SETxFCS
Southeast Texas
Flood Coordination Study

Southeast Texas Flood Coordination Study Annual Report
October 2020

Prepared by Liv Haselbach

Table of Contents

Appendices in Separate Files

1. Introduction

According to a National Hurricane Center Report (Blake and Zelinsky 2018) on Hurricane Harvey as it affected Southeast Texas from late August into September of 2017:

"*Harvey was the most significant tropical cyclone rainfall event in United States history, both in scope and peak rainfall amounts, since reliable rainfall records began around the 1880s. The highest storm total rainfall report from Harvey was 60.58 inches near Nederland, Texas, with another report of 60.54 inches from near Groves, Texas. Both of these values (and from five other stations) exceed the previously accepted United States tropical cyclone storm total rainfall record of 52.00 inches at Kanalohuluhulu Ranger Station, Hawaii, in August of 1950…. For the continental United States, the previous tropical cyclone rainfall record was 48.00 inches in Medina, Texas from Tropical Storm Amelia in 1978."*

And just two years later, according to another report by the National Hurricane Center (Latto and Berg 2020) Tropical Storm Imelda brought more devastation to Southeast Texas from September 17th to 19th 2019, with possibly the highest peak 12- hour intensity ever recorded as:

"*The highest rainfall total was 44.29 inches recorded 2 miles south-southwest of Fannett, Texas. Also noteworthy about the Fannett rainfall total is that 31 inches fell in 12 h. This rainfall caused devastating flooding along the I-10 corridor from Winnie eastward to Fannett, Beaumont, Vidor, and Orange, Texas……The 44.29-inch peak rainfall total makes Imelda the 7th-wettest tropical cyclone (in terms of highest rainfall total for a tropical cyclone) to impact the United States, the fifth wettest in the contiguous United States, and the fourth wettest in the state of Texas since 1940."*

Shortly after Imelda, Dr. David Maidment of the University of Texas (UT), called in September 2019 to the Civil and Environmental Engineering Department at Lamar University to discuss a river gage study along I10 and the growing national interest in Southeast Texas for flood studies. At about the same time the Beaumont District of the Texas Department of Transportation (TxDOT) led discussions about flooding issues along I10. This prompted a meeting at Lamar University on October 9th, 2019 to discuss interest in forming a collaborate group on flooding in Southeast Texas with participation from local, regional, statewide and national groups. The consensus was to go forward, with Dr. Liv Haselbach of Lamar University chosen as the initial lead. Thus, the Southeast Texas Flood Coordination Study (SETxFCS) was launched as an adhoc group in November 2019 in order to bring more collaboration amongst interested parties related to the frequent flooding events occurring in the region. SETxFCS monthly meetings and other meetings and communications continued to bring in more collaborators, until in about a half year a serious effort was underway. Draft mission, vision and initial steps statements were proposed for the study and an updated version of them in a flyer, with wording close to the original are presented in Figure 1.1. Initial participation included individuals from Lamar, UT, TxDOT, the Texas Department of Emergency Management, the US Army Corps of Engineers, local drainage districts, counties, and cities, the US Geological Survey, regional river authorities, et al. This report is intended to contain an overview of the progress on an annual basis as these study efforts grow. Appendix A contains contact information for some key personnel.

SETxFCS
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Flood Coordination Study

Helping Southeast Texas plan for, predict, and respond to floods

With the continued risk of flooding in Southeast Texas, Lamar University and the University of Texas at Austin are working together to help the region improve its resiliency during large-scale flooding events. With improved data availability, we propose the:

- Development of a Wide-area Flood Plan for SE Texas
- Creation of a Regional Geodatabase
- Development of flood modeling of future storms for mitigation decisions
- Development of flood mapping during response

The above will aid in: Planning for mitigation measures for flood inundation, predicting where and when flooding might occur for different events, and responding during times of need.

VISION To develop Southeast Texas (SETexas) as a prototype for regional flood mitigation and response, with potential to expand the model state-wide.

MISSION Develop a funded research, agency and industry group which will:

- ✓ Facilitate flood mitigation and sensoring technologies in SETexas,
- ✓ Collect data and coordinate with local, state and national stakeholders for stormwater modeling and decision making in SETexas which is in support of the State Flood Plan,
- ✓ Work with SETexas for emergency response and facilitate an enactment exercise
- ✓ Prepare a maintenance plan for a SETexas Flood Coordination Group.

FIRST STEPS

1) Seek from agencies and interested parties what is needed and what might be funded. (GLO, TWDB, USACE, TDPS, industry, drainage districts, river authorities, TxDOT, TDEM, etc.)
2) Formulate a GIS database for SETexas to support studies of the interaction of the streamflow and the transportation networks and other development and industry, in coordination with national efforts such as from FEMA, USGS, NWC, NOAA, etc. on mapping, flood prediction, inundation and response.
3) Expand the database with data to support hydrological modeling, integration with emergency respond needs, and decision making in targeted flood mitigation strategies.

V2 LAMAR UNIVERSITY TEXAS 6/18/2020

Figure 1.1: SETxFCS Vision, Mission and First Steps One-Pager June 2020.

2. Organization and Timelines

SETxFCS started in 2019 with Dr. Liv Haselbach of Lamar University leading the overall effort, Dr. David Maidment of the University of Texas leading its parallel efforts and various representatives of the agencies, cities, and counties contributing with respect to their constituents. More formal organizational charts will be developed as the effort expands.

Figure 2.1 is a depiction of how Lamar University may serve as a communication and data collaborative for these efforts in Southeast Texas to help with planning for, mitigation and/or prevention of, response to and recovery from flooding. These might be accomplished through various means of data collection, communication, mitigation, mapping and modeling by various members of the group or other parties. Table 2.1 presents a partial list of some of the organizational contacts for the 2020 efforts as outlined in Figure 2.1

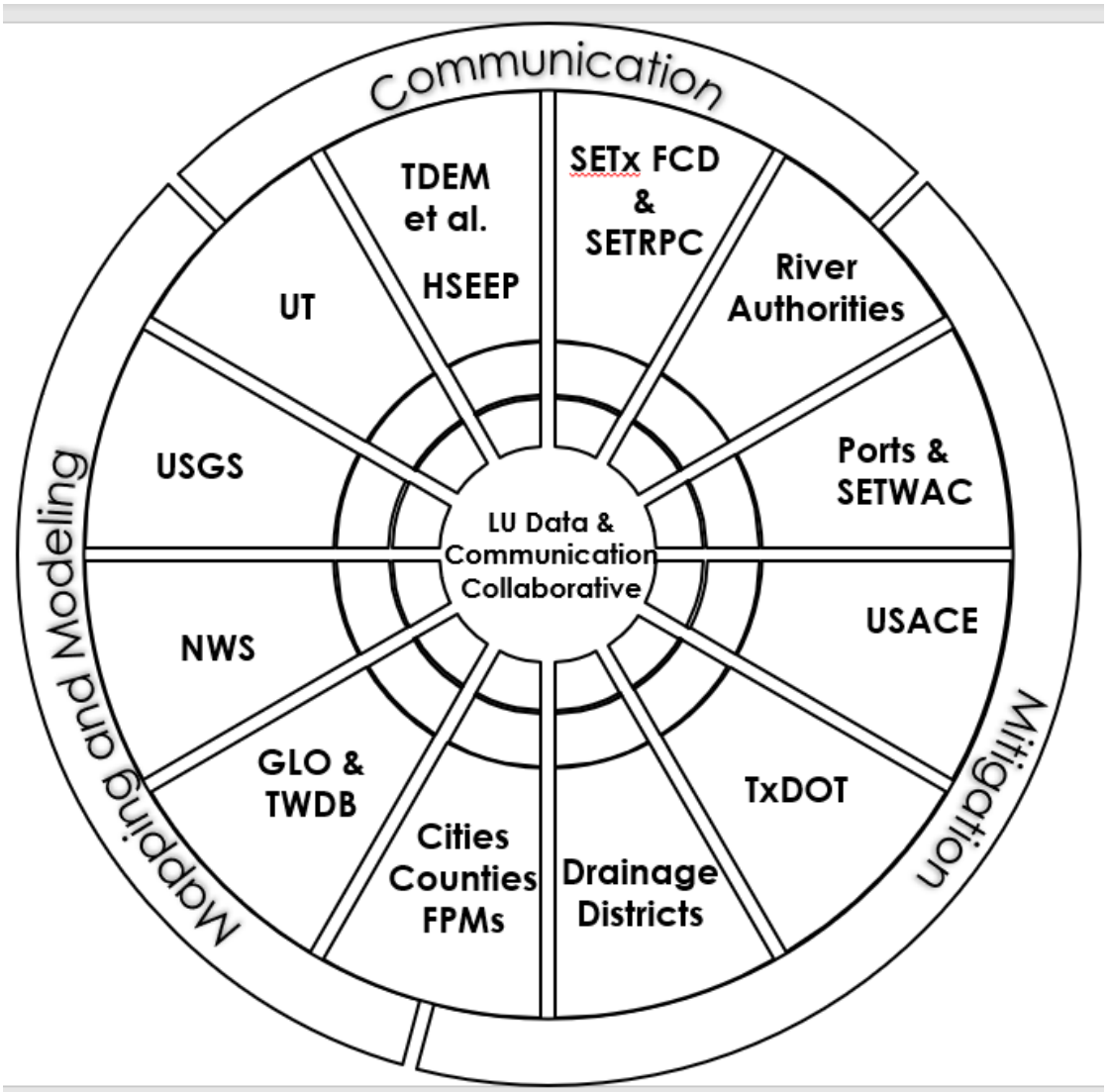

Figure 2.1: Visualization of the developing Lamar University centric collaborative.

Table 2.1: 2020 Informal SETxFCS Leadership/Contact Outline

Organization	Name	Functions
Lamar University	Liv Haselbach	Overall Study Management
	Nicholas Brake	Regional Data Collection
	NatalieTindall	Community Data Collection
	Thinesh Selvaratnam	Environmental/Water Data
	Qin Qian	Sediment/Environmental/Water Data
	Xing Wu	GIS and Computer Needs
	Erik Stromberg	Center for Port Management
University of Texas	David Maidment	UT Lead
	Christine Theis	UT GIS and Response
	Harry Evans	Response
City of Beaumont	Adina Josey	Flood Plain Manager
City of Port Arthur	Alberto Elefano	Director of Public Works
City of Port Neches	Taylor Shelton	Director of Public Works
Port of Port Arthur	Larry Kelley	Executive Director
Drainage District 6	Doug Canant	Drainage District
Orange Drainage	Don Carona	Drainage District
Drainage District 7	Phil Kelley	Drainage District
Jefferson County	Steve Stafford	Flood Plain Manager
Orange County	Lisa Roberts	Flood Plain Manager
Chambers County	Brad Wilber	Flood Plain Manager
LNVA	Scott Hall	Neches River Authority
SRA	Mark Howard	Sabine River Authority
TxDOT	Adam Jack	Transportation
TDEM	Carman Apple	Response
TWDB	Yi Chan et al.	Flood Outreach
Texas GLO	Rhonda Masters	Community Outreach
USGS	Alan Rea	National Hydrography Dataset
	Jason Stoker	National Lead Elevation
	Jeff Danielson	CoNED Applications
	Jeff East	Gulf Coast Surface Water
USACE- Galveston District	Lisa McCracken Mairs Reuben Trevino	Program Management and Emergency Management
NOAA/NWS	Mark Null	West Coast River Forecast
	Jonathan Brazzell	Lake Charles District
DHS	Richard Cary (Houston) Julio Gonzalez (SETx)	Protective Security Advisors

Tables 2.2 and 2.3 provide preliminary timelines for some of the activities, deliverables, plans and areas of focus for the study. Note that for early 2020 most of the efforts are based on the downstream counties (Jefferson, Chambers, and Orange) with the other five counties in the 8-county Southeast Texas Flood Control District (Hardin, Jasper, Newton, Tyler, Liberty) being brought in later in 2020 and in subsequent years.

Table 2.2: Tentative Schedule of Preliminary Organizational Activities and Deliverables

	2019	2020				2021				2022			
	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND
Kickoff	xxx	xxx	xxx										
Initial Funding			xx LU	xxx UT	xxx CAPM	xxx LNVA	xxx	xx SRA					
Monthly Meetings	xx	xxx	x x	xxx	x x	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Monthly Minutes	xx	xxx	x x	xxx	x x	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Annual Reports					x				x				x
Story Map		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Website				xx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
HSEEP Exercises			x		x								
After Action Reports			x		x								
Data Mgmt Planning						xxx	xxx						
CAPM Report				x	x								
Seek Funds		xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx				
Future Funds?						xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

Table 2.3: Developing List of Topical Areas and Possible Future Center Development

	2019	2020				2021				2022			
	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND
Regular Mtgs	xxx	xxx	x x	xxx	x x	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Website				start	Updates								
Downstream Counties	Gather input of needs			Compile HWMs and link to other Available Data				GIS Input and Collaboration with Modeling/Mapping and Loads					
Upstream Counties				Gather input of needs				Compile HWMs and links to other Available Data		GIS etc.			
Learning Activities	Meet stakeholders		NWS GLO DDs TDEM USGS LNVA, UT, SRA			GLO, TWDB, USACE, etc.							
Other			GIS, Modeling, Gauges, River Flows, Port/Industry Needs, Sediment Loads										
Response			HSEEP and other Exercises			Collaborations for Inundation Mapping Options							
Outreach	Stakeholders			Stakeholders and Community									
Center Development	Vision and Mission		Member & Support Growth and Task Development			Formalization of Organizational Structure and Various Stakeholder Collaborations, Development of Procedures and Protocols such as Data Management. Future visions.							

3. Communication

Communication efforts need to be developed both internally amongst the various participants and then externally to the community and other interested parties. Internal communication originated with the monthly meetings and minutes. Updated lists of these meetings can be found in Appendix B. Many links to other websites and resources have been provided at these meetings and a listing of them can be found in Appendix C. Various participants are also attending meetings or conferences hosted by other related parties.

In the spring of 2020 Christine Thies of the University of Texas developed a story map for the study available to the study participants with links to various websites and recaps of meetings. It is being updated monthly. Additional communication has occurred with the development of a website (https://www.setxfloodcoordstudy.org) both for internal and external use led by Dr. Natalie Tindall of the Communication Department at Lamar University.

It is also important to aid in understanding the terminology used by the various stakeholders from the many different groups and disciplines. Appendix D contains an ever expanding list of the various acronyms being used and Appendix E is a growing lexicon to aid in understanding the terminology used by the various participants.

Data and mapping are other forms of communication and are intended to be major contributions that this study can provide for the many stakeholders. As such, various participants are extending their Geographical Information System (GIS) training and applications to flooding and the various presentations at the monthly meetings include more links to the developing resources and technologies in these fields.

On May 13th, 2020 the SETx-FCS helped to host a virtual exercise which followed the Homeland Security Exercise Evaluation Program (HSEEP), bringing together flood professionals and emergency response groups to build communication and share ideas. The Texas Division of Emergency Management (TDEM) and the University of Texas (UT) ran the exercise which resulted in an After Action Report and Improvement Plan (SETxFCS et al. 2020). The listing from the improvement plan serves as a guide to many of the activities going forward. They are:

1. Centralized portal for all local/regional flood data
2. Static maps of historical data collection and locating areas at high risk for flooding
3. Communication and public outreach to the community
4. Better mapping with predictions included
5. Flood inundation and water dept
6. Educate public safety/emergency managers on local water behavior
7. Water flows and velocities
8. Drones technology planning

4. Activities/Products

Based on the many monthly meetings starting in November of 2019 and the HSEEP exercise held in May 2020 with a listing from the after action improvement plan in the preceding section, various activities have started. Additional details will be presented in the appendices or in separate referenced reports as the study progresses.

4.1. Data

One of the goals is for this study to be a basis for establishing a data collaborative, a portal through which data can be collected, compiled and managed, and also where data can be referenced that are hosted at other locations, such as elevation data from the US Geological Survey (USGS), rainfall data at the National Weather Service (NWS) and address point data at the Texas Natural Resource Information Service (TNRIS).

Data is currently being collected from various agencies and governmental groups in the region by members of the study from Lamar University and a summary of some of their efforts in early 2020 is in Appendix F. Data is also being collected from various industry, port and waterway groups in conjunction the Lamar University Center for Port Management (CAPM) through collaborations with the Southeast Texas Waterway Advisory Council (SETWAC) at workshops and meetings of the group. In addition, members of the study from Lamar University are approaching regional industrial representatives with respect to flooding concerns and associated environmental issues.

Various additional data sources can be found in the listings in Appendix C with links to sites from many of the regional, state and national partners in this study. Parallel to the local efforts, the USGS has received funding in this fiscal year to update the three county (Jefferson, Orange and Chamber) elevation data to a new level of detail as a pilot for the country referred to as the 3D National Terrain Model (3DNTM). Figures 4.1 and 4.2 display how the USGS is hoping for these data sets to develop in the future.

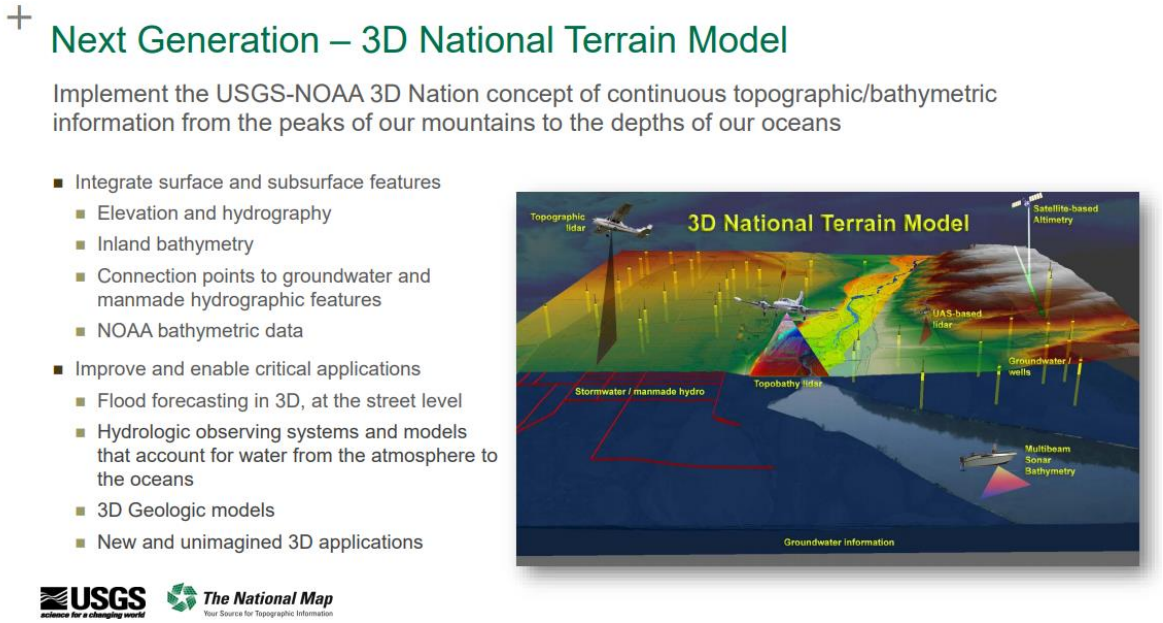

Figure 4.1: Explanation of the 3DNTM from the USGS.

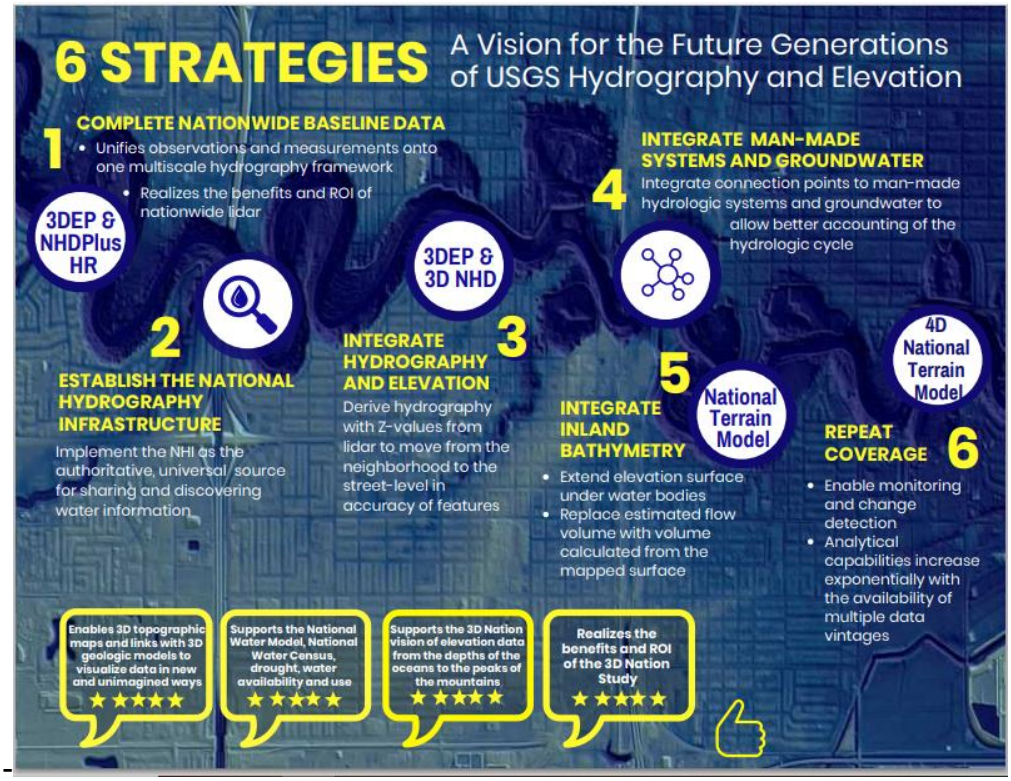

Figure 4.2: Development and Future Vision of the 3DNTM from the USGS.

There are many computer resources that are needed in order to collect, store and use data, especially when using a geographic information system (GIS). A summary of some of the GIS data collected to date, and information on additional needs can be found in Appendix F.

The SETxFCS also has plans to reach out to the communities for input. This effort is being led by Natalie Tindall of Lamar University. The goal of this exploratory, qualitative research is to understand media and communication preferences during a weather crisis. What are community stakeholders wanting and needing to know during a storm, and how are they accessing help and information during that weather crisis? It will focus on conducting semi-structured interviews with the residents of Jefferson, Orange, or Hardin counties who have been a resident during a catastrophic weather event such as Tropical storm Imelda or Tropical Storm Harvey.

4.2. Response

Also involved in the SETx-FCS are members of the response and recovery communities such as the Texas Division of Emergency Management (TDEM) and Homeland Security, and agencies that are highly affected by floodwaters such as the Texas Department of Transportation (TxDOT). As previously mentioned, TDEM and response and mapping professionals from the University of Texas hosted the Homeland Security Exercise Evaluation Program (HSEEP) in May of 2020 focusing on the conditions found in Tropical Storm Imelda. There are plans to host another HSEEP exercise in the late fall of 2020 which would focus on the expanded use of the Southeast Texas Regional Alerting and Information Network (R.A.I.N.). R.A.I.N. is a website with realtime river gauge information. More details can be found in Appendix C.

A critical need of the response and recovery professionals is timely information on flooded areas. Therefore, the need for technologies which provide predictive and real-time data such as flood inundation mapping. The study hosted presentations by Dr. Maidment of the University of Texas on a developing technology referred to as Pin2Flood and by Mark Null of the National Weather Service on NWS developments in inundation mapping. Based on the great need for these tools, Lamar University and the University of Texas are seeking additional funding to provide historical data to validate inundation mapping and to develop the technologies for their production and use, respectively. Figures 4.3 and 4.4 outline the goals and provide an example information flow of the Pin2Flood program being developed by the University of Texas in conjunction with the Texas Water Development Board (TWDB).

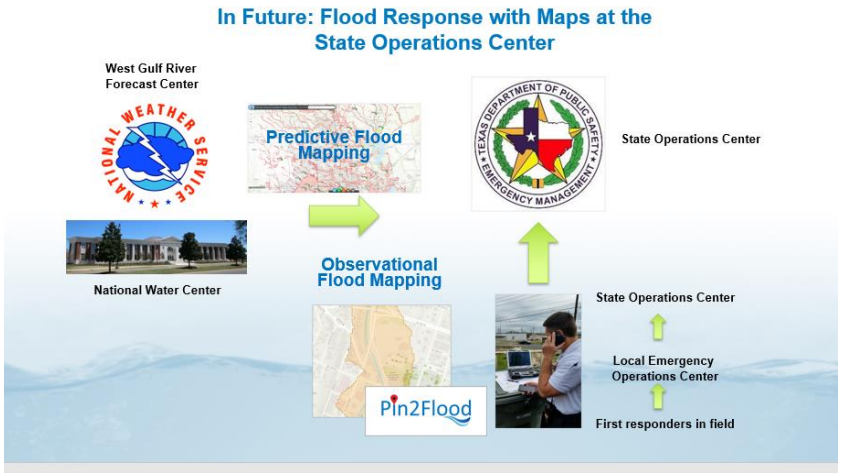

Figure 4.3: Outline of the Pin2Flood application.

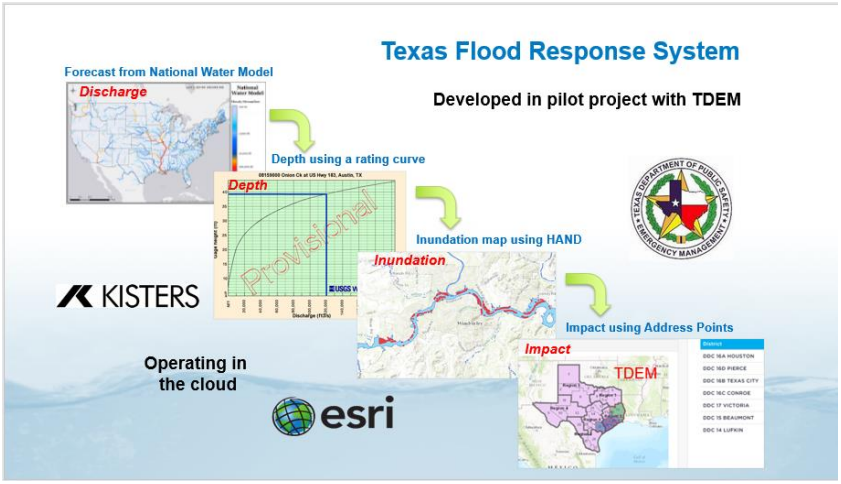

Figure 4.4: Anticipated information flow of the Pin2Flood application.

A future need expressed by the emergency responder community is to have more information on water depths and how fast they might recede post an event. Current efforts are looking into whether we can facilitate the implementation of an area wide effort to install staff gauges on permanent structures such as light poles to provide more widespread information during and post

events. Figures 4.5 and 4.6 depict a staff gauge on a light pole and how such gauges might be used by the public to send information to a community.

Figure 4.5: Staff gauge on a light pole

Figure 4.6: Example of how citizens might provide information to the community from a staff gauge.

4.3. Modeling/Mapping

As evidenced from the discussions at the monthly meetings and from the HSEEP on May 13th, 2020, there is a great need for modeling and mapping. Three of the take-aways from the HSEEP focus on this:

1. Static maps of historical data collection and locating areas at high risk for flooding
2. Better mapping with predictions included
3. Flood inundation and water depth

As noted in Table 2.2 modeling and mapping are anticipated to be continual activities amongst the many study partners over the next several years. Updates on these activities are ongoing at the monthly meetings. In addition, several studies began in 2020 at Lamar University.

Dr. Qian in conjunction with the Port of Port Arthur is working on a sediment loading study to see what factors might influence the buildup of sediment at the Port that necessitates annual dredging. These might include storm events, vessel traffic, river flows or other impacts.

Dr. Wu has been collecting damage data from Hurricane Harvey and Tropical Storm Imelda to initiate mapping of areas of flooding in addition to those that are otherwise expected from fluvial flooding. Some additional information about the progress of this effort is in Appendix F.

4.4. Other Events

On March 10, 2020 Liv Haselbach moderated the Panel on Port Resilience at the Port of the Future Conference at the University of Houston. Speakers in this panel included Katherine Chambers (USACE), Omar Garcia (Port of Corpus Christi) and Lauren Davis (NC A&T Univ.).

Erik Stromberg of the Lamar Center for Advances in Port Management (CAPM) organized the 2020 HURRICANE SEASON PLANNING IN A PANDEMIC WEBINAR in conjunction with the Southeast Texas Waterways Advisory Committee (SETWAC). Speakers were from various agencies and groups including the National Weather Service (NWS), TDEM, Jefferson County, the City of Beaumont, the US Coast Guard, the US Army Corps of Engineers, the Southeast Texas Regional Planning Commission (SETRPC) and the Sabine River Pilots.

On August 4th, 2020 Liv Haselbach presented on "Addressing Flood Risk: A Path Forward for Texas After Hurricane Harvey, ASCE Texas Section Task Committee on Post Hurricane Harvey Recommendations" and "Low Impact Development" at the Recovery and Resiliency: Building Tomorrow Virtual Summit hosted by the Resilience and Recovery group at Lamar University.

4.5. Products

1. The Homeland Security Exercise Evaluation Program (HSEEP) exercise held in May 2020 resulted in an after action report (SETxFCS et al. 2020) and will be posted on the study website.
2. A white paper is under development entitled *Transportation Hurricane Planning in a Pandemic* for possible presentation at conferences in 2021 (Haselbach et al. 2021). It overviews the capabilities of hosting the HSEEP exercise during a pandemic and the results of the aforementioned 2020 HURRICANE SEASON PLANNING IN A PANDEMIC WEBINAR.

5. Funding and Future Opportunities

5.1. 2020 Funding

The University of Texas at Austin Center for Water and the Environment and the College of Engineering at Lamar University have generously supported many of the participants in the study and provided resources for hosting meetings, computers, software and other IT needs. Other participants are paralleling the efforts with their own studies and participation.

In addition, in 2020 the following three organizations have generously awarded grants to Lamar University to further support the start-up year of the study:

The Lamar University Center for Port Management (LU CAPM)
The Lower Neches Valley Authority (LNVA)
The Sabine River Authority (SRA)

5.2. Future Opportunities

Efforts were also underway to solicit support for many of the activities that the SETxFCS anticipates may further its vision and mission. Some of the current applications include the following, although funding is competitive and not guaranteed.

1. An application to the Texas General Land Office Coastal Management Program for installing a high frequency radar network in Sabine Lake for near surface current data. This is led by the University of Texas at El Paso, with an anticipated subaward to Lamar University.
2. Granting of an award to the University of Texas at Austin (UT) for future river gauges, of which some may be in the region.
3. A problem statement submitted to the Texas Department of Transportation for a trial staff gauge network in the Beaumont area.
4. An application to the National Science Foundation Civic Innovation Challenge (CIVIC) by UT with an anticipated subaward to Lamar University and another application to the Texas General Land Office Coastal Management Program by UT both for various steps towards developing height about nearest drainage flood mapping protocols and other instruments that the communities designate as priorities.
5. A legislative appropriation request to the State of Texas for a Center for Resiliency at Lamar.
6. An application to the National Science Foundation Coastlines and People Hubs for Research and Broadening Participation (CoPe) by UT with an anticipated subaward to Lamar University. The proposal is focusing on the topic of a Coastal Infrastructure and Resilient Community to Leverage Engagement, with an emphasis on multiple coastal hazards.

6. References

- Blake, E.S. and Zelinsky, D.A. (2018). **HURRICANE HARVEY 17 August – 1 September 2017**. National Hurricane Center Report AL092017, National Weather Service NOAA.

- Haselbach, L., Stromberg, R.E., Thies, C., Evans, H., Apple, C. and Kabir, M. (2021). *Transportation Hurricane Planning in a Pandemic.* Whitepaper being developed for possible presentations as conferences in 2021.

- Latto, A. and Berg, R. (2020). **TROPICAL STORM IMELDA 17-19 September 2019.** National Hurricane Center Tropical Cyclone Report AL112019, National Weather Service NOAA.

- SETxFCS, TDEM, and UT CWE (2020**). Southeast Texas Flood Coordination Study Virtual Flood Exercise for Non-Public Safety Community, May 13, 2020 AFTER ACTION REPORT/ IMPROVEMENT PLAN.** Homeland Security Exercise and Evaluation Program (HSEEP) After Action Report/Improvement Plan.