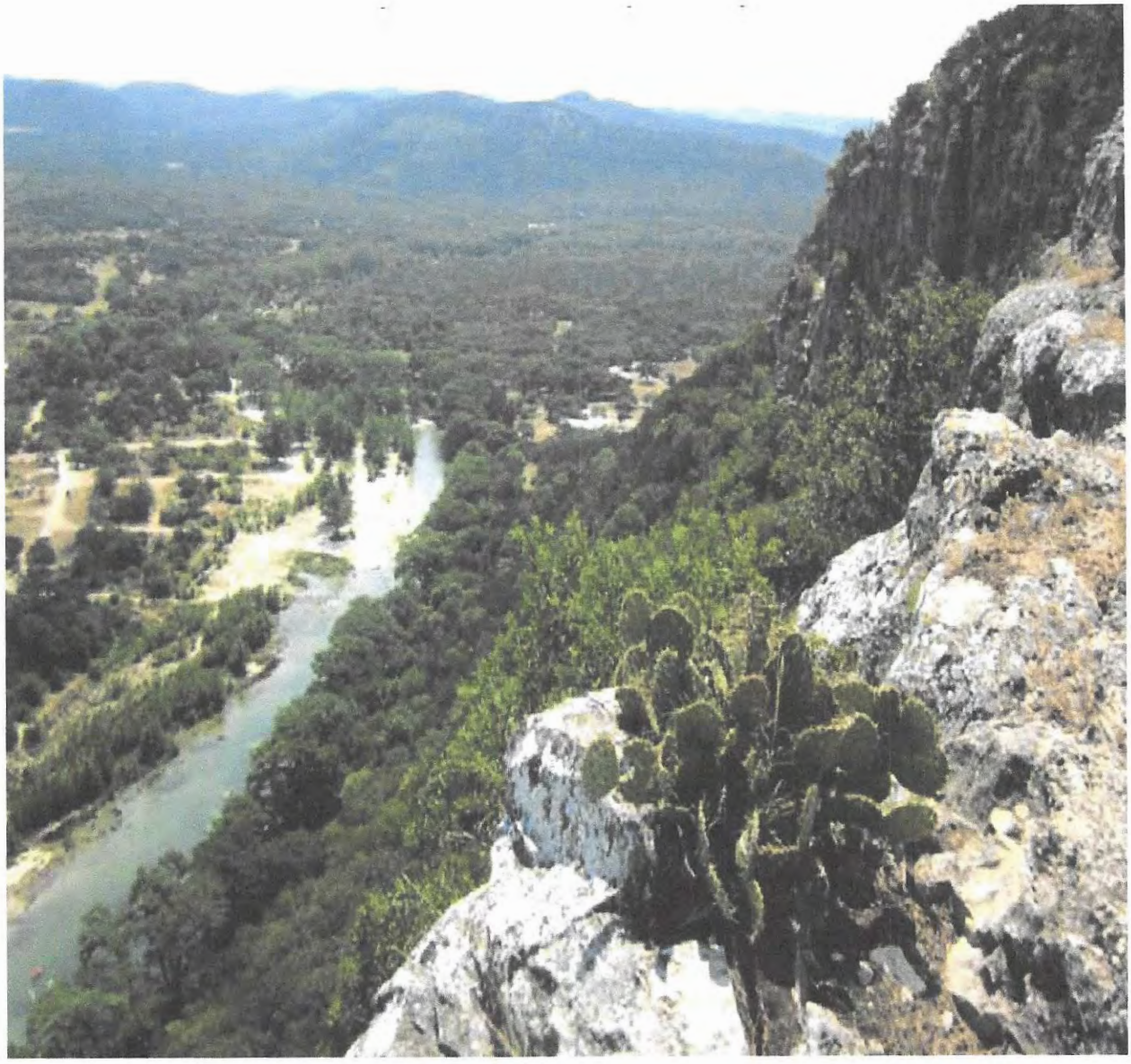


UVALDE COUNTY FLOOD PROTECTION PROGRAM FOR THE NUECES, FRIO, DRY FRIO, LEONA, AND SABINAL RIVERS IN UVALDE REAL AND BANDERA COUNTY

Introduction

Annual flood losses across the United States over the last 30 years averaged about $7.96 billion with 82 fatalities per year (NOAA, 2017a). In 2011 alone, there was a reported $9.1 billion in direct damages and 113 reported fatalities due to flooding in the United States (NOAA, 2017a). The headwaters of streams in Uvalde County (fig. 1) are influenced by the Texas Hill Country hydrology where high intensity rain rates and steep terrain frequently contribute to flash flooding, leading to potential loss of life and property. The devastating flooding in Uvalde County resulted in massive loss of property during 2015. While floods are impossible to prevent completely, and there is no way to guarantee protection of property, the U.S. Geological Survey (USGS), National Weather Service (NWS), and other federal, state, and local agencies have demonstrated that the economic impacts and loss of life associated with flooding can be greatly reduced with more informed flood warning systems.

A key aspect of flood warning systems is having a network of rainfall and streamflow gaging stations located upstream of at-risk areas. These gaging networks can provide advanced notice of potential impending floods. Data from real-time datasets, are transmitted every fifteen minutes from the sites and posted on the Uvalde County website. Flood early warning systems are estimated to show a potential savings of as much as $1.62 billion annually (EASPE, 2002).

Uvalde County, located in the Texas Hill Country has more miles of fresh water streams and rivers than any other county in Texas (Honorable William R. Mitchell, Uvalde County Judge). These rivers and streams include the Nueces, Frio, Sabinal, Dry Frio, Blanco, Little Blanco, and Leona River.

One specific area of flooding concern in Uvalde County is the Frio River along the reach from Leakey to Con Can. Specifically, Garner State Park, which is located between Leakey and Con Can, attracts several thousand tourists from across Texas on an annual basis. Unfortunately, many of the visitors are not aware of the Hill Country hydrology and associated potential

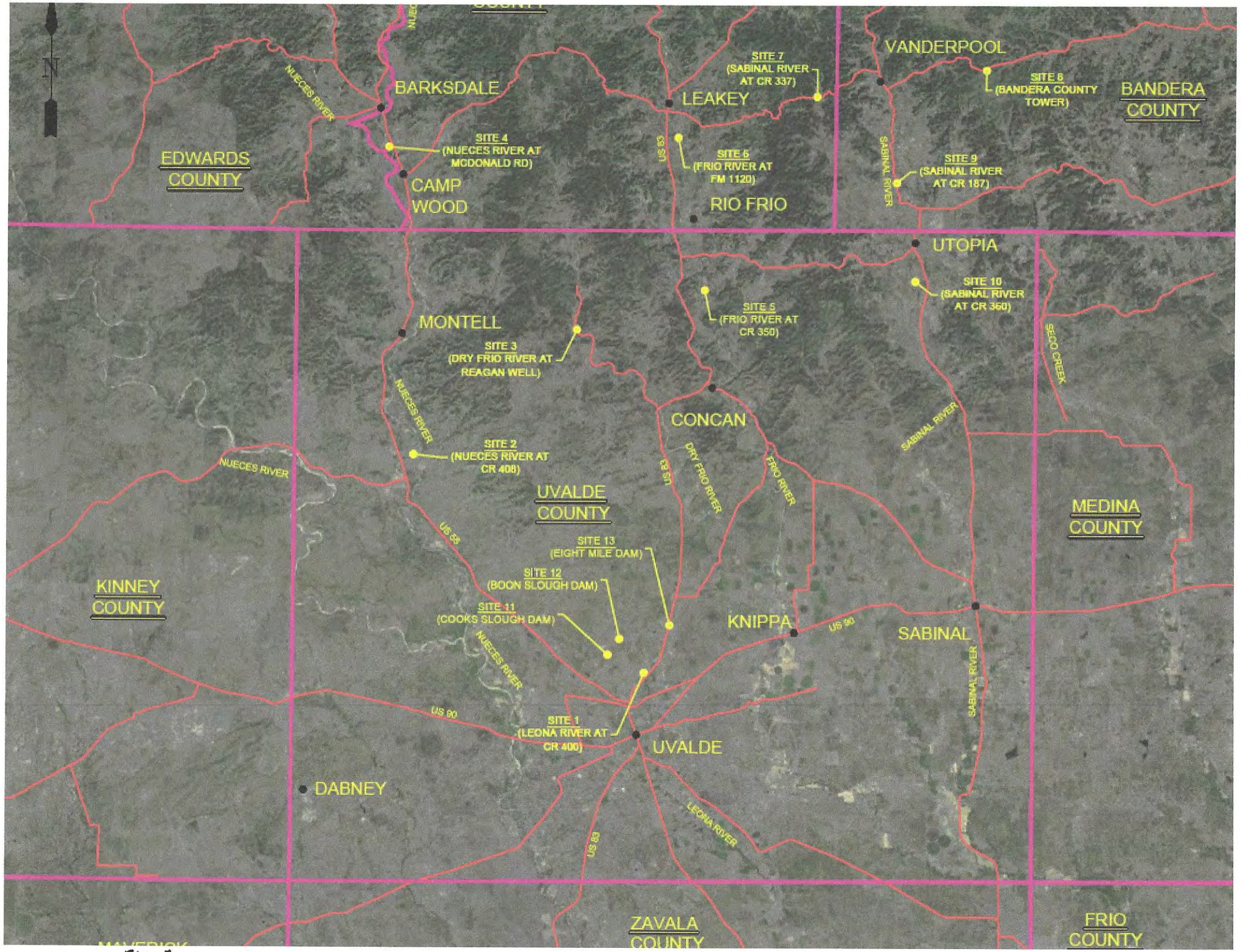

N
EDWARDS COUNTY
NUECES RIVER
BARKSDALE
SITE 4 (NUECES RIVER AT MCDONALD RD)
CAMP WOOD
SITE 7 (SABINAL RIVER AT CR 337)
LEAKEY
US 83
SITE 6 (FRIO RIVER AT FM 1120)
RIO FRIO
VANDERPOOL
SITE 8 (BANDERA COUNTY TOWER)
BANDERA COUNTY
SABINAL RIVER
SITE 9 (SABINAL RIVER AT CR 187)
UTOPIA
SITE 10 (SABINAL RIVER AT CR 360)
SITE 5 (FRIO RIVER AT CR 350)
SECO CREEK
MONTELL
SITE 3 (DRY FRIO RIVER AT REAGAN WELL)
NUECES RIVER
CONCAN
SABINAL RIVER
SITE 2 (NUECES RIVER AT CR 408)
DRY FRIO RIVER
FRIO RIVER
US 83
NUECES RIVER
UVALDE COUNTY
MEDINA COUNTY
US 83
SITE 13 (EIGHT MILE DAM)
SITE 12 (BOON SLOUGH DAM)
KINNEY COUNTY
SITE 11 (COOKS SLOUGH DAM)
KNIPPA
US 90
SABINAL
NUECES RIVER
SABINAL RIVER
US 90
SITE 1 (LEONA RIVER AT CR 400)
UVALDE
DABNEY
LEONA RIVER
US 83
ZAVALA COUNTY
FRIO COUNTY

Fig. 1

flooding hazards. To assist emergency management staff in conveying potential, or impending, hazards a flood protection program is critical in this popular recreational area.

Similarly, a second area of flooding concern is along the Sabinal River from approximately Vanderpool to Sabinal, Tex. Though the Sabinal is a smaller river than the Frio, it is as prone to flash flooding as the Frio is.

Problem Statement

The lack of real-time rainfall monitoring and streamflow gaging stations in the upstream reaches of the Frio, Sabinal, Nueces, and Leona Rivers means there are limited hydrologic data available to help provide an early warning of impending flooding. Rainfall and streamflow monitoring stations are needed by local authorities, emergency-response managers, and the National Weather Service to provide valuable early-warning information.

Objective

To help assess potential risks associated with flooding events Uvalde County and Texas Water Development Board developed a flood monitoring system for Uvalde County, Real County and Bandera County. This included real-time rainfall and streamflow-gage monitoring network. Community meetings were scheduled to assist Uvalde County in formulating the flood protection plan. The first meeting was conducted in Con Can on March 27, 2017. Twenty seven participants contributed to this meeting, stressing the need for a flood protection system and the need to provide flood protection information not only for local residents but folks who visit this recreational area between Leakey and Con Can.

Uvalde County scheduled and conducted two (2) additional public information meetings with cooperating communities and stakeholders. On April 13, 2017 the second public meeting for the TWDB Flood Protection Early Warning System was held in the City of Sabinal at 6:30 p.m. at the Senior Citizen Building. Seven (7) participants attended and gave their views and comments regarding the proposed project. Then on April 20, 2017 at 5:00 p.m. the third public information meeting for TWDB Flood Protection Early Warning System was held in Utopia. Thirty (30) participants attended and gave their views and comments regarding the proposed

project. Of most importance at the Utopia meeting was public comment that Utopia residents could greatly benefit by knowing how much it rained during an event on the upper Sabinal River watersheds, in order to inform the residents of Utopia of potential flooding that might occur. This public input was incorporated into the Uvalde County Early Warning System Plan, resulting in rainfall gauges being installed on the West Prong of the Sabinal River on RR 337 West in Real County and a rainfall gauge being installed on RR 337 East in Bandera County. At the time of construction completion community meetings were again held to inform the public on how to access the rainfall and stream flow data from the Uvalde County Early Warning System website. On April 29, 2019 an informative meeting was held at the Con Can Community Center sponsored by the Texas Hill Country River Region. Another public meeting was conducted at Utopia May 8, 2019. Additionally on May 27, 2019 the Uvalde County Commissioners Court was immersed in a tutorial on how to navigate the website that compiles the data from the Uvalde County Flood Warning System.

Approach

On January 30, 2019 a training session was held at the Uvalde County Fairplex to inform Uvalde County residents on how to view the data collected from instrumentation installed along Uvalde County rivers and streams. The event was attended by first responders, volunteers with the Uvalde County Emergency Operations Center and local and surrounding area officials and residents. Residents are able to view the data by visiting uvalde.onerain.com or the Uvalde County main website. The training was conducted by Mike Zucosky of Colorado based One Rain a provider of rainfall related data. Contrail user training included viewing data with map view, and site lists, use of single and multiple graphs, retrieving historical data, exporting data, and an overview of the detailed help system. Training for Administration for Core Staff such as the Uvalde County Emergency Operation Center staff included setting up users, and authorizing privilege levels, establishing sites and sensors, creating validation formulas, setting thresholds, creating alarm rules and notifications and adding content and links to the home page. Early detection of potential flood conditions and reliable flood forecasting are critical components of an effective local flood warning system. Advance warning of impeding floods can save lives and prevent extensive property damage. The data collected from the Early Warning System will be

made available to the Weather Service Stations to assist the National Weather Service in their decision making to issue warnings during severe weather events. Additionally the website can be accessible through Facebook, as a posted link from either the Uvalde County's Sheriff's Department or the Uvalde County Emergency Operation Center. Uvalde County selected High Sierra Electronics and One Rain the Rainfall Company for their flood warning and environmental monitoring equipment. HSE's monitoring systems include all remote site equipment, communications equipment, and central base station equipment and software required for a complete integrated solution. HSE's are ideally suited for applications requiring real-time environmental data – measurements of rainfall and water levels in rivers. The HSE system includes network ready software to facilitate data management, graphical map displays, activation of alarms, instant messaging, hydrological forecasting and analysis tolls. The software package is an easy to use menu driven program and is capable of feeding public or inter agency websites.

MODEL 3424-00 Rain Gauge Station

The Model 3424-00 Rain Gauge Station generates real time data to help in flood warning, reservoir management and any other application that calls for timely rainfall information. The data provides information of precipitation patterns and events as they happen helping the system operator understand and predict runoff. This information facilitates the decision making of emergency management personnel during time of potential flooding helping to save property and lives.

The Rain Gauge tipping bucket is machined from a solid piece of aluminum. This eliminates the possibility of cracks forming due to repeated freezing and melting which could result in leakage and errors. The standard ALERT/IFLOWS tipping bucket measures in 1mm with each tip of the bucket. With each tip of the bucket a magnet passes over a sealed reed switch. This switch closure increments one count in an accumulator (counter) circuit in the 3206-00 ALERT/IFLOWS Transmitter. This awakens the transmitter and initiates a transmission to the base station consisting of the assigned service ID# and the accumulator value. As a result, the computer and its forecasting software compute within 1mm the rainfall amounts at gauges throughout the system.

MODEL 3466 packaged Pressure Transducer Station

The MODEL 3466 packaged Pressure Transducer Station provides real-time data for monitoring water levels at dams, streams or most anywhere hydrological data is needed with an accuracy of 0/1%. An advantage of this pressure transducer is that the signal conditioning for the sensor is mounted in a desiccant box, thus making it easy to access and allowing for the periodical recalibration of the transducer insuring the long term accuracy and stability of data. The pressure transducer station includes a weatherproof Sandpipe Assembly, ALERT/IFLOWS Data transmitter with battery, Pressure Transducer w / Desiccant Box, Spun Cap Antenna, Antenna Mast & Cable, and Rainfall Gauge Top Section.

ALERT Data Transmitter

The ALERT Data Transmitter allows one to receive data from your critical monitoring sites. The Data Transmitter is a powerful and flexible addition to the ALERT family of products with the field technician in mind. The Model 3316 is housed in a weather resistant NEMA enclosure. The standard configuration accepts analog inputs, up to 2 shaft encoders, and up to 2 precipitations. The basic programming mode allows the user to configure the unit simply by using rotary switched. The user can program parameters independently for each sensor to be logged. Data is logged on a Secured Data (SD) memory card and can be retrieved via the USB port. The SD memory card can also be removed for later downloading and replaced with a spare card. The transmitters are supplied with a VHF or UHF data radio for ALERT data transmission; however other communication devices such as GPRS radio or CDMA (cellular) can utilize the serial port

Contrail Software

Measuring rainfall, river or stream water levels at several points upstream, combined with reliable and timely communications and dissemination of information via Contrail, ensures Uvalde County that sufficient lead time for actions that reduce risk, minimize losses and possible

save lives. One Rain's Contrail software platform collects processes and archives rainfall, flow level, weather station and many other hydro meteorological data from virtually any sensor type and transmission protocol. Contrail supports ALERT line of sight radio data, cellular and satellite weather gauge data as well as any web-accessible sources such as USGS gauges, RWIS and more. At the core of Contrail is its 24/7 continuous real-time data collection monitoring advanced alarm and automated delivery notifications that ensures information is automatically distributed quickly and efficiently to appropriate personnel to warn of possible flood conditions. Contrail empowers decision makers and response personnel with critical real-time information through highly customizable alarm rules, communicating response actions and multiple alert delivery notification options.

The Uvalde County Emergency Operation Center core staff and Uvalde County officials will be continually utilizing and monitoring the Flood Early Warning System data. As time progresses and rainfall events are monitored formulas and thresholds will be set for creating alarms and notifications. The system has the capability for users to receive alarms and notifications during a flood event.

From the trainings and stakeholders meetings at the end of the project it was discussed that additional rainfall gauges and stream flow monitoring equipment should be considered to be installed in the upper watersheds of both the West Prong and East Prong Frio River in Real County. This would provide for earlier detection with additional information and data to be received for the most populated resort and camping areas in and around Garner State Park and the Con Can area. Another concern is that Uvalde County should consider an additional antenna for data to be received by the Uvalde County Emergency Operation Center staff. Currently an antenna is shared with multiple entities on property that is not owned by Uvalde County. Both of these concerns will have opportunity to address funding requests in the future.

Locations of Rainfall Gauges and Streamflow Monitoring Equipment

Thirteen (13) sites were prioritized by Uvalde County stakeholders to receive rainfall gauges and/or stream flow monitoring equipment. The sites are as follows:

1. Bandera Tower in Bandera County on RR 337 West. 29.7594380, -99.4604140. Rainfall gauge only. This location was due to the request of Utopia residents in order to monitor rainfall data from the upper watershed area of the Sabinal River.

2. Boon Slough at the Boon Slough Flood Prevention Dam on Willingham Ranch eight miles north of Uvalde. 29.2834460, -99.8154180. Rainfall gauge and streamflow monitoring equipment installed. This location was due to the request of the Nueces Frio and Sabinal Soil & Water Conservation District.

3. Cook Slough at the Cook Slough Flood Prevention Dam approximately three miles northwest of Uvalde. 29.2703930, -99.8267560. Rainfall gauge and streamflow monitoring equipment installed. This location was due to the request of the Nueces Frio and Sabinal Soil & Water Conservation District.

4. Dry Frio River at the Reagan Wells Baptist Church, RR 1049 Reagan Wells, Uvalde County Texas. 29.5412330, -99.8478950. Rainfall gauge and streamflow monitoring equipment installed.

5. Frio River at FM 1120 first Frio River Crossing approximately five miles South of Leakey, Real County Texas. 29.6943200, -99.7525200. Rainfall gauge and streamflow monitoring equipment installed.

6. Frio River at Uvalde County Road 350, Magers Crossing south of Garner State Park, Uvalde County Texas. 29.5761930, -99.7250360. Rainfall gauge and streamflow monitoring equipment installed.

7. Leona Dam at 8 mile ranch on Leona River Uvalde County, Texas. 29.2948590, -99.7682180. This location was due to the request of the Nueces Frio and Sabinal Soil & Water Conservation District. Rainfall gauge and streamflow monitoring equipment installed.

8. Leona River at Uvalde County Road 400 Uvalde County, Texas. 29.2568660, -99.7786290. Rainfall gauge and streamflow monitoring equipment installed.

9. Nueces River at Uvalde County Road 408 Uvalde County, Texas. 29.4430810, -99.9939820. Rainfall gauge and streamflow monitoring equipment installed.

10. Nueces River at McDonald Road Real County, Texas. 29.6941900, -100.0270360. Rainfall gauge and streamflow monitoring equipment installed.

11. Sabinal River at Uvalde County Road 360 Uvalde County, Texas. 29.5850680, -99.5265370 Rainfall gauge and streamflow monitoring equipment installed.

12. Sabinal River at SH 187, Bandera County. 29.6664180, -99.5443840. Rainfall gauge and streamflow monitoring equipment installed.

13. West Sabinal River at RR 337 East Real County, Texas. 29.7361420, -99.6190620. Rainfall gauge only. This location was due to the request of Utopia residents.

Scheduled maintenance of equipment

Estimated maintenance of thirteen (13) gauges is proposed at approximately $1,200.00 each or approximately $15,600.00 annually. Additionally the maintenance of the Contrail Server is offered at $6,000.00 annually. Minor maintenance, such as cleaning rainfall gauges of debris will be conducted by Uvalde County. Uvalde County will contract with High Sierra Electronics for the maintenance of electronic equipment. This will be budgeted on an annual basis. Equipment is guaranteed for 12 months with the warranty ending April 2020.

Scheduled monitoring of equipment

Currently Uvalde County is monitoring the all equipment for proper recording and transmitting. As issues or concerns arise Uvalde County will contact High Sierra Electronics to request a technician to the field to address any concerns. One Rain/High Sierra will continue to address concerns/issues throughout the life of the weather stations.

References

EASPE, I., 2002. Use and Benefits of the National Weather Service River and Flood Forecasts. *http://www.nws.noaa.gov/oh/ahps/AHPS Benefits.pdf*, accessed July 27, 2017.

Honorable William R. Mitchell, Uvalde County Judge

National Oceanic and Atmospheric Administration, 2017a: National Weather Service. *http://www.nws.noaa.gov/hic*, accessed July 11, 2017.

BANDERA TOWER 29.7594380, -99.4604140

RAINFALL GUAGE ONLY

BOON SLOUGH DAM 29.2834460, -99.8154180

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

COOKS SLOUGH DAM 29.2703930, -99.8267560

RAINFALL GUAGE AND STREAM FLOW MONITORING EQUIPMENT

DRY FRIO RIVER AT REAGAN WELLS BAPTIST CHURCH 29.5412330, -99.8478950

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

FM 1120 AT FRIO RIVER 29.6943200, -99.7525200

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

FRIO RIVER AT UVALDE COUNTY ROAD 350 29.5761930, -99.7250360

MAGERS CROSSING

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

LEONA DAM AT 8 MILE WATERHOLE DAM 29.2948590, -99.7682180

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

LEONA RIVER AT UVALDE COUNTY ROAD 400 29.2568660, -99.7786290

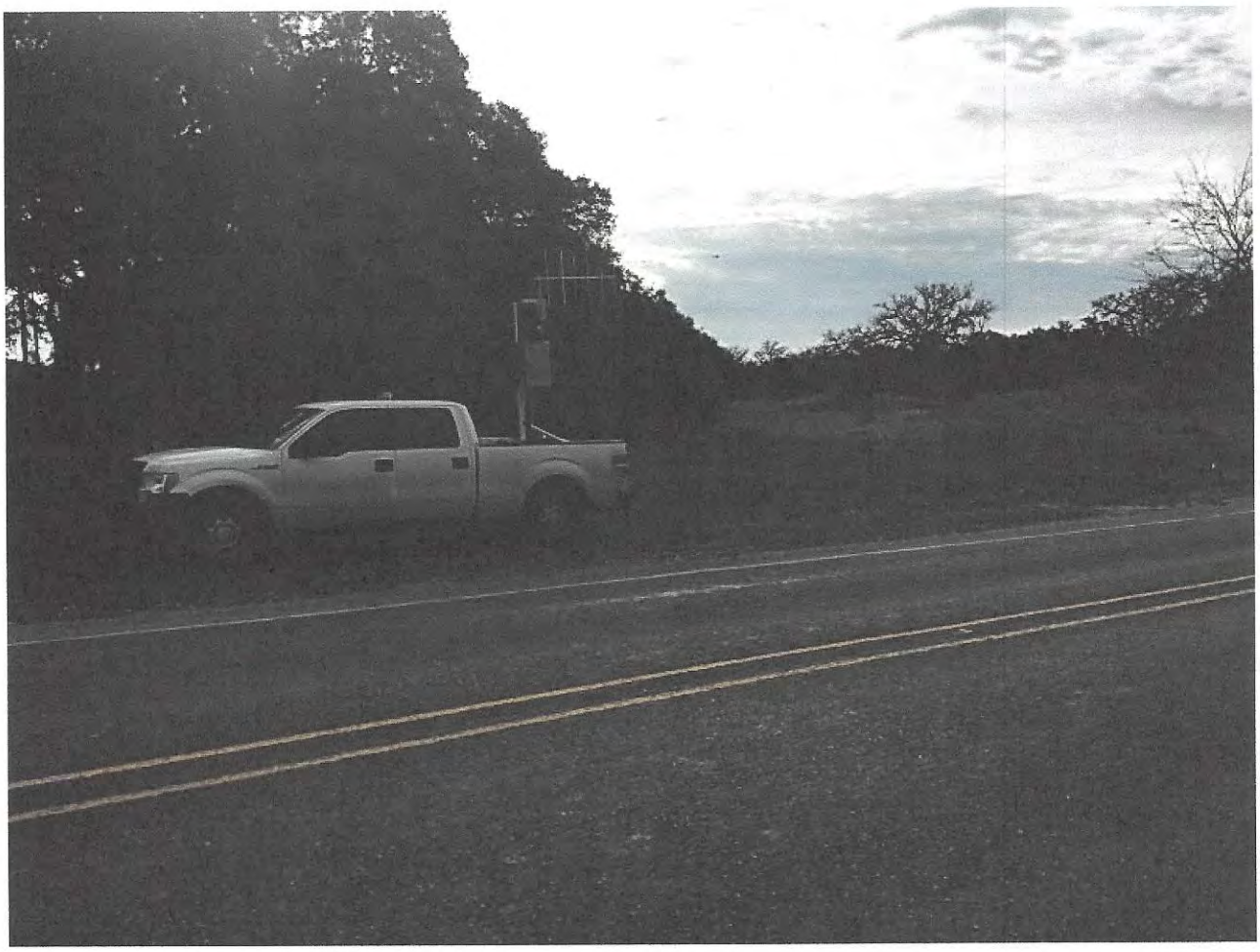
RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

NUECES RIVER AT UVALDE COUNTY ROAD 408 29.4430810, -99.9939820

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

SABINAL RIVER AT UVALDE COUNTY ROAD 360 29.5850680, -99.5265370

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT



SABINAL RIVER AT RANCH ROAD 187 29.6664180, -99.5443840

RAINFALL GUAGE AND STREAMFLOW MONITORING EQUIPMENT

WEST SABINAL RIVER AT RR 337 WEST 29.7361420, -99.6190620

RAINFALL GUAGE ONLY

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

The Honorable William R. Mitchell
Uvalde County
100 N. Getty Street
Courthouse Plaza No. 3
Uvalde, Texas 78801

RE: Flood Protection Grant with Uvalde County; Contract No. 1600012050, Comments on Draft Report Entitled "**Uvalde County Flood Early Warning System Project**"

Dear Judge Mitchell:

Staff members of the Texas Water Development Board (TWDB) have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT 1 provides the comments resulting from this review. As stated in the TWDB contract, Uvalde County will consider revising the final report in response to comments from the Executive Administrator and other reviewers. In addition, Uvalde County will include a copy of the Executive Administrator's draft report comments in the Final Report.

Please note: The TWDB logo should not be used in the Final Report.

The TWDB's Contract Administration staff looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and five (5) bound double-sided copies. **Please further note, that in compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report must comply with the requirements and standards specified in statute. For more information, visit http://www.sos.state.tx.us/tac/index.shtml.** If you have any questions on accessibility, please contact David Carter with the Contract Administration Division at (512) 936-6079 or david.carter@twdb.texas.gov.

Uvalde County shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

If you have any questions or need any further information, please feel free to contact Ms. Sara Hustead of TWDB's Flood Mitigation Planning staff at 512-463-8184 or sara.hustead@twdb.texas.gov.

Sincerely,

John T. Dupnik, P.G.
Deputy Executive Administrator
Water Science and Conservation

Date: 6/29/19

Attachment

c w/o att.: Ms. Sara Hustead, Flood Mitigation Planning

ATTACHMENT 1

Uvalde County Flood Early Warning System Project
County of Uvalde
Contract #1600012050
Texas Water Development Board Comments to Draft Report

REQUIRED CHANGES

General Draft Report Comments:

In general, the study follows standard methodologies and practice. Mitigation alternatives identified may be eligible for funding under the Texas Water Development Board's financial assistance programs. Application requirements and eligibility criteria are identified by Texas Water Development Board rules specified in Section 363 of the Texas Administrative Code (TAC). The report would be appropriate for use in support of an application to the Board for financing the proposed improvements. All additional information required by Board rules, 31 TAC 363.401-404, as well as necessary information to make legal findings as required by Texas Water Code chapter 17.771-776, would be required at the time of loan application.

Please conduct a final edit of the document for grammar, spelling, typographical errors, and inconsistent usage of acronyms, and abbreviations. Please spell out all acronyms, with the acronym in parentheses, the first time they are used. Please include a list of acronyms used in the report after the Table of Contents.

Specific Draft Report Comments:

1. **Introduction, page 2** – Please designate which figure is being referred to in the sentence "*The headwaters of streams in Uvalde County (fig. 1)*". We were unable to locate a "Figure 1".

2. **Introduction, page 2** – Please provide the source for the data in the sentence "*Flood Early Warning Systems are estimated to show potential savings of as much as $1.62 billion annually*".

3. **Introduction, page 2** – Please provide the source for the information in the sentence "*Uvalde County...has more miles of fresh water streams and rivers than any other county in Texas*".

4. **Objective, page 3** – Please specify which counties will benefit from the Flood Early Warning System.
5. **Objective, page 3** – Please list the dates for the other public meetings that were held.
6. **Objective, page 3** – Please provide some detail regarding stakeholder input that was received at the Public Meetings.
7. **Approach, page 4** – Please briefly mention that the County received training from OneRain/High Sierra Electronics.
8. **Contrail Software, page 6** – Please provide some detail about the different alarm rules that can be applied and customized.
9. **Locations, page 6** – Please provide latitude and longitude for all thirteen sites. If you have photos, that would also be a great addition.
10. **Locations, page 6** – Please provide more information as to why the citizens of Utopia requested a rainfall gauge only.
11. **Locations, page 6** – Please specify, in all thirteen site descriptions, if the site is only a rain gauge, or if it also has streamflow monitoring equipment.
12. **Scheduled Maintenance of Equipment, page 7** – Please specify if Uvalde county will be doing any maintenance of the weather stations, or if the County will pay to have the stations maintained by OneRain/High Sierra indefinitely.
13. **Scheduled Monitoring of Equipment, page 7** – Please specify if OneRain/High Sierra will continue to address issues/concerns throughout the life of the weather station or if there is a finite date that that support will end.
14. **Request for Additional Information** – The report does not include a discussion of the community staff or personnel that will be utilizing the Flood Early Warning System data. Please, provide a discussion of the personnel that will be utilizing the information, when it will be used, and how flood early warnings will be conveyed to citizens.

Exhibits and Tables Comments:

1. Please provide a map listing all the locations of the weather stations.