Applying “Depth of Closure” to Determine Sand Loss for FEMA Engineered Beach Projects

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Disaster Recovery

- Public Assistance (PA)
  - Reimbursement for repair of *“Facilities”*
  - Facility = Designed and Maintained
  - “Categories” of Facilities From C to G

FEMA's Category G Beaches

- Category G
  - "Parks, Recreational and *Other*"
  - Beaches
    - Not a USACE Beach (OFA)
    - Responsibility of an Eligible Applicant
    - Designed and Maintained
- How do we determine the damage (sand loss)?

Determining Incident-Related Sand Loss

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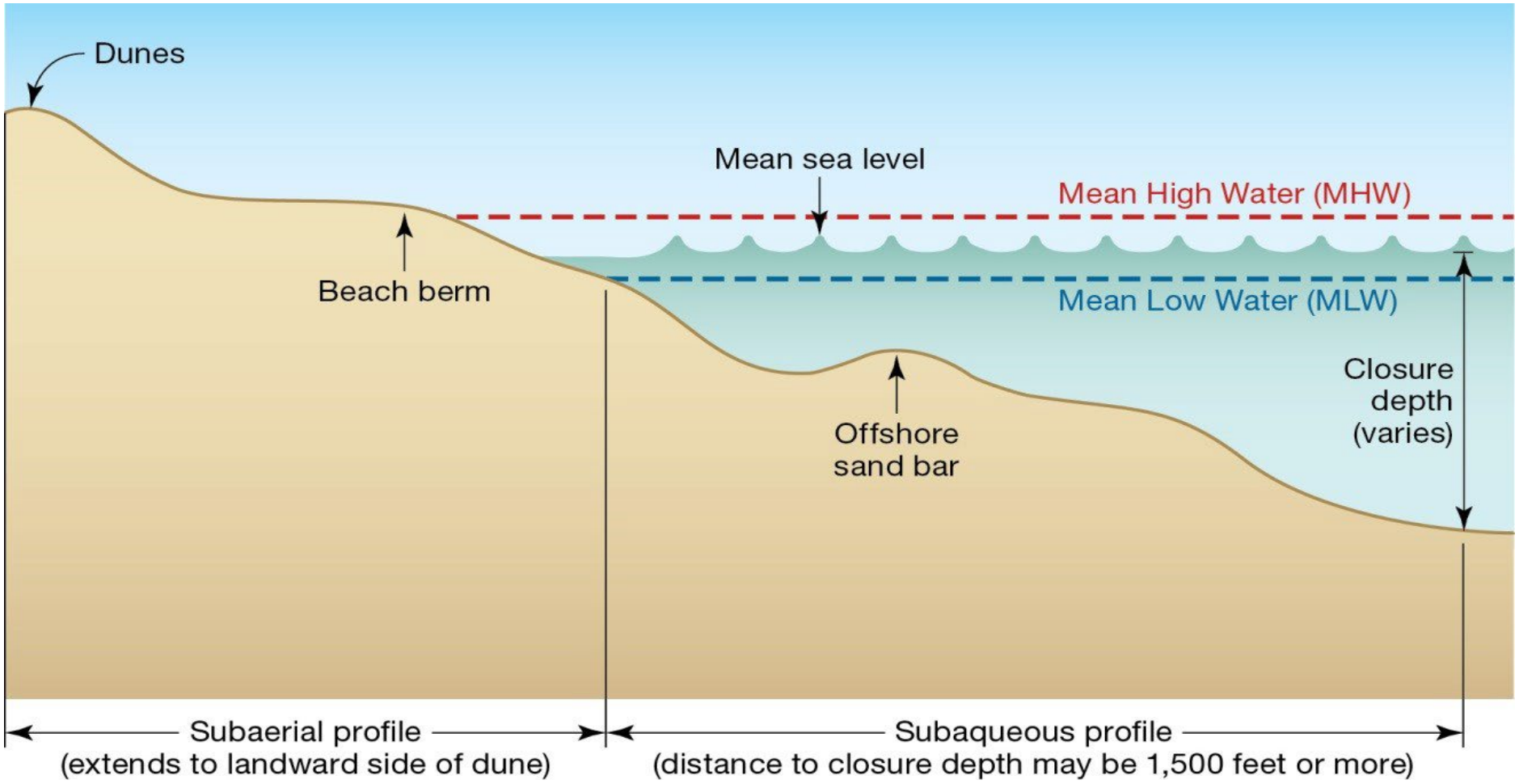
Incident-Related Sand Loss

- *The Applicant needs to substantiate the amount of sand claimed with pre-and post-incident profiles that extend at least to the seaward edge of the sub-aqueous nearshore zone **(Depth of Closure)** (see Figure 16. Typical Beach Profile). PAPPG v4, p. 181*

Incident-Related Sand Loss (FEMA Beach)



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Incident-Related Sand Loss (FEMA Beach)

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Depth of Closure

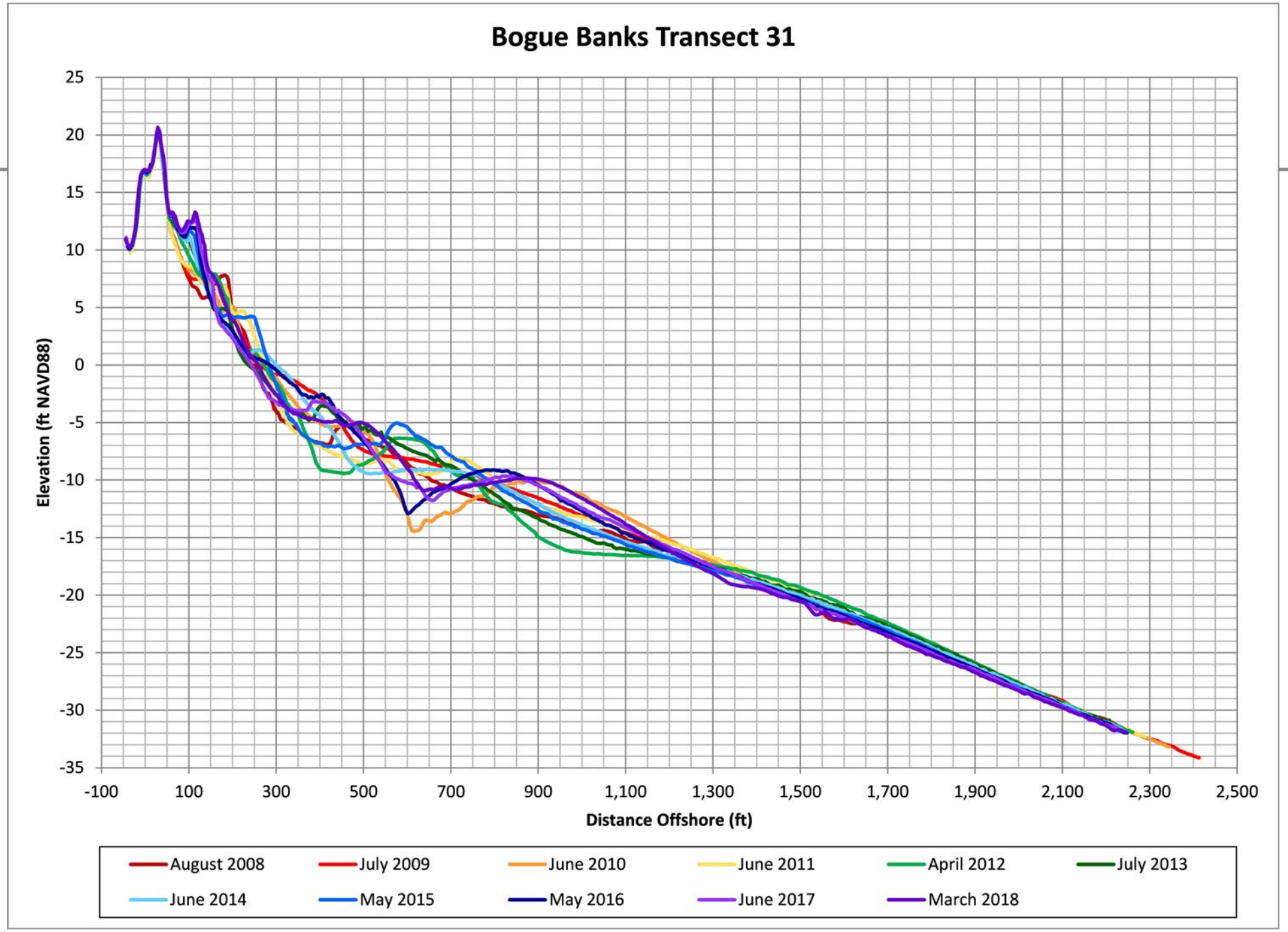
- The DOC is a theoretical depth along a beach profile where sediment transport is very small or non-existent, dependent on wave height and period, and occasionally, sediment grain size.
  - Can be observed or calculated
  - There can be disagreements…

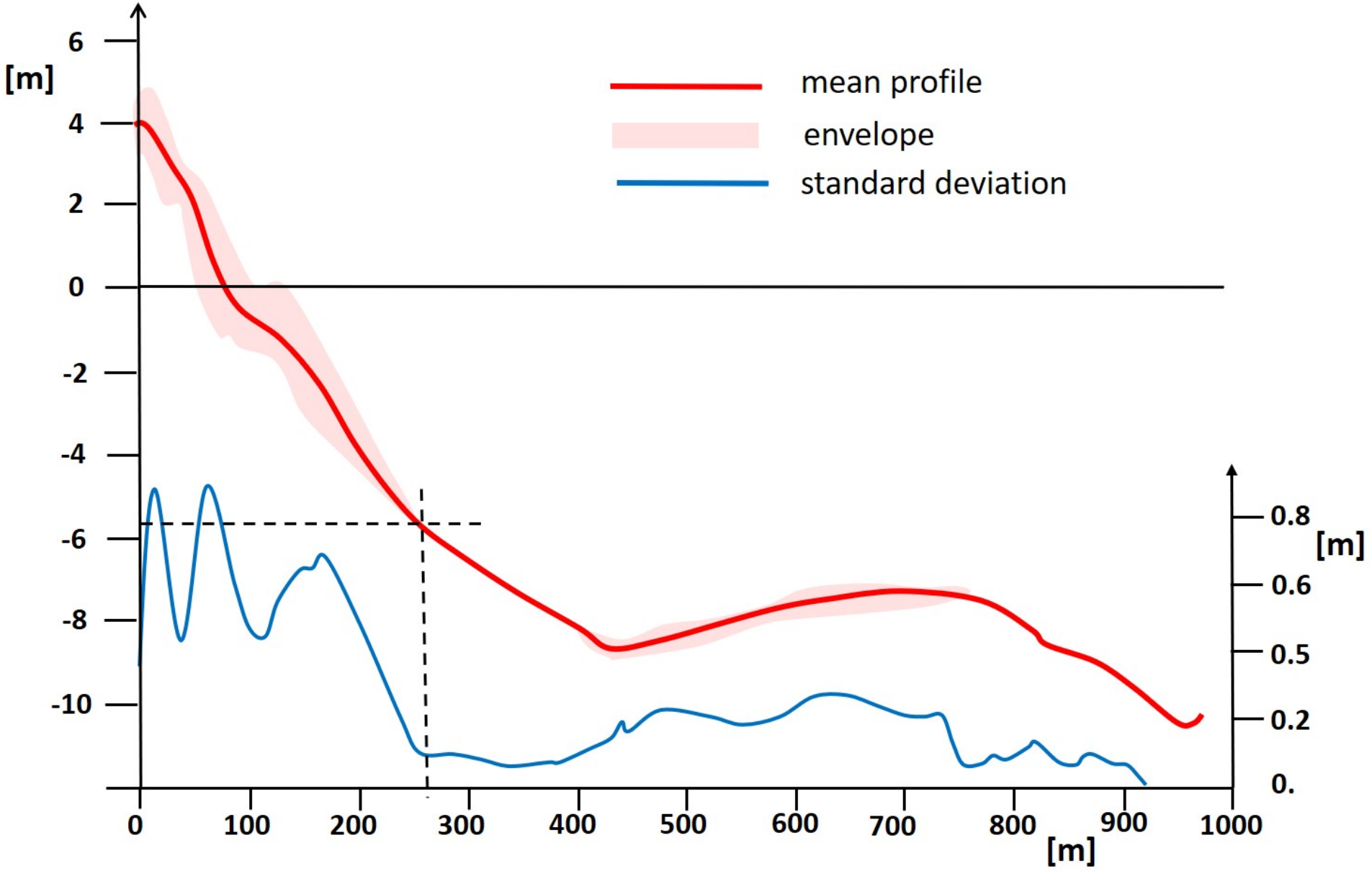
Depth of Closure

- “CLOSURE DEPTH The water depth beyond which **repetitive profile surveys** (collected over several years) **do not detect vertical seabed changes**, generally considered the seaward limit of littoral transport. The depth can be determined from repeated cross-shore profile **surveys** or estimated using **formulas** based on wave statistics…”

Closure Depth

$$d_l = 1.75H_e - 57.9\left(\frac{H_e^2}{gT_e^2}\right)$$


Bogue Banks Transect 31
Elevation (ft NAVD88)
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-100
100
300
500
700
900
1,100
1,300
1,500
1,700
1,900
2,100
2,300
2,500
Distance Offshore (ft)
August 2008
July 2009
June 2010
June 2011
April 2012
July 2013
June 2014
May 2015
May 2016
June 2017
March 2018


[m]
6
4
2
0
-2
-4
-6
-8
-10
mean profile
envelope
standard deviation
0.8
0.6
0.5
0.2
0.
[m]
0
100
200
300
400
500
600
700
800
900
1000
[m]

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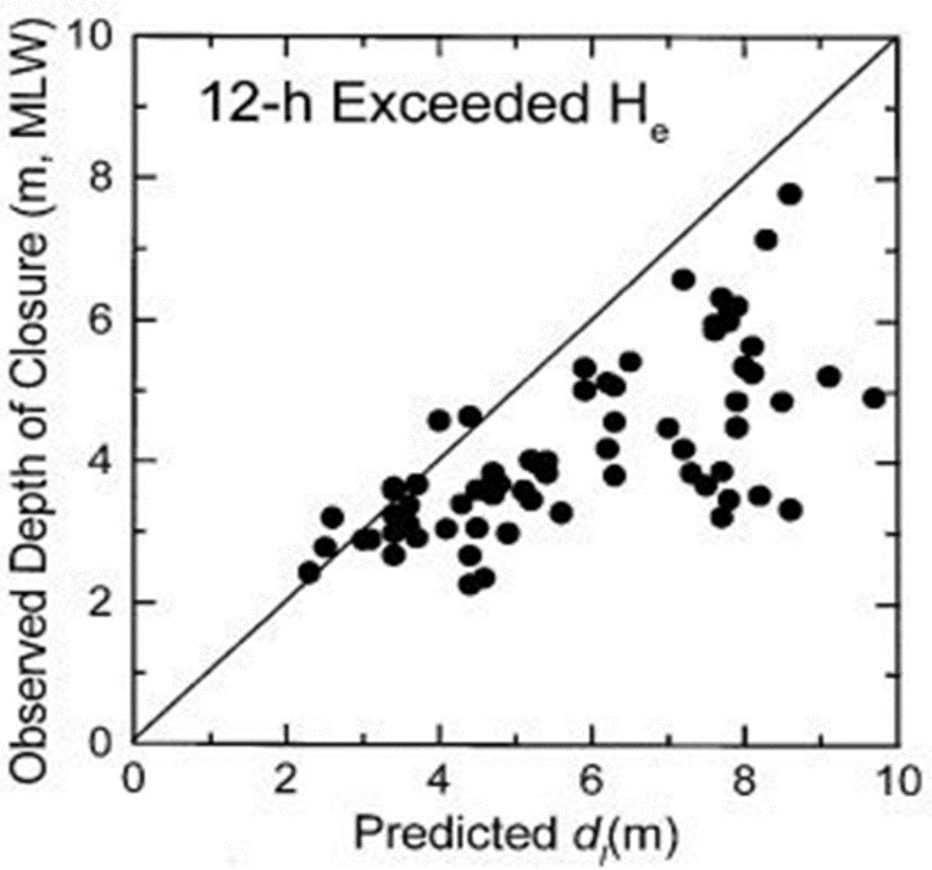
Closure Depth

$$Z \simeq 2H_5 \qquad \text{(Eq. 2)}$$



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Profiles / Pre and Post Storm

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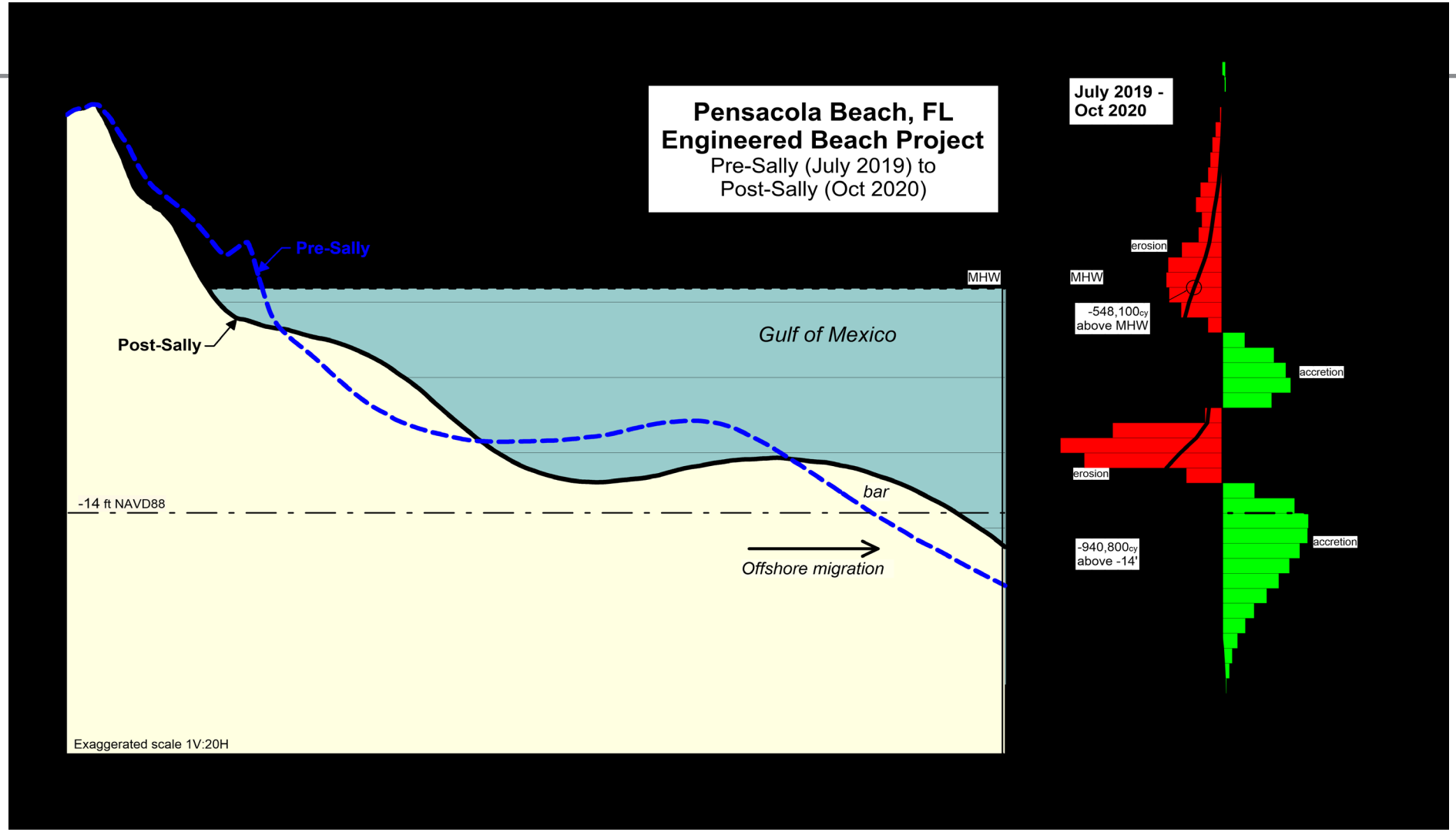
Profiles / Pre and Post Storm



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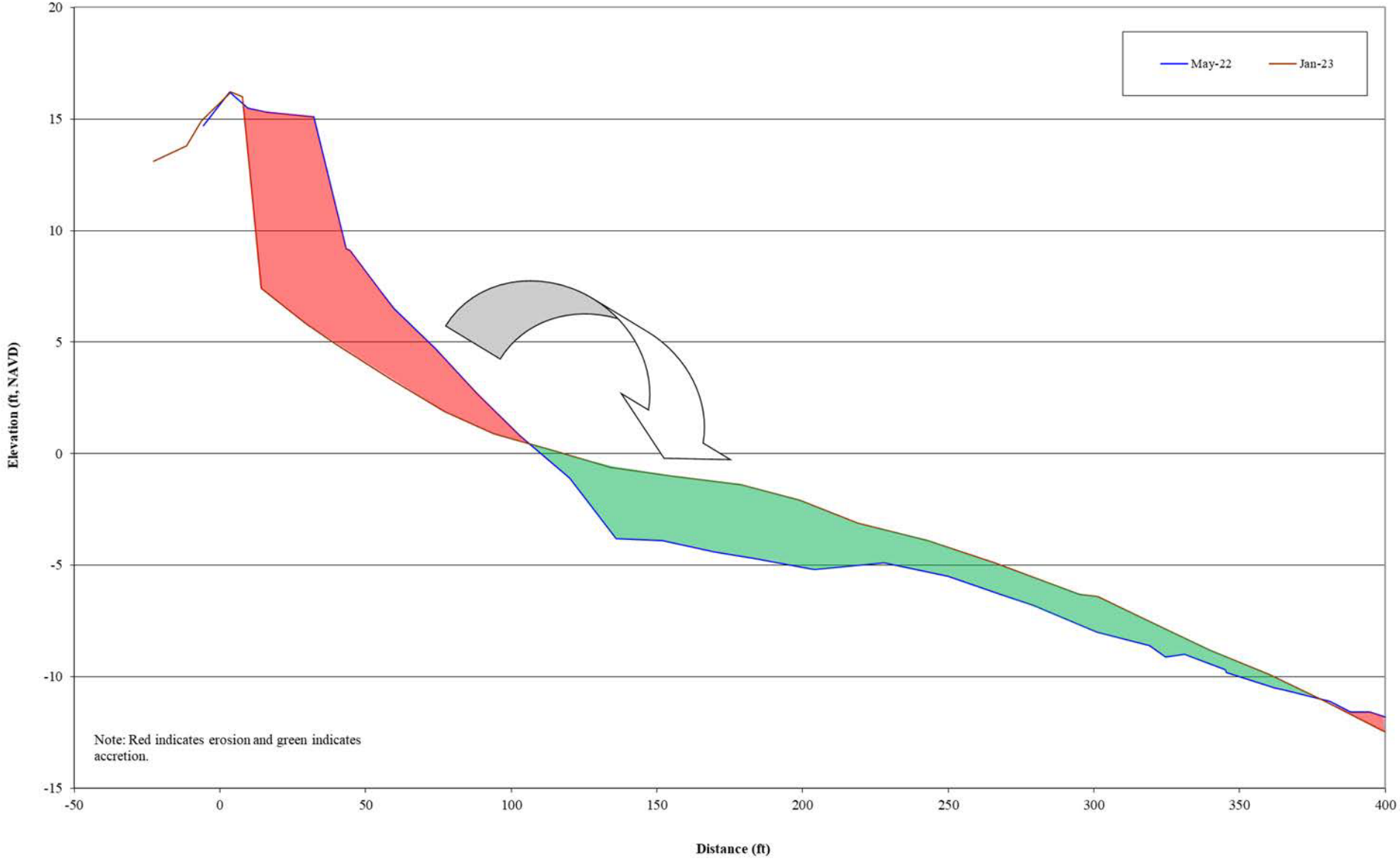
Sector 3 Profile Adjustment
R-28



Alternatives?

- Is establishing DOC the best methodology to use to determine the offshore boundary of the FEMA beach?
  - Some other measure?
  - “Storm Protection Factor”?
  - Something Else?

Questions?

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