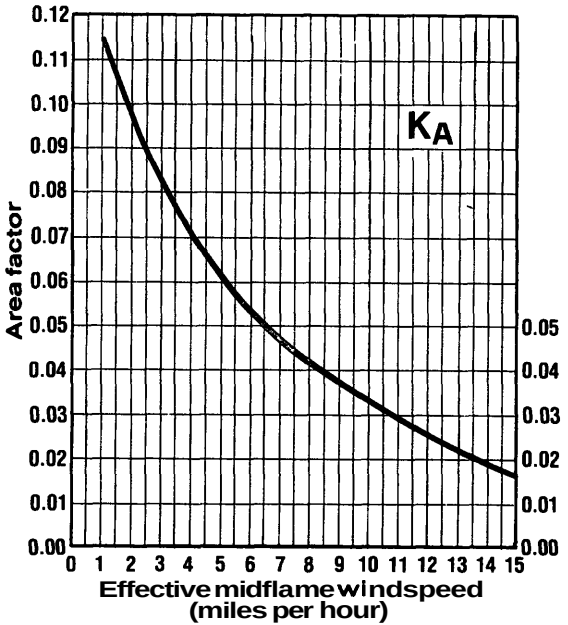
FUEL MOISTURE	RATE OF SPREAD — EFFECTIVE MIDFLAME WIND (MI/H)									FLAME LENGTH — EFFECTIVE MIDFLAME WIND (MI/H)								
	0	2	4	6	8	10	12	14	16	0	2	4	6	8	10	12	14	16
PERCENT	CHAINS PER HOUR									FEET								
2	1	4	7	10	14	18	22	29	39	2	3	4	5	6	7	7	8	10
3	1	3	6	9	12	16	19	24	34	1	3	4	5	5	6	7	7	9
4	1	3	5	8	11	14	17	22	30	1	3	3	4	5	5	6	7	8
5	1	2	5	7	10	13	15	20	27	1	2	3	4	5	5	6	6	7
6	1	2	4	7	9	12	14	18	26	1	2	3	4	4	5	5	6	7
7	0	2	4	6	9	11	14	18	24	1	2	3	4	4	5	5	6	7
8	0	2	4	6	8	11	13	17	23	1	2	3	4	4	5	5	6	7
9	0	2	4	6	8	10	12	16	22	1	2	3	3	4	4	5	5	6
10	0	2	4	5	7	9	11	15	20	1	2	3	3	4	4	5	5	6
11	0	2	3	5	7	8	10	13	18	1	2	2	3	3	4	4	5	5
12	0	1	3	4	6	7	9	11	15	1	2	2	3	3	3	4	4	5
13	0	1	2	3	4	5	7	8	12	1	1	2	2	2	3	3	3	4
14	0	1	1	2	3	3	4	5	7	0	1	1	1	1	2	2	2	2
15	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0

Appendix 1

Fire Perimeter and Area Calculation Graphs and Formulas

(Adapted from Fire Behavior Officer's Field Reference, National Interagency Fire Training Center, Marana, Arizona)





P = Perimeter (chains)

$P = K_P D$

$= K_P(RxT)$

A = Area (acres)

$A = K_A D^2$

$= K_A(RxT)^2$

WHERE

K_P = Perimeter factor
R = Rate of spread (chains per hour)
T = Time (hour); 1-hour maximum
K_A = Area factor
D = R x T; spread distance (chains)

Appendix 2

Resistance to control ratings, flame length adjustment factor, slope adjustment factor, and conversion of resistance to control rating values to chains-per hour of'line constructed by one person

The resistance to control rating (table 31) times flame length adjustment factor (table 32) times slope adjustment factor (table 33) equals the adjusted rating. Use table 34 to convert adjusted rating to actual resistance to control.

Table 31--Fuel resistance to control ratings by photo number[1]

PHOTO NUMBER	RATING	PHOTO NUMBER	RATING
1-MC-4-RC	4	1-TF-4-RC	1
2-MC-4-RC	11	2-TF-4-RC	2
3-MC-4-RC	30	3-TF-4-RC	9
		4-TF-4-RC	11
1-MC-4-PC	2	5-TF-4-RC	6
2-MC-4-PC	12	6-TF-4-RC	17
3-MC-4-PC	5		
4-MC-4-PC	10	1-TF-4-PC	4
5-MC-4-PC	13	2-TF-4-PC	7
6-MC-4-PC	17	3-TF-4-PC	8
7-MC-4-PC	20	4-TF-4-PC	17
8-MC-4-PC	17	5-TF-4-PC	27
1-MC-3-PC	2		
2-MC-3-PC	6		
3-MC-3-PC	5		
4-MC-3-PC	6		
5-MC-3-PC	7		
6-MC-3-PC	9		
7-MC-3-PC	13		
8-MC-3-PC	8		

[1]Ratings derived frommatrix by Wayne G. Maxwell (on file at Pacific Northwest Forest and Range Experiment Station, Portland, Oregon).

Table 32--Flame length adjustment factor

Flame length (feet)	*0–4*	5–8	9–12	13+
Adjustment factor	1	1.5	2.0	3.0

Table 33--Slope adjustment factor

Slope (percent)	0–30	31–60	61–75	75+
Adjustment factor	1	1.2	1.5	1.9

Table 34--Conversion of rating values to chains per hour of line constructed by 1 person

Adjusted rating values	Chains per hour	Adjusted rating values	Chains per hour
1	12.00	13	0.92
2	6.00	14	.86
3	4.00	15	a80
4	3.00	16	a75
5	2a40	17	.71
6	2.00	18	.67
7	1a70	19	.63
8	1a50	20	a60
9	1a30	25	.48
10	1a20	30	a40
11	1.10	35	.34
12	1.00	40	a30

*GPO 797-498

The Forest Service of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

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