



Flood Warning Toolset for the Medina River in Bandera County, Texas

Overview

Floods are the most common natural disaster in the United States (Federal Emergency Management Agency, 2019). The Medina River in Bandera County, Texas, is in the Edwards Plateau (fig. 1) (Hill, 1901), where high-intensity rain rates and steep terrain frequently contribute to severe flash flooding capable of causing loss of life and property. For example, the July 5, 2002, flood claimed a total of 12 lives in the central Texas area (National Weather Service, 2019a). The estimated peak discharge during this flood at U.S. Geological Survey (USGS) streamflow-gaging station 08178880 Medina River at Bandera, Tex. (hereinafter “Bandera station”), was 159,000 cubic feet per second (corresponding to a stage or gage height of 38.91 feet), causing significant flooding in Bandera near Mud Creek (fig. 2) and farther downstream (fig. 3) (U.S. Geological Survey, 2018).

In 2018, the USGS, in cooperation with the Bandera County River Authority and Groundwater District and the Texas Water Development Board, developed a flood early-warning toolset to enhance the communication of flood risk and provide emergency management with additional information to

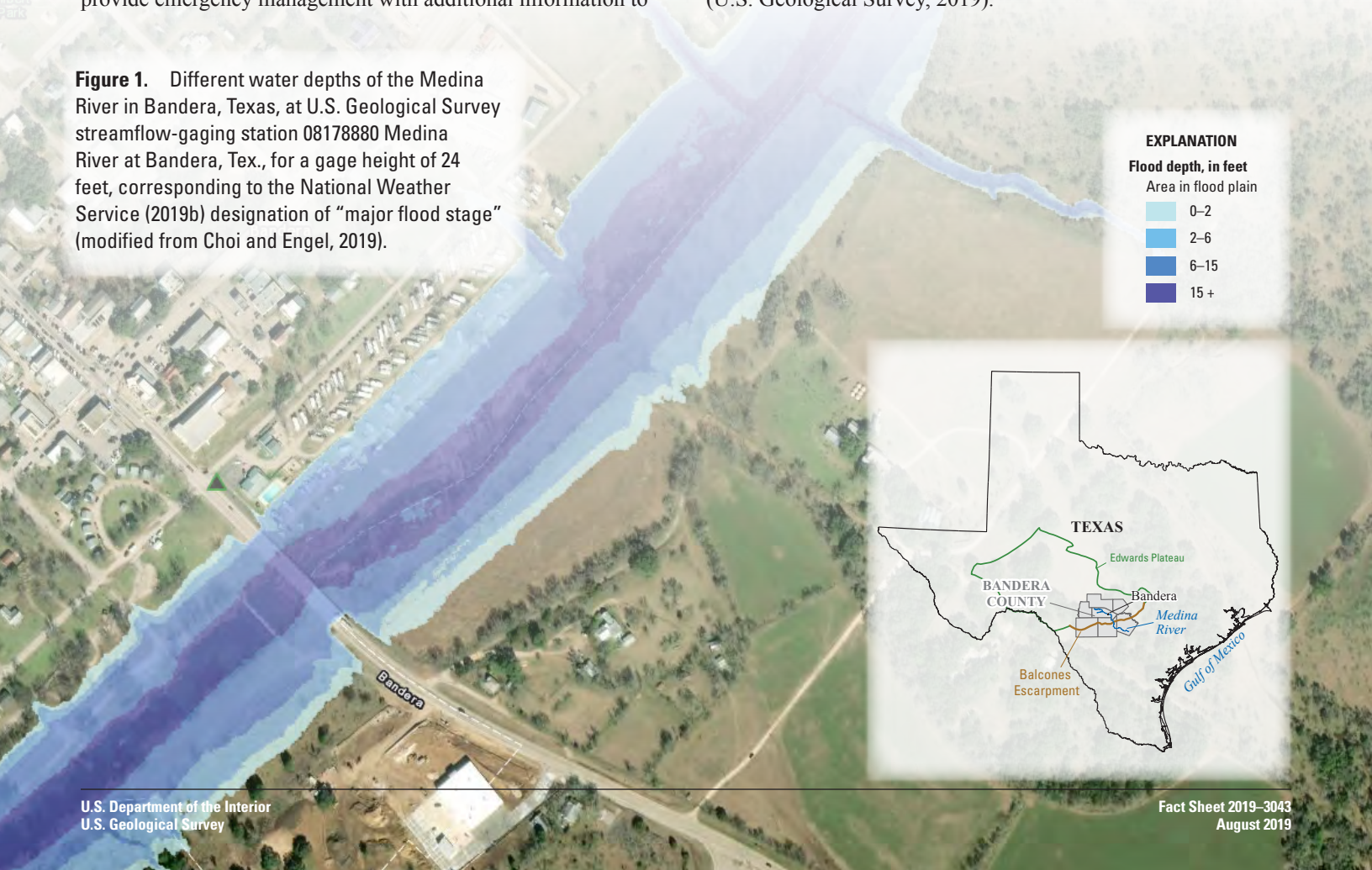
improve flood response and mitigation. This toolset consists of a continuous streamflow-gage monitoring network, a well-calibrated hydraulic model of the Medina River, and a flood-inundation mapper application for the study area. A library of flood-inundation maps tied to the National Weather Service (NWS) river stage forecast capability is included with the toolset (National Weather Service, 2019b).

Creation of Flood Warning Toolset

Hydrologic Data

In addition to the existing Bandera streamflow-gaging station, two stage-only gaging stations equipped with the ability to collect rainfall measurements were installed upstream from the Bandera station to function as flood warning sites. River measurements at all gages are continuously measured and recorded every 15 minutes, transmitted every hour to a satellite, and made available on the internet through the USGS National Water Information System (NWIS) web interface (U.S. Geological Survey, 2019).

Figure 1. Different water depths of the Medina River in Bandera, Texas, at U.S. Geological Survey streamflow-gaging station 08178880 Medina River at Bandera, Tex., for a gage height of 24 feet, corresponding to the National Weather Service (2019b) designation of “major flood stage” (modified from Choi and Engel, 2019).



Hydraulic Model

To simulate potential flood-inundation areas, a hydraulic model was developed for the 23-mile reach of the Medina River at and near Bandera, Tex. Using high-resolution digital elevation data, aerial photographs to estimate roughness coefficients, field surveys on structures and channel cross sections, and the stage-discharge rating curve established at the Bandera station, the hydraulic model was calibrated to accurately depict the hydraulic characteristics of the study reach. The hydraulic model was then used to develop 29 flood-inundation maps that show potential inundation areas and depths for stages ranging from 10 to 38 feet.

Flood-Inundation Communication

The library of flood-inundation maps is provided to the public through the USGS Flood Inundation Mapping (FIM) Program (<https://www.usgs.gov/mission-areas/water-resources/science/flood-inundation-mapping-fim-program>). The program hosts the Flood Inundation Mapper (<https://wimcloud.usgs.gov/apps/FIM/FloodInundationMapper.html>), the interactive online application that provides detailed information on flood-inundation extents and water depths for each stage at corresponding USGS gaging stations and includes real-time stage at the Bandera station, as well as predicted stage, from the NWS Advanced Hydrologic Prediction Service (AHPS). The public can also subscribe to the USGS WaterAlert service (<https://maps.waterdata.usgs.gov/mapper/wateralert/>) to receive email or text (short message service [SMS]) alerts when selected gaging station parameters, such as streamflow or stage, exceed user-definable thresholds.

The flood-inundation maps developed in this study, in conjunction with the real-time stage data from the Bandera station, are intended to help guide the public in taking individual safety precautions and provide emergency management personnel with a toolset to efficiently manage emergency flood operations and post-flood recovery efforts.



Figure 2. Northeast-oriented view of the Medina River in flood stage at State Route 16 near Bandera, Texas, July 2002 (photograph courtesy of Bandera County Honorable Judge Richard Evans).

This fact sheet is based on the following publication:

Choi, N., and Engel, F.L., 2019, Flood-inundation maps for a 23-mile reach of the Medina River at Bandera, Texas, 2018: U.S. Geological Survey Scientific Investigations Report 2019–5067, 15 p., <https://doi.org/10.3133/sir20195067>.



Figure 3. Inundation in the Medina River near Bandera, Texas, during the July 2002 flood (photograph courtesy of Bandera County River Authority and Groundwater District board member Jerry Sides).

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