# Smoke Dispersion and Fire Prescription Planner

# Questions You Should Be Able to Answer by the End of this Module

- What are the two major adverse impacts of smoke?
- What is an inversion layer and what happens to smoke caught within it?
- Which of the six dispersion categories from the Oklahoma Dispersion Model are good for prescribed burning?
- How can the Fire Prescription Planner be used for prescribed burning?



## wildland Fire Emissions (Health Impacts)

- Carbon Dioxide (CO2) and Water Vapor
- Carbon Monoxide (CO)
- Hydrocarbons (HC)
- Nitrogen Oxides (NOx)
- Particulate Matter
  - < PM2.5 (70%)</p>
  - PM2.5-10 (20%)
  - -> PM10 (10%)





### Atmospheric Dispersion =

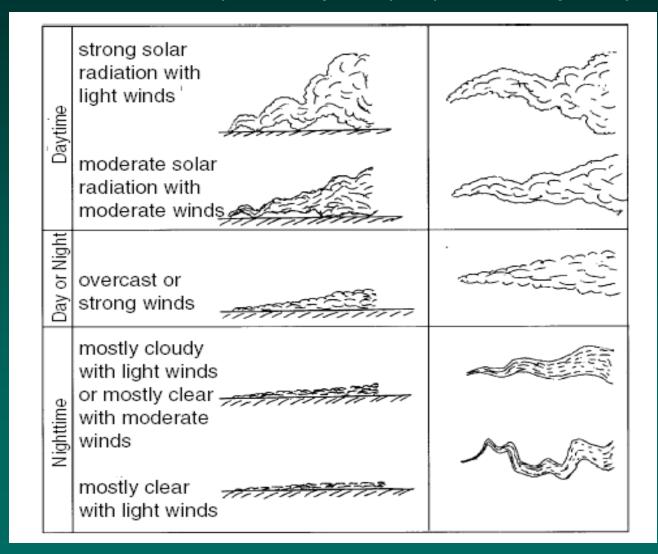
the ability of the atmosphere to horizontally and vertically disperse and dilute embedded gases and/or particulate matter

### **TYPES OF ATMOSPHERIC DISPERSION**

Weather Factors

Side View (vertical dispersion)

Top View (horizontal dispersion)



UNSTABLE ATMOSPHERE

NEUTRAL ATMOSPHERE

STABLE ATMOSPHERE

### Unstable Atmosphere – Good Dispersion





### Figure 3

A closer view of the behaviour of the plume in convective conditions. Note the grounding of the plume indicated by the arrow.



# Neutral Atmosphere – *Moderate* Dispersion

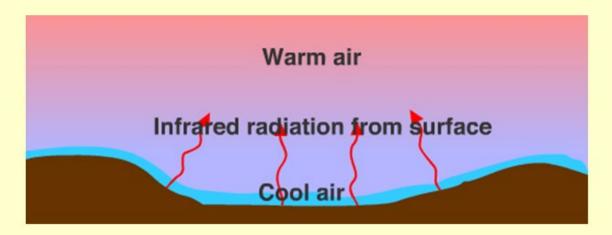


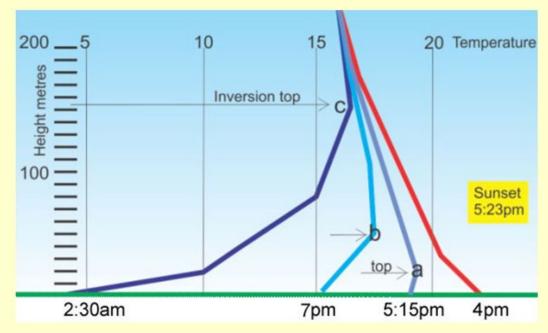




### Stable Atmosphere – Poor Dispersion

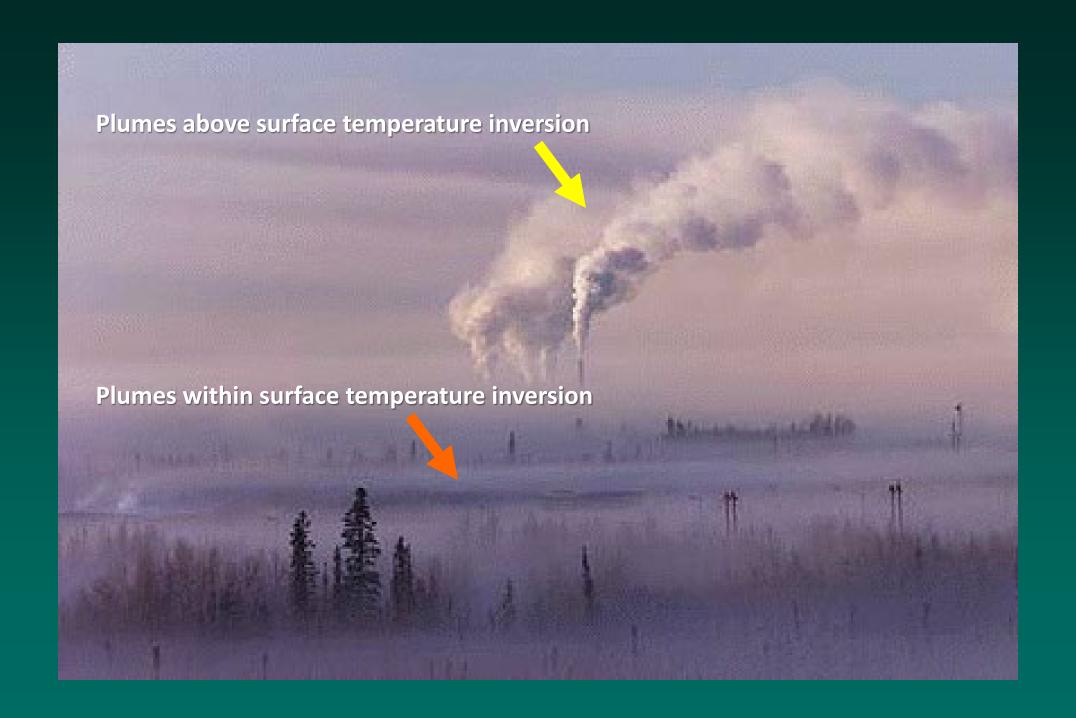
### **Surface Radiation Inversion**



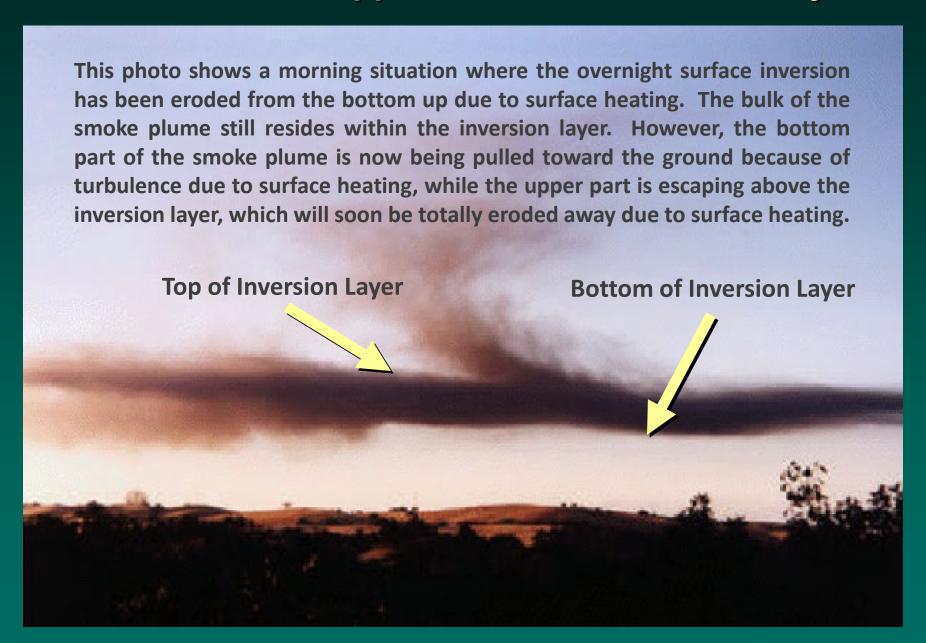








### **Smoke Plume Trapped within an Inversion Layer**

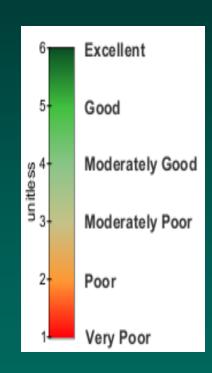


### The Oklahoma Dispersion Model

(What are the relative downwind smoke levels near the surface where people live and drive?)

### **Six Dispersion Categories**

- Excellent = 6.0 ("EX"; dark green)
- Good = 5.0 ("G"; green)
- Moderately Good = 4.0 ("MG"; light green)
- Moderately Poor = 3.0 ("MP"; beige)
- Poor = 2.0 ("P"; orange)
- Very Poor = 1.0 ("VP"; red)



### TYPES OF ATMOSPHERIC DISPERSION

Weather Factors

Side View (vertical dispersion)

Top View (horizontal dispersion)

_		
Daytime	strong solar radiation with light winds	
Da	moderate solar radiation with moderate winds	
Day or Night	overcast or strong winds	
Nighttime	mostly cloudy with light winds or mostly clear ————————————————————————————————————	
Nigh	winds mostly clear with light winds	

**Excellent (EX=6)** 

**Good (G=5)** 

**Moderately Good (MG=4)** 

**Moderately Poor (MP=3)** 

Poor (P=2)

**Very Poor (VP=1)** 

### **Dispersion Conditions for Smoke**

EX (6), G (5), MG (4)

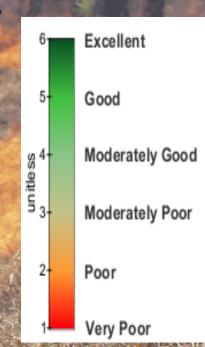
MP (3)

P (2), VP(1)

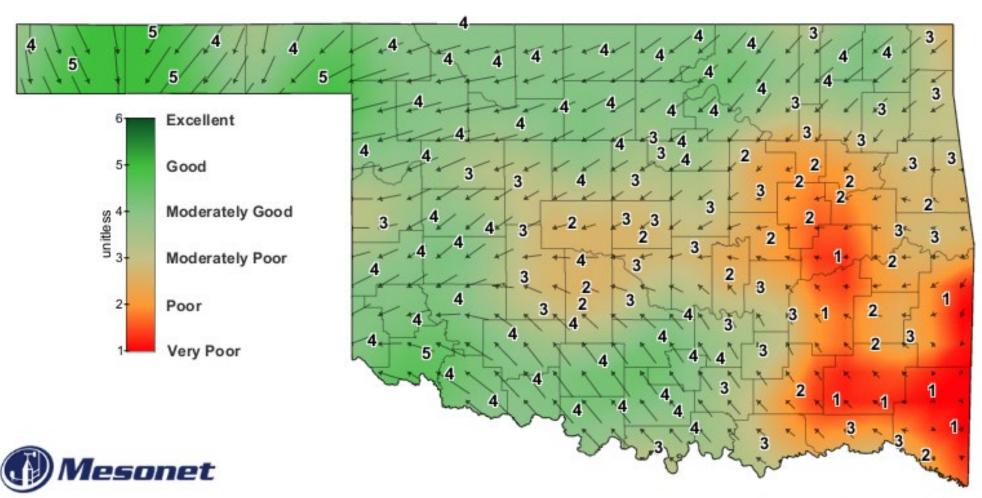
Good conditions for prescribed burns

Acceptable if no sensitive areas downwind

Avoid these times



### **Dispersion Conditions and Winds**

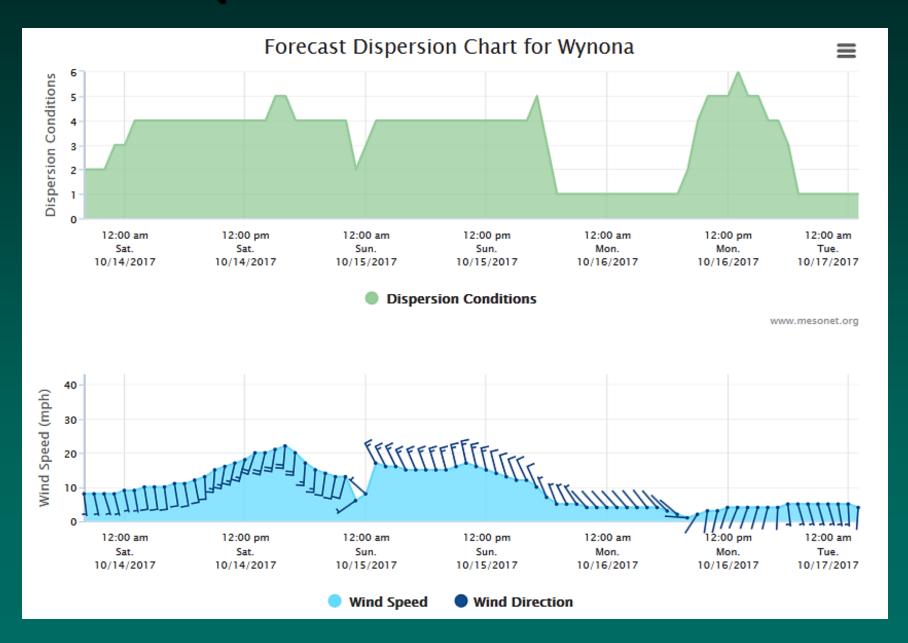


**Dispersion Conditions and Winds** 

10:00 PM May 2, 2017 CDT

Created 10:05:34 PM May 2, 2017 CDT. @ Copyright 2017

### **Dispersion and Wind Charts**





### **Relative Humidity**



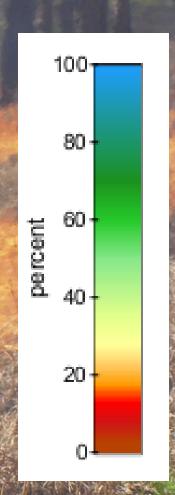
- **30-80%**
- **20-30%**
- **< 20%**

Fuels may be too moist for fire; heavy smoke possible

Normal range for prescribed burning

Containment difficult; quick ignition; spotfires increase

Extreme fire behavior; spotfires frequent



### Wind Speed

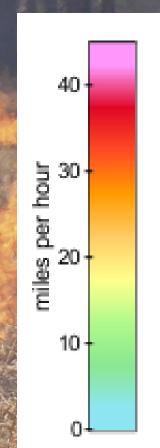
- 4 mph
- 4-15 mph
- 15-20 mph
- > 20 mph

Generally unsuitable for prescribed burning; variable direction

Normal range for prescribed burning

Threshold range

Increasingly problematic; spotfires increase; containment more difficult



### 1 and 10-h Dead Fuel Moisture

1-hr fuels 10-hr fuels

> 20% > 15%

7-20% 6-15%

5-7% 5-6%

< 5% < 5%

Fire Behavior

Fuels too moist for fire spread; heavy smoke possible

Normal range for prescribed burning

Containment difficult; quick ignition; spotfires increase

Extreme fire behavior; spotfires frequent; burn with extreme caution

# "Fire Prescription Planner"

Current Station Conditions	>
Current Maps	>
Past & Forecast Animated Maps	>
Past & Forecast Charts/Tables	>
Fire Prescription Planner	>
NWS Forecast Chart (Stillwater)	>
NWS Forecast Table (Stillwater)	>
Relative Greenness Zoom Map	>
Default Fuel Model Zoom Map	>
Fire Advisories and Outlooks	>
3.9 µ Infrared Satellite Map	>
Recent Lightning Activity	>
Oklahoma Burn Bans	>
Additional Resources	>
Contacts and Learning Tools	>
News	>

### Current Fuel Model for Stillwater

T - Tallgrass with open evergreen b 

Default is T

### **DK-FORE** Fire Prescription Planner Share ■ Tweet Use Conditions for Beginning Burners Reset Values Lower Limit Upper Limit Variable NNE Air Temperature (F) 281° Relative Humidity W (%) 124° ESE WSW Wind Speed (mph) SSW SSE 1-hr Precipitation (inches) Wind Direction Heat Index [heat stress] (F) \*\* Click on the sectors you wish to prescribe \*\* Dispersion Conditions







Share

Tweet

Use Conditions for Begi	nning Burners	Reset Values	
Variable	Lower Limit	Upper Limit	NNW NNE
Air Temperature (F)	35		NW 326° 34° NE
Relative Humidity (%)	40	80	281° W 259°
Wind Speed (mph)	4	15	wsw 236° sw 214° 146° se
1-hr Precipitation (inches)		0.00	SSW S SSE
Heat Index [heat stress] (F)		104	Wind Direction  ** Click on the sectors you wish to prescrit
Dispersion Conditions	Moderately	Good v	<b>v</b>

1-hr Dead Fuel Moisture (%)	8	20
10-hr Dead Fuel Moisture (%)	7	15
Burning Index (10*ft)		
Ignition Component (%)		
Spread Component (ft/min)		
Energy Release Component (BTU/ft2)	)	
KBDI (0-800)		

Fri 8/30/24 2 am CDT	No	<b>81</b> °F	58%	<b>83</b> °F	S	3 mph	<b>0.00</b> in.	1 (VP)	8%	8%
Fri 8/30/24 3 am CDT	No	<b>79</b> °F	63%	<b>79</b> °F	NW	3 mph	<b>0.00</b> in.	1 (VP)	8%	9%
Fri 8/30/24 4 am CDT	Yes	<b>77</b> °F	69%	<b>77</b> °F	NNW	9 mph	<b>0.00</b> in.	4 (MG)	9%	9%
Fri 8/30/24 5 am CDT	Yes	<b>75</b> °F	75%	<b>75</b> °F	NNW	<b>10</b> mph	<b>0.00</b> in.	4 (MG)	11%	10%
Fri 8/30/24 6 am CDT	Yes	<b>73</b> °F	80%	<b>73</b> °F	NNW	<b>11</b> mph	<b>0.00</b> in.	4 (MG)	12%	11%
Fri 8/30/24 7 am CDT	No	<b>71</b> °F	86%	<b>71</b> °F	N	<b>12</b> mph	<b>0.00</b> in.	4 (MG)	14%	13%
Fri 8/30/24 8 am CDT	No	<b>71</b> °F	85%	<b>71</b> °F	N	<b>13</b> mph	<b>0.02</b> in.	4 (MG)	85%	15%
Fri 8/30/24 9 am CDT	No	<b>71</b> °F	83%	<b>71</b> °F	NNW	<b>13</b> mph	<b>0.02</b> in.	4 (MG)	85%	17%
DATE / TIME	Criteria Met?	TAIR	RELH	HEAT INDEX	WDIR	WSPD	1hr PRECIP	DISPERSION	1hr DFM	10hr DFM
Fri 8/30/24 10 am CDT	No	<b>71</b> °F	81%	<b>71</b> °F	NNW	<b>13</b> mph	<b>0.02</b> in.	4 (MG)	85%	19%
Fri 8/30/24 11 am CDT	No	<b>74</b> °F	74%	<b>74</b> °F	N	<b>13</b> mph	<b>0.00</b> in.	4 (MG)	30%	18%
Fri 8/30/24 12 pm CDT	No	<b>77</b> °F	68%	<b>77</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	18%	17%
Fri 8/30/24 1 pm CDT	Yes	<b>80</b> °F	61%	<b>80</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	13%	<b>15</b> %
Fri 8/30/24 2 pm CDT	Yes	<b>81</b> °F	59%	<b>82</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	10%	14%
Fri 8/30/24 3 pm CDT	Yes	<b>82</b> °F	58%	<b>83</b> °F	N	<b>15</b> mph	<b>0.00</b> in.	4 (MG)	9%	13%
Fri 8/30/24 4 pm CDT	Yes	<b>82</b> °F	56%	<b>84</b> °F	N	<b>15</b> mph	<b>0.00</b> in.	4 (MG)	8%	13%
Fri 8/30/24 5 pm CDT	Yes	<b>81</b> °F	59%	<b>83</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	8%	<b>12</b> %
Fri 8/30/24 6 pm CDT	Yes	<b>80</b> °F	61%	<b>80</b> °F	N	<b>13</b> mph	<b>0.00</b> in.	4 (MG)	8%	<b>12</b> %
Fri 8/30/24 7 pm CDT	Yes	<b>78</b> °F	64%	<b>78</b> °F	N	<b>12</b> mph	<b>0.00</b> in.	4 (MG)	9%	<b>12</b> %
Fri 8/30/24 8 pm CDT	Yes	<b>76</b> °F	67%	<b>76</b> °F	N	<b>10</b> mph	<b>0.00</b> in.	4 (MG)	9%	<b>12</b> %
Fri 8/30/24 9 pm CDT	No	<b>74</b> °F	71%	<b>74</b> °F	N	8 mph	<b>0.00</b> in.	2 (P)	10%	<b>12</b> %
Fri 8/30/24 10 pm CDT	No	<b>73</b> °F	<b>75</b> %	<b>73</b> °F	N	6 mph	<b>0.00</b> in.	1 (VP)	11%	13%
Fri 8/30/24 11 pm CDT	No	<b>71</b> °F	76%	<b>71</b> °F	N	6 mph	<b>0.00</b> in.	1 (VP)	<b>12</b> %	14%
Sat 8/31/24 12 am CDT	No	<b>70</b> °F	77%	<b>70</b> °F	N	7 mph	<b>0.00</b> in.	1 (VP)	13%	14%
Sat 8/31/24 1 am CDT	No	<b>69</b> °F	<b>78</b> %	<b>69</b> °F	N	7 mph	<b>0.00</b> in.	1 (VP)	13%	15%
Sat 8/31/24 2 am CDT	No	<b>68</b> °F	82%	<b>68</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	14%	15%
Sat 8/31/24 3 am CDT	No	<b>66</b> °F	86%	<b>66</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	15%	16%
Sat 8/31/24 4 am CDT	No	<b>65</b> °F	90%	<b>65</b> °F	NNW	5 mph	<b>0.00</b> in.	1 (VP)	17%	17%
Sat 8/31/24 5 am CDT	No	<b>63</b> °F	92%	<b>63</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	19%	17%
DATE / TIME	Criteria Met?	TAIR	RELH	HEAT INDEX	WDIR	WSPD	1hr PRECIP	DISPERSION	1hr DFM	10hr DFM
Sat 8/31/24 6 am CDT	No	<b>62</b> °F	94%	<b>62</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	22%	18%





Use Conditions for Begi	nning Burner	Reset Values	
Variable	Lower Limit	Upper Limit	NNW N NNE
Air Temperature (F)	35		NW 326° 34° NE  304° NE  WNW 56° ENE
Relative Humidity (%)	40	80	281°
Wind Speed (mph)	4	15	WSW 236° 124° ESE 146° SE
1-hr Precipitation (inches)		0.00	SSW S SSE
Heat Index [heat stress] (F)		104	** Click on the sectors you wish to prescribe **
Dispersion Conditions	Moderately	Good v	<b>▼</b>

1-hr Dead Fuel Moisture (%)	8	20	
10-hr Dead Fuel Moisture (%)	7	15	
Burning Index (10*ft)			
Ignition Component (%)			
Spread Component (ft/min)			
Energy Release Component (BTU/ft2)			
KBDI (0-800)			
			✓ Include All Non

Stillwater

Show: Next 84 Hours >

✓ Include All Non-Prescribed Variables

■ Save Settings as Default

Get Data

Fri 8/30/24 2 am CDT	No	<b>81</b> °F	58%	<b>83</b> °F	S	3 mph	<b>0.00</b> in.	1 (VP)	8%	8%	12	7%	16	1	691
Fri 8/30/24 3 am CDT	No	79°F	63%	79°F	NW	3 mph	0.00 in.	1 (VP)	8%	9%	11	6%	16	1	691
Fri 8/30/24 4 am CDT	Yes	77°F	69%	77°F	NNW	9 mph	0.00 in.	4 (MG)	9%	9%	17	9%	53	1	691
Fri 8/30/24 5 am CDT	Yes	<b>75</b> °F	75%	75°F	NNW	<b>10</b> mph	0.00 in.	4 (MG)	11%	10%	14	6%	43	1	691
Fri 8/30/24 6 am CDT	Yes	<b>73</b> °F	80%	73°F	NNW	<b>11</b> mph	0.00 in.	4 (MG)	12%	11%	9	4%	27	0	691
Fri 8/30/24 7 am CDT	No	71°F	86%	<b>71</b> °F	N	<b>12</b> mph	0.00 in.	4 (MG)	14%	13%	3	1%	6	0	691
Fri 8/30/24 8 am CDT	No	<b>71</b> °F	85%	<b>71</b> °F	N	<b>13</b> mph	0.02 in.	4 (MG)	85%	15%	0	0%	0	0	691
Fri 8/30/24 9 am CDT	No	<b>71</b> °F	83%	<b>71</b> °F	NNW	<b>13</b> mph	0.02 in.	4 (MG)	85%	17%	0	0%	0	0	691
	Criteria			HEAT			1hr	. ,	1hr	10hr					
DATE / TIME	Met?	TAIR	RELH	INDEX	WDIR	WSPD	PRECIP	DISPERSION	DFM	DFM	ВІ	IC	SC	ERC	KBDI
Fri 8/30/24 10 am CDT	No	<b>71</b> °F	81%	<b>71</b> °F	NNW	<b>13</b> mph	<b>0.02</b> in.	4 (MG)	85%	19%	0	0%	0	0	691
Fri 8/30/24 11 am CDT	No	<b>74</b> °F	74%	<b>74</b> °F	N	<b>13</b> mph	<b>0.00</b> in.	4 (MG)	30%	18%	0	0%	0	0	691
Fri 8/30/24 12 pm CDT	No	<b>77</b> °F	68%	<b>77</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	18%	17%	0	0%	0	0	691
Fri 8/30/24 1 pm CDT	Yes	<b>80</b> °F	61%	<b>80</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	13%	15%	6	2%	15	0	691
Fri 8/30/24 2 pm CDT	Yes	<b>81</b> °F	<b>59</b> %	<b>82</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	10%	14%	15	7%	47	1	691
Fri 8/30/24 3 pm CDT	Yes	<b>82</b> °F	58%	<b>83</b> °F	N	<b>15</b> mph	<b>0.00</b> in.	4 (MG)	9%	13%	19	11%	57	1	691
Fri 8/30/24 4 pm CDT	Yes	<b>82</b> °F	56%	<b>84</b> °F	N	<b>15</b> mph	<b>0.00</b> in.	4 (MG)	8%	13%	21	12%	60	1	691
Fri 8/30/24 5 pm CDT	Yes	<b>81</b> °F	<b>59</b> %	<b>83</b> °F	N	<b>14</b> mph	<b>0.00</b> in.	4 (MG)	8%	<b>12</b> %	21	12%	61	1	691
Fri 8/30/24 6 pm CDT	Yes	<b>80</b> °F	61%	<b>80</b> °F	N	<b>13</b> mph	<b>0.00</b> in.	4 (MG)	8%	<b>12</b> %	20	12%	59	1	691
Fri 8/30/24 7 pm CDT	Yes	<b>78</b> °F	64%	<b>78</b> °F	N	<b>12</b> mph	<b>0.00</b> in.	4 (MG)	9%	<b>12</b> %	19	11%	57	1	691
Fri 8/30/24 8 pm CDT	Yes	<b>76</b> °F	67%	<b>76</b> °F	N	<b>10</b> mph	<b>0.00</b> in.	4 (MG)	9%	<b>12</b> %	17	9%	53	1	691
Fri 8/30/24 9 pm CDT	No	<b>74</b> °F	71%	<b>74</b> °F	N	8 mph	<b>0.00</b> in.	2 (P)	10%	<b>12</b> %	15	7%	46	1	691
Fri 8/30/24 10 pm CDT	No	<b>73</b> °F	<b>75</b> %	<b>73</b> °F	N	6 mph	<b>0.00</b> in.	1 (VP)	11%	13%	11	5%	28	1	691
Fri 8/30/24 11 pm CDT	No	<b>71</b> °F	76%	<b>71</b> °F	N	6 mph	<b>0.00</b> in.	1 (VP)	12%	14%	9	4%	26	0	691
Sat 8/31/24 12 am CDT	No	<b>70</b> °F	77%	<b>70</b> °F	N	7 mph	<b>0.00</b> in.	1 (VP)	13%	14%	7	3%	18	0	691
Sat 8/31/24 1 am CDT	No	<b>69</b> °F	<b>78</b> %	<b>69</b> °F	N	7 mph	<b>0.00</b> in.	1 (VP)	13%	15%	5	2%	12	0	693
Sat 8/31/24 2 am CDT	No	<b>68</b> °F	<b>82</b> %	<b>68</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	14%	<b>15</b> %	2	1%	4	0	693
Sat 8/31/24 3 am CDT	No	<b>66</b> °F	86%	<b>66</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	15%	16%	0	0%	0	0	693
Sat 8/31/24 4 am CDT	No	65°F	90%	<b>65</b> °F	NNW	5 mph	<b>0.00</b> in.	1 (VP)	17%	17%	0	0%	0	0	693
Sat 8/31/24 5 am CDT	No	<b>63</b> °F	92%	<b>63</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	19%	17%	0	0%	0	0	693
DATE / TIME	Criteria Met?	TAIR	RELH	HEAT INDEX	WDIR	WSPD	1hr PRECIP	DISPERSION	1hr DFM	10hr DFM	ВІ	IC	SC	ERC	KBDI
Sat 8/31/24 6 am CDT	No	<b>62</b> °F	94%	<b>62</b> °F	NNW	6 mph	<b>0.00</b> in.	1 (VP)	22%	18%	0	0%	0	0	693





Use Conditions for Begi	inning Burners Res	set Values	
Variable	Lower Limit	Upper Limit	N
Air Temperature (F)			NNW 349° NNE 11° NNE 304° NE 56° ENE
Relative Humidity (%)		40	281° 79° E
Wind Speed (mph)	15		WSW 236° 124° ESE 146° SE
1-hr Precipitation (inches)			SSW S SSE
Heat Index [heat stress] (F)			Wind Direction  ** Click on the sectors you wish to prescribe **
Dispersion Conditions		~ ~	
1-hr Dead Fuel Moisture (%)		7	
10-hr Dead Fuel Moisture (%)			
Burning Index (10*ft)	40		

Latest forecast based on 7 am CDT 08/29/24 NAM; next 6-hr update expected 5 pm CDT 08/29/24

### Fire Prescription Table for Hollis

Print Table

**Disclaimer:** This forecast table, as with other OK-FIRE products, is based solely on output from the latest 84-hr NAM forecast. As no weather forecast model is perfect, users are encouraged to check the official forecasts of the National Weather Service for consistency or discrepancies in the weather variable portion of this forecast.

## **Change Prescription or Site**

DATE / TIME	Criteria Met?	RELH	HEAT INDEX	WDIR	WSPD	DISPERSION	1hr DFM	ВІ
Thu 8/29/24 3 pm CDT	Yes	32%	97°F	SSE	<b>15</b> mph	4 (MG)	5%	73
Thu 8/29/24 4 pm CDT	Yes	30%	98°F	SSE	<b>15</b> mph	4 (MG)	5%	75
Thu 8/29/24 5 pm CDT	Yes	31%	97°F	SSE	<b>15</b> mph	4 (MG)	5%	75
Thu 8/29/24 6 pm CDT	Yes	32%	96°F	SSE	<b>15</b> mph	4 (MG)	5%	74
Thu 8/29/24 7 pm CDT	No	33%	95°F	SSE	<b>14</b> mph	4 (MG)	5%	73
Thu 8/29/24 8 pm CDT	No	35%	94°F	SSE	<b>13</b> mph	4 (MG)	5%	66
Thu 8/29/24 9 pm CDT	No	38%	92°F	SSE	<b>11</b> mph	3 (MP)	5%	58
Thu 8/29/24 10 pm CDT	No	40%	90°F	SSE	9 mph	3 (MP)	6%	51
Thu 8/29/24 11 pm CDT	No	44%	88°F	SSE	<b>10</b> mph	4 (MG)	6%	52
Fri 8/30/24 12 am CDT	No	47%	87°F	SSE	<b>11</b> mph	4 (MG)	6%	53
Fri 8/30/24 1 am CDT	No	51%	85°F	SSE	<b>11</b> mph	4 (MG)	<b>7</b> %	53
Fri 8/30/24 2 am CDT	No	55%	84°F	SSE	<b>10</b> mph	3 (MP)	7%	46
Fri 8/30/24 3 am CDT	No	59%	82°F	SSE	8 mph	2 (P)	8%	38
Fri 8/30/24 4 am CDT	No	63%	78°F	SSE	6 mph	1 (VP)	9%	29
Fri 8/30/24 5 am CDT	No	66%	77°F	SSE	4 mph	1 (VP)	9%	18
Fri 8/30/24 6 am CDT	No	69%	76°F	SE	2 mph	1 (VP)	10%	8
Fri 8/30/24 7 am CDT	No	<b>72</b> %	75°F	NE	1 mph	1 (VP)	11%	5



- What are the two major adverse impacts of smoke?
- What is an inversion layer and what happens to smoke caught within it?
- Which of the six dispersion categories from the Oklahoma Dispersion Model are good for prescribed burning?
- How can the Fire Prescription Planner be used for prescribed burning?



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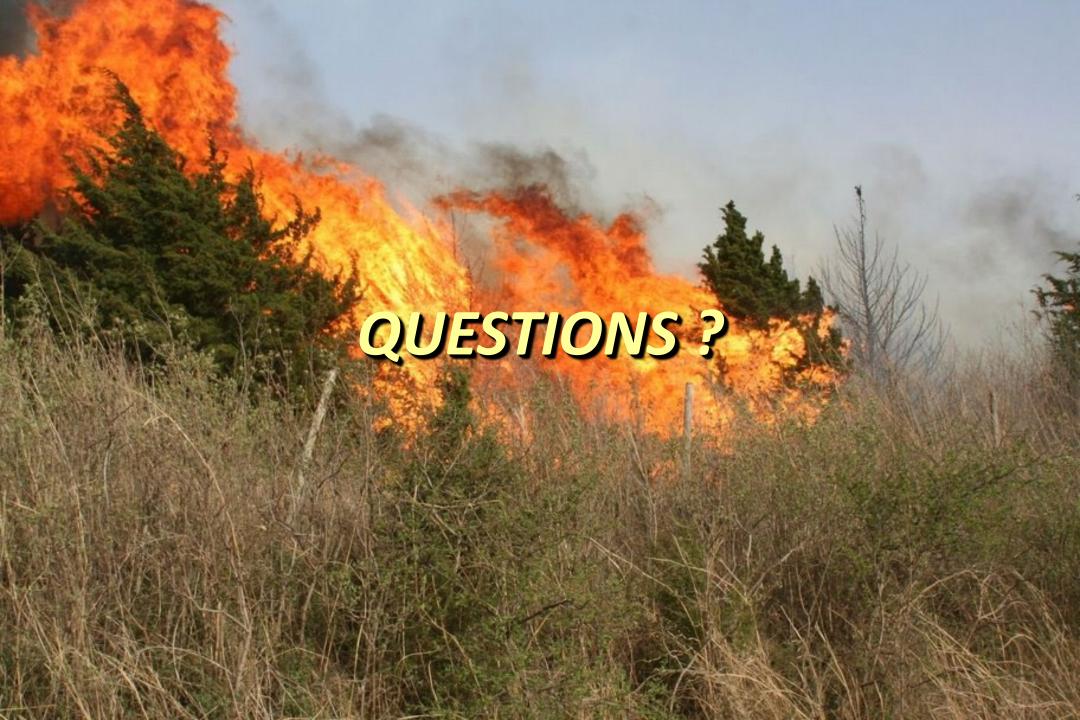
# **Introduction to Prescribed Fire**

Time limit: 120 days

\$20 Enroll Now







# Web Site Demo: Dispersion Products and Fire Prescription Planner