Guide to using the Fire Behaviour Prediction Worksheet

The procedure to determine the key fire characteristics using the Fire Behaviour Worksheet is outlined below. This procedure is based around use of the Field Guide to Fire Behaviour in New Zealand Fuel Types[1]. Please refer to this document to work through and understand the process followed. A completed example of the worksheet follows.

The procedure should be repeated for each different fuel type or slope change that is likely to be encountered during the prediction period. Predictions can also be made for subsequent time intervals using forecasted weather and fire danger information, if available.

Steps:

1. Record date, time and name of fire incident the prediction is being made for.
2. Input standard daily Fire Weather Index (FWI) System codes and indices as the starting point for today's prediction. If the required prediction time is before 1200 noon NZST (1300 NZDT), use yesterday's values; alternatively, if predictions are required for during the afternoon or evening, use today's noon standard values.
3. Enter the time(s) the prediction is required for (note times are typically quoted as NZST).
4. Enter the weather conditions for the time of the prediction, obtained from onsite measurements, Remote Automatic Weather Station (RAWS) observations or forecasted values, including temperature, relative humidity (either directly, or determined from wet (WBT) and dry-bulb (DBT) measurements), and wind speed and direction. Wind speed may be measured by RAWS, using hand-held instruments (page C-1), or estimated using the Beaufort scale (page C-2).
5. Determine FWI System codes and indices adjusted for the time of prediction, either from hourly calculations (after Alexander et al. 1984), diurnal estimates (after Lawson et al. 1996), or by re-determining Fine Fuel Moisture Code (FFMC) and/or Initial Spread Index (ISI) using Section D.
6. Select the most appropriate Fuel Type (see page E-1 for a list of options) that represents the fuels in the prediction area, ensuring that this is the dominant fuel type that will carry the fire. Predictions may be necessary for several fuel types for the same prediction period.
7. Record any necessary fuel modifiers, such as fuel height and cover, pine plantation characteristics, or Degree of Curing (DoC%) (i.e., proportion of dead fuels within the grass complex) for grass fuels.
8. Determine the Available Fuel Load (AFL) for the selected fuel type, based on either the Buildup Index (BUI) for forested fuel types, or fuel height and/or cover for grass and scrub fuel types, using Section E.
9. Determine the equilibrium Rate of Spread (ROS) (usually of the head fire) on flat terrain using Section F. For forested fuel types, this requires the ISI and BUI components; grassland fuel types use the ISI and Degree of Curing; other fuel types (i.e., scrublands) require only the ISI component.
10. Where slope is a factor, determine the slope steepness (and aspect) for the prediction area (see page G-2).
11. Determine the Slope Correction Factor (SCF) for the appropriate slope angle (page G-1).
12. Determine the slope-adjusted ROS by multiplying the flat-ground ROS by the SCF.
13. Determine the Head Fire Intensity (HFI) from the AFL and slope-adjusted ROS, using either the equations or table contained in Section H.
14. Determine the associated Flame Length relating to this HFI (page H-3).
15. For forested fuels, determine the Fire Type (surface, intermittent torching, or crown fire) using the crown fire initiation thresholds (page I-3).
16. Using Sections I & J, determine other relevant fire characteristics (fire spread distance, fire area, perimeter length, length-to-breadth (L/B) ratio, perimeter growth rate (PGR)) or fire suppression considerations (fire suppression effectiveness, firebreak breaching).
17. Record any fire behaviour warnings or other comments.

[1] Pearce, H.G.; Anderson, S.A.J. 2008. A Manual for Predicting Fire Behaviour in New Zealand Fuel Types. Scion Rural Fire Research Group, Christchurch.

Fire Behaviour Prediction Worksheet - worked example

A fire starts during the early afternoon in grasslands on flat terrain, and over the next 3-4 hours has the potential to spread upslope through mature pine plantation and into gorse scrub fuels under the influence of an approaching cold front.

1. **Date:** 8/02/03 **Time:** 1215 NZST/ 1315 NZDT **Fire Name:** Worked Example, Canterbury Plains
2. **1200 NZST Daily FWI Codes and Indices*:**
   FFMC 85 DMC 45 DC 350 ISI 3 BUI 68 FWI 10

3.	**Prediction Time (NZST):**	1215-1300	1300-1400	1400-1600			
4.	**Weather:**						
	Wet Bulb Temp (°C)						
	Dry Bulb Temp (°C)	27.5	27.0	16.0			
	Relative Humidity (%)	50	55	70			
	Wind Speed (km/h)	10	45	30			
	Wind Direction (°)	315°	270°	225°			
5.	**FWI Components:**						
	FFMC	82	83	85			
	ISI: Head/Back	2.5/1.0	15/0	10/0.5			
	BUI	68	68	68			
	Fuels:						
6.	Fuel Type	Pasture	Mat. Pine	Gorse			
7.	Modifiers: Height, Cover, DoC%	90%	6m LCBH	1.5m			
8.	Available Fuel Load (t/ha)	3.5	16.0	29.6			
	Fire Behaviour - Flat Ground:						
9.	Equil. ROS (m/h): Head/Back	177/39	620/0	2473/53			
	Slope Correction:						
10.	Slope (°) / Aspect (°)	0	10 (270°)	5 (225°)			
11.	SCF: Head/Back	1.0	1.6/0.5	1.2/0.7			
	Fire Behaviour - Adjusted for slope:						
12.	Adj. ROS (m/h): Head/Back	177/39	992/0	2968/37			
13.	Intensity (kW/m): Head/Back	310/68	7936/0	43,926/54			
14.	Flame Length (m): Head/Back	1.1/0.5	4.8/0	10.5/1.4			
15.	Fire Type (S/I/C)#	S	C	C			
16.	**Fire Suppression Considerations:**						
	Interval Elapsed Time (min)	45	60	120			
	Spread Distance (m): Head/Back	133/29	992/0	5936/74			
	Total Spread Distance (m)	162	1154	7090			
	Fire Area (ha)	1	19	740			
	Perimeter Length (m)	360	2400	14,780			
	Length/Breadth Ratio	3.2	5.6	5.3			
	Perimeter Growth Rate (m/h)	420	2040	6200			
17.	**Warnings:**	Approach. cold front	Crowning, spotting	Spotting			

Comments: Caution crews working LH flank of approaching wind change and increasing fire activity due to frontal passage and also upslope spread. Also alert crews to potential for crowning and short-range spotting in high-pruned pine stand and gorse scrub fuels.

* If prediction time is before 1200 NZST, use yesterday's noon daily FWI values; if after 1200 NZST, use today's FWI values.

Fire Type = Surface fire (S), Intermittent (I) (i.e., torching), or continuous Crown fire (C).