Extreme Weather and Resilience

Workshop Summary

March 17-18, 2025

CITY OF SHREVEPORT
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The workshop was organized by the Southern Climate Impacts Planning Program (SCIPP; https://www.southernclimate.org/) and staff from the City of Shreveport, Louisiana (https://www.shreveportla.gov/). The workshop summary was prepared by staff at SCIPP.

Executive Summary

The City of Shreveport, Louisiana, is vulnerable to a variety of extreme weather, but is taking steps to become better prepared. Following the February 2021 winter storm, the city purchased two snowplows so they can keep major roads open during future winter storms and snowfall. The city convenes an action plan committee when inclement weather is anticipated, to ensure that power, water, and access to hospitals and dialysis centers remain available. The city also opens warming centers, including those with charging capabilities, during cold air outbreaks and the locations are announced publicly.

To further examine opportunities to build resilience, An *Extreme Weather and Resilience Workshop* was held in Shreveport in March 2025. Participants from city departments and partners collaborated with staff from the Southern Climate Impacts Planning Program (SCIPP) to examine the greatest weather-related challenges the city faces. Three areas were highlighted: High winds and storms; heat and cold; and intense rainfall. This report highlights the discussion and recommendations related to these three areas, along with general community preparedness.

High winds and storms include convective thunderstorms, squall lines, and occasional tropical cyclones and their remnants. One of the greatest challenges relates to power distribution. The workshop identified three issues for further investigation and discussion:

- Issue 1: People need to be more aware of wind risk, both straight-line and tornadoes;
- Issue 2: The frequency of tornadoes seems to be increasing;
- Issue 3: Reducing impacts from winds

Recommended actions for building resilience and for further study revolve around better understanding of what information city officials and the public at large use to make decisions and the resultant actions they take; comparing preparedness and response plans to best practices from other cities and sources; better characterization of severe storm patterns across the Parish; improving use of available products; identifying opportunities to improve the electricity grid, including potentially burying some powerlines; developing a public alert system for severe weather; and assuring adequate shelter for city residents.

Heat and cold affect both city staff and the public. Keeping people safe during heat and cold events is a central concern. The workshop identified three issues for further investigation and discussion:

- Issue 1: Reducing heat risk to city staff;
- Issue 2: Reducing heat risk to community members;
- Issue 3: Anticipating extreme cold outbreaks

Recommended actions for reducing the impacts of heat and cold include determining patterns and thresholds for Wet Bulb Globe Temperature (WBGT) and heat index for various city departments and operations; developing a notification system for anticipate heat conditions or potential winter weather; improving communication of heat warnings

outlooks into city operations and messaging; and improving access to and amenities available at cooling and warming centers.

Shreveport has experienced multiple significant flood events from the Red River along with more localized floods in recent years. This relates to changes in rainfall patterns. The workshop identified three issues for further investigation and discussion:

- Issue 1: Spatial variability of precipitation across Shreveport, Caddo Parish;
- Issue 2: More low-lying flooding or backup of wastewater treatment system when Bayou is full;
- Issue 3: Duration of heavy rainfall

Recommendations for this topical area include assessing neighborhood-scale variation of rainfall and impacts across the city and Parish; documenting changes in rainfall rates and frequency of events; compare frequency of bayou flooding to Red River stage height; documenting actions taken to reduce flooding to improve Community Rating System (CRS) class level; and installing alert signs in areas most prone to flooding.

Other multi-hazard and related aspects came up during the discussion and centered around the topic of general community preparedness. The discussion primarily focused on three issues:

- Issue 1: Water contamination and sediment buildup in Duck Pond and Cross Lake;
- Issue 2: Keeping people safe after storm events, heat waves, or cold outbreaks;
- Issue 3: Vegetation management that reduces risk from heat and wind.

Recommended actions for community preparedness include investigating potential sources and weather conditions associated with changes in water quality; development of additional Resilience Hubs across the city; and obtaining guidance on tress and other vegetation types that would optimally provide shade, be resilient to high winds, and have minimal maintenance requirements.

Some of the listed actions can be taken by the city alone; others require collaborations with other partners. While SCIPP can assist with analysis and documentation that address some of these issues, the conversation will need to be broadened to include other partners. These include officials at the National Weather Service Office in Shreveport, the Governor's Office of Homeland Security & Emergency Preparedness (GOSEP), extension horticulturalists, and neighborhood representatives.

High Winds and Storms

Shreveport is frequently impacted by strong winds from convective thunderstorms, squall lines, and occasional tropical cyclones and their remnants. The city is located far enough north to experience severe weather driven by summertime heating and the jet stream during spring and fall, yet close enough to the Gulf of Mexico for landfalling hurricanes to retain tropical-storm strength as they pass through the area. These high winds pose a particular threat to the city's power infrastructure.

Straight-line winds are the most consequential weather-related impact, with massive cleanup sometimes required (e.g., June 2023). In addition, Caddo Parish experiences the greatest number of tornadoes in the state, with 49 tornadoes since 2000[1]. Since 1865, 26 tropical storms or hurricanes have tracked within 50 miles of Shreveport – a distance at which Shreveport is likely to experience strong winds and heavy rainfall.

Most of Shreveport's power distribution system is above-ground, making it vulnerable to high winds. Downed power lines and tree limbs often render roads impassable, causing significant disruptions, especially to the oil and gas industry which is the city's largest employer. In severe cases, it can take up to a week for most roads to become passable again. Power outages also hinder the ability to provide heating and cooling, placing additional stresses on the population.

Participants in the workshop noted a lack of clarity in communicating tornado information during events, with warnings from some sources indicating "in the Parish" and not providing specific locations. National Weather Service (NWS) warnings do include specific information, but those details may not be relayed effectively to city officials and the public.

The workshop identified three issues for further investigation and discussion:

- Issue 1: People need to be more aware of wind risk, both straight-line and tornadoes;
- Issue 2: The frequency of tornadoes seems to be increasing;
- Issue 3: Reducing impacts from winds

Issue 1: People need to be more aware of wind risk, both straight-line and tornadoes

The NWS uses standard templates for issuing warnings, which includes detailed locations that are likely to be affected and expected impacts. It is not clear how, or even if, such information is reaching the public and city officials. A baseline analysis is needed to document existing communication channels to identify opportunities for improvement.

Recommendation: City officials should conduct a city-wide (or parish-wide) survey of residents to assess what information the public receives, what actions they take, and their risk perceptions. Surveys should include specific questions related to tornado, severe storm, and tropical storm warnings to assess if there are differences in perceived risk or actions taken.

[1] https://stacker.com/stories/louisiana/parishes-most-tornadoes-louisiana

Recommendation: Each city department should report how they receive severe weather information, both leading up to a potential event (days to hours), and as an event unfolds. This can be analyzed to determine if there are gaps with information reaching specific departments or activities.

A second factor in awareness is preparedness. In addition to challenges related to real-time warning information, an assessment needs to be undertaken to understand how people monitor potential severe weather in advance of events (days to hours) and what preparations they have in place. These actions need to be compared to best practices used in other communities to develop effective public education campaigns and strategies.

Recommendation: Surveys should include questions related to monitoring information sources and preparedness actions prior to events.

Recommendation: Identify best practices in preparedness, such as from the Red Cross or NWS, and case studies from other communities of similar sizes.

A third factor to consider is maintaining public attention on severe weather threats. Public tolerance for false alarms is an ongoing area of research[2]. It would be useful to understand warning frequency and false alarm rates for Shreveport and how those compare to nearby locations and cities with similar population density. Collaboration with the NWS Forecast Office in Shreveport is recommended.

Recommendation: Collect information on warnings issued by the NWS Forecast Office in Shreveport and compare to other locations in the warning area and general warning statistics such as watch frequency analyzed by the NWS Storm Prediction Center[3].

Recommendation: Examine warnings that included the City of Shreveport and document whether impacts were reported within city limits (i.e., a warning may have verified due to wind damage or large hail reported outside city limits).

Issue 2: The frequency of tornadoes seems to be increasing

There is a perception that tornado occurrence, and severe storm occurrence in general, has become more frequent in the Shreveport area. Some studies have noted an increase in conditions favorable for severe storms across the region[4]. The increasingly favorable environments are more evident in the winter months, with less change or even a slight decrease noted in the summer and autumn.

Tornadoes are common in Caddo Parish, with 109 reported tornadoes between January 1, 1950 and May 31, 2025. However, most are weak and have very small widths and path

[2] The false alarm/surprise trade-off in weather warnings systems: an expected utility theory perspective (Elía 2022) https://link.springer.com/article/10.1007/s10669-022-09863-1

[3] NWS Storm Prediction Center maps https://www.spc.noaa.gov/wcm/

[4] Spatial trends in United States tornado frequency (Gensni and Brooks 2018) https://www.nature.com/articles/s41612-018-0048-2

lengths. The total area impacted by tornadoes during this 75-year period is approximately 75 square miles, or approximately 8% of the area of Caddo Parish. This may contribute to a perception of tornadoes missing Shreveport, sometimes referred to as the "Barksdale Bubble". In reality, tornado paths are random, and a tornado could just as easily strike Shreveport as any other location within the Parish.

Another question is whether storm patterns are becoming more variable. Although the total number of reported tornadoes has increased in recent decades, much of this is driven by better detection and documentation of weak (EF0 or EF1) tornadoes, which pose little threat to well-built structures. When looking at strong tornadoes (EF2 or higher), no trend is evident, with the total remaining steady at 3-5 events within the Parish per decade.

Recommendation: Create a short document or video explaining tornado patterns in Shreveport and Caddo Parish to address some risk perception issues.

Issue 3: Reducing impacts from winds

Although tornadoes are relatively small-scale phenomena, high winds from severe thunderstorms and squall lines occur much more frequently and can cause far more widespread damage. These winds are particularly destructive to powerlines and trees. Protecting and strengthening infrastructure, improving warning systems, and maintaining accessible shelters are important for the city to enhance resilience and public safety.

Protecting the electrical infrastructure involves anticipating potential power outages, likely impacts, and reducing the exposure of the infrastructure to high winds. With regards to anticipating power outages, products from the NWS Storm Prediction Center (SPC) may be useful. The SPC issues outlooks several days in advance and severe storm watches several hours in advance. This can help the city to pre-position resources if necessary and protect assets such as vehicles when possible.

Recommendation: Collaborate with the NWS Weather Forecast Office in Shreveport to identify how high winds impact city operations and train city officials on use of SPC products.

Protecting the electrical infrastructure is more difficult and more costly. In some cases, powerlines can be buried which prevents their damage and destruction from high winds or ice storms. However, powerlines emit heat as energy moves through them, and that heat must be dissipated. If that heat accumulates, it can damage buried lines which are more difficult to repair than overhead lines. Some powerlines, such as distribution lines for local service and service lines (the final connection from the distribution lines to individual buildings) generate less heat and can be buried, while higher-capacity transmission lines would be more likely to fail if buried.

Recommendation: Identify types and locations of powerlines that could be safely buried with low fail rates, such as in neighborhoods, based upon similar experiences from other cities. Identify funding sources to cover the costs of burying existing lines where possible. Trim tree limbs away from powerlines that must remain above-ground.

Recommendation: Change zoning so that new construction of residential areas and smaller commercial businesses require distribution lines to be buried.

Alerting the public for tornadoes and high winds is also a challenge for Shreveport. The city currently is seeking funding to install outdoor warning (tornado) sirens. The city has locations in mind, but needs funding to acquire and install them.

Recommendation: Sources such as FEMA Hazard Mitigation Grant Program and state mitigation funds received from disasters can be used for purchasing and installing sirens, even if a declared disaster did not include Caddo Parish. City officials should contact the Governor's Office of Homeland Security & Emergency Preparedness (GOHSEP) to inquire about FEMA mitigation funds and advocate for sirens.

Recommendation: City officials should consult with experts in meteorology and geospatial techniques to assure optimal placement of the sirens to cover critical areas of as much of the city as possible. Students at the University of Oklahoma have been developing such techniques.

Another challenge of tornadoes and high winds is protecting the public, both from impacts of flying debris and from falling tree limbs. The City operates locations for sheltering from extreme temperatures and post-event impacts. New commercial construction requires installation of tornado shelters.

Recommendation: City officials should request assistance from parish emergency management or GOHSEP to review shelter locations to assure survivability in tornadoes. Buildings with large-expanse roofs, such as gymnasiums, may not be properly anchored to survive high winds.

Recommendation: City officials should review shelter-in-place options rather than centralized tornado shelters. People in transit to shelters are vulnerable to weather-related impacts and delays. Furthermore, maintaining City shelters can be costly and challenging, along with assuring security at shelters during operations.

Temperatures: Heat and Cold

Temperature extremes, both heat and cold, were identified as major challenges within Shreveport. These temperature extremes affect both city staff and the public. Keeping people safe during heat and cold events and potential post-event power outages is a central concern.

On the hot side of the temperature spectrum, assessing heat risk to human health and the effectiveness of cooling techniques is important. Nationally, policies related to extreme heat are usually based upon recorded and forecast temperatures or the heat index. However, the Wet Bulb Glob Temperature (WBGT) is a more effective assessment of heat risk to people[5]. Heat index combines temperature with humidity; WBGT also includes the effects of solar radiation (direct sunshine) and wind. Direct exposure to sunshine or low wind speeds can inhibit the body's ability to cool itself, increasing risk factors beyond those indicated by the heat index alone.

Research shows that misters and splashpads are more effective in dry environments than in humid environments[6]. The body's mechanism to cool itself is through perspiration (sweating). Water molecules on the skin's surface are evaporated, which takes heat away from the body. When the wet bulb temperature – the lowest temperature to which air can be cooled by evaporation of water into the air at a constant pressure – exceeds 95˚F, the body becomes unable to naturally cool itself[7]. Artificial cooling systems such as misters and splashpads become equally ineffective. Thresholds for WBGT are not yet determined, but recent studies suggest WBGT values above 88˚ F makes evaporation an inefficient means of cooling the human body.

Heat waves occur more frequently than cold waves in Shreveport, but the city is vulnerable to the impacts of cold as well. Many homes are older construction and may not be well-insulated. When temperature drops below freezing, pipes may freeze quickly. Homes in the area of Shreveport that was built before the 1960s are especially vulnerable to freezes. If the temperature drops below about 13˚F, or below 32 ˚F for an extended time, burst pipes can cause a decrease in water pressure that can become catastrophic.

Cold and attendant ice or snow also introduces mobility problems. Roads may become impassible for some time, usually until melting occurs naturally as there are limited abilities for road treatment. Oil and gas wells may become shut in, causing large losses in production and contributing to price spikes. This can also reduce in loss of income for the oil and gas industry, which is the largest employer in Shreveport. City plans to account for

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[5] National Weather Service, https://www.weather.gov/tsa/wbgt

[6] Study of mist-cooling for semi-enclosed spaces in Osaka, Japan. (Farnham et al., 2011). https://www.sciencedirect.com/science/article/pii/S1878029611000533

[7] An adaptability limit to climate change due to heat stress (Sherwood and Huber, 2010). https://www.pnas.org/doi/10.1073/pnas.0913352107. Recent research suggests these thresholds may be lower in drier environments.: Evaluating the 35°C wet-bulb temperature adaptability threshold for young, healthy subjects (PSU HEAT Project) (Vecellio et al., 2022). https://journals.physiology.org/doi/full/10.1152/japplphysiol.00738.2021

such conditions include all city-owned vehicles being four-wheel drive and filled with gas before anticipated events. The city also operates overnight shelters at city facilities as needed. Following the February 2021 snowstorm and deep freeze, the city purchased two snowplows to keep major roads open during future snowfall events.

The workshop identified three issues for further investigation and discussion:

- Issue 1: Reducing heat risk to city staff;
- Issue 2: Reducing heat risk to community members;
- Issue 3: Anticipating extreme cold outbreaks

Issue 1: Reducing heat risk to city staff

The impacts of heat are not felt universally. Those working outdoors, especially those exposed to direct sunshine, may need cooling aid more frequently than those working indoors. City departments may therefore want to use different thresholds for action, calibrated to agency experiences. Likewise, heat can become a more pronounced issue during power outages after hurricanes or severe storms, when people are unable to cool their homes with air conditioning and may lack public shelters able to operate air conditioning.

Recommendation: Determine thresholds for city departments when heat becomes problematic for outdoor work.

Recommendation: Compare activities of city departments to establish how much time workers spend outdoors during summer and compare to OSHA guidelines for WBGT[8]. Determine if breaks are needed more frequently during heat waves or if work can be scheduled to reduce the time exposed to heat when such conditions are anticipated.

Recommendation: Connect with the NWS Weather Forecast Office in Shreveport to develop a notification system for outdoor events in Shreveport that would provide at least 24 hours advance notice to allow for preparations.

Recommendation: Integrate heat warnings and outlooks into city operations and messaging without having to go to multiple sources.

Issue 2: Reducing heat risk to community members

Reducing exposure of community members to heat includes consideration of when to open cooling shelters, frequency of heat wave occurrence, time of the day, and coordination with health care facilities. Along with opening shelters, consideration must be given to how people can get to those shelters, as it is not wise to walk long distances in the heat. The National Weather Service Forecast Office in Shreveport should be consulted for the heat wave / heat advisory criteria that they use.

Recommendation: Determine the frequency with which various heat criteria are met, including a WBGT threshold of 90˚F (black flag criteria), heat index values of 110˚F-115˚F,

[8] OSHA, https://www.osha.gov/heat-exposure/hazards

or extended duration such as a heat index of 105˚F (danger criteria) for three consecutive days.

Recommendation: Determine typical diurnal patterns of heat in Shreveport, including the time of day critical conditions are most likely to occur and if the air cools below caution levels (heat index of 80˚F, WBGT of 85˚F) at night.

Recommendation: Examine the relationship between heat index and WBGT threshold and health outcomes for Shreveport.

Using appropriate thresholds for Shreveport, it is essential to alert city staff, partners, and community members when conditions may become dangerous. Partners include health care facilities, as they may anticipate receiving more admissions than usual. Cooling areas, like the mall and civic center, should be opened in advance of people arriving and should include a police presence.

Recommendation: Post heat alert messages, either originating from the NWS or if forecast conditions exceed thresholds, via regular city communication channels, including websites and social media. Advisories should begin at least 24 hours in advance of an anticipated heat event.

Recommendation: Survey or interview people who use the cooling areas to determine amenities and activities that may make them more inviting, such as games, food, or entertainment.

Issue 3: Anticipating extreme cold outbreaks

Although the number of cold nights in Shreveport has been decreasing since the 1950s[9], cold air outbreaks and associated winter weather still pose a risk for residents. Extremely low temperatures are most likely if there is snow cover; consequently, if snow is anticipated in Shreveport, it may become more likely to experience temperatures low enough to cause pipes to freeze and create other problems. It is possible to experience extreme cold without snow cover, although less likely. The most recent notable extended cold-air outbreak occurred in February 2021, with another brief occurrence in December 2022. Extended cold periods are becoming less frequent, but remain possible.

Winter temperatures are difficult to predict precisely, and a small difference in temperature can be the difference between a cold rain, ice, sleet, or snow. Strong cold waves originate in the Arctic and take several days to move southward, giving notice of potential cold events. Air masses moderate based on the surface temperatures they encounter. If they move across heavy snowpack, they are more likely to maintain intense cold for longer. Consequently, heavy snowpack along their track can be an indication of a cold air mass remaining intact as far south as Shreveport.

[9] County-Level Minimum Temperature Explorer (SCIPP): https://cmintemp.scipp.lsu.edu/

Recommendation: Monitor weather forecasts for large-scale weather patterns favorable for Arctic air across the Central U.S. and for the potential of snow, either in Shreveport or in adjacent parishes or counties to the north.

Recommendation: Improve use of warming centers, which are opened at least 24 hours in advance of anticipated winter weather. Evidence suggests many people are unaware of or unwilling to use the services. The city offers free transportation to help people to reach the warming centers, especially if roads become impassable from snow or ice.

Intense Rainfall

Flooding remains a recurrent threat for Shreveport due to the Red River and potential for water to backup in nearby bayous. Multiple significant flood events occurred between 2015-2019, though impacts have been more localized in recent years. Flooding in and around Shreveport can result from intense local thunderstorms, tropical moisture moving inland from the Gulf of Mexico, and prolonged heavy precipitation in upstream reaches of the Red River basin.

The greatest risk for heavy rainfall from tropical storms occurs when landfall takes place between Matagorda Bay in Texas and Vermillion Bay (Lafayette) in Louisiana, although weather patterns associated with individual storms can bring heavy rainfall from any landfalling tropical storm along the western Gulf. Flooding risk is also increased when the Red River is high, which may be caused by extended heavy rainfall upstream in Oklahoma. In such cases, it becomes more difficult for bayous to drain into the river, which causes flooding along those tributaries. In extreme cases, flooding on the Red River could cause it to change course, as it is a meandering river which cuts new channels and isolates previous parts in oxbow lakes.

Summer thunderstorms are capable of producing heavy localized rainfall, which can cause urban flooding in areas covered by concrete. Evidence suggests that total rainfall amounts may not be changing, but that rainfall is occurring in shorter bursts, meaning rain rates are higher and can overwhelm existing stormwater management systems[10]. Intense rainfall may also impact area agriculture, including cotton and crawfish, and cause water quality issues after a heavy rainfall event. Public Works is using the information about changing rainfall intensity to improve newly identified areas of concern. The city has identified road flooding and drain blockage problems to be partly from litter, grass, and leaves from homeowners. An education program has been initiated as well as a block-by-block clean sweep program with the cooperation of neighborhoods.

The workshop identified three issues for further investigation and discussion:

- Issue 1: Spatial variability of precipitation across Shreveport, Caddo Parish;
- Issue 2: More low-lying flooding or backup of wastewater treatment system when Bayou is full;
- Issue 3: Duration of heavy rainfall

Issue 1: Spatial variability of precipitation across Shreveport, Caddo Parish

Individual storms can produce large amounts of rainfall over relatively small areas, but over time, these variations usually average out into a more uniform pattern. Some variation across the Parish is expected, with total annual rainfall increasing toward the south, closer to the Gulf of Mexico (moisture source). There may also be terrain features which can enhance precipitation, such as along mountain slopes, but that is probably not significant in Caddo Parish.

[10] Trend analysis of multiple extreme hourly precipitation time series in the Southeastern United States (Brown et al. 2020), https://journals.ametsoc.org/view/journals/apme/59/3/jamc-d-19-0119.1.xml

Recommendation: Produce a high-resolution analysis of precipitation totals across Caddo Parish to assess if there are differences between what is reported at the official observing station (Shreveport Airport) and other parts of the city (such as Cross Lake Dam).

Recommendation: Determine the rates of change in hourly precipitation accumulation and duration for Shreveport.

Recommendation: Examine heavy rainfall events from the last 3-5 years to determine the frequency of type (training thunderstorms, localized thunderstorms, tropical storms, cold front systems. etc.).

Issue 2: More low-lying flooding or backup of wastewater treatment system when Bayou is full
Flooding within the city may be enhanced when the Red River is at a high stage. Under normal conditions, bayous drain into the Red River, but elevated river levels can slow the flow from bayous into the river, or even reverse the process if the Red River is exceptionally high. Although direct flooding from the Red River is rare, the interaction between the river and the bayou system warrants closer attention.

Recommendation: Determine the frequency of bayou flooding associated with Red River stage. Document if there is a change in frequency.

Recommendation: Examine whether tributary flooding is more likely to occur with lesser rainfall amounts when the Red River stage is high (i.e., if flooding may occur with a 2-inch rainfall at high stage versus a 4-inch rainfall at low stage).

Recommendation: Analyze frequency of Red River flood stages at Shreveport to develop a climatology of when river stage is likely to be highest, thereby potentially increasing the risk of flooding along tributaries[11].

Because of the many tributaries and urban areas, flooding is a risk to homes and businesses within Shreveport. As of July 2021, there were 4,488 flood insurance policies issued to homes and businesses within Shreveport as part of the National Flood Insurance Program (NFIP)[12]. The NFIP uses a Community Rating System (CRS) to evaluate efforts taken by jurisdictions to reduce their flood risk. Locations are assessed a class from 1 to 9, with a 5% discount on insurance rates for each level achieved (CRS class 1 is 8 levels higher than class 9, giving a 40% discount). Each point improvement on the CRS rating could save residents up to $200,000 per year on insurance rates, based upon current average insurance costs and number of policies. Currently, Shreveport is listed at Class 8.

First Street Foundation uses a technique to assess flood risk at the individual property level. Their technique better captures urban runoff and flow into tributaries, as compared to the FEMA floodplain maps. First Street's analysis identified 17,654 properties, or 18.9%

[11] National Water Prediction Service, https://water.noaa.gov/gauges/SVPL1
[12] CRS Resources, https://crsresources.org/files/100/maps/states/louisiana_crs_map_october_2021.pdf

of all properties in Shreveport, as being at risk of flooding over the next 30 years[13]. Of these, 8,579 are classified as major or higher risk, which is comparable to the number of properties in FEMA's Special Flood Hazard Area (8,258 properties).

Recommendation: Actions may have been taken by the city but not properly documented in the CRS applications. Review CRS criteria to determine if Shreveport can get credit for actions already taken to move to reduce the CRS level from 8. Contact other cities, such as Tulsa, Oklahoma, that have received level 1 or 2 CRS rating.

Recommendation: Contact First Street Foundation to obtain an analysis of properties in Shreveport at risk of flooding (may have fees attached).

Issue 3: Duration of heavy rainfall

How long rainstorms last affects response. Stormwater management systems are typically designed to handle short-duration heavy rainfall, but when it extends beyond an hour, it may lead to problems. As impoundments and drainage networks fill, water may back up onto streets and collect in low-lying areas, sometimes necessitating water rescues. Understanding how frequently heavy rainfall lasts for more than an hour is therefore critical. If such events occur often enough, installing alert systems, such as flashing flood warning signs in flood-prone areas, may be warranted.

Recommendation: Examine hourly rainfall data and determine how often heavy rainfall (rain rates greater than 1 inch per hour) extends more than one hour duration. Include analysis by month and season.

Recommendation: Identify costs of installing flashing signs in problematic areas[14]. Use the rainfall frequency analysis to conduct a benefit-cost analysis to determine if alert signs are necessary.

[13] First Street Foundation, https://firststreet.org/city/shreveport-la/2270000_fsid/flood
[14] For example, hyfi, https://www.hyfi.io/

Community Preparedness

There are many active efforts underway to help the City prepare for near-term weather events. Representatives from the City participate in regular regional meetings with the NWS Forecast Office in Shreveport and the Disaster Assessment Response Team (DART). Law enforcement has weekly meetings with the NWS and has good relationships with city agencies and counterparts within the parish. Shreveport has a local emergency operations unit and includes conversations with the Salvation Army, non-governmental organizations, hospitals, and others in advance of anticipated severe weather.

Preparedness on longer time scales is more challenging. There is limited participation in the parish hazard mitigation plan process. The police department and water & sewerage department were involved, but most other city agencies and broader public were not aware of the planning process.

Recommendation: City officials should coordinate more active involvement in the next hazard mitigation plan process, including representation from more city agencies and citizen groups.

Three issues in community preparedness, beyond those already discussed, were identified:

- Issue 1: Water contamination and sediment buildup in Duck Pond and Cross Lake;
- Issue 2: Keeping people safe after storm events, heat waves, or cold outbreaks;
- Issue 3: Vegetation management that reduces risk from heat and wind.

Issue 1: Water contamination and sediment buildup in Duck Pond and Cross Lake

Another area of concern relates to water quality. During heavy rainfall events, manganese may spike in Cross Lake, the primary source of drinking water for the city. Intense rainfall events have been associated with manganese levels five to ten times greater than normal levels, resulting in yellow water and requiring excessive treatment. Identifying the source of the manganese and the weather conditions which cause increases in concentration in Cross Lake are critical. Furthermore, the Duck Pond, a popular outdoor recreation spot, gets clogged by sediment and is prone to algae outbreaks.

Approximately every two years, the U.S. Army Corps of Engineers prepares a comprehensive package of projects that provide for conservation and development of water and related resources. The Water Resources Development Act (WRDA)[15] provides the authorizing legislation to pursue the listed projects, dependent upon Congressional appropriations.

Recommendation: Identify potential source regions for manganese, primarily if it is likely washed into Cross Lake from headwaters areas during heavy rainfall or is stirred up from the bottom during high inflows to the lake.

[15] U.S. Army Corps of Engineers, https://www.usace.army.mil/Missions/Civil-Works/Water-Resources-Development-Act/

Recommendation: Identify weather conditions associated with previous spikes in manganese concentration, both directly at Cross Lake and within the inflow sources.

Recommendation: Identify potential funding sources that can be used to dredge Cross Lake and the Duck Pond to increase storage capacity, reduce contaminants, and decrease the likelihood of algae outbreaks. Direct funding through WRDA may be one such avenue for projects.

Issue 2: Keeping people safe after storm events, heat waves, or cold outbreaks

The city convenes an action plan committee when inclement weather is expected and operates numerous shelters during and following significant weather events, including impacts from storm damage, heat waves, and cold outbreaks. Travel to centralized shelters may be difficult for some. A recent trend in many cities is to develop neighborhood-scale Resilience Hubs[16]. Resilience Hubs are community-serving facilities augmented to support residents and coordinate resource distribution and services before, during, or after a natural hazard event.

Resilience Hubs are structures that are likely to have minimal damage from weather events in order to keep operating during and after an event. Hubs provide power, communications, and operations, in addition to programming and services. This allows people to have access to heating or cooling, an ability to charge phones or operate medical devices that require electricity, and to refrigerate medicine. They also serve as a distribution point for food and resources within a community. Resilience Hubs also host activities and workshops that promote preparedness, health, and well-being before and after weather-related events.

One Resilience Hub has been established with Community Lighthouse Project at a church and one at the Highlands Center. Some residents may be apprehensive about facilities such as government-owned buildings or churches, so a variety of hosts allows the greatest access.

Recommendation: The city should support development of additional Resilience Hubs, so such resources are available within easy walking distance in every neighborhood in Shreveport.

Recommendation: The city should work with non-governmental organizations and community groups within the city to identify the most appropriate host facilities within each neighborhood.

Issue 3: Vegetation management that reduces risk from heat and wind

As noted above, a significant threat to the city is tree damage from high winds and winter storms. A primary means to reducing the urban heat island effect is to plant more trees to provide shade; however, this creates more risk from falling tree limbs in high winds or ice. Furthermore, sight lines along major roads need to be maintained, which limits tree

[16] Urban Sustainability Directors Network, https://www.usdn.org/resilience-hubs.html

planting in certain areas. Managing vegetation in a way that reduces heat within the city while also reducing the risk of damage from storms is a challenge.

Recommendation: Consult Louisiana State University Extension horticulturalists for guidance on what tree species are best suited for the environment, both in terms of providing shade and being resilient to high winds. For example, many Bradford Pears planted near parking lots are very fragile and break as they age, so they would not be suitable candidates for long-term tree coverage.

Recommendation: Consult Louisiana State University Extension horticulturalists to identify types of vegetation that can be planted along roadways that does not grow as high as trees, have minimum maintenance requirements, are drought and fire resistant, and are good at absorbing pollutants. This can reduce the costs of mowing while providing co-benefits of cleaner air and stormwater runoff and potentially reducing some effects of urban heat.