Erosion Mitigation And Shoreline Management Feasibility Study

Town of Duck, North Carolina

Coastal Planning & Engineering of North Carolina

February 28, 2013

Ken Willson

Goals of the Study

- Evaluate shoreline changes along entire town
- Develop a long term shoreline management strategy for the entire Town
- Investigate the cause, extent, and severity of the chronic erosion area or “Hot Spot” just north of the Research Pier
- Develop an erosion mitigation strategy to address this “Hot Spot”
- **Evaluate Storm Damage Vulnerability***

Shoreline Change Analysis

Shoreline Segment	Transect Grouping	Boundaries by Landmark (Approximate)	Shoreline Length (ft)
1	9 to 89	Dolphin Run to 9th Ave.	8,000
2	89 to 149	9th Ave. to Four Seasons Drive	6,000
3	149 to 169	Four Seasons Drive to Duck Landing Ln.	2,000
4	169 to 209	Duck Landing Ln. to Ships Watch Dr.	4,000
5	209 to 229	Ships Watch Drive to FRF Pier	2,000
6	229 to 239	FRF Pier to N. FRF Property Line	1,000
7	239 to 289	N. FRF Property Line to Dianne St.	5,000
8	289 to 369	Dianne St. to Martin Ln.	8,000
9	369 to 389	Martin Ln. to Sanderling Resort	2,000
10	389 to 529	Sanderling Resort to Hampton Inn	14,000

Segment 2

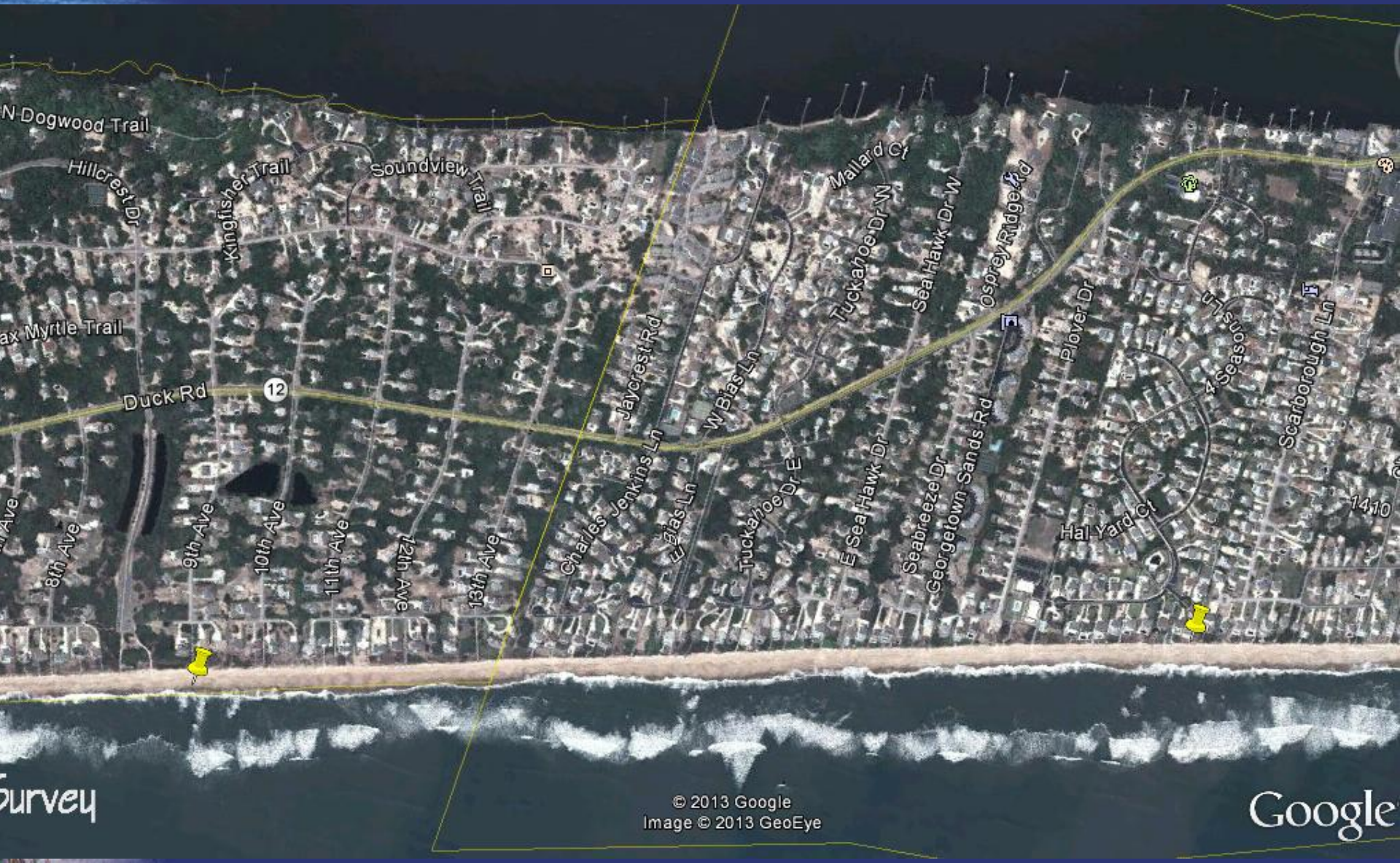
N Dogwood Trail
Hillcrest Dr
Kingfisher Trail
Soundview Trail
Mallard Ct
Tuckahoe Dr W
Sea Hawk Dr W
Osprey Ridge Rd
Plover Dr
4 Seasons Ln
Scarborough Ln
ax Myrtle Trail
Duck Rd
12
Jaycrest Rd
W Bias Ln
Charles Jenkins Ln
E Bias Ln
Tuckahoe Dr E
E Sea Hawk Dr
Seabreeze Dr
Georgetown Sands Rd
Hal Yard Ct
1410
8th Ave
9th Ave
10th Ave
11th Ave
12th Ave
13th Ave
urvey
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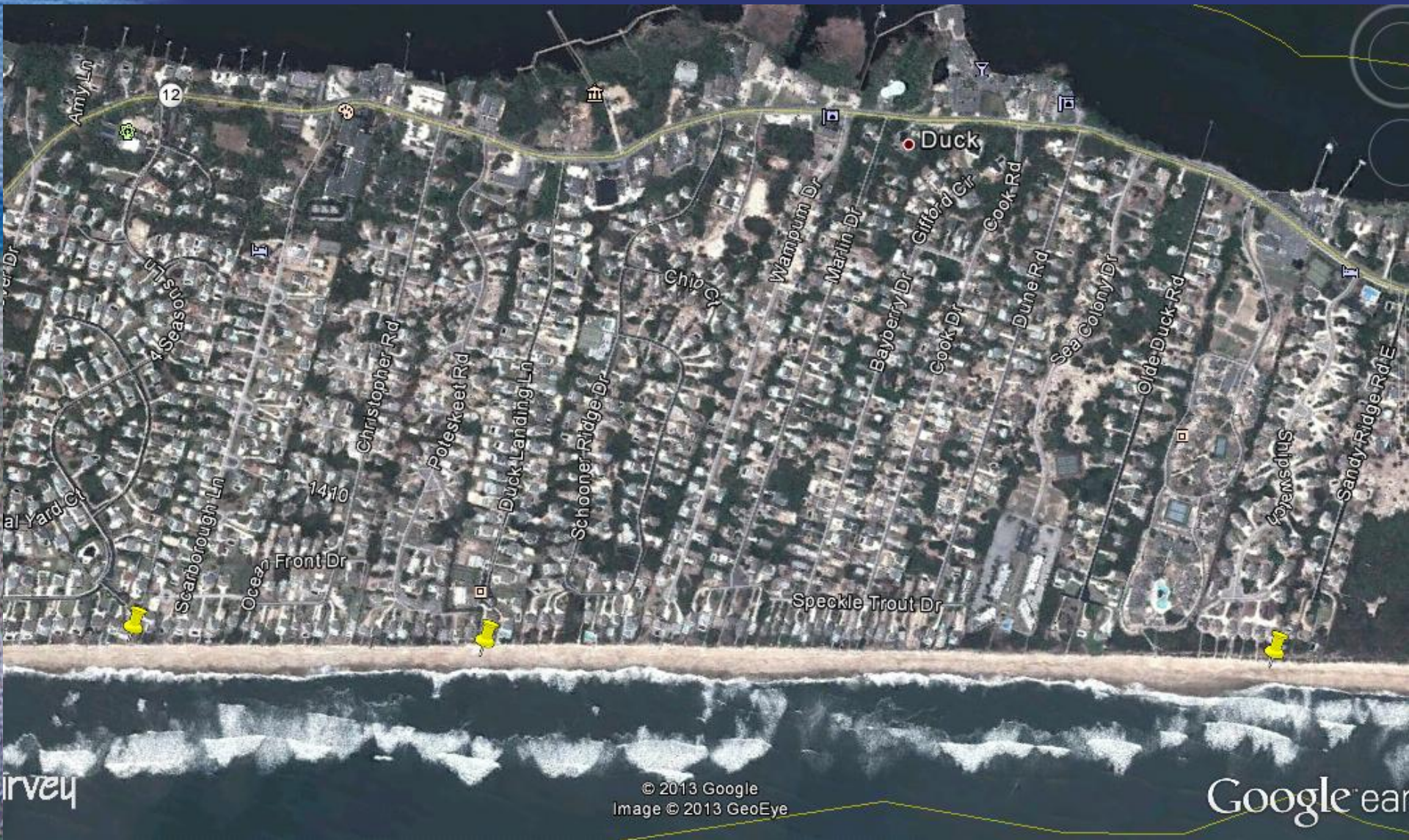
Image © 2013 GeoEye
Google

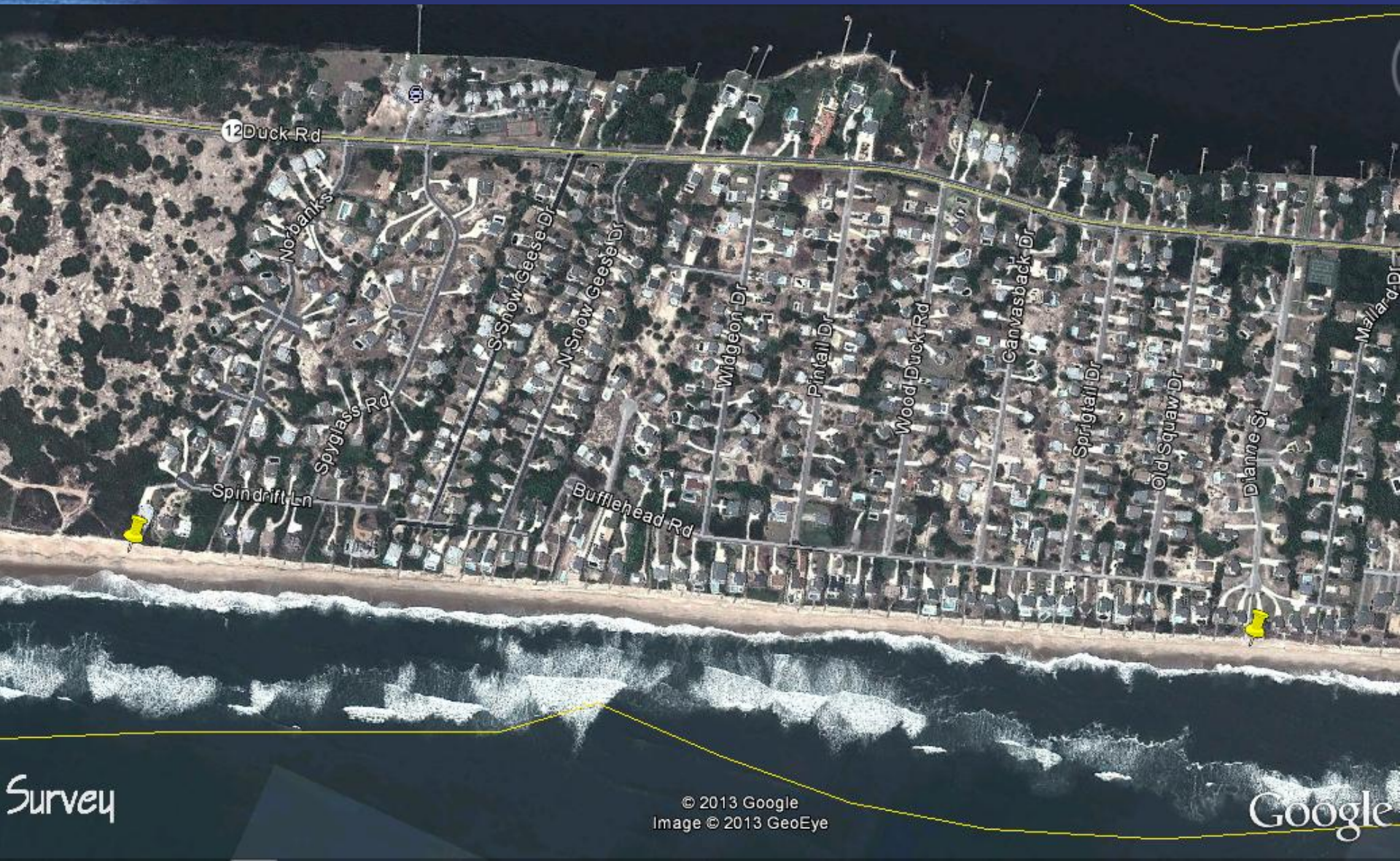
Segment 3 & 4


Duck
Amy Ln
12
4 Seasons Ln
Christopher Rd
Poteskeet Rd
Duck Landing Ln
Schooner Ridge Dr
Chic Ct
Wampum Dr
Marlin Dr
Bayberry Dr
Gifford Cir
Cook Rd
Cook Dr
Dune Rd
Sea Colony Dr
Olde Duck Rd
Shipsway
Sandy Ridge Rd E
1410
Scarborough Ln
Ocean Front Dr
Speckle Trout Dr
© 2013 Google
Image © 2013 GeoEye
Google earth

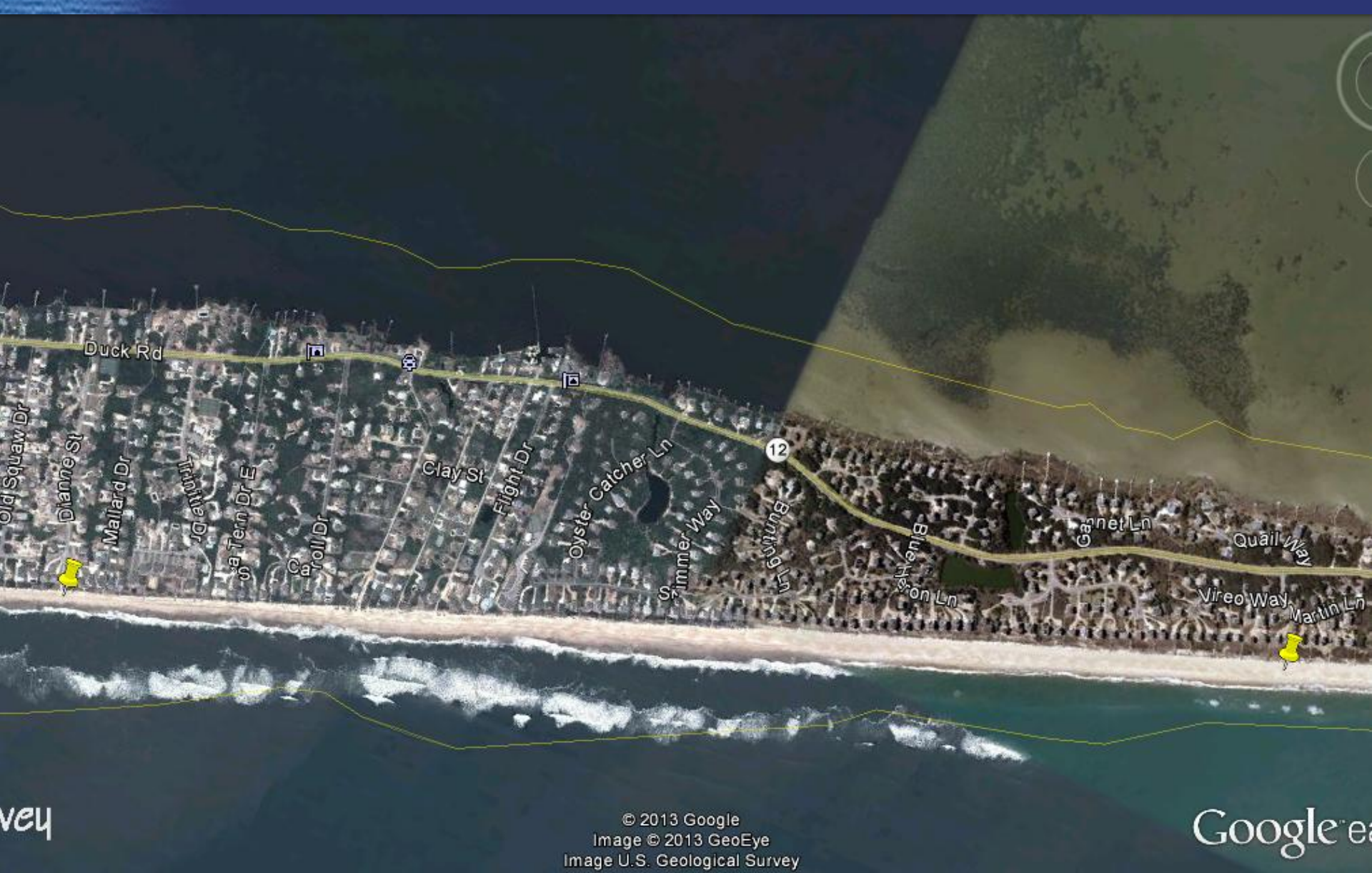
Segment 5 & 6


Olde Duck Rd
Sandy Ridge Rd E
Shipsway Cir
12
Norbanks
Spyglass Rd

Segment 7


12 Duck Rd
Norbanks
S Snow Geese Dr
N Snow Geese Dr
Widgeon Dr
Pintail Dr
Wood Duck Rd
Canvasback Dr
Sprigtail Dr
Old Squaw Dr
Diane St
Mallard Dr
Spyglass Rd
Spindrift Ln
Bufflehead Rd
Survey
© 2013 Google
Image © 2013 GeoEye
Google

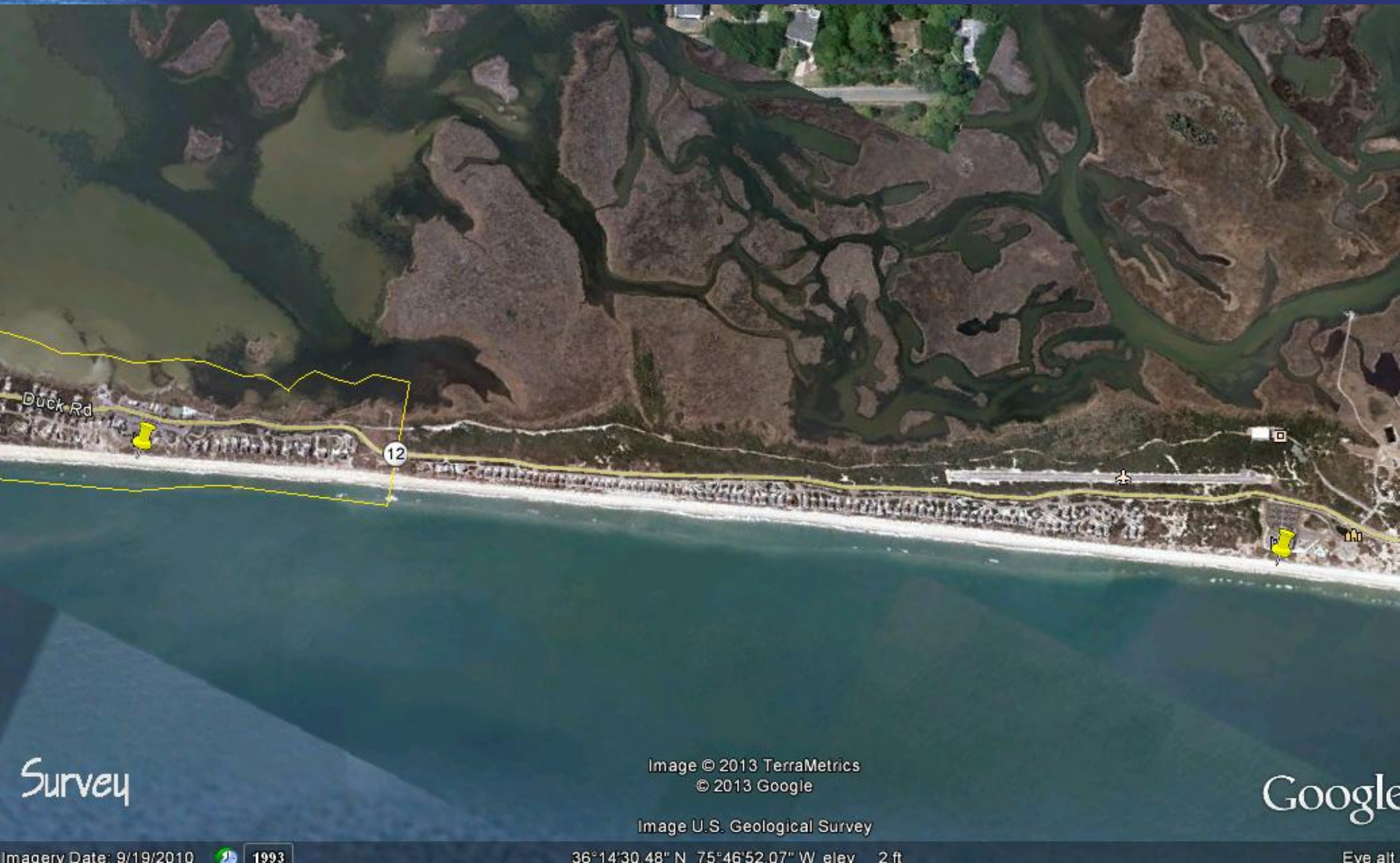
Segment 8


Duck Rd
12
Old Squaw Dr
Dianne St
Mallard Dr
Trinitie Dr
Sea Tern Dr E
Carroll Dr
Clay St
Flight Dr
Oyster Catcher Ln
Summer Way
Bunting Ln
Blue Heron Ln
Gannet Ln
Quail Way
Vireo Way
Martin Ln
© 2013 Google
Image © 2013 GeoEye
Image U.S. Geological Survey
Google

Segment 9


Duck Rd
Quail Way
12
Vireo Way
Martin Ln
Station Bay Dr
S Baum Trail
© 2013 Google
Image © 2013 GeoEye
Image U.S. Geological Survey

Segment 10


Duck Rd
12
Survey
Image © 2013 TerraMetrics
© 2013 Google
Image U.S. Geological Survey
Google
Imagery Date: 9/19/2010
1993
36°14'30.48" N 75°46'52.07" W elev 2 ft
Eye alt

Shoreline Change Analysis

Shoreline Segment	Transect Grouping	Average Shoreline Trend by Segment for 1996 to 2011	
		Overall Trend (ft/yr)	Total Movement (ft)
1	9 to 89	+0.60	+9.1
2	89 to 149	-0.36	-4.7
3	149 to 169	+1.82	+27.5
4	169 to 209	-1.04	-15.8
5	209 to 229	+0.15	+2.2
6	229 to 239	-1.68	-25.4
7	239 to 289	-4.82	-72.9
8	289 to 369	+1.12	+15.5
9	369 to 389	-0.56	-8.5
10	389 to 529	+1.27	+23.7

Phase 1: Coastal Process and Shoreline Impact Analysis

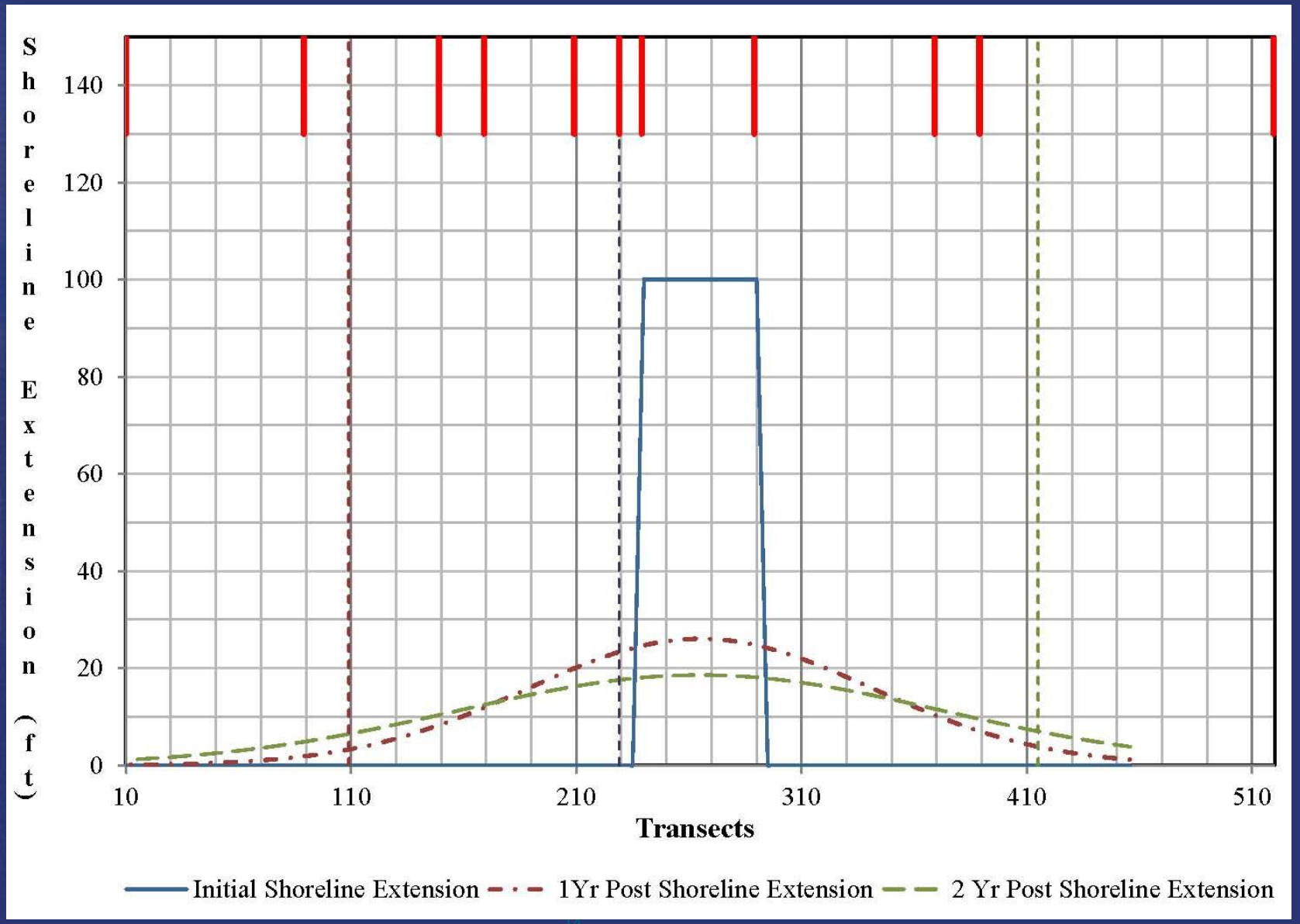
4: Economic Losses Due To Shoreline Change Rates

Segment Number	Timeframe					Total
	2011-2016	2016-2021	2021-2026	2026-2041	2041-2061	
1	N/A	N/A	N/A	N/A	N/A	N/A
2	4.9%	2.7%	1.4%	2.9%	5.7%	3.3%
3	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
4	10.5%	7.2%	3.5%	7.3%	16.0%	8.6%
5	N/A	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A	N/A
7	82.8%	89.6%	94.9%	89.4%	77.4%	87.4%
8	1.0%	0.3%	0.2%	0.3%	0.6%	0.4%
9	0.6%	0.1%	0.1%	0.2%	0.3%	0.2%
10	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	$6,631,267	$9,235,952	$19,255,065	$27,786,350	$18,688,323	$81,596,958

Conceptual Alternatives

- No Action Alternative
- Retreat
- Beach Restoration By Truck Haul
- Dune Replenishment By Truck Haul
- Erosion Mitigation Project By Offshore Dredging
- Storm Damage Reduction Project By Offshore Dredging

Beach Fill (Truck Haul):



Beach Fill (Truck Haul): $1.5 Million - $2 Million

- 60,000 cy of Fill
- 30 - 90 day construction period
- Placed along 5,000 ft. of Hot Spot
- Provide 1 year of erosion mitigation and some fill along the adjacent beaches.

Dune Fill (Truck Haul): $815,000

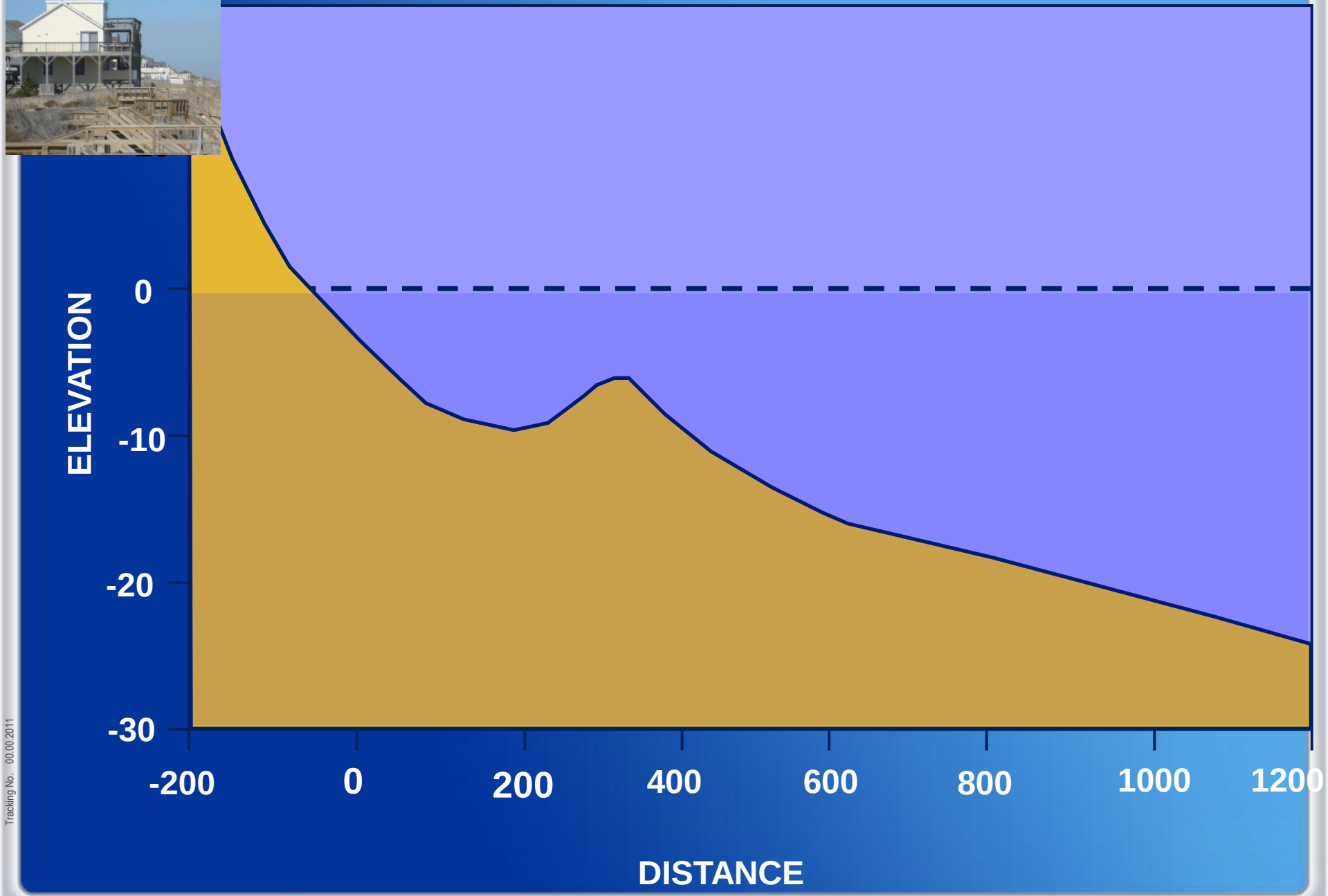
- 30,000 cy of Fill
- 5 – 7 months permitting
- 30 day construction period
- Placed along 5,000 ft. of Hot Spot
- Provide 1 year of erosion mitigation

Beach Fill (dredge and fill):

- Nags Head style project.
- ~ 842,000 cy of fill
- Offshore borrow area
- Placed along most of segment 7 and 8
- Tapers to minimize spreading losses.
- Provide ~ 5 years of erosion mitigation.
- $11.35 Million - $14 Million
- Limited storm damage reduction

Storm Damage Reduction

PROFILE EVOLUTION OF BEACH NOURISHMENT



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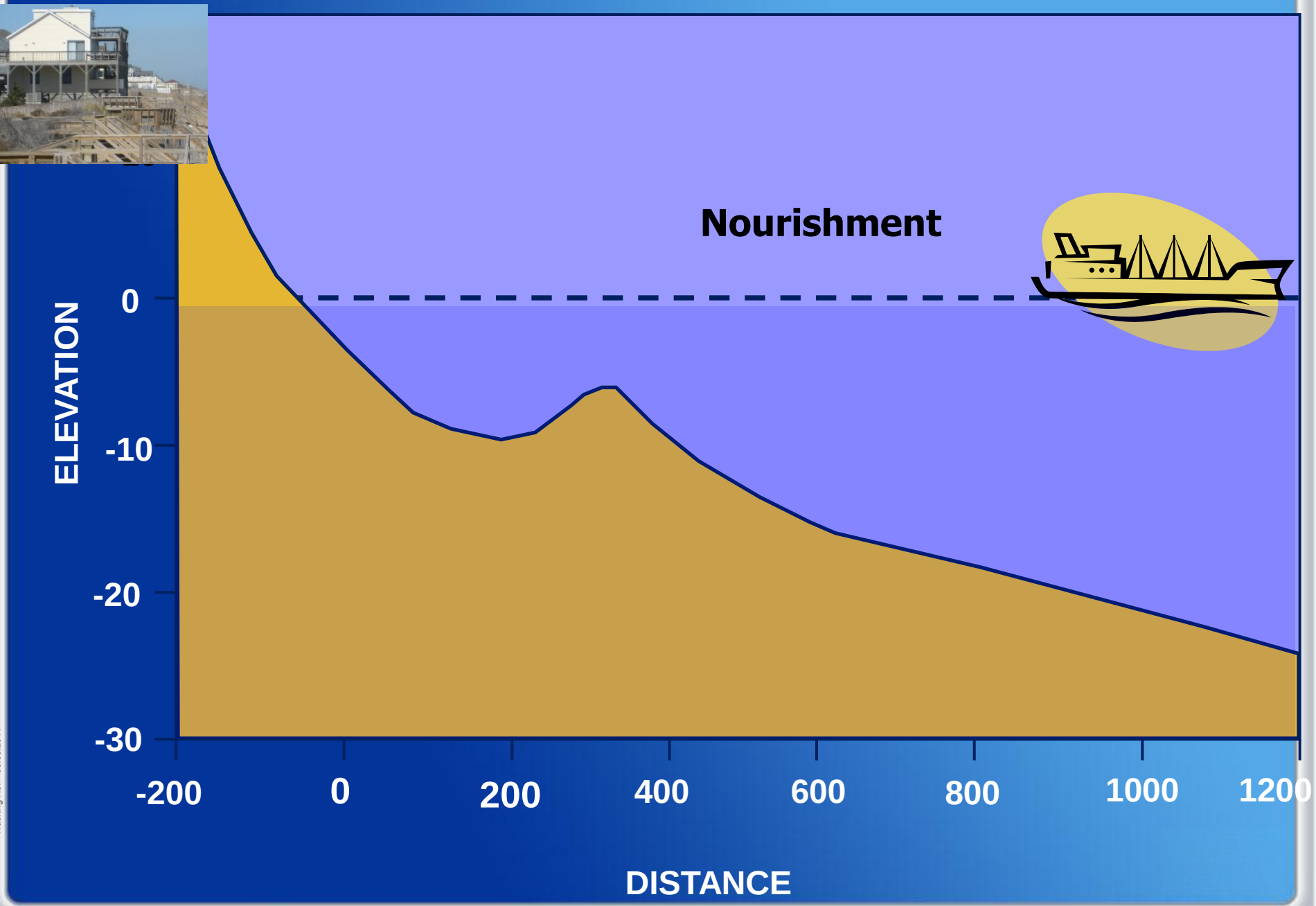

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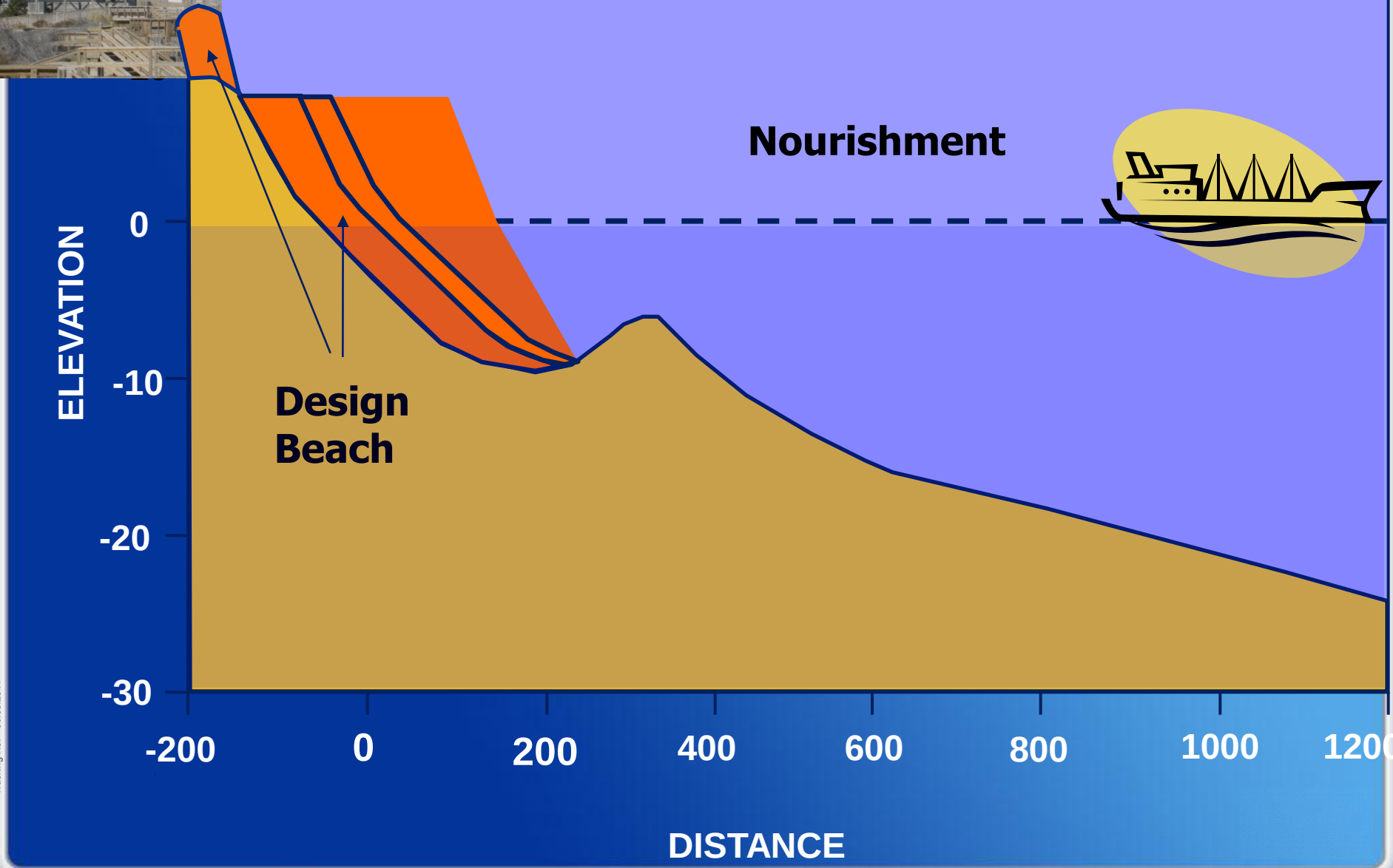

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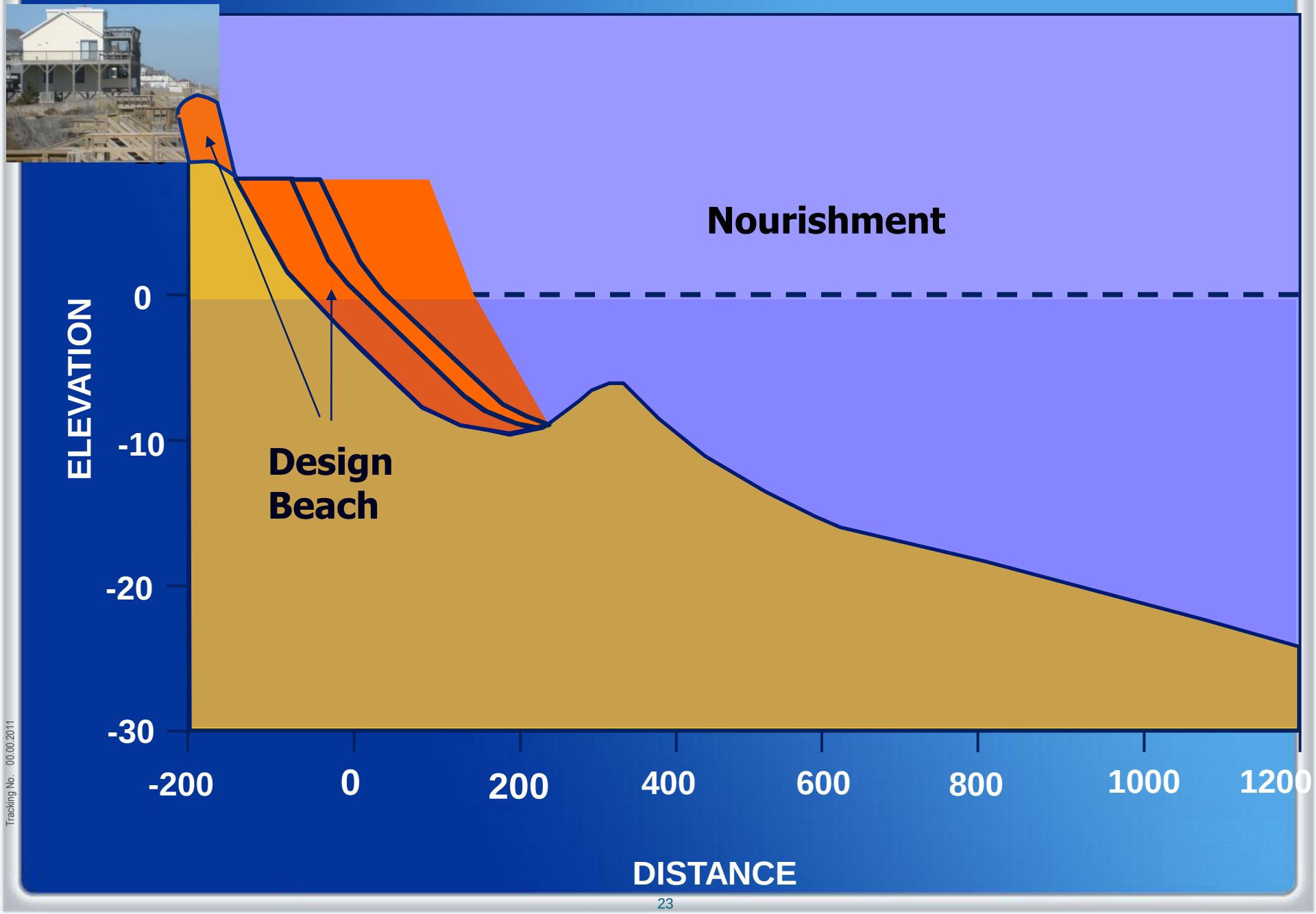

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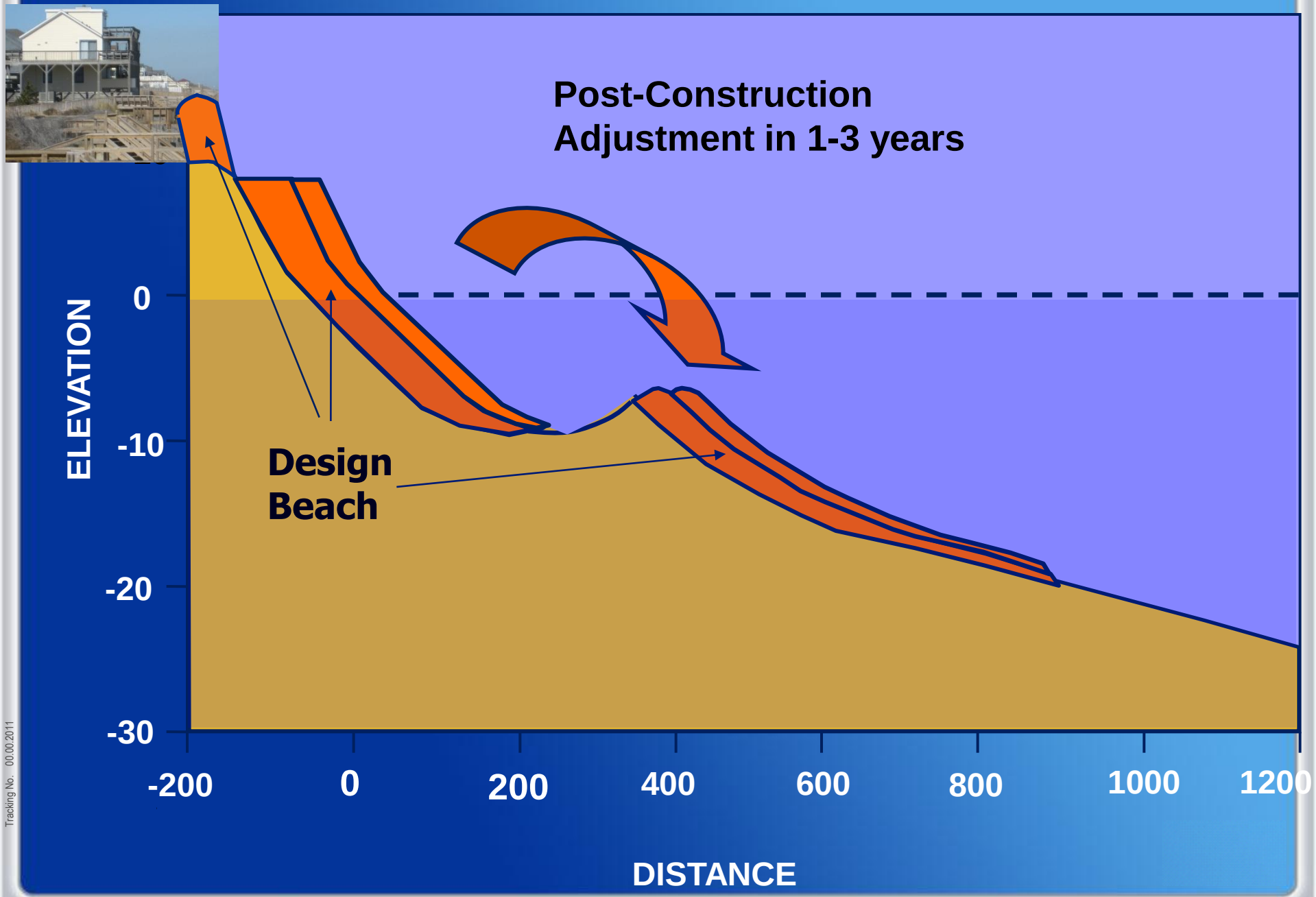

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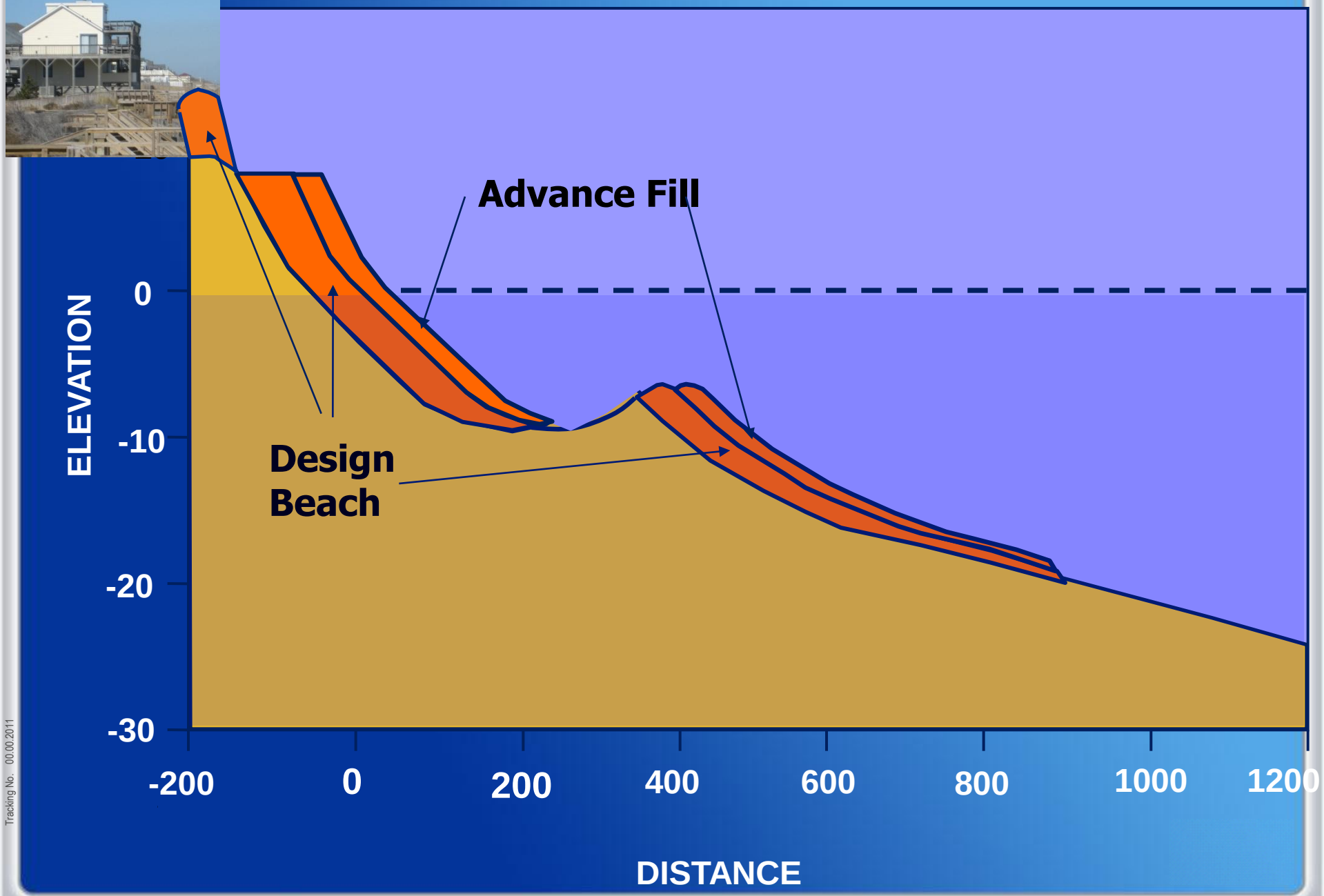

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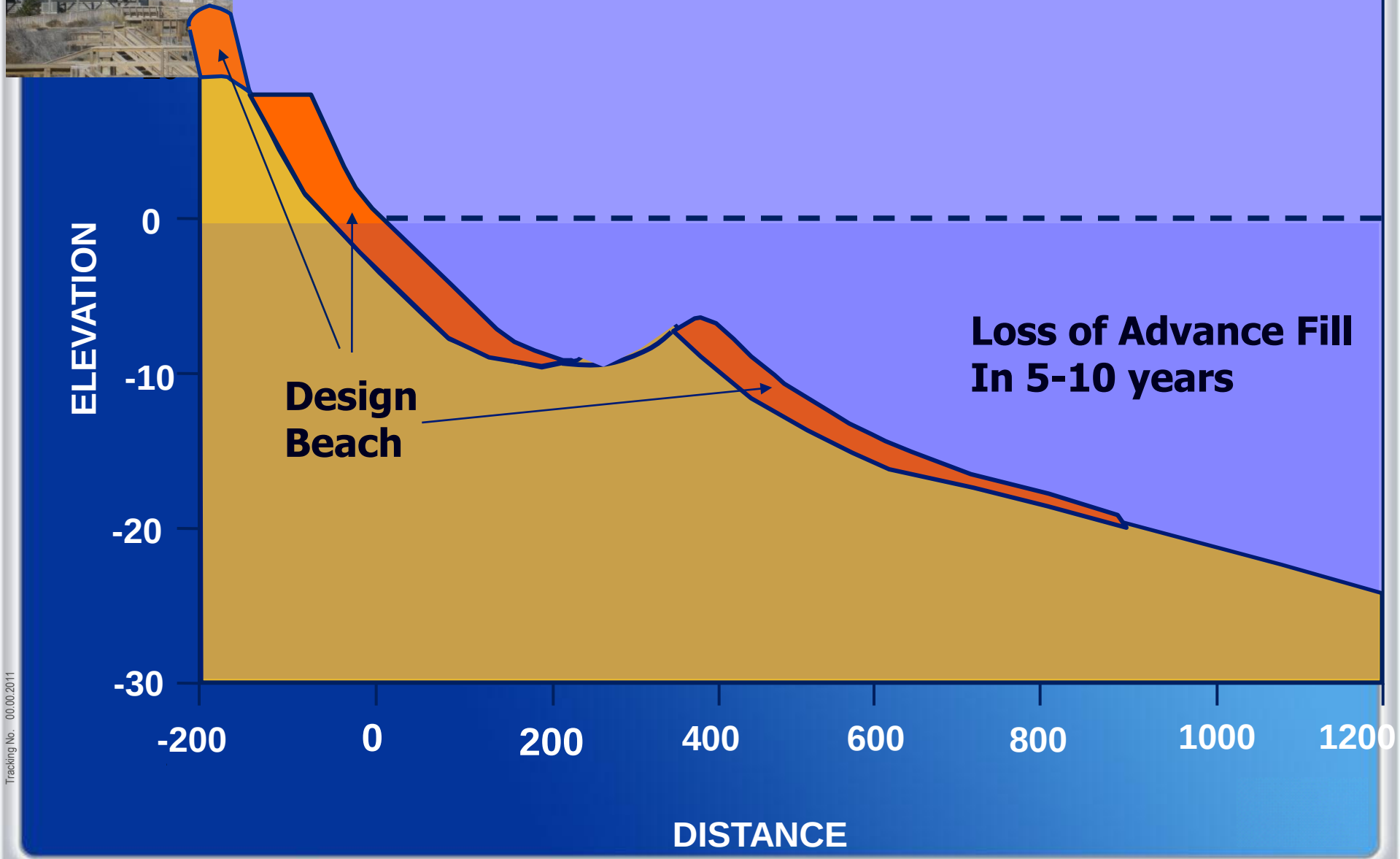

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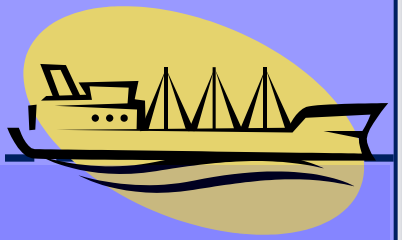


ELEVATION

0

-10

-20

-30

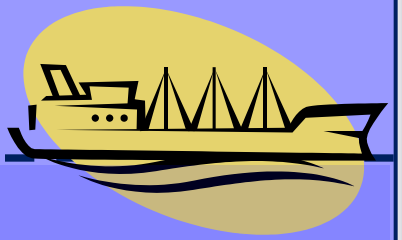
Design
Beach

-200 0 200 400 600 800 1000 1200

DISTANCE

Tracking No. 00.00.2011

PROFILE EVOLUTION OF BEACH NOURISHMENT



ELEVATION

0

-10

-20

-30

Design
Beach

-200 0 200 400 600 800 1000 1200

DISTANCE

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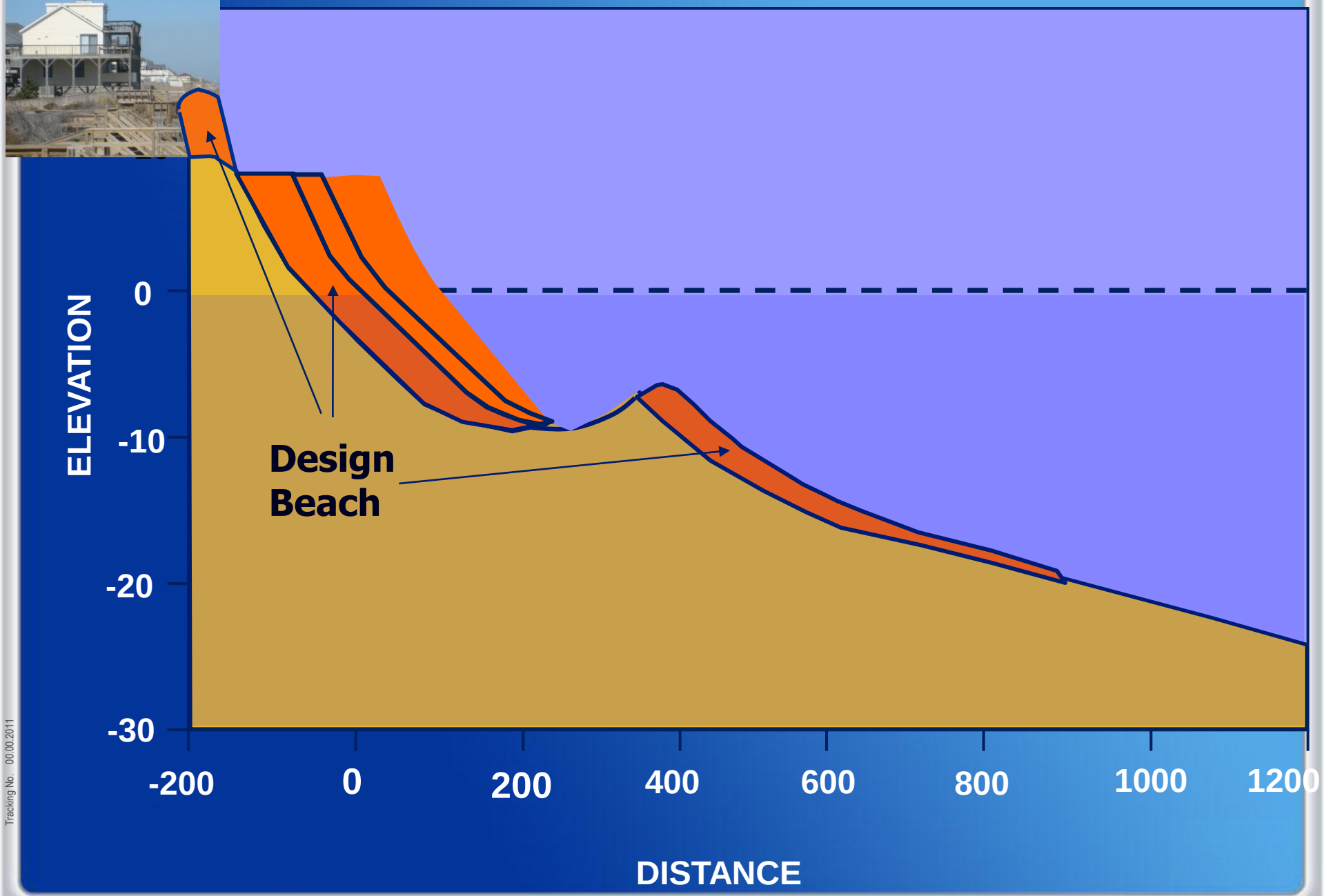
PROFILE EVOLUTION OF BEACH NOURISHMENT



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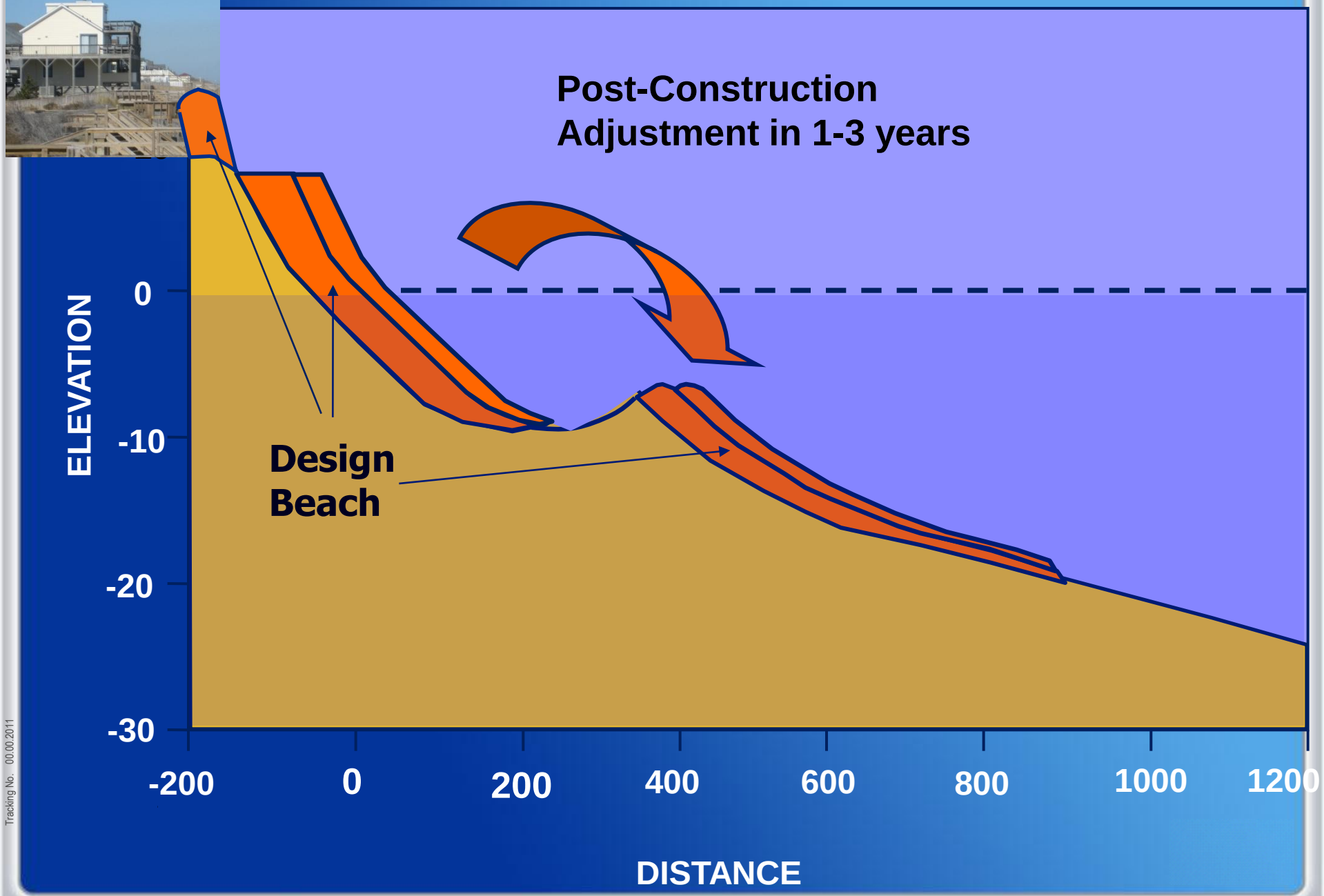

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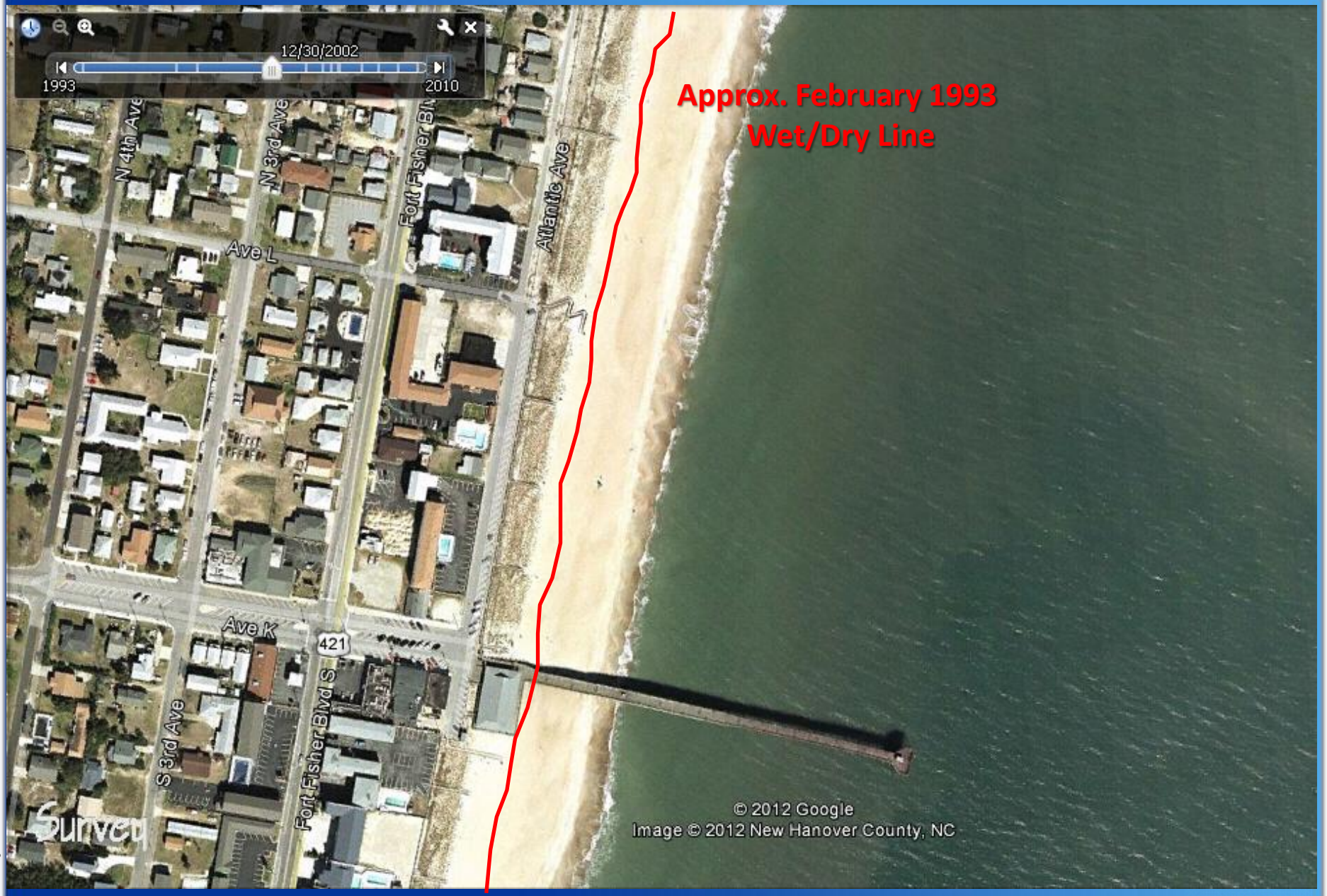

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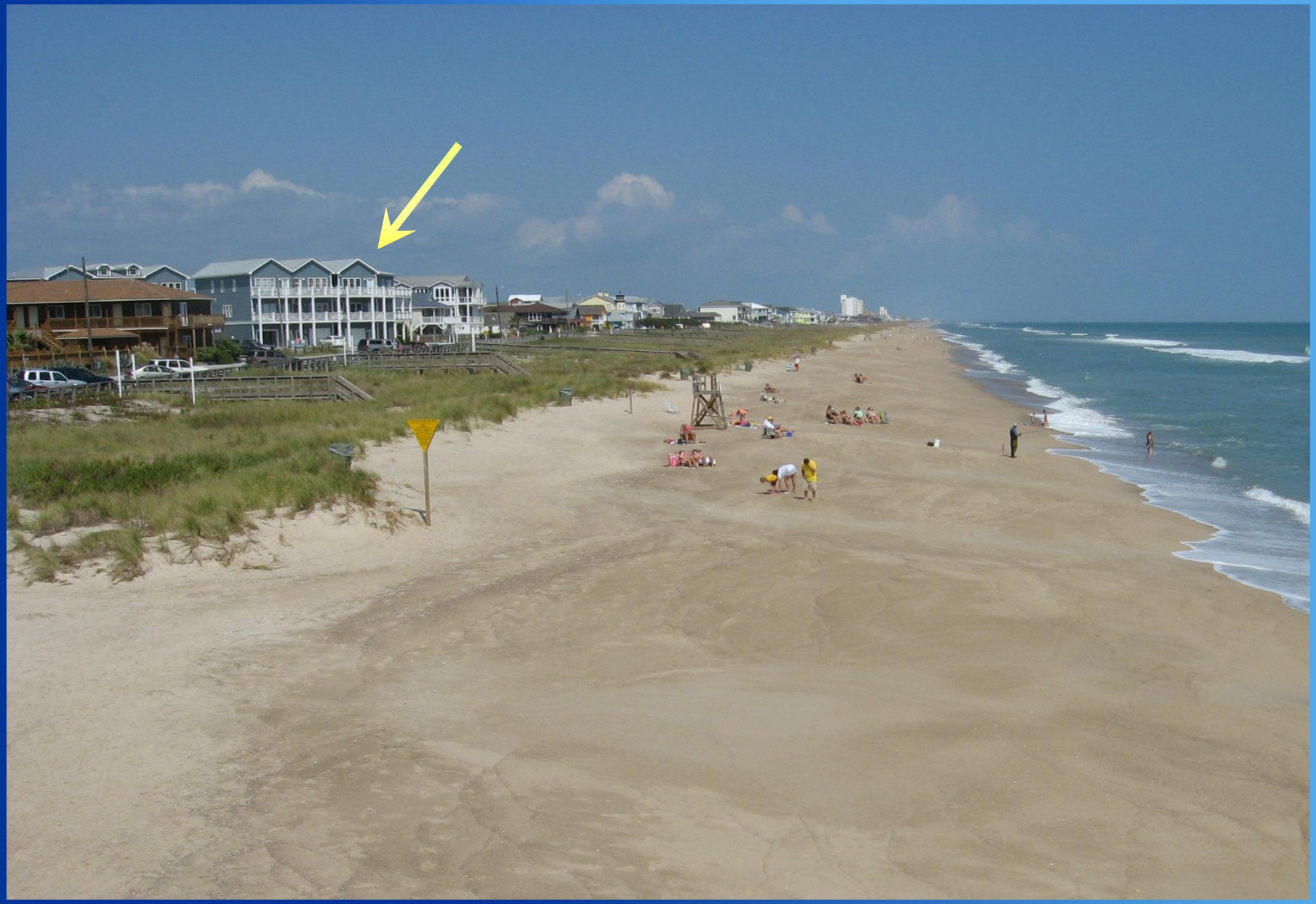

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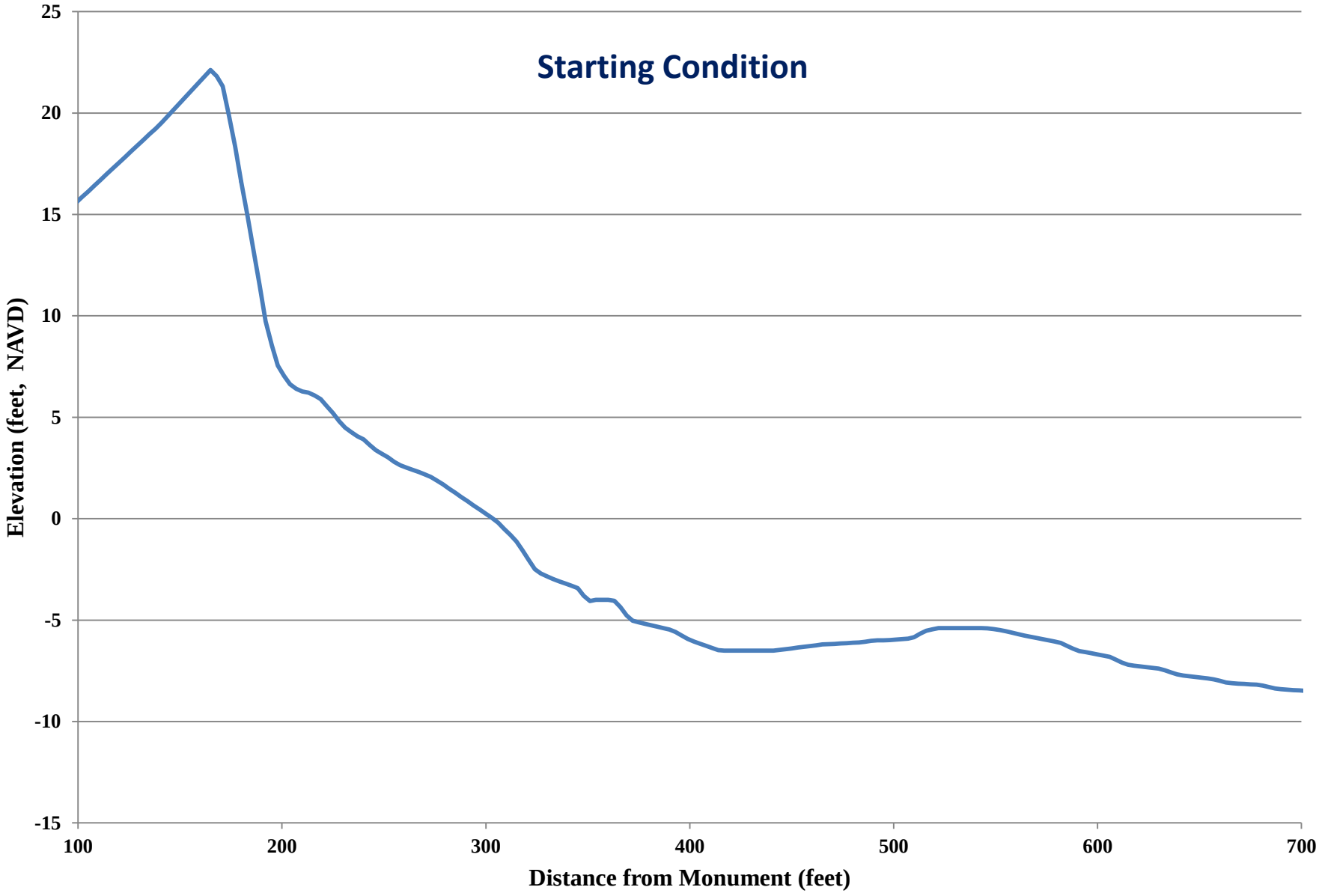
SBEACH

- **S**torm-induced **BE**Ach **CH**ange Model
- Simulates cross-shore erosion of the dune, berm, and foreshore caused by storm waves and water levels

SBEACH Change at Profile 39+04



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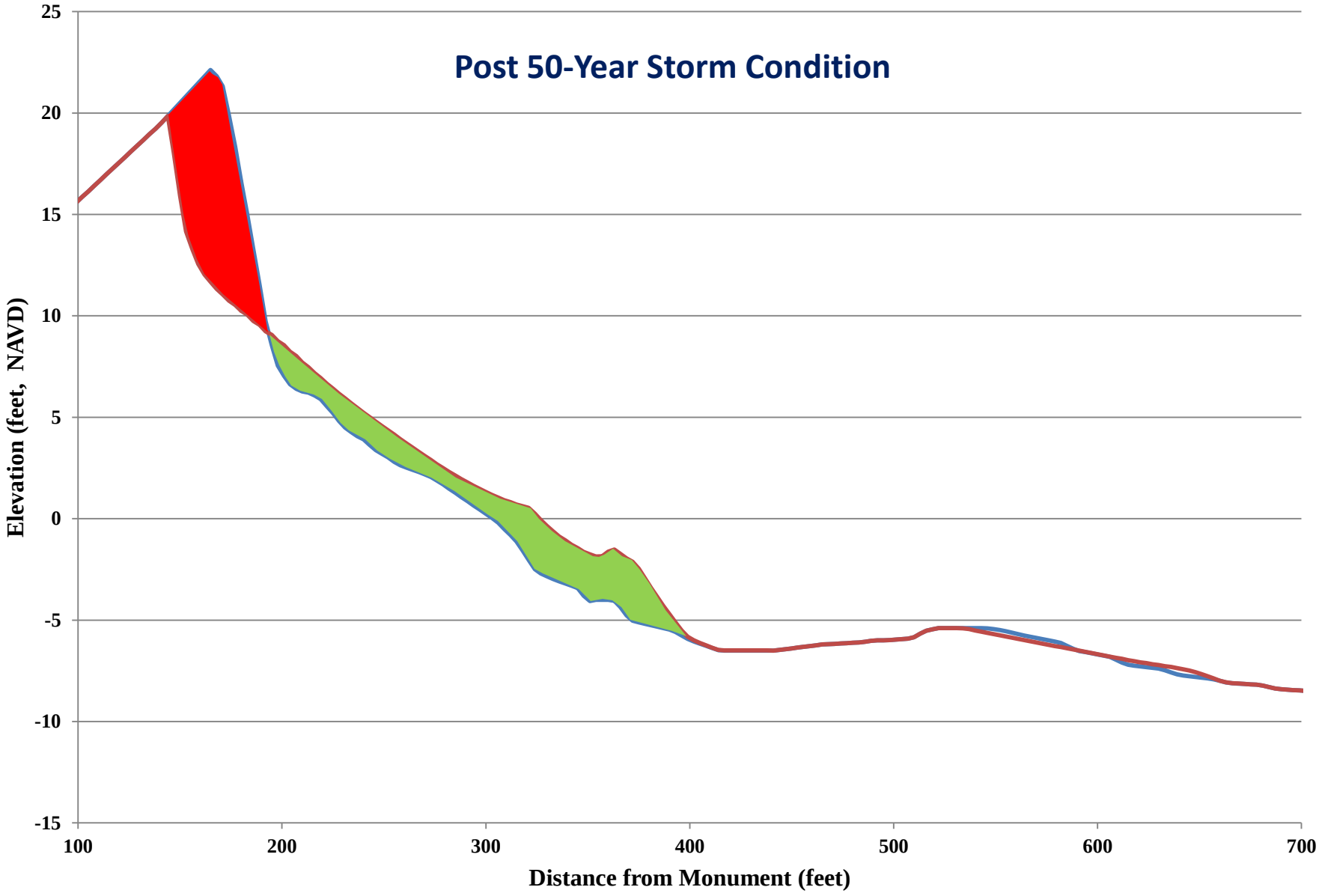

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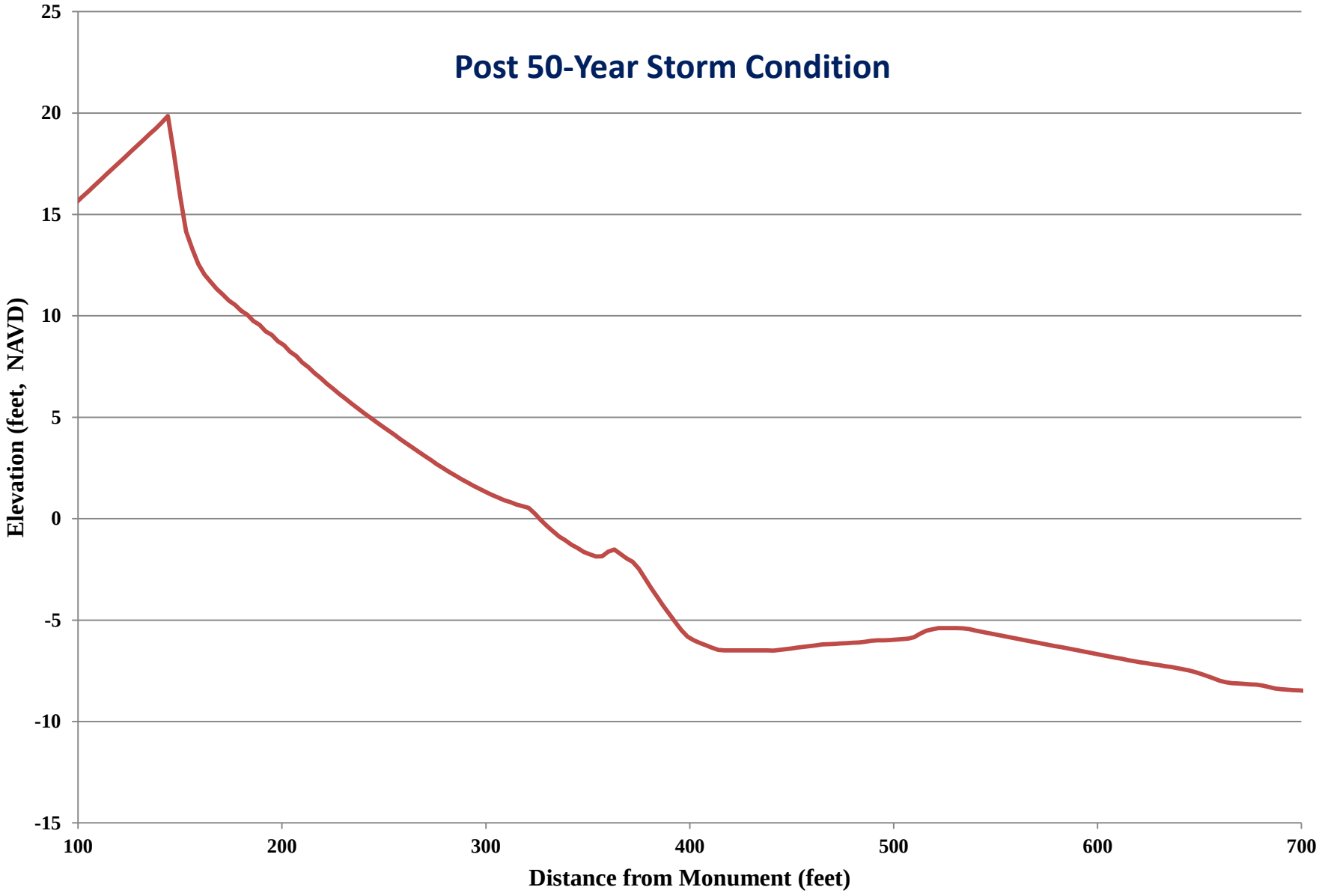

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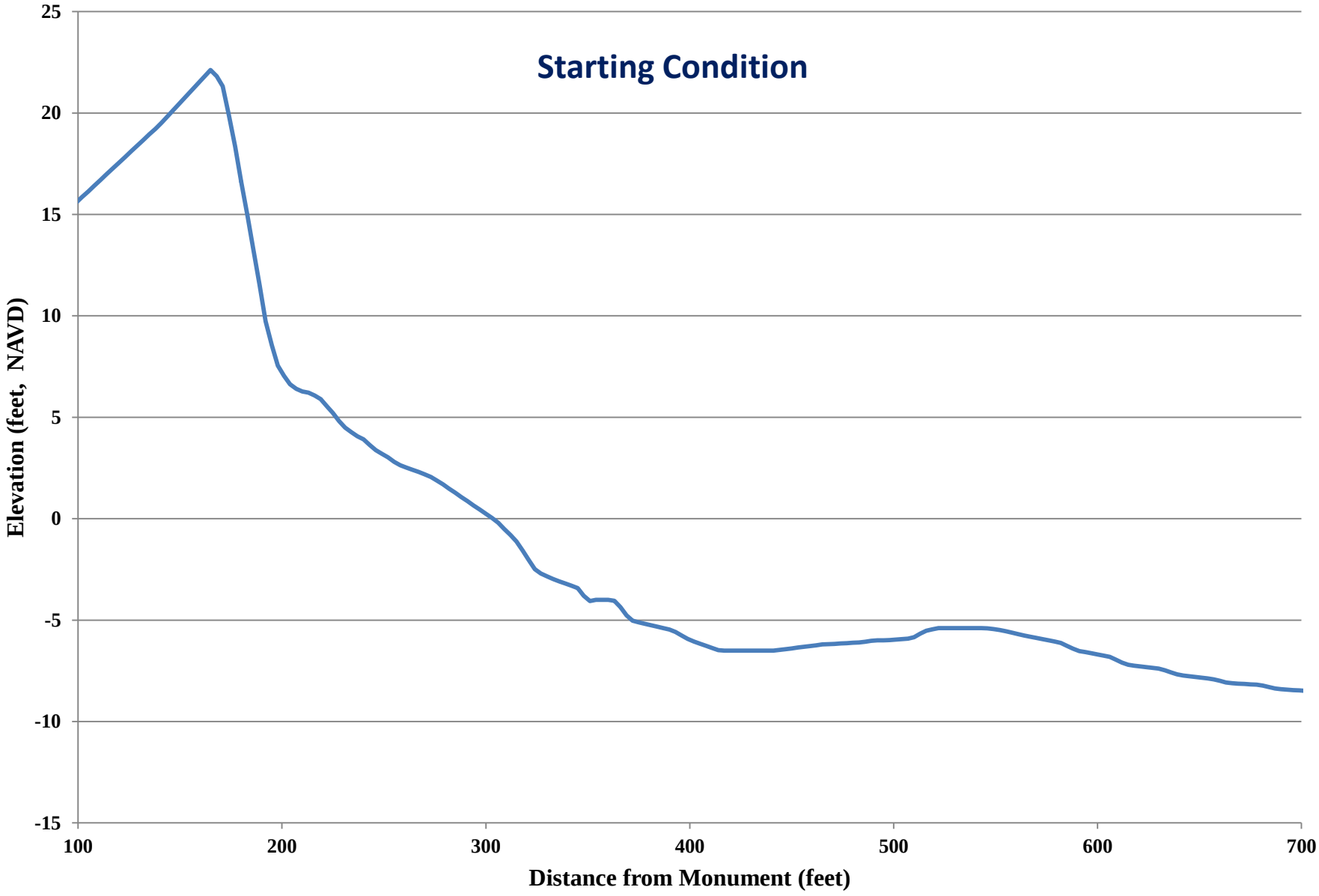

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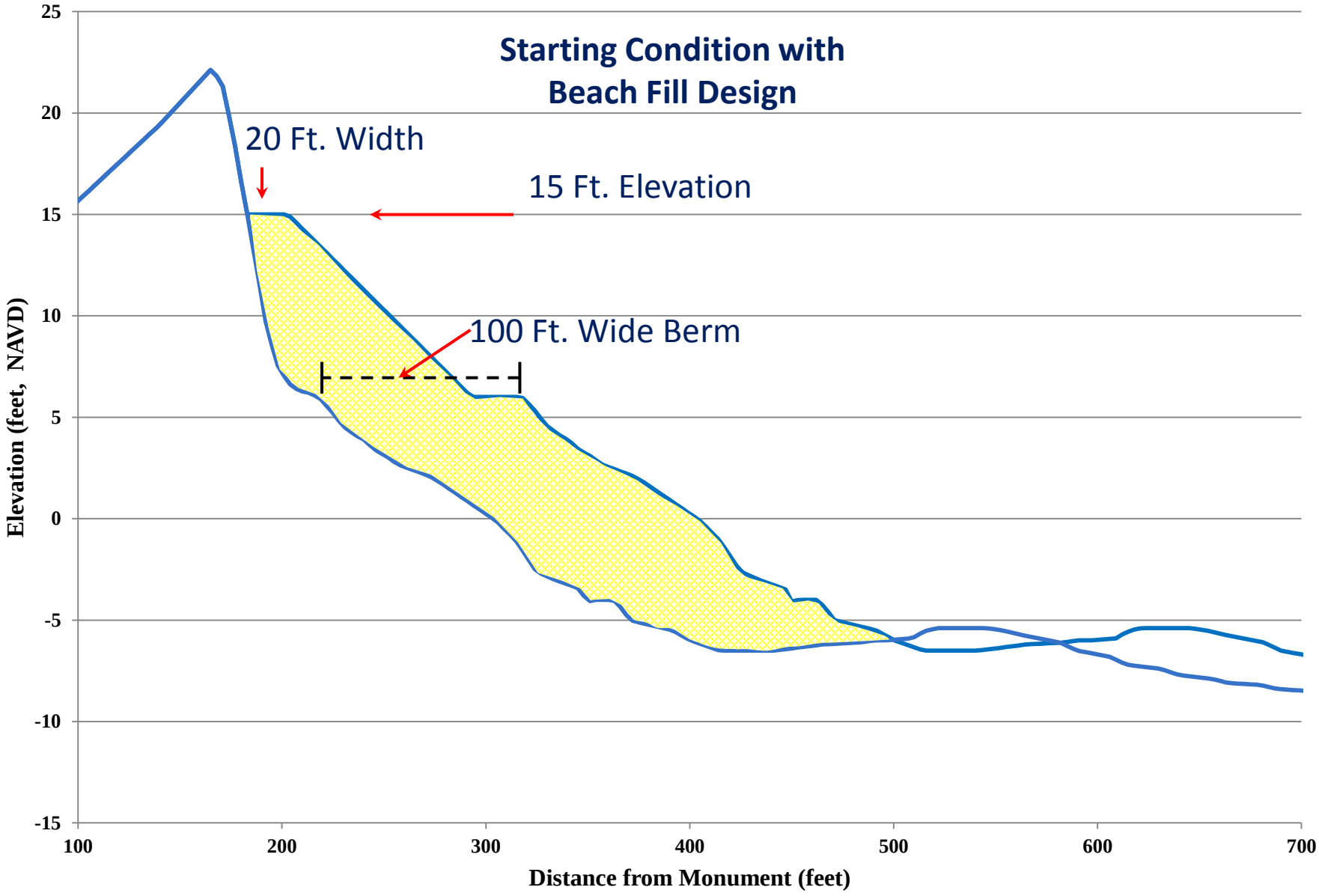

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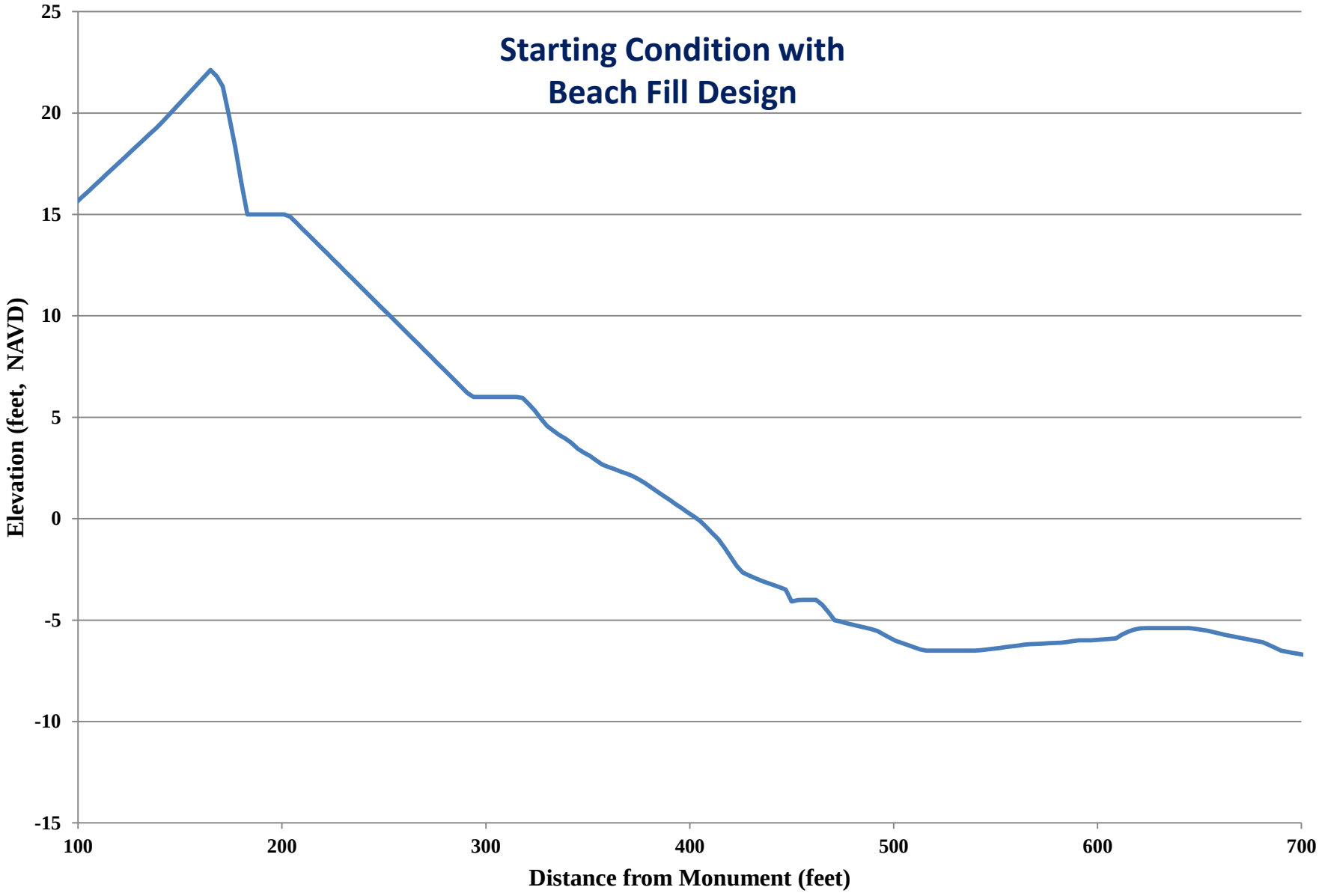

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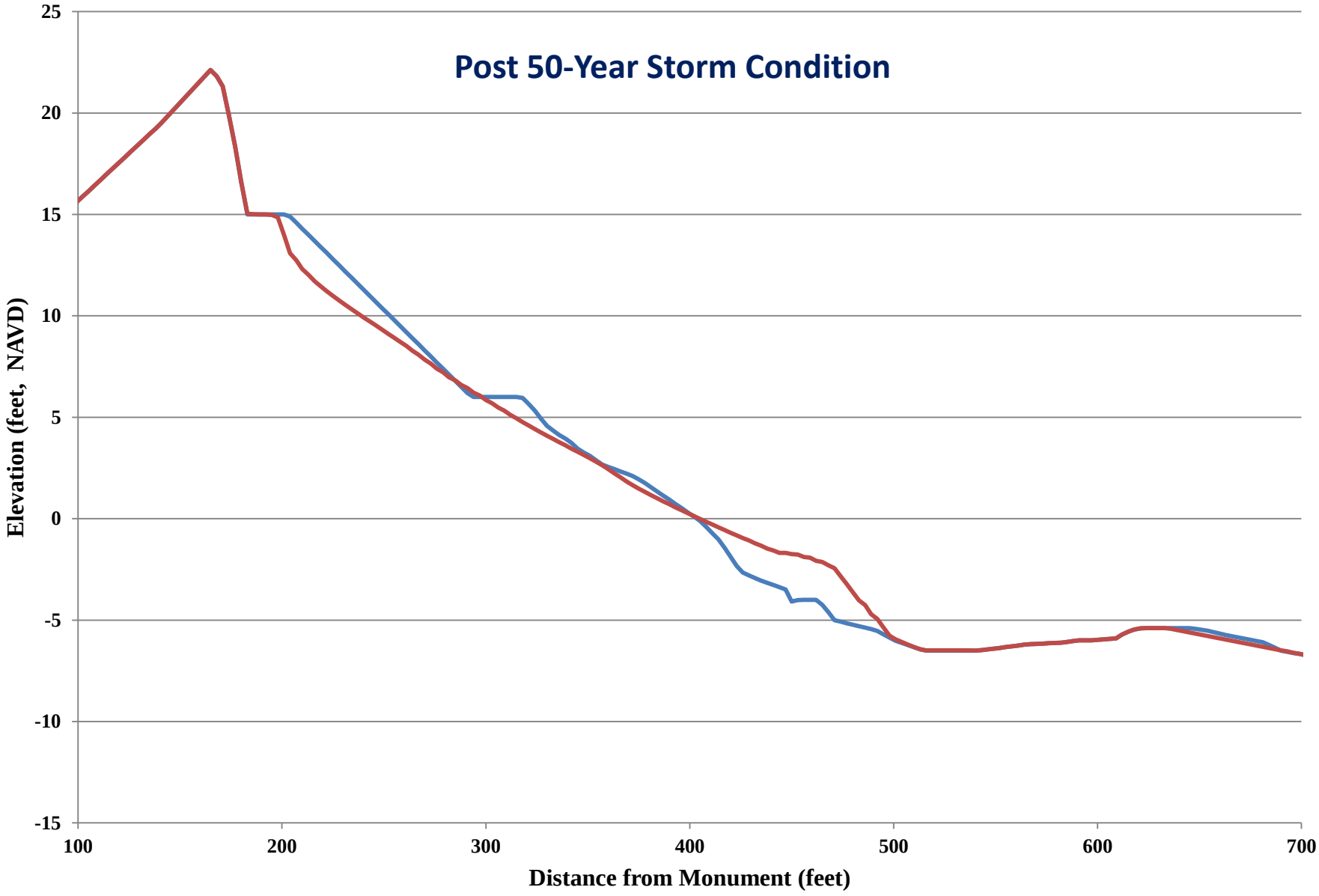

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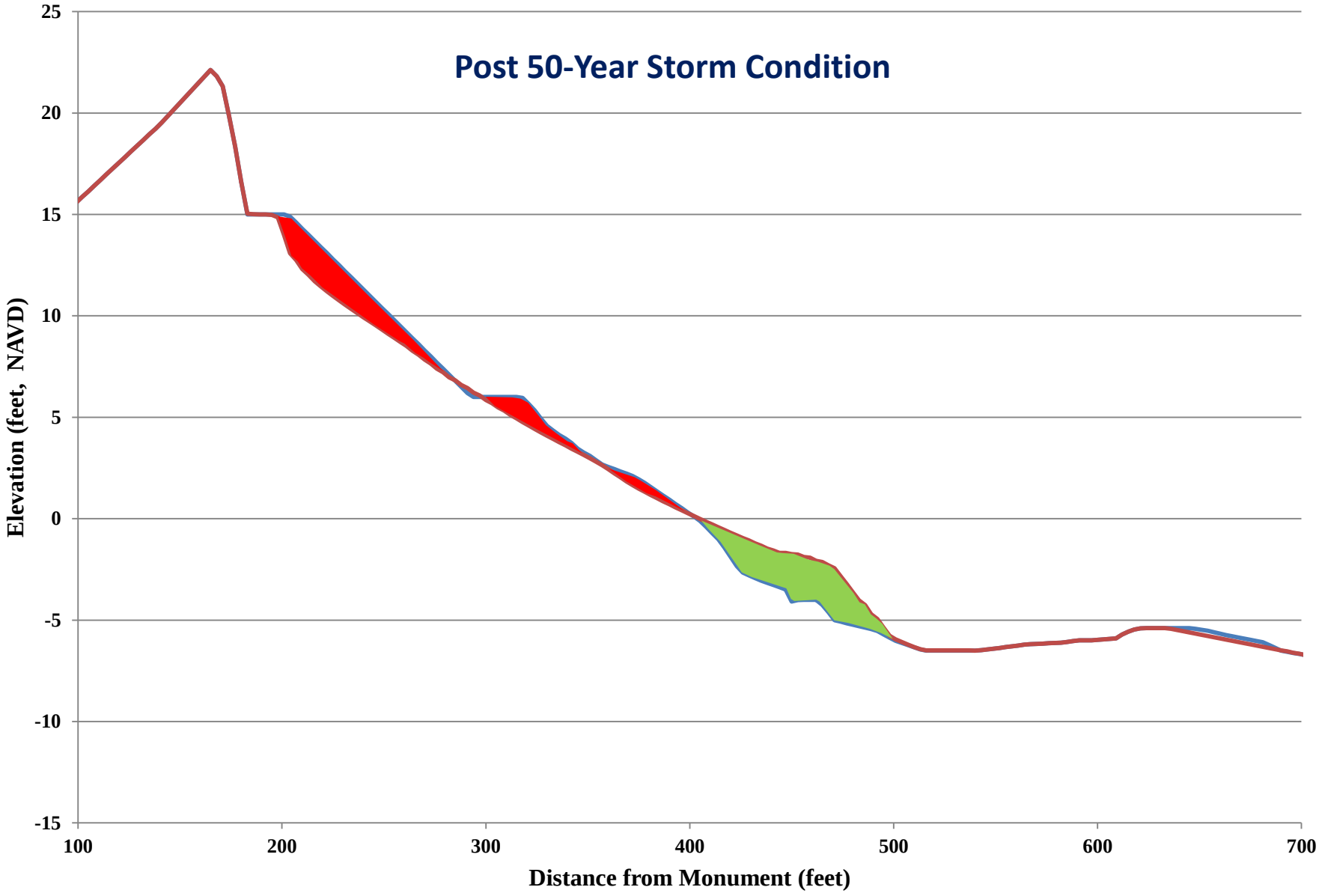

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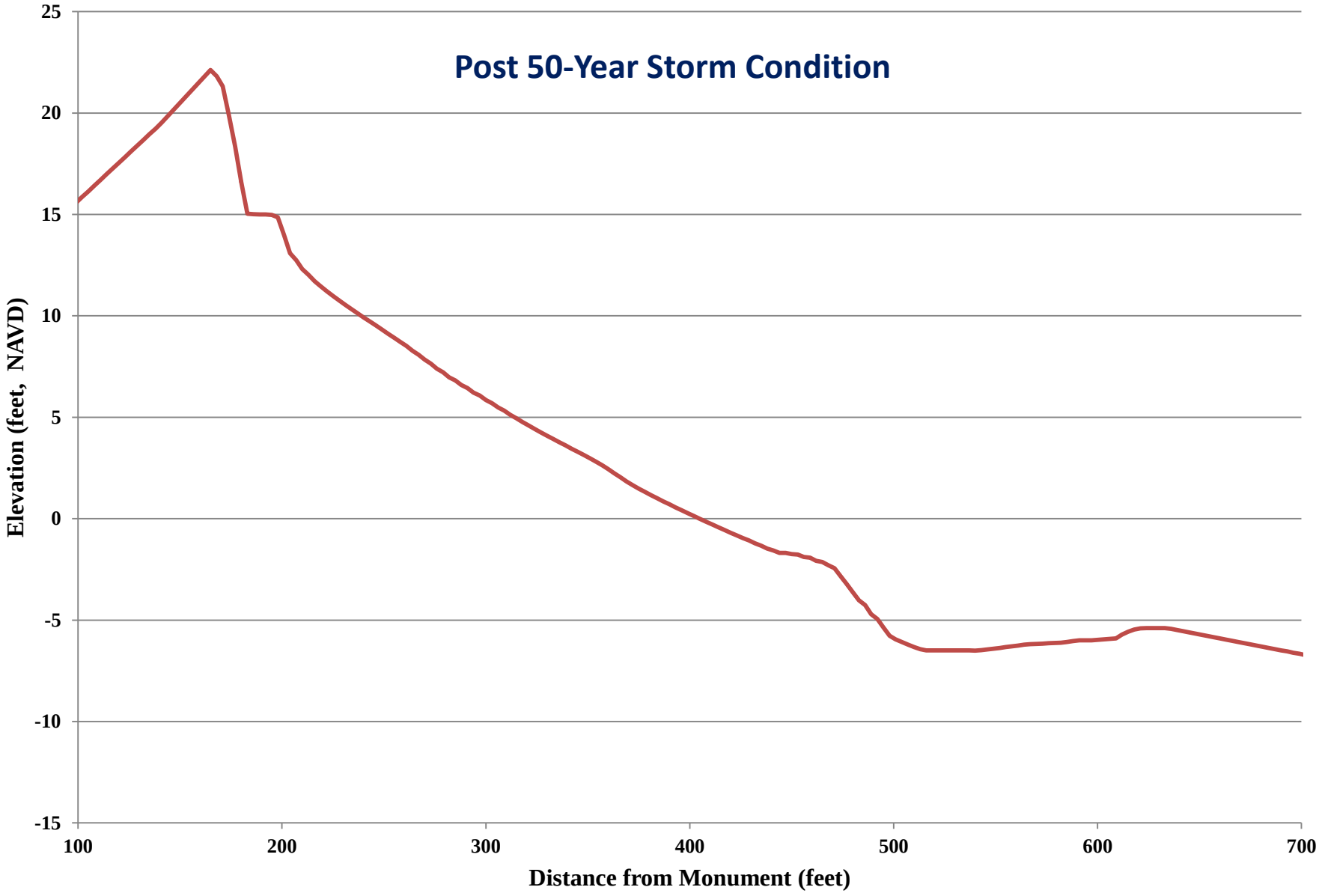

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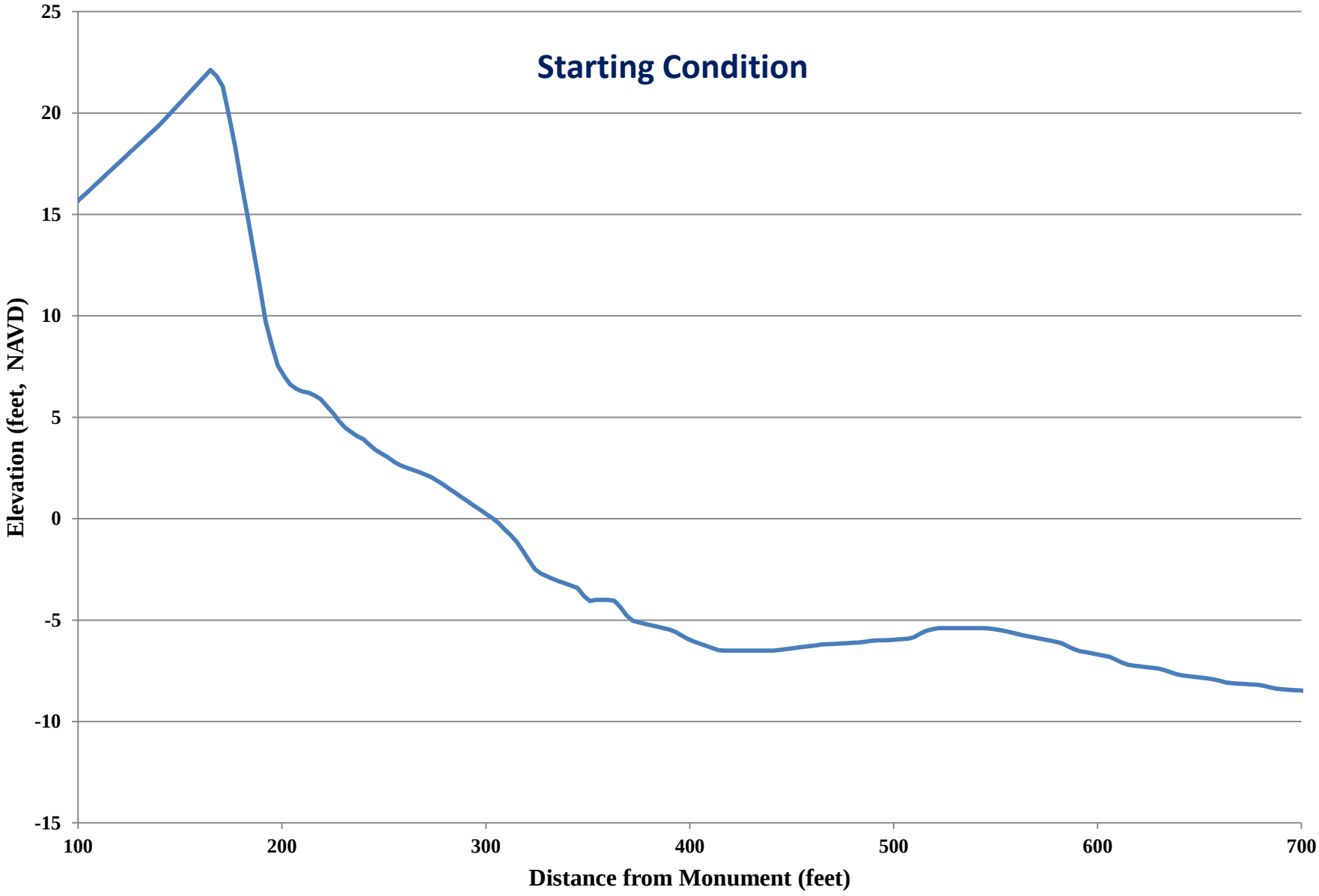
SBEACH Change at Profile 39+04



Tracking No. 00.00.2011

SBEACH
Storm Damage Analysis

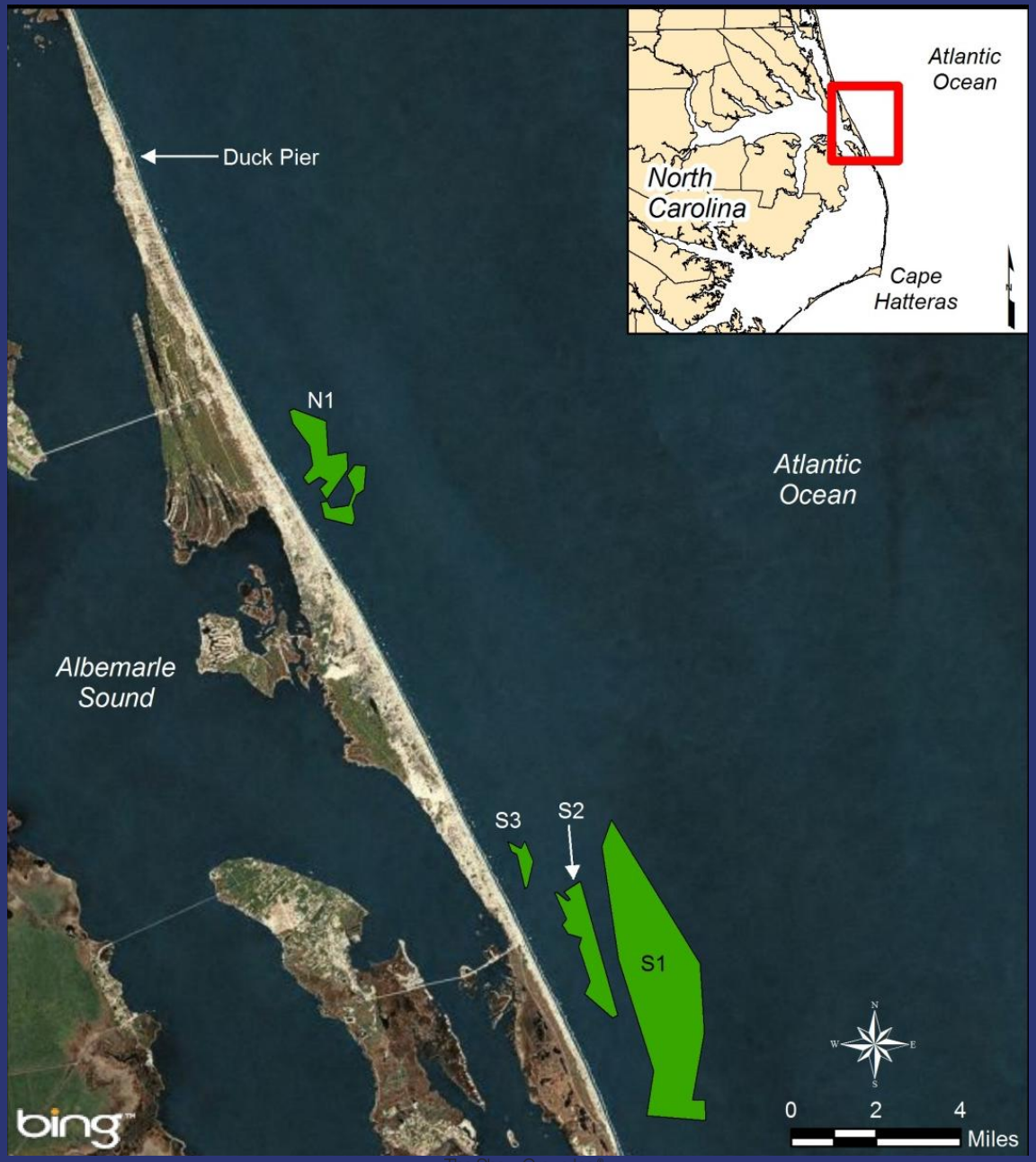
Return Period	H_S (ft.)	T_p (s)	Water Level (ft. NAVD)
1	17.6	9.9	4
5	21.2	12.9	4.2
10	22.7	14.2	4.8
20	24.3	15.5	5.7
25	24.8	16	5.8
50	26.3	17.3	6.2

Storm	Date	Measured Data			Approximate Return Period (years)		
		H_S (ft)	T_p (s)	Water Level (ft. NAVD)	H_S	T_p	Water Level
Perfect Storm	Oct-91	15.1	22.5	4	< 1	> 50	1
Hurricane Isabel	Sep-03	27.3	15.6	5.6	>50	20	10 to 20
Hurricane Irene	Aug-11	24.8	13.6	3	25	5 to 10	< 1
Hurricane Sandy	Oct-12	17.3	13.3	4.5	~ 1	5 to 10	5 to 10

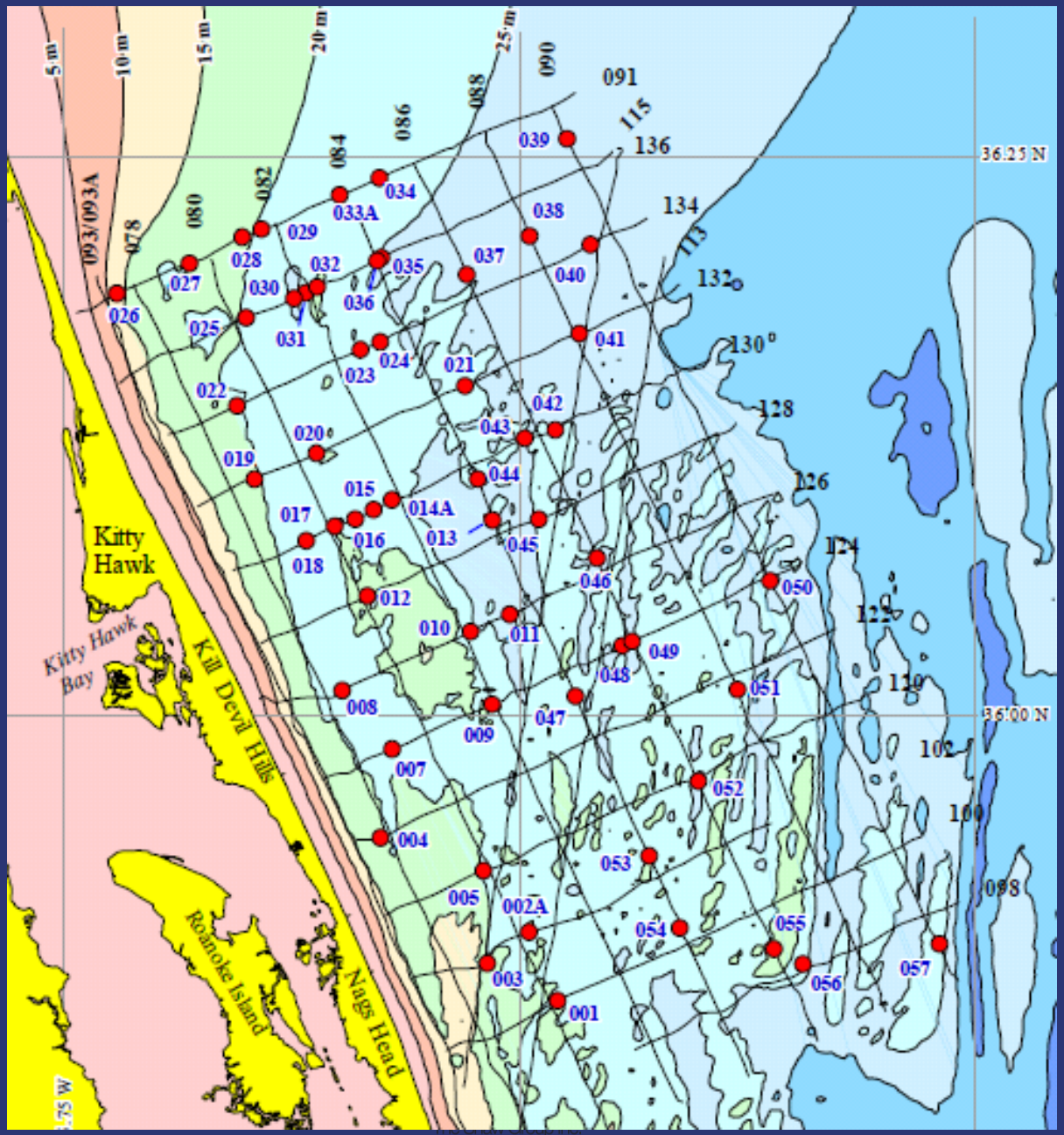
SBEACH
Storm Damage Analysis

Segment	Shore Segment	Structures Impacted during Storm Event under Existing Conditions					
		1-Year	5-Year	10-Year	20-Year	25-Year	50-Year
1	1	-	-	-	-	-	-
2	2	-	-	-	-	2	2
3	3	-	-	-	1	1	2
4	4	-	-	-	1	1	8
5	5	-	-	-	-	-	-
6	6	-	-	-	-	-	-
7	7	15	19	23	27	32	36
8	8	2	6	14	20	22	23
9	9	-	-	-	-	-	-
10	10	-	-	-	-	-	-
	Total:	**1,260,800**	**1,610,200**	**1,610,200**	**2,898,200**	**3,381,500**	**3,642,300**
	Total (7 & 8):	**1,260,800**	**1,610,200**	**1,610,200**	**2,090,800**	**2,313,200**	**2,492,200**

Sand Sources

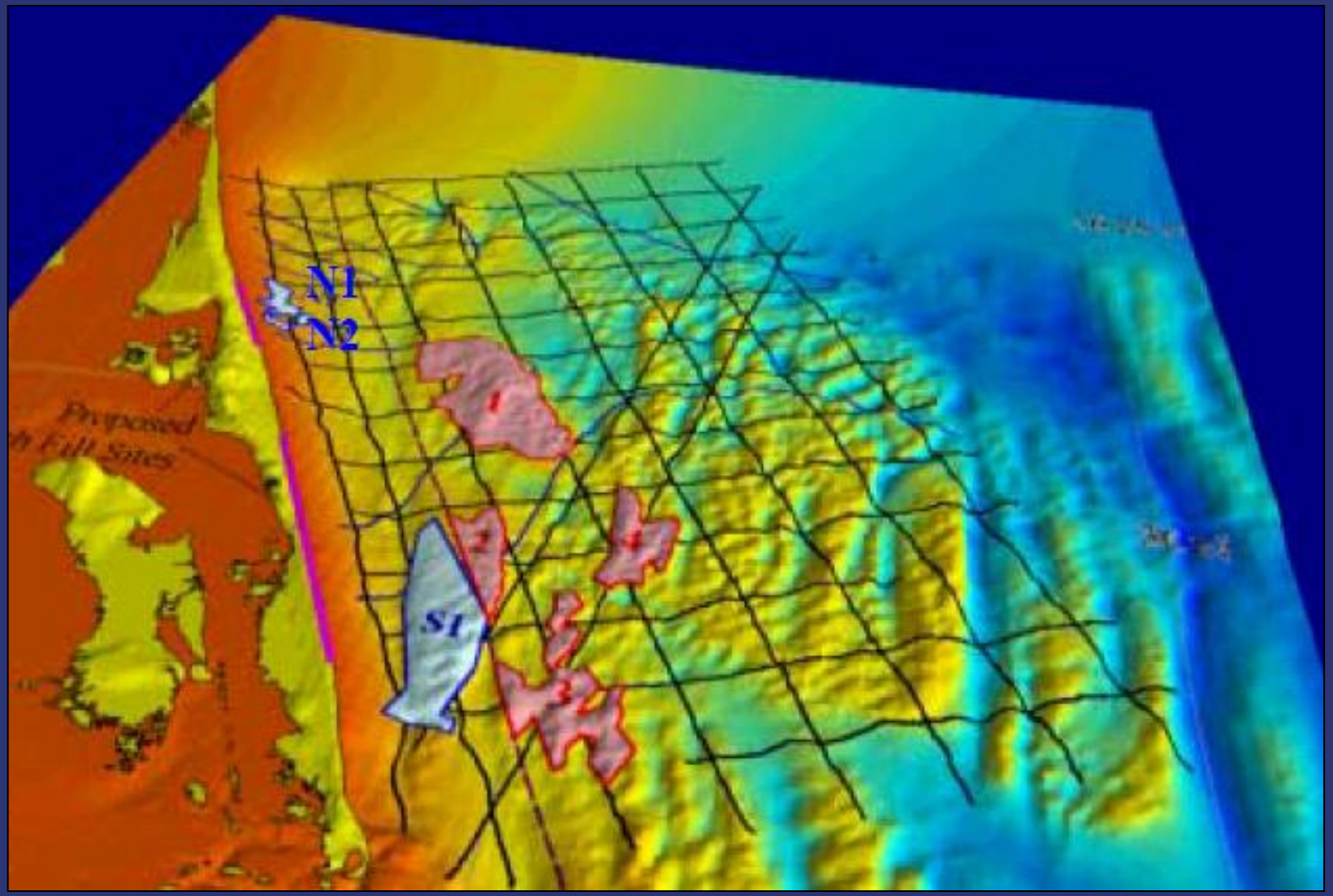


Sand Sources



(Boss & Hoffman, 2001)

Sand Sources



(Boss & Hoffman, 2001)

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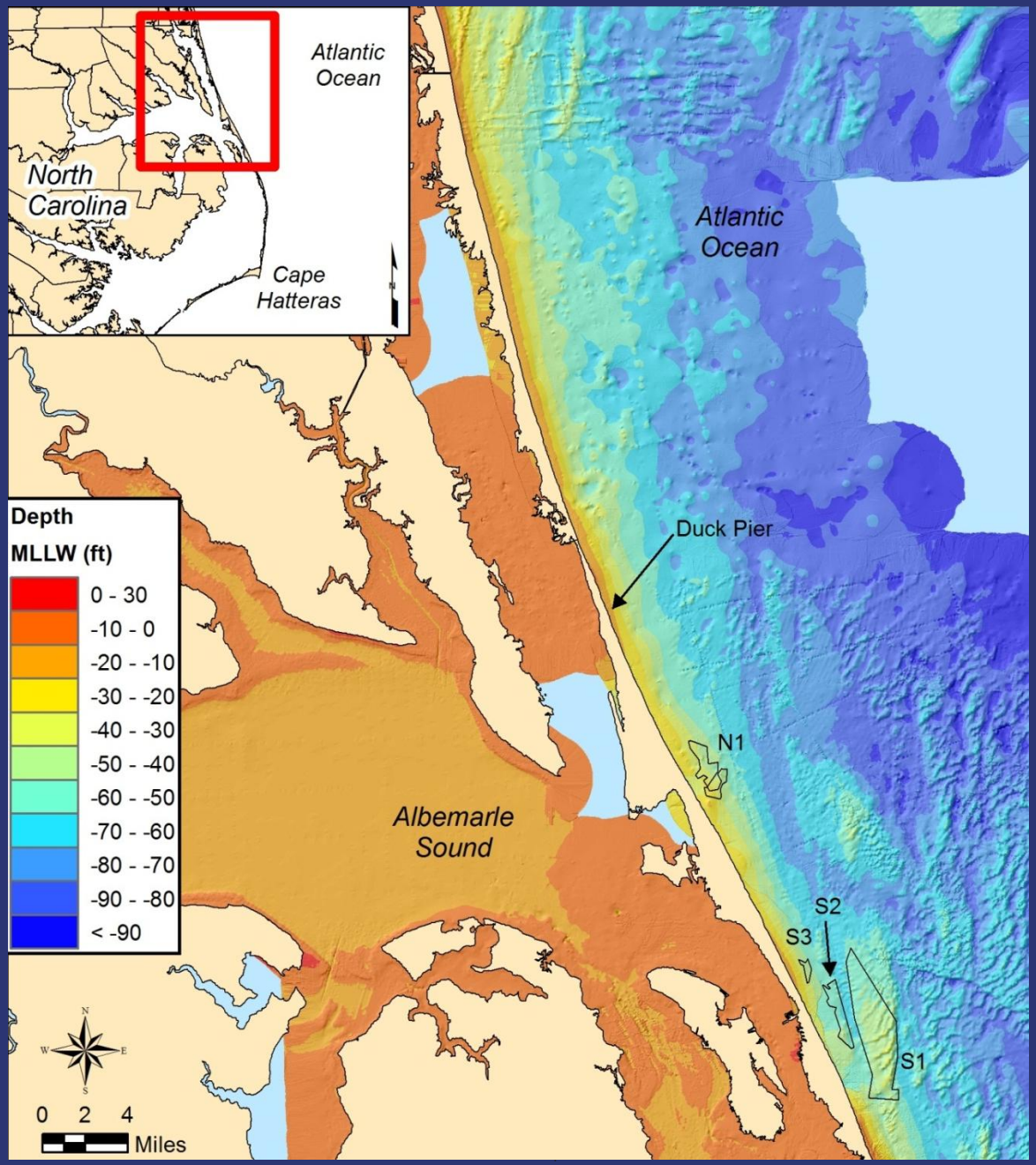

Deliverables:

- **Report to be submitted to Town by March 29th**
  - **Final Updates to Conceptual Alternatives**
  - **Final Recommendations**

Conceptual Alternative Summary

Plan	Project Extent	Volume of Sand (CY)	Sand Source	Project Life	Cost (x $1,000,000)
Dune Replenishment	Segment 7 (5000 Feet)	30,000	Truck Haul	1 Year	**0.85**
Beach Replenishment	Segment 7 (5000 Feet)	60,000	Truck Haul	1 Year	**1.5 - 2**
Long-Term Erosion Mitigation Project	Segment 7 & 8 (13,000 Feet)	842,000	Offshore	5 Years	**11.35 - 14**
10 Year Storm Damage Reduction Project	Segment 7 & 8 (13,000 Feet)	1,610,000	Offshore	5 Years	**18.75 - 22.5**
20 Year Storm Damage Reduction Project	Segment 7 & 8 (13,000 Feet)	2,091,000	Offshore	5 Years	**23.35 - 27.75**
25 Year Storm Damage Reduction Project	Segment 7 & 8 (13,000 Feet)	2,313,000	Offshore	5 Years	**25.5 - 30.25**

Thank You For Your Time!!

Questions?

Ken Willson – Kenneth.Willson@CBI.com