# DESIGNING TURTLE-FRIENDLY BEACHES: ENGINEERING, ECOLOGICAL, AND REGULATORY PERSPECTIVES

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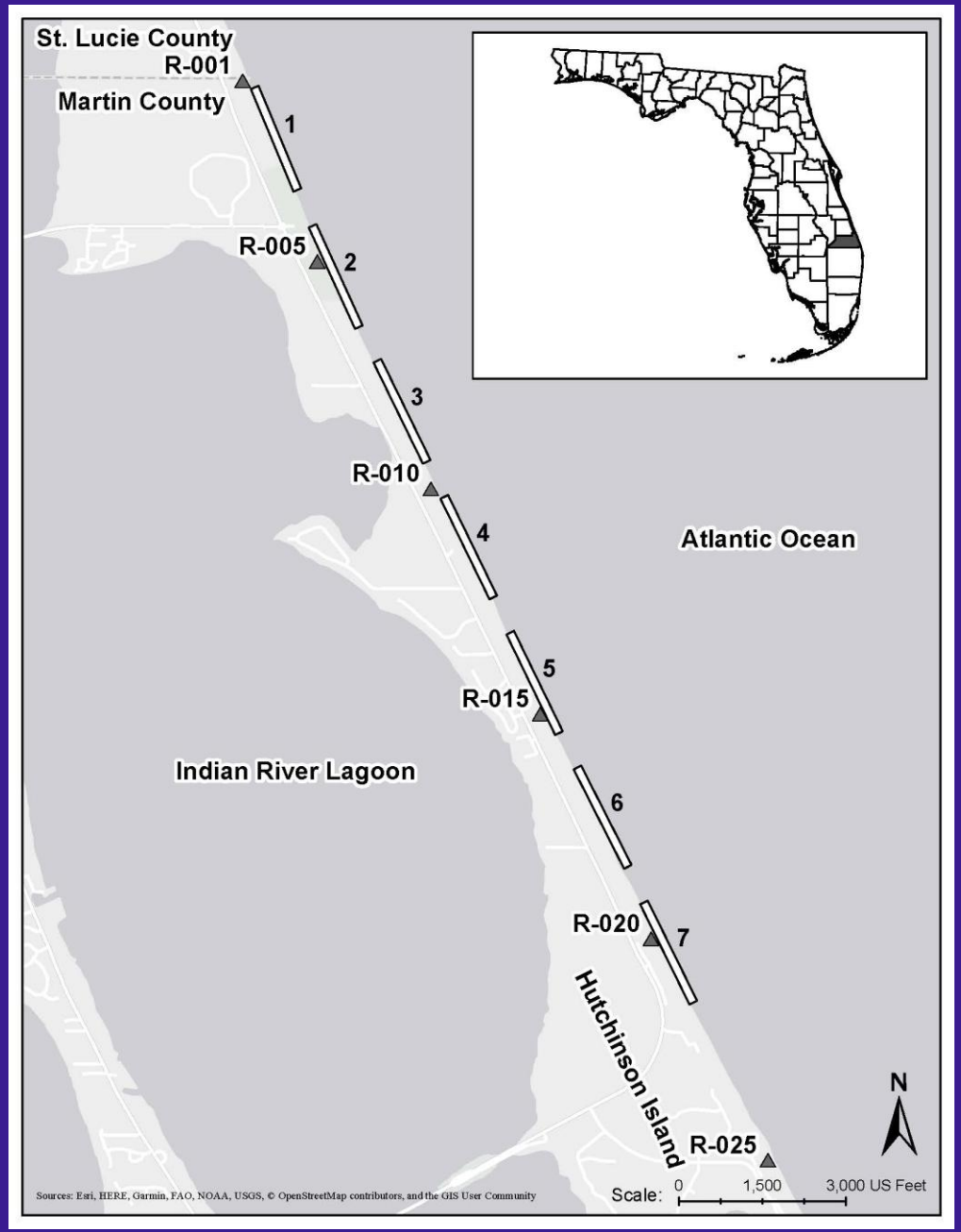
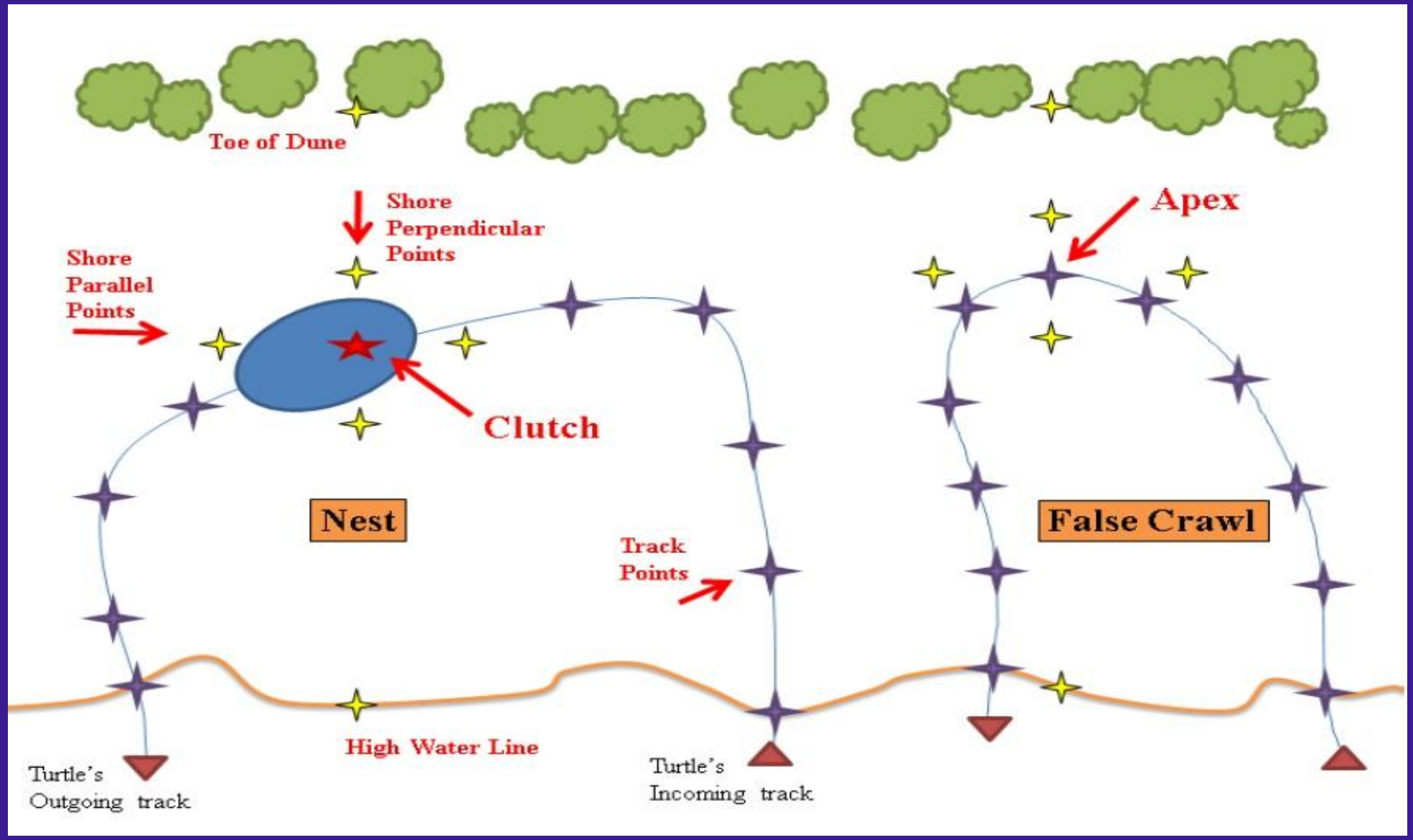
National Conference on
Beach Preservation Technology
St. Augustine Beach, Florida
February 4, 2026

# NFWF Grant

- 2012 -2013
- Martin County 4-Mile (6.4 km) Beach Nourishment Project
- 7 Cells – Collectively 2.7 mi (4.3 km)
- RTK GPS



# Binary Dataset - Decision Points



# Loggerhead Nesting Success Pre- (2012) and Post-Nourishment (2013)

| METRIC | 2012 | 2013 |
|---|---|---|
| Nests | 713 | 520 |
| False Crawls | 374 | 584 |
| Total Crawls* | 1087 | 1104 |
| Nesting Success | 65.6 | 47.1 |

***Excludes crawls with scarp encounters and abandoned digs**

# Binned Logistic Regression (BLR) Application to Slope Data

- Incorporates all data for each metric analyzed, excluding outliers
- Assigns data to equally sized bins
- Determines the probability of a binary outcome (nesting vs. not nesting) for each bin

# Binned Logistic Regression
## Slope at the Decision Point (2012)

| | Bin Range (Degrees) |
|---|---|
| Upper Limit | 29.1 - 32.1 |
| Lower Limit | -12.5 to -9.5 |

# Binned Logistic Regression
## Slope at the Decision Point (2012)

| 15 Bins | Bin Range (Degrees) |
| --- | --- |
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# Binned Logistic Regression
## Slope at the Decision Point (2012)

| 15 Bins | Bin Range (Degrees) |
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| Upper Limit | 29.1 - 32.1 |
| | 11.3- 14.3 |
| Significant Odds of Nesting | 8.3 - 11.3 |
| | 5.4 - 8.3 |
| | 2.4 - 5.4 |
| Lower Limit | -12.5 to -9.5 |

# Binned Logistic Regression
## Slope at the Decision Point (2012)

| 15 Bins | Bin Range (Degrees) | 88% of all Loggerhead Crawls |
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| Upper Limit | 29.1 - 32.1 | |
| | 11.3- 14.3 | 75.0 |
| Significant Odds of Nesting | 8.3 - 11.3 | 84.2 |
| | 5.4 - 8.3 | 80.5 |
| | 2.4 - 5.4 | 65.3 |
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| | 11.3- 14.3 | 75.0 | |
| Significant Odds of Nesting | 8.3 - 11.3 | 84.2 | *> 5x more likely to nest* |
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**36.4% of all Loggerhead Crawls**

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|---|---|---|
| | | Nesting Success (%) |
| Upper Limit | 29.1 - 32.1 | |
| Significant Odds of Nesting | 11.3- 14.3 | 68.1 |
| | 8.3 - 11.3 | 75.8 |
| | 5.4 - 8.3 | 80.2 |
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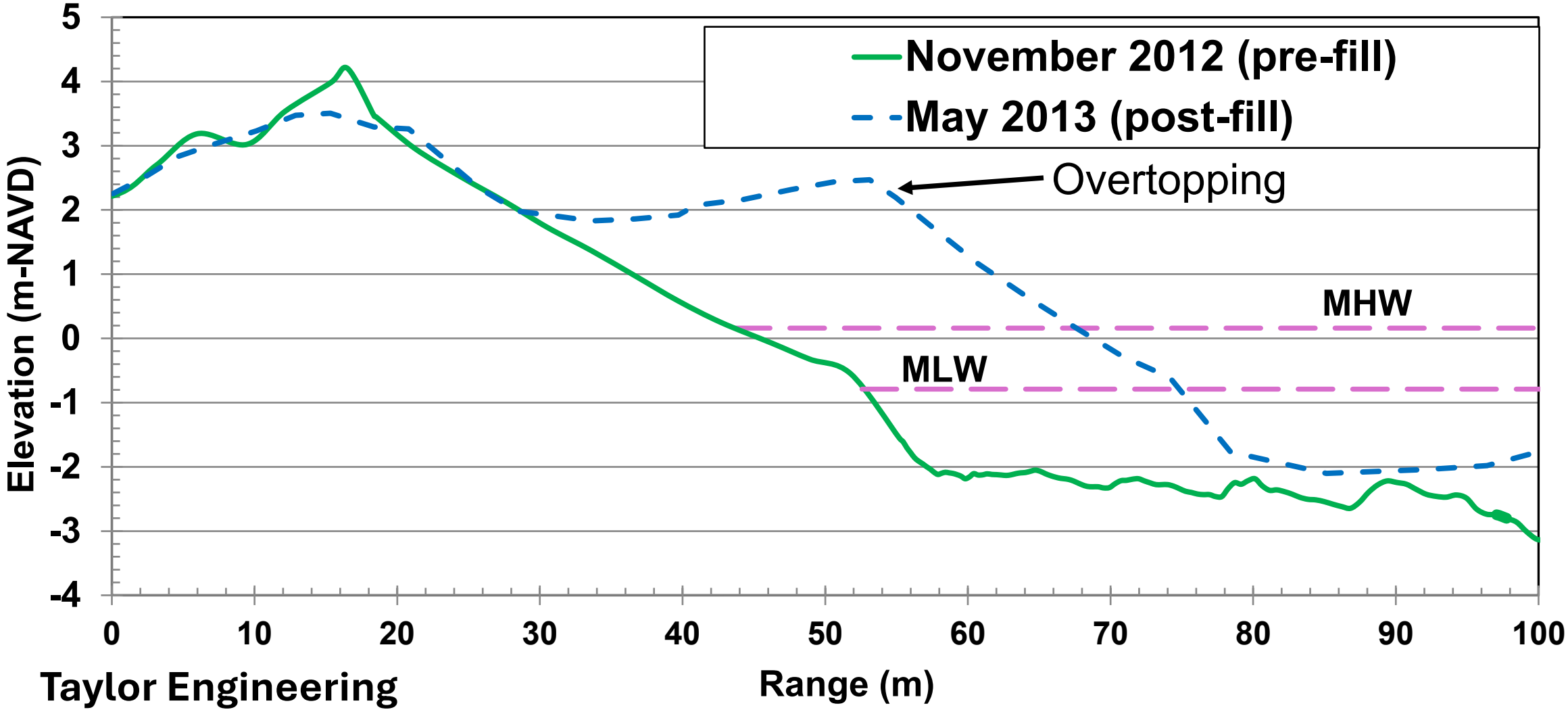
***At very high slopes and negative slopes - significant odds of NOT nesting***

# Pre- and Post-Construction Beach Profiles



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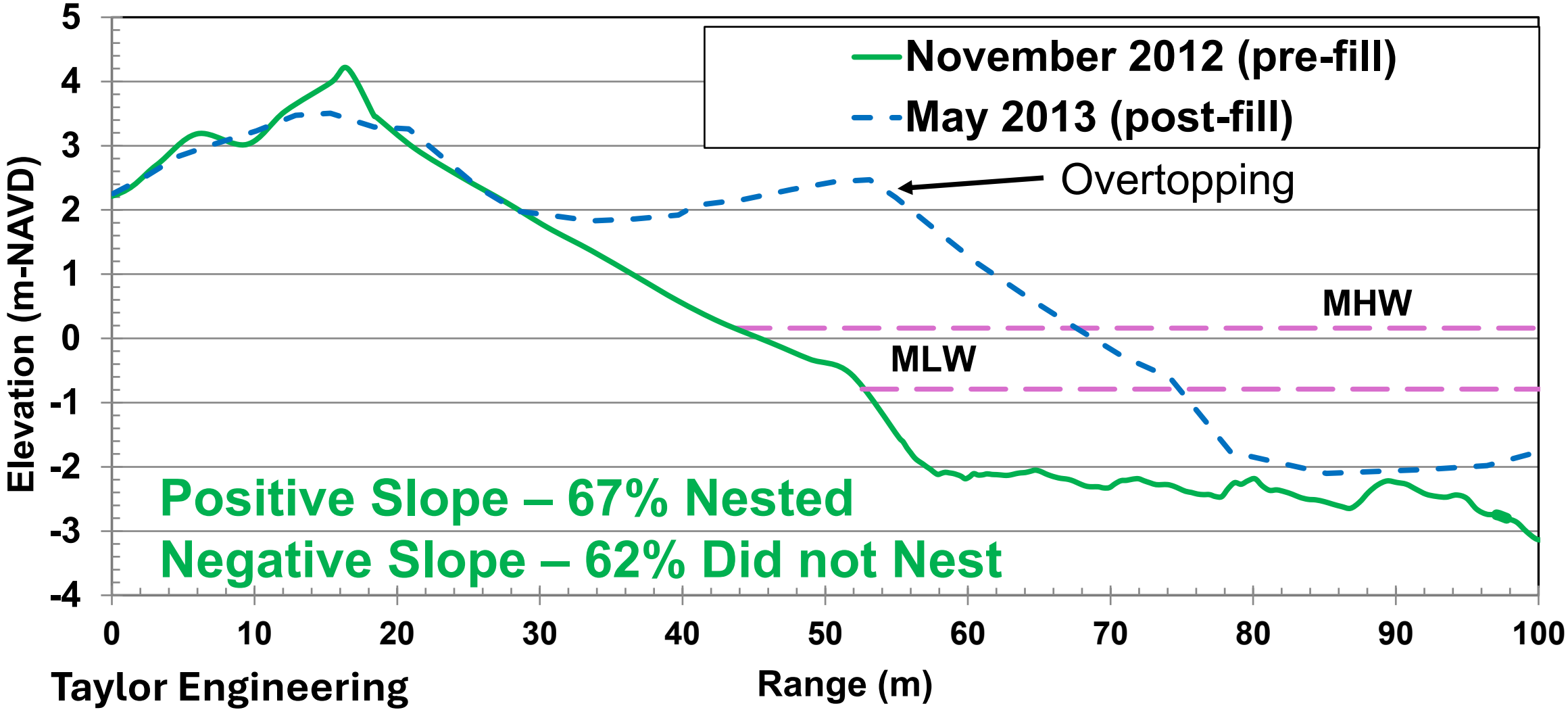


# Importance of Slope in Sea Turtle Nesting Behavior

- Wood and Bjorndal (2000)
- **Long, Angelo, and Weishampel (2011)**
- Hays (2012)
- Mauer and Johnson (2017)

# CONCLUSIONS AND CAVEATS

- Loggerhead turtles respond favorably to positive slopes (5-11° = 1:10-1:5 ROR)

- Negative slopes significantly increase the odds of not nesting

- Optimal slopes may pose environmental and regulatory hurdles (permitting)

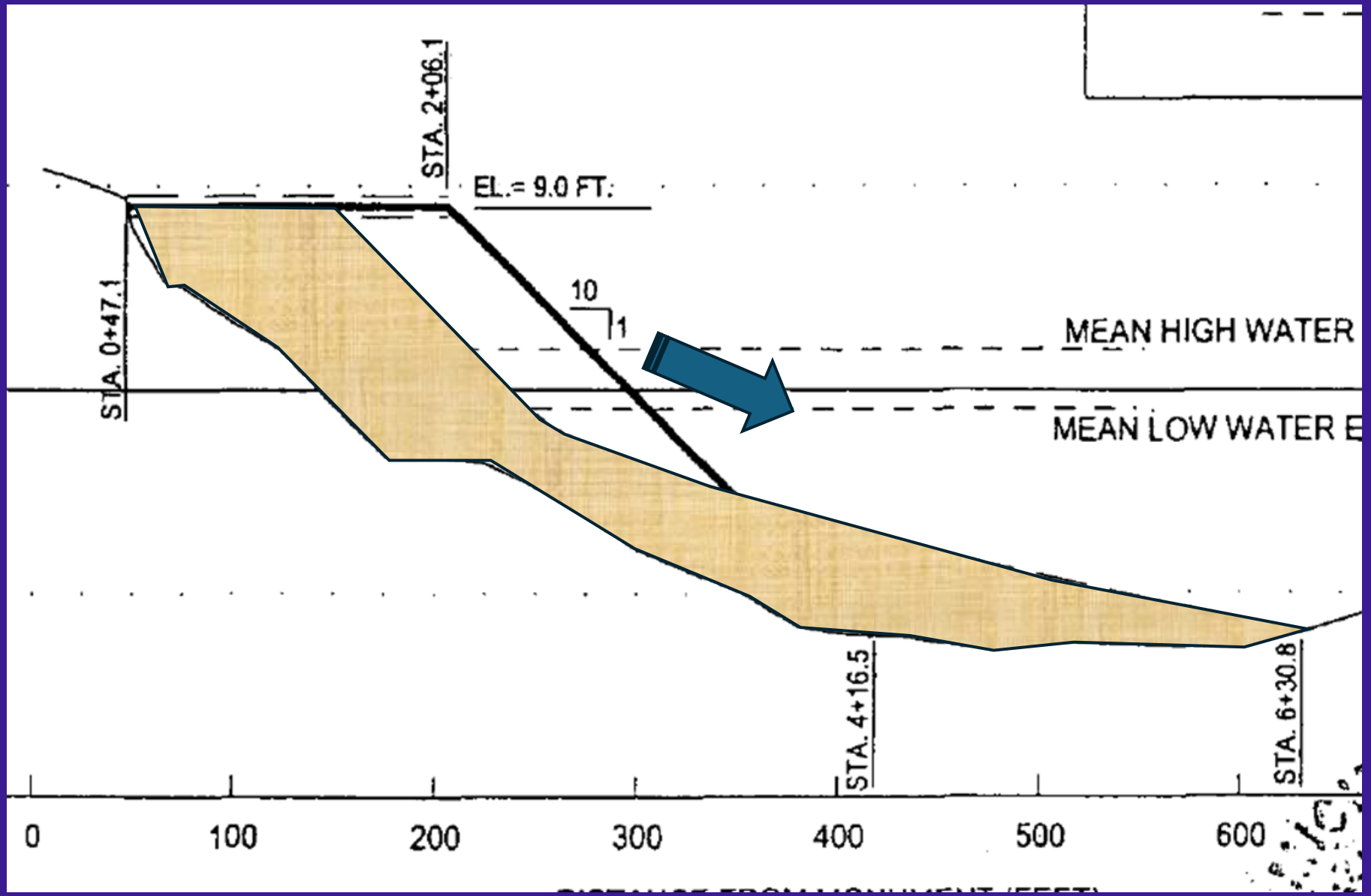
- **Avoid flat berms – Design with as much positive slope as possible**

- Every project site is different – Trial and error

# Design and Engineering Considerations

- Hydraulic Placement – Limited ability to control placement in the water
- Regulatory Constraints – Required to limit turbidity with diking
- ***Result is we stack sand on the upper beach and it equilibrates into the nearshore***
- Advances in Grading – We can be more precise now

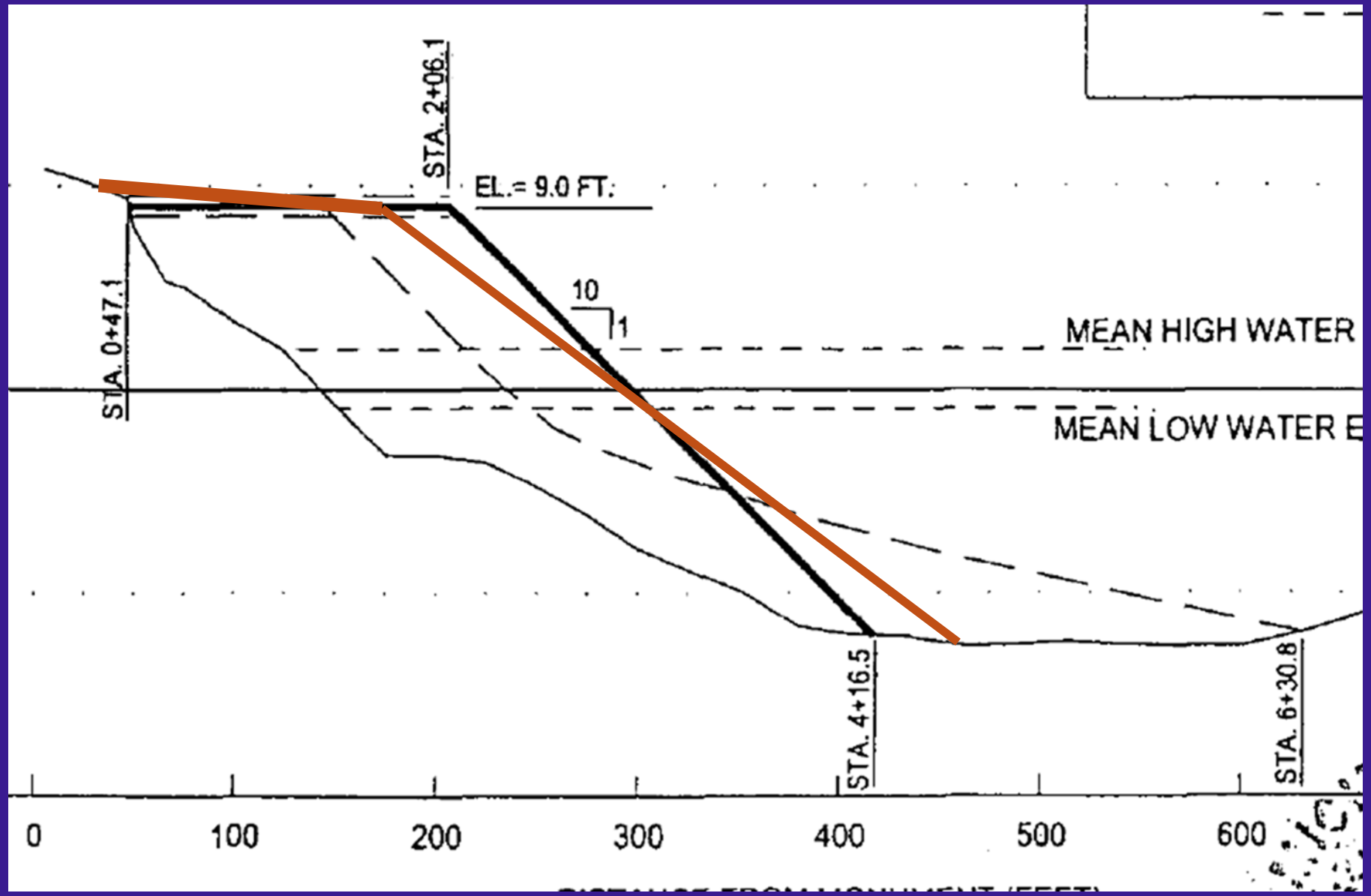
# Traditional Beach Template



# Turtle Friendly Approaches

- Beach Slope – milder is better
- Berm Break- might need to be higher or lower
- Berm Slope- add a slope back to the dune
- Dune Slopes- abrupt change from berm
- Dune Crest – don’t make wide and flat
- Dune Intersection with Upland – beach shadowing and barriers

# Template Examples



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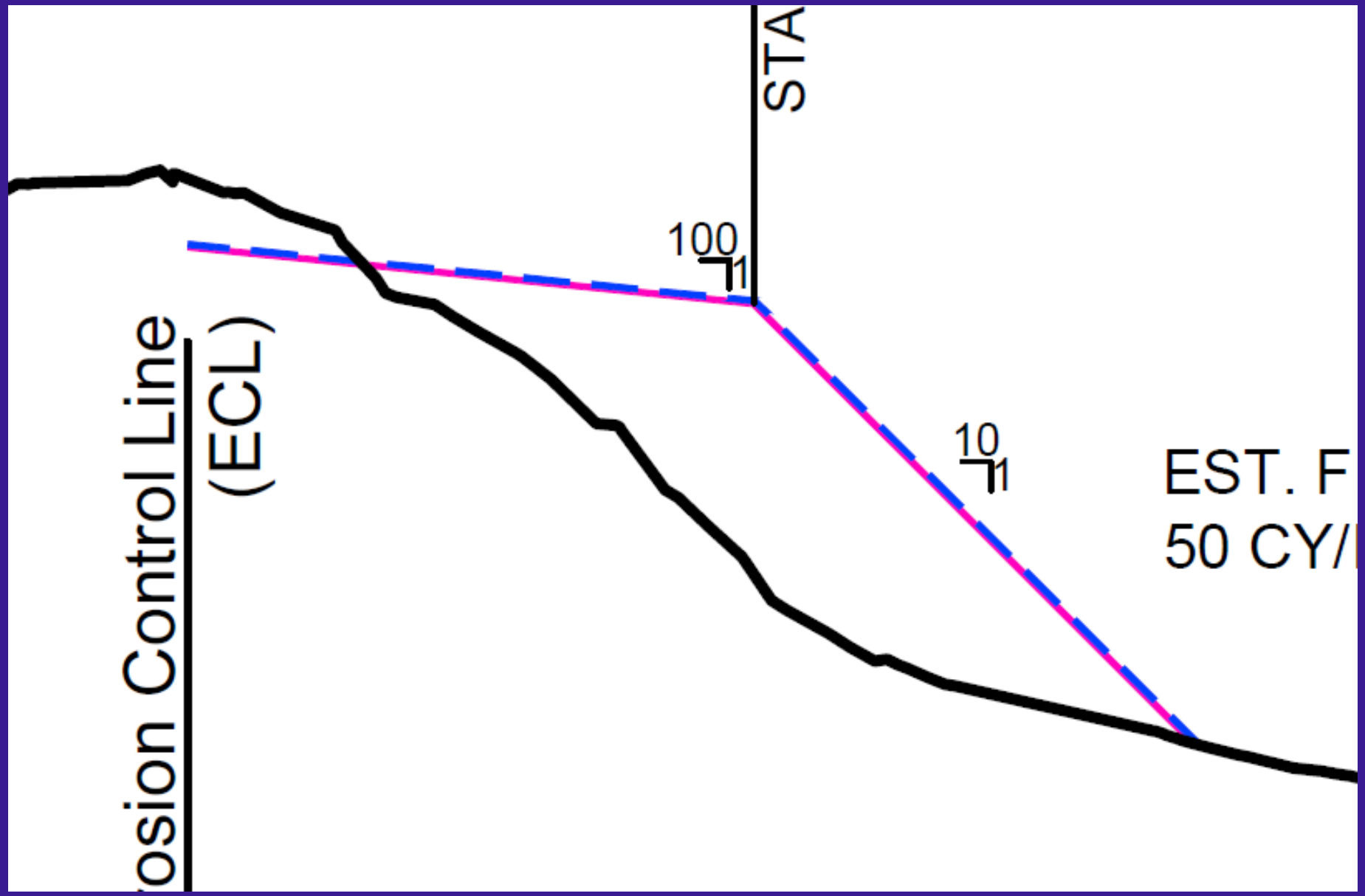

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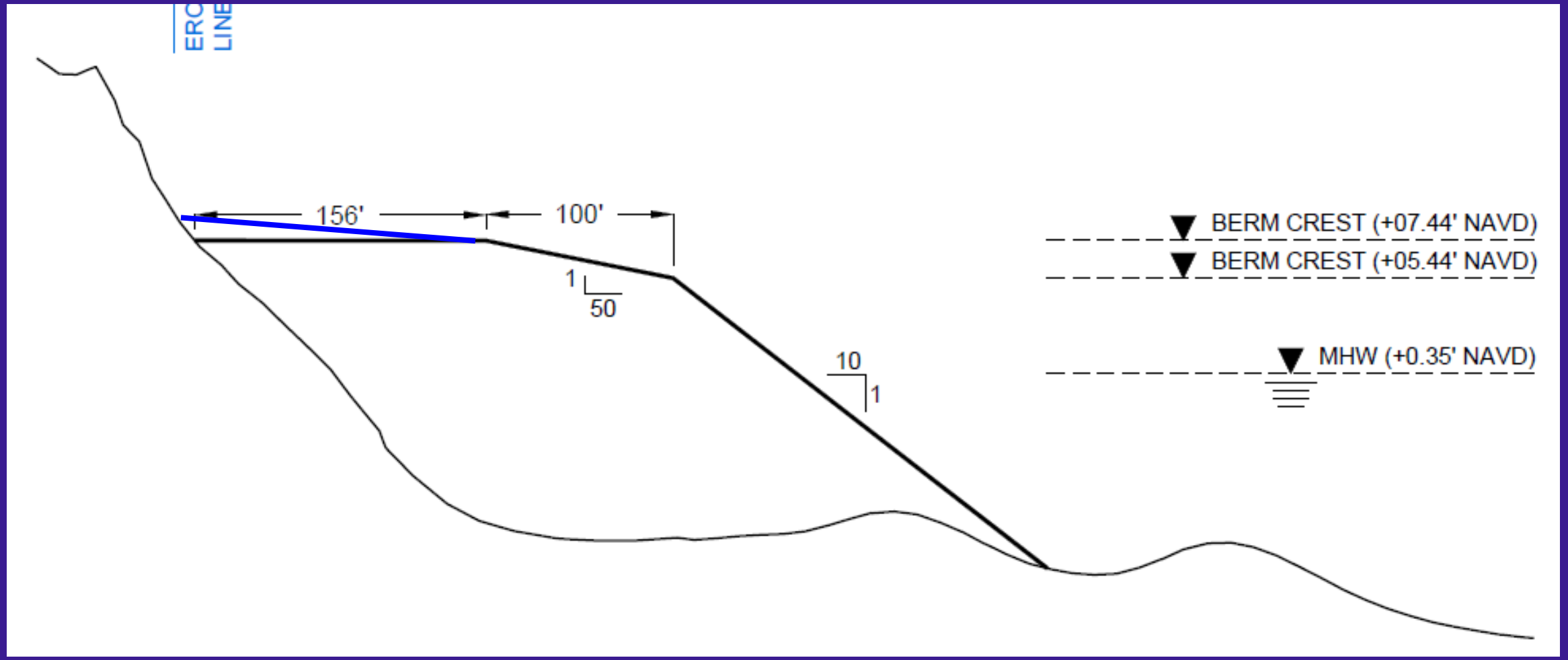
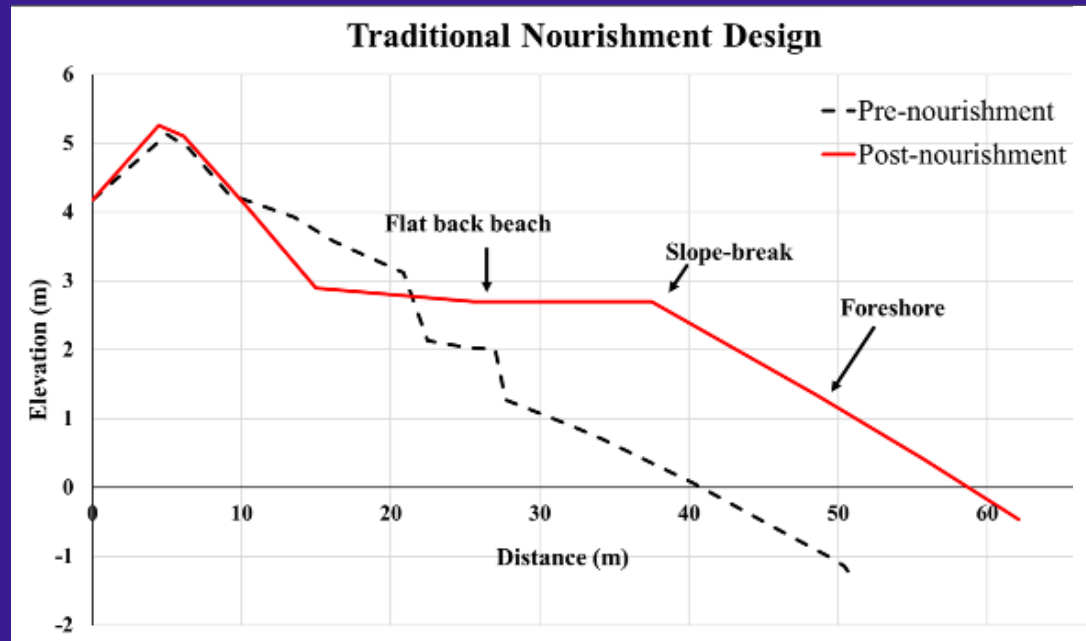


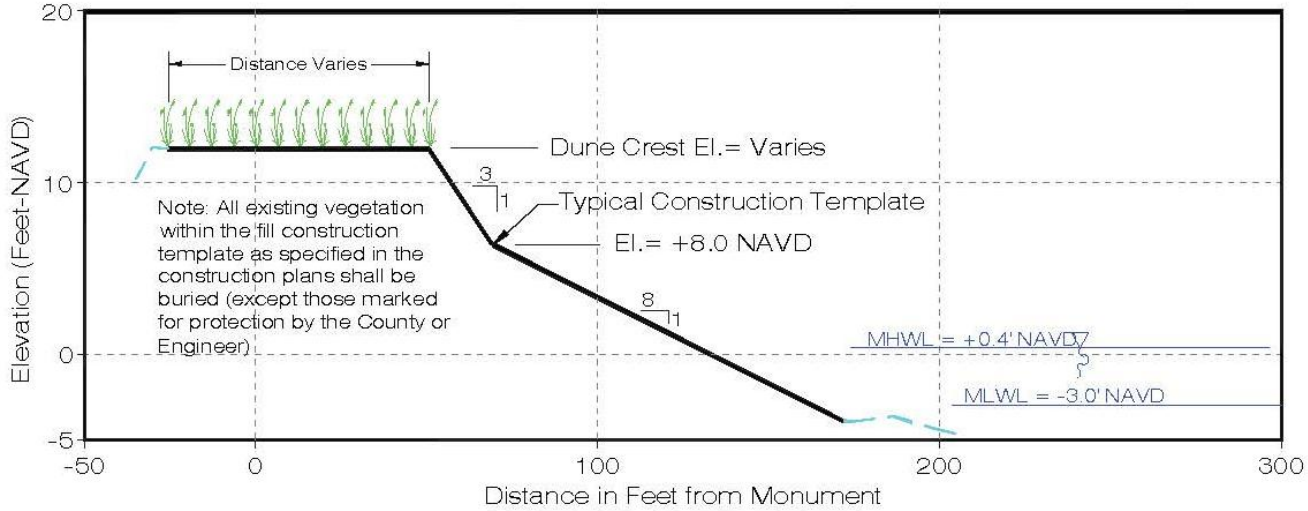
# Nourishment Design

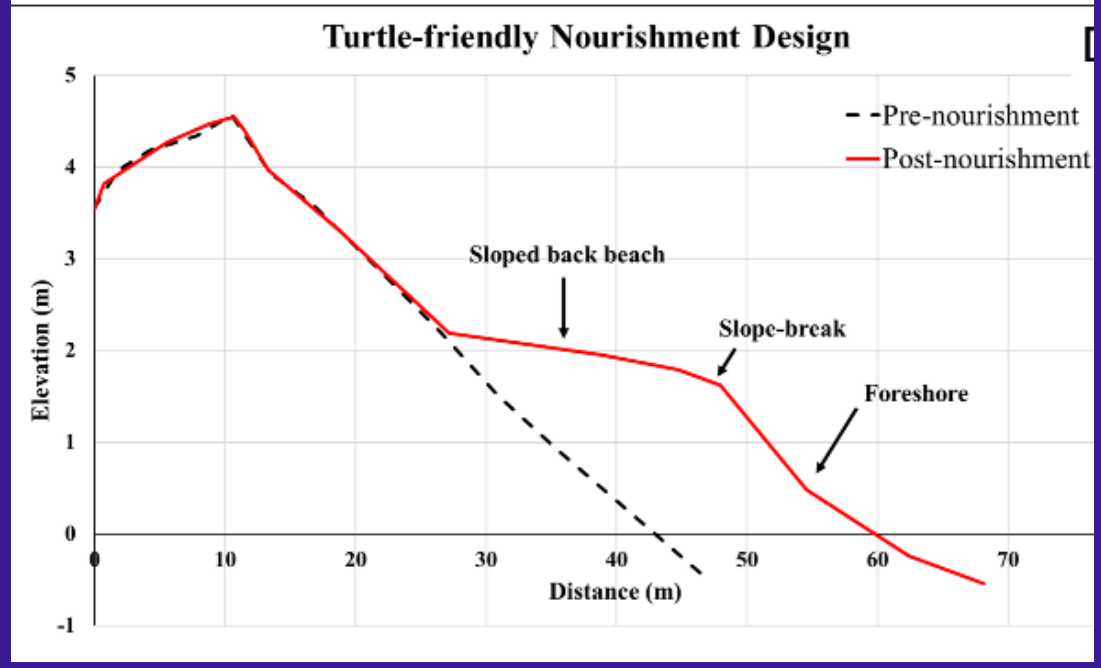
- Loggerhead nesting success is found to be higher at beaches with a turtle-friendly design than the traditional design
  - Fewer nests are washed out
  - Decreased risk of flooding
- Different berm designs will influence post nourishment profile equilibration
- Nourishment completed 1-2 months prior to nesting season can lead to significant beach profile equilibration
  - Timing is important

# Turtle Friendly Dune Construction

- Higher emergence rates of nesting turtles on darker beaches with taller, dark landward silhouettes
- Reflect natural processes
- Seaward toe should be at least 30 feet from seasonal high waterline
- Plant dune vegetation for dune stabilization and to limit light reaching the beach
- Minimize width of the dune crest
- Wide dune crests can lead to higher risk of disorientation


Traditional Nourishment Design
Pre-nourishment
Post-nourishment
Flat back beach
Slope-break
Foreshore
Elevation (m)
Distance (m)


Distance Varies
Dune Crest El.= Varies
3
1
Typical Construction Template
El.= +8.0 NAVD
8
1
Note: All existing vegetation within the fill construction template as specified in the construction plans shall be buried (except those marked for protection by the County or Engineer)
MHWL = +0.4' NAVD
MLWL = -3.0' NAVD
Elevation (Feet-NAVD)
Distance in Feet from Monument


Turtle-friendly Nourishment Design
Pre-nourishment
Post-nourishment
Sloped back beach
Slope-break
Foreshore
Elevation (m)
Distance (m)

# Regulatory Review

- Authorization for FWC to review
  - Florida Statutes
    - 379.2431 – Marine Turtle Protection Act
    - 161.053 – Beach and Shore Preservation
    - 20.331 – FWC's Commenting Authority
- Comments must be based on credible, factual scientific data
- FWC has no authority to authorize incidental take
- Consult with federal partners

# Review Process

- Assess potential impacts on marine turtles based on the information submitted in the application
- Coordinate with subject matter experts
- Compile questions / recommendations/ comments into a Request for Additional Information (RAI)
  - Preferred berm design is different for each project
  - Based on previous nourishments, current conditions, and what's being proposed
- Provide final comments / conditions

# Post Permit Issuance

- Pre-construction meeting
- Progress meetings throughout construction
- Post-construction monitoring
  - Marine turtle nest monitoring
  - Lighting surveys
  - Scarp monitoring and remediation
  - Tilling, compaction sampling

# Questions?

**Key Takeaways:**

**Stay away from FLAT (berms and dunes)**

**If you want to build a turtle-friendly template, talk to your engineer or the USACE representative for your project (there may be room for flexibility in the design)**

**Changes in Loggerhead Sea Turtle Nesting Behavior on a Nourished Beach in Southeast Florida**

**Journal of Coastal Research Volume 41, Issue 1**