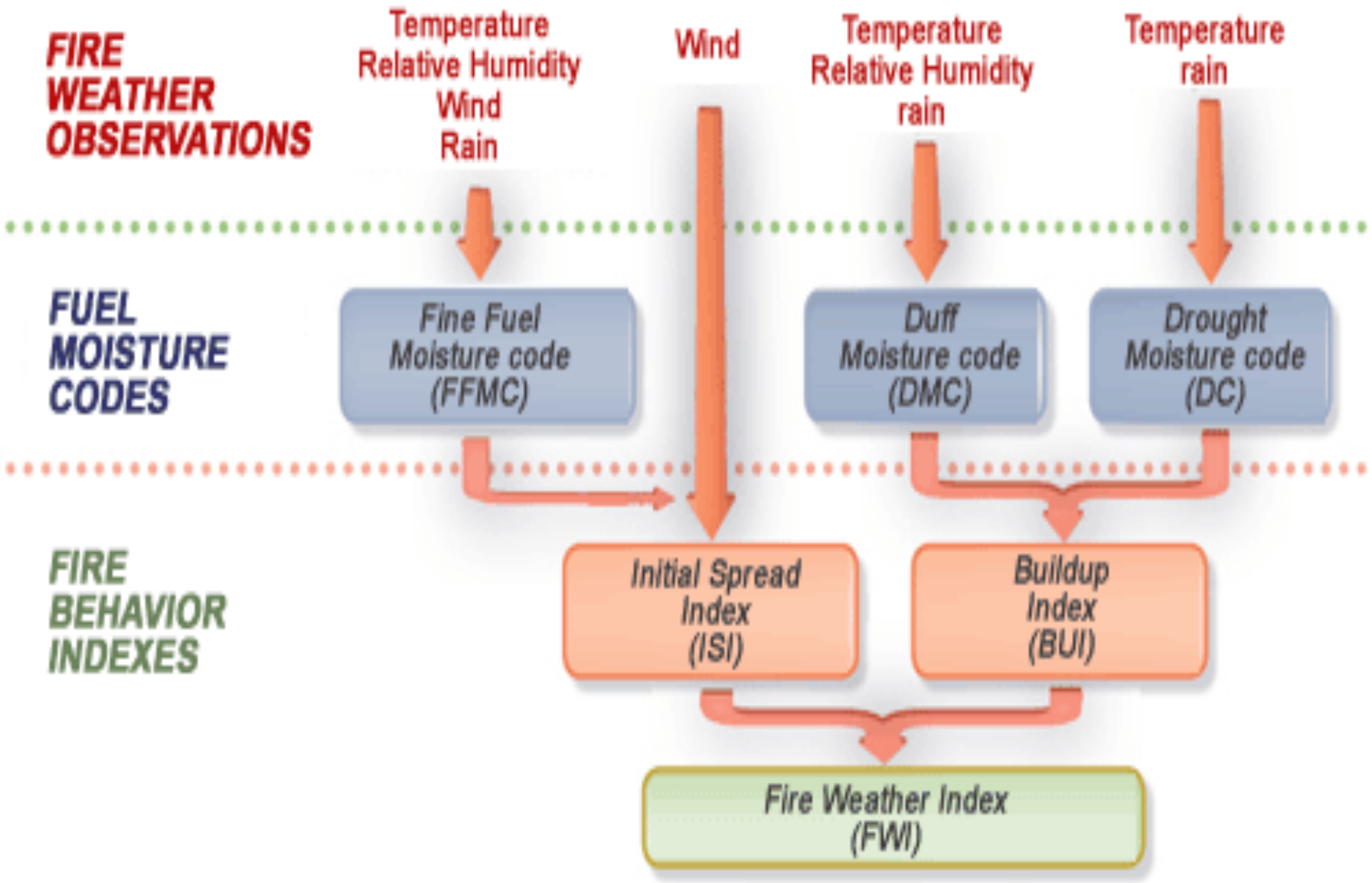
Fire Danger Rating Systems

American	**Canadian**
Physical Equations	Emperical Equations
Shallow Surface System	Deep Organic System

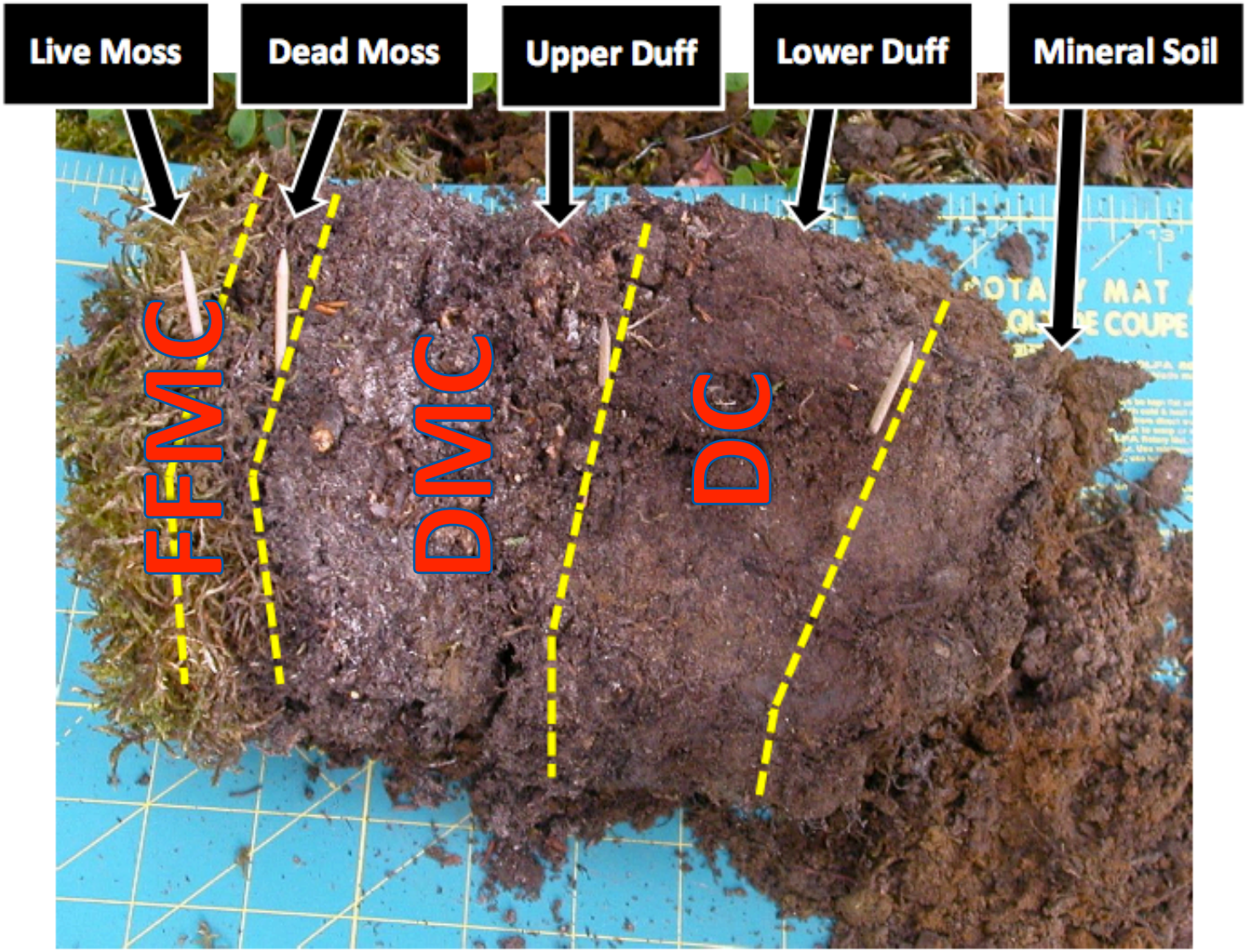
Charlie Van Wagner

The Canadian Father of Fire Science

Fire Weather Index (FWI)



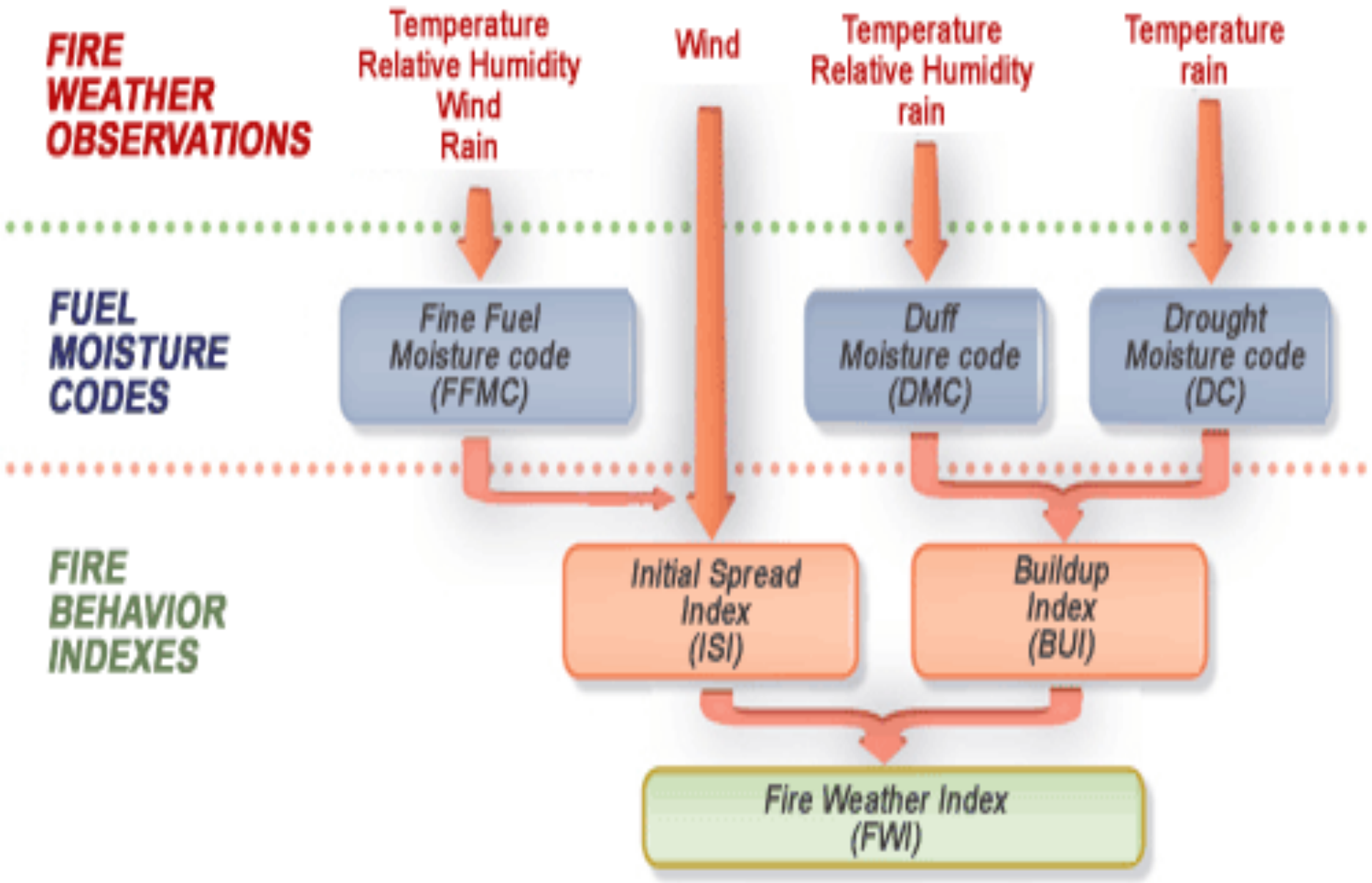
Fire Weather Observations



Temperature, Rain, Relative Humidity, and Wind

Fuel Moisture Content!

Fire Weather Index (FWI)



Fuel Types

Coniferous

C-1	Spruce-lichen woodland
C-2	Boreal spruce
C-3	Mature jack or lodgepole pine
C-4	Immature jack or lodgepole pine
C-5	Red and white pine
C-6	Conifer planatation
C-7	Ponderosa pine-Douglas-fir

Deciduous

D-1	Leafless aspen

Mixedwood

M-1	Boreal mixedwood-leafless
M-2	Boreal mixedwood-green
M-3	Dead balsam fir mixedwood-leafless
M-4	Dead balsam fir mixedwood-green

Slash

S-1	Jack or lodgepole pine slash
S-2	White spruce-balsam slash
S-3	Coastal cedar-hemlock-Douglas-fir slash

Open

O-1a	Matted grass
O-1b	Standing grass

Fire Behavior Prediction System (FBPS)

C1 – Spruce Lichen

C2 – Boreal Spruce

C3 – Mature Pine

C4 – Immature Pine

D1 – Leafless Aspen

M1 – Mixedwood Leafless

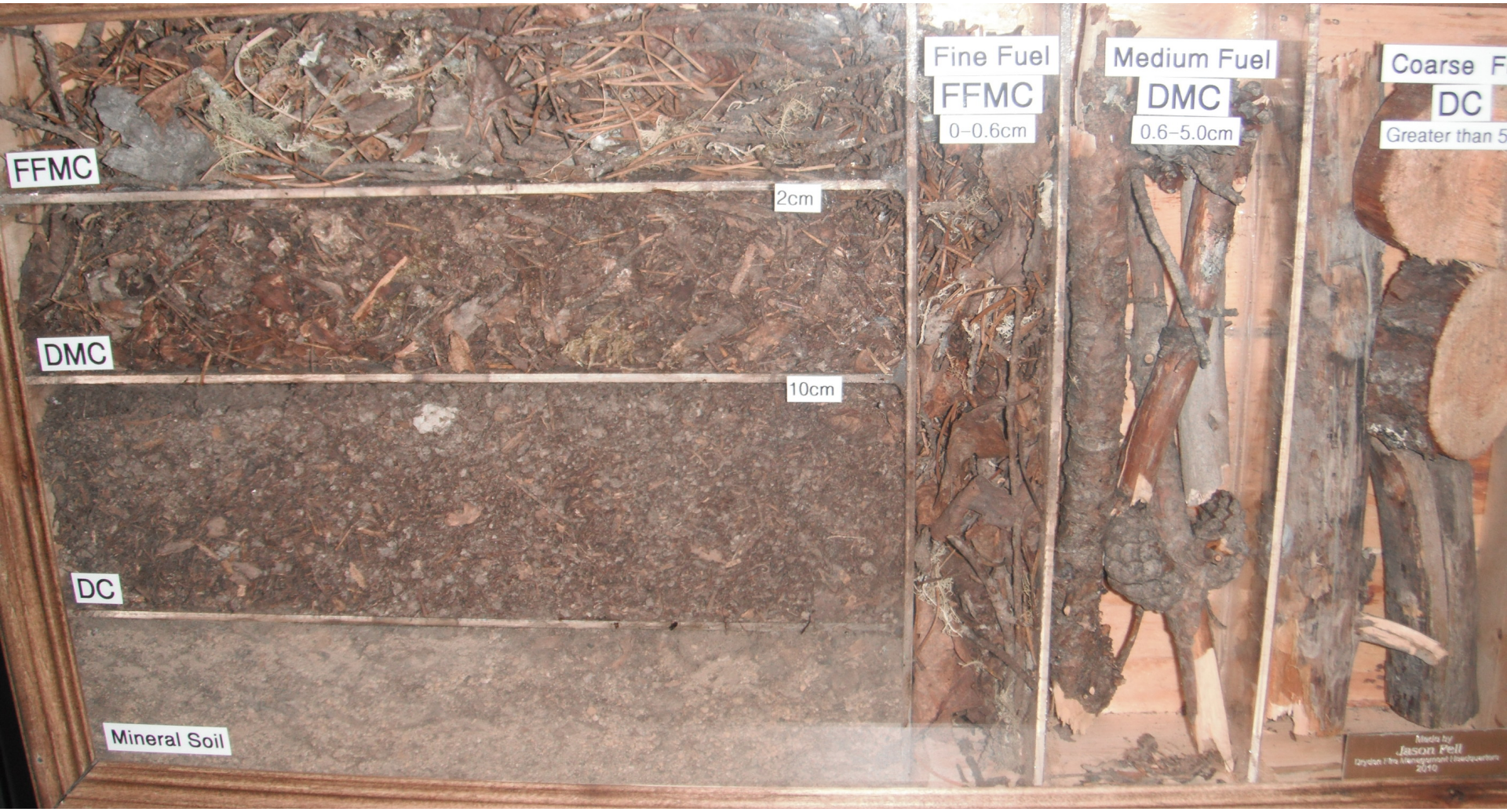
S1 – Pine Slash

S2 – Spruce Slash

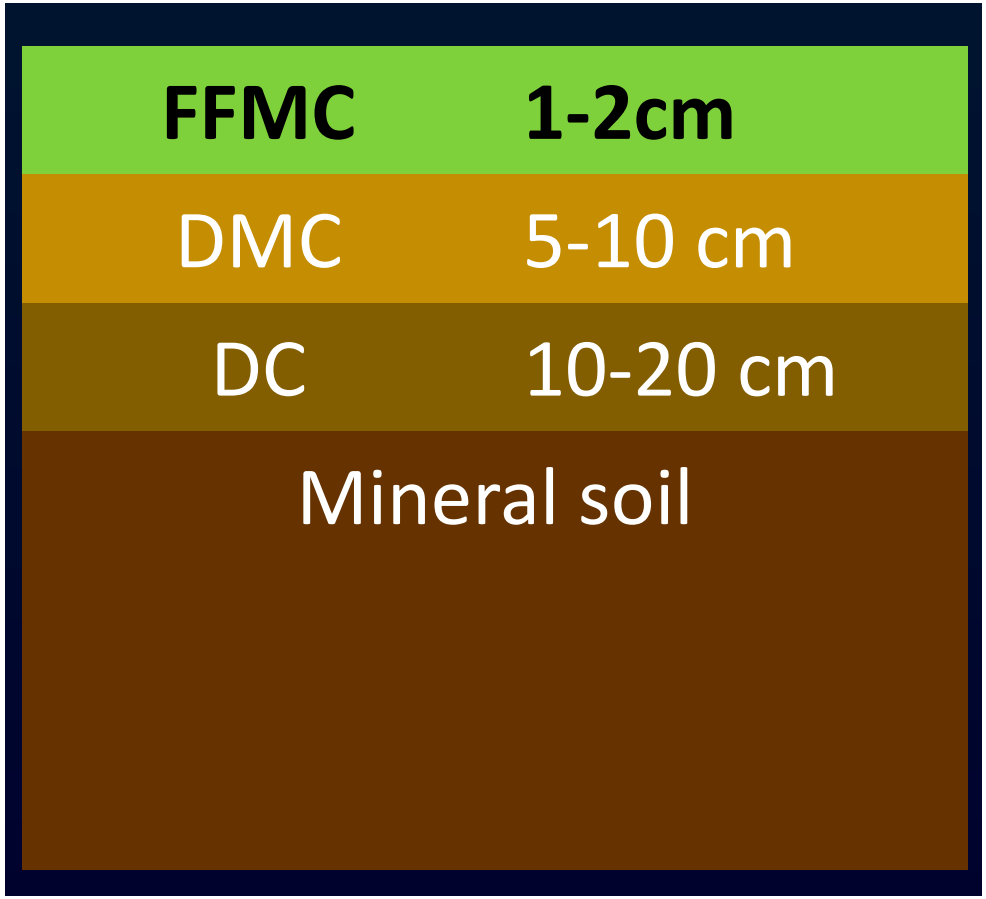
O1a – Matted Grass

O1b – Standing Grass

Fuel Moisture Codes



Drying and Wetting Phase



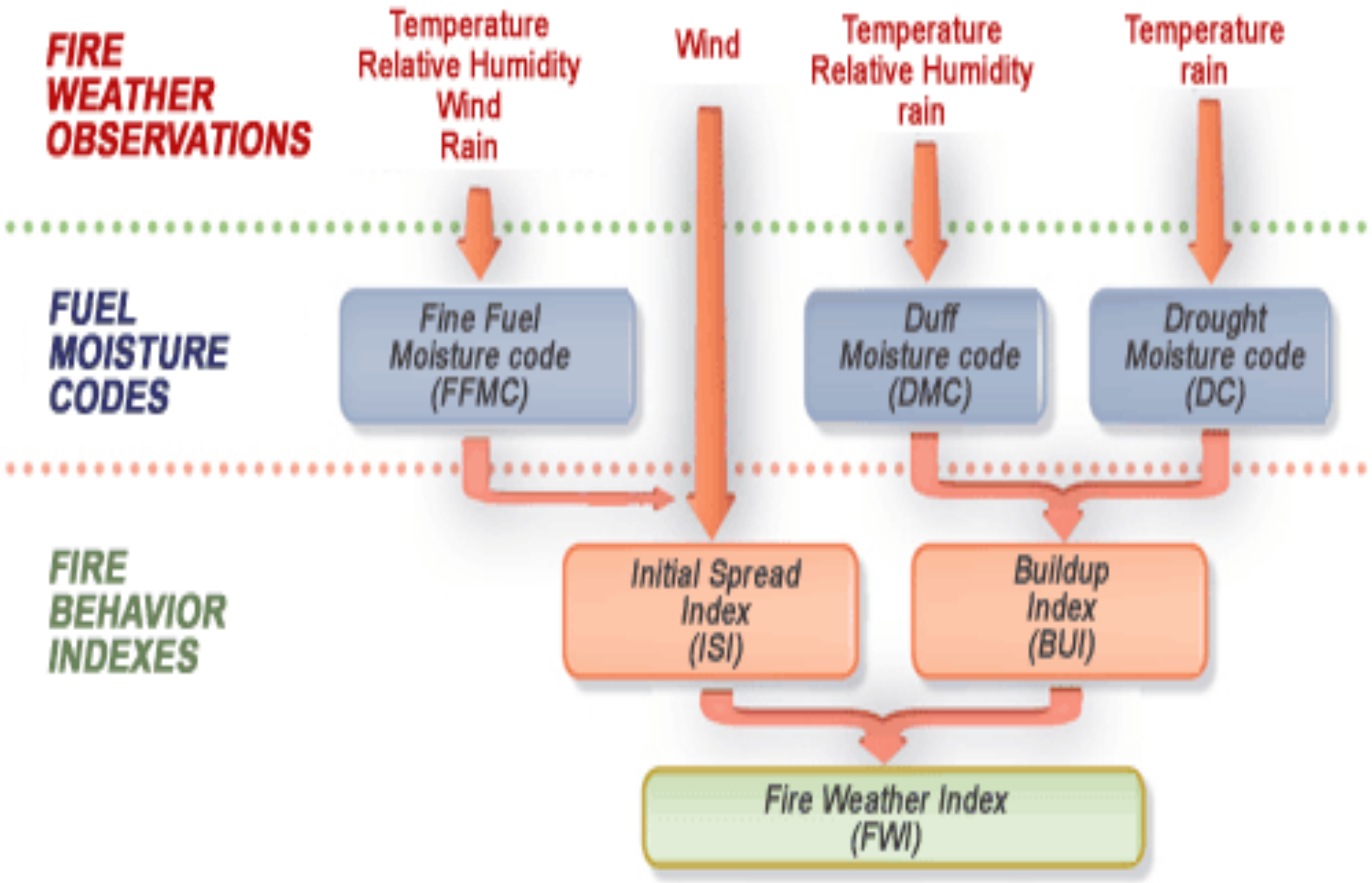
Time Lag

FFMC = 2/3 of day
DMC = 15 days
DC = 53 days

Rainfall Threshold

FFMC = 0.6 mm or 0.02”
DMC = 16 mm or 0.62”
DC = 29 mm or 1.14

Fire Weather Index (FWI)



FWI and Fire Behavior

Initial Spread Index (ISI)

Determines the Rate Of Spread (ROS) of that particular fuel type.

ISI		Effective Windspeed (in miles per hour) EL Open in at Eye Level in Open,																			
10 Meter		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
EL Open		1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12	13	13
FINE FUEL MOISTURE CODE (FFMC)	75	0.8	0.9	1	1.1	1.1	1.2	1.4	1.5	1.6	1.7	1.9	2	2.2	2.4	2.6	2.8	3	3.3	3.6	3.9
	76	0.9	1	1	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2	2.2	2.3	2.5	2.7	3	3.2	3.5	3.8	4
	77	0.9	1	1.1	1.2	1.3	1.4	1.5	1.7	1.8	2	2.1	2.3	2.5	2.7	2.9	3.2	3.5	3.7	4	4
	78	1	1.1	1.2	1.3	1.4	1.5	1.7	1.8	2	2.1	2.3	2.5	2.7	2.9	3.2	3.4	3.7	4	4	5
	79	1.1	1.2	1.3	1.4	1.5	1.7	1.8	2	2.1	2.3	2.5	2.7	3	3.2	3.5	3.8	4	4	5	5
	80	1.2	1.3	1.5	1.6	1.7	1.8	2	2.2	2.4	2.6	2.8	3	3.3	3.5	3.8	4	5	5	5	6
	81	1.4	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.9	3.1	3.4	3.6	3.9	4	5	5	6	6	6
	82	1.5	1.7	1.8	2	2.1	2.3	2.5	2.7	3	3.2	3.5	3.8	4	4	5	5	6	6	7	7
	83	1.8	1.9	2.1	2.2	2.4	2.6	2.8	3.1	3.4	3.6	3.9	4	5	5	5	6	6	7	8	8
	84	2	2.2	2.3	2.5	2.8	3	3.2	3.5	3.8	4	5	5	5	6	6	7	7	8	9	9
	85	2.3	2.5	2.7	2.9	3.2	3.4	3.7	4	4	5	5	6	6	7	7	8	8	9	10	11
	86	2.6	2.8	3.1	3.3	3.6	3.9	4	5	5	5	6	6	7	8	8	9	10	10	11	12
	87	3	3.3	3.6	3.9	4	5	5	5	6	6	7	7	8	9	9	10	11	12	13	14
	88	3.5	3.8	4	5	5	5	6	6	7	7	8	9	9	10	11	12	13	14	15	16
	89	4	4	5	5	6	6	7	7	8	8	9	10	11	12	13	14	15	16	17	19
	90	5	5	6	6	6	7	8	8	9	10	11	11	12	13	15	16	17	19	20	22
	91	5	6	6	7	7	8	9	10	10	11	12	13	14	15	17	18	20	21	23	25
	92	6	7	7	8	9	9	10	11	12	13	14	15	16	18	19	21	23	25	27	29
	93	7	8	8	9	10	11	12	13	14	15	16	17	19	20	22	24	26	28	31	33
	94	8	9	10	10	11	12	13	14	16	17	18	20	22	24	26	28	30	33	35	38
	95	9	10	11	12	13	14	15	17	18	20	21	23	25	27	29	32	34	37	40	44
	96	11	12	13	14	15	16	18	19	21	22	24	26	29	31	34	36	39	43	46	50

Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

FWI and Fire Behavior

Build-up Index (BUI)

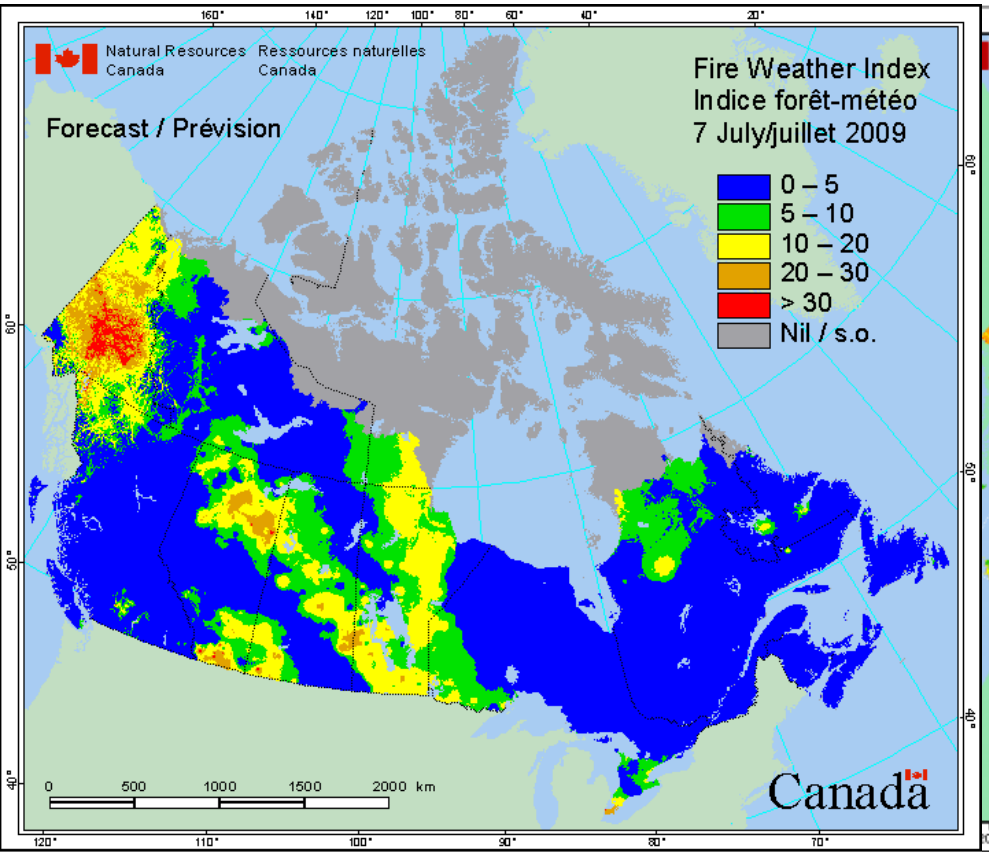
Indicates the fuel available to burn; 2/3 DMC + 1/3 DC

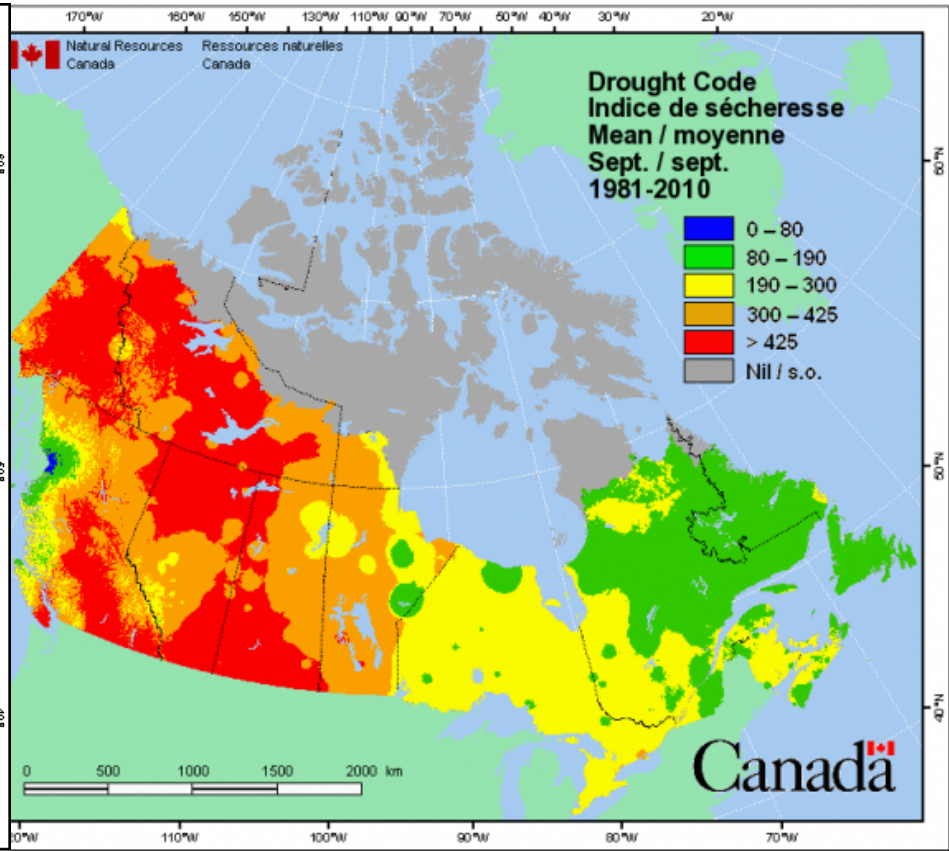
FWI	BUILDUP INDEX (BUI)																									
INITIAL SPREAD INDEX (ISI)	1	5	8-12	13-17	18-22	23-27	28-32	33-37	38-42	43-37	48-52	53-57	58-62	63-67	68-72	73-77	78-84	85-94	95-104	105-114	115-124	125-134	135-144	145-154	155-164	165-174
1	0	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	4	5	5	5	6	6	6	6	6	7
2	1	1	2	3	3	4	4	5	5	6	6	6	7	7	8	8	8	9	10	10	11	11	11	12	12	12
3	1	2	3	4	5	6	6	7	8	8	9	9	10	10	11	11	12	12	13	14	15	15	15	16	16	16
4	1	3	4	6	7	7	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18	19	19	20	20	20
5	2	4	5	7	8	9	10	11	12	13	13	14	15	15	16	17	17	18	19	20	21	22	22	23	23	24
6	3	5	7	8	9	11	12	13	14	14	15	16	17	18	18	19	20	21	22	23	24	25	26	26	27	27
7	3	5	7	9	11	12	13	14	15	16	17	18	19	20	21	21	22	23	25	26	27	28	28	29	30	30
8	4	6	8	10	12	13	15	16	17	18	19	20	21	22	23	23	24	26	27	28	29	30	31	32	32	33
9	4	7	9	11	13	15	16	17	18	20	21	22	23	24	25	25	26	28	29	31	32	33	34	34	35	35
10	5	8	10	12	14	16	17	19	20	21	22	23	24	25	26	27	28	30	32	33	34	35	36	37	37	38
11	5	8	11	13	15	17	18	20	21	23	24	25	26	27	28	29	30	32	34	35	36	37	38	39	40	40
12	6	9	12	14	16	18	20	21	23	24	25	27	28	29	30	31	32	34	36	37	38	40	41	41	42	43
13	6	10	13	15	17	19	21	22	24	25	27	28	29	30	32	33	34	36	38	39	41	42	43	44	44	45
14	7	10	13	16	18	20	22	24	25	27	28	30	31	32	33	34	35	37	39	41	43	44	45	46	46	47
15	7	11	14	17	19	21	23	25	27	28	30	31	32	34	35	36	37	39	41	43	44	46	47	48	48	49
16	7	11	15	18	20	22	24	26	28	29	31	32	34	35	36	37	39	41	43	45	46	48	49	50	50	51
17	8	12	16	18	21	23	25	27	29	31	32	34	35	36	38	39	40	42	45	46	48	49	51	52	52	53
18	8	12	16	19	22	24	26	28	30	32	33	35	36	38	39	40	42	44	46	48	50	51	52	53	54	55
19	9	13	17	20	23	25	27	29	31	33	35	36	38	39	41	42	43	46	48	50	52	53	54	55	56	57
20	9	14	18	21	23	26	28	30	32	34	36	37	39	40	42	43	45	47	49	51	53	55	56	57	58	59
21	9	14	18	21	24	27	29	31	33	35	37	39	40	42	43	45	46	49	51	53	55	56	58	59	60	60
22	10	15	19	22	25	28	30	32	34	36	38	40	41	43	45	46	47	50	52	55	56	58	59	61	61	62
23	10	15	19	23	26	29	31	33	35	37	39	41	43	44	46	47	49	51	54	56	58	60	61	62	63	64
24	11	16	20	24	27	29	32	34	36	38	40	42	44	45	47	49	50	53	55	58	60	61	63	64	65	66
25	11	16	21	24	27	30	33	35	37	39	41	43	45	47	48	50	51	54	57	59	61	63	64	65	66	67
26	11	17	21	25	28	31	34	36	38	40	42	44	46	48	49	51	53	56	58	60	63	64	66	67	68	69
27	12	17	22	26	29	32	35	37	39	41	43	45	47	49	51	52	54	57	60	62	64	66	67	68	70	70
28	12	17	22	26	30	33	35	38	40	42	44	46	48	50	52	53	55	58	61	63	65	67	69	70	71	72
29	12	18	23	27	30	33	36	39	41	43	45	47	49	51	53	55	56	59	62	65	67	69	70	71	73	73
30	13	18	23	28	31	34	37	40	42	44	46	48	50	52	54	56	57	61	63	66	68	70	72	73	74	75

FWI and Fire Behavior

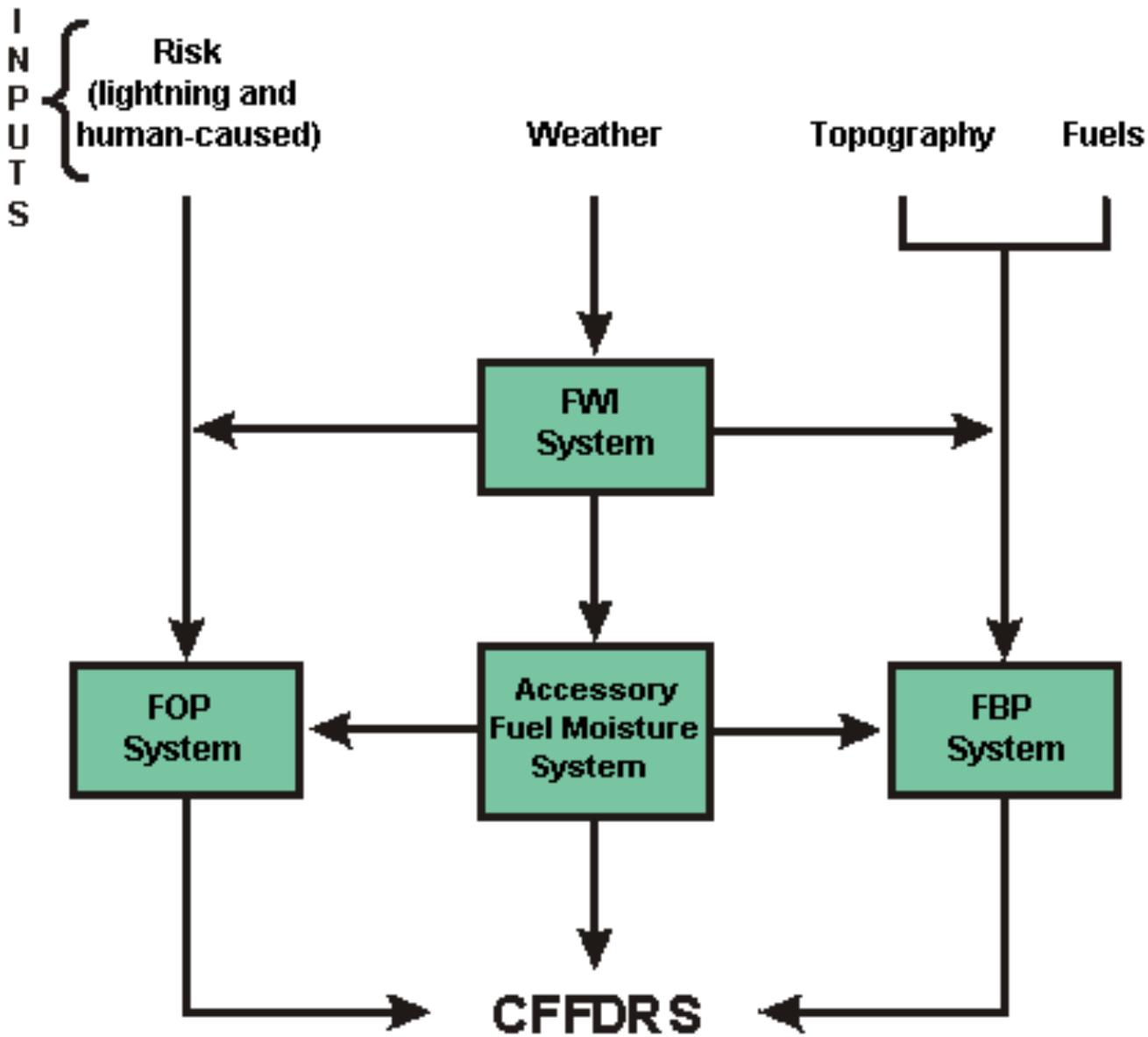
Fire Weather Index (FWI)

- Low (0.0-4.9)
- Moderate (5.0-13.9)
- High (14.0-20.9)
- Very High (21.0-32.9)
- Extreme (33.0+)





Canadian Forest Fire Danger Rating System (CFFDRS)



Canadian Forest Fire Danger Rating System (CFFDRS)

Fire Rank	Smoke	Fire Behavior	Fire Tactics
1	White Whispy	Smoldering - no visible flame	Direct Attack
2	Thick White	Surface Fire - visible flame	Flank Attack
3	Thick Grey	Vigorous Surface Fire - visible flame	Heel to Toe
4	Dark Grey	Intermittent Torching	Helicopter Support
5	Black	Crown Fire - fuel finding	Safety Zone & Tankers
6	Copper / Brown	Crown Fire - continuous flame front	Indirect Attack

On the Fireline

- An eye in the sky and a hand in the ground.
- Spot weather forecasts.
- Lack of safety is our only failure!

Any questions, comments or concerns