

2020 Tropical High Water Mark Review/Lessons learned

A 'model' for future surveys

Jeffry Evans¹ and Jeffrey Lindner²

¹National Weather Service, Houston/Galveston

²Harris County Flood Control District, Houston

Goal

Find, measure, survey, collect, and store accurate high water marks from storm surge flooding

- **Determine height & inland extent**
- **Refence Above Ground Level (AGL) & above a datum (i.e. NAVD88)**
- **Provide to the National Hurricane Center for verification/post event review (3' or greater AGL).**



Image- Jeffry Evans, NWS

Reasons for Collecting High Water Marks

- Determine water surface elevations between gage locations
- Determine water surface elevation return frequency (10, 50, 100-yr)
- Help in calibrating hydrologic models
- Help in determining the area extent of flooding
- Develops a historical record of flood events and comparisons
- Improve future forecasts and services!

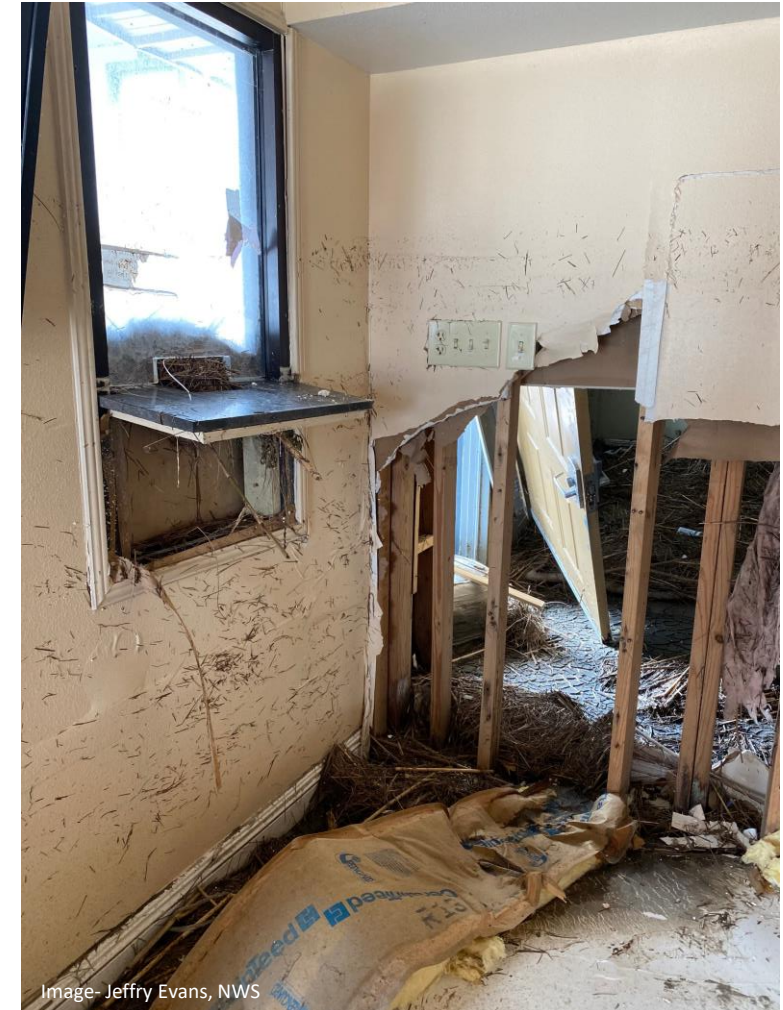


Image- Jeffry Evans, NWS

Collecting High Water Marks

- Stillwater, wave, wave run-up
- Above datum vs. Above Ground Level (AGL)
- Debris line is not always the HWM
- Examine entire area
- Finding HWM's can be difficult, frustrating, and time consuming



Image- Jeffry Evans, NWS

Collecting High Water Marks

What to look for:

- Vegetative debris lines (good, caution)
- Laid down grass (caution)
- Seed lines (excellent, inside structures)
- Mud lines (caution)
- Debris on chain link fences (good)

Where to look:

- Hills and slopes
- Bridge decks, slope paving, bridge cords
- Power poles, fences, buildings, tree trunk
(careful of tree limbs)
- Be careful and anything that can be moved or float

Examples:



Image - Jeffrey Evans, NWS

What is 'AGL'

- Determining 'AGL' of debris line is tricky along beach.
- Technically MHHW at debris line is 'zero'.
- Measure MHHW and take the difference
- Without GPS readings in the field, this would be nearly impossible to determine.



What is 'AGL'

Determining 'AGL' of HWM can be even trickier when well inland.

- There is no MHHW.
- Structures may be elevated either on mounds or stilts
- Measure 'GL' using surrounding mean level ground.
- Document what was used as GL.
- Without GPS readings in the field, this would be nearly impossible to determine.



Image- Jeff Lindner, HCFC



Image- Jeffery Evans, NWS

Laura 2020 (near Grand Chenier, LA)

Debris Line may not be HWM

Laura 2020
(near Creole, LA)



Image- Jeffrey Evans, NWS

This was spray painted as the HWM



Image- Jeffrey Evans, NWS

Be wary of waves

Laura 2020
(near Grand Chenier, LA)



5 feet of difference between an 'excellent' still water mark and a wave mark outside in close proximity

Image- Jeffry Evans, NWS



Image- Jeff Lindner, HCFC

Understand the exposure

- Need to know the wind/surge 'direction' and exposure at the location.
- Determining 'AGL' of debris line is tricky.
 - Look for MHHW and take the difference

Hanna 2020



Image- Jeffry Evans, NWS

Hanna 2020



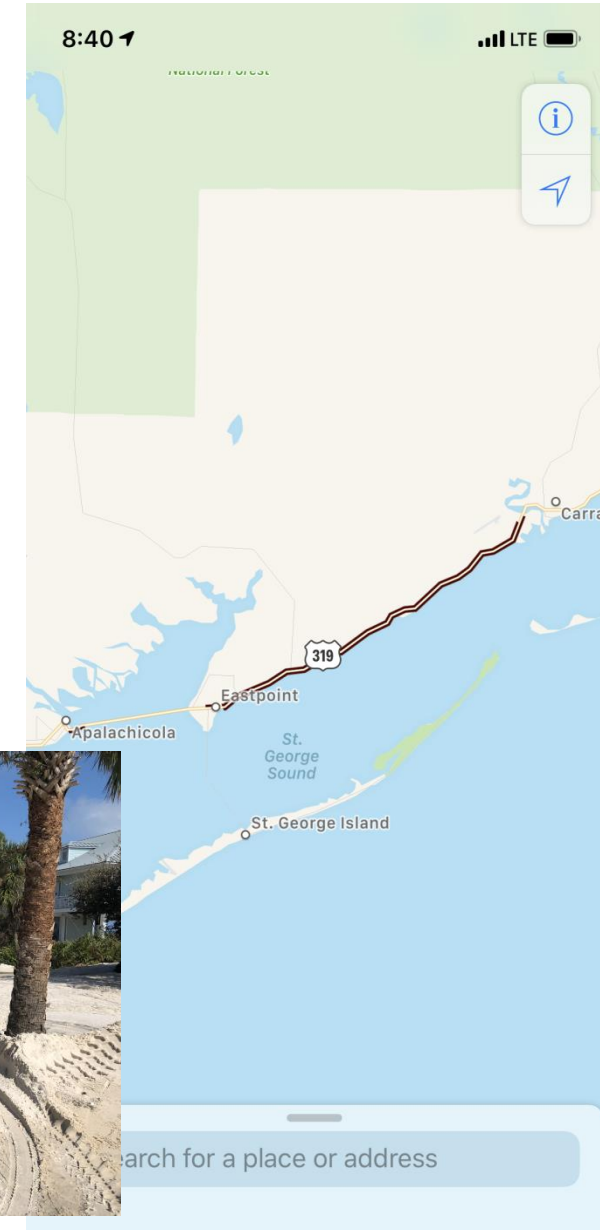
Image- Jeffry Evans, NWS

Challenge: Travel



- Roadway Damage
- Road Closures
- Clean-up/Repair
- Traffic

Hurricane Michael survey- 2018



Not for the faint hearted



Image- Jeffry Evans, NWS



Image- Jeff Lindner, HCFC



Image- Jeff Lindner, HCFC



Image- Jeffry Evans, NWS

Highest measured from Laura

Laura 2020
(near Grand Chenier, LA)



Image- Jeffry Evans, NWS

17.1 feet AGL
2.5 feet deep on SECOND floor!



Image- Jeffry Evans, NWS



Image- Jeffry Evans, NWS

18 feet AGL is the estimated peak surge for Laura using hindcast simulations

Lessons

- Arrive in impact area 1-2 weeks post event (depends on intensity)
 - SAR complete
 - Most residents not returned
- Needs to be a partnership!
 - Someone with technical skills/equipment (GPS)
 - NWS personal with local relationships/knowledge, navigation, understanding of meteorology/hydrology that caused the flooding
- Logistical challenges
 - Lodging/hotels (1-2 hours to reach impact zone)
 - Cell phone service spotty (maps, data collection devices)
 - No food, restrooms, gas
- Roads may be compromised, ferries and bridges out
- Residents may need supplies, ask for help (FEMA, ect)
- Prepare for 14-16 hour days
- Watch for nails, broken glass, hazardous wildlife
- Marking multiple events (Laura and Delta) and tide cycles



Image: Jeffery Evans, NWS

Future for tropical HWM surveys?

- Coastal Act (beginning 2023)
 - More uniform federal effort to accurately capture surge HWM
 - NHC surge unit will likely have a large role
 - Capture AGL and a set datum, in a consistent manner, across the U.S. coastline
- 2020 'concept' may become the expectation
- Partnering of agencies with expertise in equipment, surge and meteorology
- NWS, USGS, and other agencies (HCFCD) could all play a role in capturing HWM



Image- Jeff Lindner, HCFCD

Questions



Jeffry.evans@noaa.gov

Jeff.Lindner@hcfcd.hctx.net