

FIRE AREA AND PERIMETER LENGTH TABLES
FOR CANADIAN FOREST FIRE BEHAVIOR PREDICTION SYSTEM FUEL TYPES
by

Martin E. Alexander
Fire Research Officer

NOTICE

This report supersedes an earlier version with a similar title dated November 1984

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Northern Forestry Centre
Canadian Forestry Service
Western and Northern Region
Government of Canada
5320-122 Street
Edmonton, Alberta, Canada
T6H 3S5

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The following statement on fire size calculations appears in the user guide to the 1984 interim edition of the Canadian Forest Fire Behavior Prediction (FBP) System (Alexander and others 1984, p. 46 & 48):

Assuming that a fire attains a steady-state condition in a homogenous fire environment after a short period of time, and that the backfire spread is negligible for practical purposes, a rough approximation of fire size can be made ...

If the shape of potential free-burning fires can be represented by a simple ellipse (Fig. 1), to estimate the area and perimeter length of wind-driven fires originating from a point ignition requires the following inputs:

- o 10-m Open Wind Speed (km/h)
- o Head Fire Rate of Spread (ROS), adjusted for percent ground slope if the fire is burning upslope.
- o Elapsed Time Since Ignition (T)

The tables included in this report have been produced by solving equations (10), (12), (17), (18), (19), (35), and (37) in Alexander (1985). The tables presented here differ from those contained in an earlier version of this report which was released in November 1984 for 'standing timber' and 'non-forested' fuel types'. The following improvements and/or additions have been incorporated into this edition:

- o Backfire spread has been indirectly accounted for now in the shape factors used in the formula to compute area (K_A) and perimeter length (K_p).
- o A separate Length-to-Breadth Ratio (L/B) vs. 10-m Open Wind Speed relationship for slash fires.

Here is a list of the tables included in this report for making area and perimeter length estimates:

Table No.	FBP System Fuel Type Group	Area (ha)	Perimeter Length	Head Fire Spread	Page No.
1	Standing Timber*	X		20-1000 m	5
2	Standing Timber	X		1.0-6.0 km	6
3	Standing Timber		m	20-1000 m	7
4	Standing Timber		km	1.0-6.0 km	8
5	Slash (S)	X		20-1000 m	9
6	Slash (S)	X		1.0-6.0 km	10
7	Slash (S)		m	20-1000 m	11
8	Slash (S)		km	1.0-6.0 km	12
9	Open (O) - Grass	X		20-1000 m	13
10	Open (O) - Grass	X		1.0-6.0 km	14
11	Open (O) - Grass		m	20-1000 m	15
12	Open (O) - Grass		km	1.0-6.0 km	16

*Coniferous (C), Mixedwood (M), and Deciduous (D) fuel types.

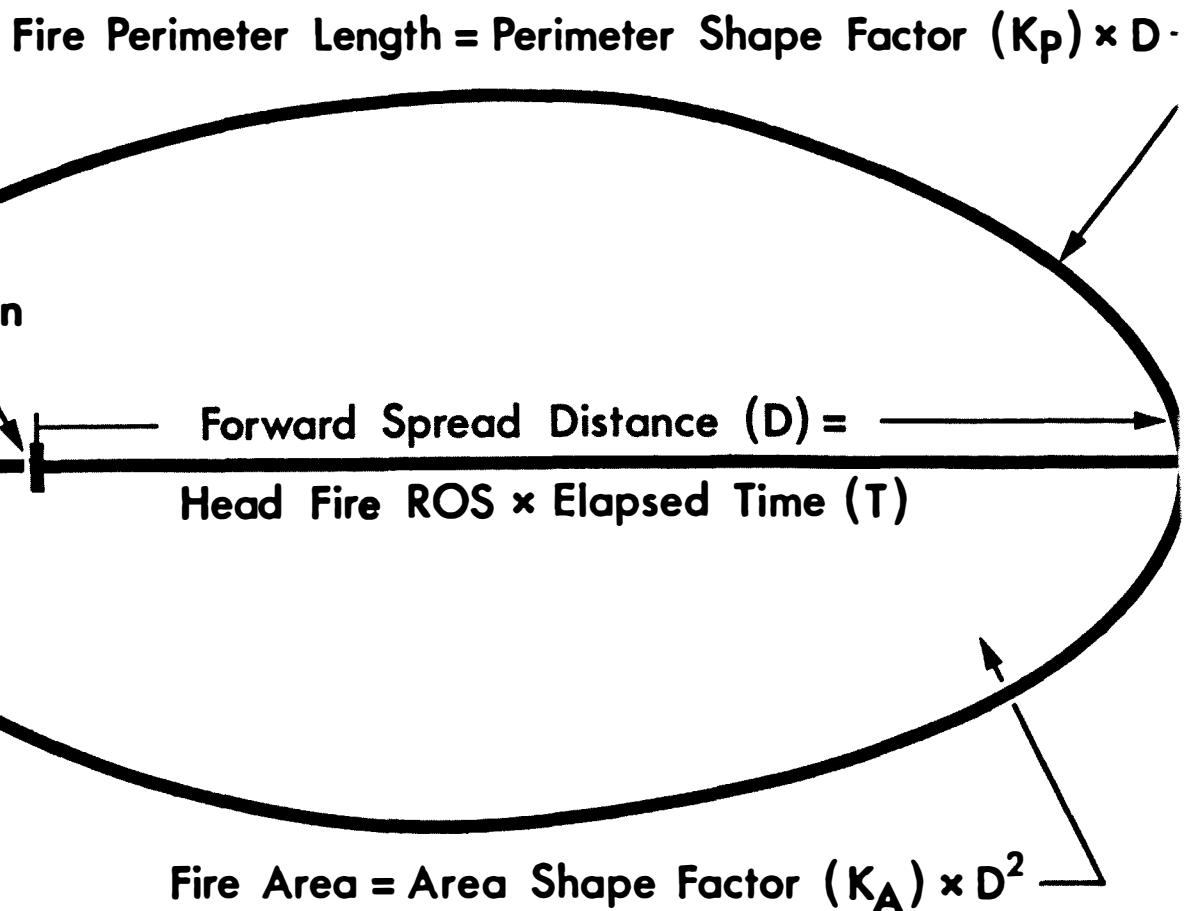


Figure 1. The free-burning elliptical shaped wind-driven fire on level terrain with a length-to-breadth ratio (L/B) of 2.0:1 (ROS = Rate of Spread and T = Elapsed Time Since Ignition).

FIRE AREA (A) COMPUTATIONS

$$A \text{ (ha)} = \frac{K_A \times [\text{ROS (m/min)} \times T \text{ (min)}]^2}{10,000}$$

$$A \text{ (ha)} = [K_A \times (\text{ROS (m/min)} \times T \text{ (h)})^2] \times 100$$

FIRE PERIMETER LENGTH (P) COMPUTATIONS

$$P \text{ (m)} = K_p \times [\text{ROS (m/min)} \times T \text{ (min)}]$$

$$P \text{ (km)} = K_p \times [\text{ROS (km/h)} \times T \text{ (h)}]$$

The odd-numbered tables (1,3,5,7,9, and 11) are intended for slow spread rates and long time lapses whereas the even-numbered tables (2,4,6,8,10, and 12) are appropriate for fast spread rates and short time lapses.

PLEASE NOTE

The units of ROS and T used to compute the fire's forward spread distance or Head Fire Spread must be compatible -- i.e., metres per minute (m/min) and minutes (min) or kilometres per hour (km/h) and hours (h):

$$\text{Head Fire Spread (m)} = \text{ROS (m/min)} \times \text{T (min)}$$

$$\text{Head Fire Spread (km)} = \text{ROS (km/h)} \times \text{T (h)}$$

Tables 1-12 in this report are somewhat analogous to those contained in Anderson (1983). They do however differ from those provided in OMNR's "Fire Behavior Analysis Field Guide" (Anon. 1984) which were prepared for wind-driven point source fires in natural forest stands in terms of ROS from 1 to 50 m/min and T of 10 to 180 min for a single L/B value (2.0:1) or 10-m open wind (22 km/h) situation.

Also appended to this report are L/B, K_A and K_P values tabulated for the 10-m open wind speed for the three major fuel type groups (see Tables 13-21) based on equations (19), (35), and (37). These tables should be considered as replacements for Tables 8-10 plus the supplemental tables in the FBP System user guide.

Instructions for plotting the area of an elliptical shaped fire on a map are given on pages 51-52 of the FBP System user guide. In order to accommodate the backfire spread, a revision of Steps 4 and 5 is required:

Step 4. Determine the Length-to-Breadth Ratio (L/B) of the elliptical fire shape based on the 10-m open wind speed for the fuel type in question.

Step 5. Draw a line on the map in the direction of probable fire spread from the prediction point equal in length to the Map Distance. Place an arrow at the end of the line to indicate the direction of head fire spread. Determine the Head Fire/Backfire Spread Ratio (H/B) based on the L/B. Divide the Map Distance by the H/B value. This quantity represents the map equivalent of the backfire spread and should be plotted from the labelled prediction point as an extension of the fire's forward spread distance. The complete line represents the total length (L) of the ellipse (i.e., the head fire or forward + backfire spread).

The H/B table in this report (Table 22) is based on equation (16) in Alexander (1985).

REFERENCES

- Alexander, M.E. 1985. Estimating the length-to-breadth ratio of elliptical forest fire patterns. Pages 287- 304. In Proceedings of Eight Conference on Fire and Forest Meteorology (April 29 - May 2, Detroit, Mich.). Society of American Foresters, Bethesda, Md. SAF Publ. 85-04.
- Alexander, M.E.; Lawson, B.D.; Stocks, B.J.; Van Wagner, C.E (listed in alphabetical order). 1984. User guide to the Canadian Forest Fire Behavior Prediction System: rate of spread relationships. Interim edition. Environment Canada, Canadian Forestry Service, Fire Danger Group. 73 p. + Supplements (1st Printing - July 1984; Revision & 2nd Printing - Sept. 1984).
- Anderson, H.E. 1983. Predicting wind-driven wildland fire size and shape. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah. Research Paper INT-305. 26 p.
- Anon. 1984. Fire behavior analysis field guide. Ontario Ministry of Natural Resources, Aviation and Fire Management Centre, Sault Ste. Marie, Ont.
- Lawson, B.D.; Stocks, B.J.; Alexander, M.E.; Van Wagner, C.E. 1985. A system for predicting fire behavior in Canadian forests. Pages 6-16. In Proceedings of Eight Conference on Fire and Forest Meteorology (April 29 - May 2, Detroit, Mich.). Society of American Foresters, Bethesda, Md. SAF Publ. 85-04.

TABLE 1: Standing Timber Fuel Types

Head Fire Spread (m)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
Fire Area (ha)											
20	0.1	0.1	*	*	*	*	*	*	*	*	*
40	0.5	0.3	0.2	0.1	0.1	0.1	*	*	*	*	*
60	1.1	0.7	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	*
80	2.0	1.2	0.7	0.5	0.3	0.3	0.2	0.1	0.1	0.1	0.
100	3.1	1.9	1.2	0.8	0.5	0.4	0.3	0.2	0.2	0.1	0.
120	4.5	2.7	1.7	1.1	0.8	0.6	0.4	0.3	0.3	0.2	0.
140	6.2	3.7	2.3	1.5	1.1	0.8	0.6	0.5	0.4	0.3	0.
160	8.0	4.8	3.0	2.0	1.4	1.0	0.8	0.6	0.5	0.4	0.
180	10.2	6.1	3.8	2.5	1.7	1.3	1.0	0.7	0.6	0.5	0.
200	12.6	7.5	4.6	3.1	2.1	1.6	1.2	0.9	0.7	0.6	0.
220	15.2	9.1	5.6	3.7	2.6	1.9	1.4	1.1	0.9	0.7	0.
240	18.1	10.8	6.7	4.4	3.1	2.3	1.7	1.3	1.1	0.9	0.
260	21.2	12.7	7.8	5.2	3.6	2.7	2.0	1.6	1.2	1.0	0.
280	24.6	14.7	9.1	6.0	4.2	3.1	2.3	1.8	1.4	1.2	1.
300	28.3	16.9	10.4	6.9	4.8	3.5	2.7	2.1	1.7	1.3	1.
320	32.2	19.2	11.9	7.9	5.5	4.0	3.0	2.4	1.9	1.5	1.
340	36.3	21.7	13.4	8.9	6.2	4.5	3.4	2.7	2.1	1.7	1.
360	40.7	24.3	15.0	9.9	7.0	5.1	3.9	3.0	2.4	1.9	1.
380	45.4	27.1	16.8	11.1	7.7	5.7	4.3	3.3	2.7	2.2	1.
400	50.3	30.0	18.6	12.3	8.6	6.3	4.8	3.7	2.9	2.4	2.
420	55.4	33.1	20.5	13.5	9.5	6.9	5.2	4.1	3.2	2.6	2.
440	60.8	36.3	22.5	14.8	10.4	7.6	5.8	4.5	3.6	2.9	2.
460	66.5	39.7	24.6	16.2	11.4	8.3	6.3	4.9	3.9	3.2	2.
480	72.4	43.2	26.7	17.7	12.4	9.0	6.8	5.3	4.2	3.4	2.
500	78.5	46.9	29.0	19.2	13.4	9.8	7.4	5.8	4.6	3.7	3.
520	84.9	50.8	31.4	20.7	14.5	10.6	8.0	6.2	5.0	4.0	3.
540	91.6	54.7	33.8	22.4	15.6	11.4	8.7	6.7	5.4	4.3	3.
560	98.5	58.9	36.4	24.0	16.8	12.3	9.3	7.2	5.8	4.7	3.
580	105.7	63.1	39.0	25.8	18.1	13.2	10.0	7.8	6.2	5.0	4.
600	113.1	67.6	41.8	27.6	19.3	14.1	10.7	8.3	6.6	5.4	4.
620	120.8	72.2	44.6	29.5	20.6	15.1	11.4	8.9	7.1	5.7	4.
640	128.7	76.9	47.5	31.4	22.0	16.1	12.2	9.5	7.5	6.1	5.
660	136.8	81.8	50.6	33.4	23.4	17.1	12.9	10.1	8.0	6.5	5.
680	145.3	86.8	53.7	35.5	24.8	18.2	13.7	10.7	8.5	6.9	5.
700	153.9	92.0	56.9	37.6	26.3	19.2	14.6	11.3	9.0	7.3	6.
720	162.9	97.3	60.2	39.7	27.8	20.3	15.4	12.0	9.5	7.7	6.
740	172.0	102.8	63.5	42.0	29.4	21.5	16.3	12.7	10.1	8.2	6.
760	181.5	108.4	67.0	44.3	31.0	22.7	17.2	13.3	10.6	8.6	7.
780	191.1	114.2	70.6	46.6	32.6	23.9	18.1	14.1	11.2	9.1	7.
800	201.1	120.1	74.3	49.1	34.3	25.1	19.0	14.8	11.8	9.5	7.
820	211.2	126.2	78.0	51.6	36.1	26.4	20.0	15.5	12.4	10.0	8.
840	221.7	132.4	81.9	54.1	37.9	27.7	21.0	16.3	13.0	10.5	8.
860	232.4	138.8	85.8	56.7	39.7	29.0	22.0	17.1	13.6	11.0	9.
880	243.3	145.4	89.9	59.4	41.6	30.4	23.0	17.9	14.2	11.5	9.
900	254.5	152.0	94.0	62.1	43.5	31.8	24.1	18.7	14.9	12.1	9.
920	265.9	158.9	98.2	64.9	45.4	33.2	25.1	19.6	15.6	12.6	10.
940	277.6	165.9	102.5	67.7	47.4	34.7	26.3	20.4	16.2	13.2	10.
960	289.5	173.0	107.0	70.7	49.5	36.2	27.4	21.3	16.9	13.7	11.
980	301.7	180.3	111.5	73.6	51.5	37.7	28.5	22.2	17.6	14.3	11.
1000	314.2	187.7	116.1	76.7	53.7	39.3	29.7	23.1	18.4	14.9	12.

* - less than 0.1 ha

Head Fire Spread (m) = Head Fire Rate of Spread (m/min) X Elapsed Time Since Ignition (m)

TABLE 2: Standing Timber Fuel Types

Head Fire Spread (km)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Area (ha)										
1.0	314	188	116	77	54	39	30	23	18	15	12
1.1	380	227	140	93	65	47	36	28	22	18	15
1.2	452	270	167	110	77	57	43	33	26	21	18
1.3	531	317	196	130	91	66	50	39	31	25	21
1.4	616	368	227	150	105	77	58	45	36	29	24
1.5	707	422	261	173	121	88	67	52	41	34	28
1.6	804	481	297	196	137	100	76	59	47	38	31
1.7	908	542	335	222	155	113	86	67	53	43	35
1.8	1018	608	376	248	174	127	96	75	60	48	40
1.9	1134	678	419	277	194	142	107	83	66	54	44
2.0	1257	751	464	307	215	157	119	92	74	60	49
2.1	1385	828	512	338	237	173	131	102	81	66	54
2.2	1521	908	562	371	260	190	144	112	89	72	59
2.3	1662	993	614	406	284	208	157	122	97	79	65
2.4	1810	1081	668	442	309	226	171	133	106	86	71
2.5	1963	1173	725	479	335	245	186	144	115	93	77
2.6	2124	1269	784	518	363	265	201	156	124	101	83
2.7	2290	1368	846	559	391	286	217	168	134	109	89
2.8	2463	1472	910	601	421	308	233	181	144	117	96
2.9	2642	1579	976	645	451	330	250	194	155	125	103
3.0	2827	1689	1044	690	483	353	267	208	165	134	110
3.1	3019	1804	1115	737	516	377	286	222	177	143	118
3.2	3217	1922	1188	785	549	402	304	237	188	153	126
3.3	3421	2044	1264	835	584	427	324	252	200	162	134
3.4	3632	2170	1342	886	620	454	343	267	212	172	142
3.5	3848	2299	1422	939	657	481	364	283	225	182	150
3.6	4072	2433	1504	994	695	509	385	299	238	193	159
3.7	4301	2570	1589	1050	735	537	407	316	252	204	168
3.8	4536	2710	1676	1107	775	567	429	334	265	215	177
3.9	4778	2855	1765	1166	816	597	452	351	280	227	187
4.0	5027	3003	1857	1227	859	628	475	370	294	238	196
4.1	5281	3155	1951	1289	902	660	499	388	309	250	206
4.2	5542	3311	2047	1353	947	692	524	408	324	263	216
4.3	5809	3471	2146	1418	992	726	549	427	340	275	221
4.4	6082	3634	2247	1484	1039	760	575	447	356	288	237
4.5	6362	3801	2350	1553	1087	795	602	468	372	302	248
4.6	6648	3972	2456	1622	1135	831	629	489	389	315	260
4.7	6940	4146	2564	1694	1185	867	656	510	406	329	271
4.8	7238	4325	2674	1767	1236	904	685	532	423	343	285
4.9	7543	4507	2786	1841	1288	942	713	555	441	358	295
5.0	7854	4693	2901	1917	1341	981	743	578	459	372	307
5.1	8171	4882	3018	1994	1396	1021	773	601	478	387	319
5.2	8495	5075	3138	2073	1451	1061	803	625	497	403	332
5.3	8825	5273	3260	2154	1507	1103	835	649	516	418	345
5.4	9161	5473	3384	2236	1565	1145	866	674	536	434	358
5.5	9503	5678	3511	2319	1623	1187	899	699	556	451	371
5.6	9852	5886	3639	2405	1683	1231	932	725	576	467	385
5.7	10207	6098	3770	2491	1743	1275	965	751	597	484	395
5.8	10568	6314	3904	2579	1805	1320	999	777	618	501	413
5.9	10936	6534	4040	2669	1868	1366	1034	804	640	518	427
6.0	11310	6757	4178	2760	1932	1413	1070	832	662	536	442

Head Fire Spread (km) = Head Fire Rate of Spread (km/h) X Elapsed Time Since Ignition (h)

TABLE 3: Standing Timber Fuel Types

Head Fire Spread (m)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
20	126	97	77	63	55	50	46	44	43	42	41
40	251	194	153	127	110	100	93	89	86	84	83
60	377	291	230	190	165	149	139	133	129	126	124
80	503	389	307	254	220	199	186	177	172	168	166
100	628	486	384	317	275	249	232	222	215	210	207
120	754	583	460	381	330	299	279	266	258	252	248
140	880	680	537	444	385	349	325	310	301	294	290
160	1005	777	614	508	440	398	372	355	344	336	331
180	1131	874	691	571	495	448	418	399	387	378	372
200	1257	972	767	635	551	498	465	443	430	420	414
220	1382	1069	844	698	606	548	511	488	472	462	455
240	1508	1166	921	761	661	597	558	532	515	504	497
260	1634	1263	998	825	716	647	604	576	558	546	538
280	1759	1360	1074	888	771	697	651	621	601	588	579
300	1885	1457	1151	952	826	747	697	665	644	630	621
320	2011	1555	1228	1015	881	797	743	709	687	672	662
340	2136	1652	1304	1079	936	846	790	754	730	714	703
360	2262	1749	1381	1142	991	896	836	798	773	756	745
380	2388	1846	1458	1206	1046	946	883	843	816	798	786
400	2513	1943	1535	1269	1101	996	929	887	859	840	828
420	2639	2040	1611	1333	1156	1046	976	931	902	882	869
440	2765	2137	1688	1396	1211	1095	1022	976	945	924	910
460	2890	2235	1765	1459	1266	1145	1069	1020	988	966	952
480	3016	2332	1842	1523	1321	1195	1115	1064	1031	1008	993
500	3142	2429	1918	1586	1376	1245	1162	1109	1074	1051	1034
520	3267	2526	1995	1650	1431	1294	1208	1153	1117	1093	1076
540	3393	2623	2072	1713	1486	1344	1255	1197	1160	1135	1117
560	3519	2720	2149	1777	1542	1394	1301	1242	1203	1177	1159
580	3644	2818	2225	1840	1597	1444	1348	1286	1246	1219	1200
600	3770	2915	2302	1904	1652	1494	1394	1330	1289	1261	1241
620	3896	3012	2379	1967	1707	1543	1440	1375	1332	1303	1283
640	4021	3109	2455	2031	1762	1593	1487	1419	1374	1345	1324
660	4147	3206	2532	2094	1817	1643	1533	1463	1417	1387	1365
680	4273	3303	2609	2157	1872	1693	1580	1508	1460	1429	1407
700	4398	3401	2686	2221	1927	1743	1626	1552	1503	1471	1448
720	4524	3498	2762	2284	1982	1792	1673	1596	1546	1513	1490
740	4650	3595	2839	2348	2037	1842	1719	1641	1589	1555	1531
760	4775	3692	2916	2411	2092	1892	1766	1685	1632	1597	1572
780	4901	3789	2993	2475	2147	1942	1812	1729	1675	1639	1614
800	5027	3886	3069	2538	2202	1991	1859	1774	1718	1681	1655
820	5152	3984	3146	2602	2257	2041	1905	1818	1761	1723	1696
840	5278	4081	3223	2665	2312	2091	1952	1862	1804	1765	1738
860	5404	4178	3300	2729	2367	2141	1998	1907	1847	1807	1779
880	5529	4275	3376	2792	2422	2191	2045	1951	1890	1849	1821
900	5655	4372	3453	2855	2477	2240	2091	1995	1933	1891	1862
920	5781	4469	3530	2919	2533	2290	2138	2040	1976	1933	1903
940	5906	4566	3606	2982	2588	2340	2184	2084	2019	1975	1945
960	6032	4664	3683	3046	2643	2390	2230	2128	2062	2017	1986
980	6158	4761	3760	3109	2698	2440	2277	2173	2105	2059	2028
1000	6283	4858	3837	3173	2753	2489	2323	2217	2148	2101	2069

Head Fire Spread (m) = Head Fire Rate of Spread (m/min) X Elapsed Time Since Ignition (mi

TABLE 4: Standing Timber Fuel Types

Head Fire Spread (km)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Perimeter Length (km)										
1.0	6.3	4.9	3.8	3.2	2.8	2.5	2.3	2.2	2.1	2.1	2.1
1.1	6.9	5.3	4.2	3.5	3.0	2.7	2.6	2.4	2.4	2.3	2.3
1.2	7.5	5.8	4.6	3.8	3.3	3.0	2.8	2.7	2.6	2.5	2.5
1.3	8.2	6.3	5.0	4.1	3.6	3.2	3.0	2.9	2.8	2.7	2.7
1.4	8.8	6.8	5.4	4.4	3.9	3.5	3.3	3.1	3.0	2.9	2.9
1.5	9.4	7.3	5.8	4.8	4.1	3.7	3.5	3.3	3.2	3.2	3.1
1.6	10.1	7.8	6.1	5.1	4.4	4.0	3.7	3.5	3.4	3.4	3.3
1.7	10.7	8.3	6.5	5.4	4.7	4.2	3.9	3.8	3.7	3.6	3.5
1.8	11.3	8.7	6.9	5.7	5.0	4.5	4.2	4.0	3.9	3.8	3.7
1.9	11.9	9.2	7.3	6.0	5.2	4.7	4.4	4.2	4.1	4.0	3.9
2.0	12.6	9.7	7.7	6.3	5.5	5.0	4.6	4.4	4.3	4.2	4.1
2.1	13.2	10.2	8.1	6.7	5.8	5.2	4.9	4.7	4.5	4.4	4.3
2.2	13.8	10.7	8.4	7.0	6.1	5.5	5.1	4.9	4.7	4.6	4.6
2.3	14.5	11.2	8.8	7.3	6.3	5.7	5.3	5.1	4.9	4.8	4.8
2.4	15.1	11.7	9.2	7.6	6.6	6.0	5.6	5.3	5.2	5.0	5.0
2.5	15.7	12.1	9.6	7.9	6.9	6.2	5.8	5.5	5.4	5.3	5.2
2.6	16.3	12.6	10.0	8.2	7.2	6.5	6.0	5.8	5.6	5.5	5.4
2.7	17.0	13.1	10.4	8.6	7.4	6.7	6.3	6.0	5.8	5.7	5.6
2.8	17.6	13.6	10.7	8.9	7.7	7.0	6.5	6.2	6.0	5.9	5.8
2.9	18.2	14.1	11.1	9.2	8.0	7.2	6.7	6.4	6.2	6.1	6.0
3.0	18.8	14.6	11.5	9.5	8.3	7.5	7.0	6.7	6.4	6.3	6.2
3.1	19.5	15.1	11.9	9.8	8.5	7.7	7.2	6.9	6.7	6.5	6.4
3.2	20.1	15.5	12.3	10.2	8.8	8.0	7.4	7.1	6.9	6.7	6.6
3.3	20.7	16.0	12.7	10.5	9.1	8.2	7.7	7.3	7.1	6.9	6.8
3.4	21.4	16.5	13.0	10.8	9.4	8.5	7.9	7.5	7.3	7.1	7.0
3.5	22.0	17.0	13.4	11.1	9.6	8.7	8.1	7.8	7.5	7.4	7.2
3.6	22.6	17.5	13.8	11.4	9.9	9.0	8.4	8.0	7.7	7.6	7.4
3.7	23.2	18.0	14.2	11.7	10.2	9.2	8.6	8.2	7.9	7.8	7.7
3.8	23.9	18.5	14.6	12.1	10.5	9.5	8.8	8.4	8.2	8.0	7.9
3.9	24.5	18.9	15.0	12.4	10.7	9.7	9.1	8.6	8.4	8.2	8.1
4.0	25.1	19.4	15.3	12.7	11.0	10.0	9.3	8.9	8.6	8.4	8.3
4.1	25.8	19.9	15.7	13.0	11.3	10.2	9.5	9.1	8.8	8.6	8.5
4.2	26.4	20.4	16.1	13.3	11.6	10.5	9.8	9.3	9.0	8.8	8.7
4.3	27.0	20.9	16.5	13.6	11.8	10.7	10.0	9.5	9.2	9.0	8.9
4.4	27.6	21.4	16.9	14.0	12.1	11.0	10.2	9.8	9.4	9.2	9.1
4.5	28.3	21.9	17.3	14.3	12.4	11.2	10.5	10.0	9.7	9.5	9.3
4.6	28.9	22.3	17.6	14.6	12.7	11.5	10.7	10.2	9.9	9.7	9.5
4.7	29.5	22.8	18.0	14.9	12.9	11.7	10.9	10.4	10.1	9.9	9.7
4.8	30.2	23.3	18.4	15.2	13.2	11.9	11.2	10.6	10.3	10.1	9.9
4.9	30.8	23.8	18.8	15.5	13.5	12.2	11.4	10.9	10.5	10.3	10.1
5.0	31.4	24.3	19.2	15.9	13.8	12.4	11.6	11.1	10.7	10.5	10.3
5.1	32.0	24.8	19.6	16.2	14.0	12.7	11.8	11.3	11.0	10.7	10.6
5.2	32.7	25.3	20.0	16.5	14.3	12.9	12.1	11.5	11.2	10.9	10.8
5.3	33.3	25.7	20.3	16.8	14.6	13.2	12.3	11.8	11.4	11.1	11.0
5.4	33.9	26.2	20.7	17.1	14.9	13.4	12.5	12.0	11.6	11.3	11.2
5.5	34.6	26.7	21.1	17.4	15.1	13.7	12.8	12.2	11.8	11.6	11.4
5.6	35.2	27.2	21.5	17.8	15.4	13.9	13.0	12.4	12.0	11.8	11.6
5.7	35.8	27.7	21.9	18.1	15.7	14.2	13.2	12.6	12.2	12.0	11.8
5.8	36.4	28.2	22.3	18.4	16.0	14.4	13.5	12.9	12.5	12.2	12.0
5.9	37.1	28.7	22.6	18.7	16.2	14.7	13.7	13.1	12.7	12.4	12.2
6.0	37.7	29.1	23.0	19.0	16.5	14.9	13.9	13.3	12.9	12.6	12.4

Head Fire Spread (km) = Head Fire Rate of Spread (km/h) X Elapsed Time Since Ignition (h)

TABLE 5: Slash Fuel Types

Head Fire Spread (m)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
Fire Area (ha)											
20	0.1	*	*	*	*	*	*	*	*	*	*
40	0.5	0.1	0.1	0.1	0.1	*	*	*	*	*	*
60	1.1	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	*	*
80	2.0	0.6	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.
100	3.1	0.9	0.6	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.
120	4.5	1.3	0.9	0.6	0.5	0.4	0.3	0.3	0.2	0.2	0.
140	6.2	1.7	1.2	0.9	0.7	0.5	0.4	0.4	0.3	0.2	0.
160	8.0	2.2	1.5	1.1	0.9	0.7	0.6	0.5	0.4	0.3	0.
180	10.2	2.8	1.9	1.4	1.1	0.9	0.7	0.6	0.5	0.4	0.
200	12.6	3.5	2.4	1.8	1.4	1.1	0.9	0.7	0.6	0.5	0.
220	15.2	4.2	2.9	2.1	1.7	1.3	1.1	0.9	0.7	0.6	0.
240	18.1	5.0	3.4	2.5	2.0	1.6	1.3	1.1	0.9	0.7	0.
260	21.2	5.9	4.0	3.0	2.3	1.9	1.5	1.2	1.0	0.9	0.
280	24.6	6.9	4.6	3.5	2.7	2.2	1.8	1.4	1.2	1.0	0.
300	28.3	7.9	5.3	4.0	3.1	2.5	2.0	1.7	1.4	1.1	1.
320	32.2	9.0	6.0	4.5	3.5	2.8	2.3	1.9	1.6	1.3	1.
340	36.3	10.1	6.8	5.1	4.0	3.2	2.6	2.1	1.8	1.5	1.
360	40.7	11.4	7.7	5.7	4.5	3.6	2.9	2.4	2.0	1.6	1.
380	45.4	12.7	8.5	6.4	5.0	4.0	3.2	2.6	2.2	1.8	1.
400	50.3	14.0	9.5	7.0	5.5	4.4	3.6	2.9	2.4	2.0	1.
420	55.4	15.5	10.4	7.8	6.1	4.8	3.9	3.2	2.7	2.2	2.
440	60.8	17.0	11.4	8.5	6.7	5.3	4.3	3.6	2.9	2.4	2.
460	66.5	18.5	12.5	9.3	7.3	5.8	4.7	3.9	3.2	2.7	2.
480	72.4	20.2	13.6	10.2	7.9	6.3	5.1	4.2	3.5	2.9	2.
500	78.5	21.9	14.8	11.0	8.6	6.9	5.6	4.6	3.8	3.2	2.
520	84.9	23.7	16.0	11.9	9.3	7.4	6.0	5.0	4.1	3.4	3.
540	91.6	25.6	17.2	12.8	10.0	8.0	6.5	5.3	4.4	3.7	3.
560	98.5	27.5	18.5	13.8	10.8	8.6	7.0	5.8	4.8	4.0	3.
580	105.7	29.5	19.9	14.8	11.6	9.2	7.5	6.2	5.1	4.2	4.
600	113.1	31.6	21.3	15.9	12.4	9.9	8.0	6.6	5.5	4.5	4.
620	120.8	33.7	22.7	16.9	13.2	10.6	8.6	7.0	5.8	4.9	4.
640	128.7	35.9	24.2	18.0	14.1	11.3	9.1	7.5	6.2	5.2	4.
660	136.8	38.2	25.7	19.2	15.0	12.0	9.7	8.0	6.6	5.5	5.
680	145.3	40.5	27.3	20.4	15.9	12.7	10.3	8.5	7.0	5.8	5.
700	153.9	42.9	28.9	21.6	16.8	13.5	10.9	9.0	7.4	6.2	5.
720	162.9	45.4	30.6	22.8	17.8	14.3	11.6	9.5	7.9	6.5	6.
740	172.0	48.0	32.3	24.1	18.8	15.1	12.2	10.0	8.3	6.9	6.
760	181.5	50.6	34.1	25.4	19.9	15.9	12.9	10.6	8.8	7.3	6.
780	191.1	53.3	35.9	26.8	20.9	16.7	13.6	11.2	9.2	7.7	7.
800	201.1	56.1	37.8	28.2	22.0	17.6	14.3	11.7	9.7	8.1	7.
820	211.2	58.9	39.7	29.6	23.1	18.5	15.0	12.3	10.2	8.5	7.
840	221.7	61.8	41.7	31.1	24.3	19.4	15.8	12.9	10.7	8.9	8.
860	232.4	64.8	43.7	32.6	25.4	20.3	16.5	13.6	11.2	9.3	8.
880	243.3	67.9	45.7	34.1	26.6	21.3	17.3	14.2	11.7	9.8	9.
900	254.5	71.0	47.8	35.7	27.8	22.3	18.1	14.9	12.3	10.2	9.
920	265.9	74.2	50.0	37.3	29.1	23.3	18.9	15.5	12.8	10.7	9.
940	277.6	77.4	52.2	38.9	30.4	24.3	19.7	16.2	13.4	11.2	10.
960	289.5	80.8	54.4	40.6	31.7	25.3	20.6	16.9	14.0	11.6	10.
980	301.7	84.2	56.7	42.3	33.0	26.4	21.5	17.6	14.6	12.1	11.
1000	314.2	87.6	59.1	44.1	34.4	27.5	22.3	18.3	15.2	12.6	11.

* - less than 0.1 ha

Head Fire Spread (m) = Head Fire Rate of Spread (m/min) X Elapsed Time Since Ignition (m)

TABLE 6: Slash Fuel Types

Head Fire Spread (km)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Area (ha)										
1.0	314	88	59	44	34	27	22	18	15	13	12
1.1	380	106	71	53	42	33	27	22	18	15	14
1.2	452	126	85	63	49	40	32	26	22	18	17
1.3	531	148	100	74	58	46	38	31	26	21	20
1.4	616	172	116	86	67	54	44	36	30	25	23
1.5	707	197	133	99	77	62	50	41	34	28	26
1.6	804	224	151	113	88	70	57	47	39	32	30
1.7	908	253	171	127	99	79	65	53	44	36	34
1.8	1018	284	191	143	111	89	72	59	49	41	38
1.9	1134	316	213	159	124	99	81	66	55	46	42
2.0	1257	351	236	176	137	110	89	73	61	50	47
2.1	1385	386	261	194	152	121	99	81	67	56	52
2.2	1521	424	286	213	166	133	108	89	73	61	57
2.3	1662	464	312	233	182	145	118	97	80	67	62
2.4	1810	505	340	254	198	158	129	106	87	73	68
2.5	1963	548	369	275	215	172	140	115	95	79	73
2.6	2124	592	399	298	232	186	151	124	103	85	79
2.7	2290	639	431	321	251	200	163	134	111	92	86
2.8	2463	687	463	345	269	216	175	144	119	99	92
2.9	2642	737	497	371	289	231	188	154	128	106	99
3.0	2827	789	532	397	309	247	201	165	137	114	106
3.1	3019	842	568	423	330	264	215	176	146	121	113
3.2	3217	897	605	451	352	282	229	188	155	129	120
3.3	3421	954	643	480	374	299	243	200	165	137	128
3.4	3632	1013	683	509	397	318	258	212	175	146	136
3.5	3848	1074	724	540	421	337	274	225	186	155	144
3.6	4072	1136	766	571	445	356	289	238	197	164	152
3.7	4301	1200	809	603	471	376	306	251	208	173	161
3.8	4536	1266	853	636	496	397	323	265	219	182	170
3.9	4778	1333	898	670	523	418	340	279	231	192	179
4.0	5027	1402	945	705	550	440	357	293	243	202	188
4.1	5281	1473	993	741	578	462	375	308	255	212	198
4.2	5542	1546	1042	777	606	485	394	324	268	223	207
4.3	5809	1620	1092	815	636	508	413	339	281	233	217
4.4	6082	1697	1144	853	665	532	432	355	294	244	228
4.5	6362	1775	1196	892	696	557	452	371	307	256	238
4.6	6648	1854	1250	932	727	582	473	388	321	267	249
4.7	6940	1936	1305	973	759	607	493	405	335	279	260
4.8	7238	2019	1361	1015	792	633	515	423	350	291	271
4.9	7543	2104	1418	1058	825	660	536	440	364	303	282
5.0	7854	2191	1477	1102	859	687	558	458	379	316	294
5.1	8171	2280	1536	1146	894	715	581	477	395	328	306
5.2	8495	2370	1597	1191	929	743	604	496	410	341	318
5.3	8825	2462	1659	1238	966	772	627	515	426	355	330
5.4	9161	2556	1723	1285	1002	802	651	535	442	368	343
5.5	9503	2651	1787	1333	1040	832	676	555	459	382	356
5.6	9852	2748	1852	1382	1078	862	700	575	476	396	369
5.7	10207	2847	1919	1432	1117	893	726	596	493	410	382
5.8	10568	2948	1987	1482	1156	925	751	617	510	425	395
5.9	10936	3051	2056	1534	1197	957	778	638	528	439	409
6.0	11310	3155	2127	1586	1237	990	804	660	546	454	423

Head Fire Spread (km) = Head Fire Rate of Spread (km/h) X Elapsed Time Since Ignition (h)

TABLE 7: Slash Fuel Types

Head Fire Spread (m)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Perimeter Length (m)										
20	126	67	57	52	48	46	44	43	42	41	41
40	251	135	114	103	96	91	88	86	84	83	83
60	377	202	171	155	144	137	132	129	126	124	124
80	503	269	228	206	192	183	176	172	168	166	165
100	628	337	285	258	240	229	221	215	210	207	206
120	754	404	342	309	288	274	265	258	253	249	248
140	880	471	399	361	336	320	309	301	295	290	289
160	1005	538	456	412	384	366	353	344	337	332	330
180	1131	606	513	464	433	412	397	386	379	373	371
200	1257	673	571	515	481	457	441	429	421	415	413
220	1382	740	628	567	529	503	485	472	463	456	454
240	1508	808	685	618	577	549	529	515	505	498	495
260	1634	875	742	670	625	595	573	558	547	539	536
280	1759	942	799	721	673	640	618	601	589	580	578
300	1885	1010	856	773	721	686	662	644	631	622	619
320	2011	1077	913	824	769	732	706	687	673	663	660
340	2136	1144	970	876	817	777	750	730	716	705	701
360	2262	1212	1027	927	865	823	794	773	758	746	743
380	2388	1279	1084	979	913	869	838	816	800	788	784
400	2513	1346	1141	1031	961	915	882	859	842	829	825
420	2639	1414	1198	1082	1009	960	926	902	884	871	866
440	2765	1481	1255	1134	1057	1006	970	945	926	912	908
460	2890	1548	1312	1185	1105	1052	1014	988	968	954	949
480	3016	1615	1369	1237	1153	1098	1059	1031	1010	995	990
500	3142	1683	1426	1288	1202	1143	1103	1074	1052	1037	1031
520	3267	1750	1483	1340	1250	1189	1147	1117	1094	1078	1073
540	3393	1817	1540	1391	1298	1235	1191	1159	1136	1119	1114
560	3519	1885	1597	1443	1346	1281	1235	1202	1179	1161	1155
580	3644	1952	1655	1494	1394	1326	1279	1245	1221	1202	1197
600	3770	2019	1712	1546	1442	1372	1323	1288	1263	1244	1238
620	3896	2087	1769	1597	1490	1418	1367	1331	1305	1285	1279
640	4021	2154	1826	1649	1538	1463	1411	1374	1347	1327	1320
660	4147	2221	1883	1700	1586	1509	1456	1417	1389	1368	1362
680	4273	2289	1940	1752	1634	1555	1500	1460	1431	1410	1403
700	4398	2356	1997	1803	1682	1601	1544	1503	1473	1451	1441
720	4524	2423	2054	1855	1730	1646	1588	1546	1515	1493	1485
740	4650	2491	2111	1906	1778	1692	1632	1589	1557	1534	1527
760	4775	2558	2168	1958	1826	1738	1676	1632	1599	1576	1568
780	4901	2625	2225	2010	1874	1784	1720	1675	1642	1617	1609
800	5027	2692	2282	2061	1922	1829	1764	1718	1684	1658	1650
820	5152	2760	2339	2113	1971	1875	1808	1761	1726	1700	1692
840	5278	2827	2396	2164	2019	1921	1853	1804	1768	1741	1733
860	5404	2894	2453	2216	2067	1967	1897	1847	1810	1783	1771
880	5529	2962	2510	2267	2115	2012	1941	1889	1852	1824	1815
900	5655	3029	2567	2319	2163	2058	1985	1932	1894	1866	1857
920	5781	3096	2624	2370	2211	2104	2029	1975	1936	1907	1898
940	5906	3164	2681	2422	2259	2149	2073	2018	1978	1949	1939
960	6032	3231	2739	2473	2307	2195	2117	2061	2020	1990	1980
980	6158	3298	2796	2525	2355	2241	2161	2104	2063	2032	2022
1000	6283	3366	2853	2576	2403	2287	2205	2147	2105	2073	2063

Head Fire Spread (m) = Head Fire Rate of Spread (m/min) X Elapsed Time Since Ignition (m)

TABLE 8: Slash Fuel Types

Head Fire Spread (km)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Perimeter Length (km)										
1.0	6.3	3.4	2.9	2.6	2.4	2.3	2.2	2.1	2.1	2.1	2.1
1.1	6.9	3.7	3.1	2.8	2.6	2.5	2.4	2.4	2.3	2.3	2.3
1.2	7.5	4.0	3.4	3.1	2.9	2.7	2.6	2.6	2.5	2.5	2.5
1.3	8.2	4.4	3.7	3.3	3.1	3.0	2.9	2.8	2.7	2.7	2.7
1.4	8.8	4.7	4.0	3.6	3.4	3.2	3.1	3.0	2.9	2.9	2.9
1.5	9.4	5.0	4.3	3.9	3.6	3.4	3.3	3.2	3.2	3.1	3.1
1.6	10.1	5.4	4.6	4.1	3.8	3.7	3.5	3.4	3.4	3.3	3.3
1.7	10.7	5.7	4.8	4.4	4.1	3.9	3.7	3.7	3.6	3.5	3.5
1.8	11.3	6.1	5.1	4.6	4.3	4.1	4.0	3.9	3.8	3.7	3.7
1.9	11.9	6.4	5.4	4.9	4.6	4.3	4.2	4.1	4.0	3.9	3.9
2.0	12.6	6.7	5.7	5.2	4.8	4.6	4.4	4.3	4.2	4.1	4.1
2.1	13.2	7.1	6.0	5.4	5.0	4.8	4.6	4.5	4.4	4.4	4.4
2.2	13.8	7.4	6.3	5.7	5.3	5.0	4.9	4.7	4.6	4.6	4.6
2.3	14.5	7.7	6.6	5.9	5.5	5.3	5.1	4.9	4.8	4.8	4.8
2.4	15.1	8.1	6.8	6.2	5.8	5.5	5.3	5.2	5.1	5.0	5.0
2.5	15.7	8.4	7.1	6.4	6.0	5.7	5.5	5.4	5.3	5.2	5.2
2.6	16.3	8.8	7.4	6.7	6.2	5.9	5.7	5.6	5.5	5.4	5.4
2.7	17.0	9.1	7.7	7.0	6.5	6.2	6.0	5.8	5.7	5.6	5.6
2.8	17.6	9.4	8.0	7.2	6.7	6.4	6.2	6.0	5.9	5.8	5.8
2.9	18.2	9.8	8.3	7.5	7.0	6.6	6.4	6.2	6.1	6.0	6.0
3.0	18.8	10.1	8.6	7.7	7.2	6.9	6.6	6.4	6.3	6.2	6.2
3.1	19.5	10.4	8.8	8.0	7.4	7.1	6.8	6.7	6.5	6.4	6.4
3.2	20.1	10.8	9.1	8.2	7.7	7.3	7.1	6.9	6.7	6.6	6.6
3.3	20.7	11.1	9.4	8.5	7.9	7.5	7.3	7.1	6.9	6.8	6.8
3.4	21.4	11.4	9.7	8.8	8.2	7.8	7.5	7.3	7.2	7.0	7.0
3.5	22.0	11.8	10.0	9.0	8.4	8.0	7.7	7.5	7.4	7.3	7.3
3.6	22.6	12.1	10.3	9.3	8.7	8.2	7.9	7.7	7.6	7.5	7.5
3.7	23.2	12.5	10.6	9.5	8.9	8.5	8.2	7.9	7.8	7.7	7.
3.8	23.9	12.8	10.8	9.8	9.1	8.7	8.4	8.2	8.0	7.9	7.
3.9	24.5	13.1	11.1	10.0	9.4	8.9	8.6	8.4	8.2	8.1	8.
4.0	25.1	13.5	11.4	10.3	9.6	9.1	8.8	8.6	8.4	8.3	8.
4.1	25.8	13.8	11.7	10.6	9.9	9.4	9.0	8.8	8.6	8.5	8.
4.2	26.4	14.1	12.0	10.8	10.1	9.6	9.3	9.0	8.8	8.7	8.
4.3	27.0	14.5	12.3	11.1	10.3	9.8	9.5	9.2	9.0	8.9	8.
4.4	27.6	14.8	12.6	11.3	10.6	10.1	9.7	9.4	9.3	9.1	9.
4.5	28.3	15.1	12.8	11.6	10.8	10.3	9.9	9.7	9.5	9.3	9.
4.6	28.9	15.5	13.1	11.9	11.1	10.5	10.1	9.9	9.7	9.5	9.
4.7	29.5	15.8	13.4	12.1	11.3	10.7	10.4	10.1	9.9	9.7	9.
4.8	30.2	16.2	13.7	12.4	11.5	11.0	10.6	10.3	10.1	10.0	9.
4.9	30.8	16.5	14.0	12.6	11.8	11.2	10.8	10.5	10.3	10.2	10.
5.0	31.4	16.8	14.3	12.9	12.0	11.4	11.0	10.7	10.5	10.4	10.
5.1	32.0	17.2	14.5	13.1	12.3	11.7	11.2	11.0	10.7	10.6	10.
5.2	32.7	17.5	14.8	13.4	12.5	11.9	11.5	11.2	10.9	10.8	10.
5.3	33.3	17.8	15.1	13.7	12.7	12.1	11.7	11.4	11.2	11.0	10.
5.4	33.9	18.2	15.4	13.9	13.0	12.3	11.9	11.6	11.4	11.2	11.
5.5	34.6	18.5	15.7	14.2	13.2	12.6	12.1	11.8	11.6	11.4	11.
5.6	35.2	18.8	16.0	14.4	13.5	12.8	12.4	12.0	11.8	11.6	11.
5.7	35.8	19.2	16.3	14.7	13.7	13.0	12.6	12.2	12.0	11.8	11.
5.8	36.4	19.5	16.5	14.9	13.9	13.3	12.8	12.5	12.2	12.0	12.
5.9	37.1	19.9	16.8	15.2	14.2	13.5	13.0	12.7	12.4	12.2	12.
6.0	37.7	20.2	17.1	15.5	14.4	13.7	13.2	12.9	12.6	12.4	12.

Head Fire Spread (km) = Head Fire Rate of Spread (km/h) X Elapsed Time Since Ignition (h)

TABLE 9: Open Fuel Types (Grass)

Head Fire Spread (m)	10 - Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Area (ha)										
20	0.1	*	*	*	*	*	*	*	*	*	*
40	0.5	0.1	*	*	*	*	*	*	*	*	*
60	1.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	*	*	*
80	2.0	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
100	3.1	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
120	4.5	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
140	6.2	0.7	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2
160	8.0	1.0	0.7	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
180	10.2	1.2	0.8	0.7	0.6	0.5	0.5	0.5	0.4	0.4	0.4
200	12.6	1.5	1.0	0.8	0.7	0.7	0.6	0.6	0.5	0.5	0.5
220	15.2	1.8	1.2	1.0	0.9	0.8	0.7	0.7	0.6	0.6	0.6
240	18.1	2.2	1.5	1.2	1.1	0.9	0.9	0.8	0.8	0.7	0.7
260	21.2	2.5	1.7	1.4	1.2	1.1	1.0	0.9	0.9	0.8	0.8
280	24.6	2.9	2.0	1.6	1.4	1.3	1.2	1.1	1.0	1.0	0.9
300	28.3	3.4	2.3	1.9	1.6	1.5	1.3	1.3	1.2	1.1	1.1
320	32.2	3.8	2.6	2.2	1.9	1.7	1.5	1.4	1.3	1.3	1.1
340	36.3	4.3	3.0	2.4	2.1	1.9	1.7	1.6	1.5	1.4	1.1
360	40.7	4.8	3.3	2.7	2.4	2.1	1.9	1.8	1.7	1.6	1.1
380	45.4	5.4	3.7	3.0	2.6	2.4	2.2	2.0	1.9	1.8	1.1
400	50.3	6.0	4.1	3.4	2.9	2.6	2.4	2.2	2.1	2.0	1.1
420	55.4	6.6	4.6	3.7	3.2	2.9	2.6	2.5	2.3	2.2	2.2
440	60.8	7.2	5.0	4.1	3.5	3.2	2.9	2.7	2.5	2.4	2.2
460	66.5	7.9	5.5	4.5	3.9	3.5	3.2	2.9	2.8	2.6	2.2
480	72.4	8.6	5.9	4.8	4.2	3.8	3.5	3.2	3.0	2.8	2.2
500	78.5	9.3	6.5	5.3	4.6	4.1	3.7	3.5	3.3	3.1	2.2
520	84.9	10.1	7.0	5.7	4.9	4.4	4.1	3.8	3.5	3.3	3.3
540	91.6	10.9	7.5	6.1	5.3	4.8	4.4	4.1	3.8	3.6	3.3
560	98.5	11.7	8.1	6.6	5.7	5.1	4.7	4.4	4.1	3.9	3.3
580	105.7	12.6	8.7	7.1	6.1	5.5	5.0	4.7	4.4	4.2	3.4
600	113.1	13.5	9.3	7.6	6.6	5.9	5.4	5.0	4.7	4.4	4.4
620	120.8	14.4	9.9	8.1	7.0	6.3	5.8	5.4	5.0	4.7	4.4
640	128.7	15.3	10.6	8.6	7.5	6.7	6.1	5.7	5.4	5.1	4.4
660	136.8	16.3	11.2	9.2	8.0	7.1	6.5	6.1	5.7	5.4	5.5
680	145.3	17.3	11.9	9.7	8.4	7.6	6.9	6.4	6.0	5.7	5.5
700	153.9	18.3	12.6	10.3	8.9	8.0	7.3	6.8	6.4	6.1	5.5
720	162.9	19.4	13.4	10.9	9.5	8.5	7.8	7.2	6.8	6.4	6.6
740	172.0	20.5	14.1	11.5	10.0	9.0	8.2	7.6	7.2	6.8	6.6
760	181.5	21.6	14.9	12.1	10.5	9.5	8.7	8.0	7.5	7.1	6.6
780	191.1	22.8	15.7	12.8	11.1	10.0	9.1	8.5	8.0	7.5	7.7
800	201.1	23.9	16.5	13.5	11.7	10.5	9.6	8.9	8.4	7.9	7.7
820	211.2	25.1	17.4	14.1	12.3	11.0	10.1	9.4	8.8	8.3	7.7
840	221.7	26.4	18.2	14.8	12.9	11.6	10.6	9.8	9.2	8.7	8.8
860	232.4	27.7	19.1	15.6	13.5	12.1	11.1	10.3	9.7	9.1	8.8
880	243.3	29.0	20.0	16.3	14.1	12.7	11.6	10.8	10.1	9.6	9.9
900	254.5	30.3	20.9	17.0	14.8	13.3	12.1	11.3	10.6	10.0	9.9
920	265.9	31.7	21.8	17.8	15.5	13.9	12.7	11.8	11.1	10.5	9.9
940	277.6	33.0	22.8	18.6	16.1	14.5	13.3	12.3	11.5	10.9	10.0
960	289.5	34.5	23.8	19.4	16.8	15.1	13.8	12.8	12.0	11.4	10.0
980	301.7	35.9	24.8	20.2	17.5	15.7	14.4	13.4	12.6	11.9	11.1
1000	314.2	37.4	25.8	21.0	18.3	16.4	15.0	13.9	13.1	12.4	11.1

* - less than 0.1 ha

Head Fire Spread (m) = Head Fire Rate of Spread (m/min) X Elapsed Time Since Ignition (min)

TABLE 10: Open Fuel Types (Grass)

Head Fire Spread (km)	10-m Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Area (ha)										
1.0	314	37	26	21	18	16	15	14	13	12	12
1.1	380	45	31	25	22	20	18	17	16	15	14
1.2	452	54	37	30	26	24	22	20	19	18	17
1.3	531	63	44	36	31	28	25	24	22	21	20
1.4	616	73	51	41	36	32	29	27	26	24	23
1.5	707	84	58	47	41	37	34	31	29	28	26
1.6	804	96	66	54	47	42	38	36	33	32	30
1.7	908	108	75	61	53	47	43	40	38	36	34
1.8	1018	121	84	68	59	53	49	45	42	40	38
1.9	1134	135	93	76	66	59	54	50	47	45	42
2.0	1257	150	103	84	73	66	60	56	52	49	47
2.1	1385	165	114	93	81	72	66	61	58	54	52
2.2	1521	181	125	102	88	79	73	67	63	60	57
2.3	1662	198	137	111	97	87	79	74	69	65	62
2.4	1810	215	149	121	105	94	86	80	75	71	68
2.5	1963	234	161	131	114	102	94	87	82	77	73
2.6	2124	253	174	142	123	111	101	94	88	84	79
2.7	2290	273	188	153	133	119	109	102	95	90	86
2.8	2463	293	202	165	143	128	118	109	102	97	92
2.9	2642	314	217	177	154	138	126	117	110	104	99
3.0	2827	337	232	189	164	147	135	125	118	111	106
3.1	3019	359	248	202	175	157	144	134	126	119	113
3.2	3217	383	264	215	187	168	154	143	134	127	120
3.3	3421	407	281	229	199	178	163	152	142	135	128
3.4	3632	432	298	243	211	189	173	161	151	143	136
3.5	3848	458	316	258	224	201	184	171	160	151	144
3.6	4072	485	334	273	237	212	194	181	169	160	152
3.7	4301	512	353	288	250	224	205	191	179	169	161
3.8	4536	540	373	304	264	236	217	201	189	178	170
3.9	4778	569	392	320	278	249	228	212	199	188	179
4.0	5027	598	413	337	292	262	240	223	209	198	188
4.1	5281	629	434	354	307	275	252	234	220	208	198
4.2	5542	660	455	371	322	289	265	246	231	218	207
4.3	5809	691	477	389	338	303	277	258	242	228	217
4.4	6082	724	500	407	353	317	290	270	253	239	228
4.5	6362	757	523	426	370	332	304	282	265	250	238
4.6	6648	791	546	445	386	347	317	295	277	261	249
4.7	6940	826	570	465	403	362	331	308	289	273	260
4.8	7238	862	595	485	421	377	346	321	301	285	271
4.9	7543	898	620	505	438	393	360	334	314	297	282
5.0	7854	935	645	526	456	409	375	348	327	309	294
5.1	8171	973	671	547	475	426	390	362	340	321	306
5.2	8495	1011	698	569	494	443	406	377	353	334	318
5.3	8825	1050	725	591	513	460	421	391	367	347	330
5.4	9161	1090	752	613	532	478	437	406	381	360	343
5.5	9503	1131	781	636	552	495	454	421	395	374	356
5.6	9852	1173	809	660	572	514	470	437	410	388	369
5.7	10207	1215	838	683	593	532	487	453	425	401	382
5.8	10568	1258	868	708	614	551	505	469	440	416	395
5.9	10936	1302	898	732	635	570	522	485	455	430	409
6.0	11310	1346	929	757	657	590	540	501	470	445	423

Head Fire Spread (km) = Head Fire Rate of Spread (km/h) X Elapsed Time Since Ignition (h)

TABLE 11: Open Fuel Types (Grass)

Head Fire Spread (m)	10-■ Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Perimeter Length (m)										
20	126	49	45	44	43	42	42	42	42	41	41
40	251	98	90	87	86	85	84	84	83	83	83
60	377	147	136	131	129	127	126	125	125	124	124
80	503	196	181	175	172	170	168	167	166	166	165
100	628	246	226	219	215	212	210	209	208	207	206
120	754	295	271	262	258	254	252	251	249	248	248
140	880	344	316	306	300	297	294	292	291	290	289
160	1005	393	362	350	343	339	336	334	333	331	330
180	1131	442	407	393	386	382	378	376	374	373	371
200	1257	491	452	437	429	424	420	418	416	414	413
220	1382	540	497	481	472	466	463	460	457	455	454
240	1508	589	542	525	515	509	505	501	499	497	495
260	1634	639	587	568	558	551	547	543	540	538	536
280	1759	688	633	612	601	594	589	585	582	580	578
300	1885	737	678	656	644	636	631	627	624	621	619
320	2011	786	723	699	687	679	673	668	665	662	660
340	2136	835	768	743	730	721	715	710	707	704	701
360	2262	884	813	787	773	763	757	752	748	745	743
380	2388	933	859	831	815	806	799	794	790	787	784
400	2513	982	904	874	858	848	841	836	831	828	825
420	2639	1032	949	918	901	891	883	877	873	869	866
440	2765	1081	994	962	944	933	925	919	915	911	908
460	2890	1130	1039	1006	987	975	967	961	956	952	949
480	3016	1179	1085	1049	1030	1018	1009	1003	998	994	990
500	3142	1228	1130	1093	1073	1060	1051	1044	1039	1035	1031
520	3267	1277	1175	1137	1116	1103	1093	1086	1081	1076	1073
540	3393	1326	1220	1180	1159	1145	1135	1128	1122	1118	1114
560	3519	1375	1265	1224	1202	1187	1177	1170	1164	1159	1155
580	3644	1425	1310	1268	1245	1230	1219	1212	1205	1201	1197
600	3770	1474	1356	1312	1288	1272	1261	1253	1247	1242	1238
620	3896	1523	1401	1355	1330	1315	1303	1295	1289	1283	1279
640	4021	1572	1446	1399	1373	1357	1346	1337	1330	1325	1320
660	4147	1621	1491	1443	1416	1399	1388	1379	1372	1366	1362
680	4273	1670	1536	1486	1459	1442	1430	1420	1413	1408	1403
700	4398	1719	1582	1530	1502	1484	1472	1462	1455	1449	1444
720	4524	1768	1627	1574	1545	1527	1514	1504	1496	1490	1485
740	4650	1818	1672	1618	1588	1569	1556	1546	1538	1532	1527
760	4775	1867	1717	1661	1631	1611	1598	1588	1580	1573	1568
780	4901	1916	1762	1705	1674	1654	1640	1629	1621	1615	1609
800	5027	1965	1808	1749	1717	1696	1682	1671	1663	1656	1650
820	5152	2014	1853	1792	1760	1739	1724	1713	1704	1697	1692
840	5278	2063	1898	1836	1803	1781	1766	1755	1746	1739	1733
860	5404	2112	1943	1880	1846	1824	1808	1796	1787	1780	1774
880	5529	2161	1988	1924	1888	1866	1850	1838	1829	1822	1815
900	5655	2211	2033	1967	1931	1908	1892	1880	1871	1863	1857
920	5781	2260	2079	2011	1974	1951	1934	1922	1912	1904	1898
940	5906	2309	2124	2055	2017	1993	1976	1964	1954	1946	1939
960	6032	2358	2169	2098	2060	2036	2018	2005	1995	1987	1980
980	6158	2407	2214	2142	2103	2078	2060	2047	2037	2029	2022
1000	6283	2456	2259	2186	2146	2120	2089	2078	2070	2063	

Head Fire Spread (m) = Head Fire Rate of Spread (m/min) X Elapsed Time Since Ignition (m)

TABLE 12: Open Fuel Types (Grass)

Head Fire Spread (km)	10-■ Open Wind (km/h)										
	0	5	10	15	20	25	30	35	40	45	50
	Fire Perimeter Length (km)										
1.0	6.3	2.5	2.3	2.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1
1.1	6.9	2.7	2.5	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.3
1.2	7.5	2.9	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5
1.3	8.2	3.2	2.9	2.8	2.8	2.8	2.7	2.7	2.7	2.7	2.7
1.4	8.8	3.4	3.2	3.1	3.0	3.0	2.9	2.9	2.9	2.9	2.9
1.5	9.4	3.7	3.4	3.3	3.2	3.2	3.2	3.1	3.1	3.1	3.1
1.6	10.1	3.9	3.6	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.3
1.7	10.7	4.2	3.8	3.7	3.6	3.6	3.6	3.6	3.5	3.5	3.5
1.8	11.3	4.4	4.1	3.9	3.9	3.8	3.8	3.8	3.7	3.7	3.7
1.9	11.9	4.7	4.3	4.2	4.1	4.0	4.0	4.0	3.9	3.9	3.9
2.0	12.6	4.9	4.5	4.4	4.3	4.2	4.2	4.2	4.2	4.1	4.1
2.1	13.2	5.2	4.7	4.6	4.5	4.5	4.4	4.4	4.4	4.3	4.3
2.2	13.8	5.4	5.0	4.8	4.7	4.7	4.6	4.6	4.6	4.6	4.5
2.3	14.5	5.6	5.2	5.0	4.9	4.9	4.8	4.8	4.8	4.8	4.7
2.4	15.1	5.9	5.4	5.2	5.2	5.1	5.0	5.0	5.0	5.0	5.0
2.5	15.7	6.1	5.6	5.5	5.4	5.3	5.3	5.2	5.2	5.2	5.2
2.6	16.3	6.4	5.9	5.7	5.6	5.5	5.5	5.4	5.4	5.4	5.4
2.7	17.0	6.6	6.1	5.9	5.8	5.7	5.7	5.6	5.6	5.6	5.6
2.8	17.6	6.9	6.3	6.1	6.0	5.9	5.9	5.8	5.8	5.8	5.8
2.9	18.2	7.1	6.6	6.3	6.2	6.1	6.1	6.1	6.0	6.0	6.0
3.0	18.8	7.4	6.8	6.6	6.4	6.4	6.3	6.3	6.2	6.2	6.2
3.1	19.5	7.6	7.0	6.8	6.7	6.6	6.5	6.5	6.4	6.4	6.4
3.2	20.1	7.9	7.2	7.0	6.9	6.8	6.7	6.7	6.7	6.6	6.6
3.3	20.7	8.1	7.5	7.2	7.1	7.0	6.9	6.9	6.9	6.8	6.8
3.4	21.4	8.4	7.7	7.4	7.3	7.2	7.1	7.1	7.1	7.0	7.0
3.5	22.0	8.6	7.9	7.7	7.5	7.4	7.4	7.3	7.3	7.2	7.2
3.6	22.6	8.8	8.1	7.9	7.7	7.6	7.6	7.5	7.5	7.5	7.5
3.7	23.2	9.1	8.4	8.1	7.9	7.8	7.8	7.7	7.7	7.7	7.7
3.8	23.9	9.3	8.6	8.3	8.2	8.1	8.0	7.9	7.9	7.9	7.8
3.9	24.5	9.6	8.8	8.5	8.4	8.3	8.2	8.1	8.1	8.1	8.0
4.0	25.1	9.8	9.0	8.7	8.6	8.5	8.4	8.4	8.3	8.3	8.0
4.1	25.8	10.1	9.3	9.0	8.8	8.7	8.6	8.6	8.5	8.5	8.4
4.2	26.4	10.3	9.5	9.2	9.0	8.9	8.8	8.8	8.7	8.7	8.4
4.3	27.0	10.6	9.7	9.4	9.2	9.1	9.0	9.0	8.9	8.9	8.4
4.4	27.6	10.8	9.9	9.6	9.4	9.3	9.3	9.2	9.1	9.1	9.1
4.5	28.3	11.1	10.2	9.8	9.7	9.5	9.5	9.4	9.4	9.3	9.1
4.6	28.9	11.3	10.4	10.1	9.9	9.8	9.7	9.6	9.6	9.5	9.1
4.7	29.5	11.5	10.6	10.3	10.1	10.0	9.9	9.8	9.8	9.7	9.1
4.8	30.2	11.8	10.8	10.5	10.3	10.2	10.1	10.0	10.0	9.9	9.1
4.9	30.8	12.0	11.1	10.7	10.5	10.4	10.3	10.2	10.2	10.1	10.
5.0	31.4	12.3	11.3	10.9	10.7	10.6	10.5	10.4	10.4	10.3	10.
5.1	32.0	12.5	11.5	11.1	10.9	10.8	10.7	10.7	10.6	10.6	10.
5.2	32.7	12.8	11.7	11.4	11.2	11.0	10.9	10.9	10.8	10.8	10.
5.3	33.3	13.0	12.0	11.6	11.4	11.2	11.1	11.1	11.0	11.0	10.
5.4	33.9	13.3	12.2	11.8	11.6	11.4	11.4	11.3	11.2	11.2	11.
5.5	34.6	13.5	12.4	12.0	11.8	11.7	11.6	11.5	11.4	11.4	11.
5.6	35.2	13.8	12.7	12.2	12.0	11.9	11.8	11.7	11.6	11.6	11.
5.7	35.8	14.0	12.9	12.5	12.2	12.1	12.0	11.9	11.8	11.8	11.
5.8	36.4	14.2	13.1	12.7	12.4	12.3	12.2	12.1	12.1	12.0	12.
5.9	37.1	14.5	13.3	12.9	12.7	12.5	12.4	12.3	12.3	12.2	12.
6.0	37.7	14.7	13.6	13.1	12.9	12.7	12.6	12.5	12.5	12.4	12.

Head Fire Spread (km) = Head Fire Rate of Spread (km/h) X Elapsed Time Since Ignition (h)

TABLE 13: Standing Timber Fuel Types

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
					L/B					
0	1.00	1.00	1.01	1.01	1.02	1.04	1.06	1.08	1.11	1.14
10	1.17	1.21	1.25	1.30	1.35	1.41	1.47	1.54	1.61	1.68
20	1.76	1.85	1.93	2.03	2.13	2.23	2.34	2.45	2.57	2.70
30	2.82	2.96	3.10	3.24	3.39	3.54	3.70	3.86	4.03	4.21
40	4.39	4.57	4.76	4.96	5.16	5.37	5.58	5.80	6.02	6.25

Note: e.g., Wind Speed = 15 km/h and L/B = 1.41.

TABLE 14: Standing Timber Fuel Types

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
					K_A					
0	3.14	2.85	2.57	2.31	2.08	1.88	1.70	1.54	1.40	1.27
10	1.16	1.06	0.98	0.90	0.83	0.77	0.71	0.66	0.62	0.57
20	0.54	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31
30	0.30	0.28	0.27	0.25	0.24	0.23	0.22	0.21	0.20	0.19
40	0.18	0.18	0.17	0.16	0.16	0.15	0.14	0.14	0.13	0.13

Note: e.g., Wind Speed = 15 km/h and K_A = 0.77.

TABLE 15: Standing Timber Fuel Types

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
					K_P					
0	6.28	5.99	5.68	5.39	5.11	4.86	4.62	4.40	4.20	4.01
10	3.84	3.68	3.53	3.40	3.28	3.17	3.07	2.98	2.90	2.82
20	2.75	2.69	2.63	2.58	2.53	2.49	2.45	2.41	2.38	2.35
30	2.32	2.30	2.28	2.25	2.23	2.22	2.20	2.19	2.17	2.16
40	2.15	2.14	2.13	2.12	2.11	2.10	2.09	2.09	2.08	2.07

Note: e.g., Wind Speed = 15 km/h and K_P = 3.17.

TABLE 16: Slash Fuel Types

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
0	1.00	1.07	1.13	1.19	1.25	1.32	1.38	1.44	1.51	1.58
10	1.65	1.72	1.80	1.87	1.95	2.04	2.12	2.21	2.30	2.39
20	2.49	2.59	2.69	2.80	2.91	3.02	3.14	3.26	3.39	3.52
30	3.65	3.79	3.94	4.09	4.24	4.40	4.56	4.73	4.90	5.09
40	5.27	5.46	5.66	5.87	6.08	6.30	6.50	6.57	6.63	6.69

Note: e.g., Wind Speed = 15 km/h and L/B = 2.04.

TABLE 17: Slash Fuel Types

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
0	3.14	1.59	1.29	1.10	0.97	0.88	0.80	0.73	0.68	0.63
10	0.59	0.55	0.52	0.49	0.47	0.44	0.42	0.40	0.38	0.36
20	0.34	0.33	0.31	0.30	0.29	0.27	0.26	0.25	0.24	0.23
30	0.22	0.21	0.21	0.20	0.19	0.18	0.18	0.17	0.16	0.16
40	0.15	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.12	0.12

Note: e.g., Wind Speed = 15 km/h and $K_A = 0.44$.

TABLE 18: Slash Fuel Types

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
0	6.28	4.48	4.03	3.74	3.53	3.37	3.23	3.11	3.01	2.93
10	2.85	2.79	2.72	2.67	2.62	2.58	2.54	2.50	2.46	2.43
20	2.40	2.38	2.35	2.33	2.31	2.29	2.27	2.25	2.23	2.22
30	2.21	2.19	2.18	2.17	2.16	2.15	2.14	2.13	2.12	2.11
40	2.10	2.10	2.09	2.08	2.08	2.07	2.07	2.07	2.07	2.06

Note: e.g., Wind Speed = 15 km/h and $K_P = 2.58$.

TABLE 19: Open Fuel Types (Grass)

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
0	1.00	1.10	1.52	1.83	2.09	2.32	2.53	2.71	2.89	3.05
10	3.20	3.35	3.48	3.62	3.74	3.86	3.98	4.10	4.21	4.31
20	4.42	4.52	4.62	4.71	4.81	4.90	4.99	5.08	5.16	5.25
30	5.33	5.41	5.49	5.57	5.65	5.73	5.80	5.88	5.95	6.02
40	6.09	6.16	6.23	6.30	6.37	6.43	6.50	6.57	6.63	6.69

Note: e.g., Wind Speed = 15 km/h and L/B = 3.86.

TABLE 20: Open Fuel Types (Grass)

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
0	3.14	1.42	0.67	0.51	0.43	0.37	0.34	0.31	0.29	0.27
10	0.26	0.25	0.24	0.23	0.22	0.21	0.20	0.20	0.19	0.19
20	0.18	0.18	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.15
30	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.13	0.13
40	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12

Note: e.g., Wind Speed = 15 km/h and $K_A = 0.21$.

TABLE 21: Open Fuel Types (Grass)

Wind Speed (km/h)	0	1	2	3	4	5	6	7	8	9
0	6.28	4.24	3.01	2.70	2.55	2.46	2.39	2.35	2.31	2.28
10	2.26	2.24	2.22	2.21	2.20	2.19	2.18	2.17	2.16	2.15
20	2.15	2.14	2.13	2.13	2.12	2.12	2.12	2.11	2.11	2.11
30	2.10	2.10	2.10	2.09	2.09	2.09	2.09	2.08	2.08	2.08
40	2.08	2.08	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.06

Note: e.g., Wind Speed = 15 km/h and $K_P = 2.19$.

TABLE 22: Head Fire/Backfire Spread Ratios (H/B) versus Length-to-Breadth Ratios (L/B) of Free-Burning Elliptical Shaped Wildland Fires.

L/B	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
	H/B									
1	1.00	2.43	3.47	4.54	5.66	6.86	8.12	9.46	10.9	12.4
2	13.9	15.6	17.3	19.1	21.0	23.0	25.0	27.1	29.3	31.6
3	34.0	36.4	38.9	41.6	44.2	47.0	49.8	52.7	55.7	58.8
4	62.0	65.2	68.6	71.9	75.4	79.0	82.6	86.3	90.2	94.0
5	98.0	102	106	110	115	119	123	128	133	137
6	142	147	152	157	162	167	172	178	183	188

Note: e.g., L/B = 2.0 and H/B = 13.9 or 13.9:1.