

Hurricane Michael

Data, including tree damage data, show Michael was weaker than Category 5 at landfall:
Panama City, Tyndall AFB, & Mexico Beach, FL.



Bob Endlich

bendlich@msn.com

Cruces Atmospheric Sciences Forum

19 Nov 2022

Evolution of my thoughts on this topic

- 2018's Hurricane Michael, in post and presentation graphics, links below:

<https://casf.me/more-climate-alarmist-false-narratives/> and

https://casf.me/wp-content/uploads/2019/11/Combined_Climate-Crisis-Examined_Hurricanes-Dorian-and-Micheael_Winter-Outlook-Failure_536-AD-ananalysis_-16-Nov_2019.pdf

- “How to Torture the Data,” by NOAA
- This is my 2022 look at the topic after Hurricane Ian struck SW Florida late September 2022

Bob's 2022 Notes on Changes

In 2022, I reviewed my 30 November 2019 post, and the accompanying presentation. Two elements needed to be revised.

In my previous, I transposed two digits in the longitude of Tyndall AFB's runway anemometer. I present the corrected data here, but the reported anemometer location still seems a mile, and a little over a mile and a half, in error.

Also, in my previous, pertaining to NOAA's declaration that 2018's Hurricane Michael was a Saffir-Simpson **Category Five** at landfall, I erroneously circled the peak gusts recorded at Tyndall AFB. <Saffir-Simpson wind category winds pertain to 1-minute average surface winds.>

I should have circled the **maximum sustained winds** and compared them with the Saffir-Simpson hurricane intensity scale.

I correct both errors here.

Bob's 2022 Notes for changes, P2.

I add a note here on the ICAO (Aviation) and Florida Coastal Management Program (FCMP) wind measurements.

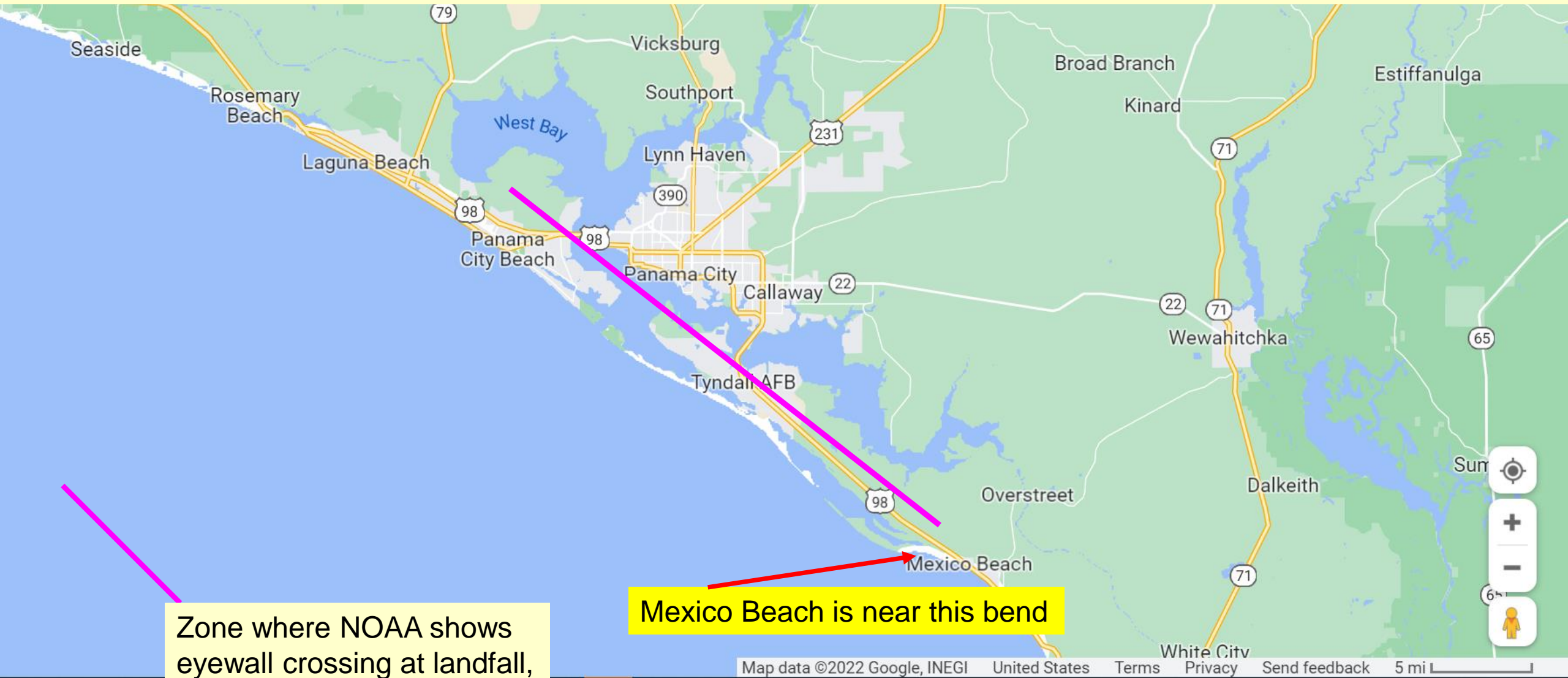
This review makes the gymnastics performed by NOAA, in bending and torturing the data to upgrade Hurricane Michael to Category Five, now seem even more unwarranted and extreme.

I present this new look at this subject, emphasizing the original Saffir-Simpson surface wind definitions and especially determinations of hurricane strength categories from observed wind damage to trees.

Internet-posted stories provide many dozens of photos. I used some in this comparison.

Google Map of Panama City, Tyndall AFB, and Mexico Beach, Florida.

The magenta line shows the eyewall passage of 10 October 2018, the source area of many photos here.

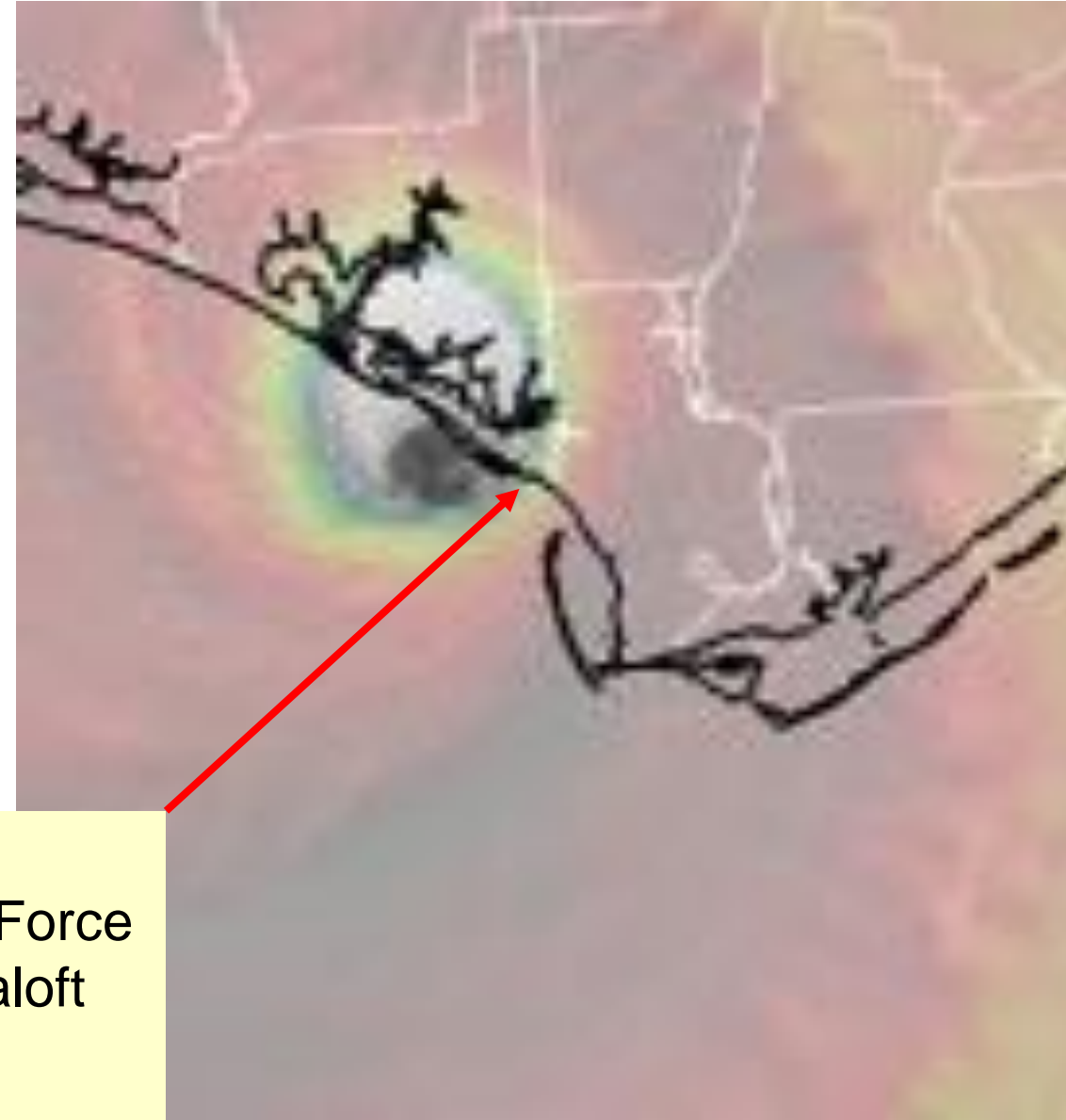


Zone where NOAA shows eyewall crossing at landfall, ~21 miles long.

Mexico Beach is near this bend

Google Maps' 5-mile distance scale

Comparison between Google Map of the area, and the NWS map of Michael at landfall.



Note Well the location of the southeast eyewall of Michael at landfall. This is the area where the Air Force Reserve WC-130 measured the strongest winds aloft at Michael's landfall, very close to, or right over Mexico Beach, FL

NOAA: 140 Kt!



Strongest hurricane on record to make landfall in the Florida Panhandle



Maximum Sustained Winds: **140 KTS**
161 MPH



Minimum Pressure: 919 mb



Peak Storm Surge Inundation:
9-14 feet Mexico Beach to Indian Pass



NWS Tallahassee
weather.gov/tallahassee

Statistics from Hurricane Michael

Aeronautical Chart of Michael's landfall area.

https://aeronav.faa.gov/visual/09-08-2022/PDFs/New_Orleans.pdf



Contact Eglin/Tyndall APP for operations within the Class E airspace in the warning areas.

EGLIN E MOA
OVERLIES ALL EGLIN/VALPARAISO RESTRICTED AREAS AND SPECIAL AIR TRAFFIC RULE, PART 93. 0600-2100 INTERMITTENT MON-FRI. OTHER TIMES BY NOTAM. SURFACE TO BUT NOT INCLUDING FL 180 CONTACT EGLIN APPROACH CONTROL 132.1 RADAR ADVISORY SVC AVBL DESTIN ARPT

Zone where NOAA shows eyewall crossing at landfall, ~21 miles long.

Beacon Hill

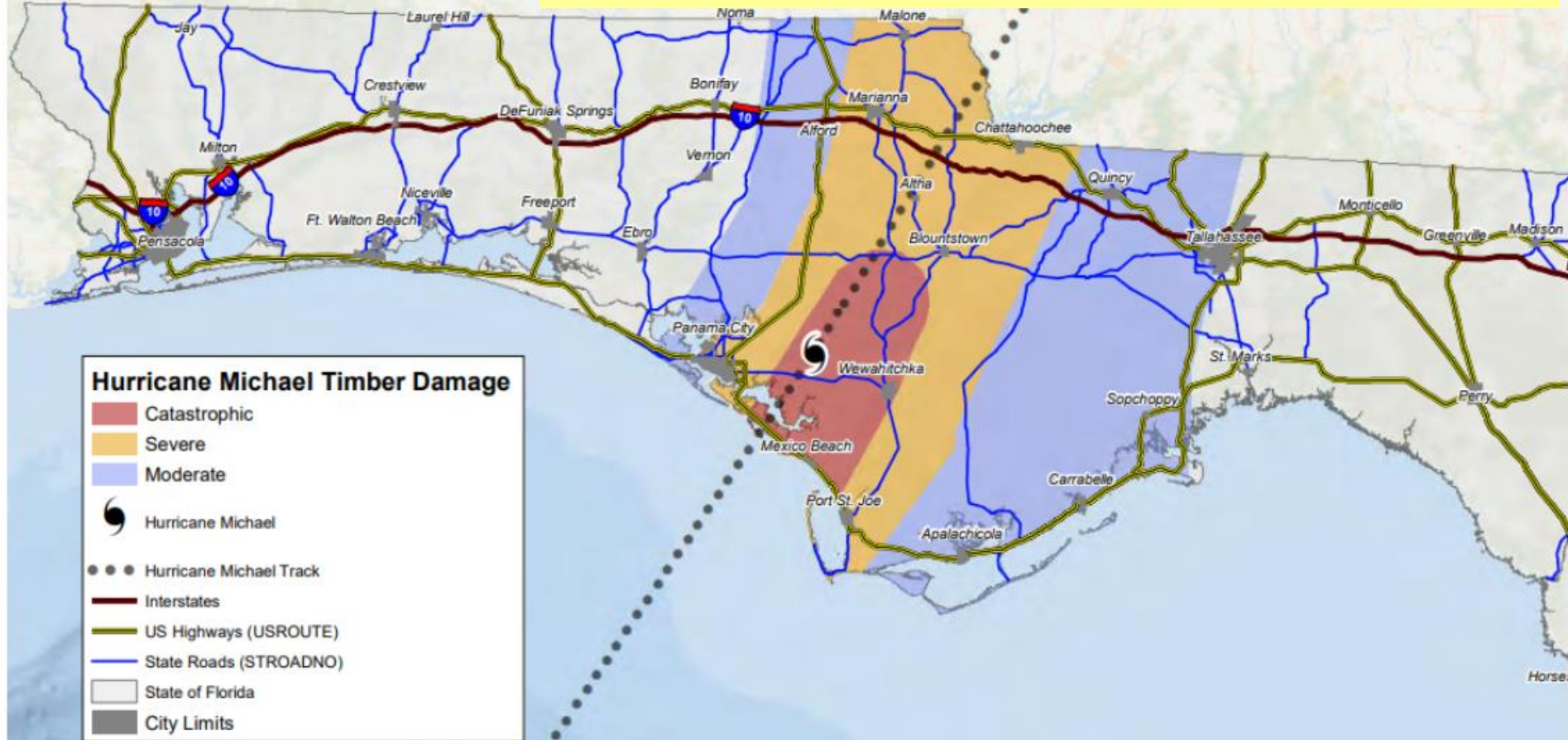


Hurricane Michael State of Florida

Map created 10/17/2018
Sources: National Weather Service;
National Oceanic and Atmospheric Administration.



<https://www.weather.gov/tae/HurricaneMichael2018#>



Hurricane Michael Timber Damage

- Catastrophic
- Severe
- Moderate
- Hurricane Michael
- Hurricane Michael Track
- Interstates
- US Highways (USROUTE)
- State Roads (STROADNO)
- State of Florida
- City Limits

This map is the product of the Florida Forest Service.
No warranties are provided for data therein, its use,
or its interpretation.



The original Saffir-Simpson hurricane wind categories

<https://www.nhc.noaa.gov/aboutsshws.php>

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

So many photos! I emphasize looking at damage to trees to determine wind speed categories.

ONE 64-82 Kt

Large branches of trees will snap, and shallowly rooted trees may be toppled.

TWO 83-95 Kt

Many shallowly rooted trees will be snapped or uprooted...

THREE 96-112 Kt

Many trees will be snapped or uprooted...

FOUR 113-136 Kt

Most trees will be snapped or uprooted, & power poles downed.

FIVE 137 Kt or higher.

Fallen trees and power poles will isolate residential areas



Hurricane Michael Was A Category 5, NOAA Finds — The First Since Andrew In 1992

“Hurricane Michael had been classified as a Category 4, at 155 mph. The last hurricane of such intensity at landfall was Hurricane Andrew, which struck South Florida and Louisiana in 1992.”

Debris from Hurricane Michael rests along a canal on Oct. 18, 2018, in Mexico Beach, Fla. NOAA upgraded the storm to a Category 5 after completing its analysis.



<https://www.npr.org/2019/04/19/715134716/hurricane-michael-was-a-category-5-noaa-finds-the-first-since-andrew-in-1992>



Hurricane Michael Was A Category 5, NOAA Finds — The First Since Andrew In 1992

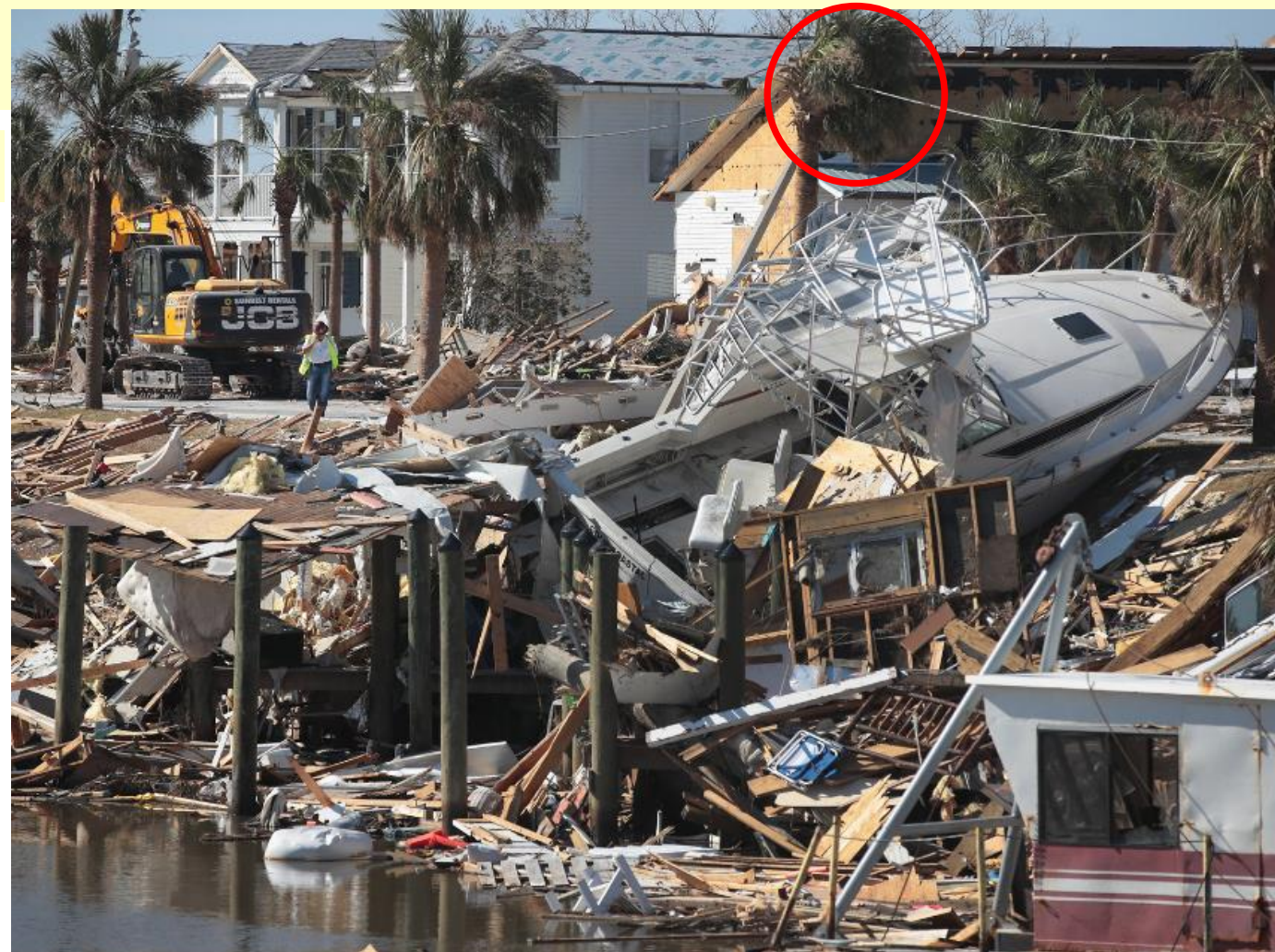
18 Oct 2018 Mexico Beach, Fla.

I count ten palm trees.

The one with the red circle appears to have damage, but is not snapped or uprooted.

Numerous trees behind white 2-story, but difficult to see damage to those trees.

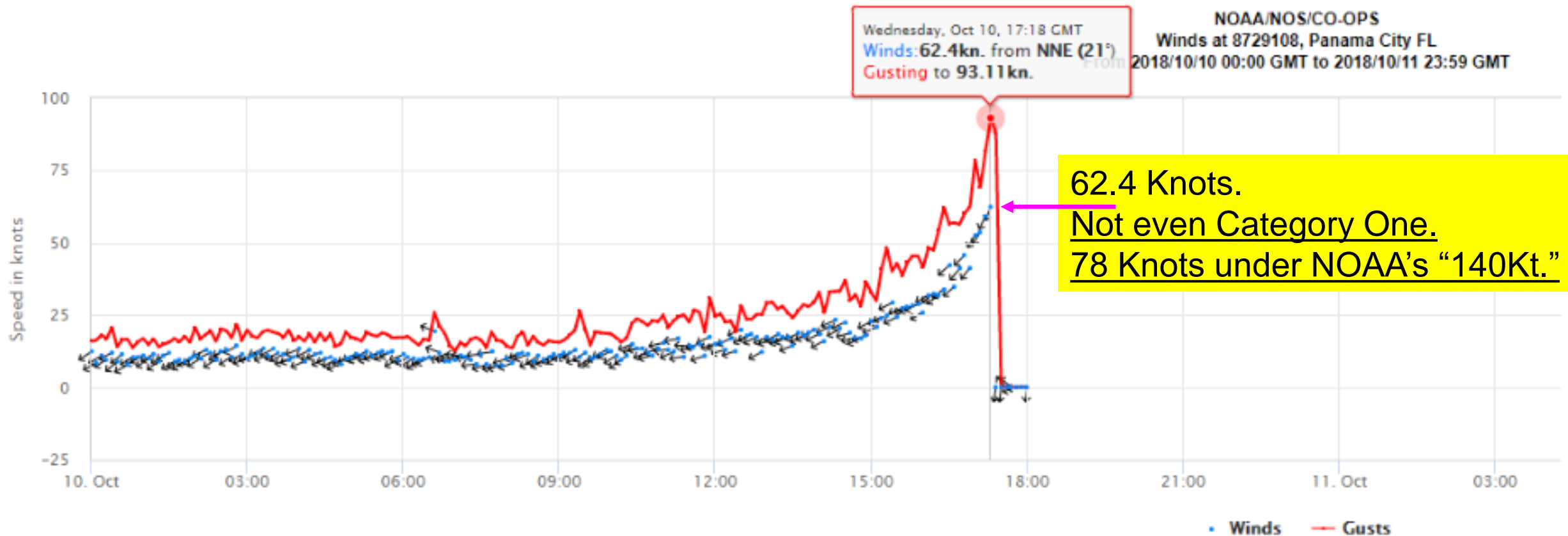
CATEGORY ONE, 64-82 Kt.



“...and then they directly contradicted themselves in the same article, with the image below. There weren't any category four wind speed gusts, much less sustained winds. I don't see any evidence from wind reports or damage reports that Michael was a category four storm at landfall.”



The NOAA wind gauge at Panama City didn't back up any of the claims. It showed a peak sustained wind speed of 62 knots before the eyewall arrived, and minimum pressure of 937.5 mb. Neither remotely close to the hype.



Notes on surface wind measurements at Tyndall AFB.

Under most daytime conditions, wind speeds increase as height above ground increases.

In operational meteorology, most customers are aircrews; the standard height for wind measurements is 10 meters, corresponding roughly to the height of the wing of the aircraft at take-off or landing.

NOAA's reported wind observations I cite are from near the landfall of Hurricane Michael at/near Tyndall AFB, ICAO Code KPAM, very near Panama City, Florida.

The wind observations from Base Weather are at standard height, 10 meters, measured immediately adjacent to the runway.

There is another observation site at Tyndall AFB, the Florida Coastal Monitoring Program, FCMP, Site T3, 15 meters high, towards Mexico Beach, FL.

Category Sustained Winds

Types of Damage Due to Hurricane Winds

1 74-95 mph
 64-82 kt
 119-153 km/h

Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

2 96-110 mph
 83-95 kt
 154-177 km/h

Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.

These screen captures are from the NOAA report on Michael.



Florida									
International Civil Aviation Organization (ICAO) Sites									
Location	Date / Time	Press (mb)	Max Sustained Wind	Gust (Kt)					
Tyndall AFB (KPAM) (30.07N 85.59W)	10/1720	922.4 ⁱ	10/1712	75 ^l	121 ^l				

Measured winds at Tyndall AFB's ICAO site, AF Weather's runway anemometer, 1712Z, were 75 Knots, Gust 121 knots. That is the middle of Category ONE, and 65 Kt below NOAA's "140 Kt."

Tyndall AFB Runway anemometer.
 10-meter height, 75 Knots.
CATEGORY ONE

Saffir–Simpson scale

Category	Wind speeds (for 1-minute maximum sustained winds)			
	m/s	knots (kn)	mph	km/h
Five	≥ 70 m/s	≥ 137 kn	≥ 157 mph	≥ 252 km/h
Four	58–70 m/s	113–136 kn	130–156 mph	209–251 km/h
Three	50–58 m/s	96–112 kn	111–129 mph	178–208 km/h
Two	43–49 m/s	83–95 kn	96–110 mph	154–177 km/h
One	33–42 m/s	64–82 kn	74–95 mph	119–153 km/h

Florida									
International Civil Aviation Organization (ICAO) Sites									
Tyndall AFB (KPAM) (30.07N 85.59W)	10/1720	922.4 ⁱ	10/1712	75 ^l	121 ^l				

Metadata for the location of the ICAO station at Tyndall AFB, KPAM: 30.07N 85.59W

Table 3. Selected surface observations for Hurricane Michael, 7–11 October 2018.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) ^o	Storm tide (ft) ^d	Estimated Inundation (ft) ^e	T
	Date/time (UTC)	Press. (mb)	Date/time (UTC) ^a	Sustained (kt) ^b	Gust (kt)				
Florida Coastal Monitoring Program (FCMP)									
FCMP T2 Beacon Hill (29.91N 85.38W)			10/1732	94 <small>(15 m, 5-min)</small>	110				
FCMP T3 Tyndall AFB (30.02N 85.53W)	10/1713	920.2	10/1657	92 ^l <small>(15 m, 1-min)</small>	112 ^l				

Metadata for the location of these FCMP stations

T2 Beacon Hill: 29.91N 85.38W **T3** Tyndall AFB: 30.02N 85.53W

46 Knots less than Category Five

Saffir–Simpson scale

Category	Wind speeds (for 1-minute maximum sustained winds)			
	m/s	knots (kn)	mph	km/h
Five	≥ 70 m/s	≥ 137 kn	≥ 157 mph	≥ 252 km/h
Four	58–70 m/s	113–136 kn	130–156 mph	209–251 km/h
Three	50–58 m/s	96–112 kn	111–129 mph	178–208 km/h
Two	43–49 m/s	83–95 kn	96–110 mph	154–177 km/h
One	33–42 m/s	64–82 kn	74–95 mph	119–153 km/h

Florida Coastal Monitoring Program (FCMP)									
FCMP T2 Beacon Hill (29.91N 85.38W)			10/1732	94 <small>(15 m, 5-min)</small>	110				
FCMP T3 Tyndall AFB (30.02N 85.53W)	10/1713	920.2	10/1657	92 [!] <small>(15 m, 1-min)</small>	112 [!]				

Location Date/Time Press (mb) Date/Time Max Wind Sustained Gust (Knots)

These FCMP winds are measured 15 meters above the surface.

Measured winds at Tyndall AFB's FCMP T3 site at 1657Z were 92 knots sustained, with gusts to 112 knots, near the top of Category Two.

Measured winds at Beacon Hill's FCMP T2 site at 1732Z were 94 knots sustained with gusts to 110 knots, nearer top of Category Two. (But, wind masts 15 m high)

Here is the NOAA/NHC report

https://www.nhc.noaa.gov/data/tcr/AL142018_Michael.pdf

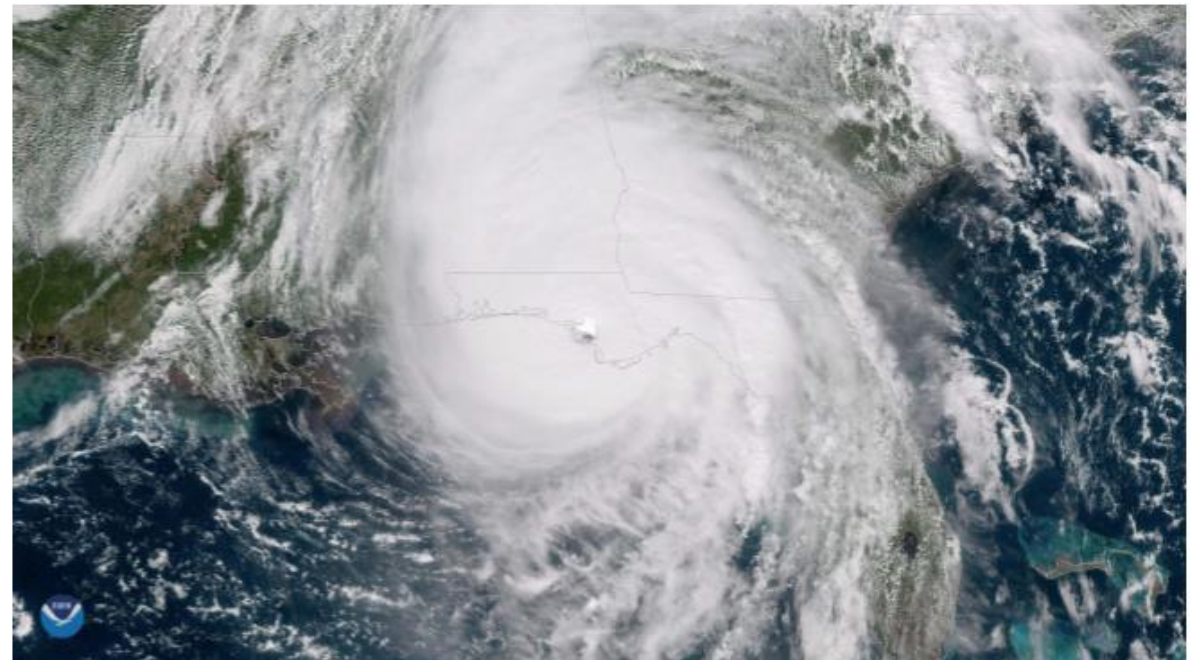


NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE MICHAEL (AL142018)

7–11 October 2018

John L. Beven II, Robbie Berg, and Andrew Hagen
National Hurricane Center
17 May 2019¹



GOES-16 PSEUDO-NATURAL COLOR IMAGE OF HURRICANE MICHAEL AT 1730 UTC 10 OCTOBER 2018. IMAGE COURTESY OF NOAA/NESDIS.

From the report:



GOES-16 PSEUDO-NATURAL COLOR IMAGE OF HURRICANE MICHAEL AT 1730 UTC 10 OCTOBER 2018. IMAGE COURTESY OF NOAA/NESDIS.

Michael was a category 5 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that made a catastrophic landfall near Mexico Beach and Tyndall Air Force Base, Florida, producing devastating winds and storm surge near the coast, and rain and wind inland. It was directly responsible for 16 deaths and about \$25 billion in damage in the United States. Before hitting the United States, the cyclone brought hurricane-force winds to the western tip of Cuba when it was a category 2 hurricane.

¹ Original report dated 19 April 2019. This version corrects the discussion of fatalities in Virginia, includes an updated version of Figure 12, and corrects various minor typos.

NOAA's Hurricane Michael Report: what I call,
"How to Torture the Data," by NOAA, the next two pages.

NOAA's assertions that 2018's Hurricane Michael was a
Category 5 Hurricane when it hit Panama City (& Beach),
Tyndall AFB, & Mexico Beach, FL

...are in the graphics which follow...

Winds and Pressure

The Florida landfall intensity

“We hope you don’t find our Mathematical Gymnastics” 😊
NOAA made “flight level to surface adjustments...” hunting for highest wind at 8000 ft, then adjusting THAT down to the surface... KPAM’s surface measurements and FMCP winds weren’t good enough

Michael’s estimated intensity at landfall in Florida is 140 kt. While the real-time operational estimate was 135 kt, the final best track intensity estimate was determined by a detailed post-storm analysis review of the available aircraft winds, surface winds, surface pressures, satellite intensity estimates, and Doppler radar velocities – including data and analyses that were not available in real time. It should be noted that the NHC best track intensities typically have an uncertainty of around $\pm 10\%$.

1) The maximum flight-level wind measured in Michael near the time of landfall was 152 kt by a USAFR aircraft at 700 mb (approximately 8,000 ft) in the southeast eyewall at 1723 UTC 10 October. This flight-level wind would yield an estimated surface wind of 137 kt using the standard NHC flight-level to surface adjustments, which account for the possibility that the aircraft did not sample the maximum flight-level wind. The maximum real-time surface wind estimate from the SFMR was 138 kt in the south eyewall at 1706 UTC that day. However, there were missing SFMR data in the real-time transmission during that penetration of the eyewall. Re-construction of the instrument’s raw brightness temperatures during the dropout period by the NOAA AOC indicates that the maximum 10-second SFMR wind estimate was 152 kt near 1707 UTC. The SFMR winds support an intensity greater than 135 kt, especially if the 152-kt value is

An example of torturing the data to achieve political objectives

https://www.nhc.noaa.gov/data/tcr/AL142018_Michael.pdf NOAA Report

Winds and Pressure

In 2019, I took NOAA to task for the mathematical gymnastics needed to adjust flight level winds down to the surface.

But there is no indication that these winds aloft directly impinged on the surface, which is the whole point of the Saffir-Simpson categories.

THIS ANALYSIS looks at measured surface winds and Saffir-Simpson tree damage descriptions.

Neither comes near Category 5, my reason to distrust NOAA's declaration of Michael's wind speed at landfall.

The Florida landfall intensity

NOAA ignored measured surface winds!

Michael's estimated intensity at landfall in Florida is 140 kt. While the real-time operational estimate was 135 kt, the final best track intensity estimate was determined by a detailed post-storm analysis review of the available aircraft winds, surface winds, surface pressures, satellite intensity estimates, and Doppler radar velocities – including data and analyses that were not available in real time. It should be noted that the NHC best track intensities typically have an uncertainty of around $\pm 10\%$.

1) The maximum flight-level wind measured in Michael near the time of landfall was 152 kt by a USAFR aircraft at 700 mb (approximately 8,000 ft) in the southeast eyewall at 1723 UTC 10 October. This flight-level wind would yield an estimated surface wind of 137 kt using the standard NHC flight-level to surface adjustments, which account for the possibility that the aircraft did not sample the maximum flight-level wind. The maximum real-time surface wind estimate from the SFMR was 138 kt in the south eyewall at 1706 UTC that day. However, there were missing SFMR data in the real-time transmission during that penetration of the eyewall. Re-construction of the instrument's raw brightness temperatures during the dropout period by the NOAA AOC indicates that the maximum 10-second SFMR wind estimate was 152 kt near 1707 UTC. The SFMR winds support an intensity greater than 135 kt, especially if the 152-kt value is correct and uncontaminated by wave shoaling in water about 89 ft deep. However, there is a significant caveat regarding the SFMR data, as experience during Hurricanes Irma, Jose, and Maria in 2017 suggests the possibility that the SFMR has a high bias at the wind speeds in question. Research to determine if this is the case is currently underway.

NOAA ignored measurements and chose "adjustments" instead.

1) The maximum flight-level wind measured in Michael near the time of landfall was 152 kt by a USAFR aircraft at 700 mb (approximately 8,000 ft) in the southeast eyewall at 1723 UTC 10 October. This flight-level wind would yield an estimated surface wind of 137 kt using the standard NHC flight-level to surface adjustments, which account for the possibility that the aircraft did not sample the maximum flight-level wind. The maximum real-time surface wind estimate from the SFMR was 138 kt in the south eyewall at 1706 UTC that day. However, there were

Heads-up to the audience:

NOAA is fixated on using “the standard NHC flight level to surface adjustments,” as the diagnostic of choice.

Why would you choose “flight level to surface adjustments” <underlining added,> when NOAAs stated “Gold Standard,” wind effect-caused damage to trees, is plainly visible in the numerous Internet-available photos of destruction caused by Michael’s winds?

My answer: NOAA’s authors were fixated on deceiving the readers into believing that Michael was a “human-caused CO2-fueled” storm of greater intensity than warranted by the data themselves.

Notes concerning anemometer locations using the metadata in NOAA's report

Below are the results of putting the location metadata into Google Maps' search bar:

NOAA's metadata for the runway **anemometer for Runway 13 at Tyndall AFB** plots close to Tyndall AFB's **gate to the runway operations area** on the north side of US 98, the approach end of **Runway 13R, at least 5000 ft away**, and **8300 ft for Runway 31L**.

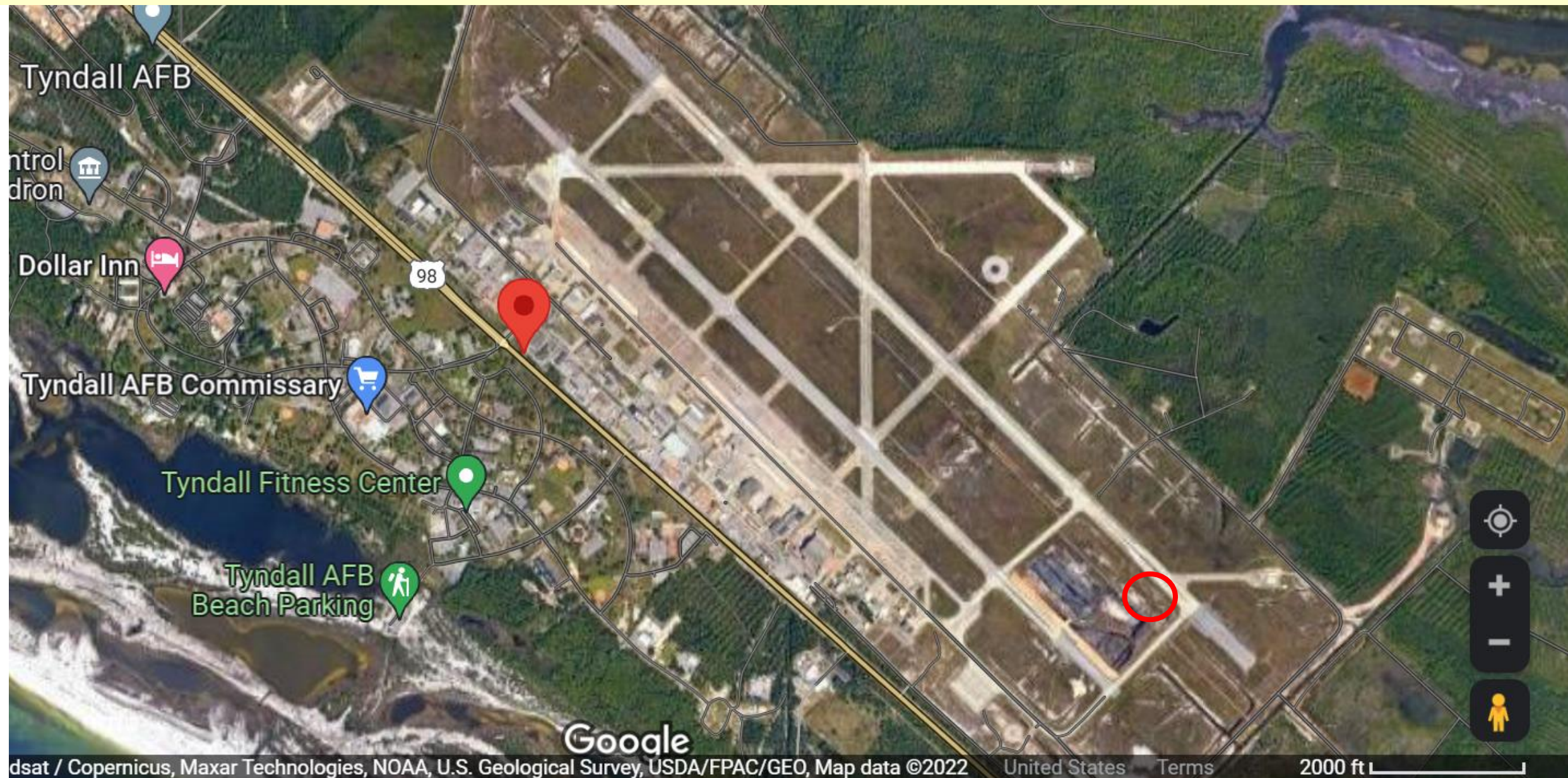
NOAAs' metadata for FCMP T2 **Beacon Hill**, 29.91N, 85.38W, plots 1500 ft offshore from US 98 **about 1250 ft out into the Gulf of Mexico**, depending on the tide. It does not match the location returned on Internet Search of <Beacon Hill, FL> which is onshore and a mile and a half northwest of the tag location on Google Maps.

NOAA's metadata for the FMCP T3 Tyndall AFB, 30.02N, 85.53W, plots 700 ft off the Gulf side of US Highway 98, about 4-1/2 miles southeast of Tyndall AFB'S Louisiana Ave crossing of Highway 98.

Red Marker plots Metadata for location of the ICAO station at Tyndall AFB, KPAM: 30.07N 85.59W, near gate for the Runway complex and Flight Operations ramp. Approach to the runway from the northwest or upper left is to Runway 13L (upper) and Runway 13R (lower). Presumed anemometer location is near the red circle ~5000 ft NNE from the Red Marker.



Red Marker plots Metadata for location of the ICAO station at Tyndall AFB, KPAM: 30.07N 85.59W, near gate for the Runway complex and Flight Operations ramp. Approach to the runway from the southeast or lower right is to Runway 31R. Presumed anemometer location is near the red circle ~8300 ft ESE or about 1.6 mi from the Red Marker.



Notes concerning the location of the anemometers based on the metadata from the NOAA report

Red tag is the location of the FCMP Tyndall AFB T3 site according to the metadata in NOAA's Hurricane Michael report using Google Maps.



☰ 30.02 -85.53



30°01'12.0"N 85°31'48.0"W

30.020000, -85.530000

Notes concerning the location of the anemometers based on the metadata from the NOAA report

Red tag is the location of the FCMP Beacon Hill T2 site according to the metadata in NOAA's Hurricane Michael report using Google Maps, another obvious error.

The anemometer plots ~1000 ft out into the Gulf.

29.91 -85.38



29°54'36.0"N 85°22'48.0"W

29.910000, -85.380000

Mexico Beach

RV Resort

Killer Seafood

386

98

98

Google

St. Joe Beach

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

There are two groups of palm trees in the photo, from Mexico Beach, Florida.

About ten palm trees, left, another six right, but none of them appear to be uprooted or snapped. The downed deciduous trees foreground, apparently from storm surge.

CATEGORY ONE

<https://www.npr.org/2019/01/24/687729891/struggling-here-with-just-living-in-the-aftermath-of-hurricane-michael>





Mexico Beach, Florida.

Two palm trees in middle distance, one on right might have top damaged. Deciduous and pine trees further in the distance. None of these appear snapped or uprooted.

Closer deciduous trees likely damaged from storm surge.

CATEGORY ONE 64-82 Kt.

This looks to me like the 340 ft tower in the Aeronautical Chart, so looking East, an hour after sunrise. Fewer trees.



Mexico Beach, Florida, as seen from a helicopter on Thursday morning, after it was battered by Hurricane Michael



WARNING
W-151B

04

RESTRICTED TO 10,000' CONTACT FLIGHT SERVICE

04

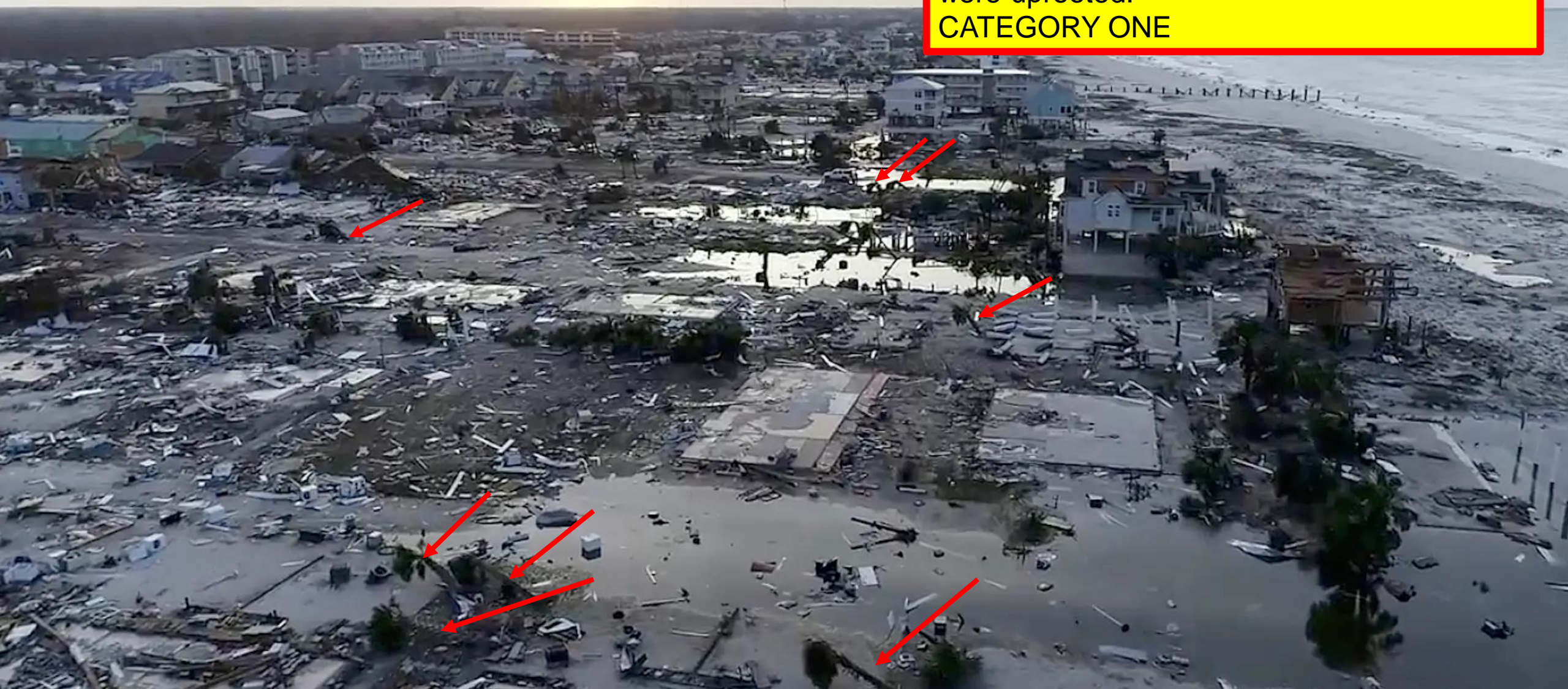
GULF OF MEXICO LOW CONTROL AREA

EST 14100 = UTC
EST 14100 = UTC

LHP

Poor light, poor color rendition, looking into the sun

I counted about fifty palm trees in this picture that I could identify, but maybe only ~eight were uprooted.
CATEGORY ONE



Mexico Beach, Florida, as seen from a helicopter on Thursday morning, after it was battered by Hurricane Michael

ONE

Large branches of trees will snap, and shallowly rooted trees may be toppled. Extensive damage to power lines & poles

TWO

Many shallowly rooted trees will be snapped or uprooted and block numerous roads.

THREE

Many trees will be snapped or uprooted, blocking numerous roads

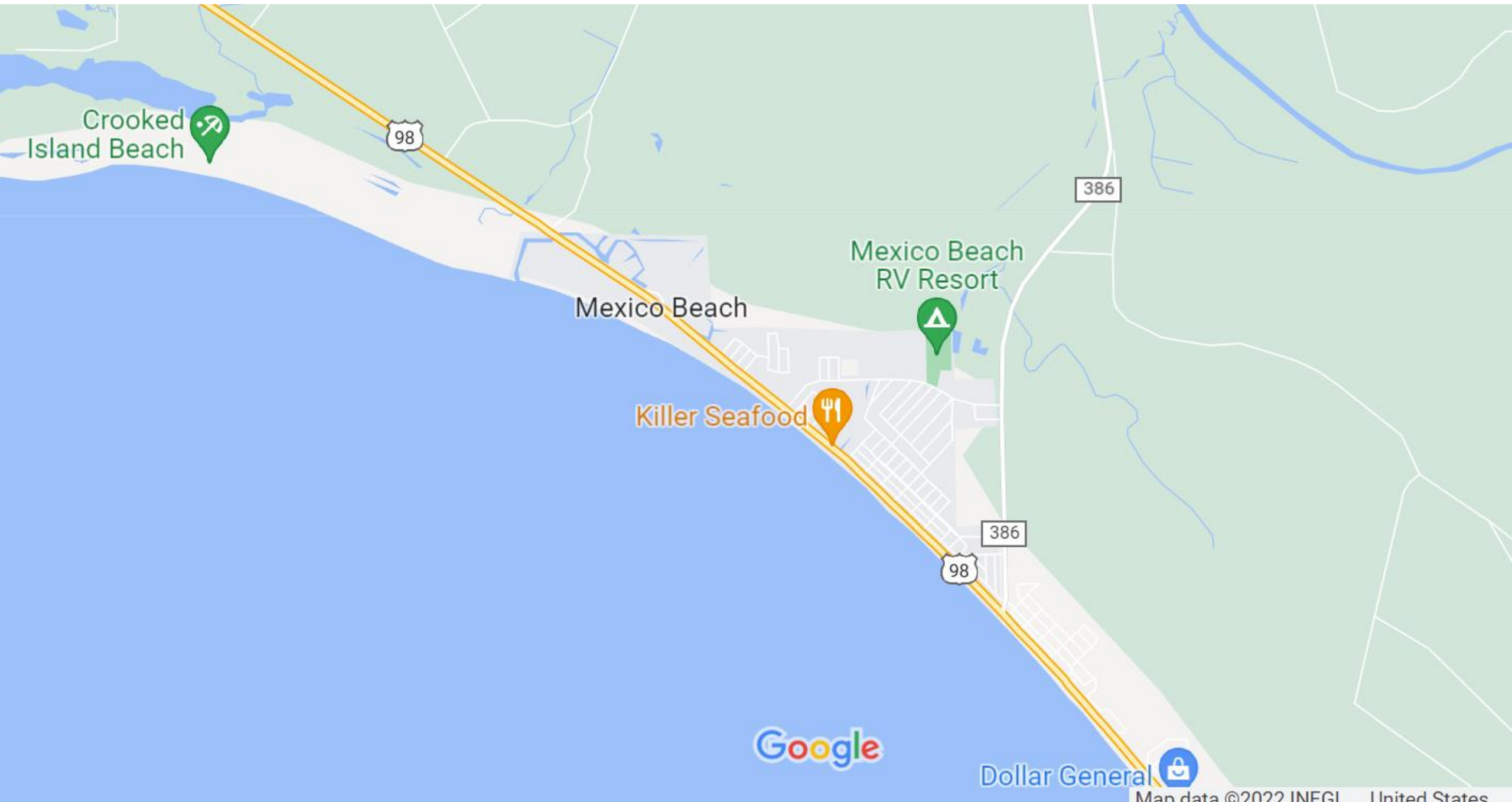
FOUR

Most trees will be snapped or uprooted, & power poles downed. Fallen trees & power poles will isolate residential areas

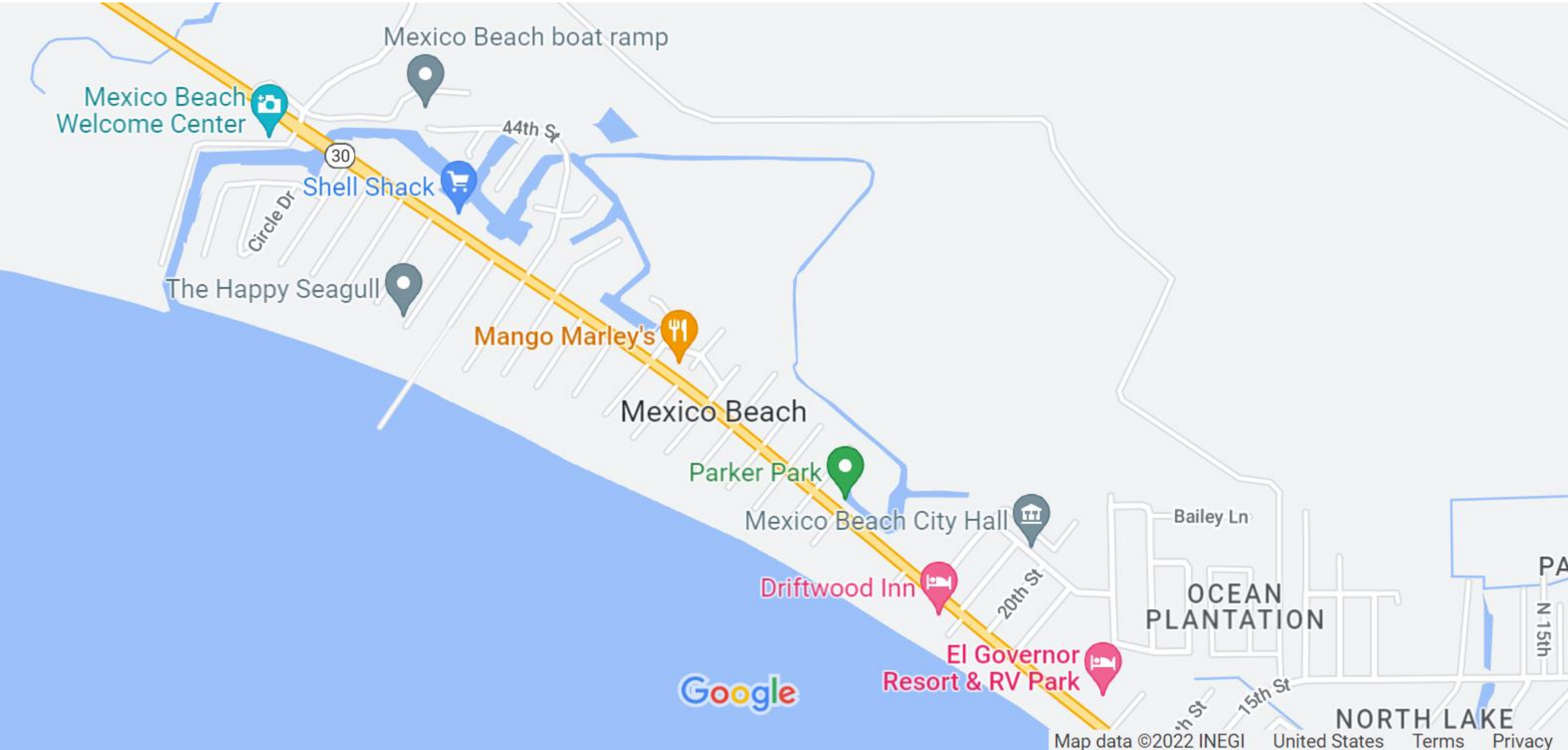
FIVE

Fallen trees and power poles will isolate residential areas

Google Map of Mexico Beach, FL. Many of the damage photos appear to come from the canal and dock area, next.



western portion of Mexico Beach, FL, showing canal, dock, and boat ramp areas

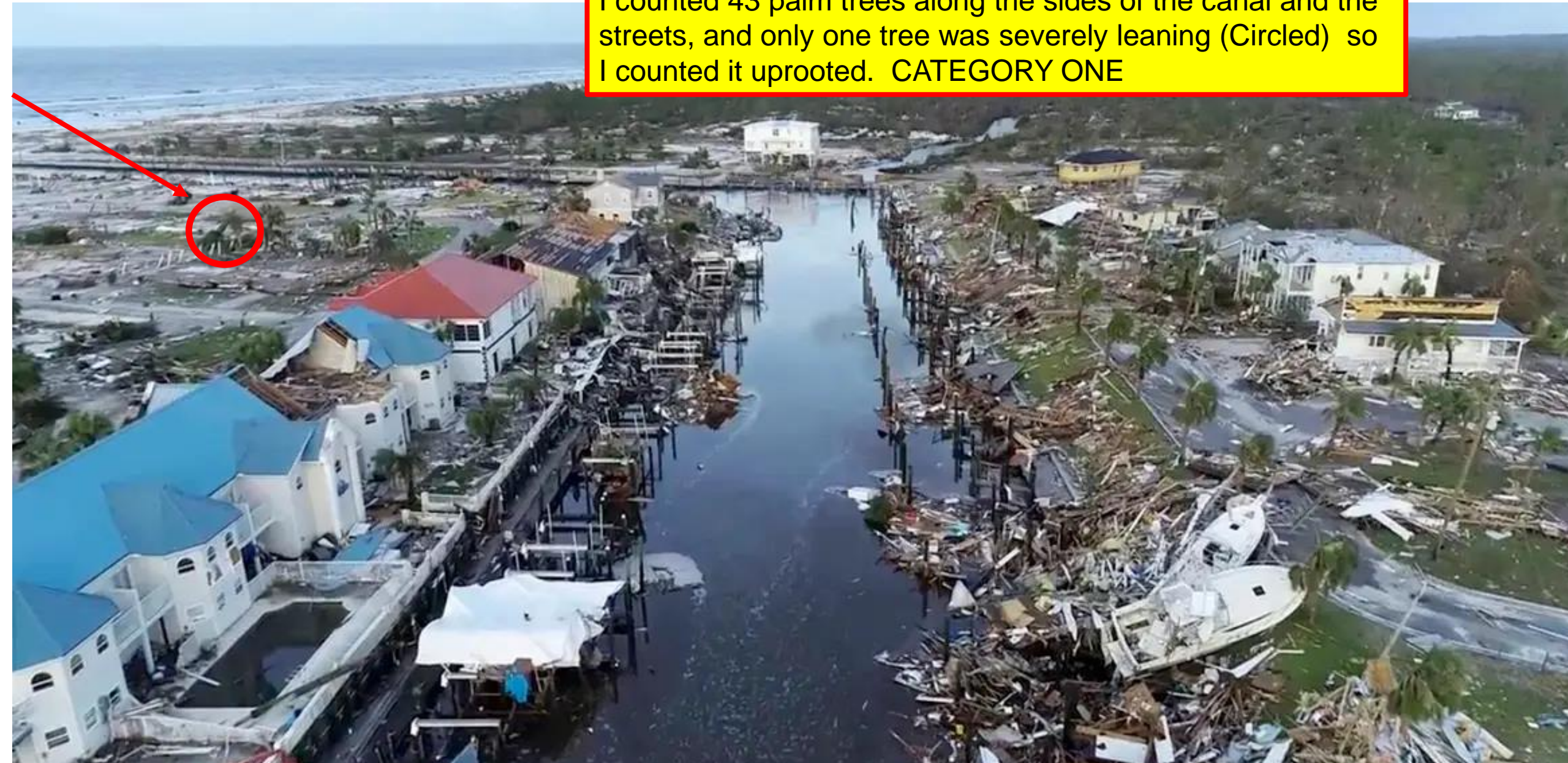


<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#hurricane-michael-made-landfall-near-mexico-beach-florida-around-noon-local-time-on-wednesday-as-a-category-4-hurricane-with-155-mph-winds-1> More trees looking northwest from Mexico Beach population center.



<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#hurricane-michael-made-landfall-near-mexico-beach-florida-around-noon-local-time-on-wednesday-as-a-category-4-hurricane-with-155-mph-winds-1>

I counted 43 palm trees along the sides of the canal and the streets, and only one tree was severely leaning (Circled) so I counted it uprooted. CATEGORY ONE



<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#that-made-it-the-third-strongest-hurricane-in-history-to-make-landfall-in-the-continental-us-2>



Mexico Beach, Florida, on Thursday.

Poor light. I counted 24 palm trees around and this side of the 3-story residence building, and ~4 were uprooted. CATEGORY ONE



Mexico Beach, Florida, on Thursday.

<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#gov-rick-scott-of-florida-said-the-national-guard-rescued-about-20-people-who-decided-to-ride-out-the-storm-in-mexico-beach-3>



<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#gov-rick-scott-of-florida-said-the-national-guard-rescued-about-20-people-who-decided-to-ride-out-the-storm-in-mexico-beach-3>

I counted ten palm trees, none uprooted or snapped. CATEGORY ONE



<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#the-small-town-of-about-1000-was-under-mandatory-evacuation-but-285-people-decided-to-stay-behind-officials-said-4>



michael 2 Homes are left swept off their foundations from the effects of Hurricane Michael, Thursday, Oct. 11, 2018, in Mexico Beach, Florida.

<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#the-small-town-of-about-1000-was-under-mandatory-evacuation-but-285-people-decided-to-stay-behind-officials-said-4>

I counted nine palm trees, one uprooted, one snapped, arrows. CATEGORY ONE

michael 2 Homes are left swept off their foundations from the effects of Hurricane Michael, Thursday, Oct. 11, 2018, in Mexico Beach, Florida.

<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#i-think-the-people-here-have-a-great-heart-and-a-lot-of-resilience-lafountain-said-we-call-them-stubborn-and-hard-headed-i-think-they-will-be-back-6>



Mexico Beach, Florida on Friday.

<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#i-think-the-people-here-have-a-great-heart-and-a-lot-of-resilience-lafountain-said-we-call-them-stubborn-and-hard-headed-i-think-they-will-be-back-6>



Wide angle photo with little detail.
I found 23 palm trees but did not find any
uprooted or snapped. CATEGORY ONE

Mexico Beach, Florida on Friday.



michael 4 A home destroyed by Hurricane Michael in Mexico Beach.



There are about 28 palm trees in this photo; 11 were uprooted or snapped
CATEGORY TWO.

michael 4 A home destroyed by Hurricane Michael in Mexico Beach.



Category 4. “Most trees will be snapped or uprooted, & power poles downed...”

By my hand count:
Snapped & uprooted: 53
Not snapped or uprooted: 45
CATEGORY FOUR 113-136 Kt.



<https://www.businessinsider.com/hurricane-michael-aerial-photos-florida-destruction-damage-2018-10#downed-trees-are-seen-at-tyndall-air-force-base-near-mexico-beach-on-friday-13>



This seems to be the same area at Tyndall AFB, viewed from the ground. Not all trees are down.



Tech. Sgt. Elizabeth Berreles, 921st Contingency Response Squadron security forces, performs an initial security assessment of the area at Tyndall Air Force Base, Florida, Oct. 12, 2018.

This seems to be the same area at Tyndall AFB, viewed from the ground. Not all trees are down.





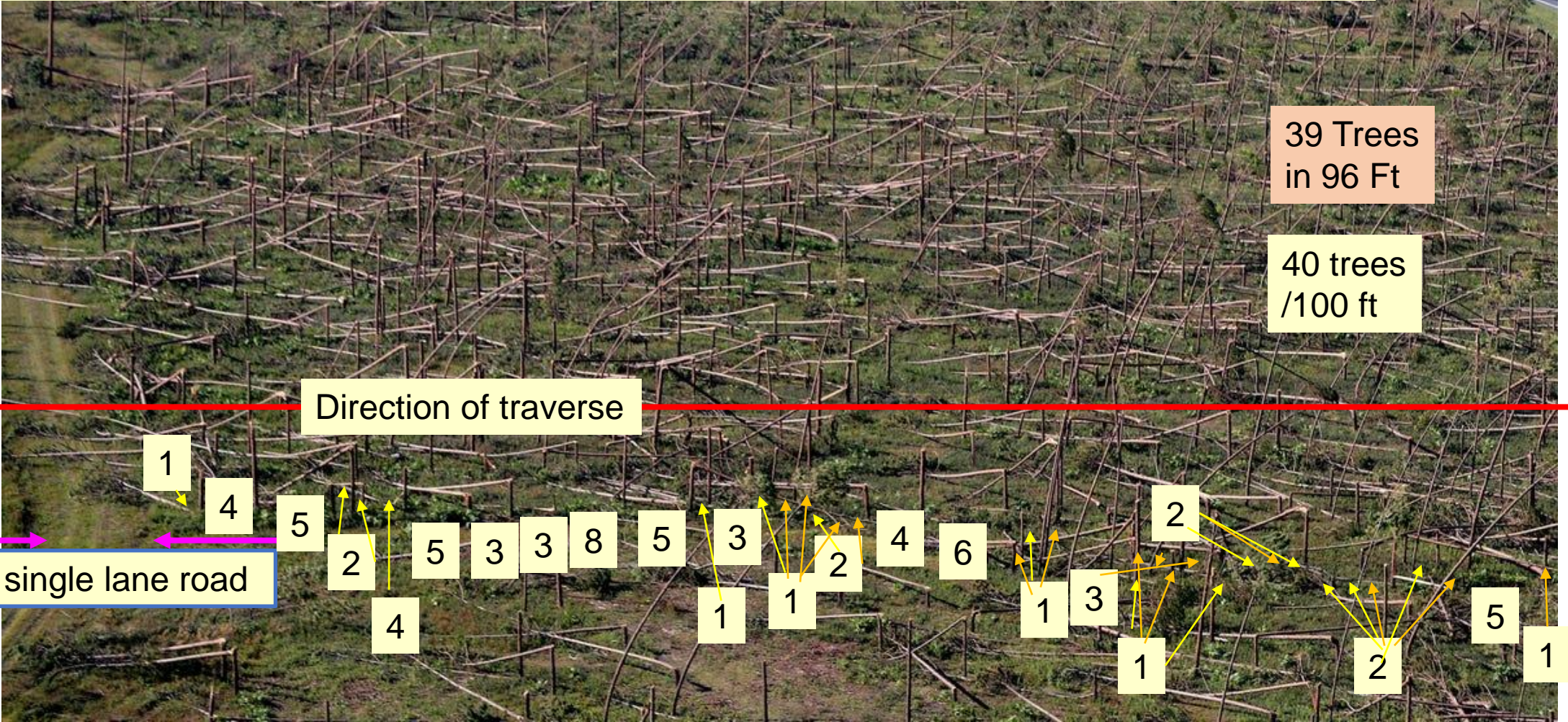
← →
10 Ft single lane road

← →
10 Ft single lane road

I estimated the tree density in this picture from Tyndall AFB using the single lane path through the woods as a 10 Ft yardstick



Traverse across the 10-ft path to the end of the picture, each yellow box, or arrow, is the distance from the previous tree to the next tree on the line, in feet.



I estimated the tree density in this picture from Tyndall AFB using the single lane path through the woods as a 10 Ft yardstick

Looks like 2.5 ft spacing between trees.
Looking at the Oregon State Charts, next topic, means many thousands of trees/acre here.



1

4

5

2

4

5

3

3

8

5

1

3

1

2

4

6

1

3

2

1

1

3

1

2

2

5

1

39 Trees
in 96 Ft

40 trees
/100 ft

10 Ft single lane road

Sidebar Topics:

ONE: Spatial Densities of Douglas Fir and Grand Fir trees from Oregon State University

TWO: “Wind and Trees: Lessons Learned from Hurricanes” a study from University of Florida, UFL.

Competition and Density in Woodland Stands

Brad Withrow-Robinson | Doug Maguire

EM 9206 Published June 2018

Share This

[Twitter](#)

[Facebook](#)

The number of trees growing in a forest at any point in time shapes the look and character of a woodland and determines the benefits woodland owners may reap from it. A thorough look at competition and stand density can help landowners get the most out of their woods.

Family forest landowners have many aims and expectations for their property. The objectives of small woodland owners are generally quite different from those of their neighbors who manage industry or government land.



Photo: Lynn Ketchum, © Oregon State University
OSU Extension Forestry and Natural Resources faculty

Figure 1. Relative density scale

This simplified illustration shows a gradual progression of stages, from bottom to top, that occur in absence of any major disturbance as a stand of trees develops from the seedling stage. It also relates to competition levels in older stands following a disturbance, such as wind throw or a thinning. As tree size increases, so does competition.

Relative Density <i>On a scale of 0-100</i>	
100	Maximum Density Level RD 100
95	Zone of No Return RD > 75
90	
85	
80	
75	
70	Danger Zone RD 55-75
65	
60	
55	
50	Upper Goldilocks Zone RD 45-55
45	
40	
35	Lower Goldilocks Zone RD 35-45
30	
25	
20	Enthusiastic Growth Zone RD 15-35
15	
10	
5	Open (Exuberant) Growth Zone RD 0-15
0	
STAND ESTABLISHMENT	

<https://catalog.extension.oregonstate.edu/em9206/html>

Abbreviations:

DBH Diameter Breast Height

TPA Trees Per Acre

RD Relative Density

Figure 2. Stand density table, abbreviated

An example of a part of a relative stand density table. Average tree diameters (DBH in inches) are shown arranged in columns by tree density (TPA) and approximate average spacing, and in rows by competition level (RD). *From Appendix F, western redcedar stand density table.*

Zones and thresholds	Relative density	Trees per acre	100	125	150
Tree spacing (Ft) (decreasing)		Spacing	21'	19'	17'
Maximum	100	Average diameter at breast height (DBH)	34"	30"	27"
Zone of No Return	75		29	25	22
	70		27	24	21
Danger Zone	65		26	23	20
	60		25	22	19
	55		24	21	18
Upper Goldilocks Zone	50		22	19	17
	45		21	18	16
Lower Goldilocks Zone	40		19	17	15
	35		18	16	14
	30		16	14	13
Enthusiastic Growth Zone	25		14	13	11
	20		13	11	10
	15		11	9	8
Crown Closure	15				

Appendix A. Douglas-fir stand density table

Approximate tree size in inches DBH at different absolute densities (trees per acre, or by approximate spacing [in feet]) and competition level (RD). Based on stand quadratic mean diameter and a maximum stand density index of 520.

Trees Per Acre (increasing) →

Tyndall AFB pine stand had 2.5 ft spacing

Tree Spacing Ft (Grey) (Ft)

Zones and thresholds	Relative density	Trees per acre	50	75	100	125	150	175	200	225	250	275	300	360	435	680
	▼	Spacing ▶	30'	24'	21'	19'	17'	16'	15'	14'	13'	12.5'	12'	11'	10'	8'
Maximum Stocking	100	▼ Average diameter at breast height (DBH)	43"	33"	28"	24"	22"	20"	18"	17"	16"	15"	14"	13"	11"	8"
Zone of No Return	75		39	30	25	22	20	18	16	15	14	13	13	11	10	8
	70		36	28	23	20	18	16	15	14	13	12	12	11	9	7
Danger Zone	65		33	26	21	19	17	15	14	13	12	11	11	10	9	6
	60		31	24	20	18	16	14	13	12	11	11	10	9	8	6
	55		30	23	19	17	15	14	12	12	11	10	10	9	8	6
Upper Goldilocks Zone	50		28	22	18	16	14	13	12	11	10	10	9	8	7	5
	45		26	20	17	15	13	12	11	10	10	9	9	8	7	5
Lower Goldilocks Zone	40		24	19	16	14	12	11	10	10	9	8	8	7	6	5
	35		22	17	15	13	11	10	9	9	8	8	7	7	6	4
Enthusiastic Growth Zone	30		20	16	13	11	10	9	9	8	8	7	7	6	5	4
	25		18	14	12	10	9	8	8	7	7	6	6	5	5	4
	20		16	12	10	9	8	7	7	6	6	5	5	5	4	3
Crown Closure	15		13	10	9	7	7	6	6	5	5	5	4	4	3	3

← Tree Diameter at Breast Height (DBH) (In)

Table: Withrow-Robinson and Maguire, © Oregon State University



Oregon State University

<https://catalog.extension.oregonstate.edu/em9206/html>

EM 9206
June 2018

Appendix B. Grand fir stand density table

Approximate tree size in inches DBH at different absolute densities (trees per acre, or by approximate spacing [in feet]) and competition level (RD). Based on stand quadratic mean diameter and a maximum stand density index of 560.

Tyndall AFB pine stand had 2.5 ft spacing

Tree Spacing Ft (Grey) (Ft)(decreasing)

Zones and thresholds	Relative density	Trees Per Acre (increasing)														
		Trees per acre	50	75	100	125	150	175	200	225	250	275	300	360	435	680
Tree Spacing Ft (Grey) (Ft)(decreasing)		Spacing	30'	24'	21'	19'	17'	16'	15'	14'	13'	12.5'	12'	11'	10'	8'
Maximum Stocking	100	Average diameter at breast height (DBH)	45"	35"	29"	25"	23"	21"	19"	18"	17"	16"	15"	13"	12"	9"
Zone of No Return	75		41	32	26	23	21	19	17	16	15	14	13	12	11	8
	70		38	29	24	21	19	17	16	15	14	13	12	11	10	7
Danger Zone	65		34	27	22	19	17	16	15	13	13	12	11	10	9	7
	60		33	25	21	19	17	15	14	13	12	11	11	10	9	6
	55		31	24	20	18	16	14	13	12	11	11	10	9	8	6
Upper Goldilocks Zone	50		29	23	19	17	15	13	12	11	11	10	10	9	8	6
	45		27	21	18	15	14	13	12	11	10	9	9	8	7	5
Lower Goldilocks Zone	40		25	20	17	14	13	12	11	10	9	9	8	7	7	5
	35		23	18	15	13	12	11	10	9	9	8	8	7	6	5
Enthusiastic Growth Zone	30		21	17	14	12	11	10	9	8	8	7	7	6	6	4
	25		19	15	12	11	10	9	8	7	7	7	6	6	5	4
	20		17	13	11	9	8	8	7	6	6	6	5	5	4	3
Crown Closure	15		14	11	9	8	7	6	6	5	5	5	5	4	4	3

Tree Diameter at Breast Height (DBH) (In)

Table: Withrow-Robinson and Maguire, © Oregon State University



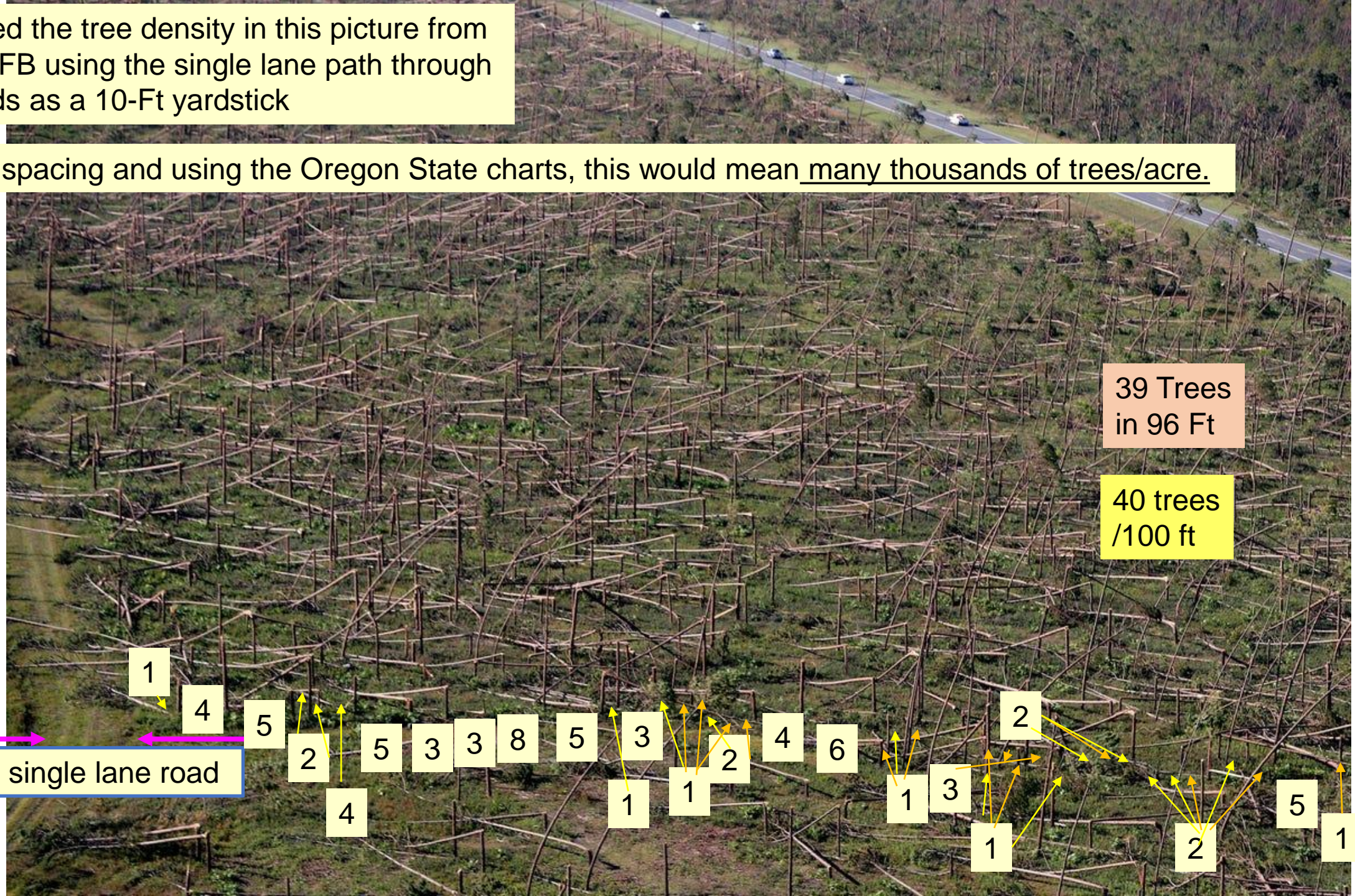
Oregon State University

<https://catalog.extension.oregonstate.edu/em9206/html>

EM 9206
June 2018

I estimated the tree density in this picture from Tyndall AFB using the single lane path through the woods as a 10-Ft yardstick

At 2.5 ft spacing and using the Oregon State charts, this would mean many thousands of trees/acre.



39 Trees
in 96 Ft

40 trees
/100 ft

10 Ft single lane road

1

4

5

2

4

5

3

3

8

5

1

1

3

2

4

6

1

3

1

2

2

2

5

1

1

Tyndall AFB pine tree spacing is 2.5 ft between trees! Way off Oregon State's Tree Density charts!

Appendix A. Douglas-fir stand density table

Trees Per Acre

Approximate tree size in inches DBH at different absolute densities (trees per acre, or by approximate spacing [in feet]) and competition level (RD). Based on stand quadratic mean diameter and a maximum stand density index of 520.

Tree Spacing Ft (Grey) (Ft) (decreasing)

Zones sholds	Relative density	Trees per acre	50	75	100	125	150	175	200	225	250	275	300	360	435	680
		Spacing	30'	24'	21'	19'	17'	16'	15'	14'	13'	12.5'	12'	11'	10'	8'
Maximum Stocking	100	Average diameter at breast height (DBH)	43"	33"	28"	24"	22"	20"	18"	17"	16"	15"	14"	13"	11"	8"
Zone of No Return	75		39	30	25	22	20	18	16	15	14	13	13	11	10	8
	70		36	28	23	20	18	16	15	14	13	12	12	11	9	7
Danger Zone	65		33	26	21	19	17	15	14	13	12	11	11	10	9	6
	60		31	24	20	18	16	14	13	12	11	11	10	9	8	6
	55		30	23	19	17	15	14	12	12	11	10	10	9	8	6
Upper Goldilocks Zone	50		28	22	18	16	14	13	12	11	10	10	9	8	7	5
	45		26	20	17	15	13	12	11	10	10	9	9	8	7	5
Lower Goldilocks Zone	40		24	19	16	14	12	11	10	10	9	8	8	7	6	5
	35		22	17	15	13	11	10	9	9	8	8	7	7	6	4
Enthusiastic Growth Zone	30		20	16	13	11	10	9	9	8	7	7	7	6	5	4
	25		18	14	12	10	9	8	8	7	7	6	6	5	5	4
	20		16	12	10	9	8	7	7	6	6	5	5	5	4	3
Crown Closure	15		13	10	9	7	7	6	6	5	5	5	4	4	3	3

Tree Diameter at Breast Height (DBH) (In)

Robinson and Maguire, © Oregon State University



<https://catalog.extension.oregonstate.edu/em9206/html>

<https://edis.ifas.ufl.edu/pdf/FR/FR173/FR173-D0fg5hluau.pdf>

Wind and Trees: Lessons Learned from Hurricanes¹

Mary L. Duryea and Eliana Kampf²

Our research has also shown that the more rooting space trees have, the less likely they are to fail (see section *Lessons Learned about Soil and Rooting Conditions* for more details). Only if they have adequate soil space can trees develop a strong supporting root system.



Figure 3.

Lesson 2

AS A GROUP, PALM SPECIES SURVIVE HURRICANES BETTER THAN BROAD-LEAVED AND CONIFER TREES

When compared to broad-leaved and other conifer trees (such as pines), palms have often been observed to be more resistant to winds. Palms grow differently than other trees because they have one terminal bud. If that bud is not damaged, palms may lose all their fronds (leaves) and still survive. Our research shows that palms in the coastal plain and tropical and subtropical regions are often more resistant to winds (Figure 9). However, individual palm

Lesson 3

PINES MAY SHOW NO IMMEDIATE VISIBLE DAMAGE AFTER HURRICANES, BUT MAY DECLINE OVER TIME

<https://edis.ifas.ufl.edu/pdf/FR/FR173/FR173-D0fg5hluau.pdf>

In our study, we measured pines right after hurricanes, when they looked green and healthy (Figure 11). However, we went back 3 months after Hurricane Charley and found that 27% of the standing south Florida slash pines and 48% of the standing longleaf pines had died. Pines have been observed to be very sensitive to wind damage. They may show no immediate visible damage after high winds but may die sometime later. They can die slowly over a period of 6 months to 2 years after wind storms. Some may remain green for a year or more, and then suddenly turn yellow (Figure 12) and quickly progress to brown needles in a very short period. The causes of yellowing of the needles and pine death are not completely understood. It is likely due to hidden damage produced by bending and twisting during hurricane-force winds. Prolonged winds may also rupture smaller roots without breaking the larger support roots. The injured stems and roots are unable then to supply the water and nutrients needed in the crown, resulting in pine decline and death.

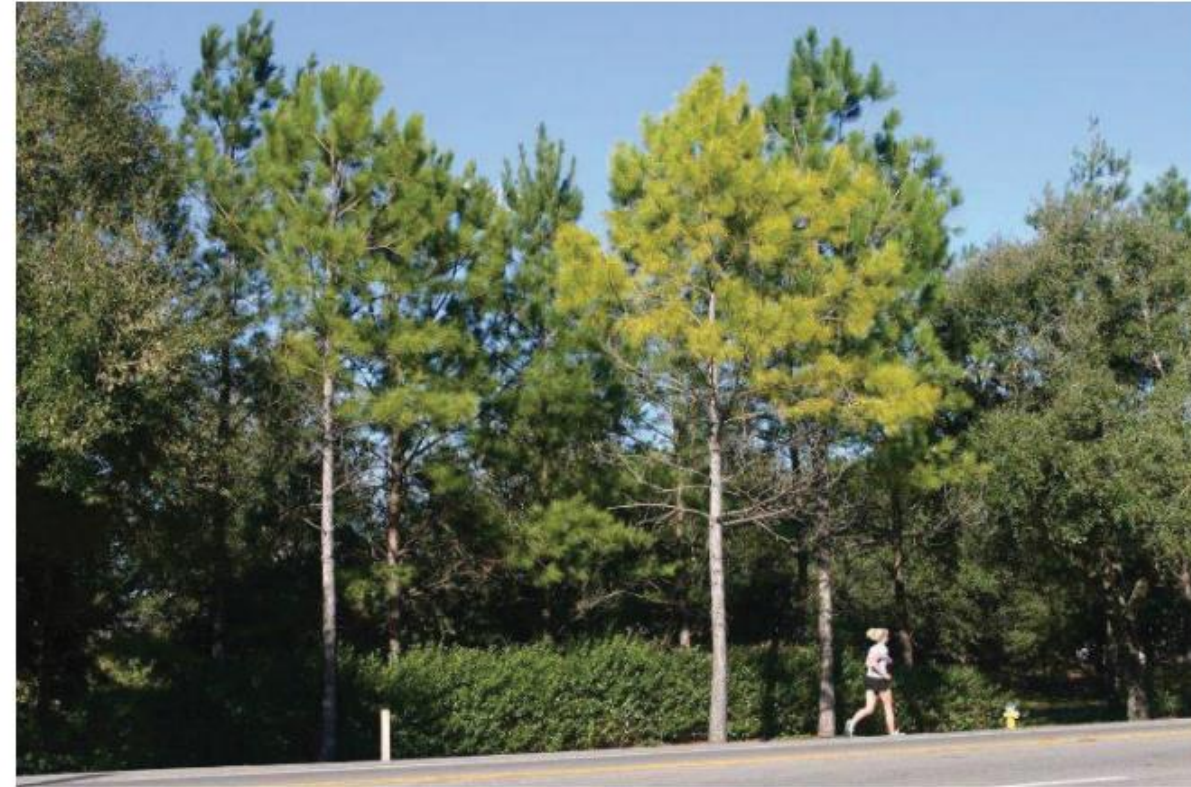


Figure 12.

III. Lessons about Soil and Rooting Conditions

Lesson 1

TREES WITH MORE ROOTING SPACE SURVIVE BETTER

The most important factor in designing a healthy urban landscape is also probably the one most often overlooked—that is providing enough soil space for tree roots to grow. In Hurricane Georges (Puerto Rico), we measured rooting space for trees and found that with more rooting space, tree survival during winds was higher (Table 2).

Soil should provide plenty of open space to allow growth of the trunk and development of the main flare roots. To provide anchorage for the tree, roots need to spread beyond the edge of the canopy and grow deep into the soil. Sidewalks, curbs, buildings, parking lots, driveways, and other urban structures restrict root development. A strong supporting root system with adequate rooting space is the most critical factor to the ability of trees to withstand hurricane-force winds in urban landscapes.

Tyndall AFB's pines only had ~2.5 ft spacing!



RECOMMENDATION

Give trees enough rooting space based on their mature size:

- Small trees need at least 10 feet by 10 feet .
- Medium trees need 20 feet by 20 feet.
- Large trees need at least 30 feet by 30 feet.

End Sidebar

Putting all this together, what
have we learned?

Surface Measurements
Red Arrows. 
Photo Damage Estimates
Orange Arrows from
Postage Stamp Photos




Surface Measurements & Saffir Simpson
Categories from Tree Damage.
Locations of Cat 1 photos are good.
Locations of Category 2 and Category 4
estimated from tree cover in the photos.

What have we learned from all of this? 1.

NOAA's report on the storm wind speed used Air Force Reserve WC-130 winds aloft measured at 8000 ft, ("southeast eyewall" of the storm) bringing them down to the surface. This was done despite numerous surface anemometer measurements and tree damage estimates at landfall were abundantly available to NOAA's analysts. IMHO, this is poor science, pushing the narrative that hurricanes are getting stronger because of <CO2> increases.

No anemometer measurements anywhere near Category Five were measured at Michael's landfall:
Panama City: not Category One, Tyndall Base Weather: Category ONE, Two FMCP towers (15 m) Category ONE.

The 15-meter FMCP winds of 92 Knots (Tyndall AFB) and 94 knots (Beacon Hill) appear almost or directly under the "southeast eyewall" at landfall.

Most wind category estimates I made from tree damage occurrences were CATEGORY ONE. I did find one CATEGORY TWO and a CATEGORY FOUR in Mexico Beach. Most Mexico Beach tree damage instances were CATEGORY ONE.

Photos of pine tree stands on Tyndall AFB show large numbers of downed trees, though some pines remain standing.

Oregon State University's report shows IF these stands had tree spacing of ~2.5 ft, corresponding tree densities are thousands per acre. Tyndall AFB's tree densities aren't observed in nature (because such densities can't survive)

What have we learned from all of this? 2.

Univ of Florida's report, "Wind and Trees, Lessons Learned from Hurricanes," shows when high numbers of trees are in an area, the trees do not survive hurricanes.

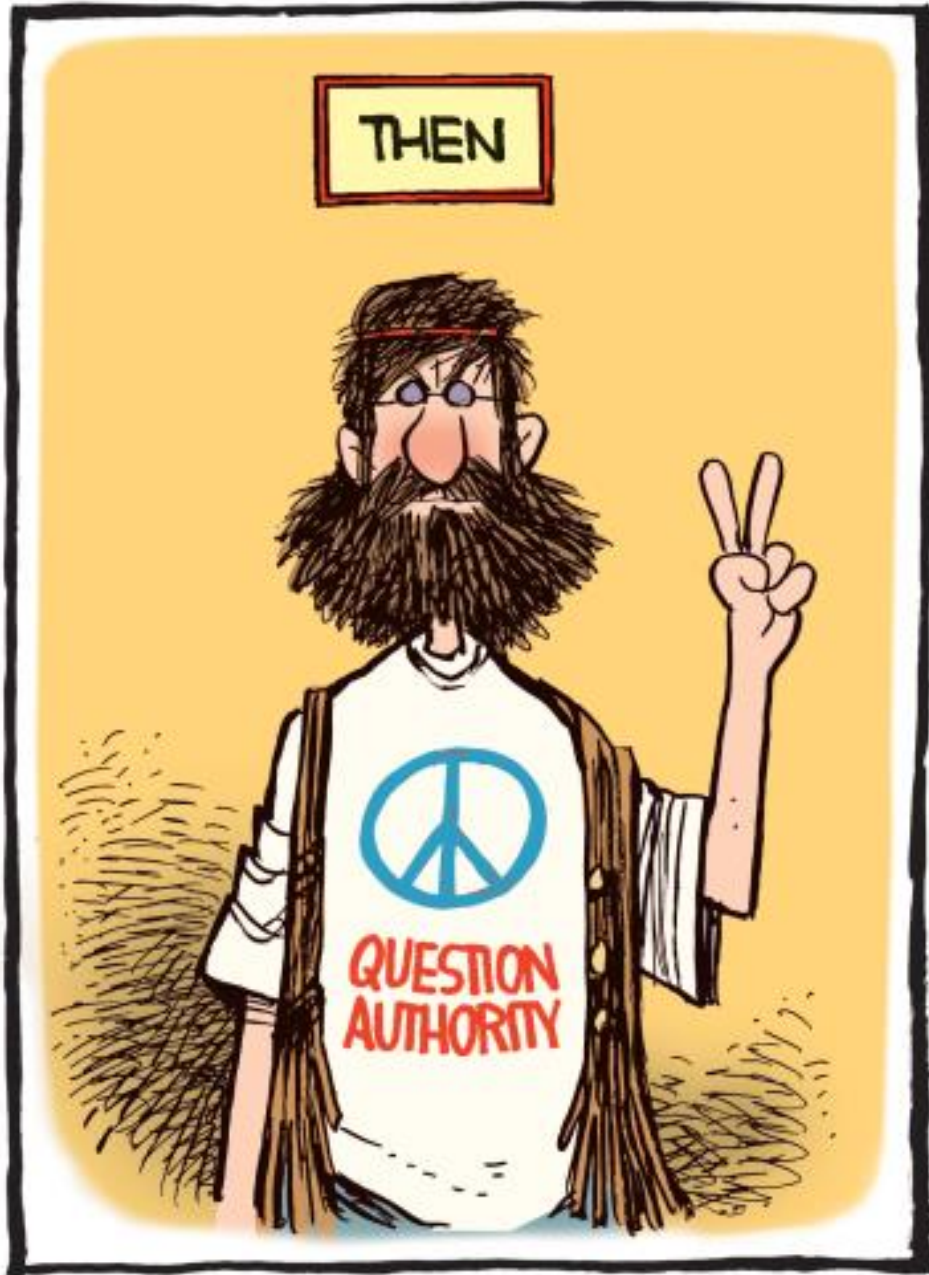
During hurricanes, pines and deciduous trees fall at much higher rates than palms.

No surface wind measurements or wind damage photos show that 2018's Hurricane Michael which struck near Panama City, Tyndall AFB, and Mexico Beach, Florida was a Category Five Storm at Landfall.

The NOAA report, which claims such, does not contain data which support such a conclusion.

No investigative journalism reports from the Main-Stream Media point this out.

A little over 50 years ago, when some of us served in Vietnam, the watchword among youth of the country was: "Question Authority."







Tyndall AFB

Control Squadron

Dollar Inn

Tyndall AFB Commissary

Tyndall Fitness Center

Tyndall AFB Beach Parking

98

Google