STUDY PROPOSAL

Update of Geo-Referenced Upper Trinity River Corridor Development Certificate Model into the Consolidated NFIP-CDC Model

U. S. Army Corps of Engineers – Fort Worth District
March 2020

1. **History of Model Development**

   The upper Trinity River Corridor Development Certificate Model (CDC Model) and the upper Trinity River Federal Emergency Management Agency Model (FEMA Model) were developed by the U. S. Army Corps of Engineers – Fort Worth District (USACE-SWF) in the 1990s. The cross-section information of both models were originally developed based on aerial photography developed in 1991. Terrain information was developed from this photography in multiple MicroStation files and cross-section data was generated from these files.

   There are two major differences between the CDC Model and FEMA models:

   - The CDC Model consists of constructed projects along with un-constructed CDC and USACE Section 404 permitted projects and future conditions flows
   - The FEMA Model consists of constructed projects and 2005 flows.

   The original CDC Model incorporated year 2040 future watershed conditions flows – the original FEMA Model incorporated year 2000 existing watershed conditions flows.

   A CDC Model update was completed by USACE-SWF in 2013, which consisted of the incorporation of more than 50 approved CDC projects and the development of year 2055 future watershed conditions flows. The FEMA Model has never been updated on a regional comprehensive basis as the CDC Model, but rather on an approved project-by-project Letter of Map Revision (LOMR) basis.

   In 2017-2019, through FEMA funding, the Risk Assessment, Mapping, and Planning Partners (RAMPP) team completed a re-working of the CDC Model by developing a fully geo-referenced model along with the year 2005 watershed flows from the CDC model. The extents of the model includes portions of the Clear Fork, West Fork, Elm Fork, and mainstem of the Trinity River, but does not currently cover any portion of the East Fork.

2. **Issue**

   The Geo-referenced RAMPP Model represents projects that have been constructed, as of 30 May 2017 and does not include approved but unconstructed CDC projects. Work needs to be performed to develop a CDC Model by incorporating CDC projects that have been approved since 30 May 2017.

3. **CDC/NFIP Model Consolidation**

   Recently, FEMA, NCTCOG, and USACE agreed that it was in each other's interests to consolidate and maintain the NFIP and CDC models within the same HEC-RAS project file. Keeping models up to date and in sync as well as having files combined into a single modeling package (HEC-RAS project file) will help administration of the NFIP and CDC programs.

4. **Purpose**

   The existing conditions (2005) model has been georeferenced by the RAMPP team, however the existing CDC model elements of approved but not yet constructed CDC project geometries as well as the future (2055) flows for recurrence intervals of 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr, 500-yr and SPF are not incorporated at this point. The

purpose of this study is to make the necessary changes to the RAMPP model to produce a georeferenced Consolidated NFIP-CDC Model. Once the georeferenced Consolidated NFIP-CDC Model is developed, the various geometries, flows, and plans can then be consolidated under the same HEC-RAS project file and can then be kept up to date and in sync with one another, benefiting FEMA, NCTCOG, and USACE.

5. Proposed Work

The work will consist of updates and necessary changes to the 2019 RAMPP model to produce a georeferenced Consolidated NFIP-CDC Model. A complete list of tasks are as follows:

1. **Review RAMPP Model -** Review and verify RAMPP Model. Review will include checking reach lengths, adding notations, etc.

2. **Incorporate CDC Model Proposed Geometries and Future Flows -** Utilizing and copying the Existing geometry file from the RAMPP model, create a Proposed geometry file within the same HEC-RAS project file by incorporating proposed CDC permitted projects (approx. 50) based on project design data previously approved. Incorporate Future (2055) flows for recurrence intervals of 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr, 500-yr and SPF. 50 CDC projects assumes model update begins in year 2022. These additions produce the Consolidated NFIP-CDC Model.

3. **Review the Consolidated NFIP-CDC Model** - Review and adjust as necessary the unified HEC-RAS Model that contains both CDC geometries, plans, and flows and FEMA/NFIP Model geometries, plans, and flows. All HEC-RAS files will fall under one project (.prj) file.

4. **CDC Inundation Mapping** - Develop inundation areas shapefiles for the Consolidated NFIP-CDC Model Future 100-yr and SPF Events. Raw shapefiles from HEC-RAS will be provided.

5. **Documentation -** Develop report consisting of documentation of work performed. Report will include documentation of technical analysis, support data, tables of results, tables, plates, etc. Update tracking chart by noting which CDC projects are incorporated into the Existing geometry file vs. the Proposed geometry file.

6. **FMTF Communities Review** - Present study and results to FMTF communities. Allow comment period for communities. Respond to any comments.

6. Performance of Proposed Work

The work will be performed by USACE-SWF.

7. Deliverables

a. One Consolidated NFIP-CDC Model containing CDC Proposed geometry and Future flows and FEMA Existing (built) geometry and 2005 flows (under one HEC-RAS project (.prj) file)

b. Inundation Area Shapefiles for Future 100-yr and SPF Events

c. Project Study Report

d. CDC tracking Chart

8. Cost/Schedule

The total cost of work described in this proposal is $215,000. The time of completion is 18 months.

STUDY PROPOSAL

UPPER TRINITY RIVER CORRIDOR DEVELOPMENT CERTIFICATE MODEL - EAST FORK ADDITION INTO THE CONSOLIDATED NFIP-CDC MODEL

U. S. Army Corps of Engineers – Fort Worth District
March 2020

1. **History of Model Development**

The upper Trinity River Corridor Development Certificate Model (CDC Model) and the upper Trinity River Federal Emergency Management Agency Model (FEMA Model) were developed by the U. S. Army Corps of Engineers – Fort Worth District (USACE-SWF) in the 1990s. The cross-section information of both models were originally developed based on aerial photography developed in 1991. Terrain information was developed from this photography in multiple MicroStation files and cross-section data was generated from these files.

There are two major differences between the CDC Model and FEMA models:

- The CDC Model consists of constructed projects along with un-constructed CDC and USACE Section 404 permitted projects and future conditions flows

- The FEMA Model consists of constructed projects and 2005 flows.

The original CDC Model incorporated year 2040 future watershed conditions flows – the original FEMA Model incorporated year 2000 existing watershed conditions flows.

A CDC Model update was completed by USACE-SWF in 2013, which consisted of the incorporation of more than 50 approved CDC projects and the development of year 2055 future watershed conditions flows. The FEMA Model has never been updated on a regional comprehensive basis as the CDC Model, but rather on an approved project-by-project Letter of Map Revision (LOMR) basis.

In 2017-2019, through FEMA funding, the Risk Assessment, Mapping, and Planning Partners (RAMPP) team completed a re-working of the CDC Model by developing a fully geo-referenced model along with the year 2005 watershed flows from the CDC model. The extents of the model includes portions of the Clear Fork, West Fork, Elm Fork, and mainstem of the Trinity River, but does not currently cover any portion of the East Fork.

In 2018, through FEMA funding, the Compass PTS joint venture team studied and developed an existing conditions model for the East Fork of the Trinity River from the Lake Ray Hubbard dam downstream to the Trinity River Mainstream; and added onto the Trinity River Mainstem model from the end of the current CDC Model at the Malloy Bridge Road crossing in southeast Dallas County to the USGS gage at Rosser, being the most southwest point of Kaufman County.

2. **Issue**

In an effort to build upon the success experienced from the common regional floodplain management criteria utilized in the CDC process, additional river miles will be added to the CDC program utilizing the recently developed East Fork existing conditions model described above. These additional river miles will include the Trinity River Mainstem from the end of the current CDC Model at the Malloy Bridge Road crossing in southeast Dallas County to the USGS gage at Rosser as well as the East Fork below Lake Ray Hubbard dam. Including these additional areas into the CDC program will help stabilize the flood risk along the East Fork and Trinity River Mainstem.

3. Proposed Work

The work will consist of an update to the new East Fork and mainstem areas existing conditions model to incorporate Future (2055) flows for recurrence intervals of 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr, 500-yr and SPF, so that the model extensions can be incorporated into the Consolidated NFIP-CDC Model. The purpose is to develop an extended Consolidated NFIP-CDC Model that can be used by local floodplain management officials to apply common regional CDC criteria to development within this portion of the Trinity River Corridor. A complete list of tasks are as follows:

1. **Obtain and Update East Fork/Mainstem HEC-RAS Model** – Obtain and review East Fork/Mainstem hydraulic modeling being developed for FEMA by Compass PTS joint venture team. Revise as necessary. Assumes 2 separate geometries will need to be developed due to levees.

2. **Develop Future Land Use HEC-HMS Model** - Obtain latest future land use information from NCTCOG. InFRM Trinity River Watershed Hydrology Assessment HEC-HMS model will be used as a base model.

3. **Develop Future Flows** - The future land use model will be used to develop future flows (8) with recurrence intervals of 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, 100-yr, 500-yr and SPF for the East Fork of the Trinity River watershed below Lake Ray Hubbard dam and for the Mainstem from the lower end of the current CDC model to the USGS gage at Rosser.

4. **Incorporate CDC Flows and Merge with Current CDC Model** - Incorporate the future flows into the model. Merge model with current Consolidated NFIP-CDC model to create a single updated Consolidated NFIP-CDC model.

5. **Compare Model with Previous Model** - Compare results with the previous CDC model. Changes in tailwater conditions due to new modeling and flows could result in some changes to previous model profiles.

6. **Floodplain Delineations** - Develop Future 100-year and SPF floodplain delineations for the Consolidated NFIP-CDC Model. Raw shapefiles from HEC-RAS will be provided.

7. **Documentation** - Develop report consisting of documentation of work performed. Report will include documentation of technical analysis, support data, tables of results, plates, etc.

8. **FMTF Communities Review** - Present study and results to FMTF communities. Allow comment period for communities. Respond to any comments. Make necessary revisions.

9. **Meetings** - Includes in-house team progress meetings, meetings with FEMA and NCTCOG during progress of work, and final presentation to FEMA and NCTCOG.

4. **Performance of Proposed Work**
   The work will be performed by USACE-SWF. Coordination with the FEMA and NCTCOG and its members will be required.

5. **Limits of Proposed Work**
   The limits of the proposed work include the development of the future condition HEC-RAS models for the upper Trinity River system as follows:

   East Fork Trinity River from Lake Ray Hubbard dam to the confluence with the Mainstem Trinity River: approx. 29 miles

   Main Stem of the Trinity River from the end of the current CDC Model to the USGS Gage at Rosser: approx. 30 miles

   Total mileage approx. 59 miles.

6. **Deliverables**
   a. HEC-HMS Extended Consolidated NFIP-CDC Model
   b. HEC-RAS Model (Extended Consolidated NFIP-CDC)
   c. Future 100-year and SPF (CDC) flood delineations
   d. Project Study Report

7. **Cost/Schedule**
   The total cost of work described in this proposal is $270,000. The time of completion is 24 months.

STUDY PROPOSAL

Storm Shifting Study for the Upper Trinity River Watershed

U. S. Army Corps of Engineers – Fort Worth District
February 2020

1. **Problem Statement**

"I have lived here 30 years and have not seen the water come anywhere close to my property". "My home is above the 100-yr floodplain, so I don't have to worry about flooding." These statements or statements similar to these have been made a countless number of times; but is this the best way to determine the risk of flooding and the appropriate measures that should be implemented to mitigate that risk? Is the published 100-yr floodplain the only scenario that should be considered? The answer to both of these questions is "No." Climate variability, uncertainty in published floodplain estimates, and uncertainty about where or when large storm events will occur are just some of the many reasons why all information available should be used in flood risk decision making and emergency preparedness. This proposal will outline the process of storm shifting as a useful tool for elected officials, floodplain managers and emergency management personnel to increase resiliency to flood disasters within their communities. The Sponsor(s) for this study will be the North Central Texas Council of Governments (NCTCOG) and interested Cities and Counties within the North Central Texas Region.

2. **Storm Shifting**

Recent technological advances have improved our ability to utilize observed storm data, shift that storm data to a new location, and combine it with engineering models to estimate the resulting flooding scenario if that observed storm were to occur over the new location. This is referred to as "storm shifting" and has the potential for increasing community resilience to flood disasters. Storm shifting can answer the questions such as "What if that large rainfall event, that occurred in our region, fell directly over our community?" "Would people's homes get flooded?", "Would the hospital or water treatment plant get flooded?" "How much freeboard should we require in our ordinances?", or "How much time would we have to evacuate...." Hydrologic Engineering Center Meteorological Visualization Utility Engine (HEC-MetVue) is a new program that facilitates viewing and shifting of rainfall datasets, amongst many other capabilities. This studywill utilize storms that have occurred within North Texas and will demonstrate their resulting floodplains and thus impacts to Communities if they had occurred over other areas.

3. **Example**

Storm shifting is currently being used as a tool to communicate flood hazard throughout the State of Texas. A recent study was performed over the Mary's Creek watershed near Benbrook Lake as part of the Interagency Flood Risk Management (InFRM) Trinity River Watershed Hydrology Assessment (WHA) using existing modeling. In June 2000, a large rainfall event fell just upstream of Benbrook Lake, with the runoff primarily being captured by the Lake. This storm had 24 hour point rainfall totals greater than 10 inches and only occurred about 15 miles away from the middle of the Mary's Creek watershed. Figure 1 shows where the observed storm fell and then where the storm was shifted or "transposed" only 15 miles North. Figure 2 compares the FEMA 100-yr floodplain to the estimated floodplain from the shifted storm. The floodplain from the shifted storm was approximately 4 feet higher than the 100-yr Base Flood Elevation (BFE). Mary's Creek as well as the Clear Fork and West Fork likely would have experienced much more severe flooding if the storm had occurred slightly to the North. This study was helpful in communicating just how close the communities along this area came to experiencing a very major flood.

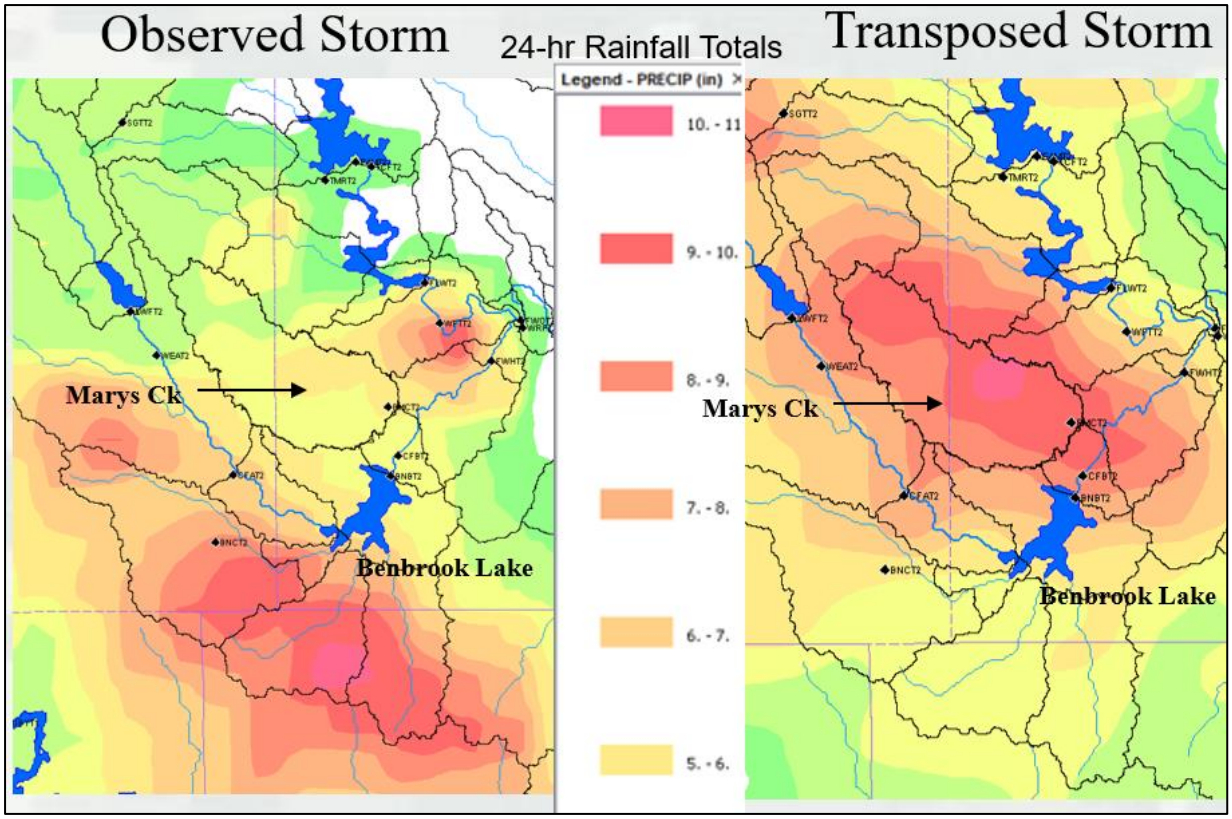

Figure 1 – June 2000 Observed and Shifted Storm for Mary's Creek Watershed

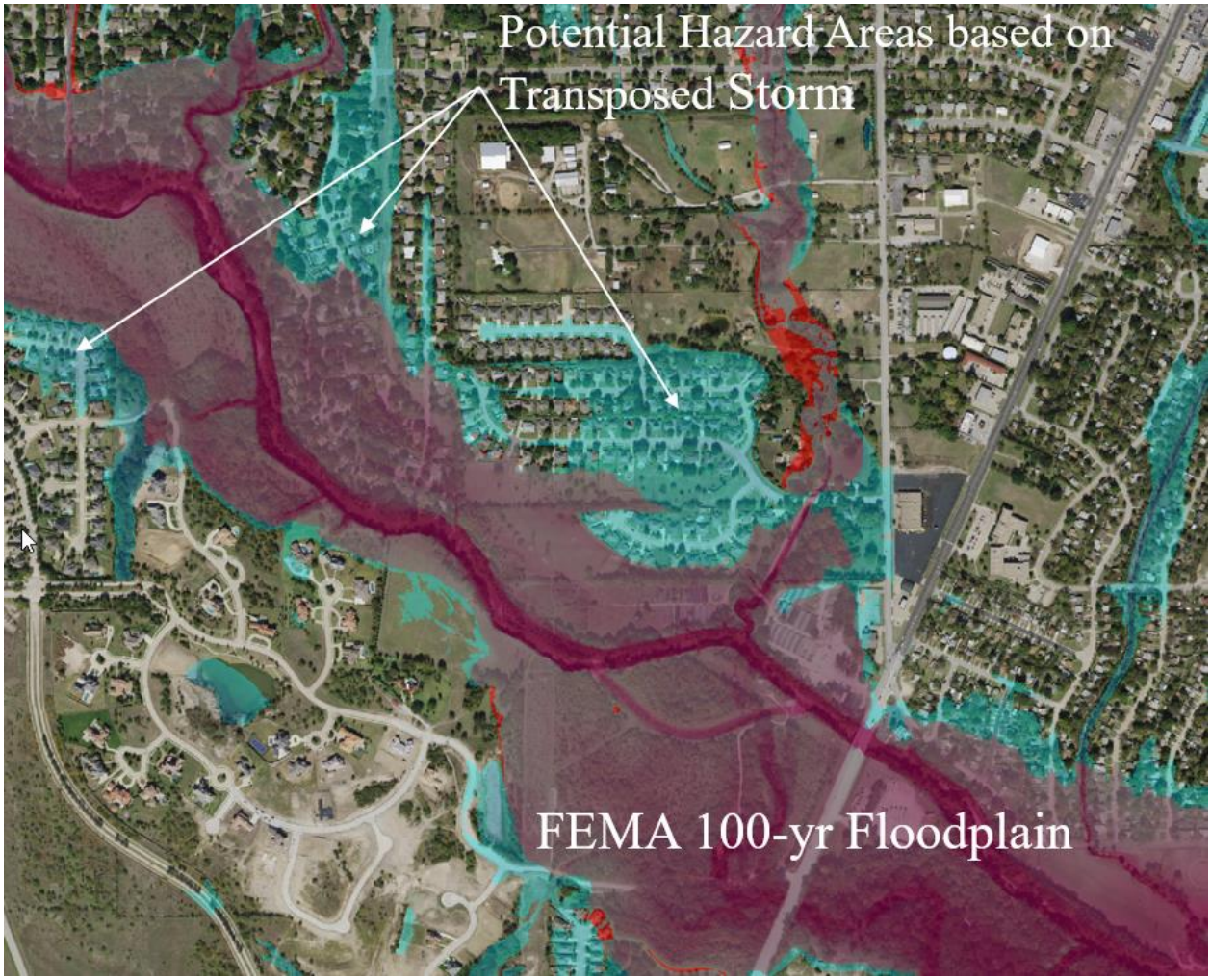

Figure 2 – Current FEMA 100-yr Floodplain Compared with Floodplain from Shifted Storm

4. **Assumptions**

- **Storm Selection Limited to North Central Texas -** There are limits to storm shifting due to meteorological parameters and atmospheric mechanisms. For example, a storm over the Balcones Escarpment should not be transposed because it is a cliff with a rapid elevation change in excess of 1,000 feet. Similarly, a storm that occurs along the coastline should not be transposed to North Texas because the Gulf of Mexico played a role in the atmospheric moisture for that storm. Shifting the storm several hundred miles away from its moisture source would change the nature of the storm and should not be done. A storm occurring over a particular location is just as likely to occur somewhere nearby so long as there is not a meteorological reason a storm wouldn't shift. This especially true for the relatively flat land of North Central Texas. Much of the area in North Central Texas is subject to the same storm threats and is therefore at the same risk.

- **Existing Data –** Existing river (HEC-RAS) modeling and terrain will be used as is available to USACE or provided by the Sponsor(s).

- **Storm Size** –Shifted storms will not be classified by return period (100-yr, 500-yr, etc). Rather generally speaking, large storms that can be generally described as 100-yr or greater within the North Texas region will be selected.

5. **Proposed Work**

The work will consist of shifting appropriate observed storms over particular areas and developing the resulting flood information of floodplains, rainfall totals, and hydrograph timing as well of the following discussions on understanding and implementing the information from the areas of interest identified by the Sponsor(s). A complete list of tasks are as follows:

1. **Determining Storm Number and Locations** – The number of storm locations that need to be analyzed will determine number of storms that can be analyzed. Correspondingly, the number of storms that are analyzed will impact the number of locations that can be analyzed. A meeting will be held with the Sponsor to discuss what combination of locations/storms.

2. **Obtain Existing Data –** The USACE will coordinate with the Sponsor(s) to obtain geo-referenced river models (HEC-RAS) and terrain data that will be used for floodplain delineation mapping.

3. **Storm Selection –** Storms will be selected for the storm shifting analysis. Storms will only be selected if they are determined to be within the appropriate storm shift region as determined by meteorological parameters and atmospheric mechanisms for North Central Texas. Final storm selection will only be made after coordination with the Sponsor(s).

4. **Storm Shifting** – The selected storm will then be shifted, using HEC-MetVue over the watershed of interest and will be applied over the rainfall-runoff model (HEC-HMS), producing flow hydrograph information (peak flow, timing and duration of flood) in the area of interest.

5. **Inundation Mapping** – The peak flows from the rainfall-runoff model will be entered into the river/hydraulic model (HEC-RAS) from which resulting inundation maps will be developed.

6. **Documentation -** Develop report consisting of documentation of work performed. Report will include documentation of technical analysis, support data, tables of results, tables, plates, etc.

7. **Post Analysis Collaboration** – The USACE will meet with the Sponsor(s) and will explain the storm shift information that was developed and discuss how it can help with floodplain management and emergency preparedness.

6. Performance of Proposed Work

The technical work will be performed by USACE-SWF. The Sponsor(s) where analysis is being performed are responsible for initiating and setting up meetings to discuss study results and their implementation. The Sponsor(s) are also responsible for providing existing data such as river models (HEC-RAS), terrain data, or other information. The USACE will not be developing any new existing river (HEC-RAS) modeling.

7. Deliverables

a. HEC-RAS Models Used to Develop Storm Shift Floodplain Maps

b. HEC-HMS Models Containing Shifted Storm Data

c. Inundation Maps for Each Storm Shift Scenario

d. Report Detailing Study Data, Methodology, and Study Results.

8. Cost/Schedule

The total cost of work described in this proposal is $100,000. The time of completion is 12 months.