City of New Orleans

2023 Heat and Health Report

Review of Heat and Heat Data from June to October 2023

December 2024

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Contents

Introduction

The 2023 City of New Orleans Heat and Health Report summarizes heat and health data from June to September of 2023. This first report from the New Orleans Health Department was developed in response to the hottest summer on record [20], as well as the first declared state of emergency pertaining to heat in 2023. Exposure to extreme heat has been intensifying given the increased severity, frequency, and duration of heat-related weather events [1] [22]. New Orleans' high humidity and severe summertime storms can increase an individual's risk of experiencing heat illness, or the body's inability to cope with a particular heat load which leads to a significant rise in body temperature. Heat illness in humans presents in many forms, including heat rash, heat cramps, heat syncope, heat exhaustion, and the most severe form of heat illness — heat stroke. Heat stroke can happen to anyone and is a life-threatening condition. Data associated with heat illness can inform surveillance efforts, strategic planning, agency collaboration efforts, risk communication, and community outreach and education. As such this report has four objectives:

1. Establish a baseline report for heat and health data in the City of New Orleans for future heat and health reports
2. Explore the relationship between heat illness, social determinants of health, and the built environment
3. Determine if recorded WeatherSTEM station temperatures mirror health outcomes related to extreme heat
4. Determine populations for targeted intervention planning for future summer months.

2023 Heat and Health Report

EXECUTIVE SUMMARY

Introduction

The 2023 City of New Orleans Heat and Health Report serves as a data snapchat captured from June to September 2023 in Orleans Parish, which has been documented as the hottest summer in recorded history [17]. In August 2023, the City declared its first local state of emergency for the ongoing effects of extreme heat, followed by a State of Louisiana emergency declaration for drought conditions that contributed to wildfires, water system outages, and seawater intrusion.

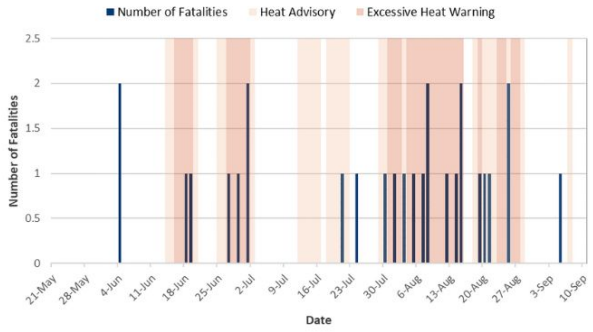
Objectives

1. Establish a baseline report for heat and health data in the City of New Orleans for future heat and health reports.
2. Determine if recorded WeatherSTEM station temperatures mirror health outcomes related to extreme heat.
3. Explore the relationship between heat illness, social determinants of health, and the built environment.
4. Determine populations for targeted intervention planning for future summer months.

Highlights and Key Findings

Reported health impact

- **367** heat-related NOEMS calls
- **28** heat-related fatalities
- Most fatalities had responder-perceived housing-related concerns (unhoused, lived alone, or could not run their air conditioning unit).
- Most fatalities that occurred in housed persons occurred in individuals aged 60 years or older.
- Fatalities in individuals under 60 years old were more likely to have a positive toxicology report, or an unhoused or unknown housing status.
- Common locations where heat-related EMS calls originated: single family residences, parks, businesses, restaurants, and bars.



This graph shows the relationship between the 28 heat-fatalities and both the heat advisories and excessive heat warnings that occurred throughout the summer of 2023. It can be seen that heat-related fatalities more often occurred during periods of prolonged excessive heat, prolonged periods being at least 4 consecutive days of excessive heat warnings.

Hot spots

- Urban daytime temperature did not appear to be an accurate predictor of greater numbers of heat-related illnesses.
- The 70130, 70118, and 70119 zip codes experienced the greatest number of heat-related health outcomes in 2023.
- Priority intervention neighborhoods based on climate-related social vulnerability and heat-related illness 911 calls:
  - Dixon, Hollygrove and the northwestern portion of Gert Town
  - Lower parts of Mid-City including along the intersection of North Broad Street and St. Louis Street, as well as along Tulane Avenue between South Lopez Street and South Murat Street
  - Upper portion of the 7th Ward that resides within the 70119 zip code
  - St. Thomas Development area

Next Steps

Improve Methodologies

- Develop defined heat index thresholds for varying levels of intervention
- Collaborate with healthcare partners to improve the case definition for heat illness and reporting practices
- Investigate development of correction factor for WeatherSTEM heat index

Fund Targeted Interventions

- Conduct outreach to single-family residences
- Post notices about heat and dehydration risks in public spaces
- Provide heat safety trainings for outdoor workers
- Support outreach to residents with unstable housing and residents who use drugs

Expand Community Research

- Quantify access to working A/C units and cost burden to run during peak heat months
- Investigate excessive heat exposure and rates of violence
- Investigate excessive heat exposure and pregnancy risk
- Monitor heat-related morbidity/mortality and drug use

Background

Extreme heat is emerging as a prominent consequence of climate change, posing significant health risks and a growing public health threat, particularly in urban settings. It ranks as the leading cause of weather-related fatalities and injuries in the United States [1][23]. Prolonged exposure to extreme heat places considerable strain on the heart, exacerbating chronic cardiac and respiratory diseases. The ability for one's body to regulate its internal temperature is directly related to the heart and thus plays a crucial role in experiencing heat-related illness. Difficulties with blood pressure control can interfere with a person's ability to regulate body temperature. Additionally, extreme heat can affect people who are managing mental health conditions. High temperatures can impact the effectiveness of anti-psychotic medications, leaving people vulnerable to experiencing aggressive behaviors, hallucinations, and suicidal thoughts. Even in individuals who are not managing mental health conditions with medication, anxiety, irritability, and depression can surge during periods of extreme heat.

Extreme weather events and patterns of sustained record high temperatures have increased over the last few decades [18][7]. Public health and climate researchers indicate that this trend will persist, making it imperative for municipalities to take proactive measures immediately. Local government responsibilities include developing equitable programs and policies that allow for sustained adaptation to these changes, engaging and educating residents of local health risks and worker rights, and collaborating with other sectors to form a cohesive response. Elevated temperatures can potentially impact crop growth, escalate the prevalence of vector-borne illnesses, worsen chronic diseases, and lead to population displacement [4][5][8][15][16][26]. These challenges disproportionately affect certain populations, such as older adults and people who are socially isolated, unstably housed, or unhoused, children, pregnant and post-partum individuals, outdoor workers, and those with mental health issues.

The continuous rise in global temperatures has resulted in more wildfires, extended allergy and pollen seasons, and worsening air quality. Longer and warmer seasons have expanded the habitat of disease-carrying insects and disrupted crop growth, reducing the overall quality of life, with the most substantial impact felt by communities of color and limited-income populations. Residential segregation, often a result of redlining, has left these neighborhoods with fewer trees and green

About the New Orleans Health Department

Mission:

To promote, protect, and improve the health of all in our community through equitable policies, programs, and partnerships.

Vision:

Building a healthy and equitable New Orleans by supporting the well-being of everyone in the region.

spaces, making them more susceptible to heat islands. Consequently, residents face higher rates of cardiovascular and respiratory diseases, largely due to food deserts, inadequate clinical care access, and proximity to industrial areas with high pollution levels. Extended extreme heat also strains energy resources, potentially overloading power grids, while lower-income communities struggle to cope with increased utility costs to stay cool. A study by the International Energy Agency revealed a 2.5-fold increase in global energy demand from 1970 to 2020, with nearly 40% of this increase occurring in humid, lower-income regions like New Orleans, a trend likely to persist [11].

Excessive heat is actively impacting New Orleans residents. The city gained attention when a Washington Post article ranked New Orleans number 1 out of 158 United States cities for having the most intense heat islands in 2021 [12]. In the article the city's infrastructure was named as the main contributing factor for its top ranking. It was in response to this article, in addition to many other arising factors, that a climate and health position was added to the New Orleans Health Department in 2022. The City's overall climate adaptation and resilience plan also added "health" as a main priority and considers the New Orleans Health Department an essential partner. Shortly after the article was published, Hurricane Ida impacted New Orleans and brought extended power outages to the entire city. During the two weeks without power, there were a total of 8 consecutive days with heat advisories that left many of those who either didn't or couldn't evacuate exposed to the elements for a prolonged period. Hurricane Ida serves as just one example of the potential coinciding exposures to climate-led weather patterns that New Orleans could experience as the climate continues to change. With recent climate trends we have seen more days with excessive heat, rapid intensification of storms such as hurricanes, drought, and wildfires that can lead to widespread negative impacts on air quality [6][19]. To protect the health of the most at-risk for severe outcomes and well-being of communities at large, it is essential to understand the pathways to mitigate and adapt to extreme heat conditions. This can be achieved through surveillance, strategic planning, multi-sector collaboration, and transparent risk communication with the public.

Methodology

This report analyzes heat morbidity and mortality data and environmental data from the following sources:

- Orleans Parish Coroner's Office
- New Orleans Emergency Medical Services
- City of Orleans WeatherSTEM stations
- National Weather Service

For more information about methodology, please review the 2023 Methodology appendix.

Data and Findings

Objective 1: Establishing a baseline for heat and health data in New Orleans

The New Orleans/Baton Rouge Weather Forecast Office of the National Weather Service (NWS) has warning and advisory criteria that specifies a heat advisory will be issued if a heat index of greater than or equal to 108°F is forecasted. Similarly, an excessive heat warning will be issued if a heat index of greater than or equal to 113°F is forecasted [23]. Given this context, it can be seen [Table 1.] that 2023 saw a substantial increase in the amount of both heat advisory and excessive heat warnings when compared to previous years.

Table 1. ***Number of heat-related National Weather Service alerts***

Alert Type	2015*	2021	2022	2023
Heat Advisory	6	20	11	26
Excessive Heat Warning	3	4	1	29

*Before 2023, 2015 was the last summer during a major El Niño event.

When broken down by month, it can be seen [Table 2.] that the month of July saw the greatest number of heat advisories, while August saw the greatest number of excessive heat warnings. Of note, even though June, July, and August respectively saw an incremental number of alerts, the month of June saw more excessive heat warnings than the month of July.

Table 2. ***Breakdown of heat-related National Weather Service alerts in 2023 by month***

Alert Type	May	June	July	August	September
Heat Advisory	0	5	13	7	1
Excessive Heat Warning	0	8	2	19	0
Total Alerts for the Month	0	13	15	26	1

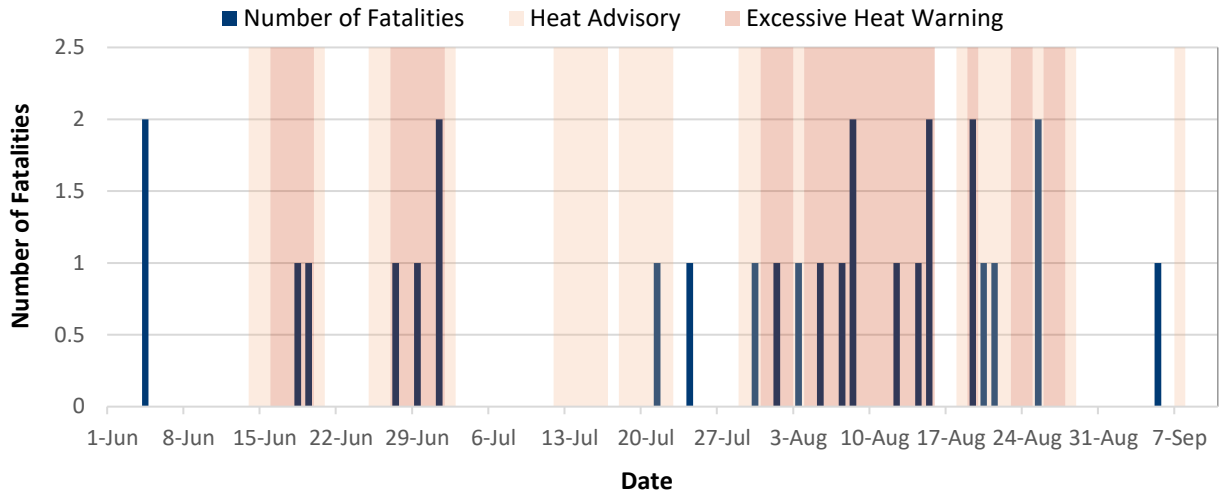
Given the record-breaking number of 2023 heat-related NWS alerts seen in the graph above, heat-related morbidity and mortality was seen as well. Throughout the summer there were 367 EMS calls pertaining to heat-related illness, and 28 heat-related fatalities occurred. (The parameters for determining heat-related EMS calls and heat-related fatalities can be found in the methodology section.)

Table 3. ***Number of Heat-Related Incidents in 2023***

Heat-Related Incidents	Number of Incidents
Heat-Related EMS Calls	367
Heat-Related Fatalities	28

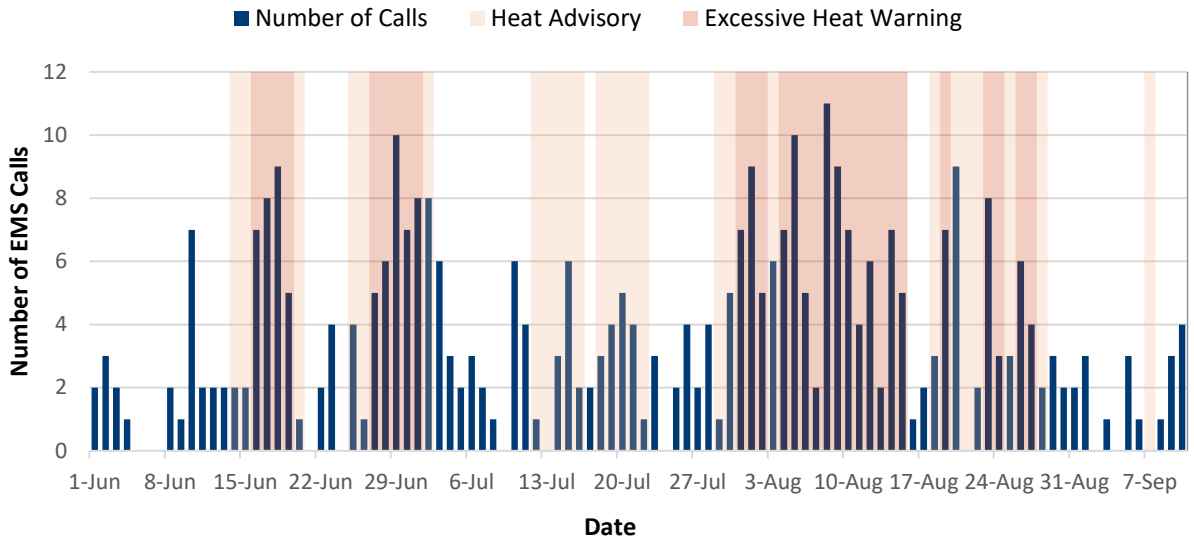
The graph below [Figure 1.] shows the relationship between the 28 heat-fatalities that occurred in Orleans Parish, and the heat-related weather alerts, both heat advisories and excessive heat warnings, that occurred throughout the summer of 2023. Most heat-related fatalities occurred in the month of August, the month that saw the greatest number of heat-related weather alerts.

Figure 1. ***2023 Heat-related fatalities and heat-related weather alerts in Orleans Parish***



The next graph below [Figure 2.] shows the relationship between the 367 heat-related EMS calls that occurred in Orleans Parish, and the heat-related weather alerts, both heat advisories and excessive heat warnings, that occurred throughout the summer of 2023. Like the heat-related fatalities, the largest portion of the heat-related EMS calls occurred in the month of August. There was an incline in call volume throughout the summer with June having 97 calls, July having 102 calls, and August having the 152 calls. There was a steep drop in call volume the following month of September, with only 16 total calls.

Figure 2. 2023 ***Heat-related EMS calls and heat-related weather alerts in Orleans Parish***



Based on both charts (Figure 1. and Figure 2.), heat-related morbidity and mortality occurred at a higher volume during excessive heat warnings. Furthermore, heat-related fatalities were more likely to occur during periods of prolonged excessive heat. In this case, prolonged periods being at least four consecutive days of excessive heat warnings. These graphs also shows that heat-related health impacts can still occur in the shoulder periods before and after known extreme heat months, particularly given the fatalities that happened on June 4th and September 5th.

The data in this section shows a relationship between extreme heat and population morbidity and mortality; however, the relationship between extreme heat and adverse health impacts is more complex and involves a variety of contributing factors. The next objective will explore the relationship between heat illness, social determinants of health, and the built environment.

Objective 2: Exploring the relationship between heat illness, social determinants of health, and the built environment.

Investigation into variations in geographical climate vulnerability found a correlation with past practices of systemic racism and environmental injustice [9][10][13][14]. In New Orleans, neighborhoods designated as rank C and D by the Federal Housing Administration in post-depression America have faced compounding environmental factors such as construction of major highways, inadequate dispersion of tree canopy, proximity to previous hazardous sites, and flood plains, leaving them considerably more vulnerable to the effects of climate change. Given the previously mentioned environmental and social influences, these areas are also more likely to experience economic instability, have less access to education opportunities, are more likely to experience barriers to health care, and overall, are at a greater risk of poor health outcomes.

Extreme heat has been associated with climate change and as the climate continues to change, we will experience longer and more frequent periods of extreme heat [7]. Many of the environmental factors mentioned above can leave a community more vulnerable to urban heat island effect. Given the importance of the role geography plays in defining climate vulnerability, this section will compare the geography of the heat-related morbidity and mortality seen in New Orleans in 2023 to social vulnerability and factors of the built environment that could contribute to heat exposure. As such, the heat-related EMS calls and heat-related fatalities seen in 2023 were mapped according to zip code as seen below [Table 4.].

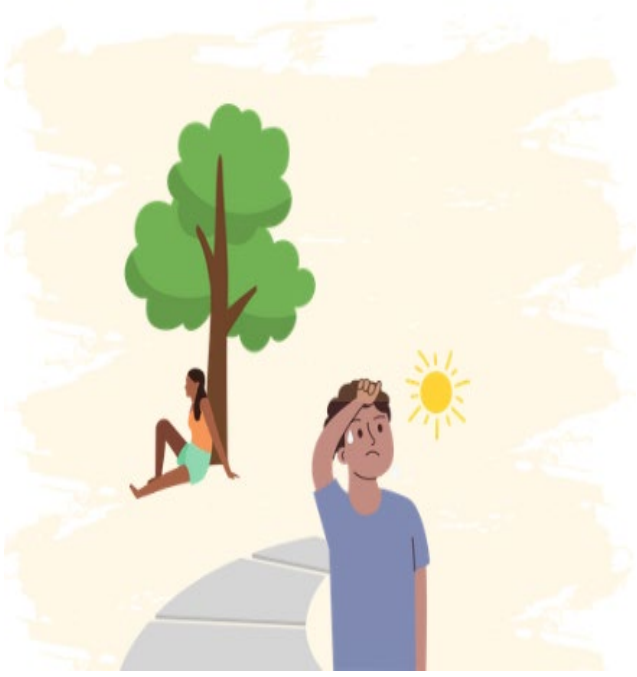
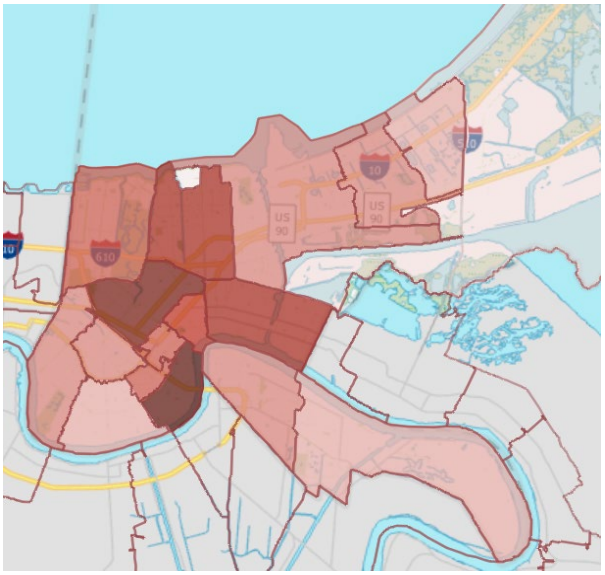
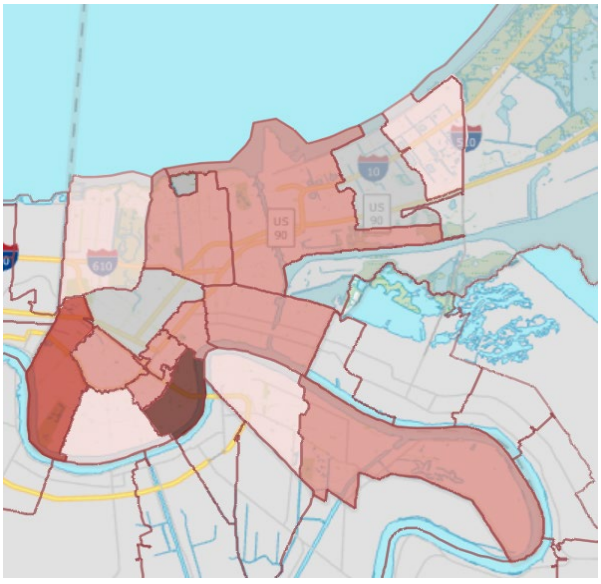


Table 4. ***Heat-related morbidity and mortality in Orleans Parish in 2023***

Number of Heat-related EMS Calls by Zip code The 70130-zip code had the greatest number of heat-related EMS calls. This area consists of the St. Thomas, Lower Garden District, and smaller parts of the Central Business District and French Quarter neighborhoods. The 70119-zip code had the second highest number of heat-related EMS calls. This area consists of the Mid-City, Bayou St John, Treme, Fair Grounds, and 7th Ward neighborhoods. The map shows higher rates of heat-related EMS calls associated with the 70122, 70117, and 70116 zip codes as well. Overall, the map indicates many of the heat-related EMS calls are more centralized in the Parish.	
Number of Heat-Related Fatalities by Zip Code The 70130-zip code also had the greatest number of heat-related fatalities. The specific neighborhoods that make up this area are listed above. Unlike the map above, the 70118 zip-code had the second highest number of heat-related fatalities. This area consists of the Holly Grove, Dixon, Leonidas, East Carrollton, and Black Pearl neighborhoods. The map shows 2 heat-related fatalities occurred within the 70125, 70113, 70112, 70116, 70117, 70131, 70122, and 70126 zip codes. Overall, the map indicates many of the heat-related fatalities were less centralized in the parish.	

By visually comparing the two maps in Table 4. with a Social Vulnerability Index (SVI) map of Orleans Parish, some overlap between the highest level of social vulnerability and the areas that had the highest number of heat-related incidences is seen. Overall, the SVI shows the highest level of social vulnerability toward the center of Orleans Parish along the I-10 Expressway corridor, in the Central City, Mid-City, and Hollygrove-Dixon and Gert Town neighborhoods, in New Orleans East, and in Algiers. Rates of EMS cases in the 70119, 70122, 70117, and 70116 show possible alignment with areas marked as highly vulnerable. In addition to the EMS call rates, these zip codes all experienced two heat-related fatalities. The 70118-zip code, which experienced the second highest number of fatalities (3 fatalities), shows possible alignment with the higher level

of social vulnerability identified in the Hollygrove-Dixon neighborhood. However, the 70130-zip code shows poor alignment. It has only one census tract with the highest level of vulnerability and one census tract with a social vulnerability in the top 3rd category; yet this zip code experienced the greatest number of fatalities (5) and the greatest number of EMS calls (53 calls).

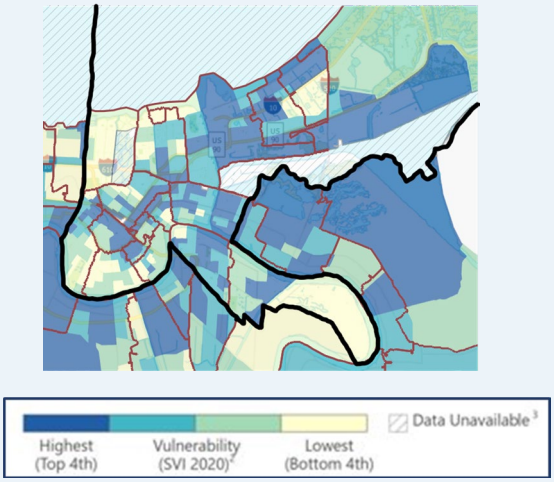
Through the Climate Smart Cities Program, Trust for Public Land (TPL) led the development of a web-based decision support tool with guidance from a technical advisory team made up of representatives from partner agencies, organizations, and universities. The Climate-Smart Cities Planning Tool considers climate risks, such as environmental threat and social vulnerabilities, in New Orleans to identify priority areas for intervention. The table below [Table. 5] shows two maps available through the web-based tool. One shows the combined climate-related inequities, and one shows combined climate-related health outcomes.

In comparing the map of climate-related inequities to the Orleans Parish SVI map, near perfect alignment can be seen. The similarities between these two maps are expected given they consider almost the same criteria in determining population vulnerability. However, the framework of a climate-specific definition of vulnerability being comparable to a more generalized definition of social vulnerability still holds value. It ensures that climate and health topics are relevant in discussions surrounding social vulnerability and, as such, should be integrated into established public health frameworks that aim to reach defined vulnerable populations in New Orleans. Given the level of alignment between the climate-related inequities map and the SVI map, the observations made in the comparison between the mapped heat-related morbidity and mortality [Table 4.] and the SVI map can be applied to comparison of climate-related inequities and heat-related morbidity and mortality.

In comparing the map of climate-related health outcomes to the SVI map, only a certain amount of alignment can be seen. Overall, the map of the climate-related health outcomes shows less overall dispersal of areas experiencing the greatest amount of negative health outcomes associated with climate change when compared to climate-related inequities. There is alignment between health outcomes and social vulnerability in the lower parts of New Orleans East associated with zip codes 70126 and 70129 as well as the center of the Parish, primarily in the Central City and Mid City neighborhoods. However, one area that standout in the health outcome

Social Vulnerability Index

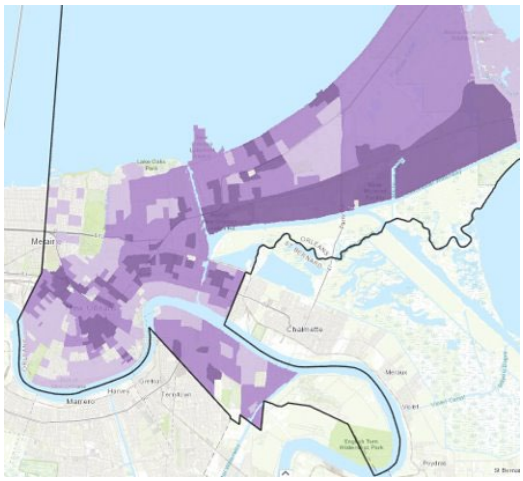
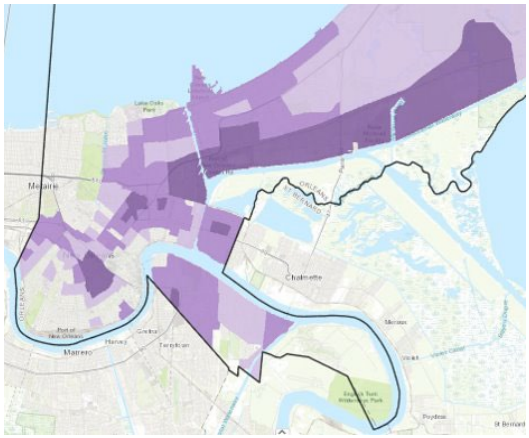
The CDC developed the SVI to support emergency response planners and public health officials in identifying communities that may need more support before, during, and after public health emergencies (CDC, 2022). Largely based on U.S. Census data from the American Community Survey (ACS), the SVI considers socioeconomic status, household characteristics, racial and ethnic minority status, housing type, and access to transportation in determining a vulnerability rating.



map is the Desire neighborhood, the most western portion of the 70126-zip code. While this entire area is experiencing the highest degree of climate-related health outcomes, the SVI for this area is in the top 3rd category. Other areas that are experiencing the highest degree of climate-related health outcomes maintain some overlap with SVI areas that rank in the highest category, the 4th category, of social vulnerability; however, the Desire area does not.

When comparing climate-related health outcomes to the heat-related morbidity and mortality seen in 2023, the 70130-zip code had similar alignment to the SVI, meaning only one census tract showed significant negative health outcomes. The 70118-zip code, the zip code that experienced the second highest level of heat-related fatalities (3), showed climate-related health outcomes are experienced in the Hollygrove/Dixon and Gert Town areas; however, to a slightly lesser degree than then climate-related health inequities. Finally, the zip code that experienced the greatest number of heat-related EMS calls, the 70119-zip code, experiences climate-related health outcomes to a lesser degree than social vulnerability and comparatively to the rest of the Parish, expect for the 7th ward which shows the highest degree of climate-related health outcomes.

Table 5. ***Mapping of climate-related social determinants of health through Trust for Public Land's Climate Smart Cities tool***

Climate-Related Inequities in New Orleans This map shows areas within the City of New Orleans that experience inequities that are capable of adversely impacting how a person, or a household, prepares for, responds to, and recovers from negative impacts related to either day-to-day climate change or a climate change-related event. These equity topics include low-income households, people of color, less than a high school education, limited English speaking, population density, households receiving SNAP, single parent households, households with disabilities, households without vehicles available, and high rent burden.	
Climate-Related Health Outcomes in New Orleans This map shows areas within the City of New Orleans that are experiencing health outcomes that are, in part, the result of climate change-related environmental impacts, or will negatively impact how a person, or household, prepares for, responds to, and/or recovers from negative impacts related to either day-to-day climate change or a climate change-related event. These health outcomes include asthma, kidney disease, cardiovascular disease, diabetes, hypertension, stroke, poor mental health, and physical inactivity.	

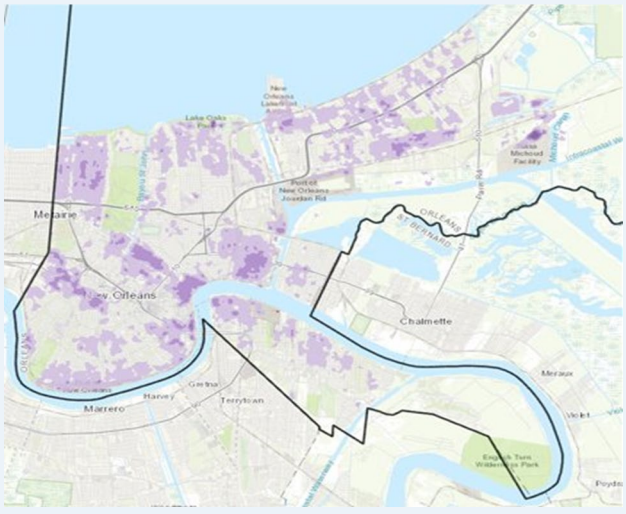
Trust for Public Land Climate Smart Cities New Orleans

The TPL Climate-Smart Cities program is providing key planning and decision-making support to help achieve goals laid out in Resilient New Orleans by leveraging the power of cutting-edge science, Geographic Information Systems (GIS) planning, and innovative design to drive park, open space and green infrastructure solutions in preparing the city and its most vulnerable for a climate-resilient future.

The web-based tool can be found at the address below:

https://web.tplgis.org/nola_csc/

The TPL's Climate Smart Cities tool also maps daytime hotspots throughout Orleans Parish. Urban heat island hot spots are most often the result of an excess of concrete covering the ground and a lack of tree cover. The purple coloring on the map is indicative of spaces with elevated daytime land surface temperatures that average at least 1.25°F above the mean land surface temperature for all of Orleans Parish. Similar to the maps from Table 5., the **dark purple** areas of the map indicate spaces with the highest levels of land surface temperature. The **light purple** areas of the map indicate spaces still experiencing higher levels of land surface temperature, but to a lesser degree than the previously indicated areas. The map was developed by the Trust for Public Land using LANDSAT satellite data from the summer of 2022.



When compared to the zip codes that experienced the greatest number of heat-related fatalities and EMS calls in 2023, the map shows the 70118-zip code having a prominent hot spot primarily in the Holly Grove neighborhood that extends into parts of Gert Town, Fontainebleau, and the upper part of Leonidas. The 70119-zip code also has a prominent hot spot that extends across Bayou St. John and most of Treme. Parts of Mid-City and Tulane/Gravier also experience hot spots, although milder than the previously mentioned neighboring areas. The 70130-zip code has some smaller prominent hot spots in the Lower Garden district and St Thomas area. These smaller hot spots also extend into the lower portion of Central City. Other areas throughout the city that have evident hot spots include St. Claude, the French Quarter, Lakeview, Algiers Point, Gentilly-Milneburg, many parts of New Orleans East, the Irish Channel, West and East Riverside, and the Black Pearl.

Overall, when exploring the relationship between heat illness, social determinants of health, and the built environment, portions of the zip codes that experienced the greatest number of heat-related EMS calls and/or heat-related fatalities had areas that experienced climate-related inequities and health outcomes, as well as prominent hot spots that result from inadequate built environments. This relationship can narrow down areas within the identified zip codes for targeted public health interventions aimed at addressing exposure to extreme heat.

Objective 3: Determine if recorded WeatherSTEM station temperatures mirror health outcomes related to extreme heat

The City of New Orleans utilizes WeatherSTEM weather stations to monitor the weather at a hyperlocal level around the city. As of the fall of 2023, there are a total of 20 stations located at different points throughout the city. Given the established importance of geographical location in the determination of community-level risk to extreme heat, the value of having neighborhood-level weather stations in the planning of public health intervention strategies was investigated. To accomplish this, data was taken from each of the stations on days that were declared excessive heat warning days by the NWS in the year of 2023. There was a total of 29 excessive heat warning days that were included in the analysis.

On each of the 29 days where an excessive heat warning was issued, the daily maximum heat index was recorded at each of the 20 WeatherSTEM stations. The 29 daily maximum heat indices were then averaged for each of the 20 WeatherSTEM stations, indicated by the blue columns of the bar graph below [Figure 6.]. The resulting 20 average daily maximum heat indices for each weather station were then averaged, to receive an overall daily maximum average of 112.5°F for excessive heat days, indicated by the red line on the graph below. When comparing the average daily maximum index at each of the WeatherSTEM stations, Lakefront, Lower 9th Ward, and Gentilly/Milneburg had the highest average maximum heat index at around 115°F. Algiers, Almonaster, and the Warehouse District/Riverwalk had maximum average heat indexes that were below 110°F, most likely indicative of the fact that these neighborhoods did not reach 113°F, the heat index threshold for an excessive heat warning alert, on days where an excessive heat warning was issued.

Weatherwise New Orleans

From NOLAReady, in partnership with WeatherSTEM, Weatherwise provides an overview of all weather stations located around Orleans Parish, providing real-time localized weatger reporting. For more information on each individual WeatherSTEM station, including location, visit the site below:

https://weatherwise.nola.gov/

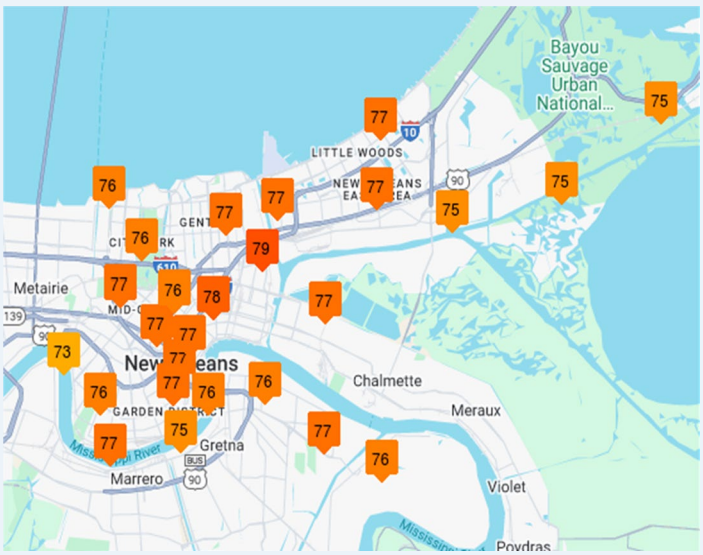


Figure 6. ***Average of the daily maximum heat index for each of the 29 declared excessive heat warning days at each WeatherSTEM station***

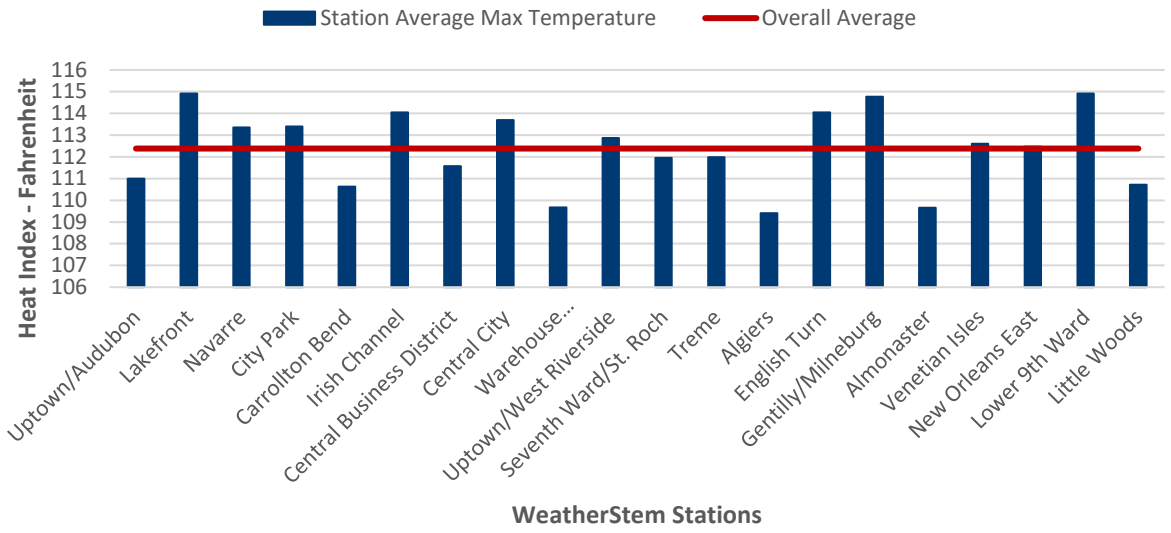
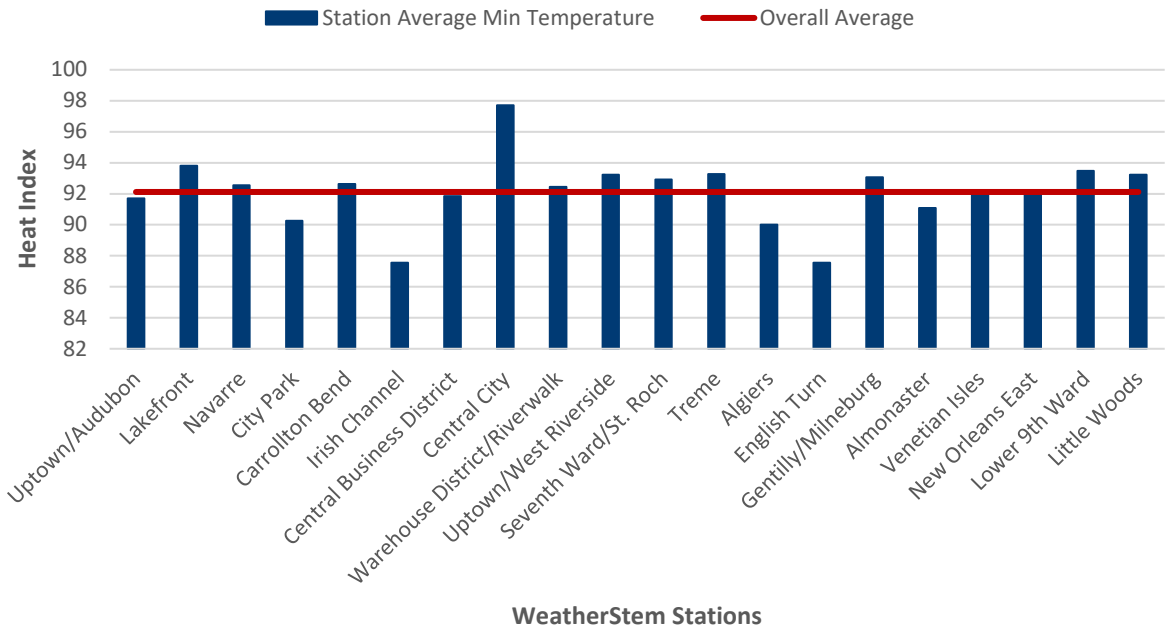


Figure 7. ***Average of the daily minimum heat indices for each of the 29 declared excessive heat warning days at each WeatherSTEM station***



On each of the 29 days where an excessive heat warning was issued, the daily minimum heat index was recorded at each of the 20 WeatherSTEM stations. The 29 daily minimum heat indices were then averaged for each of the 20 WeatherSTEM stations, indicated by the blue columns of the bar graph below [Figure 7.]. The resulting 20 average daily minimum heat indices for each

weather station were then averaged, to receive an overall daily minimum average of 92°F for excessive heat days, indicated by the red line on the graph below. Notably, Central City had a minimum average of almost 98°F, which is about 4°F higher than any other neighborhood and almost 6 degrees higher than the overall average. The high minimum average in Central City may be indicative of persistent nighttime temperatures brought about by large amounts of concrete and minimal green coverage, or urban heat island effect. Urban heat island effect is heat that is absorbed by the surface infrastructure during the day and is released at night, allowing the minimum temperature to remain high. Other than Central City, both the Irish Channel and English Turn stand out with averages that were around 4°F lower than the overall average.

The time of day that a heat index of 108°F was reached was recorded for each of the 29 days where an excessive heat warning was issued, at each WeatherSTEM Station. The 29 times for each of the excessive heat days were then averaged at each of the 20 WeatherSTEM stations. These averages were then placed in order from the earliest time to the latest as shown in the table below [Table 6.]. In addition, the 20 average times for each weather stations were averaged to receive an overall average time of 12:24PM. This time represents the overall average time of day that New Orleans reached the 108°F threshold for a heat advisory alert. Overall, there was difference of 3 hours between the earliest average time 108°F was reached in Gentilly/Milneburg and the latest average time 108°F was reached in Little Woods.

Table 6. ***Average time of day a 108°F Heat Index was reached over each of the 29 declared excessive heat warning days at each of the WeatherSTEM stations compared to the overall average***

WeatherSTEM Station	*Time of Day*
Gentilly/Milneburg	11:05 AM
Central City	11:18 AM
Lower 9th Ward	11:36 AM
English Turn	11:53 AM
Irish Channel	11:53 AM
Navarre	11:53 AM
City Park	11:54 AM
New Orleans East	12:05 PM
Uptown/West Riverside	12:07 PM
Seventh Ward/St. Roch	12:10 PM
Treme	12:12 PM
Lakefront	12:15 PM
Central Business District	12:26 PM
Uptown/Audubon	12:34 PM
Venetian Isles	12:51 PM
Warehouse District/Riverwalk	1:06 PM
Algiers	1:16 PM
Carrollton Bend	1:25 PM
Almonaster	1:54 PM
Little Woods	2:05 PM
Overall Average Time of Day	12:24 PM

The time of day that a heat index of 113°F was reached was recorded for each of the 29 days where an excessive heat warning was issued, at each WeatherSTEM Station. The 29 times for each of the excessive heat days were then averaged at each of the 20 WeatherSTEM stations. These averages were then placed in order from the earliest time to the latest as shown in the table below [Table 7.]. In addition, the 20 average times for each weather stations were averaged to receive an overall average time of 2:46PM. This time represents the overall average time of day that New Orleans reached the 113°F threshold for an excessive heat warning alert. Overall, there was difference of around 4 hours between the earliest average time 113°F was reached in Lakefront and the latest average time 113°F was reached in Carrollton Bend.

Table 7. ***Average Time of Day 113°F Heat Index was Reached over each 29 Declared Excessive Heat Warning Days at each of the WeatherSTEM Stations Compared to the Overall Average***

WeatherSTEM Station	*Time of Day*
Lakefront	12:21 PM
Gentilly/Milneburg	1:02 PM
City Park	1:50 PM
Uptown/Audubon	1:53 PM
Lower 9th Ward	2:01 PM
English Turn	2:09 PM
Irish Channel	2:09 PM
New Orleans East	2:15 PM
Central City	2:32 PM
Treme	2:50 PM
Little Woods	3:00 PM
Venetian Isles	3:04 PM
Warehouse District/Riverwalk	3:15 PM
Navarre	3:16 PM
Seventh Ward/St. Roch	3:16 PM
Uptown/West Riverside	3:26 PM
Almonaster	4:00 PM
Central Business District	4:00 PM
Algiers	4:25 PM
Carrollton Bend	4:39 PM
Overall Average Time of Day	2:46 PM

On each of the 29 days where an excessive heat warning was issued, the amount of time that the heat index was at or above 108°F, the heat index threshold for a heat advisory alert, was recorded for each of the 20 WeatherSTEM stations. The 29 timeframes for each of the excessive heat days were then averaged for each of the WeatherSTEM stations, indicated by the blue columns on the graph below [Figure 8.]. The resulting 20 timeframes for each weather station were then averaged with one another to receive an overall average daily time of around 6 hours that a 108°F threshold was sustained on excessive heat warning days, indicated by the red line on the graph below.

When comparing the average time that the 108°F threshold was sustained at each of the 20 weather stations, Central City sustained the threshold for the greatest period at an average of 9 hours, 3 hours greater than the overall average. Gentilly/Milneburg and the Lower 9th Ward also

stand out, having sustained the threshold for an average of 8.5 hours. However, Carrollton Bend, Warehouse District/Riverwalk, Algiers, Almonaster, and Little Woods sustained the threshold for the least amount of time, around 4 hours, which is about 2 hours below the overall average.

Figure 8. ***Average amount of time a 108°F heat index was sustained on each of the 29 declared excessive heat warning days at each WeatherSTEM station***

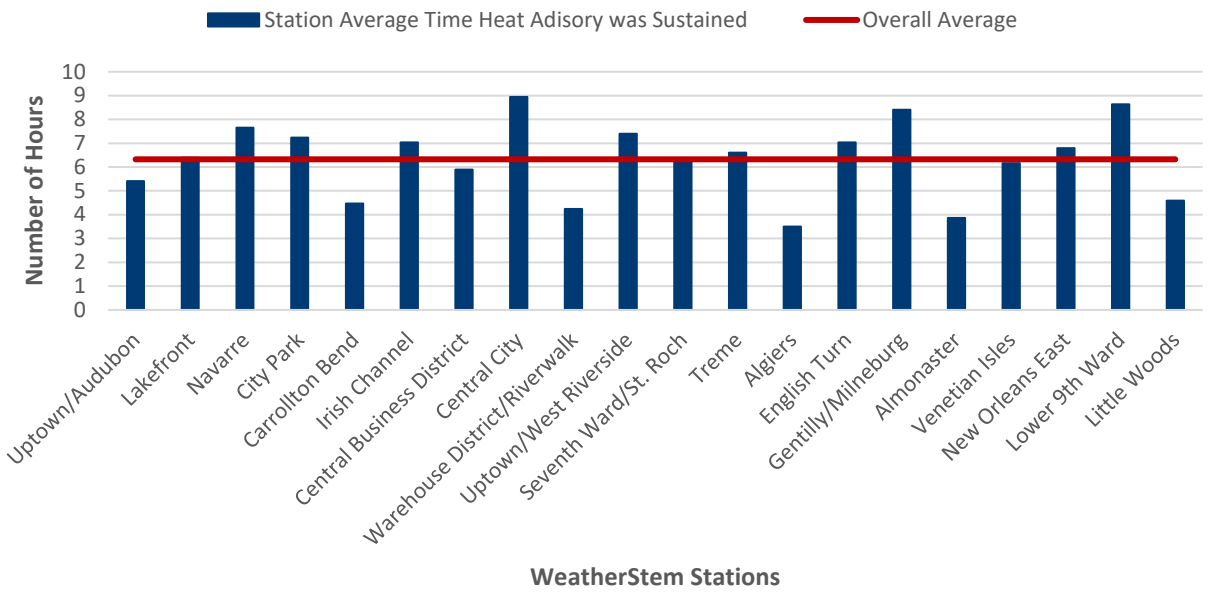
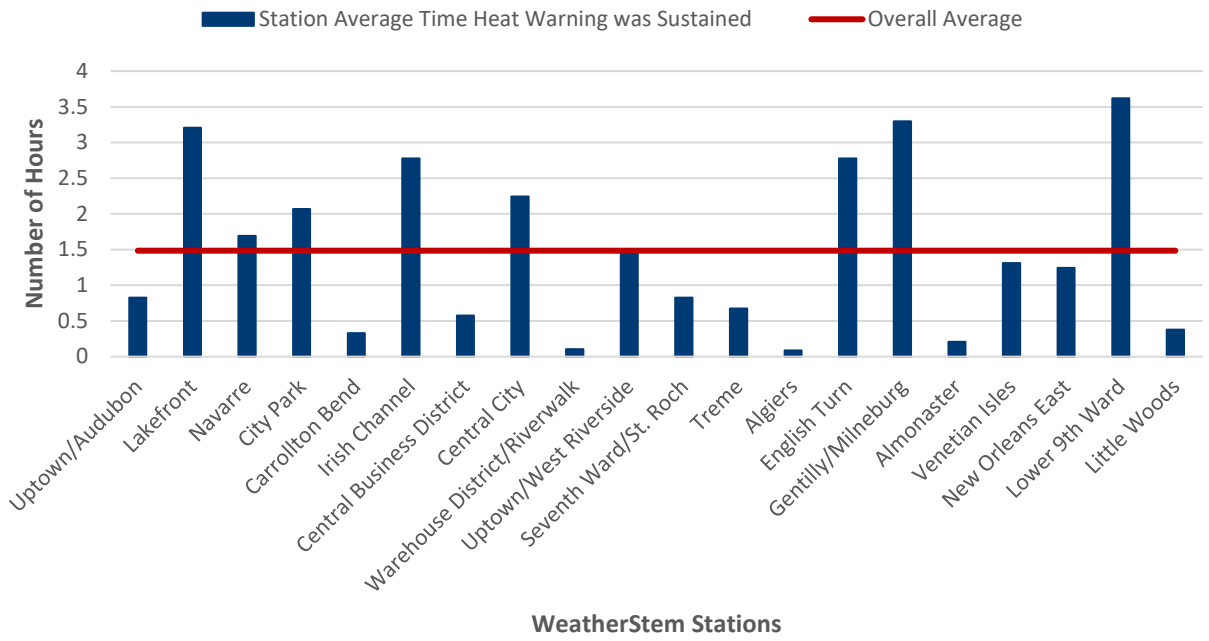


Figure 9. ***Average Amount of Time a 113°F Heat Index was Sustained on each of the 29 Declared Excessive Heat Warning Days at each WeatherSTEM Station***



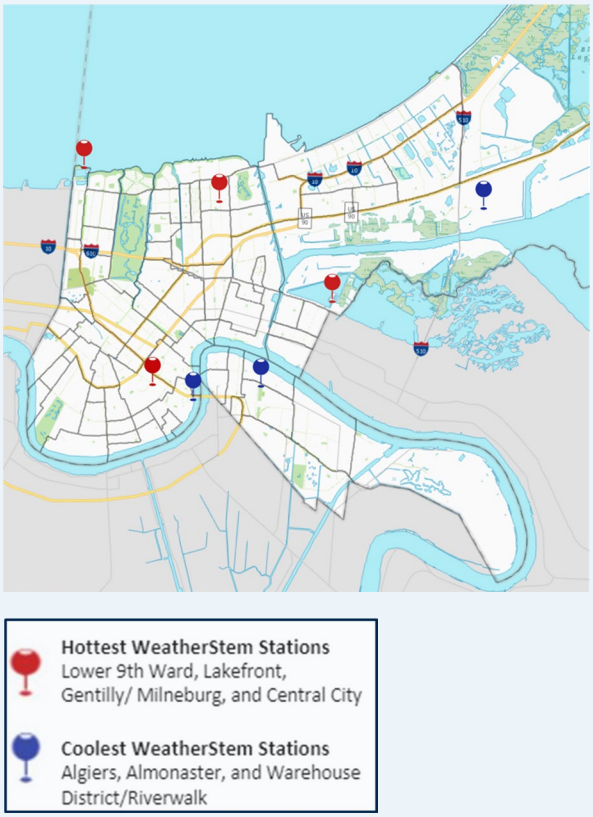
Like the graph above, on each of the 29 days where an excessive heat warning was issued, the amount of time the heat index was at or above 113°F was recorded for each of the 20 WeatherSTEM stations. Unlike the graph above, the 113°F heat index marks the threshold for an excessive heat warning, as opposed to a heat advisory. The 29 timeframes for each of the excessive heat days were then averaged for each of the 20 WeatherSTEM stations, indicated by the blue columns on the graph below [Figure 9.]. The resulting 20 timeframes for each weather station were then averaged with one another to receive an overall average daily time of around 1.5 hours that a 113°F threshold was sustained on excessive heat warning days, indicated by the red line on the graph below.

When comparing the average time that the 113°F threshold was sustained at the 20 weather stations, there was more divergence from the overall average compared to the graph based on the heat advisory threshold [Figure 8.]. The Lower 9th Ward sustained the threshold for the greatest period at an average of 3.5 hours. Lakefront and Gentilly/Milneburg also sustained the threshold for a greater period of around three hours, doubling the overall average. However, Carrollton Bend, Warehouse District/Riverwalk, Algiers, Almonaster, and Little Woods on average did not sustain the excessive heat warning threshold for more than a half an hour on days with excessive heat alerts.

When comparing the map of the identified hottest and coolest WeatherSTEM stations to the map in Objective two that identifies urban hotspots throughout the city [Figure 4.], there is no absolute alignment. Regarding the stations identified as experiencing the most extreme heat, the Gentilly Milneburg station is located on the fringe of a hot spot that is widespread, but less severe. The station itself is on the edge of the hotspot, which may be due to the large green space across the street from the location. This location has the weather station positioned on the top of a one-story fire station. The Central City station is within a hot spot. The station is within the less severe portion of the hotspot but is located very close to the most severe portion. This weather station is also positioned on the top of a one-story

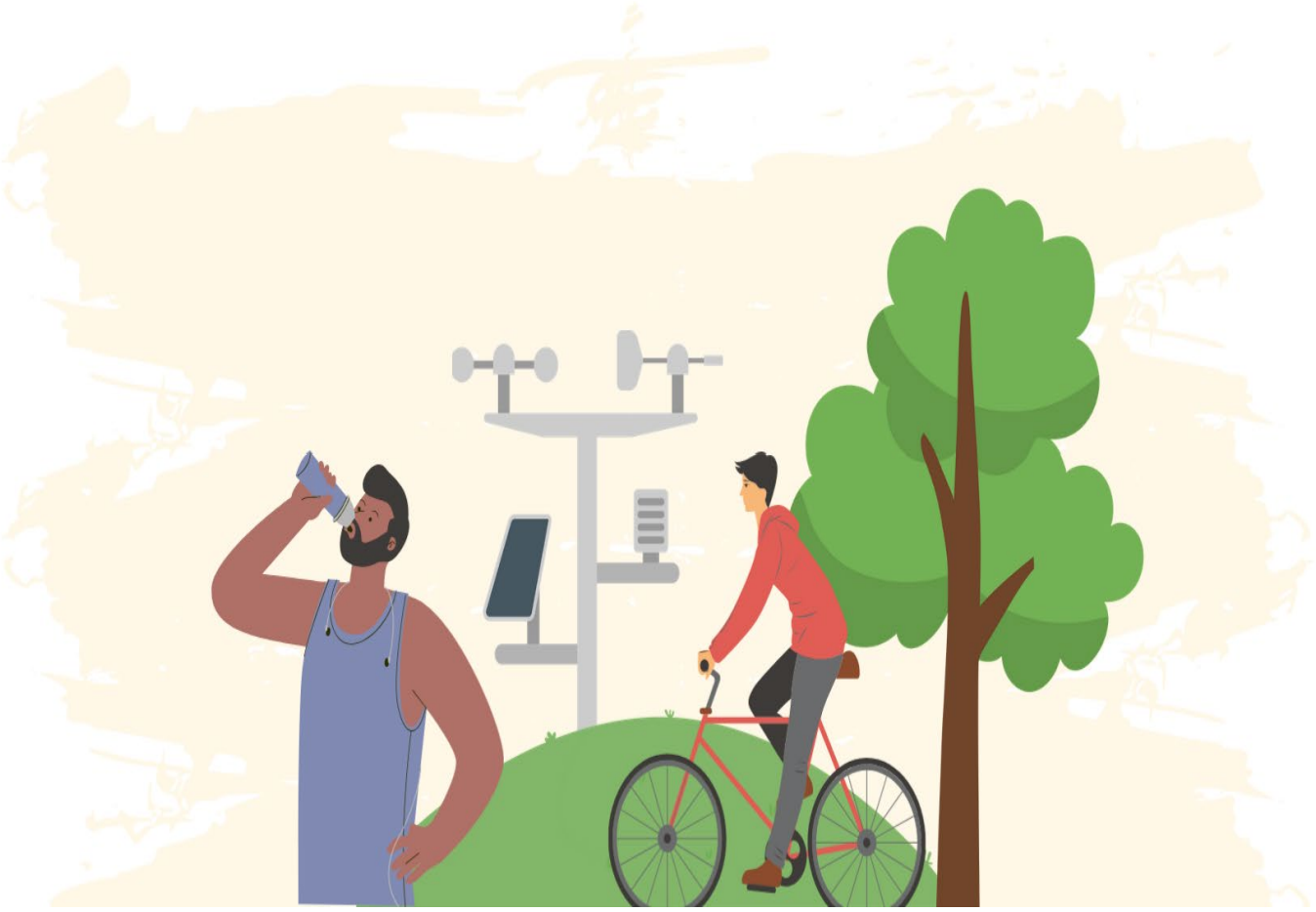
Figure 10. *WeatherSTEM Stations that Stood Out as being the Hottest and Coolest Based on the Gather Data for the 27 Excessive Heat Warning Days*

Based on the analysis of the of data from the 29 excessive heat warning, the stations that experienced the most extreme heat were determined to be the Lower 9th Ward station, the Lakefront Station, the Gentilly/Milneburg station, and the Central City Station. Additionally, the stations that experienced the least amount of extreme heat in 2023 were determined to be the Algiers station, the Almonaster station, and the Warehouse District/Riverwalk station.



fire station. The Lower 9th Ward station is not located near a hot spot. The station is isolated at a water treatment plant and is near ground level. Finally, the Lakefront station is not located within a hot spot; however, it borders a widespread hot spot that encompasses most of 70124 zip code. This weather station is located on water's edge of Lake Pontchartrain, on top of the roof of a two-story building.

When regarding the stations identified as experiencing the least amount of extreme heat, the Warehouse district/Riverwalk stations is on the fringe of a severe hot spot, while it is not located within the hotspot, it is in very close proximity. The station is located on the roof of a multi-story building alongside the Mississippi River. The Almonaster is not located within a hot spot. There is a hot spot relatively nearby, but there is distance between its edge, and the location of the station. The weather station is located on the top of a multi-story training tower at the Municipal training Academy. The Algiers station is also not located within a hot spot. The station is located at ground level and is surrounded by green space.

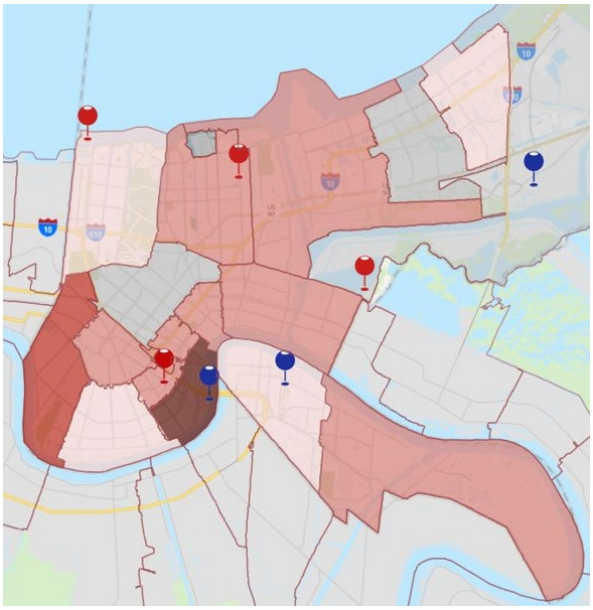


In addition to the previously identified weather station being compared to daytime urban heat island hot spots, the stations were also compared to the geographical locations of heat-related morbidity and mortality, as seen in the table below [Table 8.].

Table 8. ***Maps Showing Comparison of 2023 Heat-Related Morbidity and Mortality in the City of New Orleans with the Hottest and Coolest WeatherSTEM Stations***

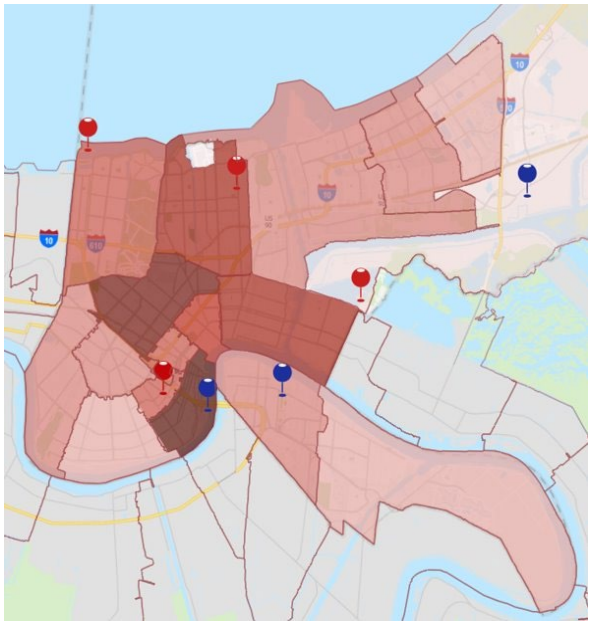
Comparison of Heat-Related Fatalities by Zip Code

The two zip codes that had the greatest number of heat-related fatalities did not coincide with the weather stations that experienced the greatest amount of extreme heat. Furthermore, the 70130-zip code, which had the greatest number of fatalities, had one of the weather stations that was found to have experienced the least amount of extreme heat over the summer of 2023. Other identified stations did not show a significant amount of alignment to fatalities either.



Comparison of Heat-Related EMS Calls by Zip Code

The two zip codes that experienced the greatest amount of heat-related EMS calls also did not coincide with the weather stations that experienced the greatest amount of extreme heat. The 70130-zip code was once again in conflict, as seen with the heat - related fatalities. However, there was some alignment with the Gentilly/Milneburg and Lower 9th Ward stations and the amount of heat-related EMS calls within the corresponding zip codes.



The comparison of the weather stations that were identified by analyzing heat index data from the 29 excessive heat warning days with daytime urban island hot spots and heat-related incidences experienced over the summer provides more understanding of the capacity the WeatherSTEM stations have as a tool for public health intervention planning surrounding the topic of extreme heat.

Objective 4: Determine populations for targeted intervention planning

To refine targeted interventions beyond geospatial vulnerability factors, heat-related mortality data was utilized to determine specific demographic characteristics of high-risk populations in New Orleans.

Figure 10 shows that the majority of the 28 heat-related fatalities that occurred in the summer of 2023 were men. For reference, the percentage of the male population in Orleans Parish is 47.1%, with the female population being 52.9%, according to US Census Bureau data [25].

When comparing fatalities by race [Figure 11.], most heat-related fatalities occurred in white and black populations, with a small portion of the fatalities occurring where the race was marked as other or unknown. US Census Bureau data shows 58.6% of the Orleans Parish population being black, with 36.1% being white, and the 5.3% of the population not identifying as either black or white. Given the small sample size of heat-related fatalities, some correlation is seen when comparing the demographics of the general population to fatality demographics.

Heat-fatalities were grouped by age to determine which age group had the greatest number of fatalities. The blue columns in the table below [Figure 12.] represent 10-year periods. For example, the first column represents ages 20 to 29 years, and the second column represents ages 30 to 39 years. In comparing age groups, most heat-related fatalities occurred in persons between the age of 60 and 69. An incremental trend in the number of heat-related fatalities per age group is seen for the 30s age group to the 60s age group. There were less heat-related fatalities for the 70s and 80s age groups, and there were no heat-related fatalities among individuals in their 20s and individuals in their 90s.

Figure 10. *2023 heat-related fatalities in Orleans Parish by sex*

19 out of 28 heat-related fatalities were male

Figure 11. *2023 heat-related fatalities in Orleans Parish by race*

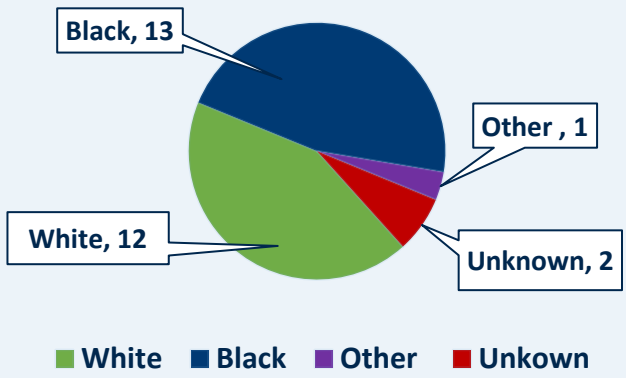


Figure 12. *2023 heat-related fatalities in Orleans Parish by age group*

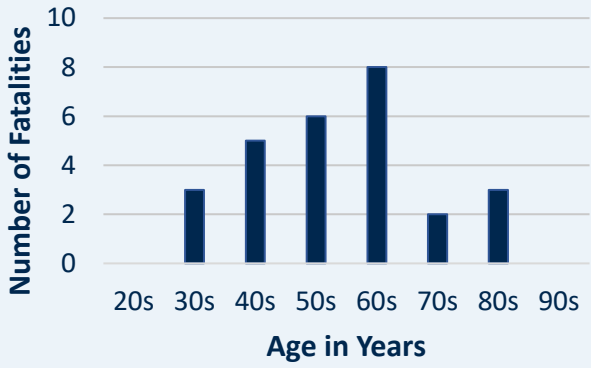


Figure 13. *2023 heat-related fatalities in Orleans Parish by housing status*

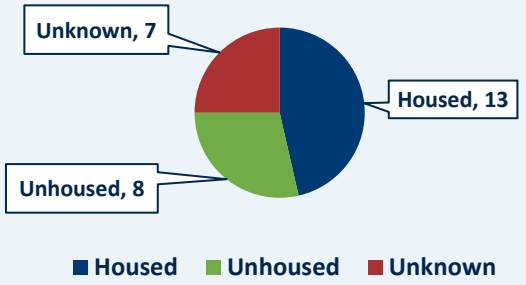


Figure 14. *Characteristics of the heat-fatalities of unknown housing status*

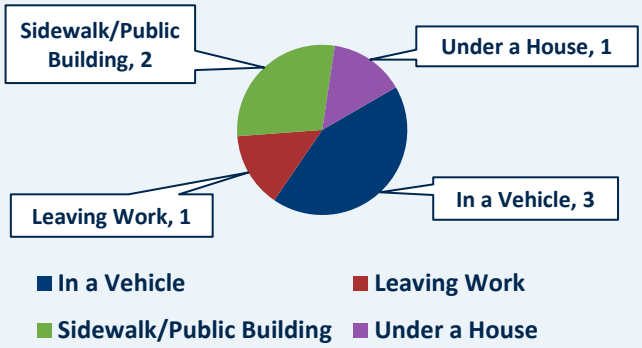
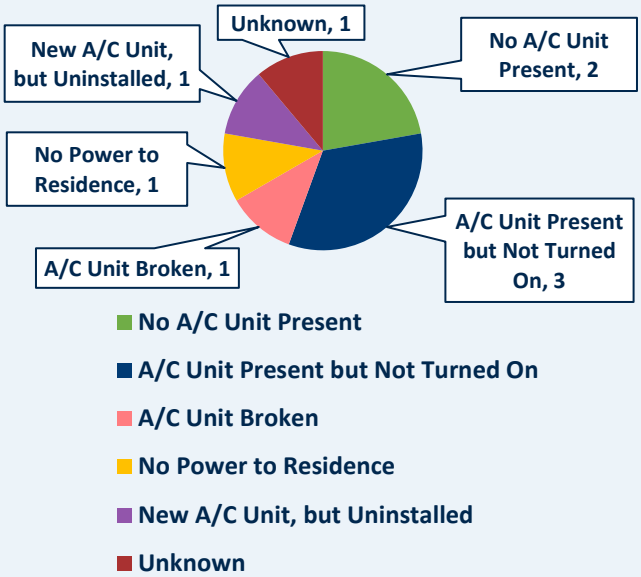


Figure 15. *Characteristics of residential heat-related fatalities*

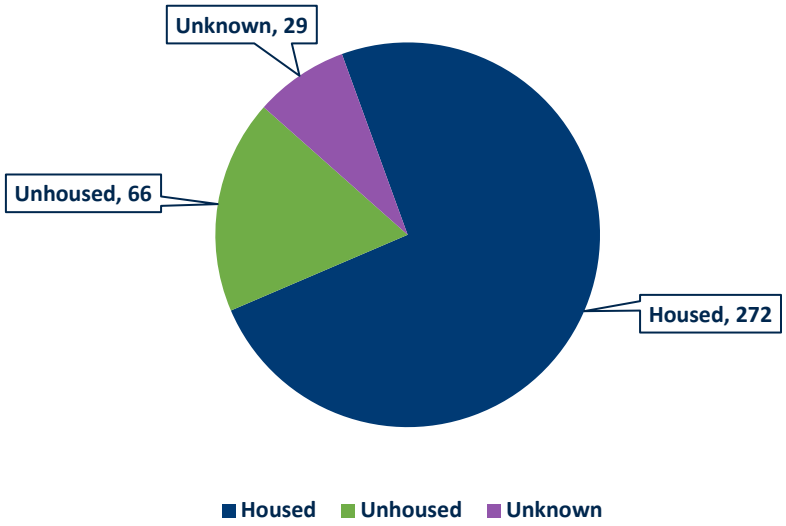


Heat-related fatalities were also compared by presumed housing status. The pie chart below [Figure 13.] shows slightly under half of the fatalities occurred in housed individuals. There were eight fatalities that occurred in unhoused individuals; however, it should be noted that there were an additional seven fatalities in individuals whose housing status could not be determined. Therefore, it is difficult to determine whether fatalities in housed individuals are a significant majority of heat-related fatalities, or if the heat-related fatalities are more evenly dispersed between housed and unhoused individuals.

Given the significance in the number of heat-related fatalities where housing status was unknown, more detailed characteristics pertaining to the fatal outcome are shown in the pie chart below [Figure 14.]. Out of the seven unknown housing status fatalities in the chart above, three of the incidences occurred in vehicles. The other four fatalities occurred outdoors with one individual leaving work, one individual under a house, and two incidents where an individual was on a sidewalk or pavement near a public building.

Characteristics of heat-related fatalities that occurred in housed individuals that were found in a place of residence were also viewed in more detail, as represented by the pie chart below [Figure 15.]. A total of nine fatalities occurred in a residential setting, seven of which occurred in single-family residences and an additional two occurred in apartment complexes. Aside from the one residential fatality with unknown characteristics, it is notable that all other residential heat-related fatalities involved a lack indoor air conditioning. There were three instances where an air conditioning unit was present in the residences but not turned on. There were two instances where the residence did not have air conditioning units, one instance with a broken air conditioner, one instance with an uninstalled air conditioner, and one instance where there was no power to the residence where the incident occurred.

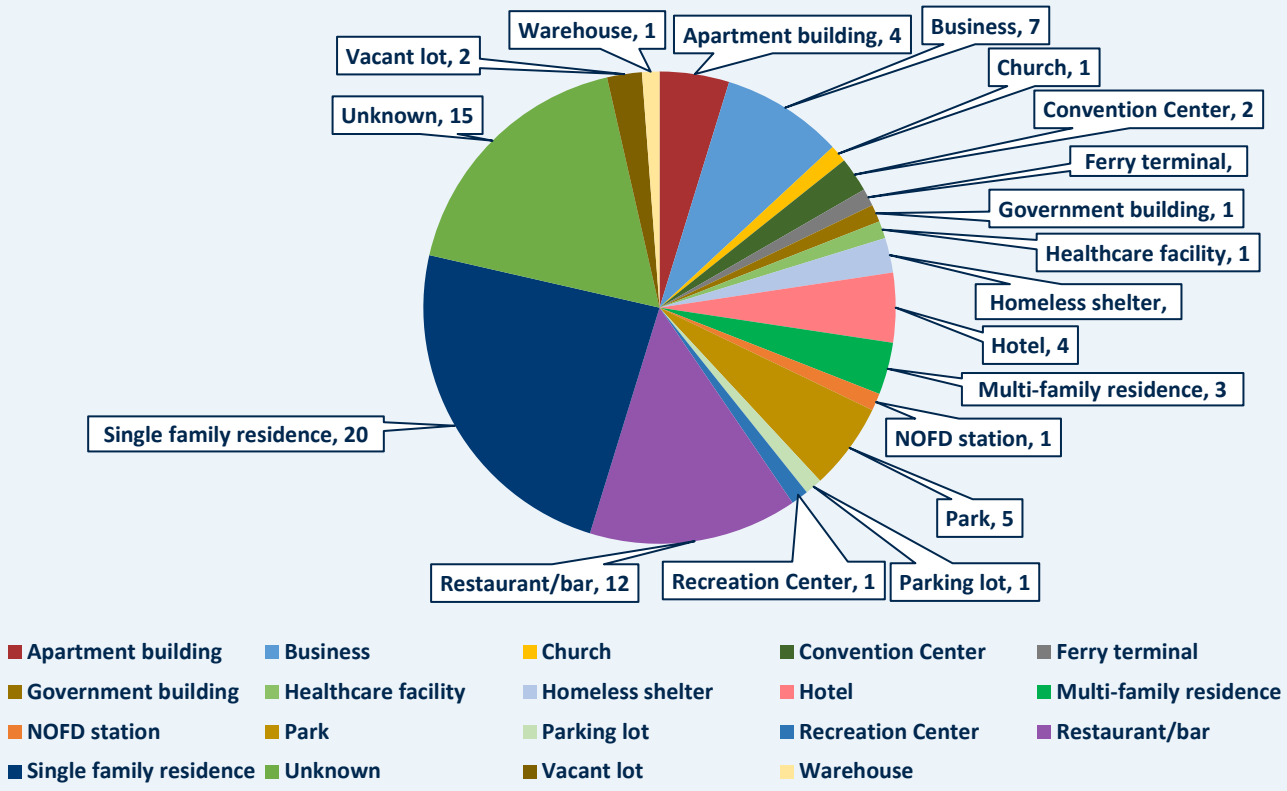
Figure 16. ***2023 heat-related EMS calls in Orleans Parish by housing status***



In addition to mortality data, morbidity data (heat-related EMS call information) was utilized to determine specific characteristics of high-risk populations in New Orleans. Characteristics from EMS calls were able to provide location type, time of day, patient disposition, patient transfer location, as well as the primary and secondary impressions of the patients associated with the call. Like the heat-related fatalities, perceived housing status was also pulled for each of the patients during the heat-related EMS calls. The corresponding data can be seen in the pie chart below [Figure 16.]. Almost three quarters of the patients were found to be housed, with 18% of the patients having an unhoused housing status and an additional 8% of patients with a housing status that could not be determined. Unlike the housing status in heat-related fatalities, it is definitive that heat-related EMS calls occurred predominantly in housed individuals.

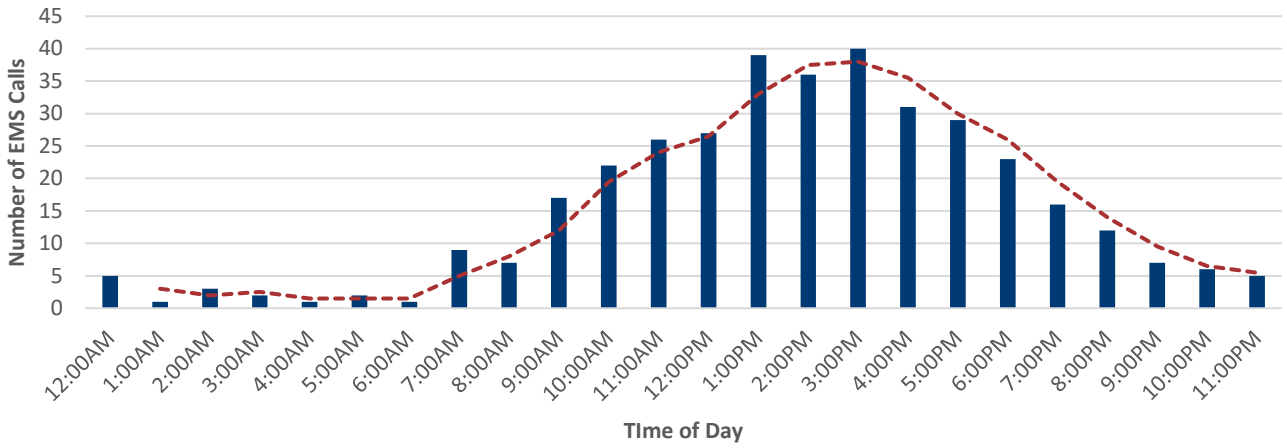
The location type provides guidance in determining the best setting for heat-related public health interventions and can be seen in the pie chart below [Figure 17.]. Types of locations where heat-related EMS calls were made were diverse, encompassing many different public and private spaces. Single family residences were the location type that experienced the greatest number of heat-related EMS calls. This aligns with the data above [Figure 16.] which determined housed individuals making up most of the heat-related EMS calls that occurred in 2023. Other notable location types include restaurants and bars, businesses, and parks. Apartment buildings and multi-family residencies experienced some heat-related calls, but less than single family residences.

Figure 17. *Location Type for 2023 Heat-Related New Orleans EMS Calls*



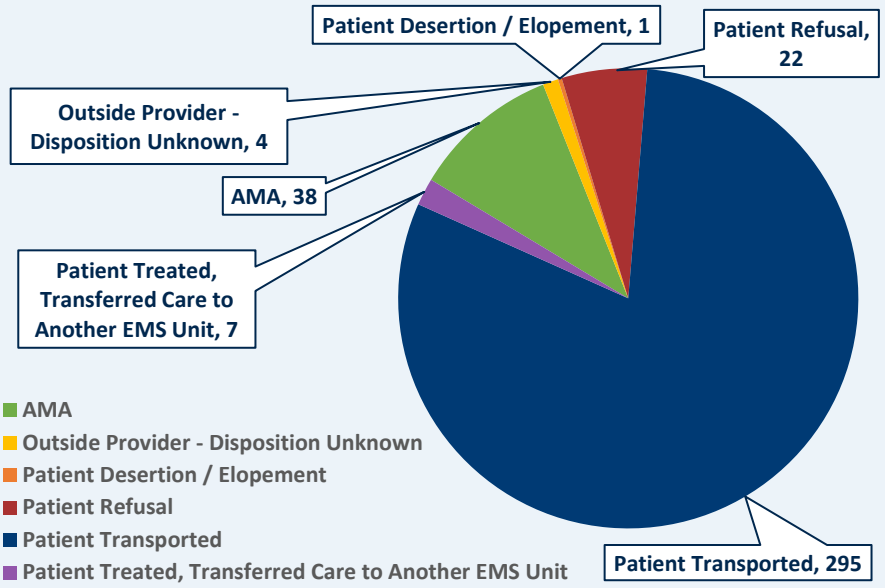
In addition to the location type, the time of day the call occurred was also documented and can be seen in the graph below [Figure 18.]. Using a moving average, an influx in call volume began around 7:00AM in the morning can be seen, increasing until it reached a peak around 3:00PM in the afternoon. After this point call volume began to decrease with the lowest point in the time series showing five or less calls per hour occurring between 11:00PM and 6:00AM in the morning.

Figure 18. ***2023 heat-related EMS calls by time of day***



Patient disposition for the heat-related EMS calls in 2023 [Figure 19.] showed that most patients were transported to an emergency department for further care, with less than 25% of the calls resulting in patients that were not directly transported. In addition to the 295 patients that were transported, there were 38 patients that refused transport against medical advice (AMA), indicating that transport was strongly advised in these cases.

Figure 16. *2023 heat-related EMS calls in Orleans Parish by housing status*

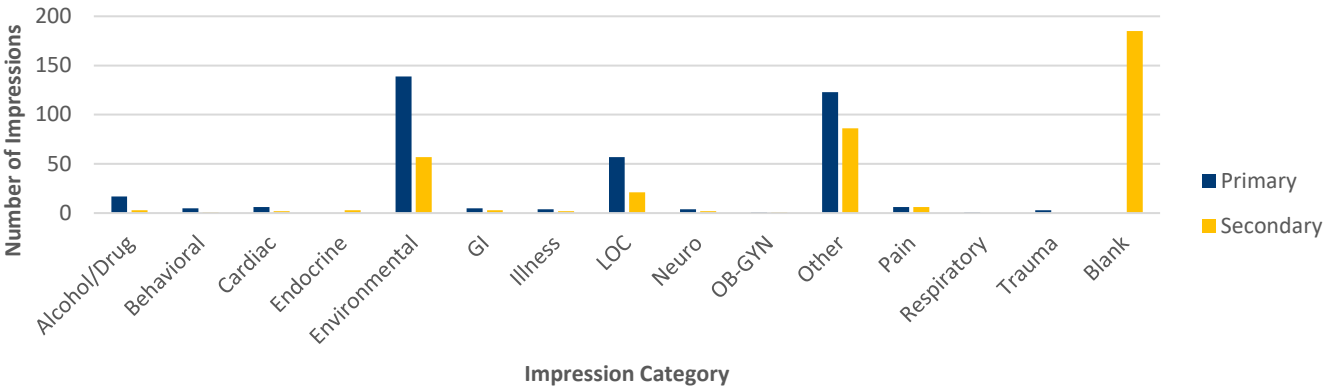


The table below [Table 10.] shows the destinations for the 295 patients that were transported because of a heat-related EMS call in 2023. University Medical Center received the highest number of heat-related patients with Tulane Medical Center and Touro Infirmary receiving significant amounts of heat-related patients as well. Other notable destinations include Ochsner Baptist, Ochsner Main, and New Orleans East Hospital.

Table 10. Hospital destination of heat-related New Orleans EMS calls that resulted in transfer

Destination Name	*Number of Calls*
University Medical Center	63
Tulane Medical Center	59
Touro Infirmary	42
Ochsner Baptist	30
Ochsner Main	26
New Orleans East Hospital	25
Ochsner Westbank	11
West Jefferson Medical Center	7
Veterans Affairs Hospital	7
Children's Hospital New Orleans	6
East Jefferson General Hospital	5
St. Bernard Parish Hospital	5
Slidell Memorial Hospital	3
Ochsner Kenner	2
Ochsner North Shore	2
Tulane-Lakeside Hospital	2
Total	**295**

Figure 20. ***Impression category for primary and secondary impressions on heat-related New Orleans EMS Calls in 2023***



Patient impressions offer guidance concerning potential physical symptoms and co-morbidities associated with extreme heat and as such, the primary and secondary impressions associated with the heat-related EMS calls are seen in the chart below [Figure 20.]. The primary impressions are represented by the blue columns while secondary impressions are represented by the yellow columns. Most of the heat-related EMS calls conducted over the summer saw either an environmental primary impression or fell into the other category. To a smaller extent both loss of consciousness and alcohol and/or drug exposure were also primary impressions associated with heat-related EMS calls.

Secondary impressions were not always utilized and therefore, a significant portion of the heat-related EMS calls have a blank associated with this metric. However, in instances where a secondary impression was recorded like the primary impression, environmental, other, and loss of consciousness were the most common impressions associated with these calls.

Given the significant portion of primary impressions categorized as other for heat-related EMS calls, more specific characteristics associated with these impressions are shown in the pie chart below [Figure 21.]. Most of the primary impressions categorized as other pertained to patients experiencing dehydration. A smaller portion of the other category was made up of patients experiencing

Figure 21. Breakdown of the "other" category for primary impressions on heat-related New Orleans EMS calls in 2023

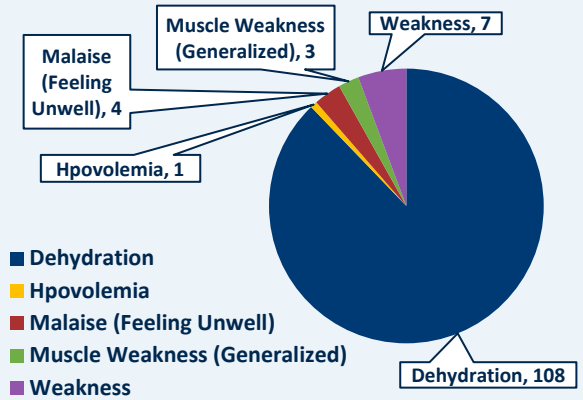
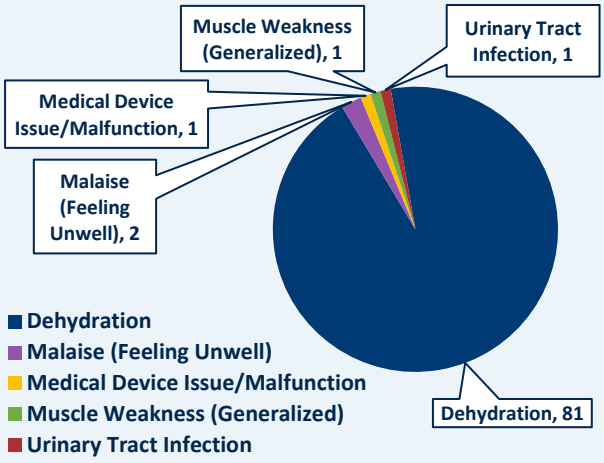


Figure 22. *Breakdown of the "other" category for secondary impressions on heat-related New Orleans EMS calls in 2023*



weakness, malaise, hypovolemia, and generalized muscle weakness. Specific characteristics associated with the secondary impressions categorized as other were also observed [Figure 22.]. Like the other characteristics associated with the primary impressions on heat-related calls, most of the secondary impressions categorized as other pertained to patients experiencing dehydration. A small portion of the other category was made up of patients experiencing generalized muscle weakness, malaise, urinary tract infection, and medical device issue and/or malfunction.

Discussion and Recommendations

In New Orleans, the extreme heat experienced in the summer of 2023 was distinct from any preceding summer in recorded history [17]. The difference between the summer of 2022 and 2023 is evident, with 1 heat excessive warning day in the previous year being compared to the 29 excessive heat warning days experienced in 2023. The summer of 2023 was an El Nino year, but a comparison between 2023 and 2015, the last summer during an El Nino event, still saw an 867% increase in the amount of excessive heat warning days. This increased level in our baseline collection year will be important to consider in the development and comparison in future reports.

A relationship between days with heat-related weather alerts and the amount of heat-related health impacts was observed. Therefore, in using the number of heat-related fatalities and heat-related EMS calls as established baselines for future report, it will be important to conceptualize these data points with the number of heat-related weather alerts that were experienced for the coinciding year. It is possible that the next summer will not see nearly as many excessive heat warning days as 2023. However, while the summer of 2023 is seen as an anomaly thus far, the changes to weather events seen with the changing climate bring about the threat of prolonged extreme heat events becoming more common place in the next few decades. It is important to establish heat safety interventions moving forward despite extreme heat levels falling below the baseline set in 2023. Finally, when looking at the heat morbidity and mortality data, it is important to consider that Orleans Parish did not experience from any tropical storms or hurricanes in 2023. However, if the type of heat experienced in 2023 had happened in 2021, when hurricane Ida hit, the health impacts could have been considerable given the extended power outages that occurred. Given the negative health impacts seen in 2023, the possibility of prolonged extreme heat events must be included as consideration in planning for extreme weather events that have the likelihood of disrupting power. Additionally, while most heat-related health impacts occurred during the peak heat months in New Orleans, special attention should be paid to the beginning and end of the peak heat season. These are periods of time where people are either reacclimatizing to the heat or are more likely to be caught off guard by high external temperatures, leading to an increased risk of heat-related illness.

When regarding excessive heat warning day heat indices, the number of heat-related fatalities, and EMS calls experienced over the summer of 2023, the neighborhoods that were impacted to

the greatest degree by extreme heat were disproportionately made up of underserved communities. Many of the fatalities experienced in 2023 were perceived to be unhoused persons or older individuals that lived alone and faced barriers to running air conditioning units during peak heat months. Age and residency status of the afflicted, as well as toxicology reports, determined that many of the fatalities were due to these comorbidities. However, almost all fatalities that occurred in housed persons, and all fatalities that occurred within a residence, occurred in individuals aged 60 or greater, while fatalities in individuals 60 and younger were more often associated with a positive toxicology report, or an unhoused or unknown housing status. In addition, it was seen that men were at greater risk of heat-related fatalities. Possibly due to the higher percentage of men holding positions doing work outdoors [3], along with the fact that around 66% of individuals who are homeless and living on the street in Orleans Parish are male [24].

Single family residences were the primary location type for heat-related EMS calls. Parks, businesses restaurants, and bars were also seen as relatively common locations for heat-related EMS calls to occur. When mapped, calls were more centralized within the parish, which did not align with the pattern seen in the mapped heat-related fatalities. The number of calls within the French Quarter are not surprising due to high, unacclimatized tourist traffic and the abundance of bars and restaurants. The frequency of heat-related EMS calls associated with the French Quarter, and other high tourist areas, could be contributing to additional stress on emergency medical services given the characteristics.

While impacted neighborhoods were found to have less than adequate tree cover, there was only some alignment between the prominent daytime hot spots and social vulnerability, climate-related inequities, and climate-related health outcomes. The greatest area of alignment was seen in the northern portion of the 70118-zip code. However, when considering both the geographically mapped heat-related morbidity and mortality data for 2023, there was more alignment with urban daytime hotspots than there was for the WeatherSTEM stations that were identified to be the hottest. This could indicate that satellite-gathered daytime urban hotspot data could be a more accurate predictor of heat-related health impacts when compared to the WeatherSTEM stations. This could be investigated further by looking at heat-related health impacts by census tract level, as opposed to the zip code level present in this report. Nevertheless, a relationship between heat illness numbers and established social vulnerability, climate-related health inequities, and climate-related health outcomes was evident. Given this comparison the following priority areas for intervention were ascertained: Dixon; Holly Grove; the Northwestern portion of Gert Town; lower parts of Mid-City, including along the intersection of North Broad Street and St. Louis Street, as well as along Tulane Avenue between South Lopez Street and South Murat Street; the upper portion of the 7th Ward that resides in the 70119-zip code; and the St. Thomas Development. While the 70130 zip-code had the greatest number of both heat-related fatalities and EMS calls, social vulnerability, climate inequities, and climate-related health outcomes within this zip code were not as severe comparatively, aside from St. Thomas Development census tract. The poor alignment in social vulnerability may be due to the presence

of the homeless encampment that existed along Tchoupitoulas Street, between Calliope Street and Melpomene Street. At the beginning of the summer, the encampment was populated by 54 individuals and given the persistent exposure to extreme heat throughout the summer, the residents were at an increased risk of suffering from heat illness. This high vulnerability may contribute to the high levels of heat-related morbidity and mortality within this zip code. Outside of the three zip codes with the highest heat-related health outcomes, Central City, Viavant-Venetian isles, the center of the Lower 9th Ward, and Algiers Whitney are additional areas that have severe health outcomes as well as social vulnerability. While these areas did not suffer as greatly as others from heat-related health outcomes in the summer of 2023, it is possible that they may suffer from extreme heat in the future, and as such community engagement should be pursued.

In looking at WeatherSTEM data, Central City was noteworthy as it was severely affected by intense heat without experiencing nighttime reprieve. The WeatherSTEM station is located within a substantial daytime hot spot, and the high nightly minimum average is a most likely the result of the off casting of absorbed daytime heat from the abundance of concrete. The CDC recommends that exposure to heat should be minimized at night, and an individual should sleep in a climate of around 75°F to allow the body to fully recover from daytime heat exposure [2]. Without reprieve from excessive heat, the body cannot keep up with internal temperature regulatory functions, increasing the risk of heat illness.

Some WeatherSTEM locations seem more reliable in representing a realistic lived experience within their associated neighborhood than others. The stations that were near highly populated areas, were close to the ground, and not isolated by an abundance of water or green space, specifically when that type of landcover is not an accurate representation of most of the neighborhood, were found to be the stations that were most accurate at depicting the lived experience during excessive heat periods. While the WeatherSTEM stations are multifaceted in their functionality at each chosen location, for heat-related public health intervention planning, the data from the stations that are more accurate in depicting human exposure to extreme heat should be prioritized. In cases of emergency response and risk communication the WeatherSTEM stations will continue to act as a valuable resource. However, for long term public health planning, heat-related morbidity data, mortality data, as well as social vulnerability data, would be more suitable.

Throughout the summer of 2023, the City of New Orleans conducted various activities in response to the excessive heat and the City's first extreme heat emergency declaration. A list of heat-related actions taken by the New Orleans Health Department, as well as other relevant city agencies, can be seen in the table below [Table 11.].

Table 11. ***New Orleans Health Department response actions to 2023 extreme heat***

Target Audience	Activities Performed	Role
General Public	• Daytime cooling centers were opened over two holiday weekends with forecasted excessive heat • A Heat Relief Map was created, and NOLA Ready text alerts were utilized to keep the public informed	Support
Unhoused Population	• An emergency overnight cooling center was opened for members of the unhoused during a period of peak heat • The city partnered with the film industry to utilize an air-conditioned filming tent for use in one of the most population-dense homeless encampment • Water bottles were passed out to known homeless encampments on a daily basis	Support
Hospitals and Medical Providers	• Communication with hospital administration to provide guidance and available resources for safely discharging patients without a defined or safe destination	Lead
Nursing Homes and Independent Living Facilities	• Maintaining contact with facility management; management is required to fill out a survey every 24hrs and submit to the City's Health Department and Office of Homeland Security and Emergency Preparedness • Reaching out and following up with facilities that did not respond to the survey in the allotted time • Performing site visits to facilities that were no compliant and submitting; if noncompliance continued, an adjudication hearing was set	Lead
School Administrators	• Provided guidance to school administration via email about safe practices surrounding extreme heat and outdoor student athletes	Lead
Special Event Organizers	• For large outdoor events, the health department consulted with event management to ensure they had the means to keep attendees safe from extreme heat	Lead

Recommendations

Given the analysis of data available in this report, NOHD has developed a series of recommendations for future action regarding heat and health safety in relation to providing outreach and education to vulnerable populations, improving methodologies, and expanding research topics.

Outreach and Awareness Building

1. Community outreach initiatives should include single-family residences. Single family residences within the areas determined to be vulnerable to heat in Objective 2 should be a priority. Special attention should also be given to areas with a higher population of people over the age of 60, especially if they live alone or are socially isolated.
2. Community outreach initiatives should also include summer tourists. These populations are more likely to be unacclimatized, in addition to practicing behaviors that are more likely to lead to dehydration. When reviewing heat-related EMS data, a large portion of the calls were centralized around the French Quarter, a high traffic area for tourists. Furthermore, around 29% of the heat-related EMS calls noted dehydration as a primary impression. To attempt to alleviate any stress on emergency medical services due to unacclimatized tourists and drinking alcohol, dehydration notices with urine color charts, as well as general heat illness prevention guidance, should be posted in bars, restaurants, and hotels throughout the French Quarter.
3. Heat illness prevention notices should also be posted in public parks to reach those who are at a higher risk for heat illness due prolonged heat exposure and physical activity outdoors.

Data Collection

To improve methodologies associated with this report and enable more thorough data collection moving forward, recommendations include:

1. Taking mapped heat-related health impacts down to the census tract level, correction factors for the WeatherSTEM stations, a more defined case definition for heat illness, and defined temperature threshold levels for intervention.

2. To improve the public health-specific utility of the WeatherSTEM Stations a correction factor should be developed to adjust the temperatures at stations that are not a ground-level, to better represent the lived experience of the individuals living in the associated neighborhoods.
3. Effort should also be made to continue to work with relevant partners toward a heat illness case definition that both thoroughly captures the human health impact of extreme heat and is cohesive between agencies. Moreover, there are differing definitions of heat illness that other local agencies are utilizing to further define the human-felt impacts of extreme heat that should be consider by the City of New Orleans. While this report focused on heat-related morbidity and mortality that is caused directly by extreme temperatures, heat-exacerbated morbidity and mortality captures deaths that are indirectly related to extreme heat. Heat-exacerbated deaths are captured with statistical modeling and represent fatalities that are caused by a primary factor, such as a chronic conditions, that have been exacerbated by extreme heat.
4. Neighborhood level impacts are another measure of heat-health impacts that are measured by other agencies. Creating a community-level risk index for each neighborhood using surface temperature, green space, air conditioning prevalence, income, and race such as the City of New York, would be beneficial for intervention planning [21].
5. Defined temperature thresholds for activation and intervention are being developed moving forward to include a tiered level of activation. The New Orleans Health Department is working with the Office of Homeland Security and Emergency Preparedness to develop tiered levels of heat-related activation, based on the degree of heat index, duration of extreme heat period, and potential threat to health to determine when to mobilize the appropriate resources.

Future Research and Analysis

1. For future reports on heat and health in New Orleans research and data collection can be expanded to include topics that further capture populations that are vulnerable to extreme heat, including households that do not have access to working air conditioning units and/or the financial ability to run them during peak heat months.
2. Data on the overall quality of housing stock throughout the City of New Orleans would be beneficial in capturing energy burden and air conditioning efficiency.
3. Additional topics for research expansion should include the following: excessive heat exposure and pregnancy risk; heat-related morbidity, mortality and drug use; and extreme heat and prevalence of vector-borne diseases.

Limitations

One limitation with the heat-related morbidity and mortality data for this report was that the data was collected at the zip-code level. Data collected at the census tract level would have been more conducive to the comparisons made between heat-related morbidity and mortality and the data from the social vulnerability index, or the Trust for Public Land data on climate-related inequities and health outcomes. Heat-related morbidity and mortality data at the census tract level would have also allowed for a more accurate representation of the felt impacts of extreme heat at the neighborhood level. A further limitation of the heat-related morbidity and mortality data is the potential year-to-year geographical variability introduced by changes in the locations of substantial homeless encampments throughout the city. Members of the unhoused population are at considerable risk for heat-related illness given their prolonged exposure to the elements. Presence of a large encampment, such as the Tchoupitoulas encampment in 2023, could have the potential to skew rates of heat-related fatalities and EMS calls. Finally, while the heat-related fatality data considers whether an individual is a resident of Orleans Parish, the EMS call data does not. Therefore, there is a potential that EMS call data considers unacclimatized tourists, while the fatality data does not. The Louisiana Department of Health (LDH) collects heat-related emergency department visit data and accounts for resident versus nonresident status and the undetermined residency status in heat-related EMS calls could limit comparisons between heat and health data sources from year-to-year.

A limitation in the temperature and weather data comes from the use of heat index data over the use of wet bulb globe data for the purposes of this report. Wet bulb globe temperature is a more accurate measurement of localized heat impact as it considers temperature, humidity, wind speed, sun angle, and cloud cover or solar radiation, while heat index only considers temperature and humidity. Wet bulb globe sensors are often used in outdoor sports stadiums to determine heat exposure in athletes. However, heat index was utilized for this report as opposed to wet bulb globe temperature as, at the time of this report, the National Weather Service (NWS) did not have weather alert thresholds associated with wet bulb globe temperatures.

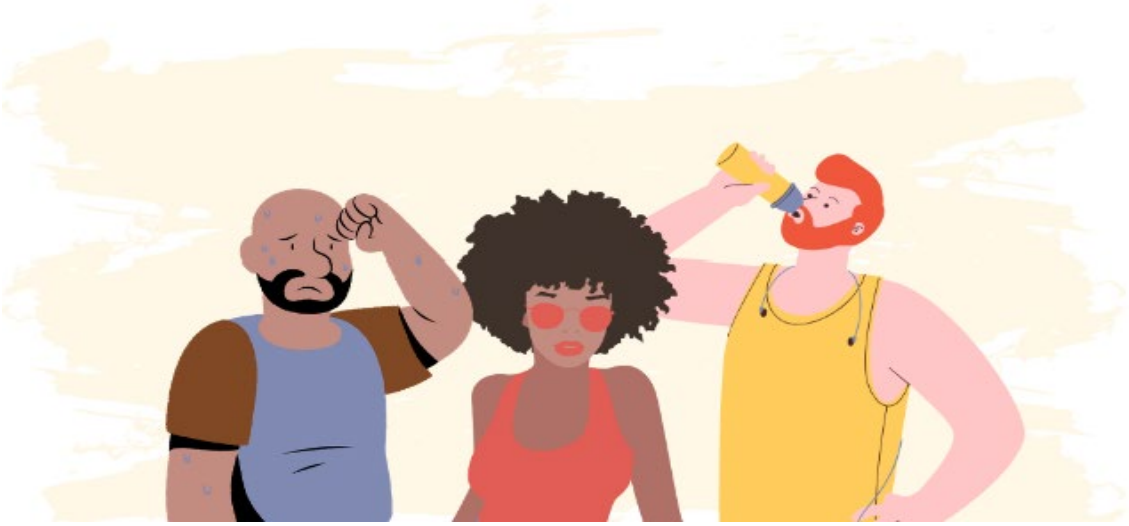
Next Steps

NOHD's next steps for addressing extreme heat are improving data collection methodologies to drive policy change, funding targeted interventions to populations at greatest risk of poor health outcomes and expanding community research.

1. Data collection methodologies will be strengthened to inform the development or refinement of organization or local government protocol, plans, and policies. The top areas of interest are finding data to better understand the relationship between extreme heat, drug use, and violence, as well as the impact of proposed Healthy Homes ordinance development will have on heat and health outcomes. From an environmental perspective, NOHD will consult with partners to determine if a correction factor can be utilized to improve the ability of all WeatherSTEM stations to accurately represent the lived experience of extreme heat at the neighborhood level.

2. Community education will center on developing messages and activities that allow people to make informed decisions for themselves, their families/communities, and their workforce. This outreach will include heat preparedness and safety information to populations at risk of severe health outcomes from exposure to extreme heat, including our residents and unacclimatized tourist populations. Education of outdoor worker groups on the importance of heat safety during peak heat months will also be prioritized to ensure the health of our local workforce.

3. Expanding community research will involve expanding partners that NOHD is collaborating with in heat and health, and associated climate topics. The research questions that NOHD is interested in exploring more include exploring resident access to working air conditioning units and cost burden in peak heat months, investigating rates of violence during extreme heat periods compared to cooler times of year, investigating excessive heat exposure and pregnancy risk, and monitoring changes in service utilization.



References

[1] Adams-Fuller, T. (2024, February 20). Extreme heat is deadlier than hurricanes, floods and tornadoes combined. *Scientific American*. https://www.scientificamerican.com/article/extreme-heat-is-deadlier-than-hurricanes-floods-and-tornadoes-combined/

[2] CDC. (2016, October 1). *Climate change and extreme heat | What you can do to prepare*. Centers for Disease Control and Prevention. https://stacks.cdc.gov/view/cdc/59784

[3] Dahl, K., & Licker, R. (2021). Too hot to work | Assessing the threats climate change poses to outdoor workers. In *Union of Concerned Scientists*. https://doi.org/10.47923/2021.14236

[4] Ebi, K. L., Capon, A., Berry, P., Broderick, C., De Dear, R., Havenith, G., Honda, Y., Kovats, R. S., Ma, W., Malik, A., Morris, N. B., Nybo, L., Seneviratne, S. I., Vanos, J., & Jay, O. (2021). Hot weather and heat extremes: health risks. *The Lancet*, *398*(10301), 698–708. https://doi.org/10.1016/s0140-6736(21)01208-3

[5] Ebi, K. L., Vanos, J., Baldwin, J. W., Bell, J. E., Hondula, D. M., Errett, N. A., Hayes, K., Reid, C. E., Saha, S., Spector, J., & Berry, P. (2021). Extreme Weather and Climate Change: population health and health system implications. *Annual Review of Public Health*, *42*(1), 293–315. https://doi.org/10.1146/annurev-publhealth-012420-105026

[6] EPA. (2024a, June 4). *Climate change impacts on air quality*. US EPA. https://www.epa.gov/climateimpacts/climate-change-impacts-air-quality

[7] EPA. (2024b, June 27). *Climate change indicators | Heat waves*. US EPA. https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves

[8] Hatfield, J. L., & Prueger, J. H. (2015). Temperature extremes: Effect on plant growth and development. *Weather and Climate Extremes*, *10*, 4–10. https://doi.org/10.1016/j.wace.2015.08.001

[9] Hoffman, J. S., Shandas, V., & Pendleton, N. (2020). The effects of historical housing policies on resident exposure to Intra-Urban Heat: A study of 108 US urban areas. *Climate*, *8*(1), 12. https://doi.org/10.3390/cli8010012

[10] Hoffman, L., Mingoya, C., Gilmore, J., & Essert, R. (2022, March 18). *Climate safe neighborhoods: Explore Groundwork New Orleans' climate resiliency planning and advocacy work*. ArcGIS | Storymaps. https://storymaps.arcgis.com/stories/e36ae913ed34474abd71664c66d6d9af

[11] IEA. (2023). *Energy Statistics Data Browser*. IEA. Paris. https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser

[12] Jeromin, K. (2021, July 15). These cities have the most stifling heat islands in the United States. *The Washington Post*. https://www.washingtonpost.com/weather/2021/07/15/heat-island-rankings-climate-central/

[13] Lee, E. K., Donley, G., Ciesielski, T. H., Gill, I., Yamoah, O., Roche, A., Martinez, R., & Freedman, D. A. (2022). Health outcomes in redlined versus non-redlined neighborhoods: A systematic review and meta-analysis. *Social Science & Medicine*, *294*, 114696. https://doi.org/10.1016/j.socscimed.2021.114696

[14] Locke, D. H., Hall, B., Grove, J. M., Pickett, S. T. A., Ogden, L. A., Aoki, C., Boone, C. G., & O'Neil-Dunne, J. P. M. (2021). Residential housing segregation and urban tree canopy in 37 US Cities. *Npj Urban Sustainability*, *1*(1). https://doi.org/10.1038/s42949-021-00022-0

[15] Mojahed, N., Mohammadkhani, M. A., & Mohamadkhani, A. (2022). Climate Crises and Developing Vector-Borne Diseases: A Narrative review. *Iranian Journal of Public Health*. https://doi.org/10.18502/ijph.v51i12.11457

[16] Mora, C., McKenzie, T., Gaw, I. M., Dean, J. M., Von Hammerstein, H., Knudson, T. A., Setter, R. O., Smith, C. Z., Webster, K. M., Patz, J. A., & Franklin, E. C. (2022). Over half of known human pathogenic diseases can be aggravated by climate change. *Nature Climate Change*, *12*(9), 869–875. https://doi.org/10.1038/s41558-022-01426-1

[17] NASA. (2023, September 14). NASA announces Summer 2023 hottest on record. https://www.nasa.gov/news-release/nasa-announces-summer-2023-hottest-on-record/

[18] NASA. (2024a, March). *Extreme weather and climate change*. https://science.nasa.gov/climate-change/extreme-weather/

[19[NASA. (2024b, March). *The effects of climate change*. https://science.nasa.gov/climate-change/effects/

[20] NCEI. (2024, January). *Monthly Global Climate Report for Annual 2023*. NOAA | National Centers for Environmental Information. https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/202313

[21] New York City. (2023). *2023 Heat Mortality Annual report in NYC*. nyc.org | Environment & Health Data Portal. https://a816-dohbesp.nyc.gov/IndicatorPublic/data-features/heat-report/

[22] NOAA & NEMAC. (n.d.). *Orleans Parish - Days w/ maximum temp > 95°F*. U.S. Climate Resilience Toolkit CLIMATE EXPLORER. https://crt-climate-explorer.nemac.org/climate_graphs/?city=New+Orleans%2C+LA&county=Orleans%2BParish&area-id=22071&fips=22071&zoom=7&lat=29.9508941&lon=-90.07583559999999&id=days_tmax_gt_95f

[23] NWS. (n.d.). *Weather related fatality and injury statistics*. https://www.weather.gov/hazstat/

[24] UNITY of Greater New Orleans. (2023). PROGRESS REVERSED: After pandemic initiatives drive homelessness down, soaring rents push numbers back up: A report of the 2023 point in time count of people experiencing homelessness in New Orleans and Jefferson Parish. In *UNITY of Greater New Orleans*. https://unitygno.org/wp-content/uploads/2023/09/2023_UNITY_PIT_Report.pdf

[25] US Census Bureau. (2020). *2020 Decennial Census*. United States Census Bureau. https://data.census.gov/profile/New_Orleans_city,_Orleans_Parish,_Louisiana?g=060XX00US2207198000#race-and-ethnicity

[26][24] Vaidyanathan, A., Malilay, J., Schramm, P., & Saha, S. (2020). Heat-Related Deaths — United States, 2004–2018. *MMWR Morbidity and Mortality Weekly Report*, *69*(24), 729–734. https://doi.org/10.15585/mmwr.mm6924a1