Hurricane Beulah: Then and Now

Is the Rio Grande Valley Ready, 50 Years Later?

Barry Goldsmith
Warning Coordination Meteorologist
NWS Brownsville/Rio Grande Valley
September 6:
Depression, 35 mph
Near Barbados

September 9:
Major Hurricane, 140 mph
South of Puerto Rico

September 13:
Tropical Storm, 60 mph
South of Jamaica

September 15:
Major Hurricane, 115 mph
Southwest of Cayman Islands

September 18:
Major Hurricane, 115 mph
East of Tampico

September 20:
Catastrophic Hurricane, 160 mph
67 miles south of Brownsville/Port Isabel/SP!

Beulah's Track
Beulah: Tale of the Tape

• Landfall: September 20, just after midnight. Wind SSHWS Rating most likely high Cat 3/Low Cat 4. Minimum central pressure ~945 mb.
  • Inland inundation was the “Memory of Record”
    – Rainfall of 15-25” (or more) region wide
    – “Lake” South Texas
    – Floodways failed in at least two places
• Wind damage widespread in Lower Valley
  – 136 mph gust in ship channel entrance; eight hours of hurricane force winds at Brownsville
  – 100 mph gusts as far west as Weslaco and McAllen
• Peak storm tides 8 to 14 feet
  – Coastal inundation of South Padre Island, Port Mansfield, and parts of Port Isabel
• 115 (to 141) tornadoes in south and central Texas, a single-storm U.S. record that stood until Ivan (2004)
Beulah: Tale of the Tape

- Damage Totals (1967 Dollars): $170 million statewide; $100 for the Rio Grande Valley. Total estimated damage was >$1 billion, second on record at time.

- Death toll still “fuzzy”; reports vary from 11 to as more than 15 persons. Four were killed in tornadoes north of the impact zone.
• Heavy Rains Continued through September 22
• River Flooding Continued Much Longer (1 week+)
Camargo Calamity

Photo Credits: Dr. Mario E. Ramirez
Hurricane Beulah Collection
Camargo Calamity

◆ 14,000 “instant” Mexican refugees crossed into Starr Co. Texas
◆ Dr. Ramirez, assisted by state and federal medical services as well as U.S. Military forces, brought food and medicine to protect lives
◆ What if Beulah happened in 2017? Is Texas ready for all flood permutations?
Wind Damage
Storm Surge Inundation

Port Isabel: Docks washed away

Port of Brownsville
Tornadoes

“Classic” Northeast Quadrant of Circulation Tornadoes 115 known, up to 141 possible
RGV: Then...

...and Now

1970 Census Tracts

2010 Census Tracts
RGV: Then... 
(Pop: 355,180)

...and Now
2010 Pop: 1,264,091
2016 Pop: 1,357,910

2010 Census
2015 Estimates in Bold
Rio Grande Valley: Tip of the Spear

Building Resilience is a Big Deal Here!

<table>
<thead>
<tr>
<th>Location</th>
<th>Population</th>
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</thead>
<tbody>
<tr>
<td>Cameron Co., TX</td>
<td>420,392</td>
</tr>
<tr>
<td>Hidalgo Co., TX</td>
<td>831,073</td>
</tr>
<tr>
<td>Starr Co., TX</td>
<td>62,955</td>
</tr>
<tr>
<td>Willacy, Co., TX</td>
<td>21,903</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>1,336,323</strong></td>
</tr>
</tbody>
</table>

- Median Income Per Capita: $14,500
  - US Average: $28,155
- Median Family Income: $36,500
  - US Average: $53,046

37% of all persons live in poverty

At least 100,000 live in Colonias...

From Rivera, 2014

...And Many Look Like This
La Joya, TX October 2015 – 65 mph winds did this!
Building Wind Resistance

Florida: Concrete Block Systems

Rio Grande Valley (except coast): Frame/Oriented Strand Board (OSB). Tens of thousands of homes built since Beulah/Allen start this way. Does it matter?
Building Wind Resistance: Roofs/Connectors

Rebar reinforced walls = Good
No viable connection to roof = Very, very BAD!
Estimated winds: 85 to 95 mph (thanks, Tim Marshall!)

Granjeno (Hidalgo Co), May 31, 2016

Hurricane straps on every frame - Good
Nails vs. bolts on ground connection: ???
Rainfall Flooding: 
River Response

In 1967...The Floodway did not adequately protect all of the Lower Rio Grande Valley

After Beulah, the Floodway was improved. In 2010, additional improvements helped protect the Valley despite equal or greater water flow in the Rio Grande Basin.
Willacy County farmland, late Oct. 2015 (14-18" rainfall)
Rio Grande Plain soils formed on a broad coastal plain consisting of sediments of Tertiary and Quaternary age. The southern extent of this nearly level plain is within the ancestral valley cut by the Rio Grande. The coastal-plain landscape is dissected by generally southeastward flowing streams. Weesatche, Duval, Samosa, Hidalgo, Brennan, Peñasco, Uvalde, Pryor, Elindio, and McAllen soils are deep and very deep, well-developed, loamy soils that occur on nearly level to moderately sloping plains and broad ridges. Olmos, Delmita, and Randado soils, shallow to a root-restrictive layer of cemented caliche (CaCO₃), formed in gravelly Pleistocene sediments. Langtry soils are shallow, Montell and Catarina soils are clayey sodium-affected soils, and Maverick soils are clayey and moderately deep to weathered shale bedrock. Falfurrias, Sarita, and Nueces soils are very deep, sandy soils on the sand-sheet prairie that covers the southeast parts of the South Texas Coastal Plain.
Soil “101”: Permeability

<table>
<thead>
<tr>
<th>Soil</th>
<th>Texture</th>
<th>Permeability</th>
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<tbody>
<tr>
<td>Clayey soils</td>
<td>Fine</td>
<td></td>
</tr>
<tr>
<td>Loamy soils</td>
<td>Moderately fine</td>
<td>From very slow to very rapid</td>
</tr>
<tr>
<td>Sandy soils</td>
<td>Coarse</td>
<td></td>
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</tbody>
</table>

**Example**
Average permeability for different soil textures in cm/hour

<table>
<thead>
<tr>
<th>Texture</th>
<th>Permeability</th>
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<tbody>
<tr>
<td>Sand</td>
<td>5.0</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>2.5</td>
</tr>
<tr>
<td>Loam</td>
<td>1.3</td>
</tr>
<tr>
<td>Clay loam</td>
<td>0.8</td>
</tr>
<tr>
<td>Silty clay</td>
<td>0.25</td>
</tr>
<tr>
<td>Clay</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Population and Permeability

2014 Census Tract Estimates, U.S. Census Bureau
Is RGV Infrastructure Keeping Up With Growth?

Population and Permeability

- Hidalgo
- Cameron
- Expon. (Hidalgo)
- Expon. (Cameron)

Year:
- 1960
- 1970
- 1980
- 1990
- 2000
- 2010
- 2014

Population:
- 0
- 200000
- 400000
- 600000
- 800000
- 1000000
- 1200000
- 1400000
In 1967...South Padre Island was a sleepy beach town.

- Fewer Buildings and Roads, but...
- ...Many buildings were older and not able to withstand 120 mph winds and floodwaters

Today...South Padre Island is a full blown beach resort.

- More buildings and roads, but...
- ...Many built to withstand 120 mph winds
- Still, damage from Beulah today could exceed $1 billion.
Where We Are Today

• Favorable:
  – Coordinated Valley-wide Evacuation and Sheltering Plans; improved Hurricane Evacuation Study
  – ARRA and Potential Future Funds earmarked to further improve levee strength, height, etc. (River Flood Impact Reduction)
  – Stronger building codes through Texas Windstorm Insurance Association (Coastal -130 mph; Inland Wind 1 - 120 mph)
Where We Are Today

- Unfavorable
  - Population and Farms replacing wetlands on loamy soil = More “Lake RGV” situations (rainfall flooding)
  - Oriented Strand Board vs. Concrete Block Systems just miles from the coast: Are roof/truss/beam clip/strap systems enough? (wind)
  - Over 1500 colonias with thousands of substandard housing and community mistrust of government information (wind/rainfall flood)
  - South Padre Island is several hundred million $$ more valuable in 2017 (storm surge/wind)
Is it Too Late... to Mitigate?

Dr. Mario Ramirez Collection:
http://library.uthscsa.edu/2011/09/hurricane-beulah-collection/

“It Happened in Texas”:
http://www.texasarchive.org/library/index.php/It_Happened_in_Texas

USACE Beulah Flood Report:
2017: What Really Matters?

#ItOnlyTakesOne

#HurricaneStrong

National Weather Service
Brownsville/Rio Grande Valley
Atlantic Season So Far

• Six named cyclones, three ahead of schedule (for Aug. 10)...

• ...Five Tropical Storms, and Hurricane Franklin (today)

• Combination of “Energy” for the first five will be less than for Franklin (total: ~6.5 units; Franklin, est. 3.5 units)

• Meaning: It’s been “quiet”, despite the numbers.
2017 Atlantic Season So Far

*Map does not include Franklin

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>TYPE</th>
<th>NAME</th>
<th>DATE</th>
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<tbody>
<tr>
<td>1</td>
<td>TS</td>
<td>ARLENE*</td>
<td>APR 19-21</td>
</tr>
<tr>
<td>2</td>
<td>TS</td>
<td>BRET</td>
<td>JUN 19-20</td>
</tr>
<tr>
<td>3</td>
<td>IS</td>
<td>CINDY</td>
<td>JUN 20-23</td>
</tr>
<tr>
<td>4</td>
<td>TS</td>
<td>DON</td>
<td>JUL 17-18</td>
</tr>
<tr>
<td>5</td>
<td>TS</td>
<td>EMILY</td>
<td>JUL 31-</td>
</tr>
</tbody>
</table>

* Denotes post-storm analysis is complete
Atlantic Season So Far: The A-B-Cs

Arlene, Apr 19-21
50 mph

Bret, June 19-20
45 mph

Cindy, 60 mph, June 20-23
Atlantic Season: And the D-E-Fs

Don, 50 mph, July 17-19

Emily, 45 mph, July 27-31
Franklin: One Finally “Launches”
Updated NOAA Atlantic Forecast
(Today, Aug. 9 2017)

• Change is only in the number of named cyclones. And only due to the “jackrabbit” start mentioned earlier.

• Conditions for the original forecast (Neutral ENSO, above average basin water temperatures remain on track as they were in May.

2017 Atlantic Hurricane Season Outlook
AUGUST 9 UPDATE

- Named storms: 14-19
- Hurricanes: 5-9
- Major Hurricanes: 2-5

Season probability:
- Above-normal: 60%
- Near-normal: 30%
- Below-normal: 10%

Be prepared: Visit hurricanes.gov and follow @NWS and @NHC_Atlantic on Twitter.

August 9, 2017
2017 Atlantic Tropical Cyclone Names

AUGUST 9 UPDATE

Arlene  Harvey  Ophelia
Bret     Irma    Philippe
Cindy    Jose    Rina
Don      Katia   Sean
Emily    Lee     Tammy
Franklin Maria  Vince
Gert                      Whitney

*Names provided by the World Meteorological Organization

Be prepared: Visit hurricanes.gov and follow @NWS and @NHC_Atlantic on Twitter.

August 9, 2017
But What About Us?

• La Canícula (The Dog Days) Dominated June and July

• It Shows No Signs of Letting Up in August

• September is *still* a wildcard – Hence the attention on Beulah!
La Canícula, Locked In

Forecast Steering Pattern through Late August 2017

- Potential Future August Tracks, IF dry air/wind shear are minimal
- Texas coast: Would remain “high” and dry
- Pattern, so far, very similar to 2016
What If the Rains Don’t Come?

Amistad Reservoir: 75.0% full as of 2017-08-09

Falcon Reservoir: 24.1% full as of 2017-08-09
What if the Rains Don’t Come?

- At least there is some water in Mexican Reservoirs 😊
- Most at or above 75% conservation
Bottom Lines

• Atlantic Season off to a “Jackrabbit” Start - but future impacts for Texas depend on the pattern “puzzle pieces”
• Other factors include deep moisture availability and wind shear. High wind shear and dry air are enemies to tropical cyclones, no matter how hot the water. The Caribbean has been “loaded” with shear this summer, so far
• September is a “wild card”, but if it follows June-August, the Texas coast may steer clear
• But Beulah reminds us that just a “crack” in the door can open the RGV up to potential danger
Thank You!

Questions?

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weather.gov/rgv

@wxdancer