

## Firefighter's Guide to Percentiles and Thresholds

Percentiles and thresholds are used to help us measure the significance of NFDRS outputs as they relate to levels of fire risk, fuel conditions and fire danger. Have you ever asked a firefighter the question “How are your fires burning” and you get a response something like “Real hot”? The definition of “Real hot” will vary depending upon whom you ask. One objective of this refresher is to define the NFDRS and fire weather thresholds that relate to problematic fire behavior.

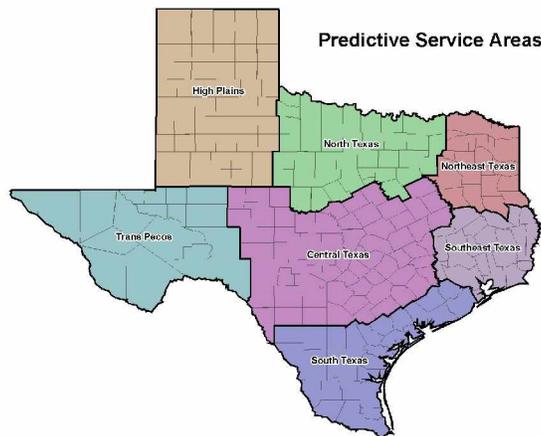
**Percentiles** are based on a scale of 0-100. We use percentiles to sort and rank a collection of data. **Thresholds** are the actual values of NFDRS indices (ERC, BI, KBDI), weather observations (RH, windspeed) or fuel moistures (1-hr, 1000-hr) that mark the change from one category to another. As an example the Fort Davis RAWS has calculated the burning index (BI) every day over 14 years for a total of 5000 observations. In sorting through these 5000 BI observations we find that only 10% of these BI observations have a BI value of 60 or greater. The BI of 60 is the threshold. BI values greater than or equal to the threshold of 60 exceed the 90<sup>th</sup> percentile. We found that only 3% of the observations occur above the BI value of 74. Crossing the threshold of a 74 BI ranks in the 97<sup>th</sup> percentile.

Percentiles				
0-49	50-74	75-89	90-96	97+

Whether we are looking at fuel moistures, BI, KBDI or ERC, we generally make the same associations when rating the percentiles. At the low end of the scale in the green and blues we see normal to below normal conditions. Initial attack should be successful with few complexities. At the upper end of the scale in the orange and reds we see unusual or rare conditions and we would expect to see complex fires where initial attack may often fail. So the difficult category to describe and thus maybe the most important category for initial attack is the middle or transition zone in the yellow. Somewhere in the yellow, fires transition from normal to problematic.

### Predictive Serve Areas (PSA)

The underlying philosophy for determination of our Predictive Service Areas is that they represent areas where the weather reporting stations (RAWs) tend to react similarly to daily weather regimes and exhibit similar fluctuations in fire danger and climate. Seven PSA were delineated in Texas. Fire weather thresholds, fuel moisture thresholds and NFDRS thresholds have been developed for each PSA and are unique to the designated PSA. Threshold values developed from one PSA should not be used in another PSA.



Central Texas NFDRS Thresholds						
Percentile	Fuel Model 78G		Fuel Model 88L		Fuel Model 88F	
	ERC	BI	ERC	BI	ERC	BI
97	47	58	NA	47	58	119
90-96	41-46	48-57	NA	36-46	44-57	93-118
75-89	35-40	38-47	NA	25-35	25-43	60-92
50-74	28-34	30-37	NA	13-24	8-24	21-69
0-49	0-27	0-29	NA	0-23	0-7	0-20

North Texas NFDRS Thresholds						
Percentile	Fuel Model 78G		Fuel Model 88L		Fuel Model 78L	
	ERC	BI	ERC	BI	ERC	BI
97	63	82	NA	63	NA	57
90-96	51-62	68-81	NA	51-62	NA	48-56
75-89	41-50	54-67	NA	38-50	NA	39-47
50-74	31-40	42-53	NA	25-37	NA	28-38
0-49	0-30	41	NA	24	NA	27

Here is an example. In the Central Texas PSA a BI of 25 in fuel model 88L would fall at the 75<sup>th</sup> percentile (yellow). In the North Texas PSA the same BI of 25 in the fuel model 88L would fall right at the 50<sup>th</sup> percentile (blue). It is also critical to compare the thresholds in the appropriate fuel model.

### Predictive Service Area Critical Thresholds

The critical thresholds for each PSA can be found in Appendix 3. These PSA sheets can also be found on the Texas Forest Service predictive service web page where they can be copied and printed.

### Finding Threshold Values

Current or forecasted values for NFDRS indices, fire weather observations, and fuel moistures are required to determine the percentiles. In some regions, dispatchers may broadcast the numbers. In regions without dispatch centers, firefighters will have to access the Internet to find the values. Following are the sources where firefighters can find the values for each type of threshold.

#### Fire Weather Thresholds

The most common source for **forecasted** values of relative humidity, temperature and 20-foot windspeed is the National Weather Service daily fire weather forecast. Spot weather forecasts are another source for forecast values when there are ongoing fires or prescribed burns. **Current** and hourly values can be taken from remote automated weather stations (RAWS). The hourly observations are available on the Internet and most dispatchers can access the RAWS by phone for the current readings. Firefighters can also measure temperature and relative humidity. Most firefighters have the ability to measure eye-level windspeed. The critical threshold windspeed values are 20-foot windspeed, which are generally higher than eye-level windspeed due to sheltering. Be aware of the difference if you use an eye-level windspeed.

#### Fuel Moisture Thresholds

The daily 1300 observation of the 1000-hr, 100-hr, and 10-hr dead fuel moistures are posted on the Wildland Fire Assessment (WFAS) web page daily. There is a link to this site on the TFS predictive service page. Here is an explanation of what you will see.

***** Texas *****	Elev	Lat	Long	Mdl	Tmp	RH	Wind	PPT	ERC	BI	SC	KBDI	HUN	THOU	TEN	STL	ADJ
410202 CADD0	800	33.7	95.9	7L	89	54	9	.00	0	3	3	269	12	19	9	1	L
410401 CLARKSVILLE	480	33.0	95.0	8D	89	50	6	.00	18	19	3	267	15	23	9	1	L
410501 TEXARKANA	200	33.3	94.0	8D	88	56	5	.02	17	16	2	235	18	25	10	1	L
411102 LINDEN	500	33.0	94.0	8D	89	56	3	.38	2	0	0	389	27	28	35	1	L

The yellow highlighted section shows the values (from left to right) for the 100, 1000, and 10-hr dead fuel moistures. Current 10-hour fuel moisture is calculated hourly by the RAWS and can be accessed by Internet or phone. 1-hr fuel moisture can be calculated using the fine dead fuel calculation tables in the fireline handbook or estimated by reducing the 10-hr fuel moisture by 2. For a complete explanation of the WFAS NFDRS observations format, see appendix 4, NFDRS observations. **Live fuel moistures** for southern pine spp. and juniper spp. are posted on the TFS predictive service page.

#### NFDRS Thresholds

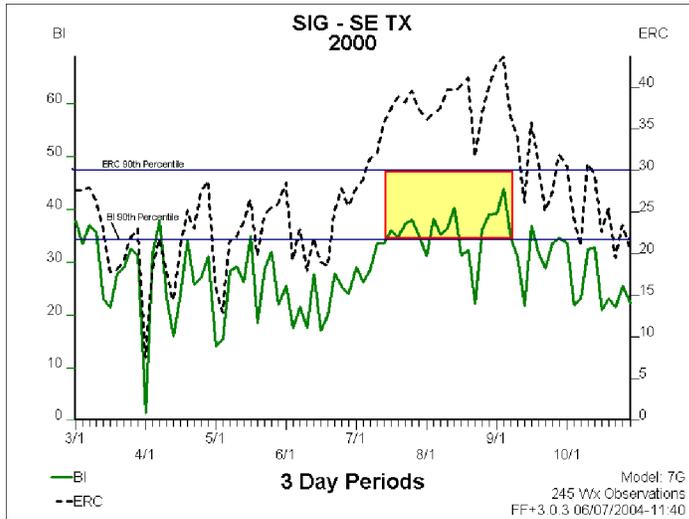
The most available source for finding the current and forecast values for BI and ERC is the Wildland Fire Assessment (WFAS) web page. The **forecast values** are needed (especially BI) to provide the firefighter a sense of fire risk for the upcoming burning period. The forecast values are available on the WFAS page at 0800 CST and are applicable for that same day. Unfortunately, at the time of this writing, the BI and ERC are not forecast for every RAWS in Texas. We are working with the National Weather Service to provide these forecasts for all Texas RAWS. The **current values** for ERC and BI are applicable at 1300 CST the previous day. The value for ERC can still be used as ERC values are slow to change but the BI value from the previous day will not be of much use as a measure of the next day's fire risk. Wind speed is a major factor in determining BI, which causes daily variability in BI values.

#### Measure of Fire Business

Fire managers and firefighters should never observe unexpected fire behavior. We should be able to use the tools available to us and anticipate containment problems that may occur during initial attack.

It would be great if there were one magic index or number that would predict fire business. Unfortunately this number does not exist. We should look at combinations of fire weather, fuel moistures and NFDRS indices to gauge fire risk potential.

Establishing thresholds and color-coding percentiles is an attempt to help firefighters judge the daily fire risk. If all of the thresholds were in the red it would be easy to recognize that it was going to be a tough day on the fireline. Most days the thresholds will not totally agree. Some will be in yellow while others may be in blue or orange. Two key thresholds to watch are the combination of ERC and BI. ERC is a good indicator of fuel conditions. BI is a good indicator of daily weather influences. The combination of these two indices can provide firefighters a sense for what to expect on the fireline.



This chart shows the seasonal tracks for BI (green) and ERC (dashed black) in southeast Texas from March through October of 2000. The blue lines are the 90<sup>th</sup> percentile lines for ERC (upper) and BI (lower). From mid-July through the first 10 days of September, both the ERC and BI regularly exceeded the 90<sup>th</sup> percentile (yellow highlight). Problematic, complex fires that sometimes escaped initial attack were common during this period in southeast Texas.

The fire weather thresholds are also key thresholds to monitor. Fire weather thresholds can be used in combination with ERC if a forecast BI is not available. If the ERC is in the yellow percentiles and the fire weather thresholds are met or exceeded, expect an active day. All of the indices and threshold values have applications in forecasting fire risk and should be monitored. Remember to stay current with weather changes and update the morning forecasts if needed.