# Storm Evacuation Forecast & Shelter-in-Place Scenarios Study

DRAFT

*prepared for*

**Hillsborough TPO**

*prepared by*

**Cambridge Systematics, Inc.**

*with*

Quest Corporation of America (QCA)

March 2022

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**March 28, 2022**

# Table of Contents

# List of Tables

# List of Figures

# Introduction

A critical component of transportation agencies' policy and program decision-making is system resilience to disruption. Evacuation plans are one way to respond to disruptions, such as hurricanes, or flooding. These plans are part of state and county emergency operations plans, and include an inventory of available shelters, identification of evacuation routes, and transportation services for persons unable to evacuate on their own.

The Hillsborough TPO and transportation partners must continue to enhance evacuation and sheltering for emergencies. This study looked at options beyond road widenings.

The Storm Evacuation Forecast & Shelter-in-Place Scenarios Study supplements this ongoing work by providing a high-level analysis of Hillsborough County's evacuation practices today. The study evaluated best practices in evacuation regionally and nationally, assessed potential evacuation enhancement options in Hillsborough County, and developed a set of recommendations and next steps for the Hillsborough Transportation Planning Organization and other agencies to consider for emergency response in Hillsborough County. The focus was on options beyond road widening and on actions within the TPO's areas of responsibilities.

The first stage of the study identified issues related to evacuation for Hillsborough County, such as evacuation congestion areas. The second step identified strategies to address the issues and assesses the strategies' ability to provide evacuation and sheltering benefits (or challenges). The final step documented here covers both the issues and strategies evaluations and provides recommendations for the TPO and partner agencies. Stakeholder and public outreach helped to identify issues of concern to county residents, businesses, and visitors as part of the first phase. Stakeholder and public outreach were performed in the second stage to gauge acceptance or usefulness of proposed strategies.

**Figure 1 Work Program**


## 1.1 Existing Evacuation System

Hillsborough County has several existing emergency response and evacuation planning elements, including evacuation routes, public evacuation shelters, and special transit routes for evacuation scenarios. These systems are shown in Figure 2.

Evacuation zones generally correlate to hurricane storm categories; however, the evacuation zone is tied to potential storm surge versus wind speed. For example, evacuation zone C would apply for a Category three

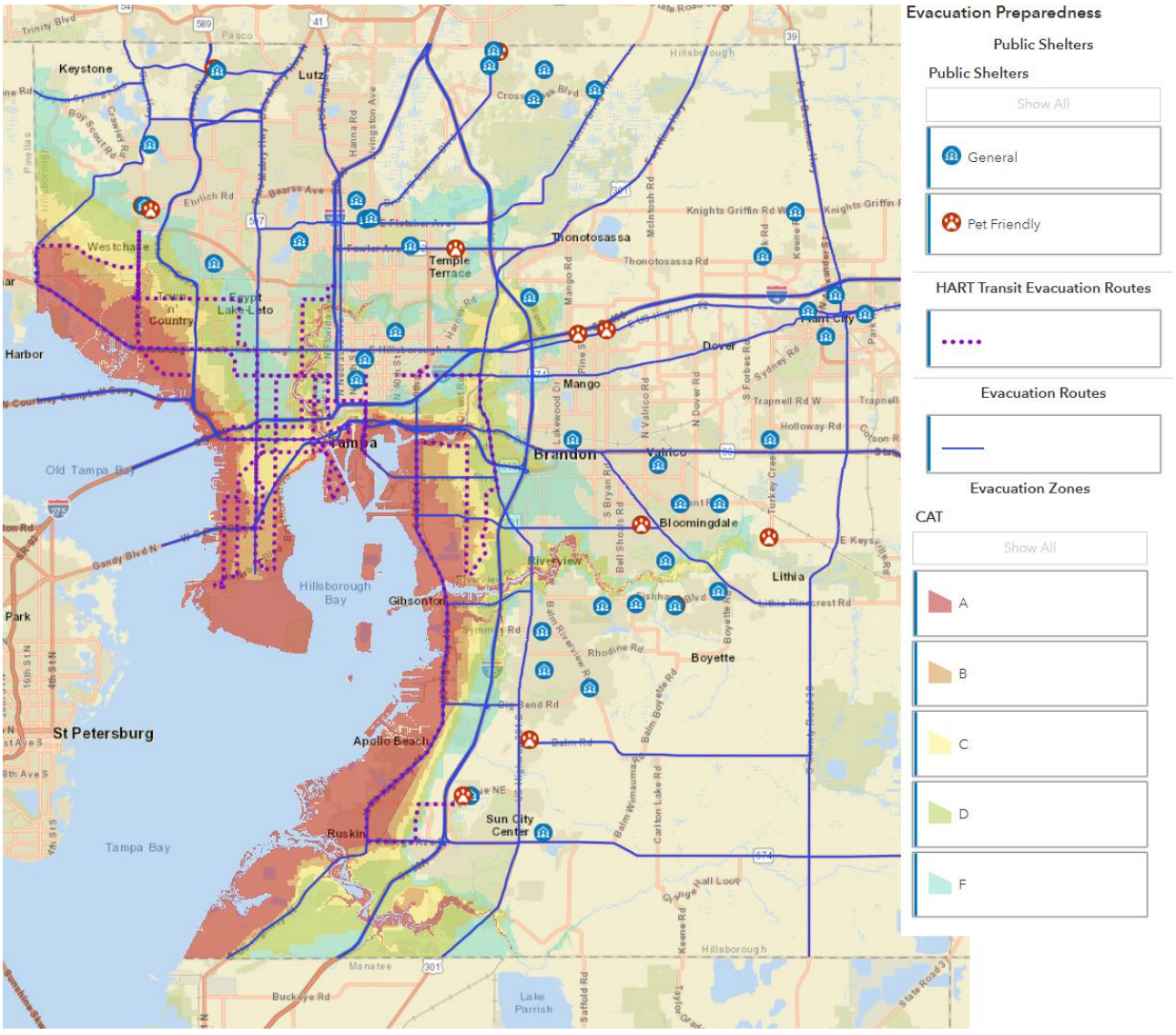
hurricane. All residents living in mobile homes or recreational vehicles are requested to evacuate with zone A regardless of storm intensity. Large areas around the bay and inland for riverine areas are designated for evacuation.

Evacuations of Hillsborough residents and visitors are projected to require 18 and 42 hours for Categories 1 and 5 hurricanes, respectively. Hurricane warnings are typically provided 24-36 hours prior to storm landfall.

All roads are available for travel during an evacuation. Evacuation routes, however, are signed for motorists, and are major north/south and east/west roads including interstates. The transit routes shown in Figure 2 are established in times of emergency and are different from HART's typical routes. Special needs transportation is available through a pre-registration mechanism and assisted by emergency management. In past years, the Hillsborough School District also has provided buses and drivers to assist in an emergency.

There are special needs shelters for people that may require support or medical assistance while evacuated, as well as pet-friendly shelters.

## Figure 2 Existing Public Shelters and Evacuation Zones Map

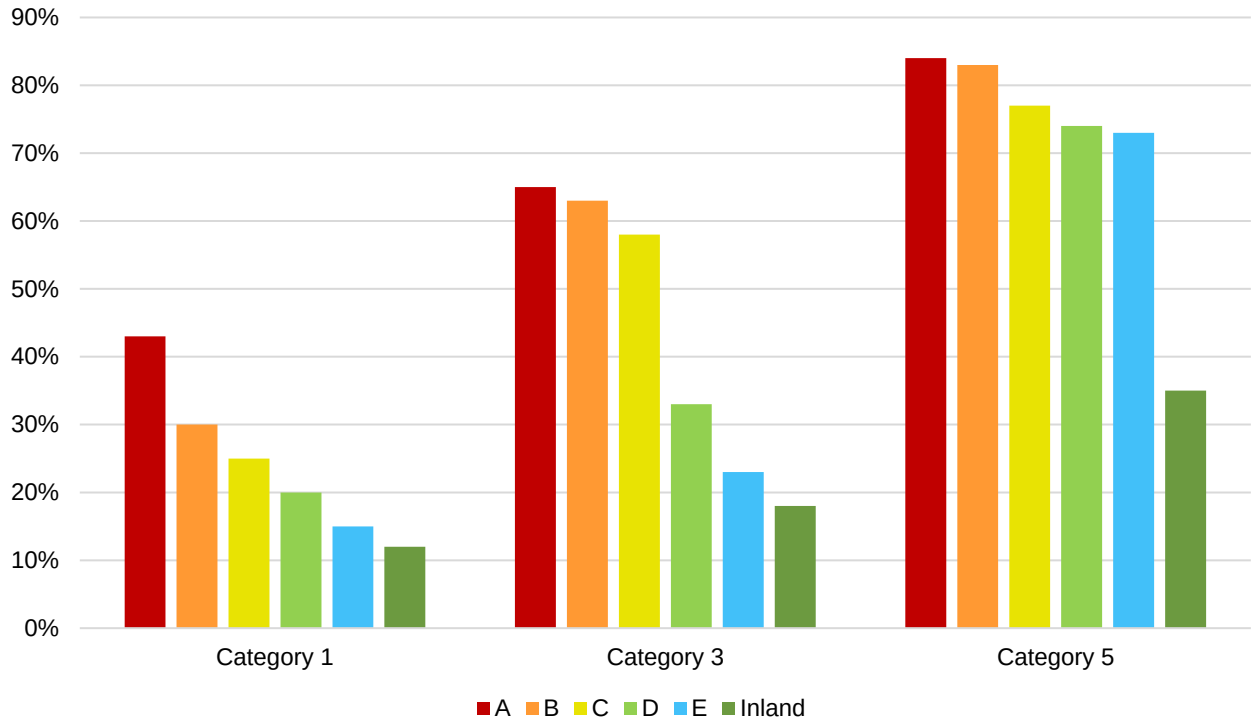


# 2.0 Input and Coordination

## 2.1 Statewide Regional Evacuation Study

A main source of information about the region was the *Statewide Regional Evacuation Study Program* (SRESP) conducted for the regional planning districts in Florida, including the Tampa Bay Regional Planning Council.[1] The Statewide Regional Evacuation study behavioral data was collected by location-based cell phone information and surveys. The figures show how people are anticipated to evacuate based on past experience. Figure 3 shows expected evacuation rates by storm severity and evacuation zone. (The term "inland" is used for geographic areas outside all evacuation zones.)

**Figure 3 Evacuation Rates by Evacuation Zone by Hurricane Category: Site-Built Home Residents**

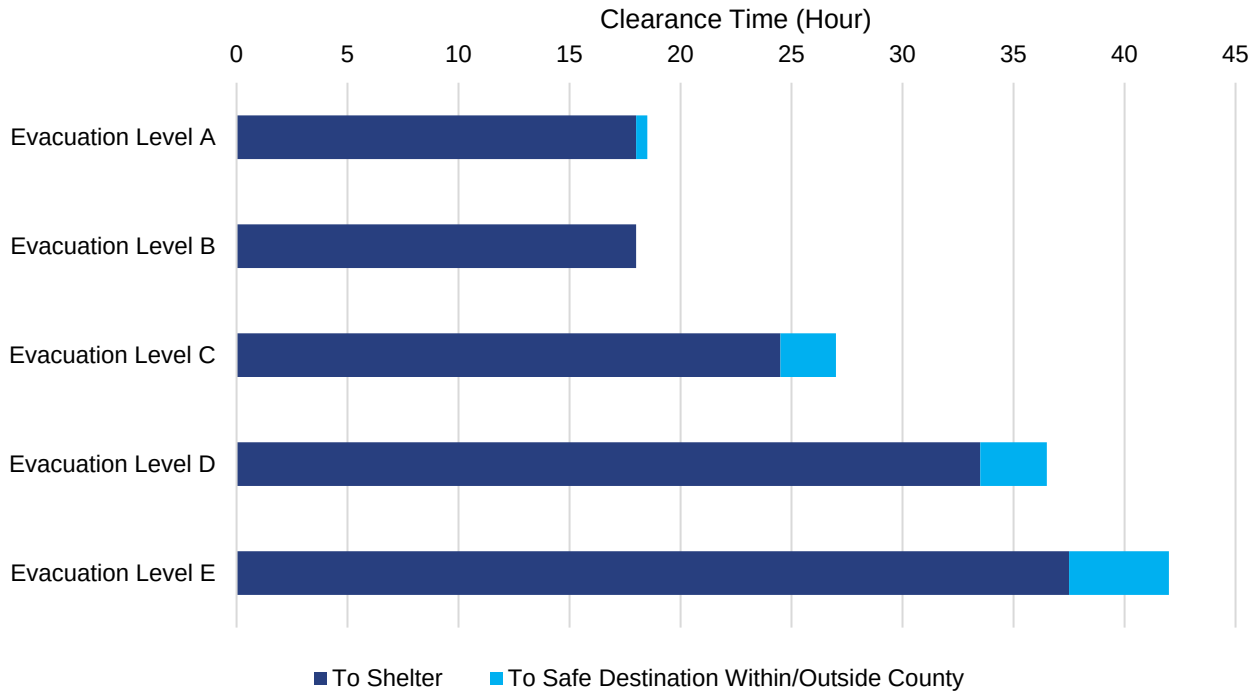



Clearance times are used as a measure for how long an evacuation can be expected to take place once it has begun. Clearance times are used by emergency management staff to determine a window of opportunity available to initiate evacuation orders, and to ensure evacuees have enough time to reach evacuation destinations safely before storm arrival. Figure 3 shows the amount of time required for people in each of the evacuation zones to evacuate during a corresponding hurricane category. The figure shows times to evacuate to a shelter as well as the time required to a safe destination (either inside or outside of Hillsborough County). This data is based on hurricane evacuation modeling and the model projects longer time to evacuate to a non-shelter destination, with the difference growing for more intense hurricanes. For example, evacuation level C is required to take approximately 24 hours for people to reach shelters and

[1] https://www.floridadisaster.org/dem/preparedness/regional-evacuation-studies/

approximately three hours longer t reach other destinations. Emergency management personnel recommend people shelter in place if in a safe facility outside an evacuation zone. Traveling shorter distances to safe destinations with family, friends, or in a hotel/motel or shelter, is encouraged to reduce vehicles on roads during regional evacuations. Shelters are available to provide safety during a storm.

**Figure 4 Hillsborough County 2025 Operational Scenarios Clearance Times**




## 2.2 Stakeholders and Partners

To obtain input of areas of concern to Hillsborough County agencies, residents, businesses, and visitors, the study team used a variety of methods for outreach. During a study kick-off meeting, partner agencies and organizations provided suggestions. A virtual open house with participant polling provided good direction on topics, as did a similar on-line survey made available on the study's website and noticed via newsletters and social media. Another resource that was used as input on issues as a statewide pandemic and evacuation survey performed by the University of South Florida, with data pulled for Hillsborough County residents only.

At a study kick-off meeting held on June 6, 2021, approximately 15 attendees from the Hillsborough TPO, the Hillsborough Planning Commission, Hillsborough County – including emergency management, City of Tampa – including emergency management, and HART, discussed the study's purpose and had suggestions about evacuations and sheltering. Some of the items are:

- HART will be looking into evacuation routes given zones and population shifts. The focus has been on covering coastal areas and changes to accommodate communities of concern may support more people. A potential concern that shelters are not on bus routes was mentioned. Changing route patterns during an emergency also may cause confusion for riders.

- There were discussions on the need to coordinate, particularly with the State of Florida, during emergency evacuations and especially large events like hurricanes. The County and cities do not function in a vacuum.
- Another topic mentioned was a need to look at future growth areas to be able to continue to support evacuation and shelter needs.

### *2.2.1 Issues Identification Surveys*

Four pieces of information helped inform the identification of evacuation topics issues to investigate further as part of this study. These were: polling during a virtual study open house, a survey provided online, and results from two university-led research surveys.

#### Open House Polling

On August 25, 2021, the TPO and study team hosted a virtual open house to explain the study's purpose and seek feedback on evacuation issues. Twenty-eight people attended and throughout the presentation polling was used to gather information. For most questions, respondents could choose up to three answers.

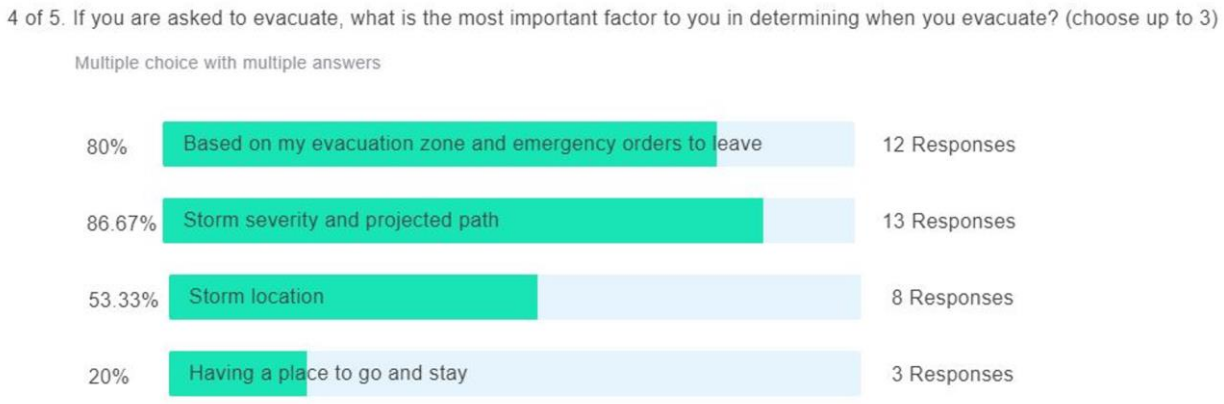
Storm uncertainty was the number one factor affecting decisions to evacuate.

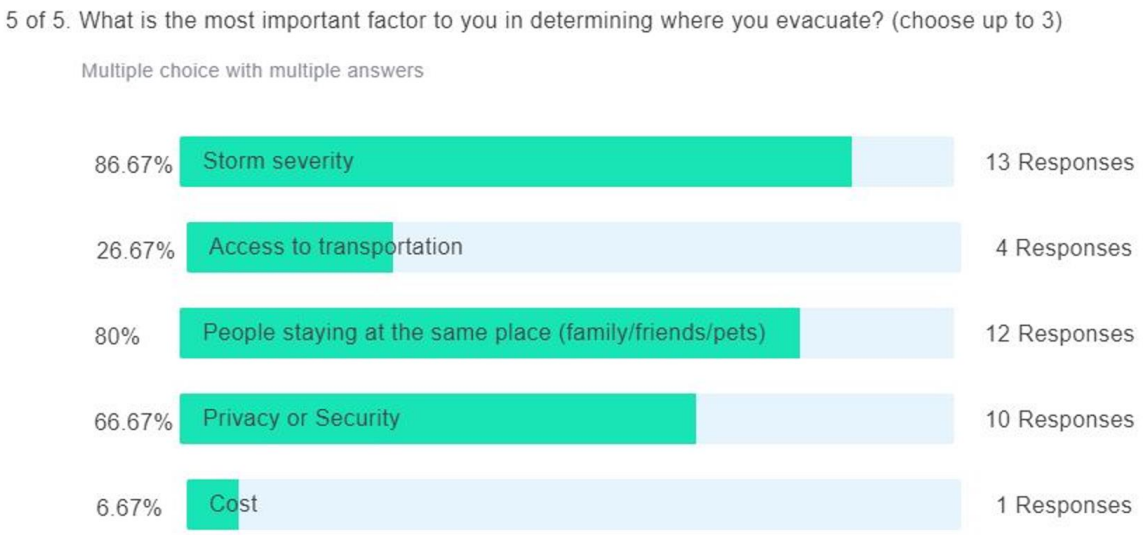
Living in an evacuation zone was the second factor.

Having a secure and private place, preferably with family, friends, and/or pets is particularly important.

Half of the participants lived in the northeast portion of the county, with 22 percent living downtown and about a third living in an evacuation zone. When determining whether to evacuate, storm severity is an important factor for 94 percent, with 63 percent citing a place to stay, and 44 percent indicating no need to evacuate. If asked to evacuate, respondents would evacuate based on storm severity and their evacuation zone as the top two answers at 87 percent and 80 percent, respectively. Similarly, 87 percent indicated storm severity and staying with family/friends/pets at 80 percent as the top two answers for where they would evacuate, with two thirds indicating privacy or security as important. Figure 5 shows some of the questions and answers.

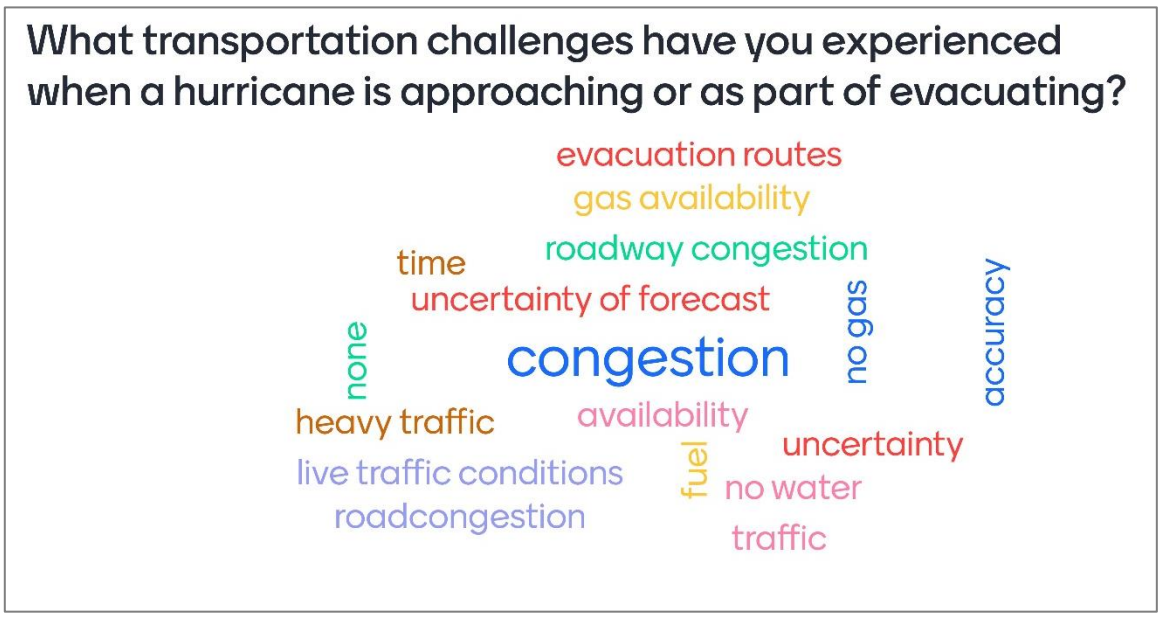
**Figure 5 Open House Polling on Evacuation Decision and Location Factors**






There were two free answer questions with the first, see Figure 6, asking what transportation challenges people have experienced when a hurricane is approaching or as part of an evacuation. Congestion was the top answer, including phrases such as road congestion, traffic, heavy traffic, and live traffic conditions. The last was presumably offered as a suggested enhancement. Gas and fuel availability was a second most frequent answer, as was forecast uncertainty or accuracy.

**Figure 6 Online Survey Response Word Map**




The second question asked if any considerations were not covered during the presentation or polling. Live data availability was a frequently mentioned answer, with traffic; a combined unfamiliar, uncertainty, and what-to-do responses; and combined access control for returns, returning traffic, and re-entry also important. Other answers were communication strategies, surface road conditions, 24-hour weather, pets, food, increase evacuation time, and snowbirds and year-round birds. Many of these topics are similar to topics identified.

## Study Survey Results

An on-line survey with questions like those asked at the open house was provided and noticed via the study's website and TPO social media. Given available space, respondents were given additional options, yet still chose at most three factors. Twenty-three responses were received, and half (12) indicated they live in an evacuation zone.

When determining if to evacuate, storm severity was identified by 19 respondents, with the second popular answer with 11 responses as having a place to stay. Access to a pet-friendly shelter and no need to evacuate due to a safe home, were next with six and five answers each. With more choices, four respondents indicated health concerns for themselves or a family member as an important factor. Job responsibilities were mentioned by three people. One respondent noted cost and access to transportation as two of their three important factors. Uncertainty about storm predictions and flooding potential were mentioned as key factors in determining whether to evacuate.

Survey responses were similar to those from the open house.

Other factors noted were job responsibilities, health concerns for themselves or others, or access to transportation as affecting evacuation and sheltering decisions.

Daily congestion and housing growth were noted as affecting the ability to evacuate.

**Figure 7 Online Survey Response on Important Factors for Whether or Not to Evacuate**

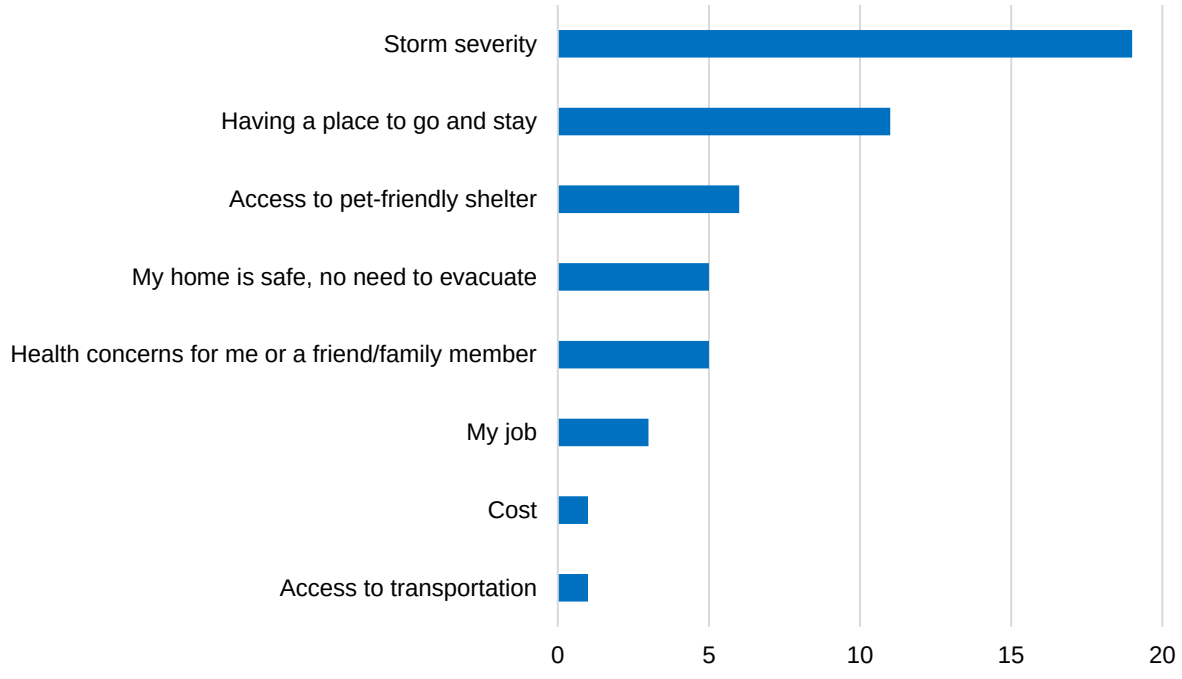
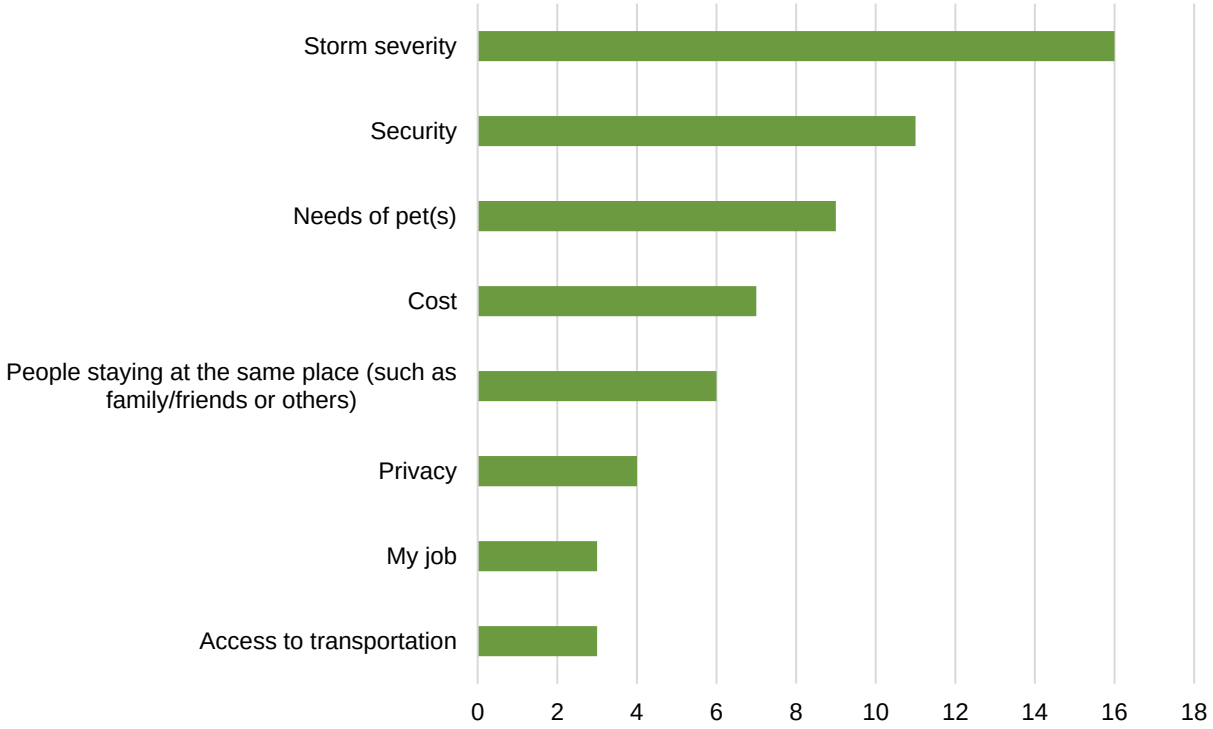


**Figure 8 Online Survey Response on Important Factors for Where to Evacuate**




When asked a question about when people would leave if asked to evacuate respondents most frequently selected storm severity and projected path as well as based on evacuation zone and orders to leave, or storm location. For those that do not live in an evacuation zone, 15 of the 23 were very likely or somewhat likely to shelter at home.

When asked about transportation challenges experienced in the past, traffic congestion and gasoline shortages were most frequently mentioned. Several noted that daily traffic congestion in non-emergency times discourages them from evacuating during a hurricane or tropical storm. Lack of public transportation and flight cancellations were mentioned by individuals.

Responses to the question about other considerations that may have been missed in the survey included many about traffic congestion and fixing roads. Several respondents indicated job responsibilities that restrict evacuation. Growth, particularly in South Tampa was mentioned. Another suggestion was to provide access to resources (e.g., gas for personal vehicles, sandbags, and supplies) for those that will shelter in place.

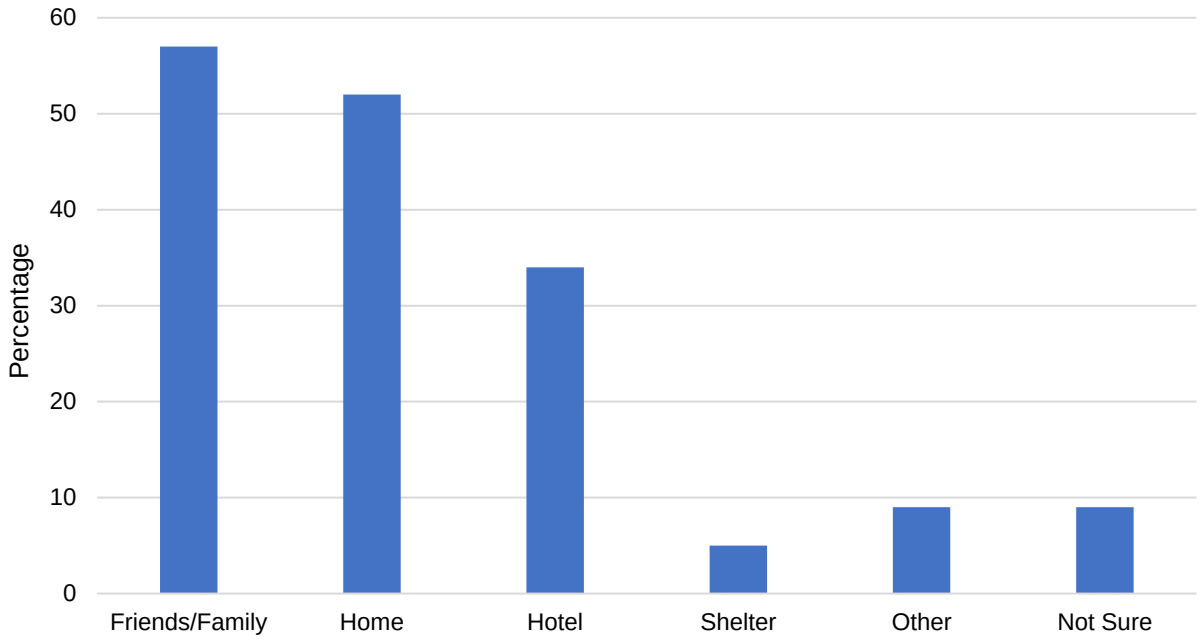
### USF Statewide COVID-19 and Evacuation Survey

The University of South Florida[2] conducted statewide surveys in 2020 and 2021 regarding COVID-19 and relationships to hurricane evacuation and sheltering. Results from the 2021 survey is summarized here, based on responses they received from 234 participants for Hillsborough County (out of the original ~1000).

[2] Collins, J., Polen, A., McSweeney, K., Colón-Burgos, D., & Jernigan, I. (2021). Hurricane Risk Perceptions and Evacuation Decision-Making in the Age of COVID-19, *Bulletin of the American Meteorological Society*, *102*(4), E836-E848. Retrieved Nov 24, 2021.

When asked where they saw themselves in case of a severe hurricane with strong winds or flooding, 5 percent indicated they would evaluate to a shelter, 34 percent would evacuate to a hotel, 57 percent would go to a friend's or family member's house, 52 percent said they would stay at home. Nine percent said "other," and 8.5 percent did not know. Respondents were allowed to select multiple options.

### Figure 9 Evacuation/Shelter Location for Severe Hurricane with Strong Winds




Many respondents, 29 percent taking the survey did not know if they live in an evacuation zone, while 18 percent knew they did not. Of the remaining, 24 percent, 10 percent, 7 percent, 5 percent, 7 percent of respondents live in zones, A, B, C, D, and E respectively. Over three-fourths (76 percent) are homeowners.

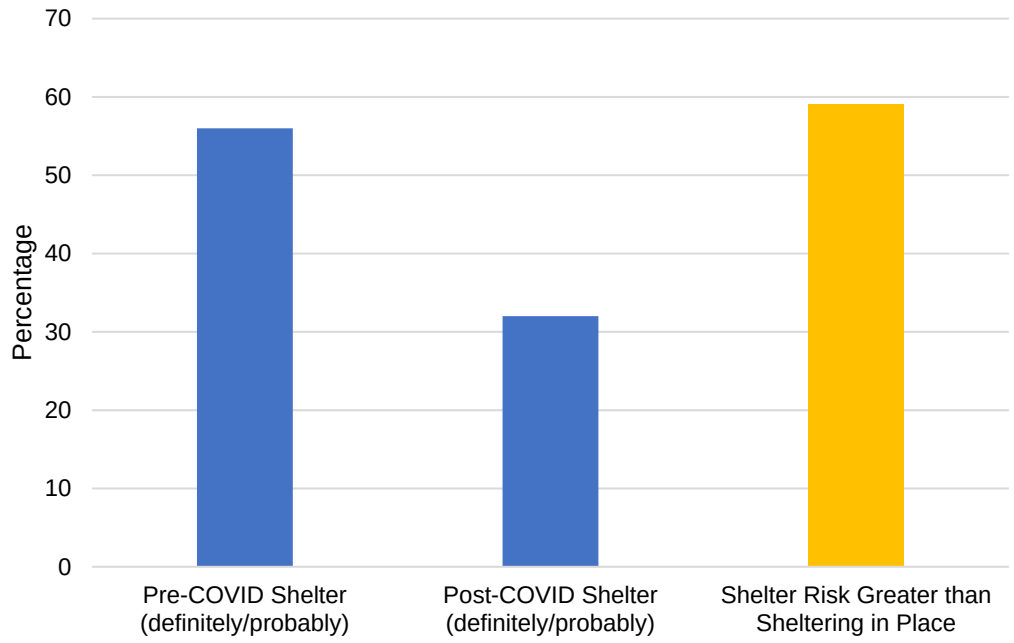
When it comes to pet ownership, 55 percent say they have a pet, and it affects their evacuation decisions. 26 percent do not have a pet, and 18 percent have a pet, and it does not affect evacuation decisions.

Given their present situation, 66 percent said they think they could evacuate if a hurricane were to impact their area, with 26 percent more indicating maybe. Those indicating they could not or do not know consist of 7 percent and 1 percent, respectively. The most frequent answers for those that could not evacuate were traffic, pets, and a secure home. Nearly 99 percent indicated they would have reliable transportation to evacuate to a shelter or elsewhere.

COVID-19 has affected people's decisions regarding sheltering. Respondents indicated that before the pandemic 56 percent definitely or probably go to a shelter during an evacuation order. In the current situation, only 32 percent stated they would definitely or probably go to a shelter. Similarly, 59 percent indicated the risks of going to a shelter would be worse than sheltering in place.

Per 2021 survey, COVID-19 has affected people's evacuations decisions, indicating risks in a shelter worse than staying in place.

**Figure 10 Survey Results on Effects of COVID on Sheltering**



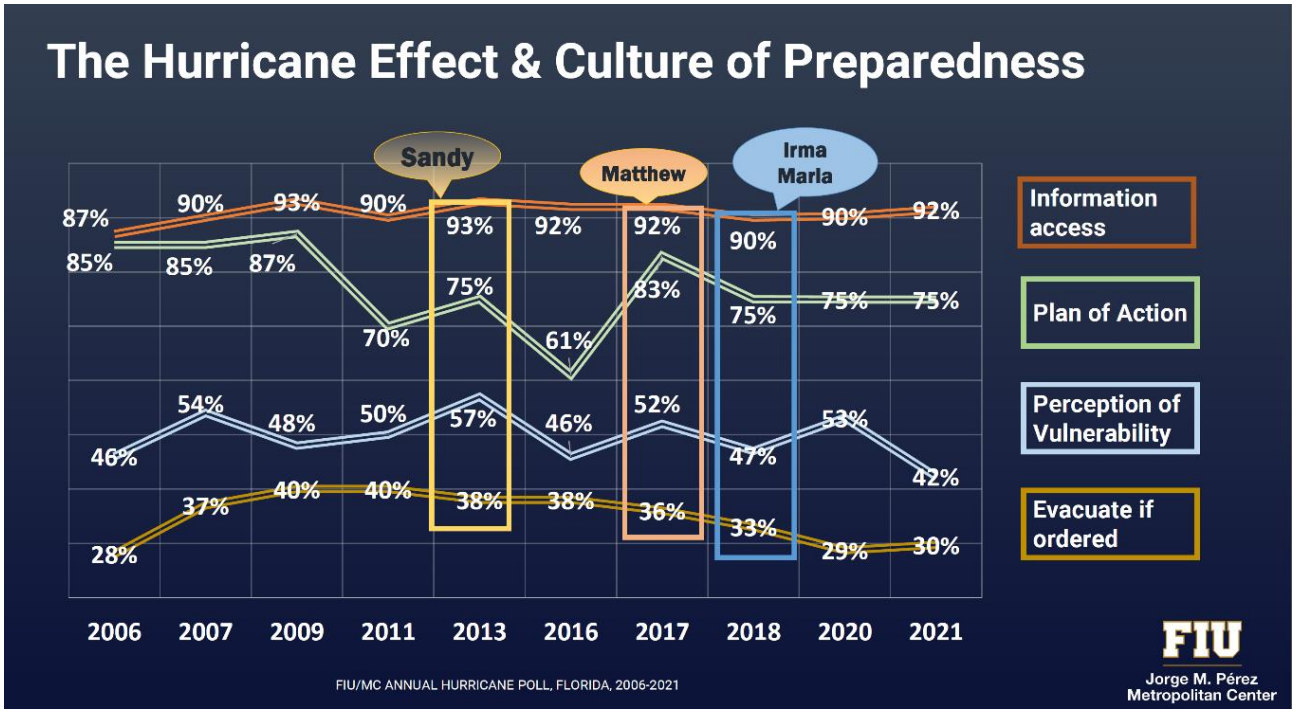

Nearly 80 percent of respondents stated they were very or somewhat likely to evacuate for the next hurricane expected to have a major impact on their area. Items offered as ways that would help with the decision included better forecasting, more advanced notice, COVID precautions, evacuation infrastructure improvements, more information on shelters and evacuating, pet support, and traffic control.

Just 2.5 percent of respondents indicated they felt they need access to a special needs shelter; however, 20 percent reported they or someone in their household applied to determine eligibility for a special needs shelter/ accommodations. On another questions 14.4 percent responded that someone in their household has a disability.

### FIU Metropolitan Center Annual Hurricane Poll

The Metropolitan Center at Florida International University (FIU) has conducted periodic statewide surveys since 2006 to gauge Floridians' preparedness and response to potential hurricanes. As shown in Figure 11, they track the results in four broad areas: access to information, having a plan of action, perception of vulnerability, and willingness to evacuate if ordered. Contrary to the study open house polling and survey, approximately 90 to 93 percent of poll respondents stated they have access to information about hurricanes. Respondents' perception of their vulnerability to an event and having a plan of action tends to go up and down around 70 percent and 45 percent, respectively, depending on whether there was a significant hurricane in the previous year. In 2021, 75 percent indicating having a plan of action and only 42 percent perceiving being vulnerable to a hurricane. The perception is the lowest percentage since the survey has been performed. Of particular concern, is that only 30 percent of respondents would evacuate if ordered. This compares with the Statewide Regional Evacuation Study for Tampa Bay (Figure 3), where over 12 percent and 35 percent of people outside all evacuation zones for category 1 and 5 hurricanes respectively, would evacuate.

**Figure 11 FIU/MC Annual Hurricane Poll Results 2006-2021**




### *2.2.2 Strategy Acceptance Survey*

After evacuation and sheltering issues were identified, the study team identified strategies addressing the issues to improve evacuations. The issues are described and assessed in Chapter 3.0. An on-line survey was performed toward the end of the study to evaluate the public's potential reactions or response to proposed strategies. Table 1 shows questions and responses from this survey.

For each question, survey participants were given an opportunity to elaborate about their choices. Some of the key themes raised were:

- Avoid Major Road Widening – Many respondents stated it is important to look to cost-effective, faster solutions before widening roads. Some indicated road widening may be necessary, especially to accommodate future population growth. About two-thirds of respondents agreed with this approach.

- Interchange/Intersection Modifications – Many in support of this strategy felt it would be beneficial daily, not only during storms. Others noted that such solutions may not be feasible, could impact neighborhoods of safety, and recommended that costs be small. About two-thirds of respondents agreed with this strategy.

- Traffic Signal Changes – This suggestion had wide appeal among respondents, and several indicated they had experienced benefits in past storms elsewhere. One commenter mentioned coordination throughout the evacuation corridor to avoid congestion at the next county, and another noted that cross streets may need to be considered for local needs, such as access to a hospital. Of the respondents, 86 percent agreed with this strategy.

- Emergency Shoulder Use – This suggestion also was generally liked, and respondents commented that the shoulder should be safe and free of debris for this solution. A few raised concerns about emergency vehicle access and lack of shoulders at narrow bridges or interchanges that could lead to congestion. Of the respondents, 61 percent agreed with this strategy.

- Travel Information – Providing additional ways to convey information resonated with a majority (68 percent) of respondents. Some noted that technology/smartphone applications are preferred, and others were concerned about the use of temporary signage requiring staff for deployment and causing potential problems due to high winds.

- Evacuation Phasing – A large percentage (84 percent) of respondents were receptive to phasing evacuations, frequently noting that congestion makes it difficult for all to evacuate at the same time. Phasing by evacuation zone was mentioned as an option. Several respondents noted that in an emergency people may be frantic and follow their own plans, possibly contrary to emergency orders or recommendations.

### Table 1 Final Survey Strategy Reponses

| Strategy | Yes | No | Maybe |
|---|---|---|---|
| This study is looking at solutions that do not require expensive major road widenings. Do you agree with making such changes to improve travel during a storm evacuation? | 68% | 11% | 18% |
| Enhancements that modify a freeway interchange or add a turn lane at intersections could reduce congestion or delays. Do you agree with making such changes to improve travel during a storm evacuation? | 68% | 11% | 19% |
| Changing traffic signals to allow more traffic to evacuate away from the storm or coast could improve travel during an emergency. Would you like to see this solution used during a storm evacuation? | 86% | 5% | 14% |
| During evacuations, would you use the shoulder of the interstate to evacuate if it's allowed, such as on I-75 or I-4? | 61% | 13% | 24% |
| Having accurate travel information during a hurricane is important. One solution being considered is adding more signs on roads and freeways to provide real time information on travel times to destinations, road closures or crashes, etc. These signs could be permanent or temporary, such as signs used during construction. Do you agree such changes to improve travel during a storm evacuation would be helpful? | 68% | 11% | 26% |
| Hillsborough County is one of the fastest growing areas of Florida, which gains 700 new residents a day. One solution under consideration is the phasing of evacuations so that some people would be asked to evacuate sooner than others. For example, visitors staying at hotels could be asked to evacuate early. Would you be in favor of phasing emergency evacuations? | 84% | 3% | 11% |

One survey respondent indicated the survey did not touch on their evacuation and sheltering needs or topics of concern. They have medical needs, rely on a support animal, and use public transportation. Finding transportation for evacuation, especially with an animal is difficult.

Part of the strategy survey asked people about whether they had experienced congestion during an evacuation at any of the 20 hotspot locations (ten interstate and ten arterial). The survey also asked if they perceived or expected there to be congestion at these locations. Information about these survey results is provided in Chapter 3.0.

## 2.3 Key Takeaways

In looking higher level at the information from the various input methods, there are several key items of note:

- Uncertainty about a storm's projected travel pattern and intensity impacts decision as to whether or when to evacuate. Having more information, and more accurate information, would be helpful.

- Traffic congestion is a main concern identified as impacting decisions to evacuate. This can be from news reports, yet everyday traffic conditions were frequently mentioned as a need.

- Being with family or friends, including pets, is very important, along with security and privacy, to encourage compliance to evacuation orders. Pet friendly and special needs shelters are available and providing transportation access to them should be evaluated.

- Cost was not often raised as a problem; however, access to transportation, particularly to get to shelters was mentioned. It is appropriate to consider expanding the focus on or resources for people and communities that experience these challenges. Hurricane evacuation and sheltering is a matter of life safety.

- Return and recovery after an event is important for transportation infrastructure and services so that people can return home and clean up or repair their homes and businesses.

- The public appears receptive to the suggested approaches to address evacuations. Traffic signal timing changes and evacuation phasing received the largest percentages of support.

- The locations identified as congested "hotspots" during evacuations were confirmed as being congested, or expected/perceived to be, by survey participants.

Uncertainty biggest influence

Traffic congestion (experienced or perceived) a major concern

Access to transportation should not be overlooked

Public receptive to strategies evaluated

A major focus of this study was on identifying actionable items the Hillsborough TPO can take to improve evacuation and sheltering during hurricane events. For example, the TPO cannot provide more accurate storm forecasts, yet there may be ways to assist in informing people to prepare for or stay alert to potential storm conditions.

# 3.0 Issues Identified and Assessed

The issues or topics identified for further evaluation are discussed in this section, along with strategies to address these issues and the benefits or challenges of each. The items chosen are based on the input received, as described in the Chapter 2.0. When assessing the strategies, the study team looked to state or national research for qualitative and quantitative outcomes. For three strategies, the study team used evacuation modeling.

The Florida statewide hurricane evacuation model, TIME (Transportation Interface for Modeling Evacuations), was run with various inputs for sensitivity analysis. Evacuation models like TIME are specialized travel demand models which include considerations unique to evacuations. Response and demand factors make up the main inputs of the TIME model. Clearance times are part of the final output. The study team identified an input factor to assess three of the issues identified below and ran the TIME model to determine the effectiveness of various approaches.

Clearance times are used as a measure for how long an evacuation can be expected to be.

They are used to initiate evacuation orders and ensure evacuees have enough time to reach destinations before storm arrival.

Clearance times are used as a measure for how long an evacuation can be expected to take place once it has begun. Clearance times are used by emergency management staff to determine a window of opportunity available to initiate evacuation orders, and to ensure evacuees have enough time to reach evacuation destinations safely before storm arrival.

The Baseline scenario for the TIME model used the operational scenario[3] with default 2025 socioeconomic data and model network, all default inputs for shelters, seasonality, emergency should use/contraflow operations (off), and with a 12-hour response curve. The model was run for a Category 3 hurricane evacuation assumption. The baseline inputs for the regional model run and results are identified in Table 2.

### Table 2 Baseline Regional TIME Model Inputs and Results

| Inputs and Outputs | Baseline |
|---|---|
| Network and population period | 2025 |
| University population | 100% residence |
| Shelter Status | All open |
| Emergency Shoulder Use | No |
| Response Curve | 12-hr |
| Hurricane Category | 3 |

It is important to remember that the TPO only has influence over certain factors relevant to evacuation and sheltering. .

[3] Mandated and operational scenarios are part of the Statewide Regional Evacuation Study. The regional planning councils define the operational components for their region. The mandated scenarios require the same assumptions for all regions of the state.

Table 3 lists some of those factors over which the TPO has influence and those they do not.

**Table 3 Evacuation and Sheltering Factors Over Which the TPO Has Influence**

| TPO has influence… (direct or indirect) | TPO does *not* have influence… |
|---|---|
| Congestion during evacuations | Event related communications |
| Transportation operations | Behaviors affecting evacuation and sheltering |
| Transit operations | |

## 3.1 Congestion During Evacuations

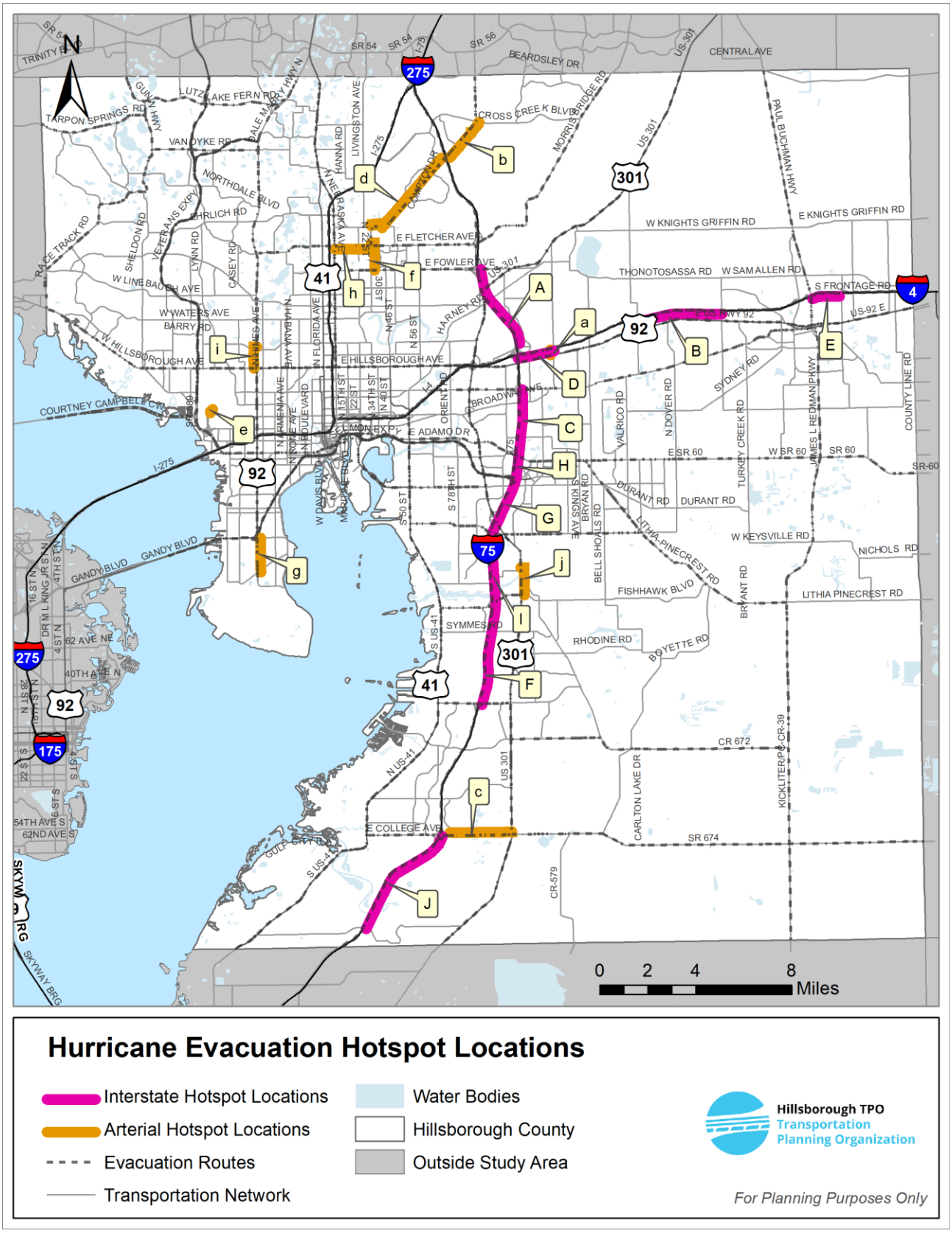
There were multiple suggestions to evaluate congested areas during evacuations and identifying the major bottlenecks was a key element of this study. As such, areas that experienced unusually high congestion during evacuation for Hurricane Irma and those areas the Hillsborough TPO has identified as congested during normal (non-evacuation) peak travel times were assessed.

The public and partners also offered areas where they have experienced congestion. These suggestions were mainly roadway segments. The study team also evaluated locations along evacuation routes or that provide access to shelters as part of identifying the most critical evacuation bottlenecks.

It is important to note that traffic from other counties evacuating through Hillsborough County is contributing to hotspot roadway locations. This is especially true for interstate hotspot locations – with traffic from Pinellas County evacuating through Hillsborough County to the east on I-4 and northbound on I-275, and traffic from southeast and southwest Florida evacuating north on I-75. However, this influx of traffic could also be impacting arterials near interstate exits on the hotspot list, such as Bruce B. Downs Blvd and Sun City Center Blvd, as evacuees exit the interstate in congested areas for food and fuel and to switch to parallel facilities. In addition to evacuees contributing to congested commercial areas, residents staying in place will be obtaining supplies and food/water.

The study team narrowed the analysis to the top 10 “hotspot” locations on the arterial/city roads and top 10 interstate/freeway hotspot locations. Not all of the hotspot locations corresponded with current evacuation routes, but most did. Figure 12 shows those hotspot locations and they are listed in Table 44 and Table 55.

## Figure 12 Hurricane Evacuation Hotspot Locations



### Table 4 Arterial Hurricane Evacuation Hotspot Locations

| Location ID | Road | Between | And | Direction | Distance (miles) |
|---|---|---|---|---|---|
| **a** | Mango Rd | I-4 Ramps | Hillsborough Ave | SB | 0.2 |
| **b** | Bruce B. Downs Blvd | I-75 Ramps | New Tampa Rd | NB | 1.9 |
| **c** | Sun City Center Blvd | I-75 Ramps | US 301 | WB | 2.7 |
| **d** | Bruce B Downs | Bearss Ave | I-75 Ramps | SB | 4.3 |
| **e** | George J Bean Pkwy | Airport Service Rd | Airport Recirculation Dr | NB | 0.3 |
| **f** | Bruce B. Downs Blvd | Fletcher Ave | Fowler Ave | NB | 1.0 |
| **g** | Fletcher Ave | Nebraska Ave | Bruce B. Downs Blvd | EB | 1.5 |
| **h** | Dale Mabry Hwy | Gandy Blvd | Interbay Blvd | NB | 1.5 |
| **i** | Dale Mabry Hwy | Sligh Ave | Hillsborough Ave | SB | 0.8 |
| **j** | US 301 | Riverview Dr | Boyette Rd | NB | 1.0 |

### Table 5 Interstate Hurricane Evacuation Hotspot Locations

| Location ID | Road | Between | And | Direction | Distance (miles) |
|---|---|---|---|---|---|
| **A** | I-75 | Fowler Ave | I-4 | NB | 3.6 |
| **B** | I-4 | McIntosh Rd | Branch Forbes Rd | EB | 3.6 |
| **C** | I-75 | Dr MLK Jr Blvd | Brandon Blvd | NB | 2.8 |
| **D** | I-4 | I-75 | Mango Rd | EB | 1.5 |
| **E** | I-4 | Paul Buchman Hwy | Park Rd | EB | 1.2 |
| **F** | I-75 | Gibsonton Dr | Big Bend Rd | NB | 4.2 |
| **G** | I-75 | Selmon Expy | US 301 | NB | 1.9 |
| **H** | I-75 | Brandon Blvd | Selmon Expy | NB | 1.0 |
| **I** | I-75 | US 301 | Gibsonton Dr | NB | 3.6 |
| **J** | I-75 | Sun City Center Blvd | Valroy Blvd | NB | 5.1 |

In the strategy acceptance survey, respondents were asked about their experiences and perceptions of these hotspot locations related to potential evacuation congestion issues. “Which of these areas have you experienced congestion during a past evacuation? Which of these areas would you expect or perceive to be congested during an evacuation?” Table 6 shows the responses for both questions for each hotspot location.

The survey had responses were from 43 people and the table shows over half of the respondents had experienced or perceived there to be congestion on the Interstate hotspots. If people evacuating anticipate congested interstates, they may not evacuate although they should. They may also use local and arterial roads to evacuate. While not as pronounced, the arterial hotspot locations also are recognized as areas where congestion may occur.

## Table 6 Final Survey Hotspot Experience/Perceptions Responses

| Hotspot Location | Experienced Evacuation Congestion | Perceive/Expect Evacuation Congestion |
|---|---|---|
| A: I-75 (Fowler Ave to I-4) | 8 | 24 |
| B: I-4 (McIntosh Rd to Branch Forbes Rd) | 7 | 21 |
| C: I-75 (Dr MLK Jr Blvd to Brandon Blvd) | 9 | 22 |
| D: I-4 (I-75 to Mango Rd) | 7 | 16 |
| E: I-4 (Paul Buchman Hwy to Park Rd) | 5 | 16 |
| F: I-75 (Gibsonton Dr to Big Bend Rd) | 7 | 16 |
| G: I-75 (Selmon Expy to US 301) | 8 | 20 |
| H: I-75 (Brandon Blvd to Selmon Expy) | 8 | 18 |
| I: I-75 (US 301 to Gibsonton Dr) | 8 | 16 |
| J: I-75 (Sun City Center Blvd to Valroy Blvd) | 5 | 15 |
| a: Mango Rd (I-4 Ramps to Hillsborough Ave) | 4 | 18 |
| b: Bruce B. Downs Blvd (I-75 Ramps to New Tampa Rd) | 6 | 17 |
| c: Sun City Center Blvd (I-75 Ramps to US 301) | 5 | 9 |
| d: Bruce B Downs (Bearss Ave to I-75 Ramps) | 6 | 15 |
| e: George J Bean Pkwy (Airport Service Rd to Airport Recirculation Dr) | 2 | 7 |
| f: Bruce B. Downs Blvd (Fletcher Ave to Fowler Ave) | 4 | 17 |
| g: Fletcher Ave (Nebraska Ave to Bruce B. Downs Blvd) | 7 | 17 |
| h: Dale Mabry Hwy (Gandy Blvd to Interbay Blvd) | 6 | 16 |
| i: Dale Mabry Hwy (Sligh Ave to Hillsborough Ave) | 6 | 17 |
| j: US 301 (Riverview Dr to Boyette Rd) | 6 | 12 |

Note: uppercase IDs are freeway/interstate roads, lowercase IDs are arterial roads.

The Hillsborough TPO Long Range Transportation Plan (LRTP) outlines Cost Feasible roadway improvements for the next 25 years. Those projects expected to be funded and begun in the next five years are outlined in the Transportation Improvement Program (TIP). Table 7 shows the status of any LRTP and TIP planned projects for the hotspot locations.

## Table 7 Hotspot Locations LRTP Cost Feasible and TIP Programmed Improvements

| Hotspot Location | LRTP Cost Feasible Projects | Project in TIP |
|---|---|---|
| A: I-75 (Fowler Ave to I-4) | Add 4 express lanes | |
| B: I-4 (McIntosh Rd to Branch Forbes Rd) | Add 4 express lanes | |
| C: I-75 (Dr MLK Jr Blvd to Brandon Blvd) | Add 4 express lanes | |
| D: I-4 (I-75 to Mango Rd) | Add 4 express lanes | |
| E: I-4 (Paul Buchman Hwy to Park Rd) | Add 4 express lanes | |
| F: I-75 (Gibsonton Dr to Big Bend Rd) | Add 4 express lanes | |
| G: I-75 (Selmon Expy to US 301) | Add 4 express lanes | |
| H: I-75 (Brandon Blvd to Selmon Expy) | Add 4 express lanes | |
| I: I-75 (US 301 to Gibsonton Dr) | Add 4 express lanes | |
| J: I-75 (Sun City Center Blvd to Valroy Blvd) | Add 4 express lanes | |

| Hotspot Location | LRTP Cost Feasible Projects | Project in TIP |
|---|---|---|
| a: Mango Rd (I-4 Ramps to Hillsborough Ave) | Interchange improvement | X |
| b: Bruce B. Downs Blvd (I-75 Ramps to New Tampa Rd) | None | |
| c: Sun City Center Blvd (I-75 Ramps to US 301) | None | |
| d: Bruce B Downs (Bearss Ave to I-75 Ramps) | New Adjacent Facility | X |
| e: George J Bean Pkwy (Airport Service Rd to Airport Recirculation Dr) | None | |
| f: Bruce B. Downs Blvd (Fletcher Ave to Fowler Ave) | None | |
| g: Fletcher Ave (Nebraska Ave to Bruce B. Downs Blvd) | None | |
| h: Dale Mabry Hwy (Gandy Blvd to Interbay Blvd) | None | |
| i: Dale Mabry Hwy (Sligh Ave to Hillsborough Ave) | None | |
| j: US 301 (Riverview Dr to Boyette Rd) | None | |

To assess arterial congestion during evacuations, the study team used the TIME model with an assumed model network of increased capacity at the bottleneck locations. The main goal of this exercise was to evaluate how increasing physical capacity through lane additions at distressed locations would impact the evacuation clearance time on a broad scale. One lane in each direction was added in the model network for all arterial hotspot identified roadways. These generally are short segments, and the lane additions were meant to capture small capital investments to improve intersections or interchange ramps.

Small strategic investments do not improve clearance times

May improve local access to supplies and goods

The arterial hotspots TIME model assessment used a baseline of only Hillsborough County evacuating to test with a higher level of sensitivity. The TIME model with arterial hotspot additional capacity did not reduce the regional clearance time from 14.0 hours. The results are shown in Table 8. This assessment shows that adding strategic capacity at distressed locations on its own does not provide a meaningful effect to systemwide clearance time.

### Table 8 TIME Model Assessment for Arterial Hotspot Congestion Sensitivity

| Inputs and Outputs | Baseline | Arterial Hotspots Additional Capacity |
|---|---|---|
| Network and population period | 2025 | 2025 |
| University population | 100% residence | 100% residence |
| Shelter Status | All open | All open |
| Emergency Shoulder Use | No | No |
| Response Curve | 12-hr | 12-hr |
| Hurricane Category | 3 | 3 |
| Clearance Time In County (hours) | 13.0 | 13.0 |
| Clearance Time Out of County (hours) | 13.0 | 13.0 |
| Clearance Time To Shelter (hours) | 12.5 | 12.5 |
| Regional Clearance Time (hours) | 14.0 | 14.0 |

## 3.2 Transportation Evacuation Operations

Transportation agencies are active during a major event, coordinating with emergency management staff and working to support efficient and safe travel for evacuation and response activities. Several operational items are part of this topic area. A few are highlighted below.

*Traffic Signal Coordination*

Traffic signal coordination is a mechanism to improve travel flow by adjusting signal timing to accommodate highly directional traffic movements. Additionally, specific signal timing may support extending a green light to allow people to clear an intersection or leave a neighborhood, for example. It is not uncommon for people experiencing congestion to mention difficulties in leaving their neighborhoods and accessing higher capacity routes during evacuation scenarios. Although traffic congestion during storm preparation and evacuation can be caused by many factors, directional traffic signal coordination on evacuation route and roadways feeding evacuation routes might reduce clearance times. Case studies have shown that adaptive coordinated traffic signalization can reduce travel time through a corridor by over 30 percent.[4] Developing a countywide evacuation signal timing plan might offer improvements to hotspot congestion. It would require additional investigations and modeling/simulation and multiple county coordination to address regional evacuation needs.

*Phased Evacuations*

For a category three hurricane, the projected clearance time for Hillsborough County is 24 hours. Evacuation clearance times will be difficult to maintain as Hillsborough County continues to grow in population and if larger numbers of people choose to evacuate instead of shelter-in-place. While not a transportation specific strategy, considering phased evacuations may improve overall clearance times. A phased evacuation frequently mandates that visitors, such as those in hotels, evacuate an area prior to the general public, typically about a day earlier. Another option might be to coordinate with MacDill Air Force Base, for example, to evacuate families and non-essential personnel early. This type of strategy requires information dissemination and communication strategies to address compliance.

*Interstate Contraflow*

Contraflow requires large numbers of personnel to implement safely

It reduces ability of FEMA and others to stage supplies and personnel for recovery

The interstate highways are major routes during evacuations. Florida is a long peninsular state, and evacuation is often northward using the key I-75 and I-95 corridors. For a northbound evacuation, contraflow operation of these interstates and Florida's Turnpike would convert southbound lanes to temporarily allow northbound travel. This approach requires significant emergency personnel (e.g., law enforcement) to close ramps and direct travel to maintain safety. Another disadvantage of contraflow is supplies and personnel to rapidly respond after a disaster often stage throughout Florida, and these goods and services are traveling in the opposite direction of evacuees. Contraflow takes personnel away from assisting with local communications and evacuations and prohibits staging by organizations such as the Federal Emergency Management Administration (FEMA), power suppliers, and building materials and

[4] Park, Byungkyu and Chen, Yin. University of Virginia Department of Civil and Environmental Engineering. Quantifying the Benefits of Coordinated Actuated Traffic Signal Systems: A Case Study. Virginia Department of Transportation.

food/water suppliers.[5] Emergency shoulder use (ESU) has been used for the past several years, whereby designated shoulder areas are opened as an additional travel, temporarily expanding travel capacity.

The Leroy Selmon Expressway, operated by the Tampa Hillsborough Expressway Authority (THEA), operates normally as a reversible direction facility. A specific evacuation scenario plan for emergency related fixed east bound travel on the Selmon Expressway could assist travel from evacuation zones. This would be particularly helpful due known congestion hotspots in the MacDill area (potentially demanding evacuation needs from MacDill Air Force Base[6]).

*Emergency Shoulder Use*

Each of the identified interstate hotspot locations are on facilities identified for Florida Department of Transportation's (FDOT) Emergency Shoulder Use (ESU) plan in 2021.[7] This plan is reviewed and updated each year. Shoulder debris removal is part of emergency preparedness.

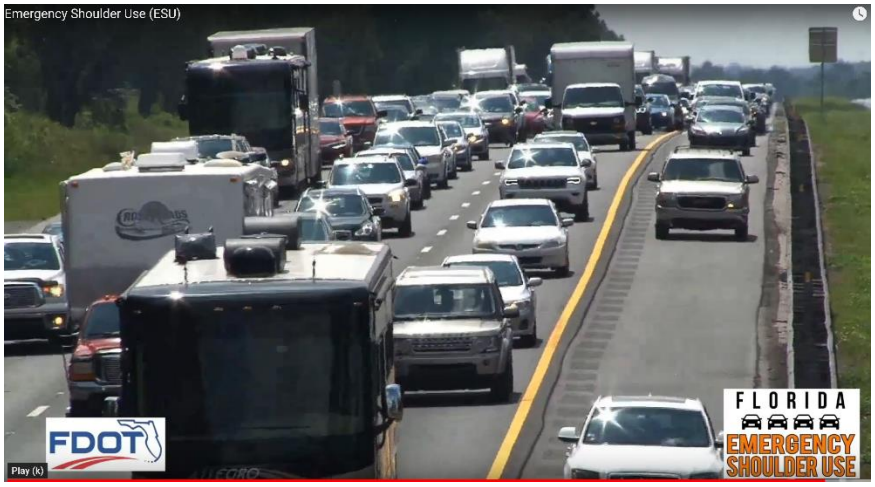
Emergency shoulder use is evaluated annually. In 2021, I-4 east bound and I-75 north bound were approved for ESU operation.

ESU modeling did not show improved clearance times, presumably due to a preference to evacuate via interstates. Local congestion could be improved.

To assess evacuation operations on interstate roads, the study team executed a TIME model run comparing a scenario with ESU activated in the region against a baseline scenario without ESU. According to Florida Department of Transportation, ESU plans are reviewed annually. For the 2021 season, plans covered the following roadway segments within the Tampa Bay region:

- Interstate 4, eastbound from US 41 in Tampa (Hillsborough) to SR 417 in Celebration (Osceola), and
- Northbound from SR 951 in Naples (Collier) to SR 143 in Jennings (Hamilton).

## Figure 13 Emergency Shoulder Use




[5] Planning Considerations: Evacuation and Shelter-in-Place, Guidance for State, Local, Tribal, and Territorial Partners. FEMA. July 2019.

[6] "From Hurricane Irma evacuation to Maria recovery – the 6th OSS." Airman 1st Class Adam R. Shanks. 6th Air Mobility Wing Public Affairs. October 10, 2017.

[7] https://www.fdot.gov/emergencymanagement/esu/default.shtm

The TIME results for interstate ESU operations were not significant; ESUs did not reduce the clearance times compared to the baseline condition. However, the additional capacity from ESU operation may provide relief from arterials and surface streets needed for sheltering preparation.

**Table 9 TIME Model Assessment for Interstate Congestion Sensitivity**

| Inputs and Outputs | Baseline | Emergency Shoulder Use |
|---|---|---|
| Network and population period | 2025 | 2025 |
| University population | 100% residence | 100% residence |
| Shelter Status | All open | All open |
| Emergency Shoulder Use | No | Yes |
| Response Curve | 12-hr | 12-hr |
| Hurricane Category | 3 | 3 |
| Clearance Time In County (hours) | 21.0 | 21.0 |
| Clearance Time Out of County (hours) | 21.0 | 21.0 |
| Clearance Time To Shelter (hours) | 20.0 | 20.0 |
| Regional Clearance Time (hours) | 21.0 | 21.0 |

## 3.3 Transit Operations

To successfully evacuate coastal areas requires access to transportation – transportation to leave the area, or transportation to temporarily relocate to a shelter or inland family and friends. For people with no or limited access to vehicles, transit service to shelters or interregional public transportation services, such as Greyhound or Amtrak, is critical.

For those without access to a personal vehicle, transit and paratransit are important for evacuation during a hurricane

HART fully recognizes this situation and has identified nine evacuation routes used to support transport from coastal areas to one of four emergency shelters. The Hillsborough School District has helped when feasible to supplement evacuation services. Operations occur during daylight hours for as long as is deemed safe by emergency personnel for buses to be on the road.

Periodic evaluation of these routes is important based on changes or increases in affected population. Daily transit riders also may need to use the service for evacuation, and maintaining routes that are well-known, instead of converting to a different operation schedule, should be considered to provide smoother evacuation. Identification of potential operational concerns, such as driver shortages, also is important. Similarly, information and communication about transportation options or the need to pre-register for services is important. Supporting development of stop/station materials or in-vehicle messages prior to a hurricane (or hurricane season) is one concept that could be considered.

## 3.4 Event Related Communications

Several open house and survey participants indicated a need for more information about evacuation and sheltering, immediately prior and during an evacuation. Storm unpredictability is likely a factor and emergency management personnel, not TPO staff, are responsible for communications. This topic area is geared toward identifying ways the TPO or transportation agencies can assist with communications during a

potential or actual emergency. The TPO has a different set of stakeholders that it can inform through its social media presence. It also might be able to take on informational campaigns during hurricane season about evacuation for those needing transportation assistance or ways to find fuel or services during an evacuation or afterward. Communications during recovery, such as about debris clean up schedules and road openings or check points, may be another consideration depending on the recommendations and considerations by emergency and operations agencies.

While the TPO will rely on emergency management staff to craft messages, it could work with local and regional partners to provide additional equipment to display information, such as digital message signs on the interstate or at key locations on arterials. These signs could be used to communicate road closures, shelter locations, detours, or channels for obtaining information, such as referring travelers to 511. If requested by emergency management personnel, these signs could be used to notify travelers of a potential storm, or mandated evacuations. As an operational procedure, allocating and dispersing portable message signs (able to withstand hurricane winds) could provide benefit in tandem with prepared plans for portable sign messages. A portable and stationary dynamic messaging plan, in coordination with and support from all Emergency Management stakeholders, could help improve evacuation clearance, by improving response curves and reducing shadow evacuation (those who evacuate despite not being at threat of storm surge) and increasing sheltering-in-place.

To assess event related communication affects, the study team executed a TIME model run with response curve inputs set shorter than a default level in a baseline scenario. This response curve input was only changed for Hillsborough County, with surrounding counties unaffected. This scenario essentially assumes that enhanced communication has resulted in people in Hillsborough County reacting more quickly and evacuating sooner, namely that people were informed early and reacted expeditiously.

Table 10 displays the inputs used for this model run, along with clearance time results. This scenario assumed response curves of six hours, down from the baseline 12-hour curves. Of the various scenarios tested, the improved communication scenario provided the largest identifiable benefit, reducing the regional clearance time from 21.0 to 20.5 hours and reducing the clearance time to shelters from 20.0 to 16.0 hours.

If people react expeditiously to evacuation orders, clearance times can be improved

### Table 10 TIME Model Assessment for Improved Communication

| Inputs and Outputs | Baseline | Improved Response Curves |
|---|---|---|
| Network and population period | 2025 | 2025 |
| University population | 100% residence | 100% residence |
| Shelter Status | All open | All open |
| Emergency Shoulder Use | No | No |
| Response Curve | 12-hr | 6-hr |
| Hurricane Category | 3 | 3 |
| **Clearance Time In County (hours)** | 21.0 | 20.5 |
| **Clearance Time Out of County (hours)** | 21.0 | 20.5 |
| **Clearance Time To Shelter (hours)** | 20.0 | 16.0 |
| **Regional Clearance Time (hours)** | 21.0 | 20.5 |

As mentioned above, communication equipment deployment could be assisted by a prepared plan for dynamic and/or portable message sign disbursement and messaging. Research has indicated that evacuation notice level (Mandatory, voluntary, advisory, or recommended) and location-based messaging can affect the level of appropriate response during evacuations.[8] Hurricane Rita is known as a case study in poor system communication which resulted in fatal evacuation efforts. A paper on this topic indicates that in September 2005, as an estimated 2.5 – 3.7 million people evacuated the Texas coastline, when a significant heat wave also affected the region. The combination of severe gridlock and excessive heat led to between 90 and 118 deaths even before the storm arrived (with only seven directly caused deaths from Hurricane Rita in Texas). 47 percent of those in the areas who did not reside in an evacuation zone reported evacuating.[9]

FEMA publishes recommendations on improving public messaging for evacuation and shelter in place.[10] Among their recommendations are:

- Understand potential impediments to action and take steps to address these barriers in advance.
- Make evacuation decisions easier by only issuing mandatory evacuations.
- Provide residents and tourists with multiple ways of knowing if they are in a zone under an evacuation order.
- Use multiple, authoritative messaging channels that include photos or links to other visual information about the hazard and encourage individuals to share this information with friends and families.
- Provide frequent updates with information that can reduce the stress of the unknown related to evacuation.

This scenario also offers some suggestions for phased evacuation mentioned previously. Spreading out evacuation, by having people react sooner, helps improve overall evacuation rates. However, asking people to evacuate is a burden on households, and emergency management staff use caution with these types of decisions.

## 3.5 Behaviors Affecting Evacuation and Sheltering

As part of Florida's Statewide Regional Evacuation Study Program (SRESP) conducted in used location-based services (LBS) data to infer actual behavior for the hurricane seasons from 2016 to 2020. The focus of this analysis was on the three hurricanes that struck Florida during this period: Matthew (2016), Irma (2017), and Michael (2018). Because the 2021 statewide regional study relied on phone application data, it provides a detailed picture of person travel during the three hurricanes. Information about who evacuates, where they

[8] Improving Coastal Storm Evacuation Messages. Cuite, Cara L, et al. Weather, Climate, and Society, Vol. 9, Iss. 2. April 1, 2017.

[9] Weisgerber, C. & Butler, S. (2006, April). "Should we stay or should we go? Leadership communication in the face of a potentially catastrophic hurricane." Paper presented to the Crisis Communication Division of the Southern States Communication Association, Dallas, TX

[10] FEMA. Improving Public Messaging for Evacuation and Shelter-in-Place: Findings and Recommendations for Emergency Managers from Peer-Reviewed Research. April 2021.

evacuate to, and whether they stay in-county are below. The information below provides a snapshot of data and additional information is provided in the Statewide Regional Study.

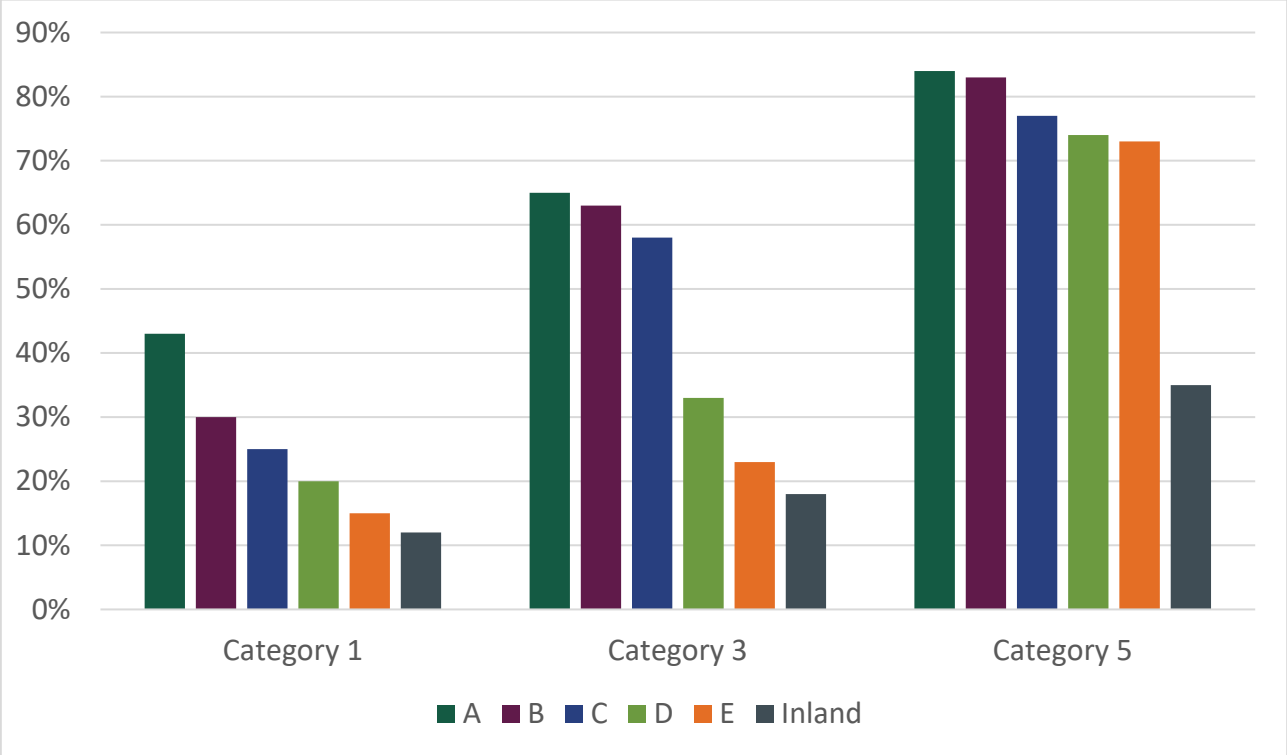
For site-built homes, depending on evacuation level…

55% (Level A) to 25% (Level E) asked to evacuate will not

10% (Level A) to 35% (Level E) outside evacuation zones will evacuate

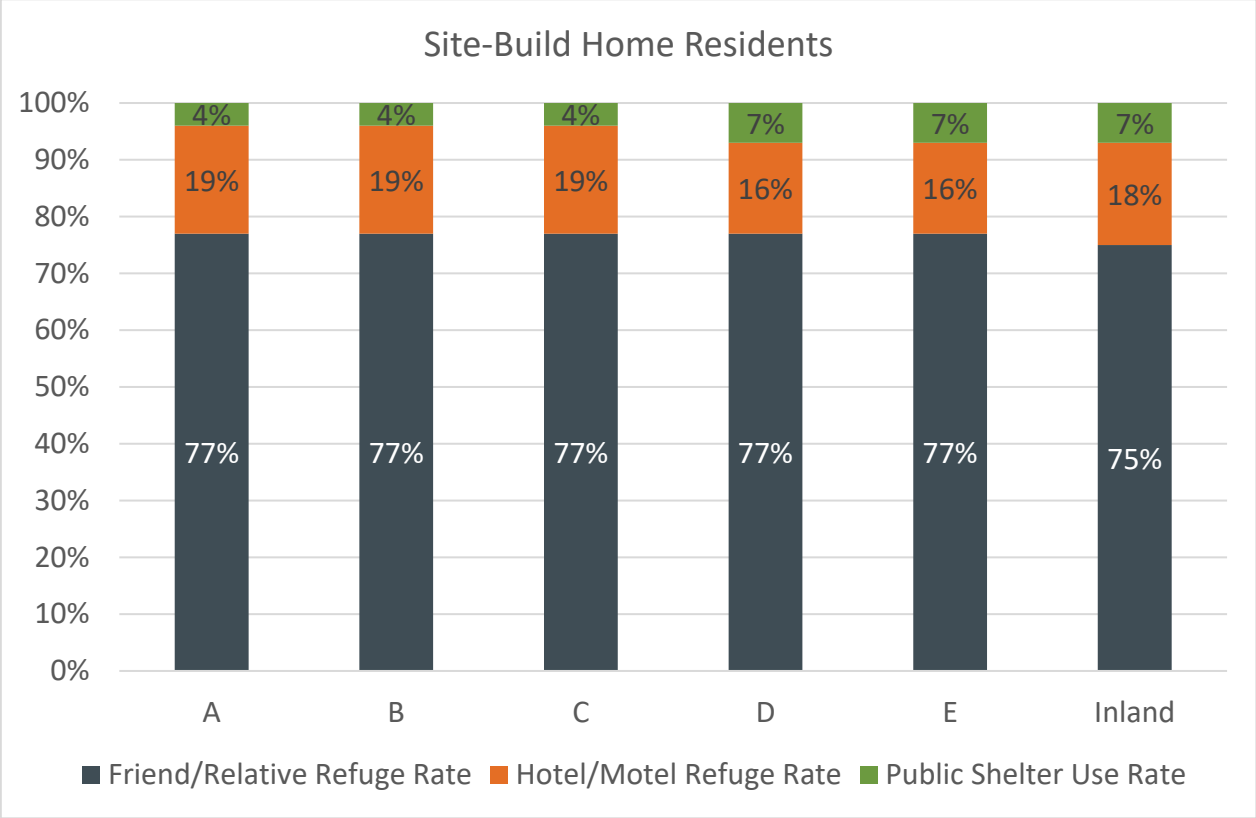
As reflected in Figure 14, the 2021 behavioral information shows those living closer to coastal areas evacuate at higher rates. However, 15 percent to 25 percent of people in evacuation zones will not evacuate for a Category 5 storm, which could place them in harm's way due to storm surge. Meanwhile over 10 percent of people outside evacuation zones (labeled inland for this study) will leave for a Category 1 storm, affecting evacuation clearance times. This information is for homes built on-site; people living in mobile homes or recreational vehicles are asked to evacuate for all categories of zones, i.e., they are to evacuate as part of Zone A.

**Figure 14 Evacuation Rates by Evacuation Zone by Hurricane Category (Site-Built Homes)**

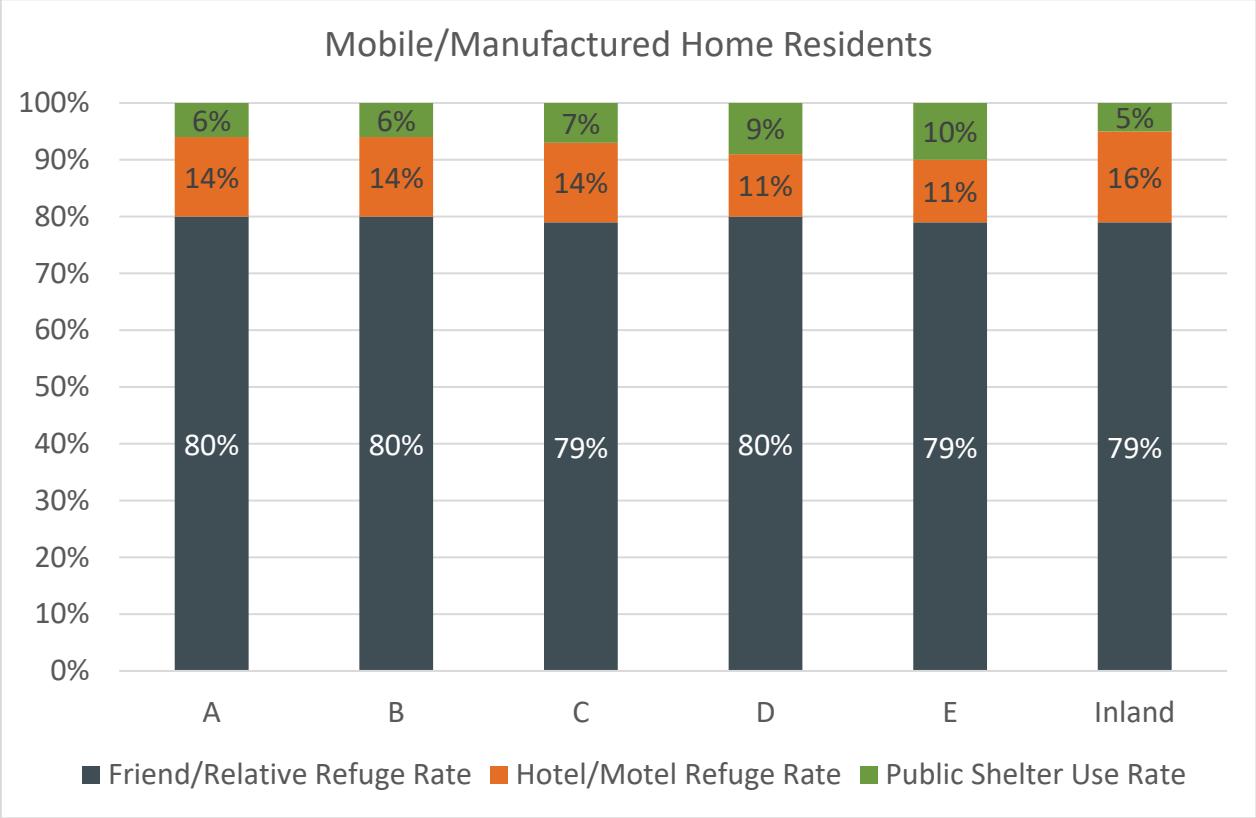



For Category 1 storms of those people evacuating, the SRESP noted a large share of people evacuating to stay with friends or family – approximately 80 percent of people living in mobile homes and 75 percent of people living in site-built homes. The next largest share would stay in hotels/motels. Less than 10 percent of people would evacuate to shelters. Figures 15 and 16 show this information.

**Figure 15 Evacuation Locations (Site-Built Homes)**



## Figure 16 Evacuation Locations (Non-Site-Built Homes)




Of the people evacuating, some will leave Hillsborough County. They could be traveling to second homes, staying with family and friends who live outside the County, or staying in motels/hotels, for example. People living in mobile homes/RVs in any of the evacuation zones A-E are expected to have the same percentages of people leaving the county regardless of hurricane strength. This is 40-45 percent. People inland will evacuate a slightly higher rates depending on hurricane category, at a 40-47 percent rate. People not living in mobile homes/RVs in evacuation zones B – E will leave the county at a rate between 47 and 50 percent, will people in zone A will leave the county at slightly higher rates – 50-52 percent. Half the people living outside an evacuation zone (i.e., inland) that evacuate will leave the county.

Less than one in ten people will stay at a shelter during an evacuation

Approximately four or five out ten people evacuating will leave Hillsborough County

**Figure 17 People Evacuating that Leave Hillsborough County (Site-Built Homes)**

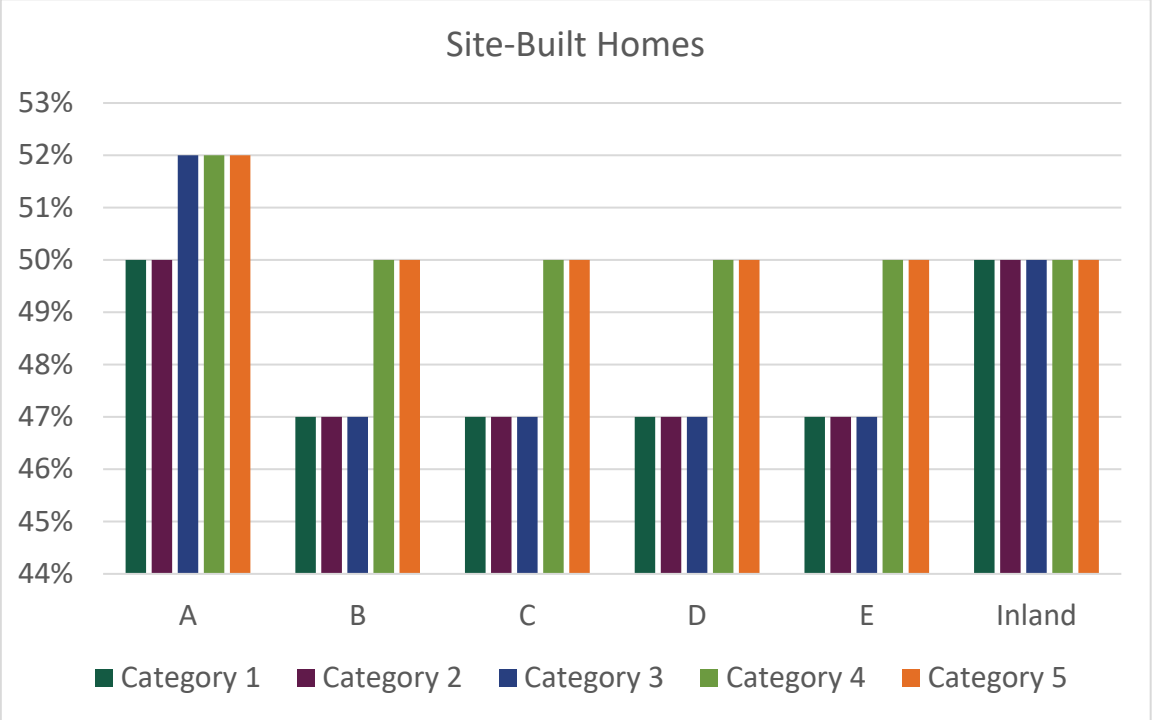
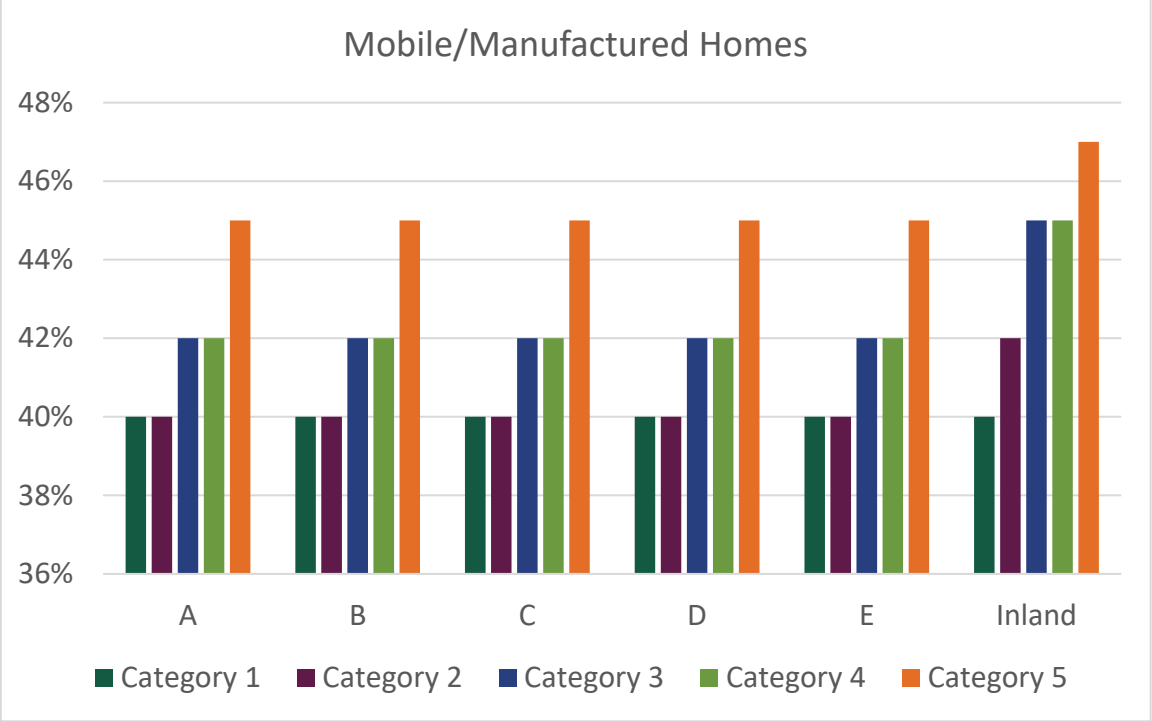



**Figure 18 People Evacuating that Leave Hillsborough County (Non-Site-Built Homes)**




Not captured in the SRESP is the number of people that are concerned about pets when evacuating. This behavioral topic influences evacuation. Cost was infrequently mentioned as an issue affecting transportation. However, when mentioned, it affected all aspects of evacuation – when, how, and where.

Behavioral data generally indicates large numbers of people will evacuate, and they will choose to stay with family and friends when possible.

The Statewide Regional Evacuation Study results imply that many people often plan to shelter with friends or family for major storms. This additional preparation and travel could be disruptive to the shelter-in-place expectations concerning traffic demand on roadways. Preventing shadow evacuation can drastically help reduce demand on roadways during a mass evacuation, but changing the unnecessary behaviors is not easy. The best method from the Emergency Management side is to be early and often with communication efforts to educate the population on the benefits of sheltering in place when appropriate. Of those who should shelter in place, the more who stay with friends/family instead of evacuating the region, the better. And of those in sturdy homes, the more who stay in place instead of travel across town to friends/family, the better.

Surveys and stakeholder input indicates that people's pets can be a contributing factor in their decisions concerning evacuation. The robustness of pet available shelters along with proper messaging and communication can help reduce this factor in improper evacuation.

Evacuation decisions are largely impacted by behavioral factors. Such factors could include social connectedness, socio-economic and demographic background, and specific situations. Even more, past experience can impact whether some choose to evacuate.[11] These behavioral factors cannot be changed in real-time but can be understood when planning for emergency management. Even more time and effort toward assessing some of these behavioral impacts with model input adjustments may provide meaningful conclusions.

[11] Collins, J., Polen, A., McSweeney, K., Colón-Burgos, D., & Jernigan, I. (2021). Hurricane Risk Perceptions and Evacuation Decision-Making in the Age of COVID-19, *Bulletin of the American Meteorological Society*, *102*(4), E836-E848. Retrieved Nov 24, 2021.

# 4.0 Recommendations

There are many broad and specific recommendations for the TPO to consider based on the assessment of identified issues. The following goals broadly summarize how the TPO can address issues concerning evacuation and sheltering in Hillsborough County:

1. **Engage in multiple strategies to improve evacuation and sheltering.** There is no one action that will enhance evacuation times. With expected increased population, it will become more imperative to consider and engage multiple, simultaneous strategies.

2. **Continue collaboration and coordination with emergency managers and transportation providers.** Many of the strategies involve collaboration between the TPO and other agencies/departments. The TPO is somewhat constrained in support that can be provided operationally and during events. However, the TPO can bring multiple parties together to continue sharing information and cooperating to improve emergency preparation and planning.

3. **Continue education as part of emergency preparation.** Evacuation and sheltering plans often only work as well as residents and visitors are aware of them. This study identifies the public's interest in having additional timely and accurate information. The TPO can assist in identifying opportunities to inform the public prior to hurricane season and when storms are forming/approaching to carry them out. These materials and plans must be in place early to activate quickly when needed.

Based on the results of issue evaluation, it is clear that single strategies often do not lead to major improvements by themselves. However, a comprehensive approach with multiple strategies can lead to meaningful improvement in evacuation and sheltering outcomes. Also, many of the recommendations for the TPO require collaboration and coordination with other partners. Continuing to work together with emergency managers and providers on many of these strategies is crucial to effective planning and implementation. Evacuation and sheltering plans and programs can only work if the public is aware of them and have adequately included them into their personal planning and decision making. Educating the public will remain a vital piece of planning for evacuation and sheltering strategies. These main ideas apply to all of the following recommendations.

***Roadway Improvements***

Based on the results of this study, interchange ramp and intersection roadway capacity improvements do not improve evacuation clearance times. However, targeted improvements at specific locations may help reduce local congestion in commercial areas as people prepare for an approaching hurricane. It can be one strategy in a multi-faceted approach to improve evacuation and sheltering.

Here are other recommendations to consider regarding roadway improvements:

- Some minor arterial improvements in evacuation "hotspots" (where it has been experienced and is perceived as an evacuation bottleneck) could improve local congestion. Intersection and interchange ramps improvements can assist during evacuation and daily operations.

- Florida's interstate system is the backbone of evacuation, supporting long distance travel to safe destinations. The proposed managed lanes projects on I-75 and I-4 will provide significant capacity improvements. As tolls are traditionally suspended, these additional lanes will enhance evacuation.

- In the interim, coordinating with FDOT and informing the public on Emergency Shoulder Use (ESU) operation plans prior to hurricane season and before a storm can address some concerns raised by survey respondents. For example, travelers want to know what to expect concerning shoulder debris rumble strips, narrow bridges or interchanges. Law enforcement manages access/egress to/from ESU areas, shoulders are cleared of debris, and slower speeds make travel in narrow areas safer.

- The Tampa-Hillsborough Expressway Authority also plays a role in evacuation and it is important as part of the regional evacuation plan for continual eastbound flow on the Leroy Selmon Expressway during the approach of a storm. Once recovery is underway and people can return home, a fixed westbound flow may ease travel and congestion.

***Transit***

Transit is a crucial mode of travel for many, including Hillsborough residents most vulnerable to emergencies. In an evacuation scenario, efficiently moving people to shelter locations is essential. Both paratransit and fixed route transit operations should be leveraged as an opportunity for evacuees, and access/route updates must be clearly communicated. Here are some recommendations to consider regarding transit:

- Continue to develop and enhance annual transit evacuation plans, coordinating established transit routes, temporary routes, access to shelters and or regional transit citers. This also should address paratransit and similar services.

- Investigate the effectiveness of maintaining consistent transit route operation, possible with supplement for key areas.

- Consider ways to expand services for those without personal vehicles, such as coordinating to provide transportation networking companies (TNCs), such as Uber or Lyft, or taxi services. This is important for families and individuals with health issues or pets/support animals that may be able to stay with family or friends instead of going to a shelter.

- Provide information about paratransit and transit evacuation plans and operations to transit users, on buses/stops/etc. prior to hurricane season and ideally immediately prior to a storm. For example, the need to register for transportation assistance, or ways to

***Communication***

Improved communication and response time was identified in this study as one of the most impactful strategies to improve evacuation. Regional evacuation clearance times improved noticeably in the TIME model when response time curve inputs were reduced. The faster residents respond to evacuation declarations, the quicker more people can get to safety. This requires clear and effective communication. Here are some recommendations to consider regarding communication:

- Maintain standards laid out in Hillsborough's Nondiscrimination and Equity Plan. Include multiple languages and means for conveying information as feasible when preparing and responding to an emergency or hurricane.

- Work with emergency management staff and consider incorporating emergency management communications in the TPO's public participation and involvement plan.

- Make efforts for all communications targeted appropriately pre-season, as well as pre-storm.

- Develop a plan to acquire (funding) and deploy permanent (preferred) or portable message signs, in coordination with emergency management officials, especially in evacuation zones, to communicate relevant information.

***Education***

Another method of expediting evacuation/sheltering clearance equitably and efficiently is ensuring the public is well-educated on plans and information. Educated residents and visitors are more prepared and can react quicker the more they are aware of evacuation and sheltering options. Here are some recommendations to consider regarding education:

- Make public aware of all useful options, evacuating away from the region, to a shelter, to an inland family/friend, or shelter in place. Special emphasis on how to evacuate with pets is warranted.

- In some surveys up to 29 percent of respondents did not know if they resided in an evacuation zone. Make basic evacuation plan information accessible in preparation for storm season via social media and other community relevant means.

- Hurricane forecast implications, warnings and their meaning, timing required to finalize decisions. This item should also factor in information about congestion that increases during evacuation as people delay evacuation.

Education may be one way to "right size" the number of shadow evacuees (i.e., people reside outside the specific evacuation level zone). It is appropriate for those outside evacuation zones residing in homes unable to withstand a hurricane (winds) or in need of improvements to evacuate. Others could potentially shelter in place. Coordinating with agencies to assess housing (e.g., year built, structural conditions) or provide opportunities for improvement, such as weatherization funding, is another educational strategy.

***Equity***

An important consideration for evacuation/sheltering preparation is equity. It is crucial to care for the most vulnerable people in the community during emergencies. People with health concerns or special needs, or those who use public transit for daily needs have special situations and needs for evacuation. Those who have less access to technology may need targeted communications to provide crucial updates from emergency management. Residents lacking access to private transportation may need mobility assistance to access public shelters or family and friends. Those who reside in homes unable to withstand hurricane force winds may wish to evacuate even if not in a flood evacuation zone. Here are some recommendations for the TPO to consider:

- Utilize TPO data, studies, and research (such as on traditionally disadvantaged communities, e.g., households without a car, those that speak languages other than English) to support emergency management preparation, response, recovery, and mitigation.

- Ensure people without smartphones or computers also have access to all communications, prepare flyers, signs, etc. and disperse from accessible places like grocery stores, laundromats, community centers, buses, etc.

***Evacuation/Sheltering Plans***

There are also some recommendations for implementing additional evacuation strategies. There are solutions to make evacuation and sheltering overall more efficient. These recommendations related to creating and communicating plans. Here are some recommendations to consider regarding evacuation plans:

- Consider phased evacuations to regulate flow of volume on critical evacuation routes. Be clear regarding mandatory evacuations. Survey respondents were receptive to this strategy in concept.

- Assistance for supplies: availability of fuel and home preparation supplies helps people determine their options. If they are concerned about not having access to gasoline, they might not evacuate when they should. If they are concerned about their home's integrity because they don't have access to supplies to reinforce their home, they may evacuate even if not in a flood zone. Some of this can be addressed with robust storm preparation programs and messaging. Helping residents, owners, and businesses to create evacuation plans may prove beneficial. For example, the TPO could engage a speakers bureau in coordination with emergency management personnel to assist.

- Consider transportation network companies (such as Uber and Lyft) or taxis to assist in providing free, low-cost, or reimbursed rides to shelters or inland private locations (friends, family, hotels) during evacuation. This can build on past experience gained by HART, for example.