Final Report

Guadalupe Blanco River Authority

Early Warning System – San Marcos Watershed in Caldwell County, Texas

TWDB Contract No. 1600012042

April 26, 2019

Ms. Sarah Hustead
Texas Water Development Board
PO Box 13231
Austin, TX 78711-3231

Re: TWDB Contract No. 1600012042
Early warning system Report - San Marcos Watershed in Caldwell County, Texas

Dear Ms. Hustead:

The project for the installation of eight rainfall gauges and two outdoor early warning sirens in Caldwell County is complete. In accordance with the construction grant, transmitted herewith is 5 original bound final reports entitled: Final Report – Guadalupe Blanco River Authority – Early Warning System Report - San Marcos Watershed in Caldwell County, Texas; TWDB Contract No. 1600012042.

This report includes a Table of Contents, Scope of Work, Equipment Installed and List of Figures as set out in Contract No. 1600012042.

Please contact me should you have any questions or require any additional information to finalize the reporting requirements

Sincerely,

Thomas D. Hill, P.E.
Chief Engineer

Main Office: 933 East Court Street ~ Seguin, Texas 78155
830-379-5822 ~ 800-413-4130 ~ 830-379-9718 fax ~ www.gbra.org

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LIST OF ACRONYMS

EAA – Edwards Aquifer Authority

EMC – Emergency Management Coordinator

GBRA – Guadalupe Blanco River Authority

HADS – Hydrometeorological Automated Data System

LCRA – Lower Colorado River Authority

NEMA – National Electrical Manufacturers Association

NWS – National Weather Service

NWS/FAA – National Weather Service/Federal Aviation Administration

NWS-RFC – National Weather Service River Forecast Center

SCADA - Supervisory Control and Data Acquisition

USGS – United Stated Geological Survey

RAINFALL SCADA CALDWELL COUNTY

INTRODUCTION

A. General Purpose

The areas all along the San Marcos River watershed have seen considerable growth. With rapidly developing communities bringing concerns about the increasing threat of flooding and associated damages due to increased urbanization. These areas have been hit hard affecting many populated areas, scenic and environmental resources since major flood events in 1998, 2002, the Memorial Day Flooding in May 2015 and again on October 30, 2015.

The Texas Hill County is known as "Flash Flood Alley". This area is the most flash flood-prone in the state, and among the most flood-prone areas in the country. Much like other flash flood-prone communities across the country, the geography in this region can rapidly transform the rivers and creeks in the Hill Country into raging tidal surges of water, mud and debris that is capable of taking out entire homes, businesses, roads and bridges.

The purpose of this project provided additional rainfall gauges to an early warning system in the watershed of the San Marcos River by expanding it into Caldwell County. Using existing supervisory control and data acquisition (SCADA) system, the Guadalupe-Blanco River Authority (GBRA) network incorporated these gauges into their monitoring network. The real-time monitoring of the rainfall gauges allows for a rapid response to changing conditions, reducing losses and improving the overall efficiency in notifying City Officials and Emergency Management Coordinators (EMC) and officers of potential flooding.

The Blanco - Memorial Day Flood of 2015 brought to light the need to improve metrological data collection within the watershed. Due to the steep terrain of the upper watershed, floodwaters peak higher and travel faster than most rivers. The high growth rate of the region, and the accompanying additions of impervious cover leading to runoff of floodwaters in major rain events, increases the potential for additional loss of life in the future for residents and those coming to the area for recreational activities.

B. SCOPE OF WORK

The project sets out to expand the existing GBRA rainfall network into Caldwell County. The existing GBRA rainfall program was created to provide a data collection platform with the Guadalupe River Watershed to support flooding monitoring and flood forecasting efforts by the National Weather Service (NWS) and local emergency responders. The network in Caldwell County assists in improved forecasting and warning dissemination along the San Marcos River watershed by (1) an expansion of the rainfall telemetry network in Caldwell County, TX and (2) the installation of warning sirens in the City of Martindale.

Additional rain gauges maintained by other entities located in Caldwell County are shown in Figures "A-2" and "A-3". These gauges are sponsored by Hydrometeorological Automated Data System (HADS); Lower Colorado River Authority (LCRA); and National Weather Service/Federal Aviation Administration (NWS/FAA).

Type of Rain Gauge Equipment:

The eight rainfall gauging sites utilized equipment which was consistent with the existing GBRA rainfall network. Each rain gauge site consisted of a 6 inch diameter tipping bucket rain gauge Model TR-525 by Texas Electronics, Inc., a SCADA-Pack Model 201 programmable logic controller with a built-in Freewave Radio and a Yagi antenna. Power was provide by a 50 watt solar panel and 75 amp-hour battery. The battery has the electrical storage capacity to last 6 or 7 days with minimal sunlight.

The equipment was placed in a NEMA 4 Electrical metal box and mounted on a vertical 4 inch diameter galvanized pole which transitioned to a 3 inch pole at the top. The electrical enclosure equipment was placed 6 to 7 feet above the ground to minimize vandalism. The solar panel, tipping bucket and Yagi antenna was located toward the top of the pole.

Outdoor Siren Equipment:

Federal Signal Model 2001-130 Siren was purchased for alerting citizens of the City of Martindale of an impending flood event on the San Marcos River. The system consists of two outdoor warning sirens located adjacent to the San Marcos River. The siren locations were selected based on a) obtaining right of way from willing property owners and b) source of 240 volt power circuits and c) appropriate acoustic levels to reach most homes within the flood prone areas. The first site is located 600 feet North West of Martindale City Hall while the second site is 9000 feet North West of City Hall. See Figure C-1 for area location map-siren locations.

The Outdoor warning siren system consists of a 50 foot pole, antenna, radio-styled and omni-directional siren. The radio is a VHF radio that interfaces with the Caldwell County Sheriff's radio system. The Model 2001-130 omni-directional siren utilizes an AC/DC motor, controlled with battery backup in the event of a power failure.

Siting of Rainfall Gauges

A number of factors were used to select the gauge locations including:

a) Maintain spacing between gauges to 5 or 6 miles.
b) Insure an unobstructed radio frequency path to the site,
c) The ease of obtaining right of way for the equipment.
d) A site location which provides ease of access for maintenance.

A review of past studies suggested rain gauges should be spaced approximately 7 to 8 miles apart. Due to the compact nature of storm events in Central Texas, a spacing of 5-6 miles was selected and used where possible. The map showing the location and coordinates for the rain gauges can be found in Figure "A-1", "A-2", and "A-3". Pictures of each rain gauge can be found in Figures "B-1" through "B-8".

Siting of Outdoor Sirens

The primary purpose of the siren is to warn homeowners within the flood plain along the San Marcos River in Martindale. The sirens were placed no further than ½ mile from the San Marcos River and no further than two miles from each other. The siren placement acoustic map can be found in Figure "C-1". Pictures of the two sirens can be found on Figures "C-2" and "C-3".

Use of Data

Rainfall data is available for use by a number of entities and include:

a) County Road Administrator to identify and install flood road blockage of low water crossings
b) County Emergency Management Coordinator (EMC) to assist with localized flooding issues.
c) The NWS Forecast Office to help forecasters decide whether to issue flood and weather warning
d) The NWS River Forecast Center in Fort Worth utilizes this data to assist with the calibration of NEXRAD weather radar rainfall estimates. This process is sometimes referred to as "ground-truthing."
e) General Public to better prepare for a developing heavy rainfall event.

Access to Data

The rainfall-telemetry gauge reports every 6 minutes to the Master GBRA computer located in Seguin, Texas. A web report is published every 10 minutes in a tabular format. The data can be accessed from two sources:
a) Data can be found at https://www.gbra.org/rain. The web report displays rainfall totals for every 1hour, 3-hour, 6-hour and 24-hour. See Figure "D-1a"
b) The Caldwell county eight gauging sites along with the other GBRA gauging sites are also displayed on the TWDB TexMesonet web-site and can be found at https://www.texmesonet.org/.

TexMesonet provides access to rainfall data from not only GBRA but from Lower Colorado River Authority (LCRA), United Stated Geological Survey (USGS), Federal Aviation Administration (FAA), Edward Aquifer Authority (EAA) and City of Austin. See Figure "D-1b".

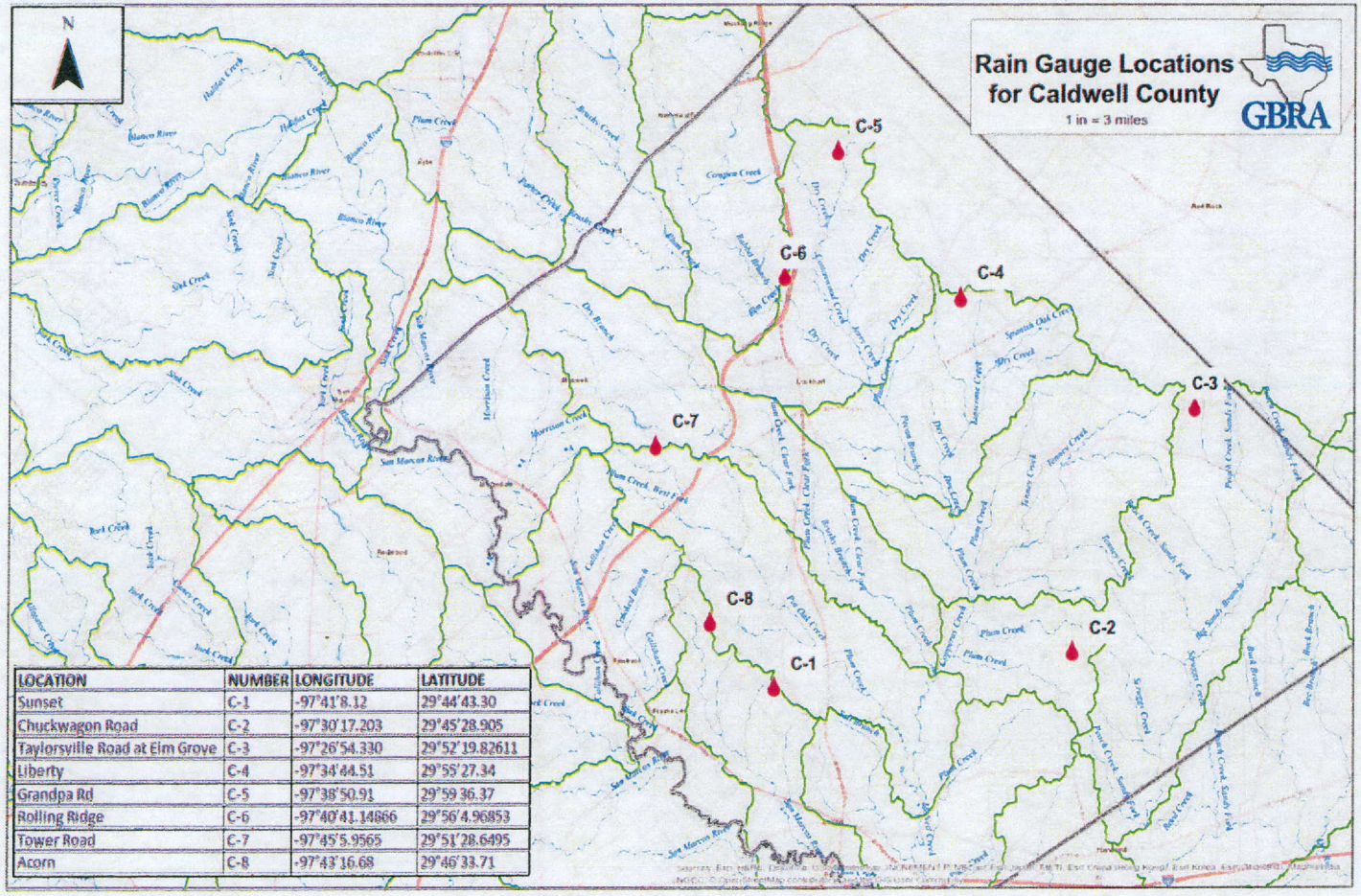
Maintenance

Rainfall sites will be visited at least every two to three months to check for visual signs of damages from high wind or vandals. The rain gauges will be inspected to insure the tipping bucket mechanism is not jammed. The battery will need to be checked at least once a year. The battery is expected to last for four to six years. The remaining equipment will have a life expectancy of twenty-five to thirty years.

FIGURE "A-1"

AREA MAP

RAINFALL GAUGE PLACEMENT MAP FOR NEW INSTALLS IN ALDWELL COUNTY WITH TWDB FUNDING



LOCATION	NUMBER	LONGITUDE	LATITUDE
Sunset	C-1	-97°41'8.12	29°44'43.30
Chuckwagon Road	C-2	-97°30'17.203	29°45'28.905
Taylorsville Road at Elm Grove	C-3	-97°26'54.330	29°52'19.82611
Liberty	C-4	-97°34'44.51	29°55'27.34
Grandpa Rd	C-5	-97°38'50.91	29°59 36.37
Rolling Ridge	C-6	-97°40'41.14866	29°56'4.96853
Tower Road	C-7	-97°45'5.9565	29°51'28.6495
Acorn	C-8	-97°43'16.68	29°46'33.71

FIGURE "A-2"

ALL RAINFALL GAUGE COORDINATES IN CALDWELL COUNTY

Map Label	Station	Location Name	Latitude	Longitude
LCRA	LRCT2	Lockhart 6 NE - LCRA	30°7'46.9"N	97°53'47.4"W
KHY1	KHY1	San Marcos, San Marcos Municipal Airport - NWS/FAA	29°53'54.24"N	97°52'0.83"W
LLGT2	LLGT2	San Marcos River Near Luling 1S - HADS	29°39'55.4"N	97°39'2.99"W
SMRT2	SMRT2	San Marcos River Near Martindale 1SSW - HADS	29°50'3.46"N	97°50'18.64"W
GBR01	GBR01	Sunset Trail - GBRA	29°44'43.30"N	97°41'8.12"W
GBR02	GBR02	Chuck Wagon Road GBRA	29°45'28.91"N	97°30'17.20"W
GBR03	GBR03	Taylorville Road - GBRA	29°52'19.83"N	97°26'54.33"W
GBR04	GBR04	Liberty Lane - GBRA	29°55'27.34"N	97°34'44.51"W
GBR05	GBR05	Grandpa Road - GBRA	29°59'36.37"N	97°38'50.91"W
GBR06	GBR06	Rolling Ridge - GBRA	29°56'4.97"N	97°40'41.15"W
GBR07	GBR07	Tower Road - GBRA	29°51'28.65"N	97°45'5.96"W
GBR08	GBR08	Acorn Road - GBRA	29°46'33.71"N	97°43'16.68"W
GBR09	GBR09	Rogers Ranch Road - GBRA	29°58'28.85"N	97°43'51.11"W
GBR19	GBR19	FM 21 off FM 2720 - GBRA	29°56'35.57"N	97°47'56.88"W

FIGURE "A-3"

AREA MAP

PLACEMENT MAP OF ALL INSTALLED RAINFALL GAUGES FOR CALDWELL COUNTY

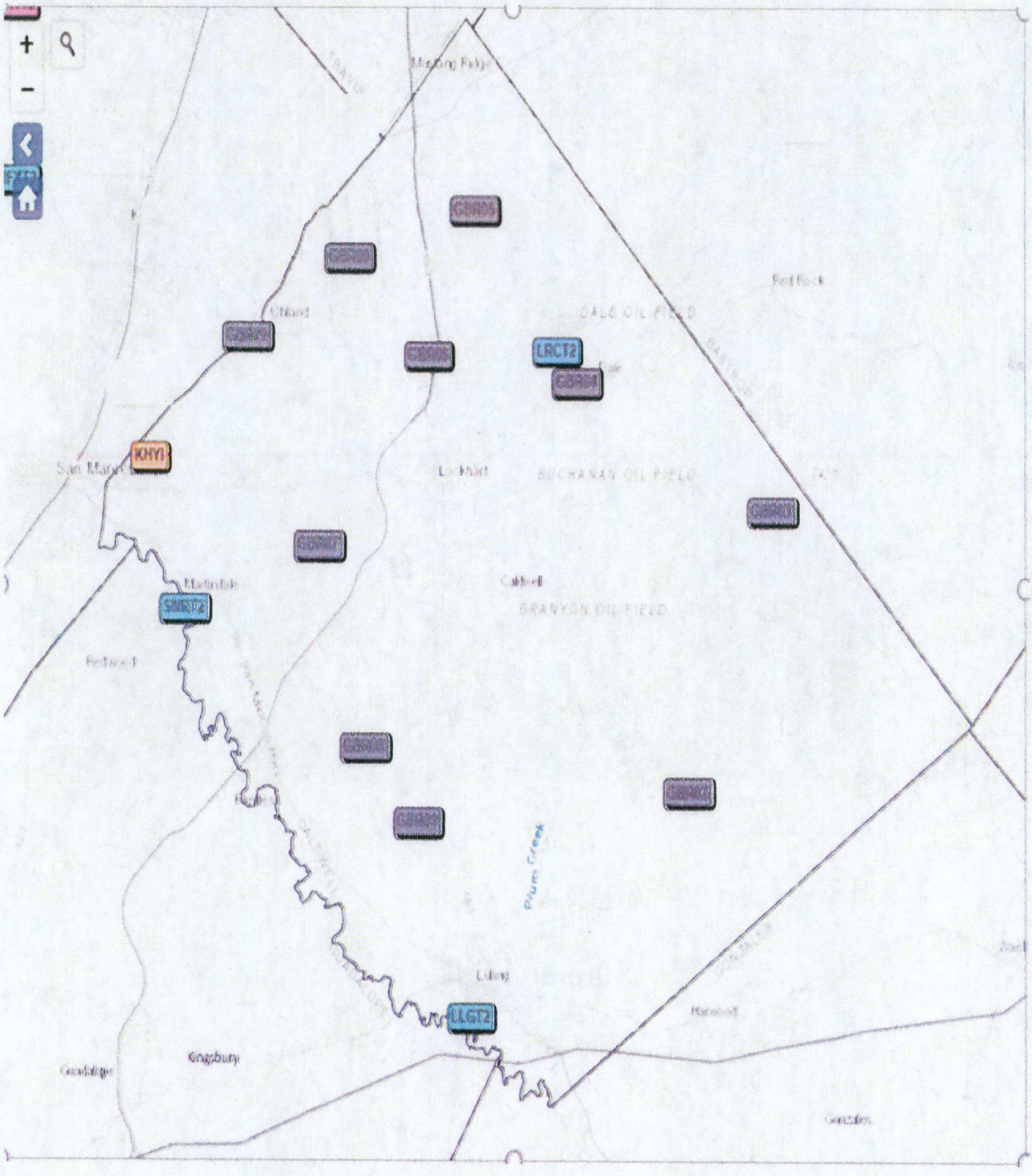


FIGURE "B-1"

Rain Gauges Installed

GBRA – C-1

Sunset Trail

29°44'43.30"N 97°41'8.12"W

FIGURE "B-2"

Rain Gauges Installed

GBRA – C-2

Chuck Wagon Road

29°45'28.91"N 97°30'17.20"W

FIGURE "B-3"

Rain Gauges Installed

GBRA – C-3

Taylorsville Road at Elm Creek

29°52'19.83" N 97°26'54.33"W

FIGURE "B-4"

Rain Gauges Installed

GBRA – C-4

Liberty Lane

29°55'27.34"N 97°34'44.51"W

FIGURE "B-5"

Rain Gauges Installed

GBRA – C-5

Grandpa Road

29°59'36.37"N 97°38'50.91"W

FIGURE "B-6"

Rain Gauges Installed

GBRA – C-6

Rolling Ridge

29°56'4.97"N 97°40'41.15"W

FIGURE "B-7"

Rain Gauges Installed

GBRA – C-7

Tower Road

29°51'28.65"N 97°45'5.96"W

FIGURE "B-8"

Rain Gauges Installed

GBRA – C-8

Acorn Road

29°46'33.71"N 97°43'16.68"W

Figure "C-1" - AREA MAP
SIREN PLACEMENT ACOUSTIC ANALYSIS CALDWELL COUNTY

Figure "C-2" – MARTINDALE SIREN SITE 1

Behind Martindale Water Supply Corporation

Figure "C-3" – MARTINDALE SIREN SITE 2

"D-1a" - Public Information – Rain Gauge Reports

www.gbra.org/rain

Rain Gauge Report

Monday, October 8, 2018

3:42 PM CST (RTU Times Do Not Reflect Daylight Saving Time)

Note: Data is gathered by remote automated sensors and is posted without a quality check. GBRA assumes no responsibility for inaccuracy due to equipment failure. Interactive map Comal and Guadalupe County rain gauge map (PDF)

County	Station Name	RTU Time	Rainfall Total (inches) 1-Hr	3-Hr	6-Hr	24-Hr
Caldwell						
	Sunset Trail	2:36 PM	0.00	0.00	0.01	0.01
	Chuck Wagon Rd	2:36 PM	0.00	0.03	0.03	0.03
	Taylorville Rd	2:36 PM	0.00	0.00	0.00	0.00
	Liberty Lane	2:36 PM	0.00	0.06	0.06	0.07
	Grandpa Rd	2:36 PM	0.00	0.09	0.09	0.09
	Rolling Ridge	2:36 PM	0.00	0.18	0.18	0.18
	Tower Rd	2:36 PM	0.00	0.00	0.06	0.06
	Acorn Rd	2:36 PM	0.00	0.00	0.00	0.01
	Rogers Ranch Rd	2:36 PM	0.00	0.17	0.17	0.17
Comal						
	GBRA Tower	2:29 PM	0.00	0.10	0.10	0.20
	Bear Creek	2:14 PM	0.00	0.00	0.00	0.06
	Startzville	2:48 PM	0.00	0.00	0.00	0.11
	Hoffman Road	2:44 PM	0.01	0.31	0.31	0.35
	Third Crossing	3:02 PM	0.00	0.01	0.01	0.23
	Waggner Ranch	2:17 PM	0.00	0.00	0.00	0.00
	Stenen Road	2:39 PM	0.00	0.00	0.00	0.27
	Shadow Hills	3:17 PM	0.00	0.01	0.01	0.01
	NBU Tower on Geronimo Creek	2:30 PM	0.03	0.19	0.19	0.19
	FM 3009 on Dry Comal Creek	2:30 PM	0.00	0.00	0.00	0.01
	Kruger Canyon Rd on Dry Comal	2:30 PM	0.00	0.00	0.00	0.01
	Bresky Road on Isaac Creek	2:30 PM	0.03	0.03	0.04	0.22
Guadalupe						
	Seguin WTP	2:30 PM	0.00	0.11	0.11	0.11
	Hwy 123 @ Geronimo Creek	2:30 PM	0.00	0.30	0.30	0.30
	Branch Road on Geronimo Creek	2:30 PM	0.04	0.07	0.10	0.10
	FM 1044 on Young Creek	2:30 PM	0.00	0.06	0.06	0.36
	FM 1044 on Long Creek	2:30 PM	0.01	0.16	0.16	0.19
	FM 775 on Deadmans Creek	2:30 PM	0.02	0.16	0.16	0.19
	Still Meadow Rd on Cottonwood Cr	2:31 PM	0.00	0.01	0.01	0.05
	Nash Creek Road on Darst Creek	2:31 PM	0.00	0.01	0.02	0.03
Hays						
	Harris Hill Rd	2:36 PM	0.00	0.00	0.05	0.05
	Bunton Lane	2:36 PM	0.01	0.01	0.03	0.03
	Engelke Rd	2:36 PM	0.00	0.25	0.25	0.25
	Hays Youth Complex	2:36 PM	0.00	0.01	0.19	0.19
	Sierra West Rd	2:36 PM	0.01	0.09	0.23	0.35
	Rocking M Rd	2:36 PM	0.00	0.07	0.86	0.89
	FM 21 off FM 2720	2:36 PM	0.00	0.00	0.01	0.04
	Long Horn Trail	2:37 PM	0.00	0.06	0.06	0.34
	Mt. Olive School Rd	2:37 PM	0.00	0.29	0.29	0.29
	Rim Rock Rd	2:37 PM	0.00	0.48	0.48	0.50

FIGURE "D-1b"
Public Information –
TXMesonet
https://www.texmesonet.org