Streets of Fire: Will We Ever Get it? or Just Drone On?

As the City of Phoenix is piloting a cool pavements program looking for ways to combat the ever-increasing urban heat island problem, east valley mayors are promoting maintaining the regional freeway system in black asphalt rubber, ignoring the impact of the regional freeways 8000 acres contribution to the problem. As noted below, there were 323 heat related deaths in Maricopa County in 2020. To put this in context, between 2004 and 2018 the total number of heat related deaths in the US averaged 704 annually[1]. The urban heat island problem is alive and well in Maricopa County, yet many agencies seem unwilling to try and mitigate the problem even in times of ever-increasing population.

The year 2020 was memorable for Maricopa County in terms of weather and quality of life issues. August 2020 was the hottest month on record since 1896 when record keeping began[2]. The average daily temperature was 99 degrees for the month[2]. Historically, July has always been the hottest month on record, but August 2020 broke through that ceiling smashing 33 record highs[2,3]. Among these are:

- Most Number of days at or above 115 ^{O}F (14 d)
- Most Number of days at or above 110 ^{O}F (53 d)
- Most Number of days at or above 105 ^{O}F (102 d)
- Most Number of days at or above 100 ^{O}F (145 d)
- Most Number of days at or above 95 ^{O}F (172 d)

Fortunately, no record high-lows were set during August 2020, but the summer of 2020 was also the driest summer on record with only two measurable rain events[4]. The seriousness of these weather events may have been overshadowed somewhat by COVID, but they are still very significant. In 2020, there were 323 heat related deaths in Maricopa County[5]. In 2019, there were 428 traffic fatalities in Maricopa County[6]. Therefore, heat related fatalities in 2020 amounted to 75% of the 2019 traffic fatalities, yet receives little attention. Using ADOT's state adjusted crash cost per fatality for accidents (i.e., $9,515,371), heat related deaths resulted in just over *four billion dollars of economic losses to Maricopa County* in 2020 alone[6].

Maricopa County's population has increased approximately 37% since 2003, and no doubt is an important factor, but infrastructure must also be considered a cause and planned for appropriately.

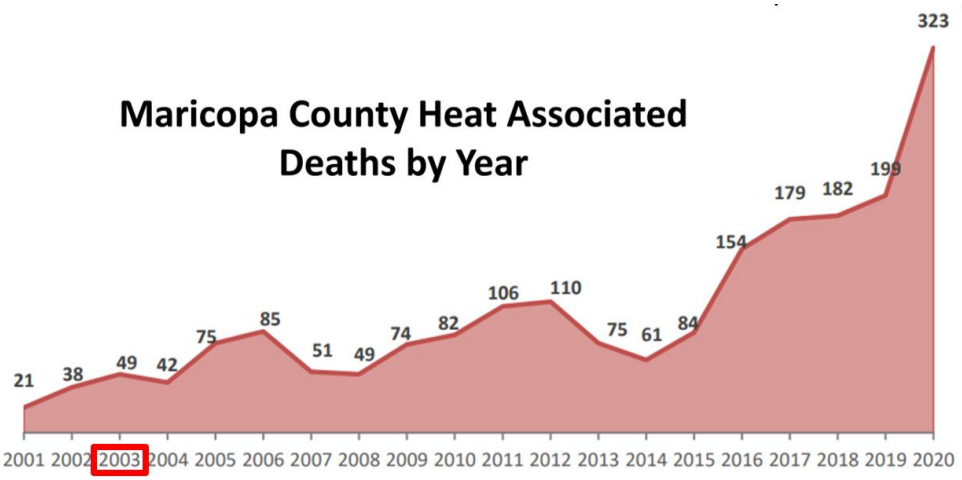

Figure 1 Number of Heat Related Deaths by Year in Maricopa County

The valley freeway system currently represents approximately 8,000 acres of paved surface. Starting in **2003**, it has been the goal of the Maricopa Association of Governments (MAG) to overlay the concrete pavement with asphalt rubber and maintain this black surface perpetually. This decision was made to solve a noise issue created by transverse tining used to texture the original concrete surface.

Since then, ADOT has piloted several diamond-grinding projects that remove the transverse tining and allow the surface to remain a quiet, and cooler, diamond ground concrete surface. ADOT estimates that over a 30-year period, it costs $4B more to maintain the asphalt rubber surface than a diamond ground surface[7].

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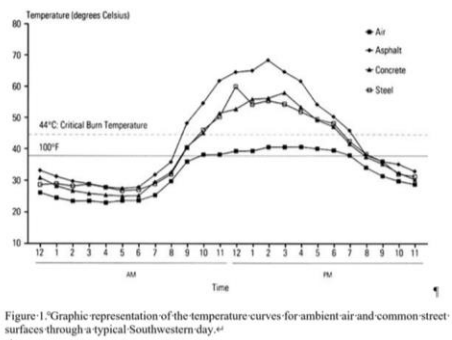
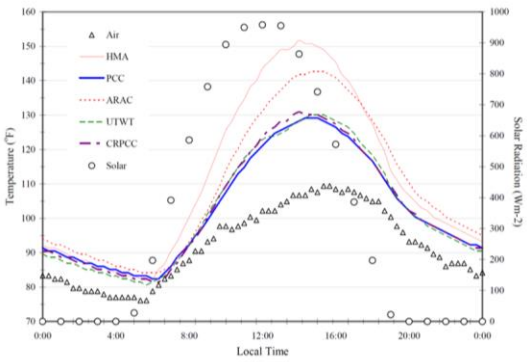
In addition to the added cost, the black asphalt surface contributes to Maricopa County's increasing urban heat island problem. This aspect, although studied in Arizona for over a ¼ century, has not been addressed by MAG in their freeway strategy selections.

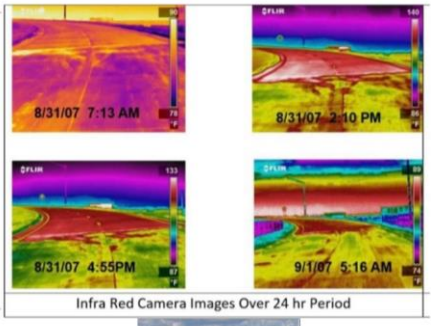
In 2004-5, the Portland Cement Association contracted with ASU to study the difference in environmental impact between concrete and asphalt surfaces[8]. The results of that study are indicated in Figure 2 along with a 1995 Emergency Medical Study, and a 2007 American Concrete Pavement Association (ACPA) study. All three studies indicated that asphalt rubber is hotter during the entire 24-hour daily cycle than concrete pavements.



Pavement Temperature and Burns: Streets of Fire– March 1995 Emergency Medical



The Thermal and Radiative Characteristics of Concrete Pavements in Mitigating Urban Heat Island Effects ASU - 2008



ACPA 2007

Figure 2 24 hr. Comparison of Asphalt Rubber and Concrete Pavement Temperatures [8,9]

As evident in all three studies represented in Figure 2, the asphalt rubber and other asphalt surfaces remain hotter than concrete surfaces during the entire 24-hour period. However, these all represented no trafficked temperature readings, meaning there is no traffic traveling over the surfaces to dissipate the heat. Therefore, to verify whether concrete surfaces remain cooler during the entire daily cycle with live traffic, it was necessary to capture infrared images under normal traffic operating conditions. Drone technology was used to accomplish this.

To prove that black pavements are always hotter than white pavements, even though it should be obvious, the International Grooving and Grinding Association (IGGA) used drones to conduct infrared (IR) imaging of two sections of the freeway system to validate that the asphalt rubber is always hotter. To accomplish this, two sections of freeway on SR202 EB were selected. The first site was an asphalt pavement with a 1/2-inch asphalt rubber overlay. The second site consisted of a concrete pavement that had two lanes of diamond ground surface and 4 lanes of a one-inch asphalt rubber overlay. Figures 3 & 4 indicate the results of that testing and their legends graphically represent the three different pavement structures.

Figure 3 indicates the temperatures taken at the shoulder. Although this location best represents the actual heat disparity between the different surface types, it is essentially a non-traffic area. Figure 4 represents the temperature difference between two adjacent lanes, one diamond ground concrete surface and the other the asphalt rubber overlay.

As indicated in Figure 3, the diamond ground concrete surface remains cooler during the entire 24 hr. period. Just before sunrise it is one to ten degrees cooler than the asphalt rubber surfaces and at peak temperature time (1:30 PM), it is 27 °F cooler than the asphalt pavement overlaid with asphalt rubber. At 2:30PM the diamond ground concrete surface was 13 to 23 °F cooler than the two asphalt rubber surfaces.

As indicated in Figure 4, which represents the travel lanes, the diamond ground concrete surface is again cooler the entire time than either of the two-asphalt rubber overlaid surfaces. At sunrise the diamond ground surface was again 1 to 10 °F cooler and at the peak temperature (1:30 PM) 7 to 14 °F cooler.

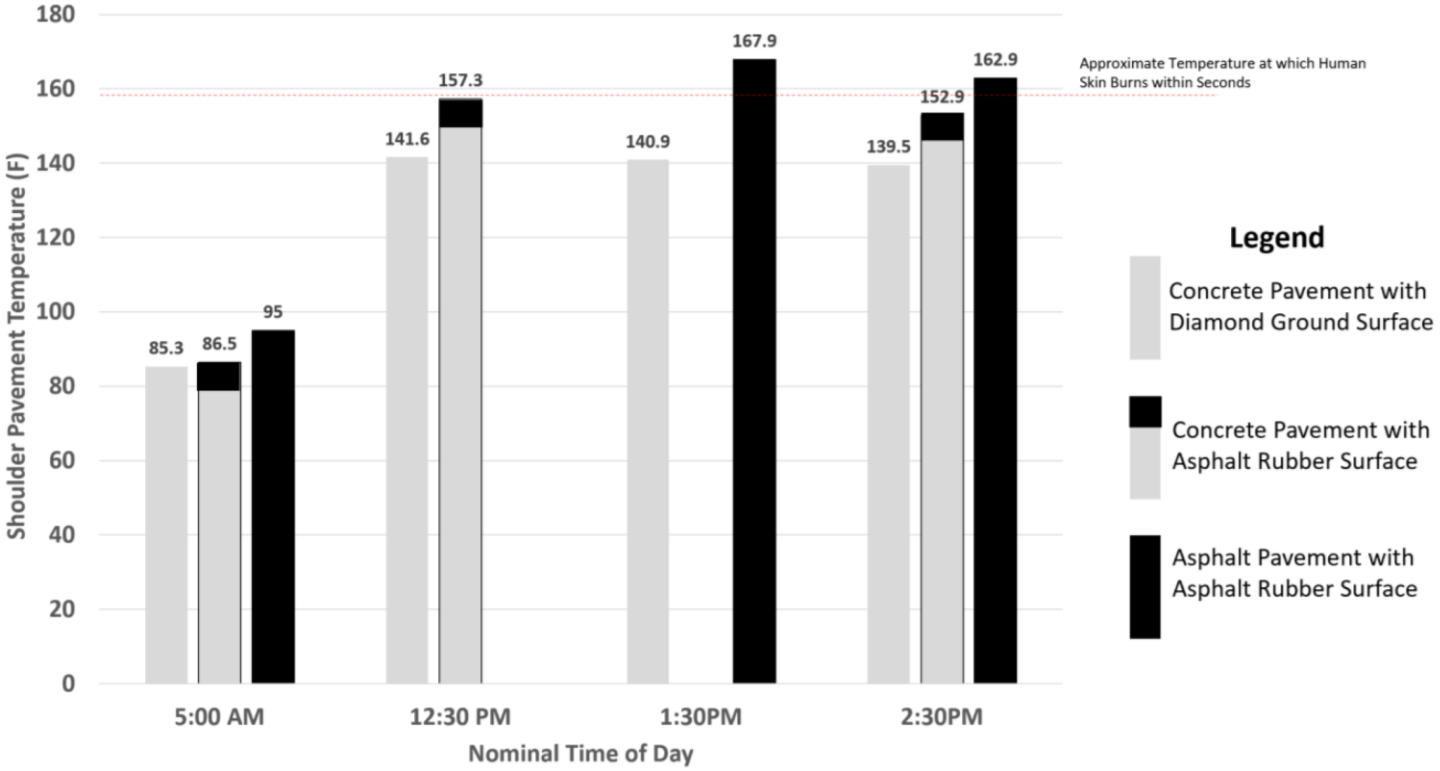


Figure 3 Pavement Shoulder Temperature for Three Pavement Structures from Drone IR Test

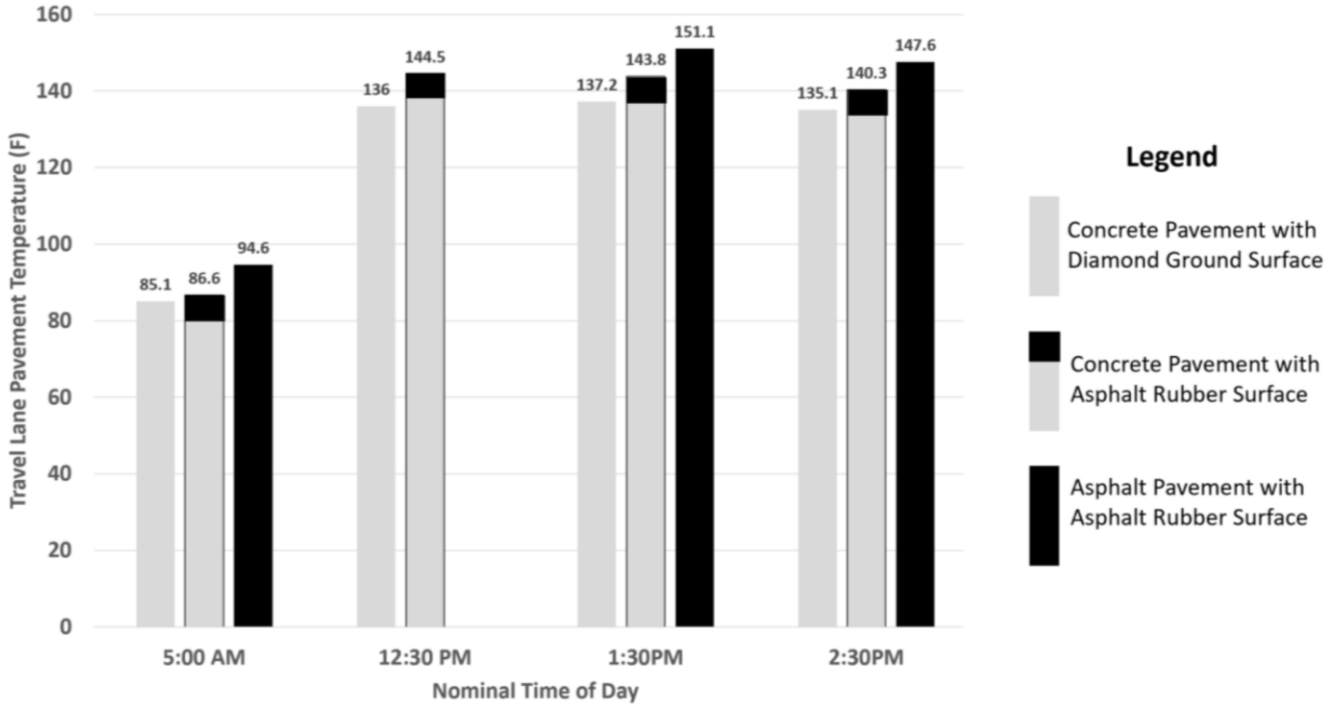
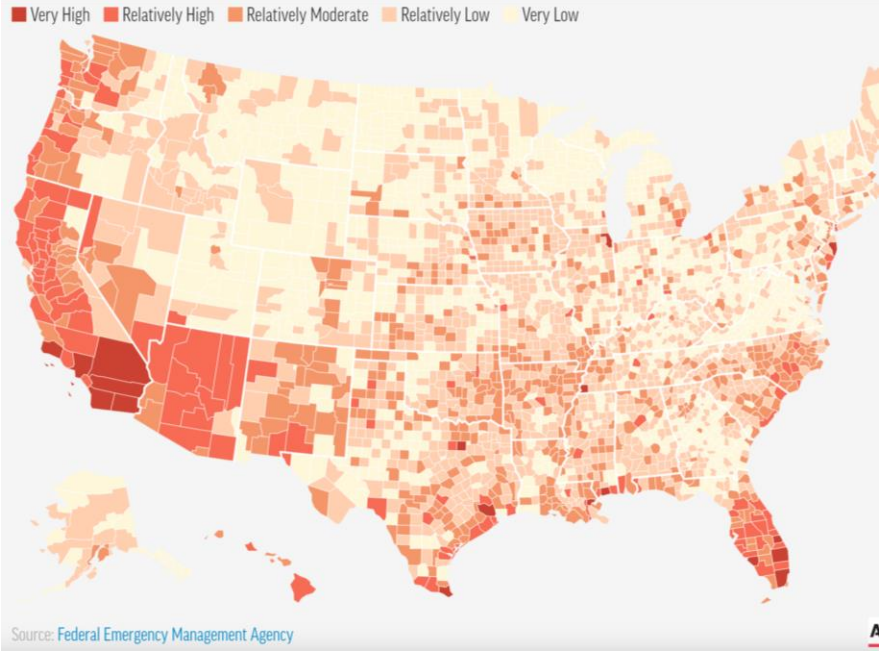


Figure 4 Pavement Travel Lane Temperatures for Three Pavement Structures from Drone IR Test

In 2020, the Arizona Burn Center at Valleywise Health recorded a record high of 104 heat related burns from June thru August, an increase of 49% over previous years[10]. The evidence continues to mount, while transportation planners provide no highway related strategies. As urban heat island continues to receive little attention locally by agencies, the Federal Emergency Management Agency (FEMA) produced a map of US counties indicating risks of natural disasters, which includes hurricanes, flooding, wildfires, and heat waves. Although wildfires probably also contribute to Arizona's relatively high risk, heat island no doubt is a significant contributor in Maricopa County.

Streets of Fire: Will We Ever Get it? or Just Drone On?



US County Map Indicating Risk of Natural Disaster [11]

It's time that Arizona's become active and ensure responsible management of the Regional Freeway System and its continuing impact on the urban heat island and the quality of life in the valley. A recent MIT study of the Phoenix Urban Heat Island condition found that the use of "Cool **Concrete** Pavements", could reduce temperatures almost four degrees (°F) and reduce greenhouse gas emissions by up to six percent [12]. The time is now, before it becomes too late.

As previously indicated, the asphalt freeway section was 10 degrees hotter at sunrise and 27 degrees hotter at peak temperature during the day than the concrete pavement. Asphalt is simply not an acceptable option. The urban heat island impacts the quality of life of all 4.4 million residents of Maricopa County.

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Appendix

FINAL EDITION

THE ARIZONA REPUBLIC

Wednesday, June 27, 1995 ★★★★ Phoenix, Arizona 101st year, N

1:00 p.m. 1:05 p.m. 1:08 p.m. 1:27 p.m. 2:47 p.m.

118° 119° 120° 121° 122°

3 die in Valley — Today: Only 120°

By Mike Burgess
The Arizona Republic

Lethal record heat gripped the Valley for the second day in a row Tuesday. The 122-degree scorcher was suspected in three deaths and dozens of hospitalizations, caused record power usage, and even grounded airliners.

And today is expected to be just as hellish. The high temperature is expected to hit at least 120, with a low of 86, according to ACCU-Weather Inc., a private weather-forecasting company.

"It's dangerously hot," said Steve Jones, a Phoenix Fire Department spokesman. "It's time to take a serious look at people ought to go outside at all."

Phoenix's all-time high — Monday's 120 degrees — was broken Tuesday at 1:27 p.m. when the mercury reached 121. It then reached 122 at 2:47 p.m.

Before this week, Phoenix's all-time high had been 118, set in 1925. That had been matched three times, most recently last July Fourth.

Monday's record was reached about 3 p.m. The low Tuesday of 91 degrees at 6:45

— See VALLEY HEAT, page A14

Jim Talbot of Phoenix catches the sun's rays with some protection. Tuesday's rise of 91 degrees set a record for a maximum low.

Forget snow: Jetliners in Phoenix 'heatbound'

By Guy Webster
The Arizona Republic

The Phoenix version of snowed-in runways dictated Tuesday. Hundreds of passengers at Sky Harbor International Airport found their flights grounded or schedules changed when the temperature topped 121 degrees while en to way to a record 122.

At least 22 flights on five airlines were cancelled, or delayed or diverted for about 80 minutes while temperatures exceeded

— See FORGET, page A2

Regulator of body o overtime

By Peter Aleshire
The Arizona Republic

Maybe you're a cop
bullet-proof vest.

Maybe you're a roofer.

Maybe you're just a fool.

In any case, as you stroll into the 120 degrees, your
starts a vigorous internal dial
on which your life depends.

To be precise, your hypot
man, crouched in its bunker u
base of your brain, sets to
desperately trying to turn a
designed as a biological hu
into an air conditioner.

This is no small trick.
earth, the body turns food
heat to keep the body temper
at 98.6 degrees. Good thing
few degrees off either way,
you're in big trouble.

"Your body is designed
produce heat," said Dr. Sh

— See HOT, page