

SAMPLE FLOOD ANALYSIS

Report Generated: 25 August 2019
Prepared For: Local government/state transportation officials
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Robert Rohli, PhD, Forensic Meteorologist

Incident Date: 27 July 2019
Incident Location: Walker, LA

Summary:

A drainage culvert collapsed under LA Highway 1024 (Cane Market Rd.) in Walker, LA on the morning of 27 July 2019. The collapse resulted in severe buckling of the roadway and a vehicle getting stuck at the site of the culvert failure. A review of recent rainfall in the area was requested to help determine whether it was a contributing factor to the failure.

Supporting data included in this report:

- NWS Doppler radar imagery from the radar located in Slidell, LA
- Official watch, warning, and local storm report (LSR) statements issued by NWS New Orleans/Baton Rouge
- Social media reports

Note: Client and business name/location were changed to preserve confidentiality

INCIDENT OVERVIEW

During the predawn hours of 27 July 2019, a culvert collapsed underneath LA Highway 1024 (Cane Market Rd.) in Walker, LA. The collapse resulted in severe buckling of the road and one vehicle getting stuck at the site of the road failure. Two people inside of the vehicle received minor injuries (<http://bit.ly/2P1hQWc>). Louisiana DOTD officials authorized emergency repairs at an estimated cost of \$150,000 in an attempt to get the high traffic road reopened before local schools started the new school year (<http://bit.ly/2KGIc6R>).

Local government and state transportation officials requested a summary of recent rainfall in the area in order to determine if that may have been a contributing factor in the culvert collapse.



The image shows a screenshot of a Facebook post. At the top left is the profile picture of the Livingston Parish Office of Homeland Security and Emergency Preparedness. The page name is "Livingston Parish Office of Homeland Security and Emergency Preparedness" and the post is dated "July 27 at 5:03 AM". There is a "Like Page" button and a menu icon. The text of the post reads: "Please be aware that Cane Market Road is completely shut down just west of Spring Lake Subdivision. I will post when it is reopened but it will be quite a while. A culvert collapsed under the road." Below the text is a photograph of a white SUV stuck on a severely buckled road at night. The car's driver-side door is open, and a person in a high-visibility vest is visible inside. The road surface is cracked and uneven. At the bottom of the post, there are reaction icons (surprised face, thumbs up, sad face) with the number "283", and engagement statistics: "210 Comments 1.9K Shares".

6 JUNE 2019: NWS ADVISORIES/WARNINGS

The first significant rain event noted in the weeks leading up the culvert collapse occurred on the morning of 6 June 2019. An Urban and Small Stream Flood Advisory was first issued for the incident location at 7:23 AM. The advisory noted ongoing rains and the potential for an additional 2 to 4 inches of rainfall through 10:15 AM.

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620
WGUS84 KLIX 061223
FLSLIX

Flood Advisory
National Weather Service New Orleans LA
723 AM CDT Thu Jun 6 2019

LAC005-033-047-063-121-061515-
/O.NEW.KLIX.FA.Y.0026.190606T1223Z-190606T1515Z/
/00000.N.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/
Ascension LA-West Baton Rouge LA-Livingston LA-Iberville LA-
East Baton Rouge LA-
723 AM CDT Thu Jun 6 2019

The National Weather Service in New Orleans has issued a

* Urban and Small Stream Flood Advisory for Poor Drainage Areas
  for...
  Northwestern Ascension Parish in southeastern Louisiana...
  Southeastern West Baton Rouge Parish in southeastern Louisiana...
  Northwestern Livingston Parish in southeastern Louisiana...
  Southeastern Iberville Parish in southeastern Louisiana...
  East Baton Rouge Parish in southeastern Louisiana...

* Until 1015 AM CDT.

* At 722 AM CDT, Doppler radar indicated heavy rain due to
  thunderstorms. This will cause urban and small stream flooding.
  Overflowing poor drainage areas will result in minor flooding in
  the advisory area. Up to one inch of rain has already fallen.

* Some locations that will experience flooding include...
  Baton Rouge, Zachary, Baker, Denham Springs, Gonzales, Plaquemine,
  Port Allen, Oak Hills Place, St. Gabriel, Addis, Brusly, White
  Castle, Westminster, Geismer, Watson, Pride, Shenandoah, Greenwell
  Spring, Old Jefferson and Merrydale.

Additional rainfall of two to four inches is expected over the area.
This additional rain will result in minor flooding.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Turn around, don't drown when encountering flooded roads. Most flood
deaths occur in vehicles.

Excessive runoff from heavy rainfall will cause flooding of small
creeks and streams, urban areas, highways, streets and underpasses as
well as other drainage areas and low lying spots.

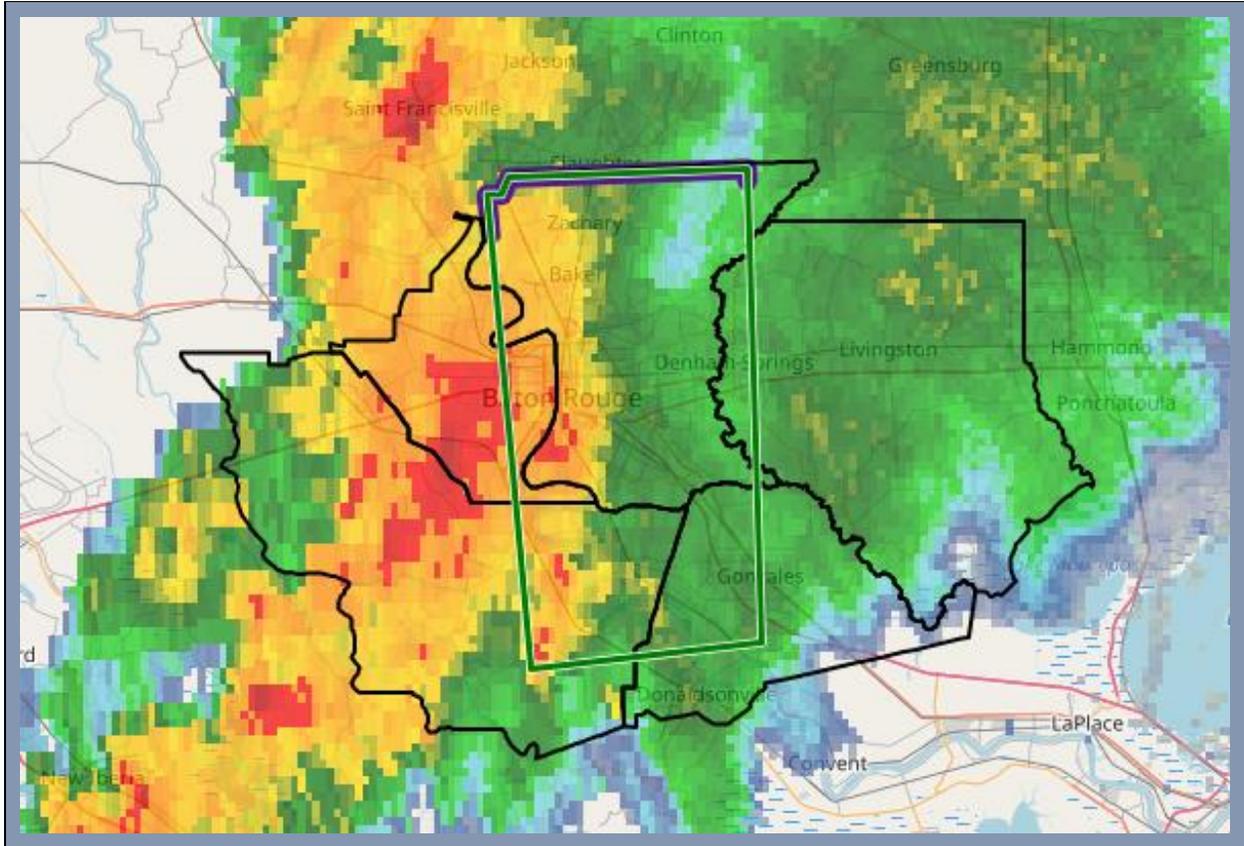
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LAT...LON 3068 9127 3070 9126 3071 9094 3016 9092
3013 9123 3068 9129

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6 JUNE 2019: NWS ADVISORIES/WARNINGS

NWS Doppler radar base reflectivity image from 7:23 AM on 6 June 2019, coinciding with the issuance of the Areal Flood Advisory (green polygon) that included the incident location, is below. The Flood Advisory was scheduled to expire at 10:15 AM but was upgraded to a Flash Flood Warning approximately 30 minutes after its initial issuance. The storms seen in this image were propagating eastward toward the incident location.



6 JUNE 2019: NWS ADVISORIES/WARNINGS

Approximately 30 minutes later, the Flood Advisory was upgraded to a Flash Flood Warning valid through 11:00 AM. The warning noted that flash flooding was "expected to begin shortly" and that rain rates of 2 to 3 inches per hour were possible.

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120
WGUS54 KLIX 061254
FFWLIX
LAC005-033-047-063-121-061600-
/O.NEW.KLIX.FF.W.0023.190606T1254Z-190606T1600Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/

BULLETIN - EAS ACTIVATION REQUESTED
Flash Flood Warning
National Weather Service New Orleans LA
754 AM CDT Thu Jun 6 2019

The National Weather Service in New Orleans has issued a

* Flash Flood Warning for...
  Western Ascension Parish in southeastern Louisiana...
  Eastern West Baton Rouge Parish in southeastern Louisiana...
  Northwestern Livingston Parish in southeastern Louisiana...
  Southeastern Iberville Parish in southeastern Louisiana...
  East Baton Rouge Parish in southeastern Louisiana...

* Until 1100 AM CDT.

* At 753 AM CDT, Doppler radar indicated thunderstorms producing
  heavy rain across the warned area. Flash flooding is expected to
  begin shortly.

* Some locations that will experience flooding include...
  Baton Rouge, Zachary, Baker, Denham Springs, Gonzales,
  Donaldsonville, Plaquemine, Port Allen, Oak Hills Place, St.
  Gabriel, Walker, Addis, Brusly, White Castle, Slaughter,
  Westminster, Geismer, Watson, Pride and Bayou Sorrel.

Rainfall rates of 2 to 3 inches per hour will be possible with this
storm.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Turn around, don't drown when encountering flooded roads. Most flood
deaths occur in vehicles.

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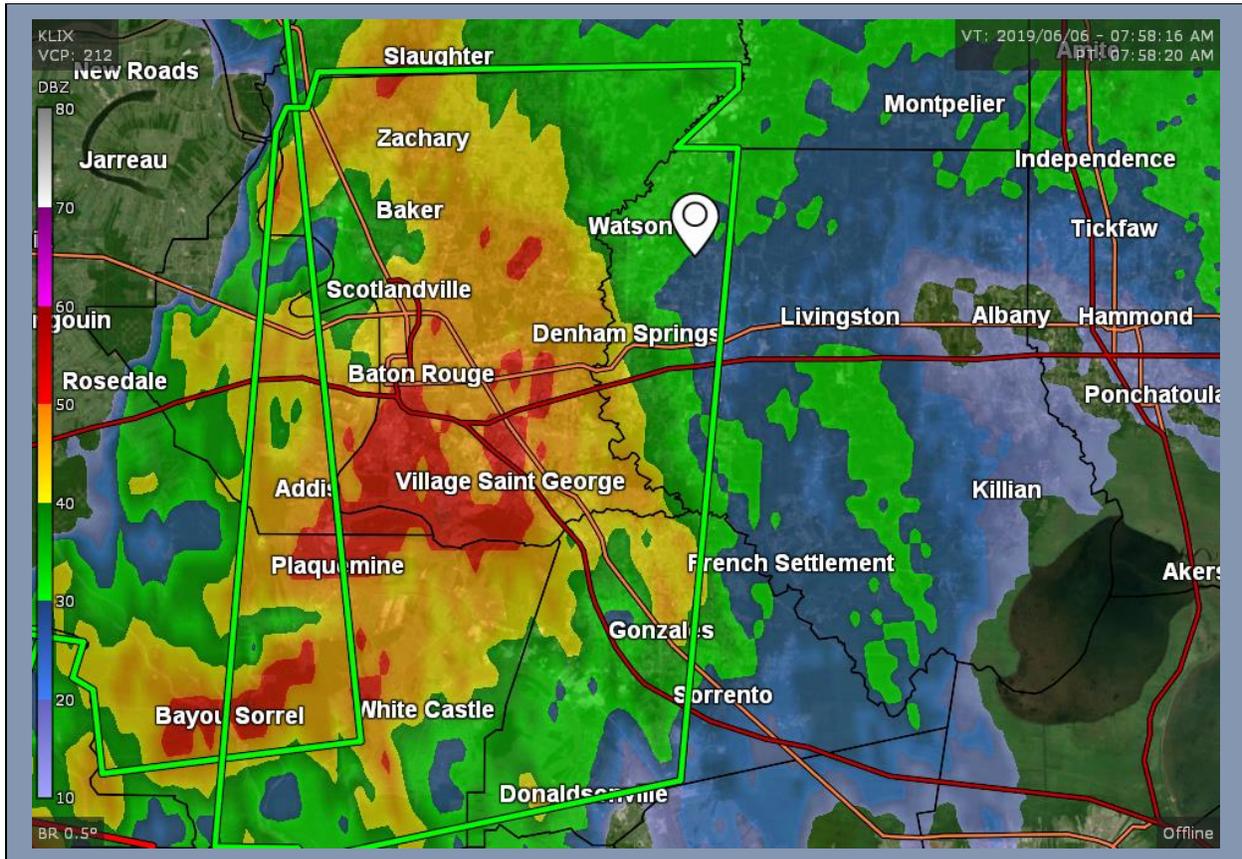
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      3072 9085 3070 9085 3065 9091 3065 9085
      3012 9090 3005 9126 3006 9127 3006 9135

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KLG
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6 JUNE 2019: NWS ADVISORIES/WARNINGS

NWS Doppler radar base reflectivity image from 7:58 AM on 6 June 2019, approximately 4 minutes after a Flash Flood Warning was issued for the incident location (white marker), is below. The Flash Flood Warning is indicated by the green polygon and was effective through 11:00 AM. The storms seen in this image were propagating eastward toward the incident location.



6 JUNE 2019: NWS ADVISORIES/WARNINGS

At 9:48 AM, a new Flash Flood Warning was issued through 12:45 PM, including the city of Walker. The warning noted that flash flooding was ongoing and that 4 inches of rain had been reported in a 2-hour stretch in the nearby town of Livingston.

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248
WGUS54 KLIX 061448
FFWLIX
LAC063-091-105-061745-
/O.NEW.KLIX.FF.W.0024.190606T1448Z-190606T1745Z/
/000000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/
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BULLETIN - EAS ACTIVATION REQUESTED
Flash Flood Warning
National Weather Service New Orleans LA
948 AM CDT Thu Jun 6 2019
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The National Weather Service in New Orleans has issued a

- * Flash Flood Warning for...
Southeastern St. Helena Parish in southeastern Louisiana...
Livingston Parish in southeastern Louisiana...
Tangipahoa Parish in southeastern Louisiana...
- * Until 1245 PM CDT.
- * At 946 AM CDT, the public reported flash flooding across the warned area. Up to three inches of rain have already fallen. Flash flooding is already occurring.
- * Some locations that will experience flooding include...
Hammond, Amite, Ponchatoula, Walker, Amite City, Livingston,
Independence, Roseland, French Settlement, Albany, Port Vincent,
Springfield, Montpelier, Wilmer, Natalbany, Robert, Whitehall,
Killian and Tickfaw.

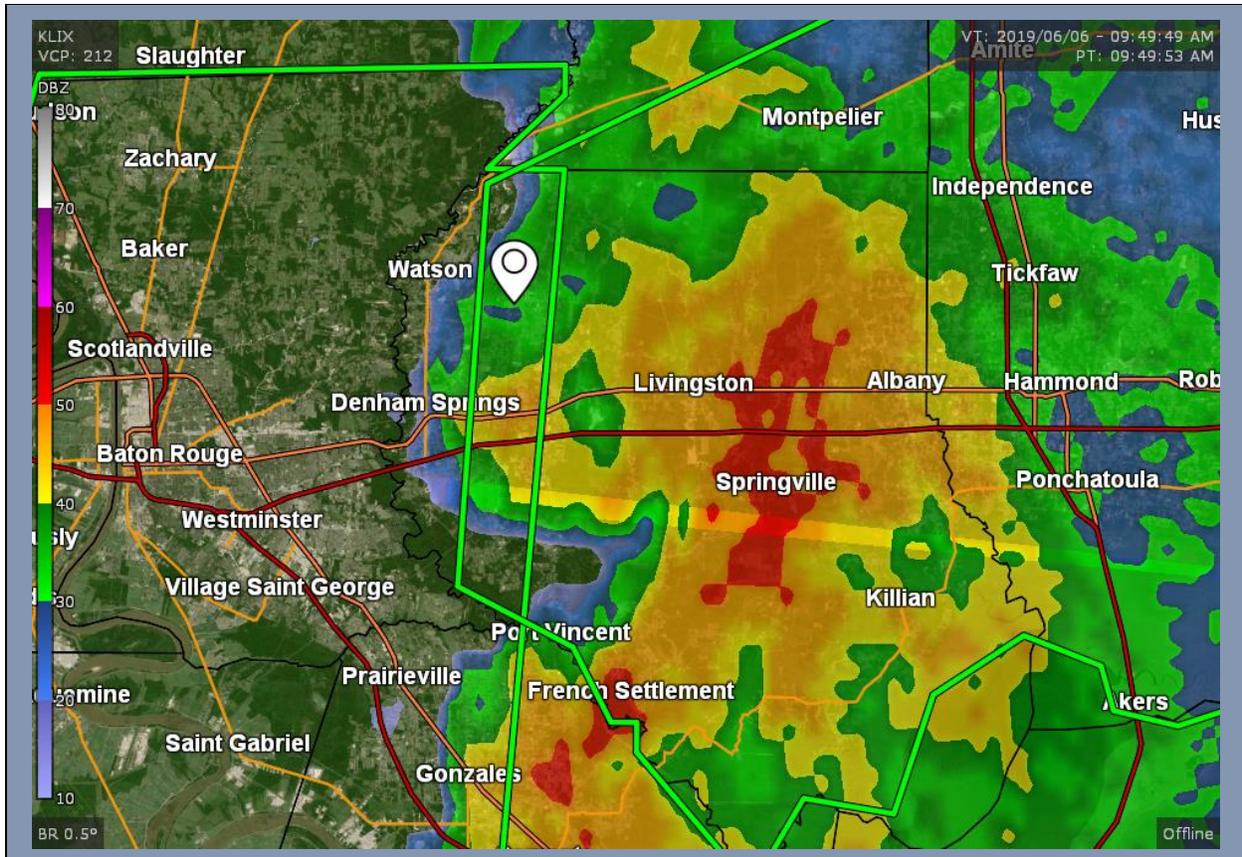
Reports of secondary roads beginning to flood along with 4 inches of rain in the last 2 hours in the town of Livingston.

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LAT...LON 3072 9025 3036 9024 3030 9030 3028 9037
3029 9042 3032 9043 3034 9049 3030 9056
3022 9059 3023 9066 3017 9070 3026 9079
3028 9079 3028 9081 3033 9084 3037 9093
3064 9091 3089 9032
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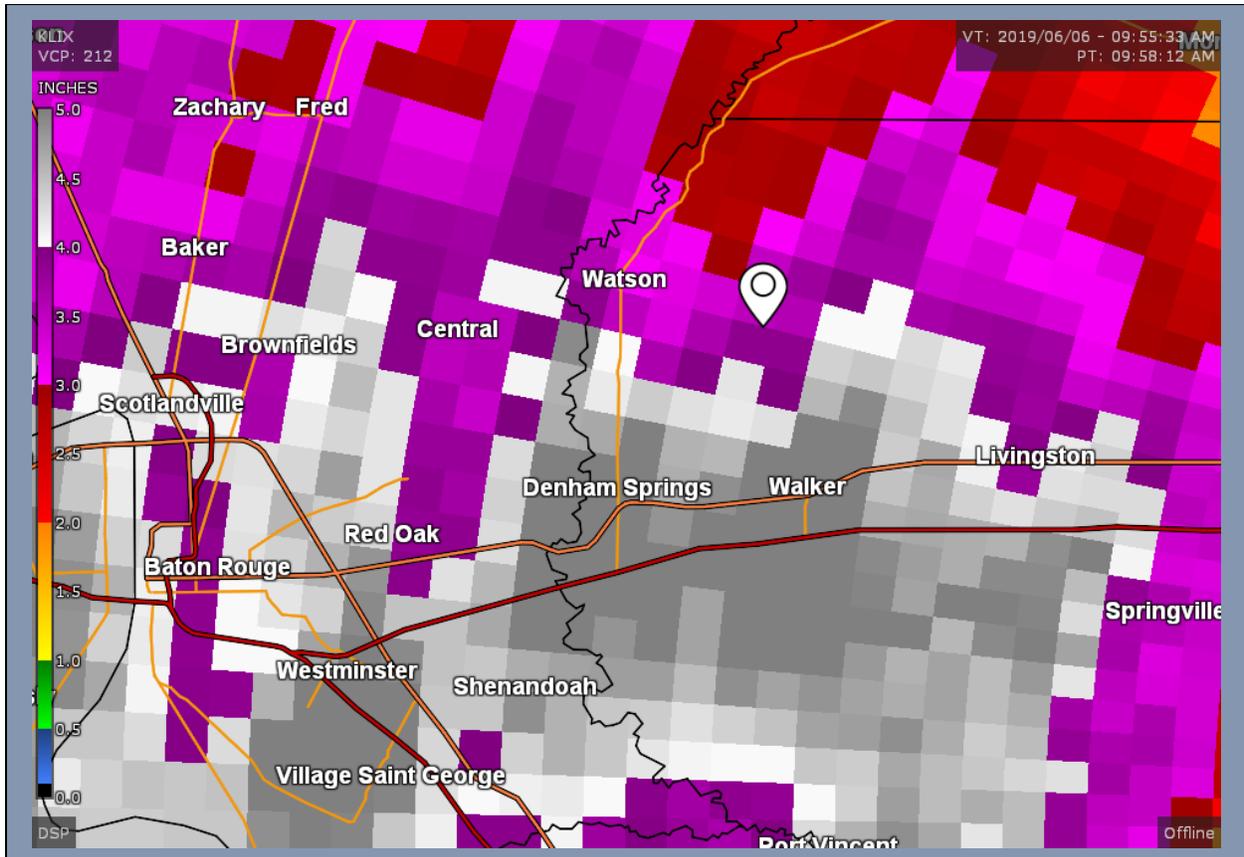
6 JUNE 2019: NWS ADVISORIES/WARNINGS

NWS Doppler radar base reflectivity image from 9:29 AM on 6 June 2019, approximately 1 minute after a second Flash Flood Warning was issued for the incident location (white marker), is below. The Flash Flood Warnings are indicated by the green polygons which intersect near the location of culvert collapse. The initial Flash Flood Warning had an expiration time of 11:00 AM, with the second warning having an expiration time of 12:45 PM. At this point in time, the back edge of the rains was nearing the incident location, but widespread flash flooding was ongoing in the areas shown below.



6 JUNE 2019: ESTIMATED RAINFALL

The nearest NWS Doppler radar located approximately 60 miles to the east in Slidell, LA provides estimated rainfall for 6 June 2019. The culvert collapse location is noted by the white marker in the image below and the radar estimate indicates between 3 to 4 inches of rain fell at the location on that date. On the next page, ground level rain gauge reports indicate that the radar estimates were likely running low in some areas on this date.



6 JUNE 2019: RAINFALL REPORTS

A Public Information Statement issued by NWS New Orleans/Baton Rouge with a summary of rainfall totals for 6 June 2019. Note that there was a report of 6.75 inches of rain 2 miles north of Walker, which is approximately 3 miles south of the culvert collapse.

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329
NOUS44 KLIX 062307
PNSLIX
LAZ034>037-039-040-046>050-056>072-MSZ068>071-077-080>082-071107-
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Public Information Statement
National Weather Service New Orleans LA
607 PM CDT Thu Jun 6 2019
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...PRECIPITATION REPORTS...

Location	Amount	Time/Date
Baton Rouge	8.97 in	0552 PM 06/06
2 N Walker	6.75 in	0600 PM 06/06
Albany	5.68 in	0555 PM 06/06
St. Gabriel	5.32 in	0555 PM 06/06
2 W Baton Rouge	4.45 in	0555 PM 06/06
Prairieville	4.44 in	0555 PM 06/06
Zachary	3.70 in	0540 PM 06/06
Lutcher	3.09 in	0546 PM 06/06
2 SSW Hammond	3.06 in	0555 PM 06/06
Hammond	3.01 in	0555 PM 06/06
Gonzales	2.90 in	0555 PM 06/06
Hammond	2.87 in	0553 PM 06/06
Gramercy	2.61 in	0555 PM 06/06
Covington	2.27 in	0546 PM 06/06
Covington	2.02 in	0559 PM 06/06
Covington	1.99 in	0546 PM 06/06
Madisonville	1.71 in	0558 PM 06/06
New Orleans	1.62 in	0545 PM 06/06
Slidell	1.55 in	0555 PM 06/06
Gramercy	1.38 in	0554 PM 06/06
Vacherie	1.38 in	0545 PM 06/06
6 S Gramercy	1.32 in	0555 PM 06/06
Thibodaux	1.24 in	0546 PM 06/06
Metairie	1.22 in	0548 PM 06/06
New Orleans	1.21 in	0556 PM 06/06
2 NE Bridge City	1.19 in	0555 PM 06/06
Napoleonville	1.09 in	0555 PM 06/06
Thibodaux	1.06 in	0545 PM 06/06
Bogue Chitto	1.06 in	0512 PM 06/06
Bayou Cane	1.04 in	0559 PM 06/06
New Orleans	1.00 in	0555 PM 06/06

These are mainly mesonet stations but give a decent representation of the rainfall across the area. Since the heaviest rain occurred after sunrise in many locations we have left off CoCoRaHS and Coop sites as these are missing much of the rain. These are not considered official.

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6 JUNE 2019: FLOODING REPORTS

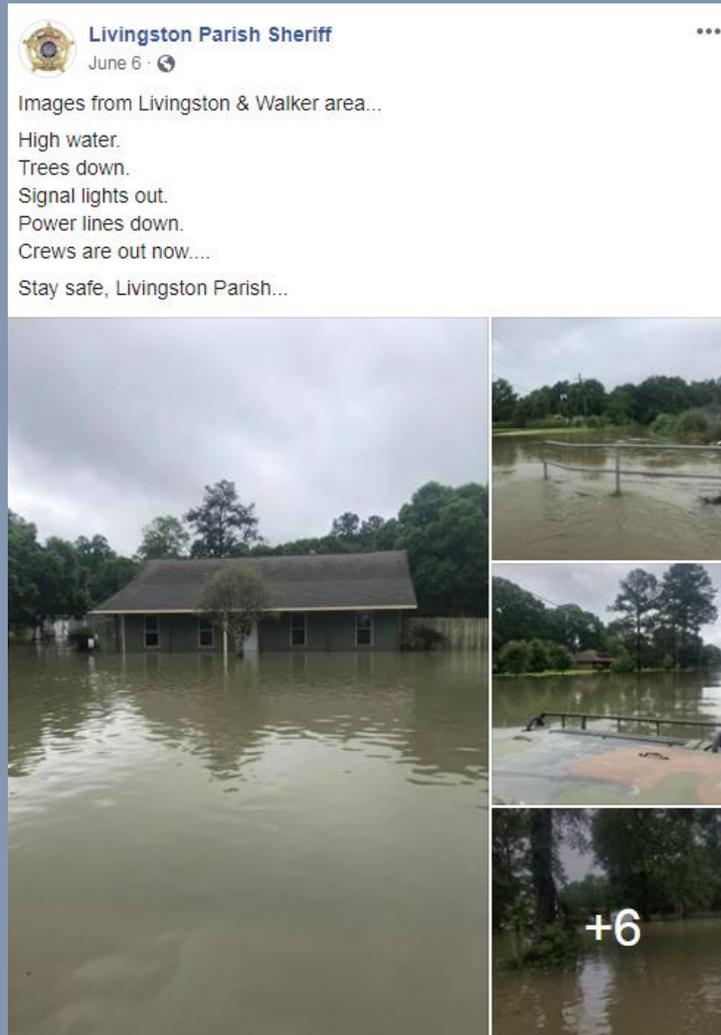
A Local Storm Report issued by NWS New Orleans/Baton Rouge at 10:50 AM indicated that multiple businesses between Denham Springs and Walker had flooded. A Facebook post from the Livingston Parish Sheriff's Office at 11:33 AM on 6 June 2019 also indicated widespread flooding around Walker.

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PRELIMINARY LOCAL STORM REPORT
NATIONAL WEATHER SERVICE NEW ORLEANS LA
1050 AM CDT THU JUN 6 2019

..TIME...  ..EVENT...  ...CITY LOCATION...  ...LAT.LON...
..DATE...  ...MAG...  ...COUNTY LOCATION..ST..  ...SOURCE...
..REMARKS..

0842 AM    FLOOD          2 E DENHAM SPRINGS    30.48N 90.93W
06/06/2019                LIVINGSTON            LA    PUBLIC

        PUBLIC REPORTED WATER IN MULTIPLE BUSINESS BETWEEN DENHAM
        SPRINGS AND WALKER.
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Post Link: <http://bit.ly/30ueYT8>

14 JULY 2019: NWS ADVISORIES/WARNINGS

Significant heavy rainfall returned to Livingston Parish less than six weeks later, on Sunday, 14 July 2019, in association with Tropical Storm Barry as it lifted northward across western Louisiana. A Flash Flood Warning was issued for several parishes, including Livingston and the city of Walker, at 12:35 PM effective through 3:30 PM. The warning noted that up to 5 inches of rain had already fallen in some areas, with an additional 1 to 3 inches possible.

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186
WGUS54 KLIX 141735
FFWLIX
LAC005-033-047-063-091-142030-
/O.NEW.KLIX.FF.W.0029.190714T1735Z-190714T2030Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/
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BULLETIN - EAS ACTIVATION REQUESTED
Flash Flood Warning
National Weather Service New Orleans LA
1235 PM CDT Sun Jul 14 2019
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The National Weather Service in New Orleans has issued a

- * Flash Flood Warning for...
Northwestern Ascension Parish in southeastern Louisiana...
Southwestern St. Helena Parish in southeastern Louisiana...
Northwestern Livingston Parish in southeastern Louisiana...
East central Iberville Parish in southeastern Louisiana...
Central East Baton Rouge Parish in southeastern Louisiana...
- * Until 330 PM CDT.
- * At 1234 PM CDT, Doppler radar indicated thunderstorms producing heavy rain across the warned area. Up to five inches of rain have already fallen. Flash flooding is expected to begin shortly.
- * Some locations that will experience flooding include...
Baton Rouge, Denham Springs, Gonzales, Oak Hills Place, St. Gabriel, Walker, White Castle, Livingston, Sorrento, French Settlement, Port Vincent, Westminster, Geismer, Old Jefferson, Inniswold, Watson, Prairieville, Village St. George, Shenandoah and Greenwell Spring.

Additional rainfall amounts of 1 to 3 inches are possible in the warned area.

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LAT...LON 3064 9106 3072 9088 3072 9085 3074 9084
3077 9077 3061 9073 3017 9084 3014 9116
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14 JULY 2019: NWS ADVISORIES/WARNINGS

The Flash Flood Warning was extended for the town of Walker at 3:32 PM with an expiration time of 6:30 PM. The warning indicated that flash flooding was "expected to begin shortly" and that an additional 2 to 4 inches of rain was possible.

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601
WGUS54 KLIX 142032
FFWLIX
LAC005-007-033-047-063-091-121-142330-
/O.NEW.KLIX.FF.W.0030.190714T2032Z-190714T2330Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/
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BULLETIN - EAS ACTIVATION REQUESTED
Flash Flood Warning
National Weather Service New Orleans LA
332 PM CDT Sun Jul 14 2019
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The National Weather Service in New Orleans has issued a

- * Flash Flood Warning for...
Western Ascension Parish in southeastern Louisiana...
Southeastern West Baton Rouge Parish in southeastern Louisiana...
Southwestern St. Helena Parish in southeastern Louisiana...
Northwestern Livingston Parish in southeastern Louisiana...
Southeastern Iberville Parish in southeastern Louisiana...
Central East Baton Rouge Parish in southeastern Louisiana...
Northwestern Assumption Parish in southeastern Louisiana...
- * Until 630 PM CDT.
- * At 331 PM CDT, Doppler radar indicated heavy rain across the warned area. Up to two inches of rain have already fallen. Flash flooding is expected to begin shortly.
- * Some locations that will experience flooding include...
Baton Rouge, Denham Springs, Gonzales, Donaldsonville, Oak Hills Place, St. Gabriel, Walker, White Castle, Westminster, Geismer, Old Jefferson, Merrydale, Inniswold, Watson, Prairieville, Village St. George, Shenandoah, Gardere, Greenwell Spring and Carville.

Additional rainfall amounts of 2 to 4 inches are possible in the warned area.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A Flash Flood Warning means that flooding is imminent or occurring. If you are in the warned area move to higher ground immediately. Residents living along streams and creeks should take immediate precautions to protect life and property.

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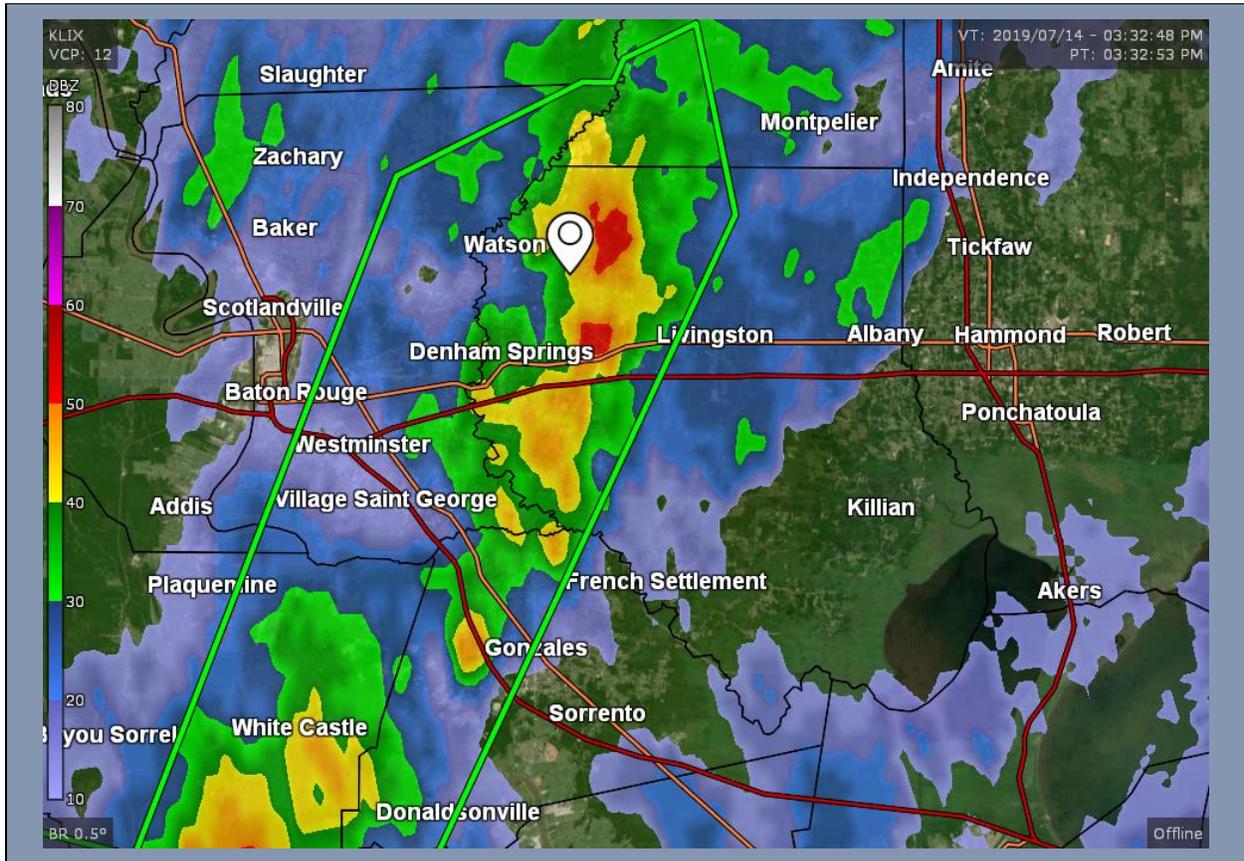
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3077 9077 3061 9073 2983 9114 2985 9118
2997 9126 3000 9126 3000 9123 3004 9122
3003 9124 3006 9127 3006 9131
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24/RR

14 JULY 2019: NWS ADVISORIES/WARNINGS

NWS Doppler radar base reflectivity image from 3:32 PM on 14 July 2019, coinciding with the second Flash Flood Warning issued for the incident location (white marker) on this date, is below. The Flash Flood Warning is indicated by the green polygon. The tropical rain band associated with Barry was continuing to produce heavy rain in the area of the culvert collapse.



14 JULY 2019: NWS ADVISORIES/WARNINGS

At 11:22 PM Sunday, an Urban and Small Stream Flood Advisory was issued that included the town of Walker. The advisory was effective through 2:15 AM and indicated the potential for an additional 4 to 6 inches of rain in association with another rain band from Tropical Storm Barry.

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154
WGUS84 KLIX 150422
FLSLIX

Flood Advisory
National Weather Service New Orleans LA
1122 PM CDT Sun Jul 14 2019

LAC005-007-033-037-047-063-091-093-150715-
/O.NEW.KLIX.FA.Y.0043.190715T0422Z-190715T0715Z/
/00000.N.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/
Ascension LA-St. James LA-St. Helena LA-Livingston LA-
East Feliciana LA-Iberville LA-East Baton Rouge LA-Assumption LA-
1122 PM CDT Sun Jul 14 2019

The National Weather Service in New Orleans has issued a

* Urban and Small Stream Flood Advisory for Poor Drainage Areas
  for...
  Ascension Parish in southeastern Louisiana...
  Western St. James Parish in southeastern Louisiana...
  St. Helena Parish in southeastern Louisiana...
  Western Livingston Parish in southeastern Louisiana...
  Eastern East Feliciana Parish in southeastern Louisiana...
  Southeastern Iberville Parish in southeastern Louisiana...
  Eastern East Baton Rouge Parish in southeastern Louisiana...
  Northern Assumption Parish in southeastern Louisiana...

* Until 215 AM CDT.

* At 1120 PM CDT, Doppler radar indicated heavy rain that will cause
  urban and small stream flooding. Overflowing poor drainage areas
  will result in minor flooding in the advisory area.

* Some locations that will experience flooding include...
  Baton Rouge, Denham Springs, Gonzales, Donaldsonville, Greensburg,
  Napoleonville, Oak Hills Place, St. Gabriel, Walker, White Castle,
  Livingston, Sorrento, French Settlement, Port Vincent, Montpelier,
  Geismer, Watson, Darlington, Pride and Shenandoah.

A band of tropical rains was slowly approaching the advisory area
from the west. The rate is falling a torrential rates, generally 3
to 4 inches per hour. Once the rains start, flooding can result in
only a few minutes.

Additional rainfall of 4 to 6 inches is expected over the area. This
additional rain will result in minor flooding. If the torrential
rains persist, a Flash Flood Warning will be issued. Stay tuned for
later statements and possible warnings.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Be especially cautious at night when it is harder to recognize the
dangers of flooding.

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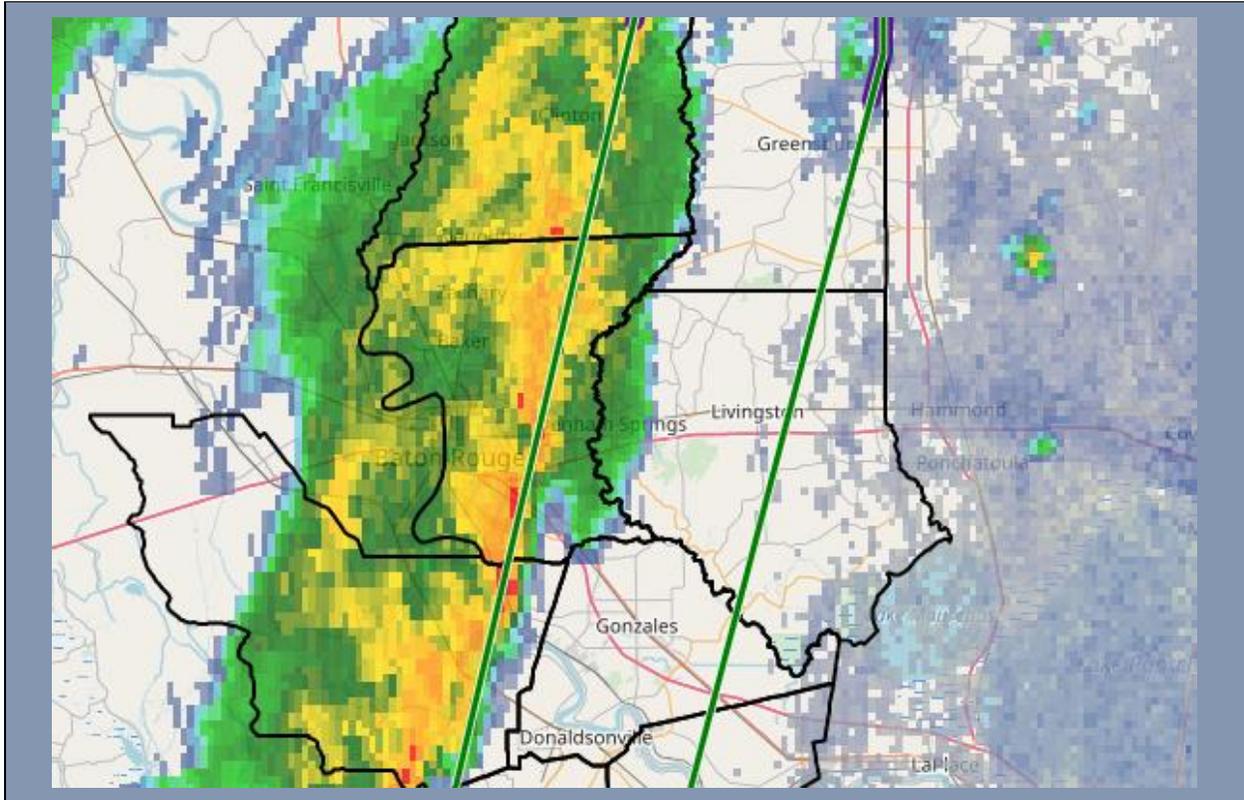
LAT...LON 3094 9057 2989 9089 2997 9126 3004 9118
3100 9092 3100 9057

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24/RR
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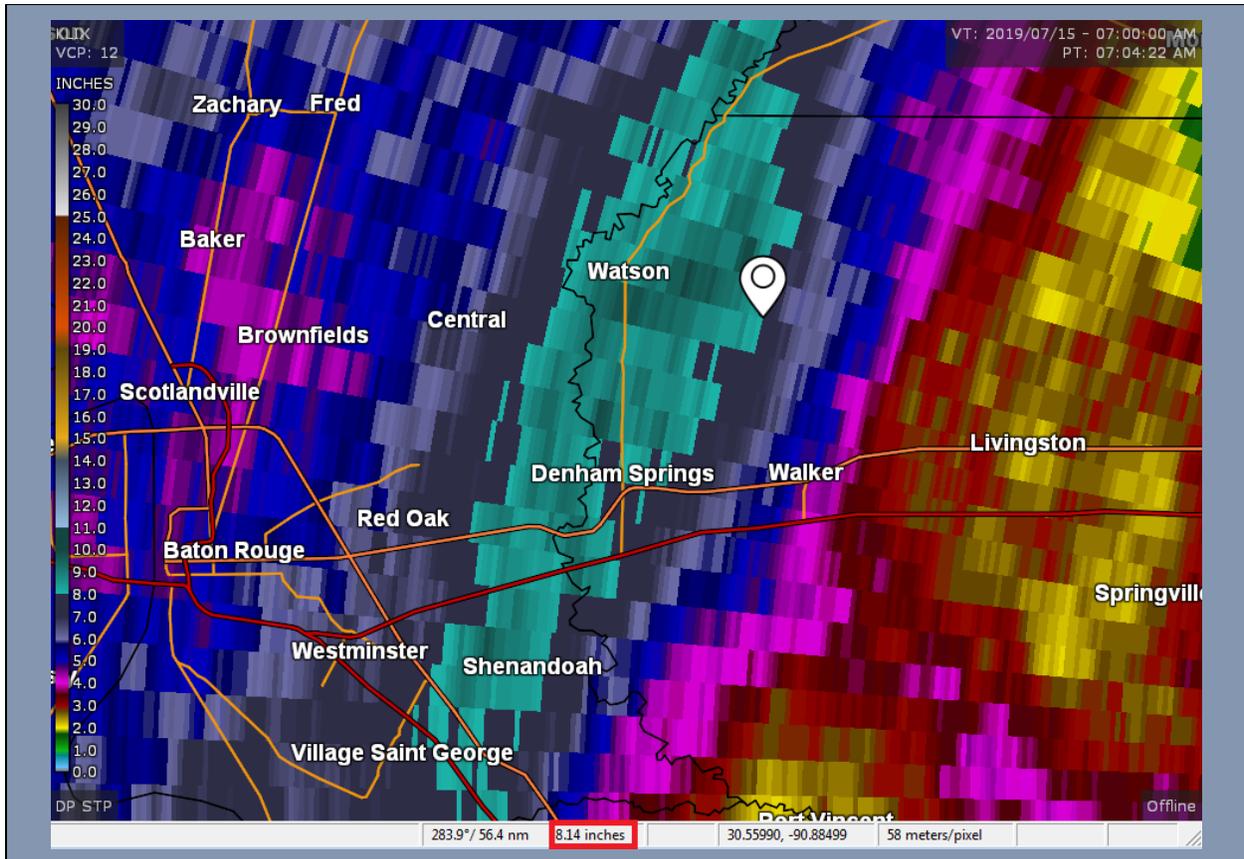
14 JULY 2019: NWS ADVISORIES/WARNINGS

NWS Doppler radar base reflectivity image from 11:22 PM on 14 July 2019, coinciding with the issuance of the Areal Flood Advisory (green polygon) that included the incident location. The precipitation seen in the image below was associated with another slow-moving rain band from Tropical Storm Barry moving eastward toward the incident location.



14-15 JULY 2019: ESTIMATED RAINFALL

The nearest NWS Doppler radar located approximately 60 miles to the east in Slidell, LA, provides estimated rainfall for the incident location. The image below represents estimated rainfall through 7:00 AM on 15 July 2019. The culvert collapse location is noted by the white marker in the image below and the radar estimate indicates approximately 8 inches of rain fell at that location in association with Hurricane (Tropical Storm) Barry.



14-15 JULY 2019: RAINFALL REPORTS

Storm total rainfall for Hurricane Barry as reported by NWS New Orleans/Baton Rouge in their Post Tropical Cyclone Report (<http://bit.ly/2TVHaMg>) is shown below. The summary includes a report of 8.83" of rain 4.1 miles NE of Denham Springs, or less than 3 miles SW of the culvert collapse, from 7:00 AM 11 July 2019 through 7:00 AM 16 July 2019. The majority of that (7.99") fell on 14-15 July 2019. The report also matches well with the estimated rainfall shown on the previous page of this report.

C. STORM TOTAL RAINFALL FROM 1200 UTC JUL 11 UNTIL 1200 UTC JUL 16			
CITY/TOWN LAT LON DEG DECIMAL	COUNTY	ID	RAINFALL (IN)
DENHAM SPRINGS 4.1 NE 30.52 -90.91	LIVINGSTON	LA-LV-4	8.83
MONTICELLO 3 ENE 30.51 -91.00	EAST BATON ROUGE	LA-EB-19	7.84
BATON ROUGE - CLAYCUT BAYOU 30.39 -91.01	EAST BATON ROUGE	CBAL1	7.39
PORT ALLEN 30.45 -91.22	WEST BATON ROUGE	PTAL1	7.36
CARVILLE 30.20 -91.13	IBERVILLE	CRVL1	6.74
SHENANDOAH 1.5 S 30.38 -91.00	EAST BATON ROUGE	LA-EB-63	6.73
CENTRAL 2.2 SE 30.54 -91.00	EAST BATON ROUGE	LA-EB-31	6.53
LACOMBE 1.4 N 30.33 -89.93	ST. TAMMANY	LA-ST-8	6.46
DENHAM SPRINGS 30.46 -90.99	LIVINGSTON	DENL1	6.14
SLIDELL 30.27 -89.77	ST. TAMMANY	SISL1	6.10
BIG BRANCH NWR 30.32 -89.94	ST. TAMMANY	BBNL1	5.89
BATON ROUGE - WARD CREEK 30.40 -91.10	EAST BATON ROUGE	WCEL1	5.80
BATON ROUGE - SHERWOOD 30.44 -91.04	EAST BATON ROUGE	BRSL1	5.79
NEW ROADS 30.73 -91.37	POINTE COUPEE	NWRL1	5.61
BAYOU MANCHAC ALLICATOR B 30.32 -91.02	ASCENSION	ABKL1	5.54
GREENWELL SPRING 30.64 -91.01	EAST BATON ROUGE	PRCL1	5.15
JACKSON 10.1 SSW 30.69 -91.26	EAST BATON ROUGE	LA-EB-56	4.97
NORWOOD 30.97 -91.10	EAST FELICIANA	NNDL1	4.84

21 JULY 2019: NWS ADVISORIES/WARNINGS

A third heavy rain event impacted the area on Sunday, 21 July 2019. At 1:13 PM, an Urban and Small Stream Flood Advisory was issued through 2:15 PM. The advisory indicated that up to an inch of rain had fallen with an additional 1 to 2 inches of rainfall expected.

309
WGUS84 KLIX 211813
FLSLIX

Flood Advisory
National Weather Service New Orleans LA
113 PM CDT Sun Jul 21 2019

LAC005-033-063-211915-
/O.NEW.KLIX.FA.Y.0047.190721T1813Z-190721T1915Z/
/00000.N.ER.000000T0000Z.000000T0000Z.000000T0000Z.00/
Ascension LA-Livingston LA-East Baton Rouge LA-
113 PM CDT Sun Jul 21 2019

The National Weather Service in New Orleans has issued a

- * Urban and Small Stream Flood Advisory for Poor Drainage Areas for...
North central Ascension Parish in southeastern Louisiana...
Central Livingston Parish in southeastern Louisiana...
South central East Baton Rouge Parish in southeastern Louisiana...
- * Until 215 PM CDT.
- * At 113 PM CDT, Doppler radar indicated heavy rain due to thunderstorms. This will cause urban and small stream flooding. Overflowing poor drainage areas will result in minor flooding in the advisory area. Up to one inch of rain has already fallen.
- * Some locations that will experience flooding include...
Baton Rouge, Denham Springs, Walker, Livingston, French Settlement, Albany, Port Vincent, Old Jefferson, Shenandoah and Killian.

Additional rainfall of 1 to 2 inches is expected over the area. This additional rain will result in minor flooding.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

Turn around, don't drown when encountering flooded roads. Most flood deaths occur in vehicles.

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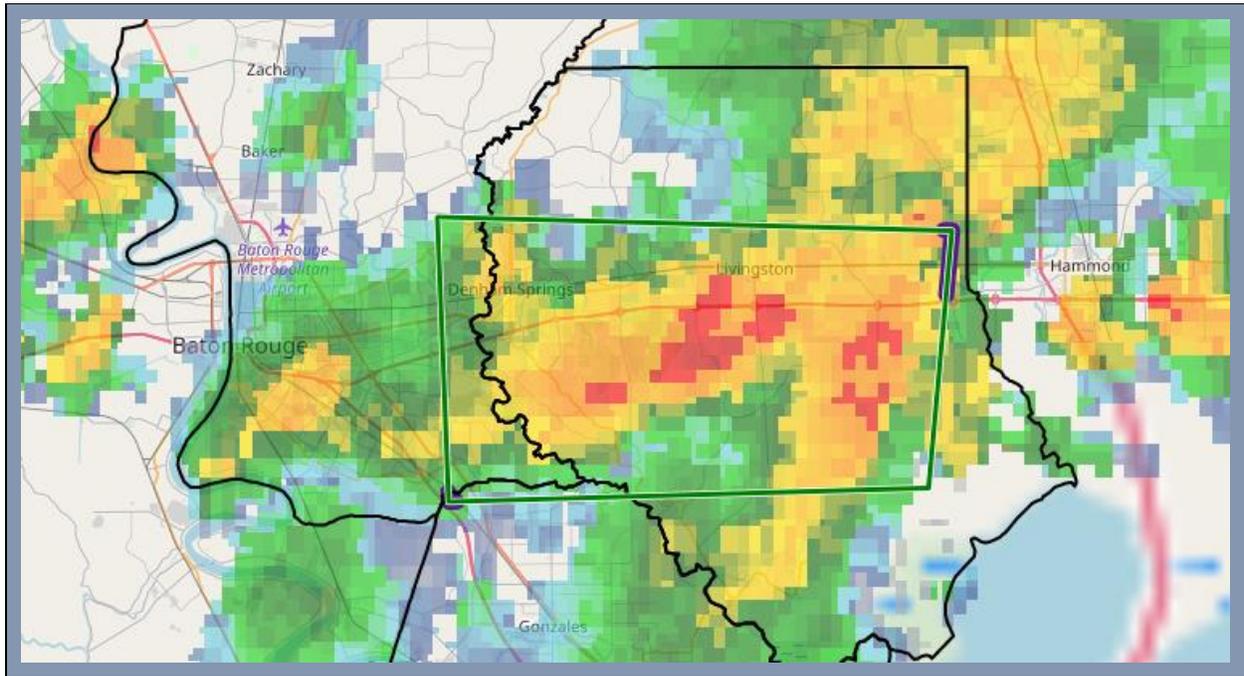
LAT...LON 3053 9058 3034 9060 3033 9101 3054 9102

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24/RR

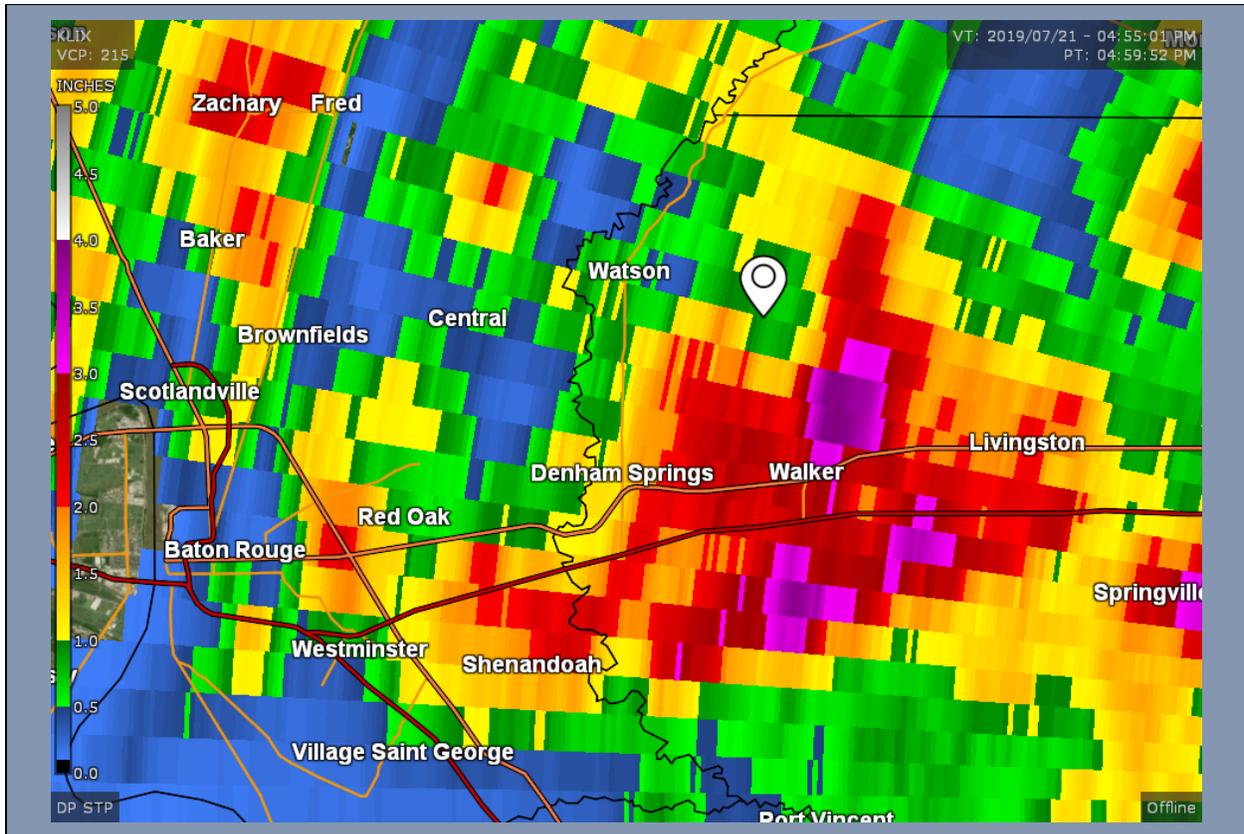
21 JULY 2019: NWS ADVISORIES/WARNINGS

NWS Doppler radar base reflectivity image from 1:13 PM on 21 July 2019, coinciding with the issuance of the Areal Flood Advisory (green polygon) that included the much of the city of Walker, but was just south of the incident location. The precipitation seen in the image below was drifting slowly northward, but it would subsequently weaken as it moved into the area of the culvert collapse.



21 JULY 2019: ESTIMATED RAINFALL

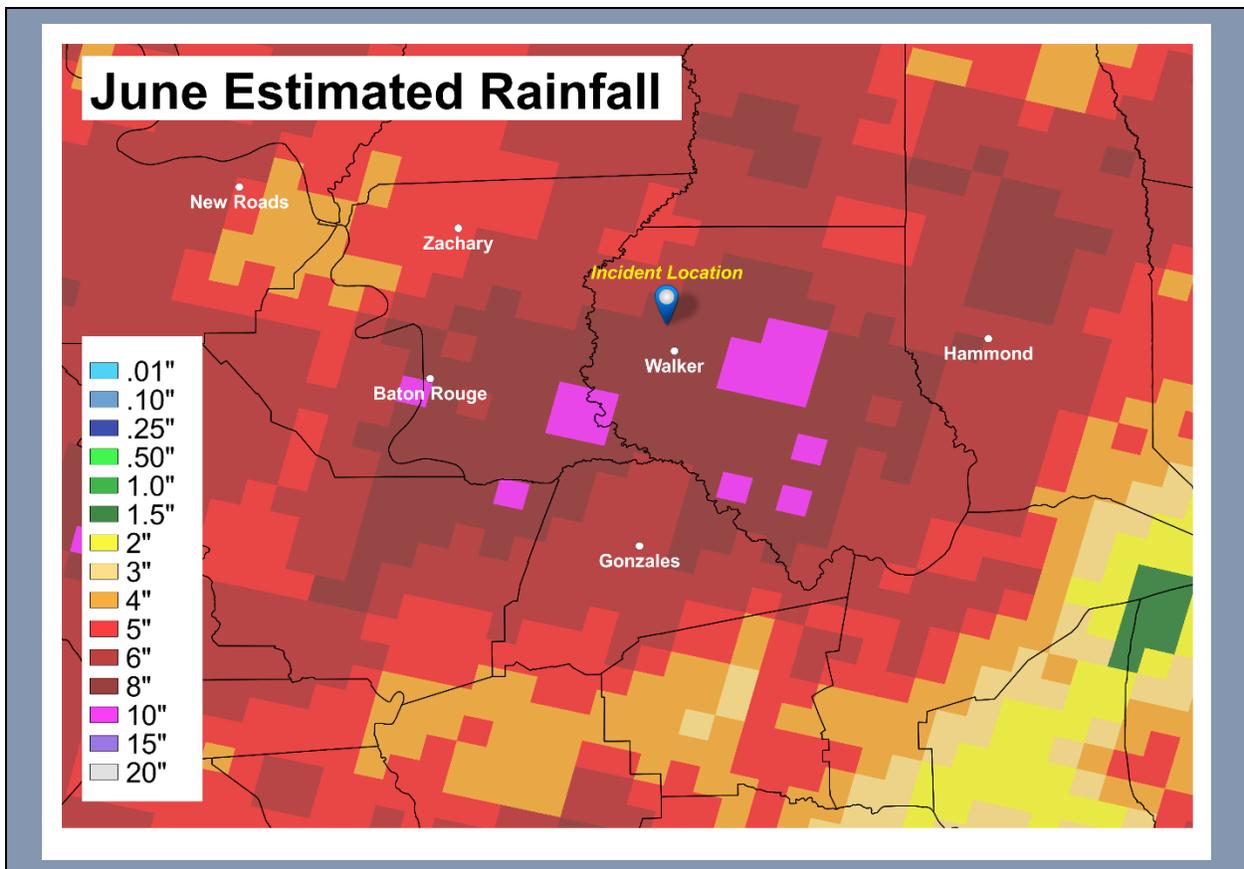
The nearest NWS Doppler radar located approximately 60 miles to the east in Slidell, LA, provides estimated rainfall for the incident location. The image below represents estimated rainfall through 5:00 AM on 21 July 2019. The culvert collapse location is noted by the white marker in the image below and the radar estimate indicates that approximately 1 inch of rain fell at that location, with totals of 2 to 4 inches or more a few miles east and southeast.



JUNE – JULY RAINFALL

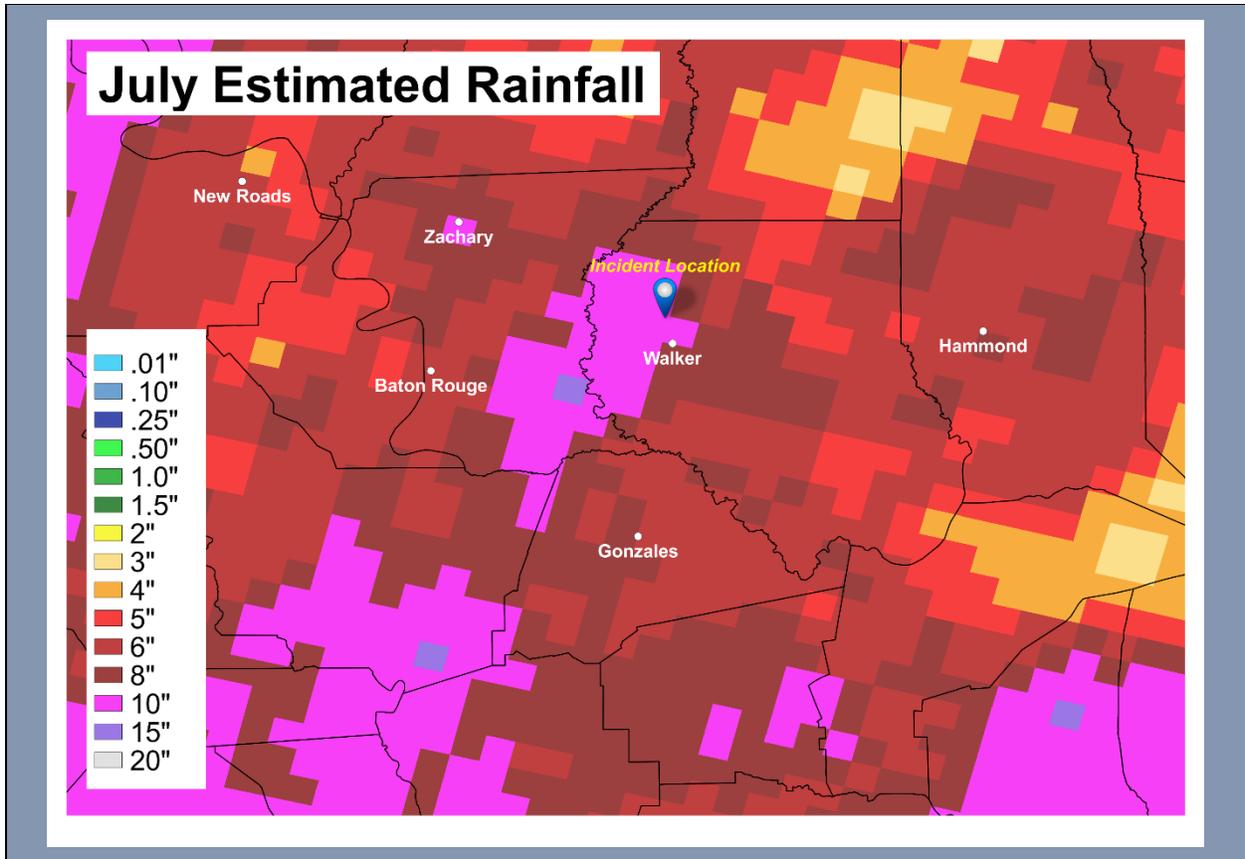
While there are no official NWS observation sites in or around Walker for obtaining rain totals, the National Centers for Environmental Prediction (NCEP) generates a Quantitative Precipitation Estimate (QPE) that provides a good look at rainfall in the area of the culvert collapse. These products are generated by comparing radar-estimated rainfall to actual rain gauge reports. A bias correction is applied once the radar estimates and actual gauge reports are compared, allowing for accurate estimates of accumulated rain even where gauges are not in place. Satellite precipitation estimates can also be incorporated to increase the accuracy of this product.

The image below shows that the area of the culvert collapse received an estimated 8”+ of rainfall during the month of June. That total is approximately 25% – 50% above the normal rainfall for this area during the month of June.



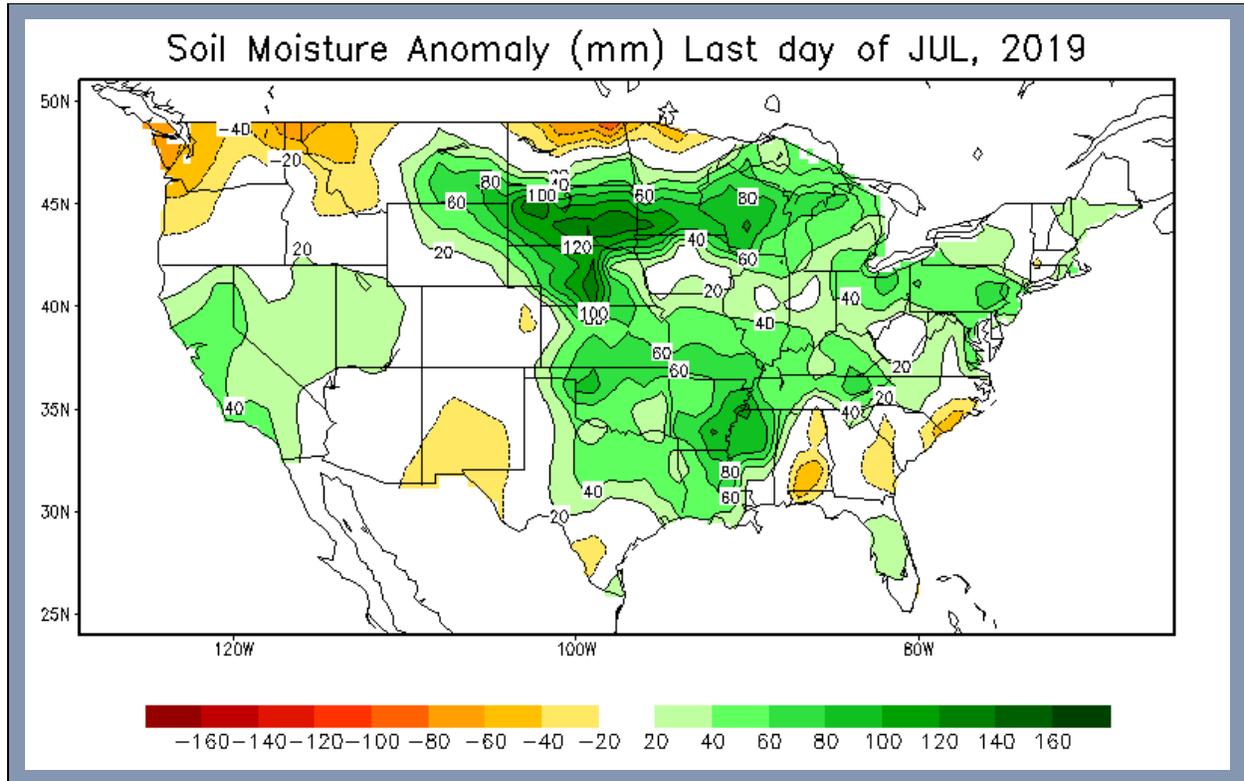
JUNE – JULY RAINFALL

July was another wet month in the area of the culvert collapse, with the QPE product indicating an estimated 10"+ of rainfall at the incident location. The incident occurred on the morning of July 27 and the product below shows rainfall for the entire month, but a review of daily estimated totals (not shown) indicates that 2" or less of the 10"+ July total fell in the days after the culvert collapse. Thus, rainfall from 1 July – 27 July 2019 was approximately 8"+ at the incident location, which is ~50% above normal for that stretch.



SOIL MOISTURE

A plot of soil moisture anomalies obtained from the NWS Climate Prediction Center (CPC) valid on 31 July 2019 indicates abnormally wet conditions across most of Louisiana, including the incident location. Positive anomalies of 60+ mm (~2.4 inches) were observed near the area of the culvert collapse, indicating an unusually moist ground at the site.



CONCLUSION

An exhaustive analysis of archived NWS Doppler radar imagery, NWS text products, social media reports, and other relevant information reveals three heavy rain events in the general vicinity of the culvert collapse in the preceding weeks, including two that directly impacted the incident location.

On 6 June 2019, widespread heavy rainfall impacted Livingston Parish, including the city of Walker. Radar-estimated 3 to 4 inches of rain fell in the area around Walker on this date, but some rain gauge reports indicate that more than 6 inches of rain fell near the culvert collapse. Widespread flooding was observed in this area, including water intrusion into some homes and businesses.

The next heavy rain event in this area occurred on 14–15 July 2019 in association with Hurricane Barry. Radar estimated that approximately 8 inches of rain fell near the incident location during that 2-day stretch and there is at least one rain gauge report relayed by the NWS that supports that estimate.

Bias-corrected rainfall estimates from NCEP indicate that approximately 16 inches of rain fell near the incident location in the 7-week stretch leading up to the culvert collapse (1 June – 27 July 2019). That represents a surplus of 5 inches or more, or approximately 50% above normal for that period. Additionally, soil moisture anomalies indicated the ground was much wetter than normal in late July as a result of the repeated heavy rains.

This report makes no attempt to examine construction or engineering variables involved in the culvert collapse, but we can verify that rainfall was significantly above normal in the area in the weeks leading up to the failure and may have been a contributing factor.

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