

# Use Of GIS-Based Heat Index Forecasting For EMS Planning For The County Of San Diego, CA

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# Background

- During extremely hot weather, there is a risk of developing heat exhaustion and heatstroke (which can result in organ failure, brain damage or death)
- Heat emergencies are slower to develop than some emergencies and it is only after a few days of high heat that the cumulative effect will impact vulnerable populations

## Slide 2

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**b1**

Barbara Stepanski MPH, 10/8/2007

# Background

- Annually, summer temperatures in CA contribute to the death of 20 people
- In July 2006, a prolonged heat wave in CA resulted in the death of 138 people over a 13 day period

# Background: Excessive Heat Response Plan

- This event prompted establishment of the Excessive Heat Response Plan:
  - Four Phase Plan
  - Seasonal (June 1 to Sept 30) forecasting of daily temperature and relative humidity using data from multiple weather stations
  - Uses ArcGIS to create heat index maps to identify zone/regional forecast
  - Provides lead time for response personnel to set up facilities, plan for heavier use of medical services, and alert the public

# Background: Excessive Heat Response Plan cont.

Heat emergencies are coordinated by:

- Public Health Services (PHS)/Emergency Medical Services (EMS) - monitors the Heat Index data
- Aging and Independent Services (AIS) – Identifies vulnerable populations
- Local law enforcement - contacts those specifically at risk
- Office of Media and Public Affairs - alerts the general public
- Office of Emergency Services (OES) - manages countywide response to an emergency

# Excessive Heat Response Plan Phase I

- **Seasonal Readiness** (in June)
  - Revise/distribute information materials
  - Cooling Zone locations
  - Provide fans and bus passes (if needed)
  - National Weather Service (NWS) data monitoring begins
  - Heat Plan Task Force hold initial meeting

# Excessive Heat Response Plan Phase II

- **Increased Readiness** – triggered by credible predictions of prolonged heat or of power outages during warmer than normal weather conditions
  - Monitor weather and Prehospital data (chief complaints)
  - Prepare heat advisory announcements
  - Outreach to community partners for prevention of heat related illness



# Excessive Heat Response Plan Phase III

- **Heat Alert** – triggered by excessive hot weather for more than 3 days with no relief at night, or NWS advisory of excessive heat, or high heat with electrical blackouts
  - Daily conference calls (EMS, PHS, Office of Media Relations, AIS, Office of Emergency Services, and the Medical Examiner)
  - Enhanced outreach
  - Media releases on prevention, risks, Cool Zone location and hours
  - NWS data monitored twice daily
  - Enhanced monitoring of Prehospital data

# Excessive Heat Response Plan

## Phase IV

- **Heat Emergency** – triggered by excessive heat index over 105°F with similar forecasts for 3 or more days, or NWS advisory of excessive heat for more than 3 days, or abnormal human medical emergencies and mortality due to heat, or continued high heat with extended electrical blackouts
  - Phase III data monitoring and conference calls
  - Regular media releases
  - Encourage cancellation of school and sporting events
  - Consider declaring a Public Health emergency

# Background: San Diego County

- Over 3 million population
- Popular tourist destination - 15 million overnight tourists annually
- Largest military installation in continental US
- 4526 Sq Miles
- Geographically isolated (borders Mexico, Pacific Ocean and Camp Pendleton military base)



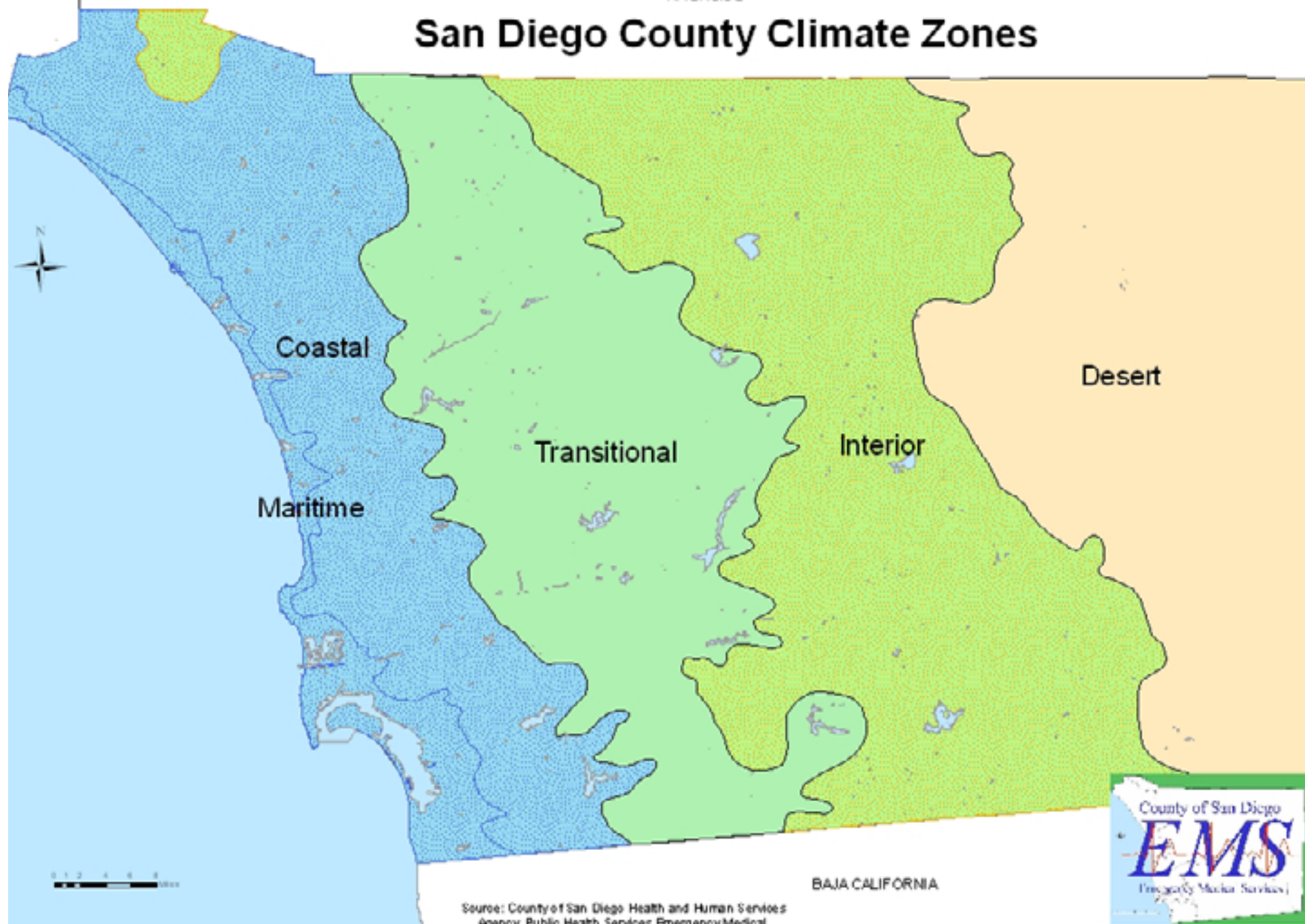
# Background: San Diego County

- Four Climate Zones as distinguished by the National Oceanic and Atmospheric Association (NOAA)
  - Zone 0743 Maritime/Coastal
  - Zone 0750 Coastal/Transitional (Inland)
  - Zone 0758 Interior (Mountain)
  - Zone 0762 Desert

RANGE

RIVERSIDE

# San Diego County Climate Zones



Source: County of San Diego Health and Human Services  
Agency, Public Health Services Emergency Medical

BAJA CALIFORNIA



# Background: Heat Index

- Heat index is often referred to as the "apparent temperature" and is reported in degrees F. It is a measure of how hot it feels when the relative humidity is added to the actual air temperature.
- When the Heat Index is..
  - 90°F heat exhaustion is possible with prolonged exposure and/or physical activity
  - 90°-105°F, possibility of sunstroke, heat cramps or heat exhaustion with prolonged exposure and/or physical activity
  - 105°-129°F sunstroke, heat cramps, or heat exhaustion is likely, and heatstroke is possible with prolonged exposure and/or physical activity
  - 130°F and higher, heatstroke and sunstroke are extremely likely with continue exposure. Physical activity and prolonged exposure to the heat increase the risks



# How San Diego County Heat Index Is Calculated

- High temperature forecast for each of 4 climate zones
- Relative humidity (RH) measured at different weather stations within each zone between 2-3pm on previous day
- Calculate average RH for each zone

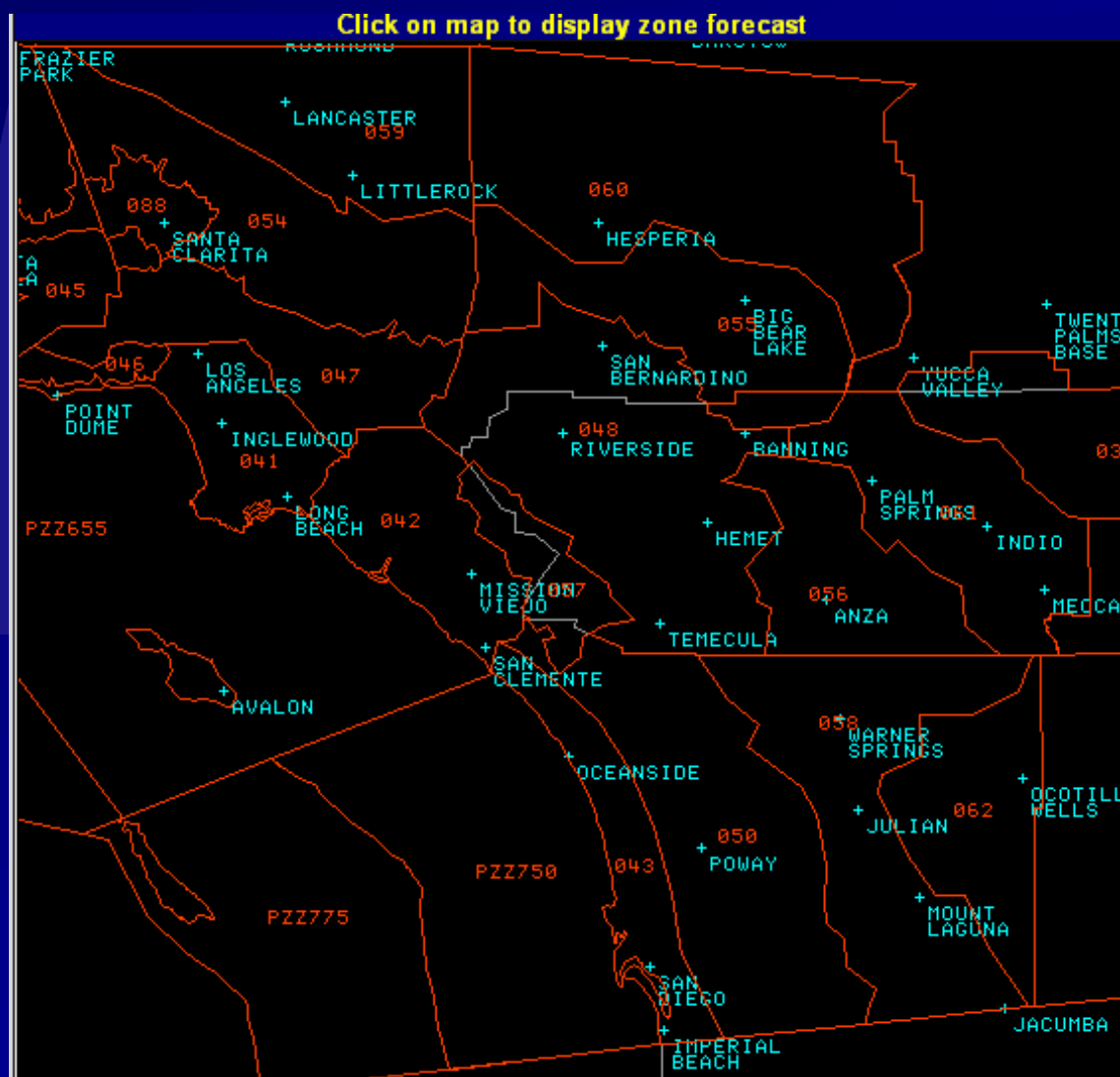
# High Temperature Forecast (Map)

National Weather  
Service Forecast  
Office

<http://www.wrh.noaa.gov/sqx/fcst/zonemap.php>



County of San Diego





# High Temperature Forecast (Narrative)

■ CAZ043-020745-  
SAN DIEGO COUNTY COASTAL AREAS-  
931 AM PDT MON OCT 1 2007

.REST OF TODAY...PARTLY CLOUDY WITH A SLIGHT CHANCE OF SHOWERS  
AND THUNDERSTORMS. HIGHS 71 TO 76 NEAR THE COAST TO 75 TO  
80 INLAND. LIGHT WINDS. CHANCE OF MEASURABLE PRECIPITATION  
20 PERCENT.

.TONIGHT...PARTLY CLOUDY. LOWS 57 TO 64. LIGHT WINDS.

.TUESDAY...PARTLY CLOUDY IN THE MORNING...BECOMING MOSTLY SUNNY.  
HIGHS 71 TO 76 NEAR THE COAST TO 76 TO 81 INLAND. LIGHT WINDS.

.TUESDAY NIGHT...MOSTLY CLEAR IN THE EVENING...BECOMING PARTLY  
CLOUDY. PATCHY FOG AFTER MIDNIGHT. LOWS 58 TO 64. LIGHT WINDS.

.WEDNESDAY...PARTLY CLOUDY IN THE MORNING...BECOMING MOSTLY  
SUNNY. PATCHY FOG IN THE MORNING. HIGHS 70 TO 75 NEAR THE COAST  
TO 74 TO 79 INLAND. LIGHT WINDS.

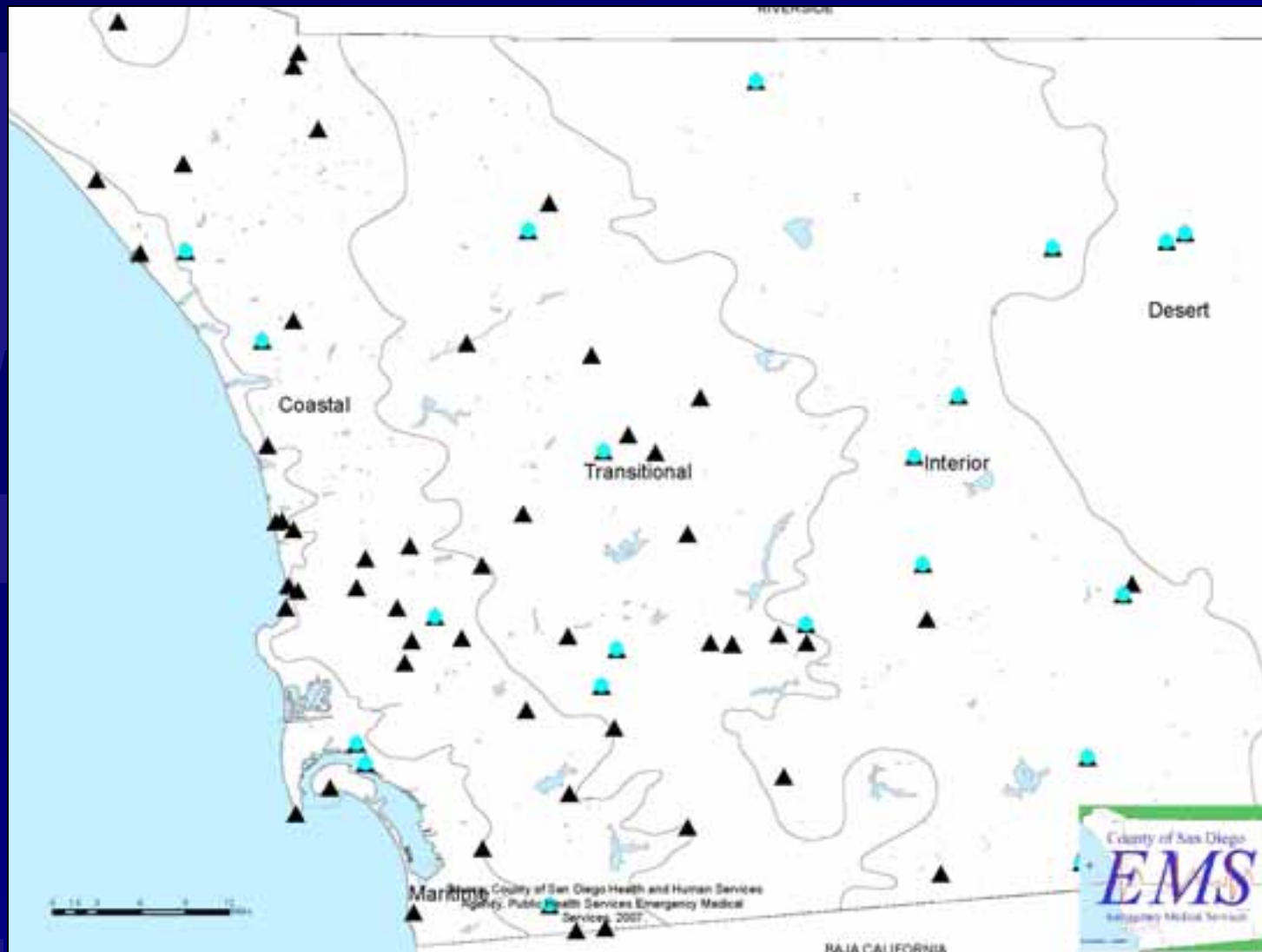
.WEDNESDAY NIGHT...PARTLY CLOUDY IN THE EVENING...BECOMING  
MOSTLY  
CLOUDY. PATCHY FOG AFTER MIDNIGHT. LOWS 56 TO 62.

.....

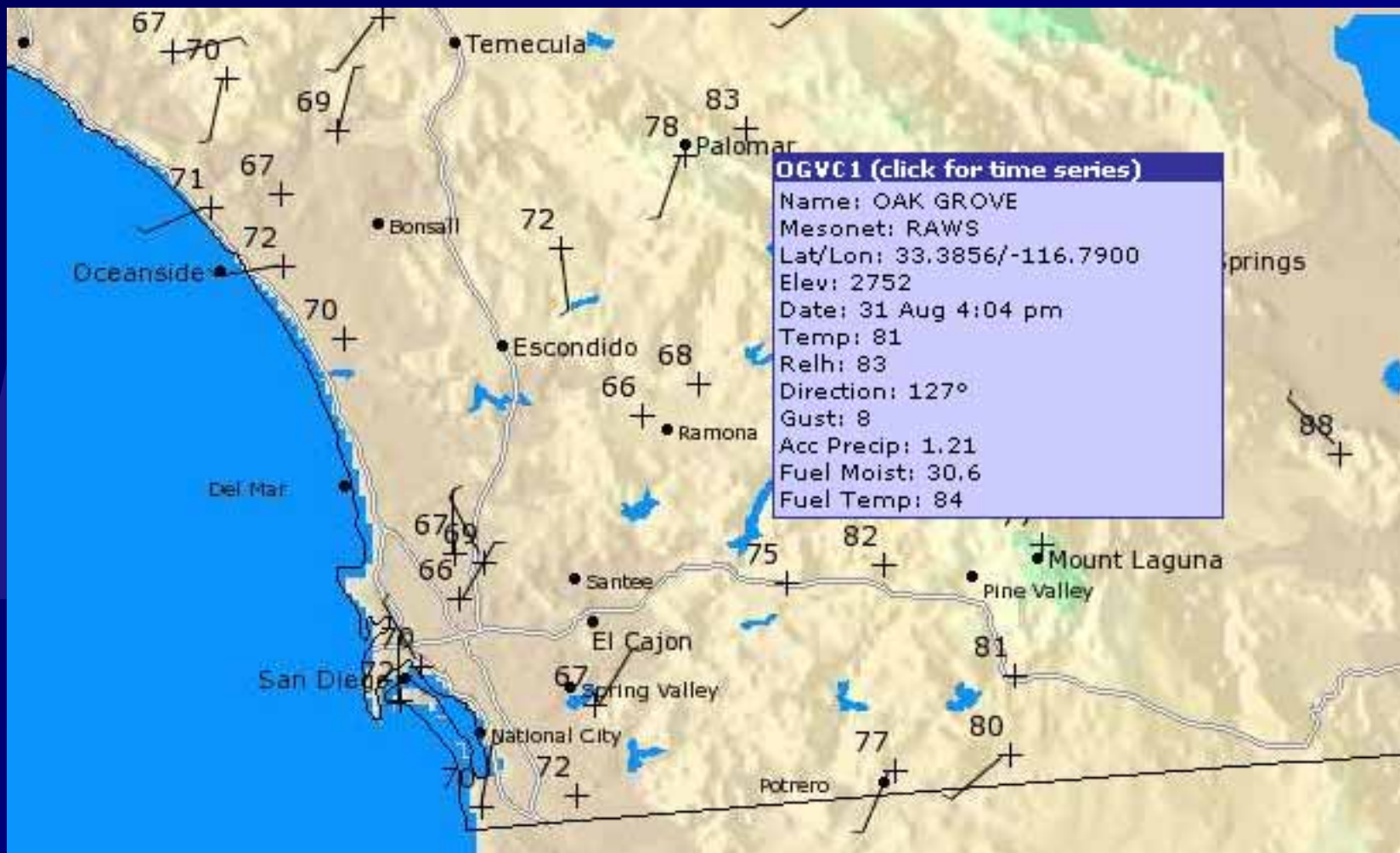
# How San Diego County Heat Index Is Calculated

- High temperature forecast for each of 4 climate zones
- Relative humidity (RH) measured at different weather stations within each zone between 2-3pm on previous day
- Calculate average RH for each zone

# Weather Stations



# Current Weather Station Detail



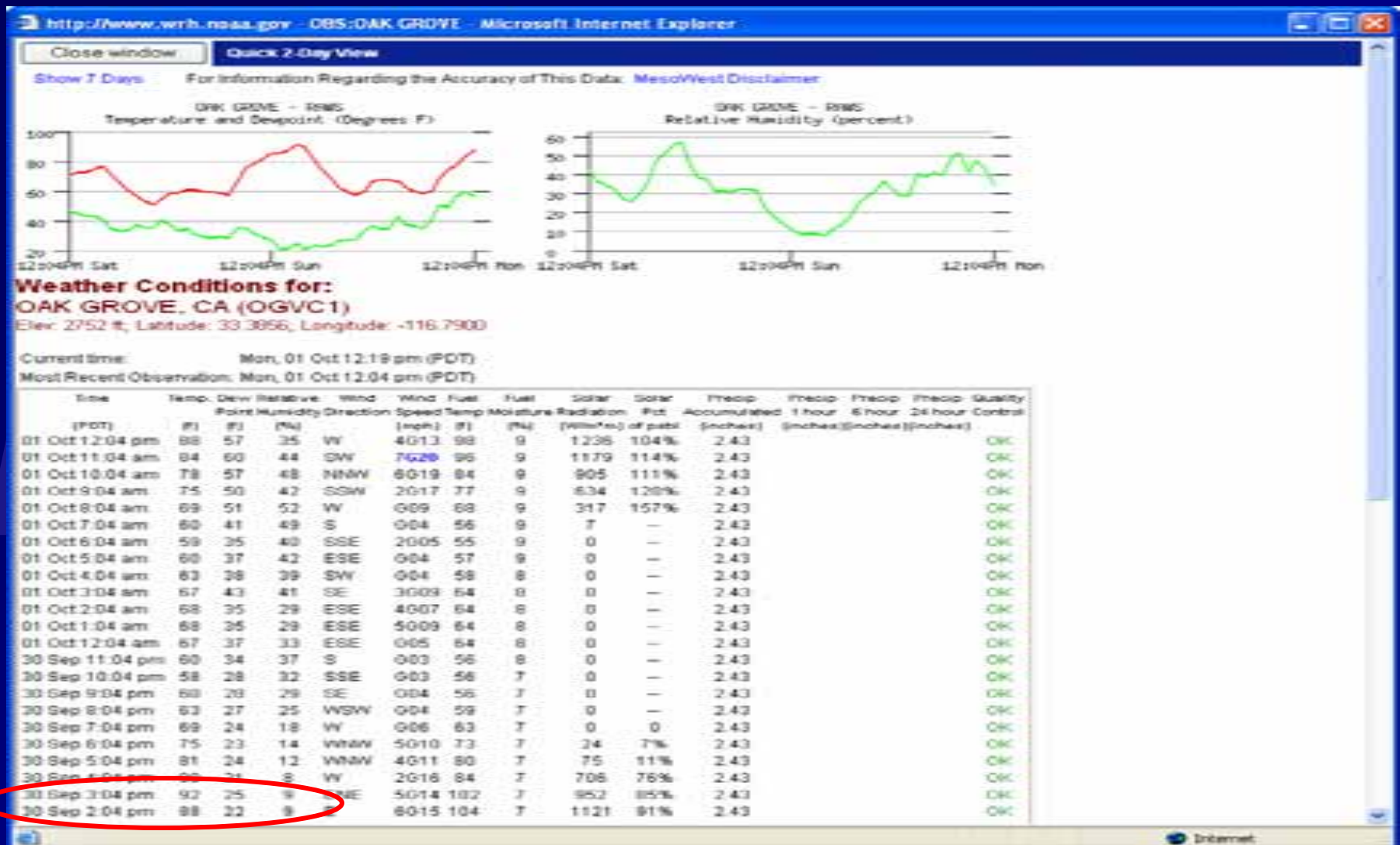
NOAA/Mesowest

<http://www.wrh.noaa.gov/mesowest/mwmap.php?map=sgx&limit=1&list=1>



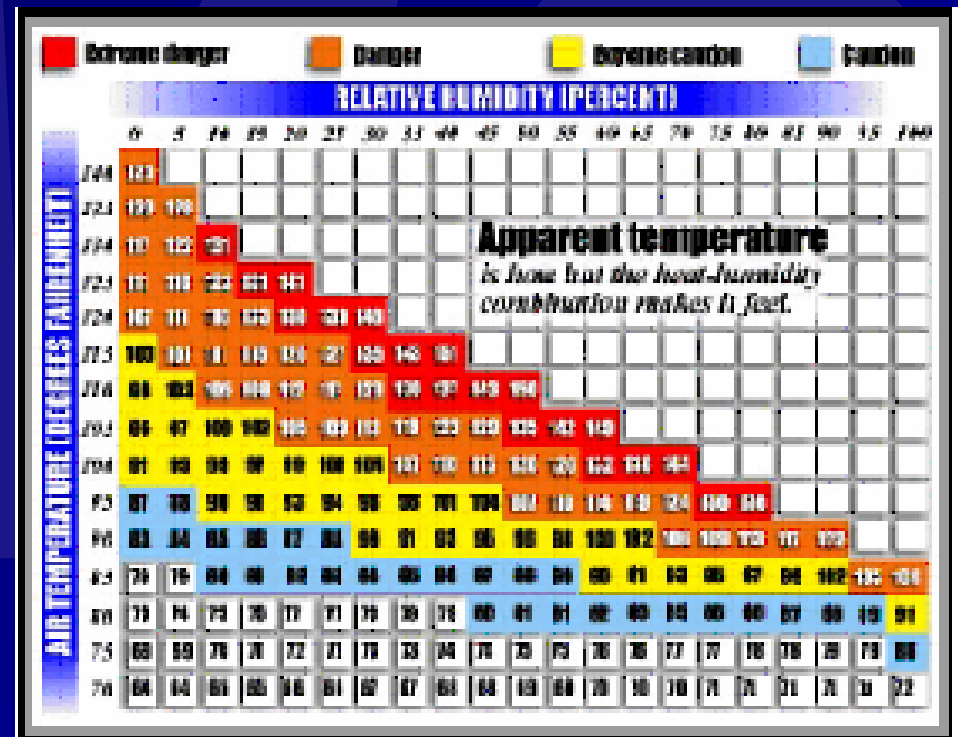


# Historical Weather Station Detail



# NOAA Heat Index Chart

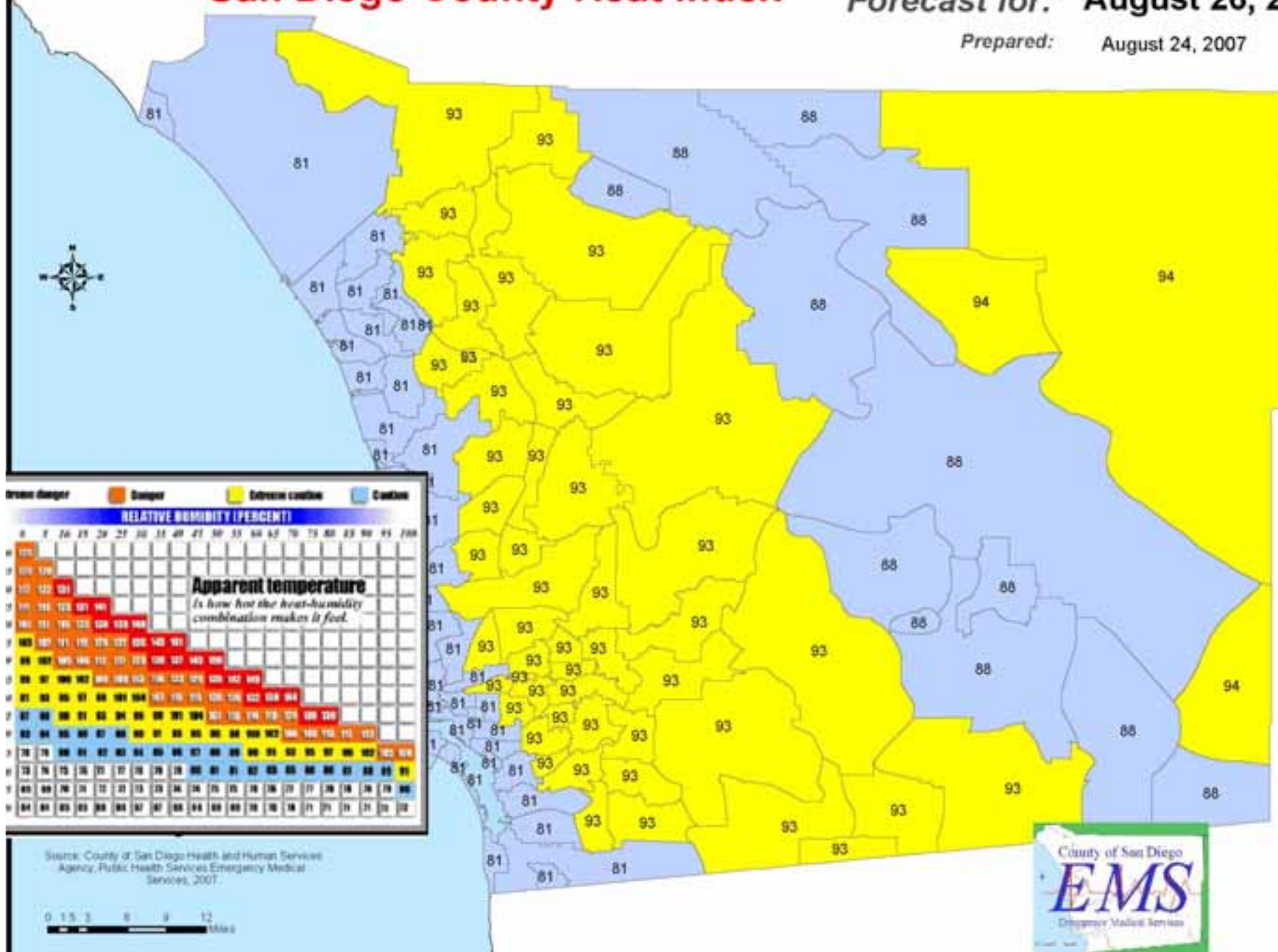
64 – 79 White  
 80 – 89 Blue (Caution)  
 90 – 104 Yellow (Extreme Caution)  
 105 – 129 Orange (Danger)  
 130 – 151 Red (Extreme Danger)



# San Diego County Heat Index

Forecast for: **August 26, 2007**

Prepared: August 24, 2007

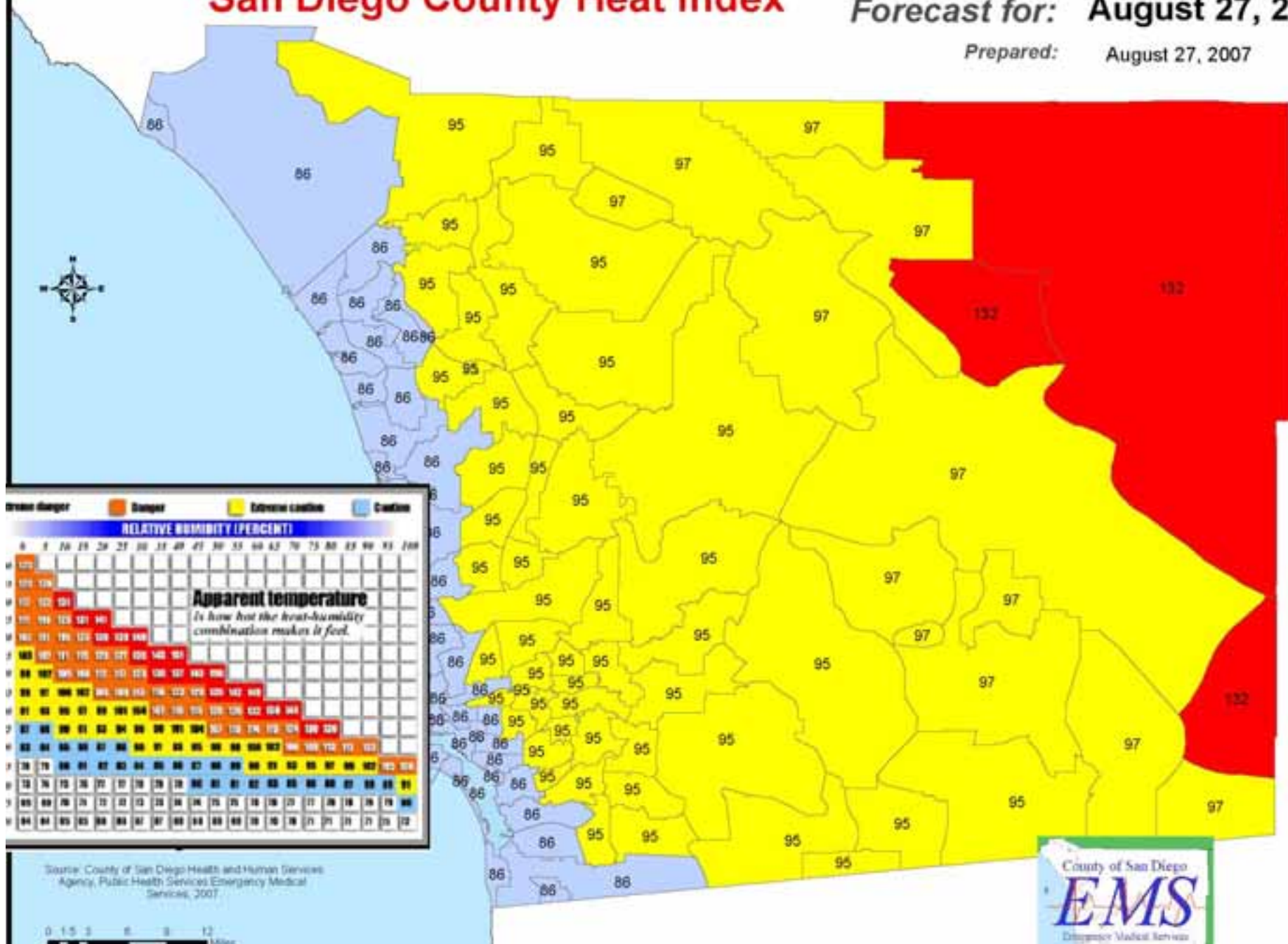




# San Diego County Heat Index

Forecast for: **August 27, 2007**

Prepared: August 27, 2007

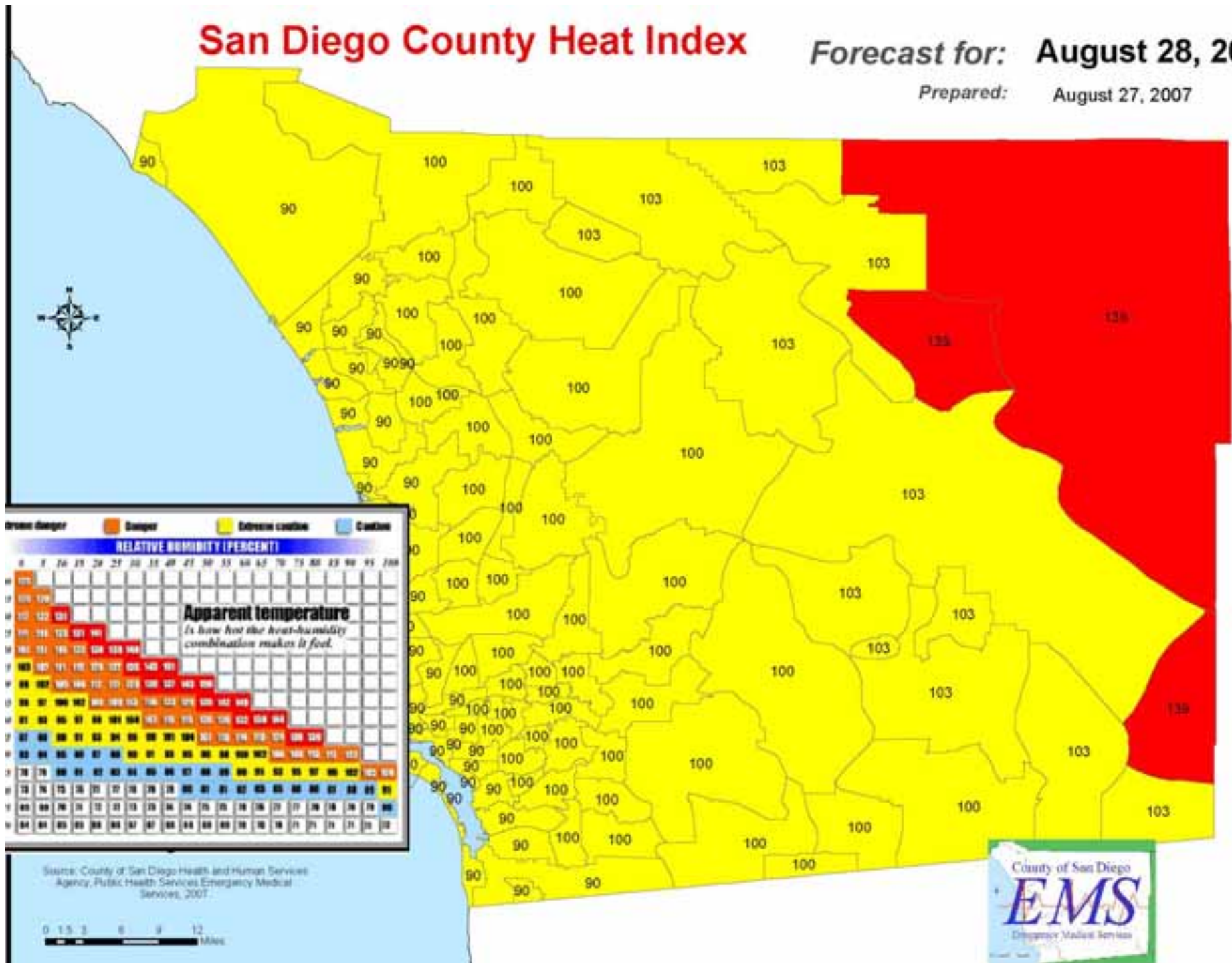




# San Diego County Heat Index

Forecast for: **August 28, 2007**

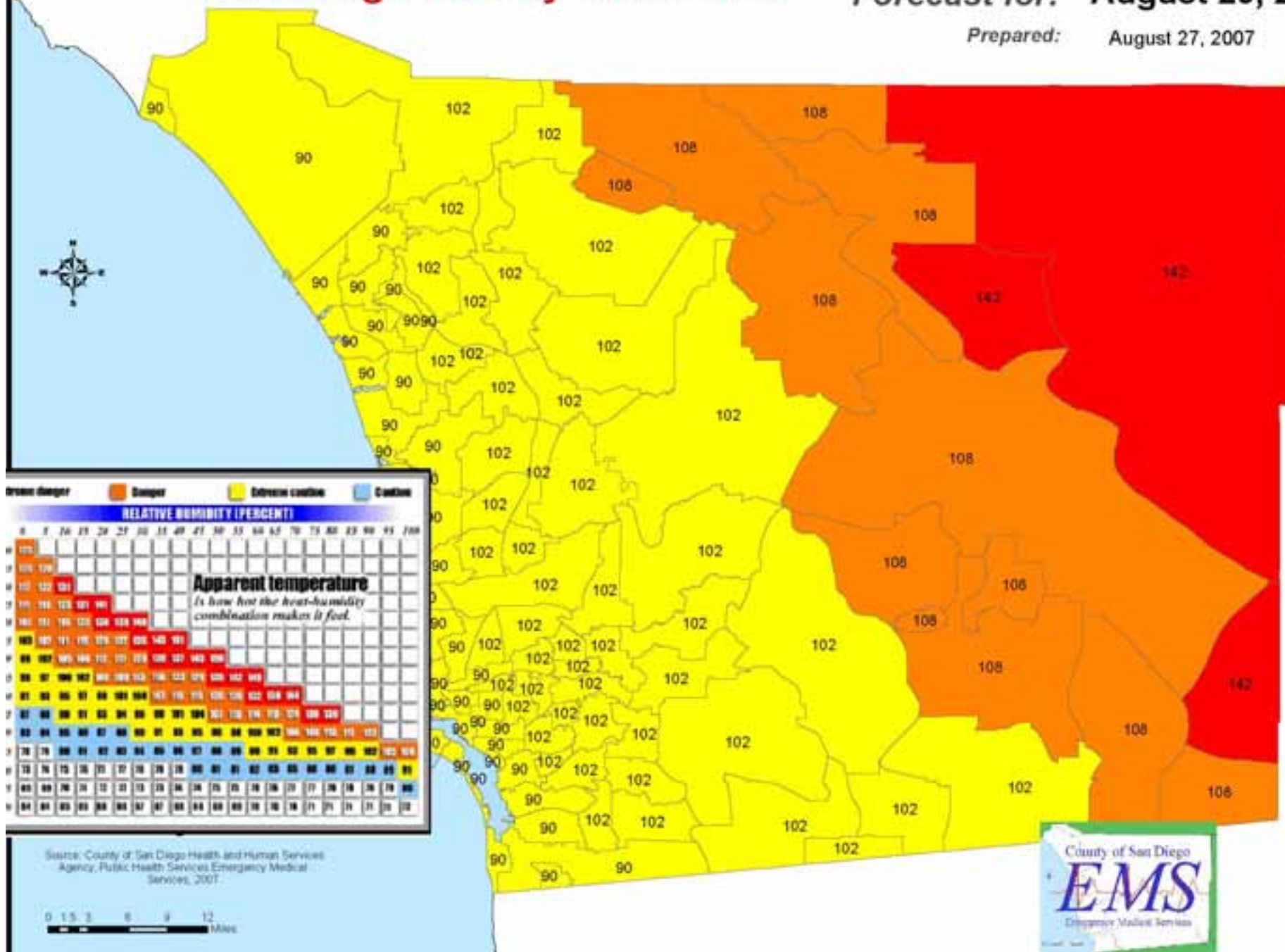
Prepared: August 27, 2007



# San Diego County Heat Index

Forecast for: **August 29, 2007**

Prepared: August 27, 2007

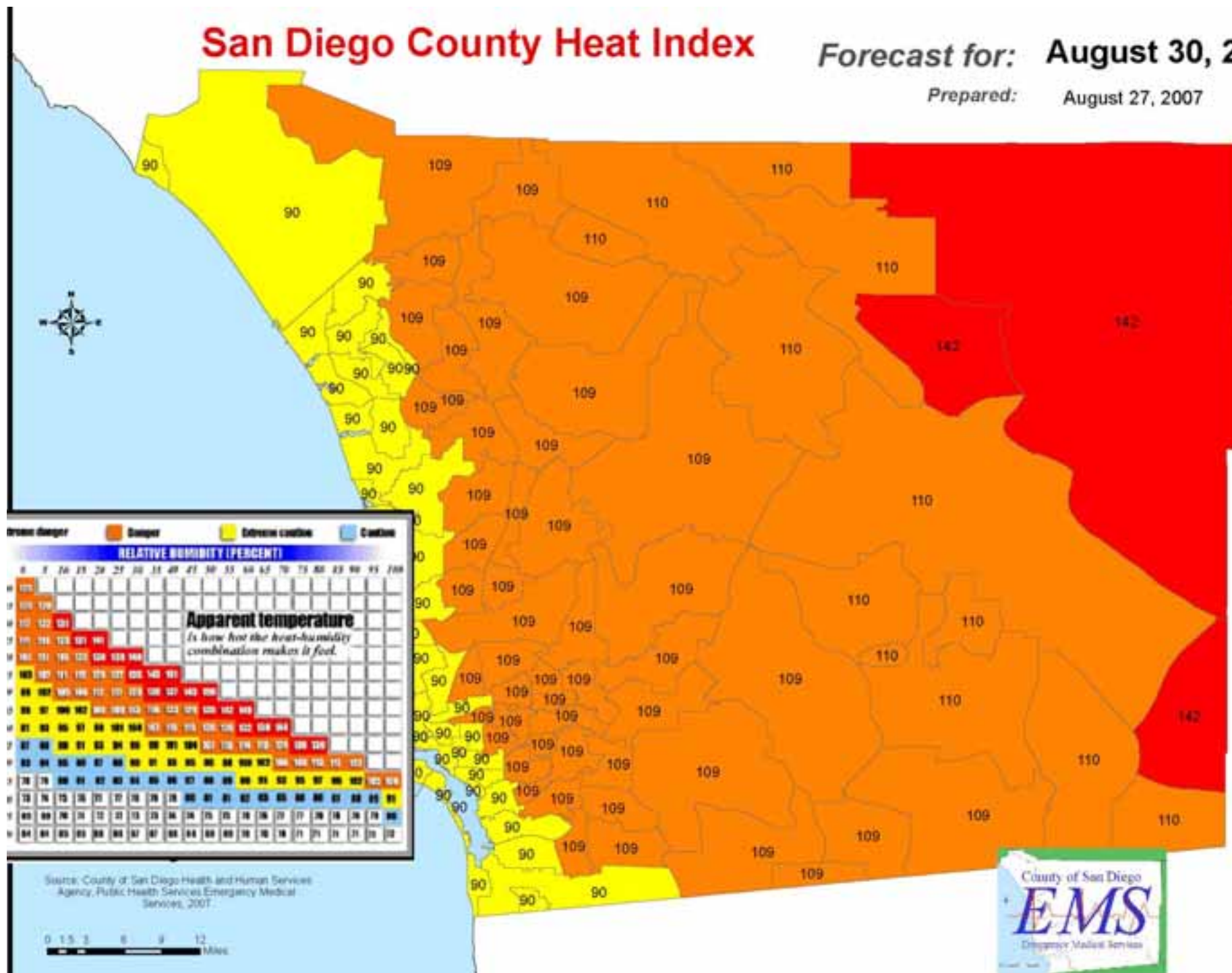




# San Diego County Heat Index

Forecast for: **August 30, 2007**

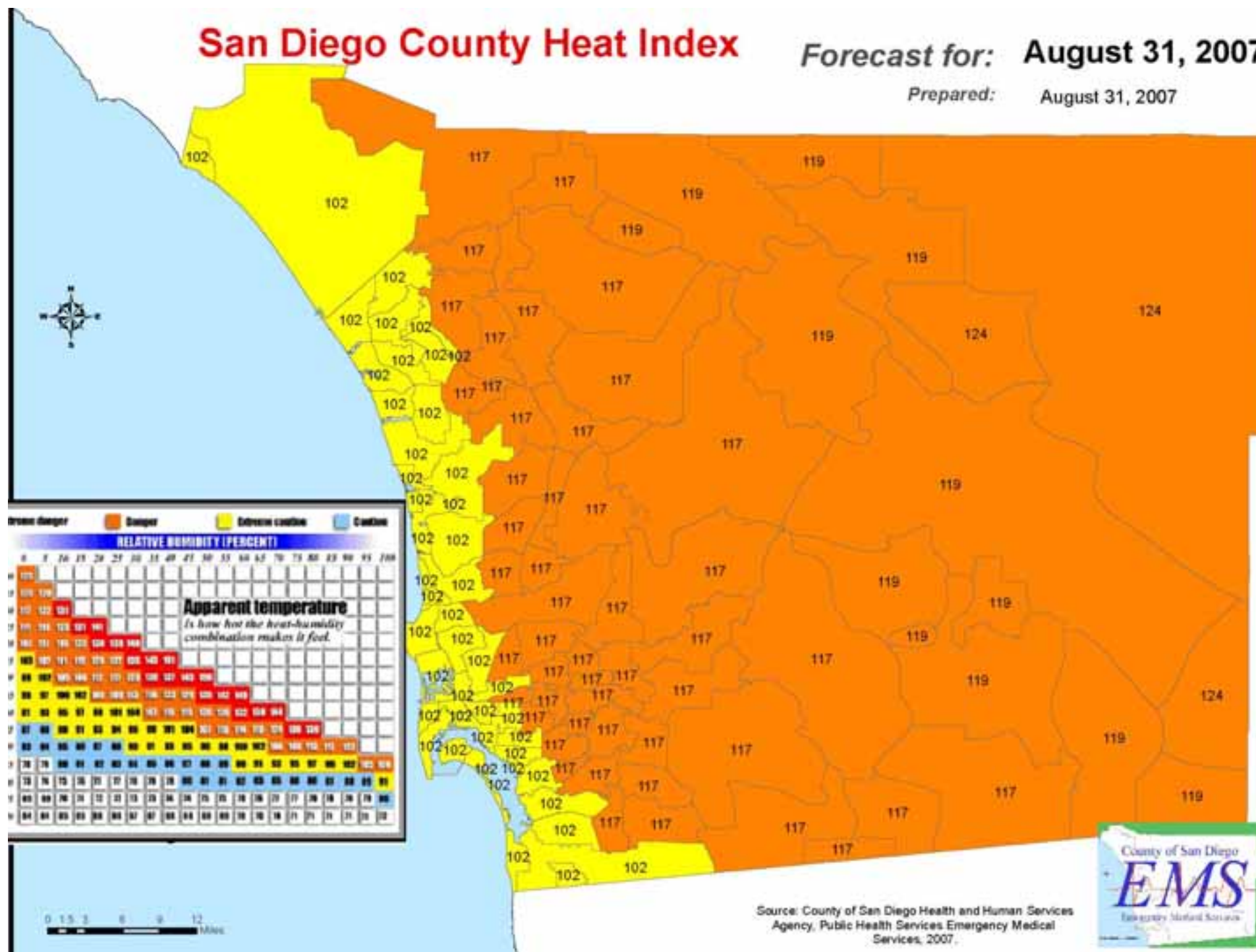
Prepared: August 27, 2007



## San Diego County Heat Index

**Forecast for: August 31, 2007**

*Prepared:* August 31, 2007

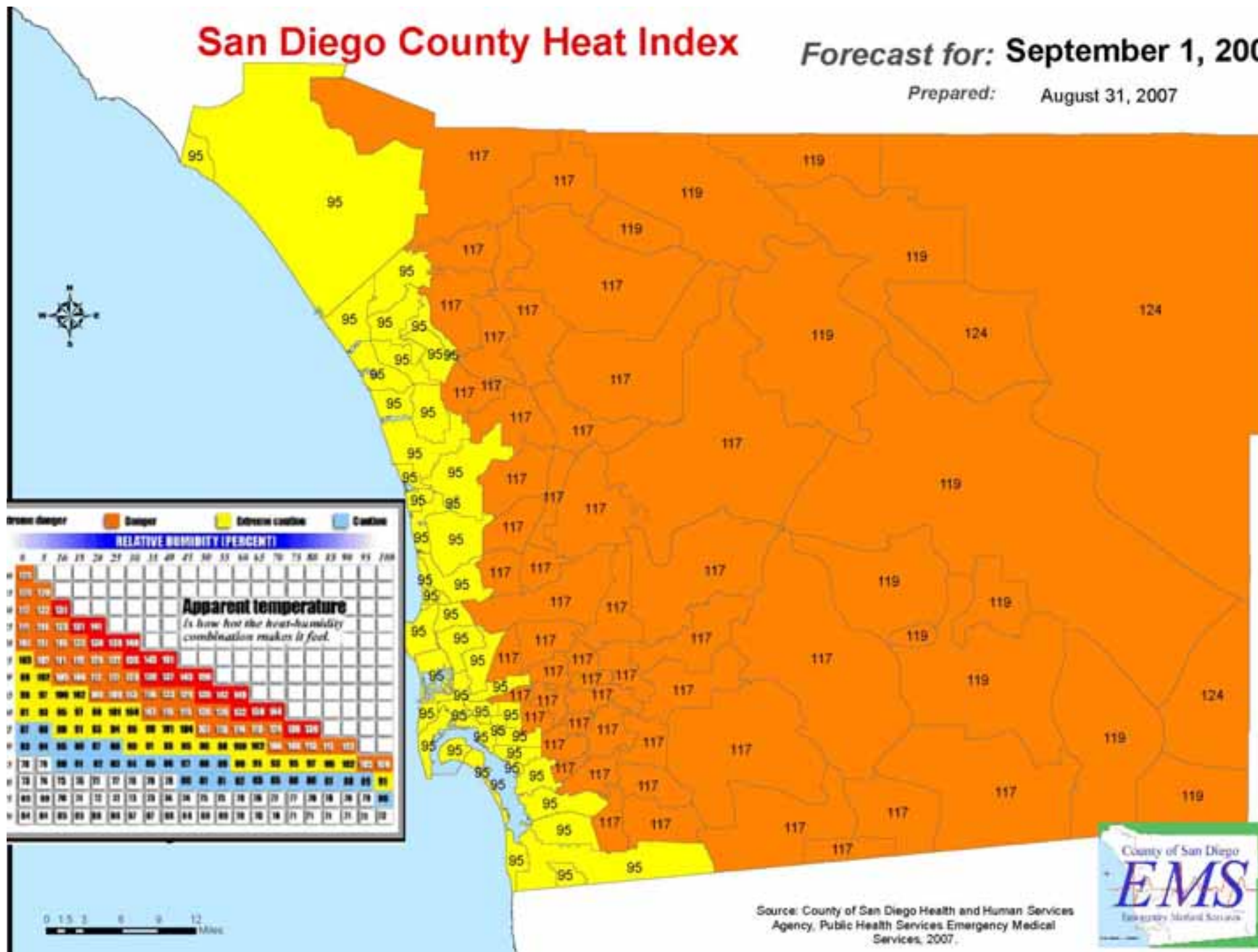




# San Diego County Heat Index

Forecast for: September 1, 2007

Prepared: August 31, 2007



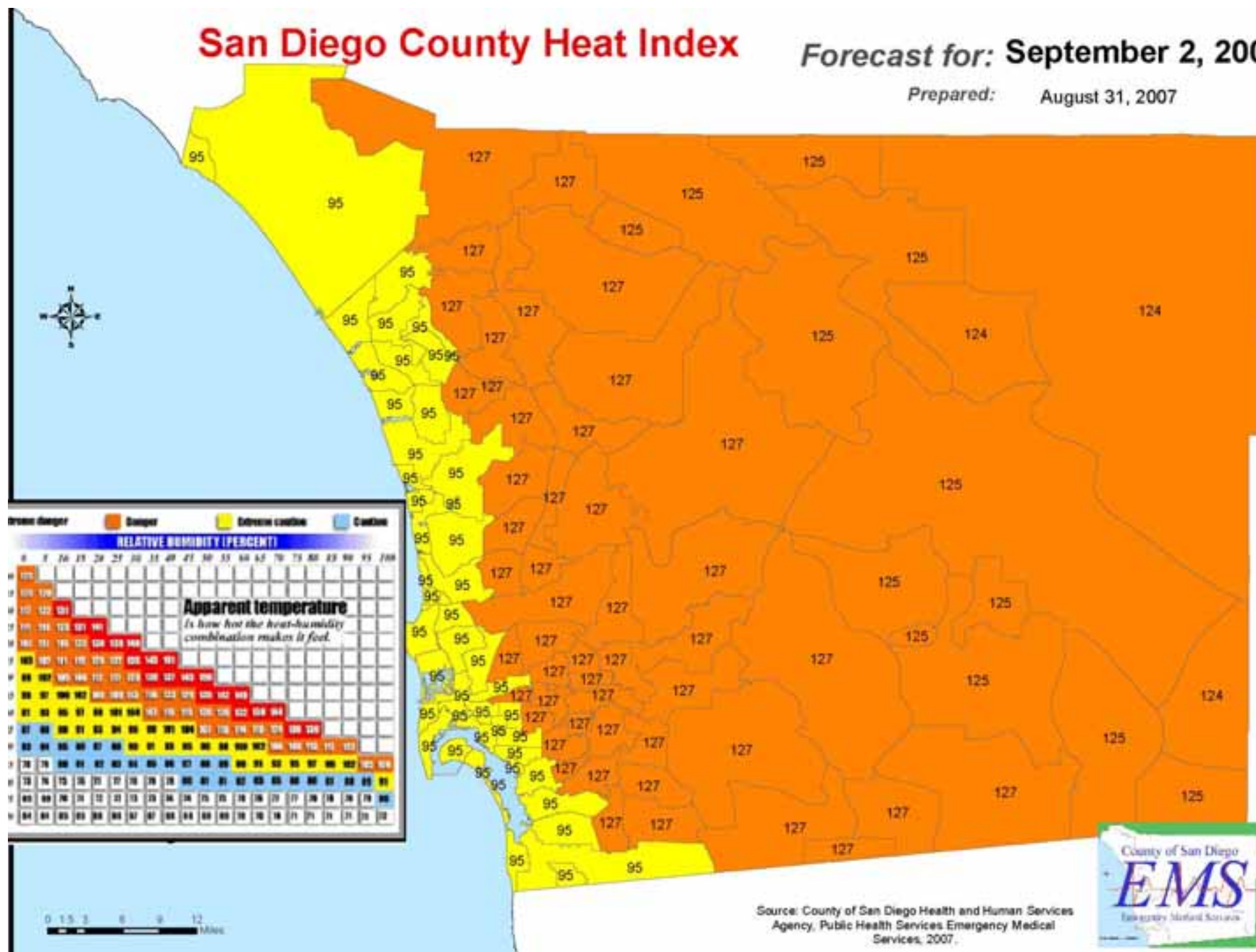
Source: County of San Diego Health and Human Services Agency, Public Health Services Emergency Medical Services, 2007.



## San Diego County Heat Index

**Forecast for: September 2, 2007**

*Prepared:* August 31, 2007

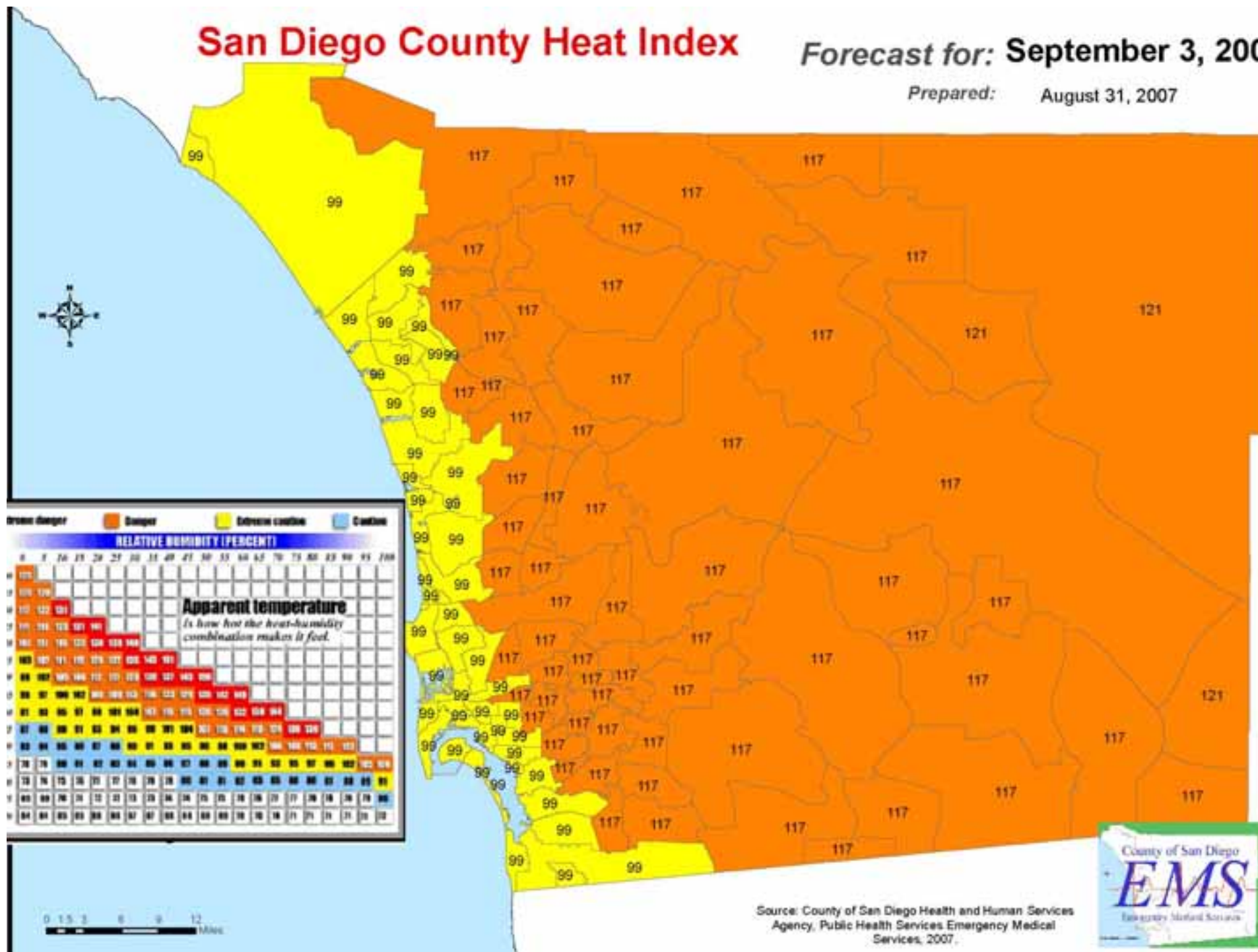




# San Diego County Heat Index

Forecast for: September 3, 2007

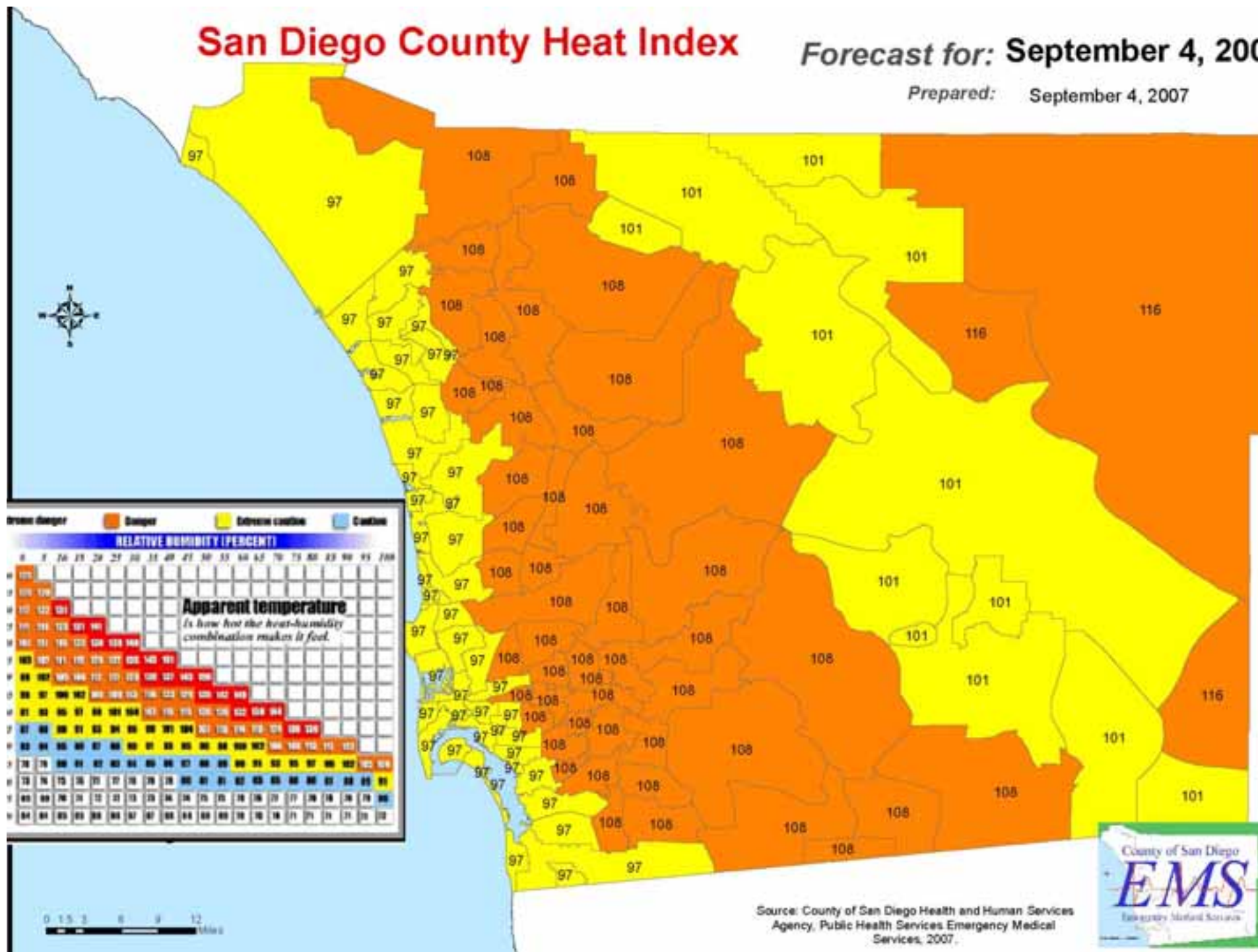
Prepared: August 31, 2007



# San Diego County Heat Index

Forecast for: **September 4, 2007**

Prepared: September 4, 2007



Source: County of San Diego Health and Human Services Agency, Public Health Services Emergency Medical Services, 2007.

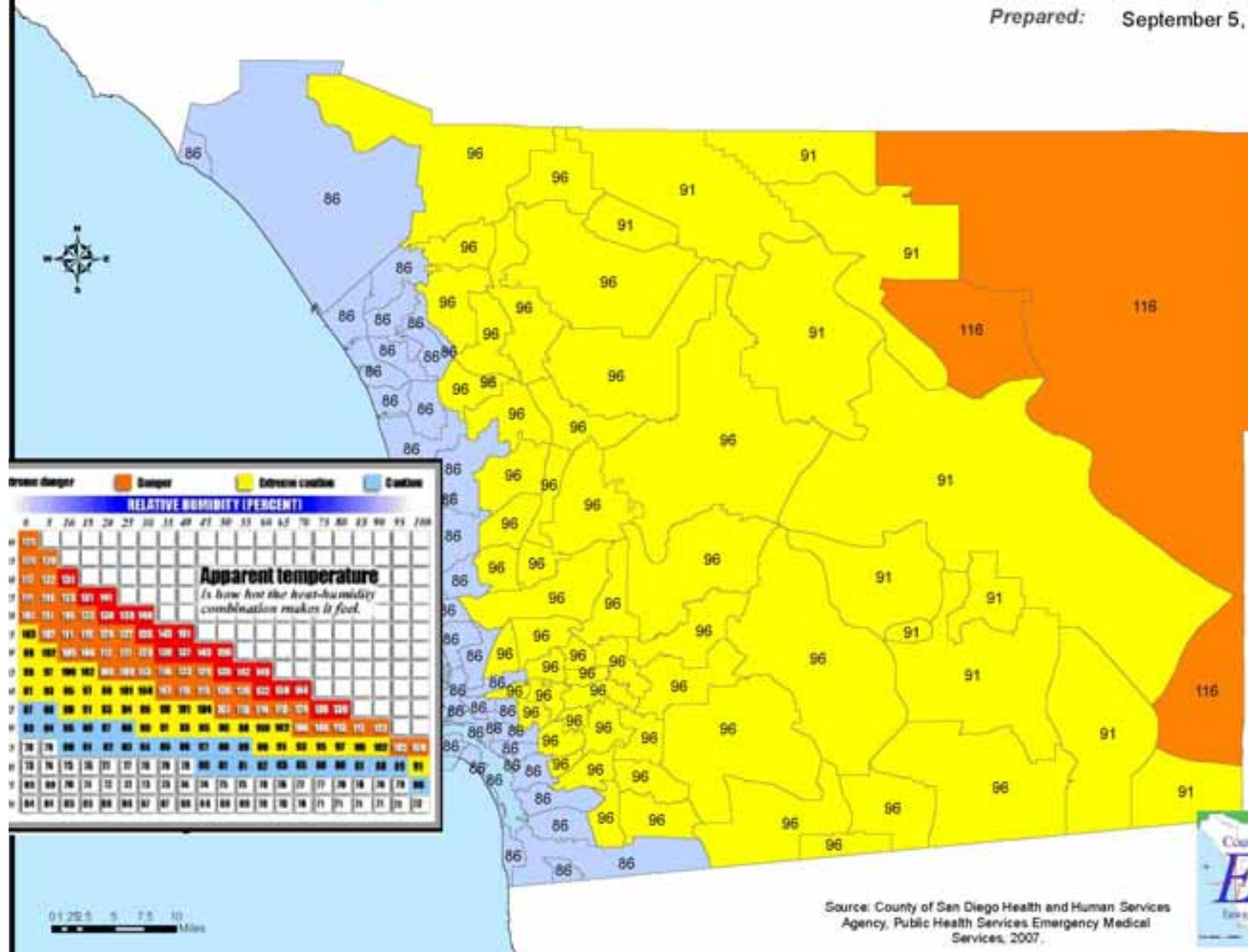




## San Diego County Heat Index

**Forecast for: September 5, 2007**

*Prepared:* September 5, 2007



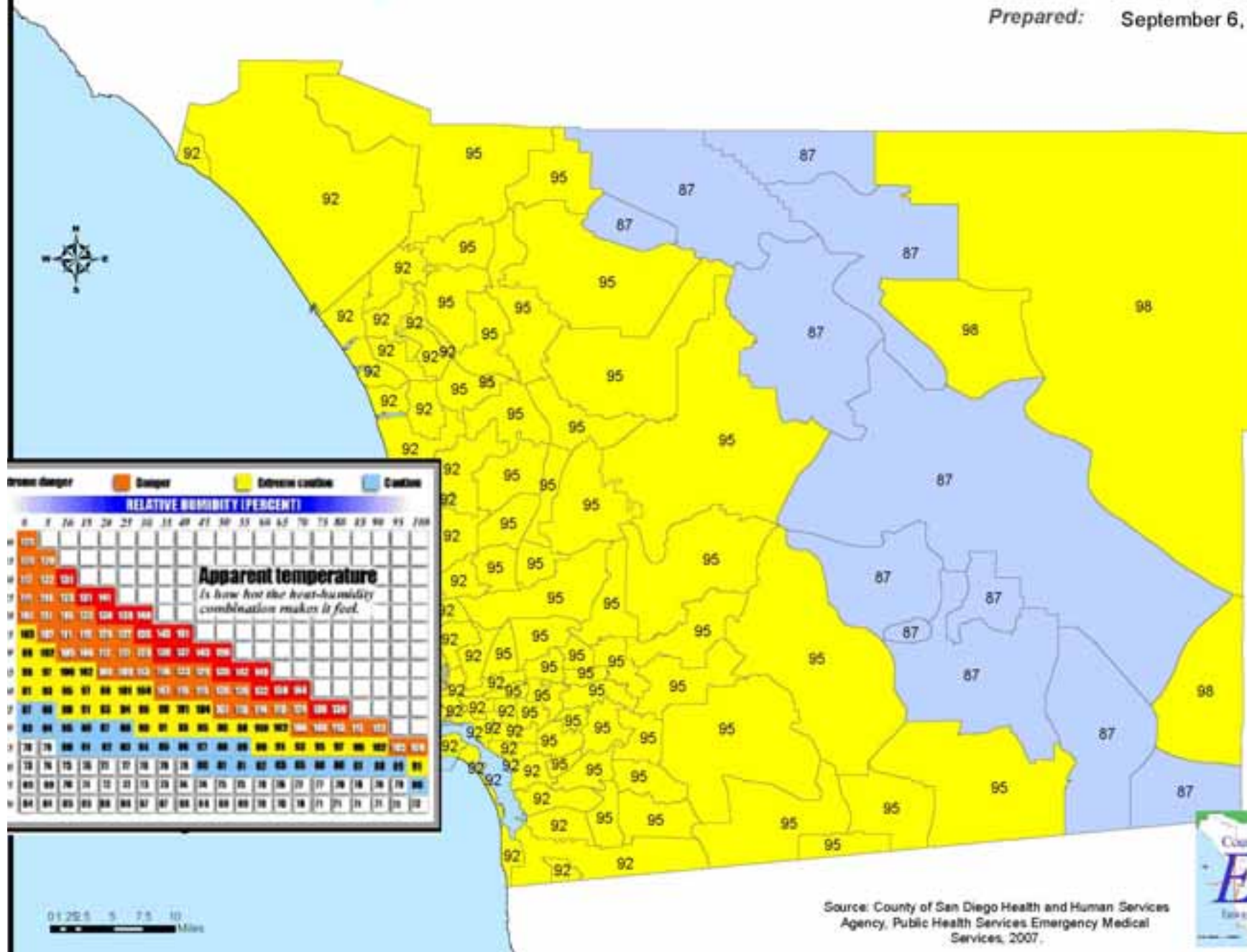
Source: County of San Diego Health and Human Services Agency, Public Health Services Emergency Medical Services, 2007.



# San Diego County Heat Index

Forecast for: **September 6, 2007**

Prepared: September 6, 2007



Source: County of San Diego Health and Human Services Agency, Public Health Services Emergency Medical Services, 2007.

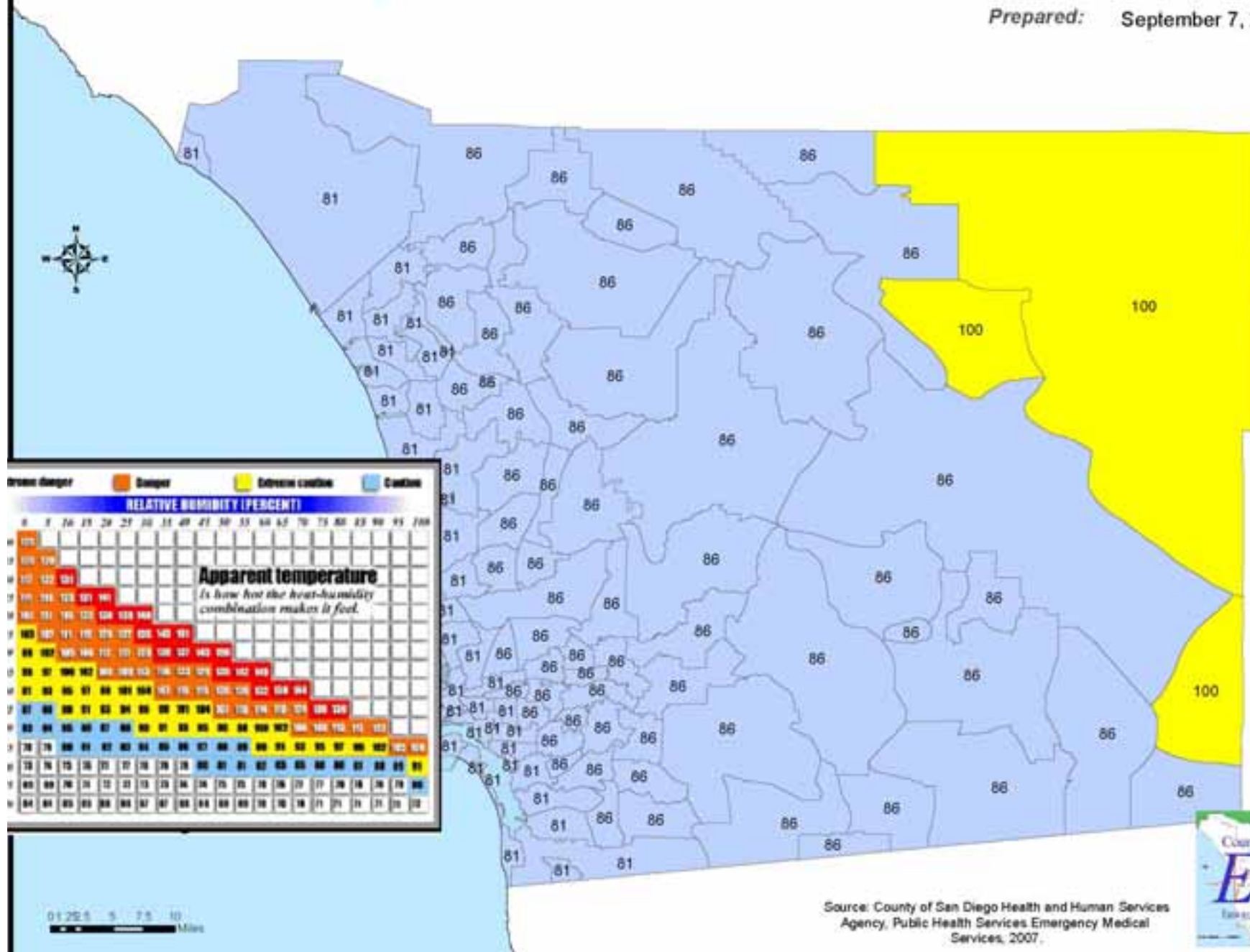




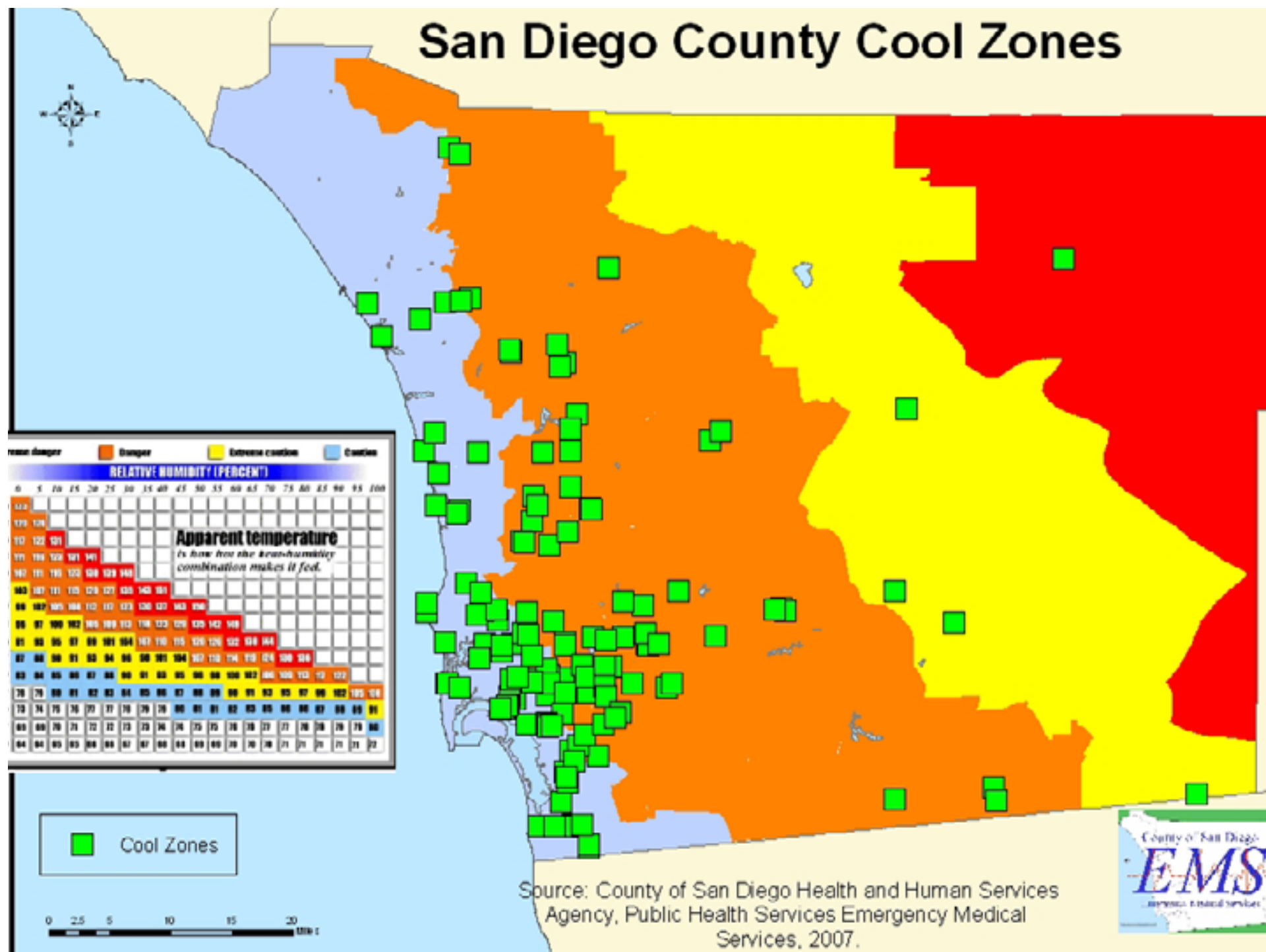
# San Diego County Heat Index

Forecast for: **September 7, 2007**

Prepared: September 7, 2007



# San Diego County Cool Zones





## **Seek a Cool Zone When It's Hot**

HHSA Aging & Independence Services' Cool Zone program offers 150 locations for anyone to beat the heat. Call toll-free 1-800-510-2020 for information. A list of Cool Zone sites and tips for staying cool are on the County Web site – [www.ais-sd.org](http://www.ais-sd.org) and click "View All Services," then look for "Cool Zones."

# Conclusions

- Our Excessive Heat Response Plan provides a method for advance preparation for heat emergencies
- The use of the climate zone data allows us to provide more County-specific heat index forecasts, as opposed to a generalized heat alert from NWS
- Currently looking to see if there is a significant difference in providing smaller area (zip code) Heat index values to warrant the additional analysis

# Acknowledgements

- National Oceanic and Atmospheric Administration (NOAA): <http://www.noaa.gov>
- NOAA's National Weather Service Office: <http://www.weather.gov/>
- The Base Hospitals and Paramedic/EMT Agencies in San Diego County

# Contact Information

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[barbara.stepanski@sdcounty.ca.gov](mailto:barbara.stepanski@sdcounty.ca.gov)



# Heat Index Equation

- Use average RH & high temp forecast in Heat Index Equation:

$$\begin{aligned} & -42.40 + (2.04901523 * [\text{TEMP}]) + (10.14333127 * [\text{HUMIDITY}]) - \\ & (.22475541 * [\text{TEMP}] * [\text{HUMIDITY}]) - (.00683783 * ([\text{TEMP}]^2)) - \\ & (.05481717 * ([\text{HUMIDITY}]^2)) + (.00122874 * ([\text{TEMP}]^2) * \\ & [\text{HUMIDITY}]) + (.00085282 * [\text{TEMP}] * ([\text{HUMIDITY}]^2)) - (.00000199 \\ & * ([\text{TEMP}]^2) * ([\text{HUMIDITY}]^2)) \end{aligned}$$

**Cool Zones** - Facilities that are made available by public, private and volunteer organizations as heat relief stations.

**Heat Advisory** - Official advise issued when conditions of a Heat Wave are present.

**Heat Disorders or Heat Illness** - Conditions that result in the body's inability to maintain a normal temperature. Major heat disorders are:

**Heat Cramps** - Symptoms: painful spasms usually in leg muscles and possibly the abdomen, heavy sweating.

**Heat Exhaustion** - Symptoms: heavy sweating, weakness, cold, pale and clammy skin, possible fainting and vomiting. May have normal temperature.

**Heat Stroke** - Symptoms: high body temperature (106 or higher). Hot, dry skin. Rapid pulse. Possible loss of consciousness.

**Heat Index** – A factor used to determine how hot it feels based on temperature and called apparent relative humidity. Heat index values can be up to fifteen degrees higher with exposure to direct sunlight. Heat index values assume calm wind conditions. Hot dry winds can also increase heat index factors.

**Heat-Related Death** -Most heat-related deaths are a direct result of heat stroke, which is almost always fatal when not treated.

**Heat Wave-** When temperatures reach 10" or more above the average high temperature for a certain date for the region, and this lasts, or is predicted to last, for a prolonged period of time. A Heat Wave may be accompanied by high humidity.

- **Vulnerable Populations** - Certain groups that are at particular risk during a heatwave. These include: older people, especially over 75; people who are bedbound; babies and young children under 4 years of age; people who are severely mentally ill or have dementia; people on certain types of medications.

# Heat Emergency Process

- The Heat Index Map is meant to provide a worst case scenario outlook in order to identify conditions that would warrant activation of the Excessive Heat Plan