

# WEATHER SAFETY WARMUP

WEBINAR SERIES

# HOUSEKEEPING

- This webinar is being recorded and will be sent out shortly after the webinar
- Have a question? Use the chat box and we will get to the question at the end of the session
- Want to learn more? We have additional sessions every month!
- For those interested in a **certificate of attendance**, please let us know in the chat or reply to the follow up email
- You can also provide feedback, suggest a topic or ask a question by emailing us at [info@earthnetworks.com](mailto:info@earthnetworks.com)

# MASTERING WBGT AND HEAT STRESS MANAGEMENT

## AGENDA

- Heat stress and its impact
- Monitoring the threat
  - Temperature
  - Heat index
  - Wet Bulb Globe Temperature (WBGT)
- Mastering heat stress management
  - Analyze
  - Plan
  - Monitor
  - Alert
  - Implement
  - Evaluate
- Takeaways

## PRESENTER

**MARK HOEKZEMA**

*Chief Meteorologist, Director  
of Meteorological Operations  
at Earth Networks*



# MASTERING WBGT AND HEAT STRESS MANAGEMENT





# HEAT STRESS

IS A MAJOR HEALTH RISK  
IN SPORTS, ATHLETICS,  
OUTDOOR RECREATION,  
AND OUTDOOR EVENTS



# HEAT STRESS

Heat stress occurs when your body cannot cool itself enough to maintain a healthy temperature





# EFFECTS OF HEAT STRESS

1. An inability to concentrate
2. Muscle cramps
3. Heat rash
4. Severe thirst - a late symptom of heat stress
5. Fainting
6. Heat exhaustion - fatigue, giddiness, nausea, headache, moist skin
7. Heat stroke





# THE REALITY OF HEAT STRESS

170

---

NWS reported a yearly average of 170 direct and indirect heat related fatalities

2,800

---

A study by the EPA found an average of 2,800 yearly heat related hospitalizations per year

Indoor Heat Stress?

---

You don't have to be outdoors to be at risk for Heat Stress

On the Rise

---

EPA also reports that heat related deaths are on the rise nationwide

# 2018 HEAT RELATED INCIDENTS IN ATHLETICS ACROSS THE COUNTRY

**Gilbert, AZ**

**Gilbert Perry High School**

**5/11/2018**

Football player hospitalized due to heat-related illness

**College Park, MD**

**University of Maryland, College Park**

**5/29/2018**

Offensive lineman hospitalized and died due to heatstroke

**Scottsdale, AZ**

**Saguaro High School**

**8/1/2018**

3 football players hospitalized for heat-related symptoms

**Atoka, OK**

**Atoka High School**

**8/2/2018**

9 school band members sent to clinic due to heat related illness

**Henderson, TN**

**Freed-Hardeman University**

**8/26/2018**

Baseball player collapsed while running due to heat stroke

**Moundsville, WV**

**John Marshall High School**

**9/6/2018**

37 students hospitalized due to heat exhaustion

**Austin, TX**

**University of Texas**

**9/8/2018**

Offensive lineman hospitalized due to heat-related illness

**Bowling Green, OH**

**Bowling Green State University**

**9/29/2018**

Football player hospitalized at away game due to heat stress



# MONITORING THE RISK OF HEAT STRESS

## Temperature

- Basic temperature reading
- First step to predicting heat stress

## Heat Index

- More advanced metric
- Looks at temperature and relative humidity
- Used by NWS currently

## Wet Bulb Globe Temperature (WBGT)

- A more advanced standard for managing heat stress
- Looks at multiple environmental factors





# TEMPERATURE | AVERAGE 90+ DEGREE DAYS IN MAJOR CITIES IN THE REGION



City	Number of 90+ Degree Days
Phoenix, AZ	168
San Antonio, TX	113
Orlando, FL	106
Jackson, MS	93
Montgomery, AL	78
Columbus, GA	76
Little Rock, AR	73
New Orleans, LA	72
Oklahoma City, OK	68
Memphis, TN	67
Albuquerque, MN	62
Denver, CO	34

# HEAT INDEX| WHAT IS IT?

The Heat Index is a measure of how hot it really feels when relative humidity is factored in with the actual air temperature

## Did you know?

- The National Weather Service heat alerts are based off heat index warnings
- Heat Index has been around since the 70s





# WET BULB GLOBE TEMPERATURE (WBGT) | WHAT IS IT?

WBGT is a measure of the heat stress in direct sunlight

## Did you know?

- WBGT was invented and first used in U.S. Marines and U.S. Army training camps in the 1950s
- Learn more at:  
[www.earthnetworks.com/wet-bulb-globe-temperature](http://www.earthnetworks.com/wet-bulb-globe-temperature)





# WET BULB GLOBE TEMPERATURE (WBGT) | HOW IS IT CALCULATED

## Environmental factors considered

- Temperature,
- Dew point (Humidity)
- Wind speed
- Sun angle
- Cloud cover (Solar Radiation)

**Formula:**  $WBGT=0.7T_w+0.2T_g+0.1T_d$

- **$T_w$ :** Natural Wet Bulb Temperature (which indicates humidity)
- **$T_g$ :** Globe Thermometer Temperature (which indicates radiant heat)
- **$T_d$ :** Dry Bulb Temperature (which indicates ambient air temperature)





# MASTERING HEAT STRESS MANAGEMENT



**ANALYZE**



**PLAN**



**MONITOR**



**ALERT**



**IMPLEMENT**



**EVALUATE**

# MASTERING HEAT STRESS MANAGEMENT – **ANALYZE**



**ANALYZE**

**Assets and exposures**

**Activities and events**

**Threats posed by weather variables  
(Heat Stress)**















**Sanctioning body guidelines**

**Initiation protocols and sheltering locations**

















# REGIONAL EXAMPLES – SEVERE WEATHER GRADE CARD

## CALIFORNIA

SEVERE WEATHER GRADE CARD							
 THUNDERSTORM HIGH WINDS	 LARGE HAIL	 TORNADOES	 EXTREME HEAT	 WILDFIRES	 DROUGHT	 FLOODING	
RARE, NONE	RARE, NONE	RARE, NONE	LOW	HIGH	HIGH	LOW	
 TROPICAL WEATHER	 NON- THUNDERSTORM HIGH WINDS	 HEAVY SNOW	 FREEZING RAIN	 FREQUENT LIGHTNING	 INVERSION/ AIR QUALITY	 DENSE FOG EVENTS	
RARE, NONE	HIGH	RARE, NONE	RARE, NONE	RARE, NONE	LOW	MEDIUM	

## FLORIDA

SEVERE WEATHER GRADE CARD							
 THUNDERSTORM HIGH WINDS	 LARGE HAIL	 TORNADOES	 EXTREME HEAT	 WILDFIRES	 DROUGHT	 FLOODING	
HIGH	LOW	MEDIUM	HIGH	LOW	LOW	HIGH	
 TROPICAL WEATHER	 NON- THUNDERSTORM HIGH WINDS	 HEAVY SNOW	 FREEZING RAIN	 FREQUENT LIGHTNING	 INVERSION/ AIR QUALITY	 DENSE FOG EVENTS	
HIGH	LOW	RARE, NONE	RARE, NONE	HIGH	LOW	LOW	

# ANALYZE – HIGH SCHOOL CAMPUS EXAMPLE



## STAKEHOLDERS AFFECTED

Students, athletes, coaches, faculty staff, referees, visitors



## ASSETS AND EXPOSURES

Sports field, outdoor campus area, outdoor leisure area, indoor field



## ACTIVITIES AND EVENTS

Sports program: football, soccer, track & field, etc. Outdoor recreation and events



## THREATS POSED BY WEATHER VARIABLES

Heat stress



## SANCTIONING BODY GUIDELINES

Required to monitor heat index or WBGT and stop activities when high



## PROTOCOLS

When WBGT is rising, monitor situation. When alert goes off, safety protocol is initiated



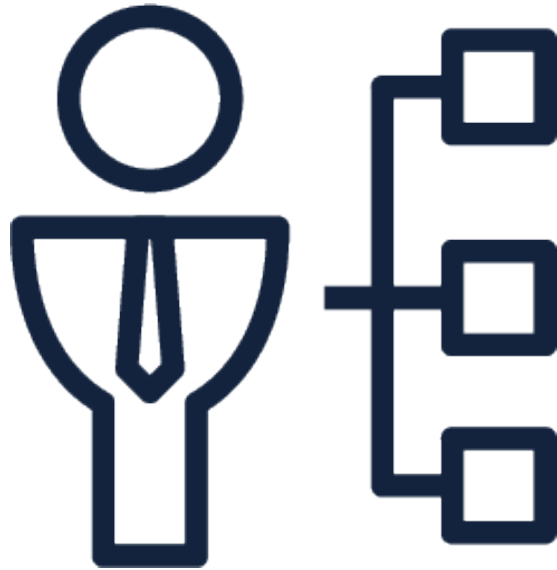
## SHELTERING LOCATIONS

Club house, main campus building, shaded dugout etc. with liquids and cooling stations





# MASTERING HEAT STRESS MANAGEMENT – **PLAN**



## **PLAN**

### **Build a custom policy spreadsheet by:**

- a. Type of outdoor activity
- b. Severe weather variable – WBGT, Heat Index
- c. Season and/or month – Spring, Summer & Fall months
- d. Responsible parties

### **Develop plan of action to include:**

- a. Forecasting & detection
- b. Alerting procedure
- c. Criteria for event suspension and resumption
- d. Safety protocol
- e. Designated safe shelters
- f. Chain of command

**Draft an effective communication strategy using all available channels**

# WGBT SAFETY POLICY CHART EXAMPLE

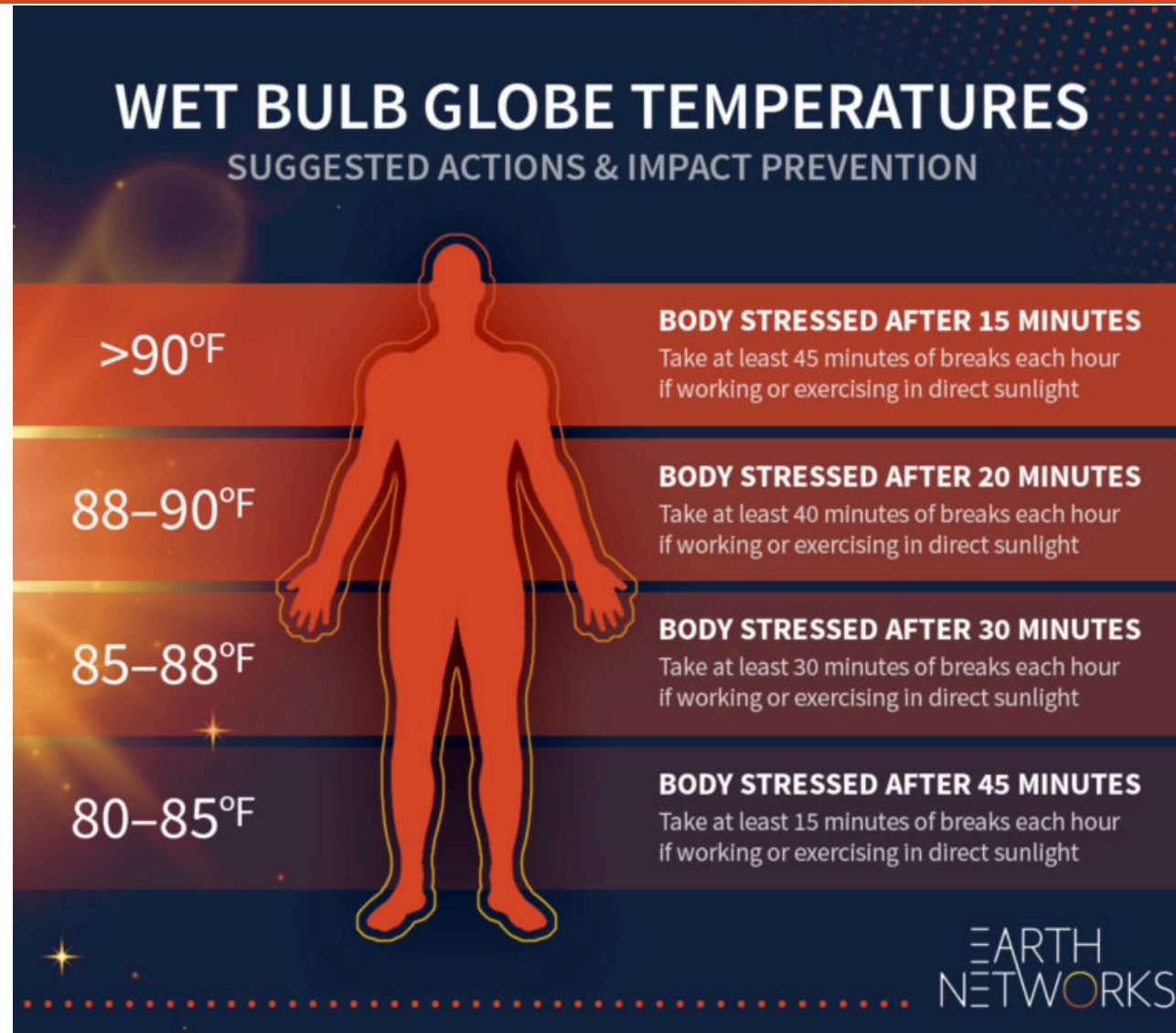
## Wet Bulb Globe Temperature Category Work/Rest and Water Intake

Unacclimated and Acclimated Work/Rest and Water Intake Chart

Heat Risk Category		Wet Bulb Globe Temp	Light Work		Moderate Work		Heavy Work	
			Work/Rest	Water Intake (quart/hr)	Work/Rest	Water Intake (quart/hr)	Work/Rest	Water Intake (quart/hr)
No Risk	Unacclimated	78 – 79.9	50/10 min	1/2	40/20 min	3/4	30/30 min	3/4
	Acclimated	78 – 79.9	continuous	1/2	continuous	3/4	50/10 min	3/4
Low	Unacclimated	80 – 84.9	40/20 min	1/2	30/30 min	3/4	20/40 min	1
	Acclimated	80 – 84.9	continuous	1/2	50/10 min	3/4	40/20 min	1
Moderate	Unacclimated	85 – 87.9	30/30 min	3/4	20/40 min	3/4	10/50 min	1
	Acclimated	85 – 87.9	continuous	3/4	40/20 min	3/4	30/30 min	1
High	Unacclimated	88 – 90	20/40 min	3/4	10/50 min	3/4	avoid	1
	Acclimated	88 – 90	continuous	3/4	30/30 min	3/4	20/40 min	1
Extreme	Unacclimated	> 90	10/50 min	1	avoid	1	avoid	1
	Acclimated	> 90	50/10 min	1	20/40 min	1	10/50 min	1



# NWS SUGGESTED PREVENTIVE ACTIONS



# MASTERING HEAT STRESS MANAGEMENT – **MONITOR**



## **MONITOR**

**Weather variables monitored – WBGT**

**Threats being monitored**

**Area being monitored**

**Technology being used**

**Integration to alerting platform**



# MONITORING WET BULB GLOBE TEMPERATURE (WBGT)

## CALCULATE IT YOURSELF

- You can use the index below to calculate WBGT readings
- Requires constant calculation, isn't automated and isn't accurate

**Wet Bulb Globe Temperature (WBGT) from Temperature and Relative Humidity**

		Temperature (°C)																														
		20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Relative Humidity (%)	0	15	16	16	17	18	18	19	19	20	20	21	22	22	23	23	24	24	25	25	26	27	27	28	28	29	29	30	31	31	32	32
	5	16	16	17	18	18	19	19	20	21	21	22	22	23	24	24	25	26	26	27	27	28	29	29	30	31	31	32	33	33	34	35
	10	16	17	17	18	19	19	20	21	21	22	23	23	24	25	25	26	27	27	28	29	30	30	31	32	32	33	34	35	36	36	37
	15	17	17	18	19	19	20	21	21	22	23	23	24	25	26	26	27	28	29	29	30	31	32	33	33	34	35	36	37	38	39	
	20	17	18	18	19	20	21	21	22	23	24	24	25	26	27	27	28	29	30	31	32	32	33	34	35	36	37	38	39			
	25	18	18	19	20	20	21	22	23	24	24	25	26	27	28	28	29	30	31	32	33	34	35	36	37	38	39					
	30	18	19	20	20	21	22	23	23	24	25	26	27	28	29	29	30	31	32	33	34	35	36	37	39							
	35	18	19	20	21	22	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39								
	40	19	20	21	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39									
	45	19	20	21	22	23	24	25	26	27	27	28	29	30	32	33	34	35	36	37	38											
	50	20	21	22	23	23	24	25	26	27	28	29	30	31	33	34	35	36	37	39												
55	20	21	22	23	24	25	26	27	28	29	30	31	32	34	35	36	37	38														
60	21	22	23	24	25	26	27	28	29	30	31	32	33	35	36	37	38															
65	21	22	23	24	25	26	27	28	29	31	32	33	34	36	37	38																
70	22	23	24	25	26	27	28	29	30	31	33	34	35	36	38	39																
75	22	23	24	25	26	27	29	30	31	32	33	35	36	37	39																	
80	23	24	25	26	27	28	29	30	32	33	34	36	37	38																		
85	23	24	25	26	28	29	30	31	32	34	35	37	38	39																		
90	24	25	26	27	28	29	31	32	33	35	36	37	39																			
95	24	25	26	27	29	30	31	33	34	35	37	38																				
100	24	26	27	28	29	31	32	33	35	36	38	39																				

WBGT > 40

Note: This table is compiled from an approximate formula which only depends on temperature and humidity. The formula is valid for full sunshine and a light wind

## HAND HELD DEVICES

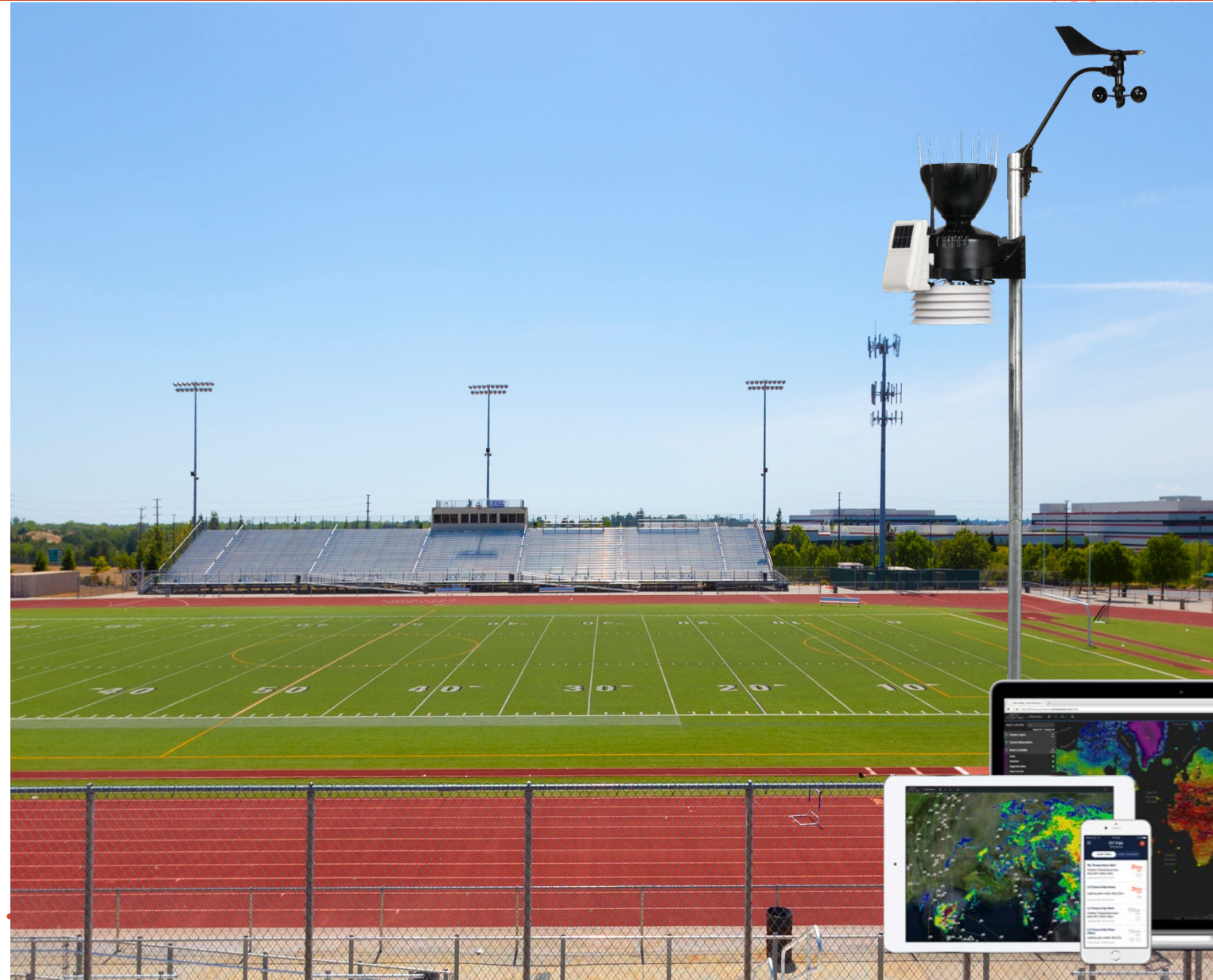
- Relatively inexpensive
- Very short range of coverage
- Doesn't alert



# MONITORING WET BULB GLOBE TEMPERATURE (WBGT)

## PROFESSIONAL WEATHER MONITORING

- Comprehensive campus wide monitoring
- Mobile alerting capability
- Automated
- Accurate
- Customizable
- Compatible with your safety policy
- Ability to visualize weather patterns helps with planning



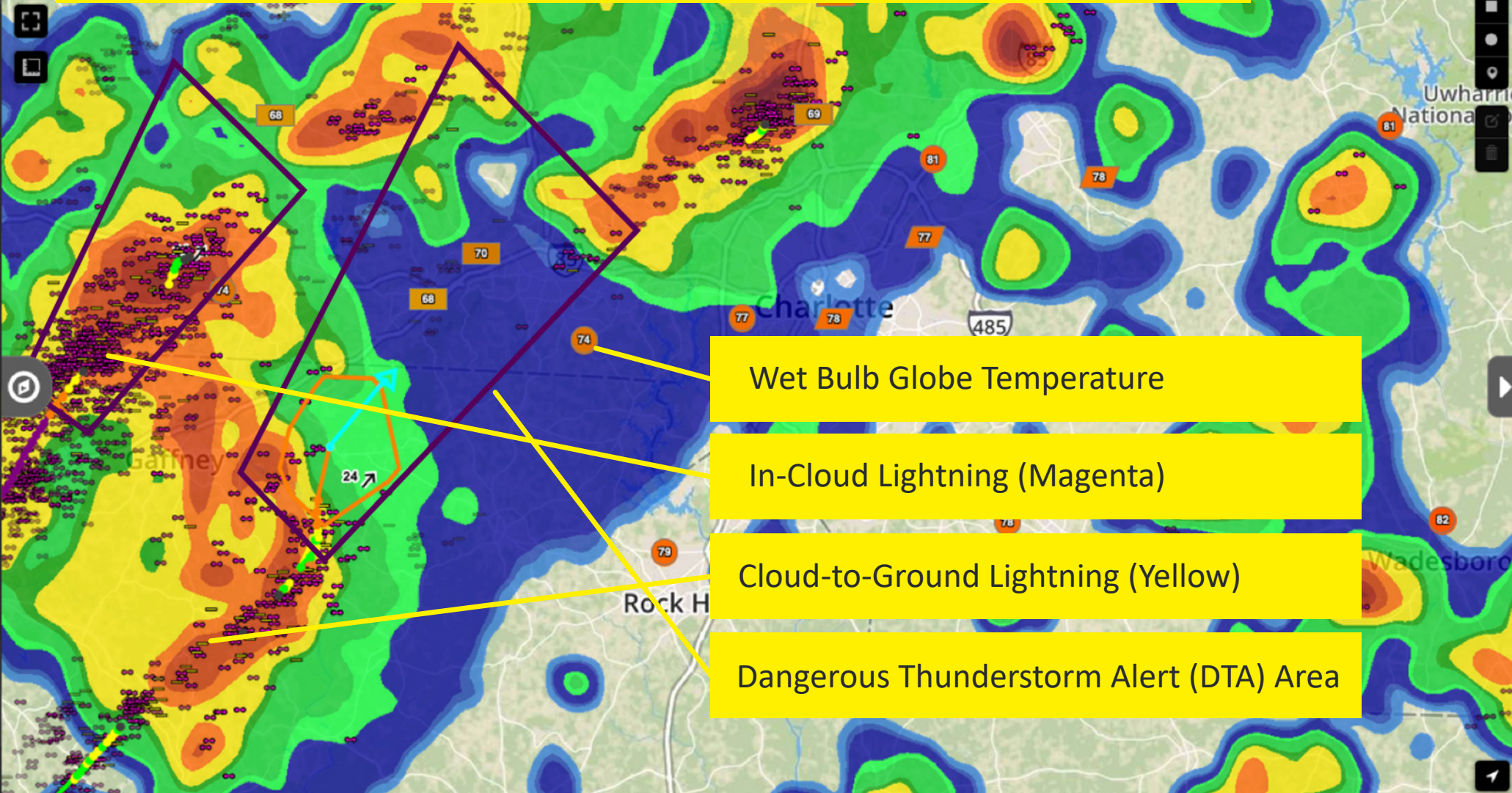


MAP LAYERS

Expand All | Collapse All

	POINT	CONTOUR
Temperature	<input type="checkbox"/>	<input type="checkbox"/>
Temperature Rate	<input type="checkbox"/>	<input type="checkbox"/>
High Temperature	<input type="checkbox"/>	<input type="checkbox"/>
Low Temperature	<input type="checkbox"/>	<input type="checkbox"/>
Dew Point	<input type="checkbox"/>	<input type="checkbox"/>
Dew Point Depression	<input type="checkbox"/>	<input type="checkbox"/>
Wet Bulb Globe Temperature	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Humidity	<input type="checkbox"/>	<input type="checkbox"/>
Heat Index	<input type="checkbox"/>	<input type="checkbox"/>
Wind Chill	<input type="checkbox"/>	<input type="checkbox"/>
Wind Speed and Direction	<input type="checkbox"/>	<input type="checkbox"/>
Hourly Wind Gust and Direction	<input type="checkbox"/>	<input type="checkbox"/>
Daily Wind Gust and Direction	<input type="checkbox"/>	<input type="checkbox"/>
Rain Rate	<input type="checkbox"/>	<input type="checkbox"/>
Daily Rain	<input type="checkbox"/>	<input type="checkbox"/>
Sea Level Pressure	<input type="checkbox"/>	<input type="checkbox"/>
Sea Level Pressure Rate	<input type="checkbox"/>	<input type="checkbox"/>
Pollen	<input type="checkbox"/>	<input type="checkbox"/>
<b>Radar &amp; Satellite</b>		
Radar	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Forecast Radar (U.S.)	<input type="checkbox"/>	<input type="checkbox"/>
PulseRad	<input type="checkbox"/>	<input type="checkbox"/>

# VISUALIZED SEVERE WEATHER TRACKING



- Wet Bulb Globe Temperature
- In-Cloud Lightning (Magenta)
- Cloud-to-Ground Lightning (Yellow)
- Dangerous Thunderstorm Alert (DTA) Area

# MASTERING HEAT STRESS MANAGEMENT – **ALERT**



**ALERT**

Type of threat - WBGT

Area being alerted

Type of alert

Alert recipients

Action after alert is received



# USE THE RIGHT ALERT FOR THE RIGHT AUDIENCE AND SITUATION

## TYPES OF ALERTS

**IN PERSON**



**AUDIBLE ALERTS**



**VISUAL ALERTS**



**MOBILE ALERTS**



**SYSTEM ALERTS**



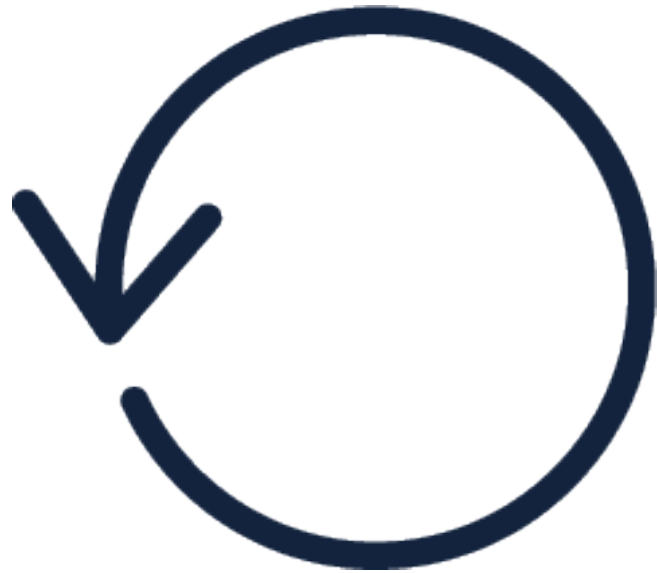
## TYPICAL RECIPIENTS OF ALERTS

- Key Safety Admins
- All Staff
- Patrons/Students/Visitors
- General Public
- Emergency Departments





# MASTERING HEAT STRESS MANAGEMENT – IMPLEMENT



## IMPLEMENT

Implement all technologies to support safety policy

Activate alerts against established protocols

Disseminate safety protocol to all parties

Educate stakeholders on risk and safety procedures

Establish chain of command

## PREVENTIVE ACTIONS WHEN ALERTED

- Cancel or reschedule outdoor or poorly-cooled indoor activities
- Find shade
- Hydrate! Avoid sugar, caffeine, and alcohol. Drink more than you think you need before the event and throughout. When you're thirsty, it may be too late!
- Circulation: fans, air-conditioning, breeze
- Alternative Cooling - ice water rags, ice packing





# MASTER HEAT STRESS MANAGEMENT IN 6 EASY STEPS – **EVALUATE**



## **EVALUATE**

**Test Test Test**

**Evaluate past events to ensure effectiveness**

**Gather regular feedback from safety admins, staff, students/athletes/patrons and visitors**

**Constantly look to improve based on past results and feedback**

**Keep it all fresh with tweaks and slight changes to alerting**

# KEY TAKEAWAYS



## ANALYZE

Evaluate your current posture before developing a plan



## PLAN

Consider all angles when developing a plan



## MONITOR

Have a professional weather solution for WBGT monitoring



## ALERT

Use automated, timely alerts to assist with decision making and remove confusion



## IMPLEMENT

Educate and disseminate safety protocols to all parties



## EVALUATE

Test Test Test! Make constant tweaks based on feedback





# THANK YOU

QUESTIONS AND COMMENTS?

Contact us at [info@earthnetworks.com](mailto:info@earthnetworks.com)

Learn more about WBGT

[www.earthnetworks.com/wet-bulb-globe-temperature](http://www.earthnetworks.com/wet-bulb-globe-temperature)