

# Geospatial Management of Temporary Erosion Control Structures (Sandbags)

Along the Oceanfront Shoreline in North Carolina



Ken Richardson

North Carolina Division of Coastal Management

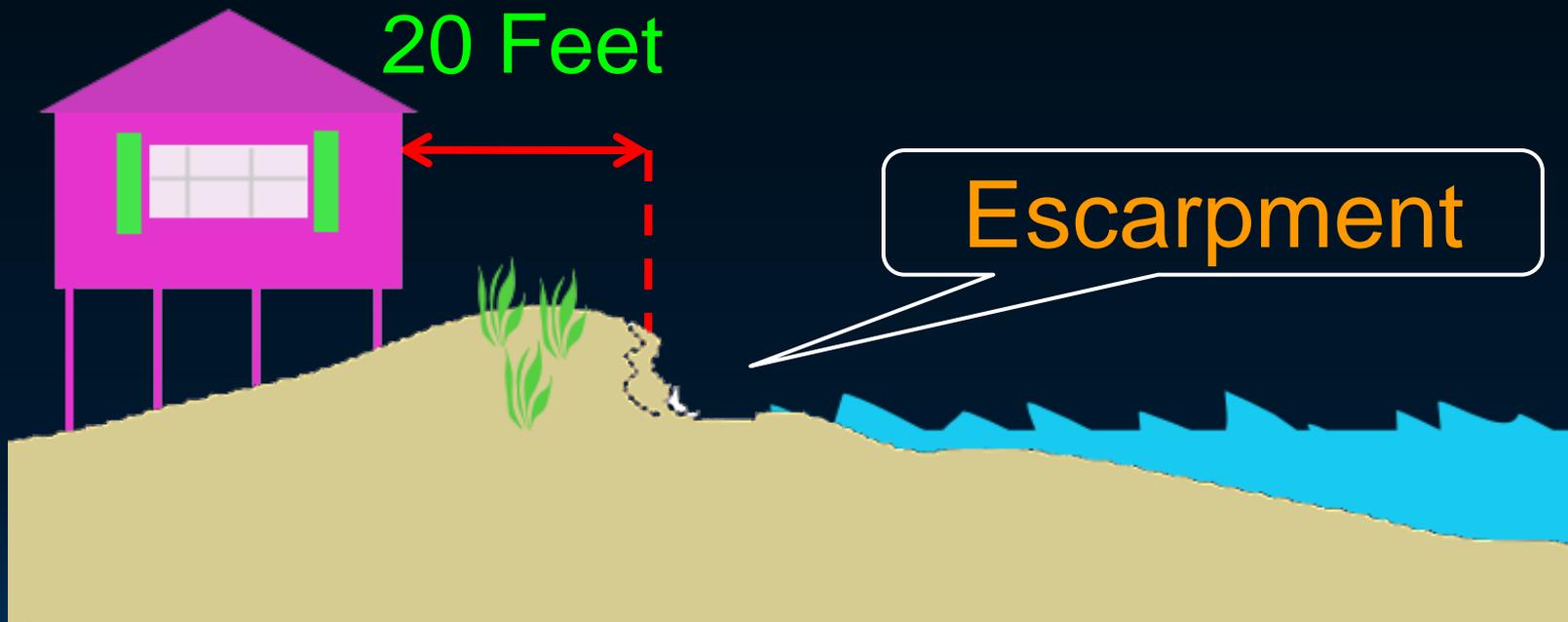
NOAA Coastal GeoTools – March 4, 2009

# Sandbags and the State

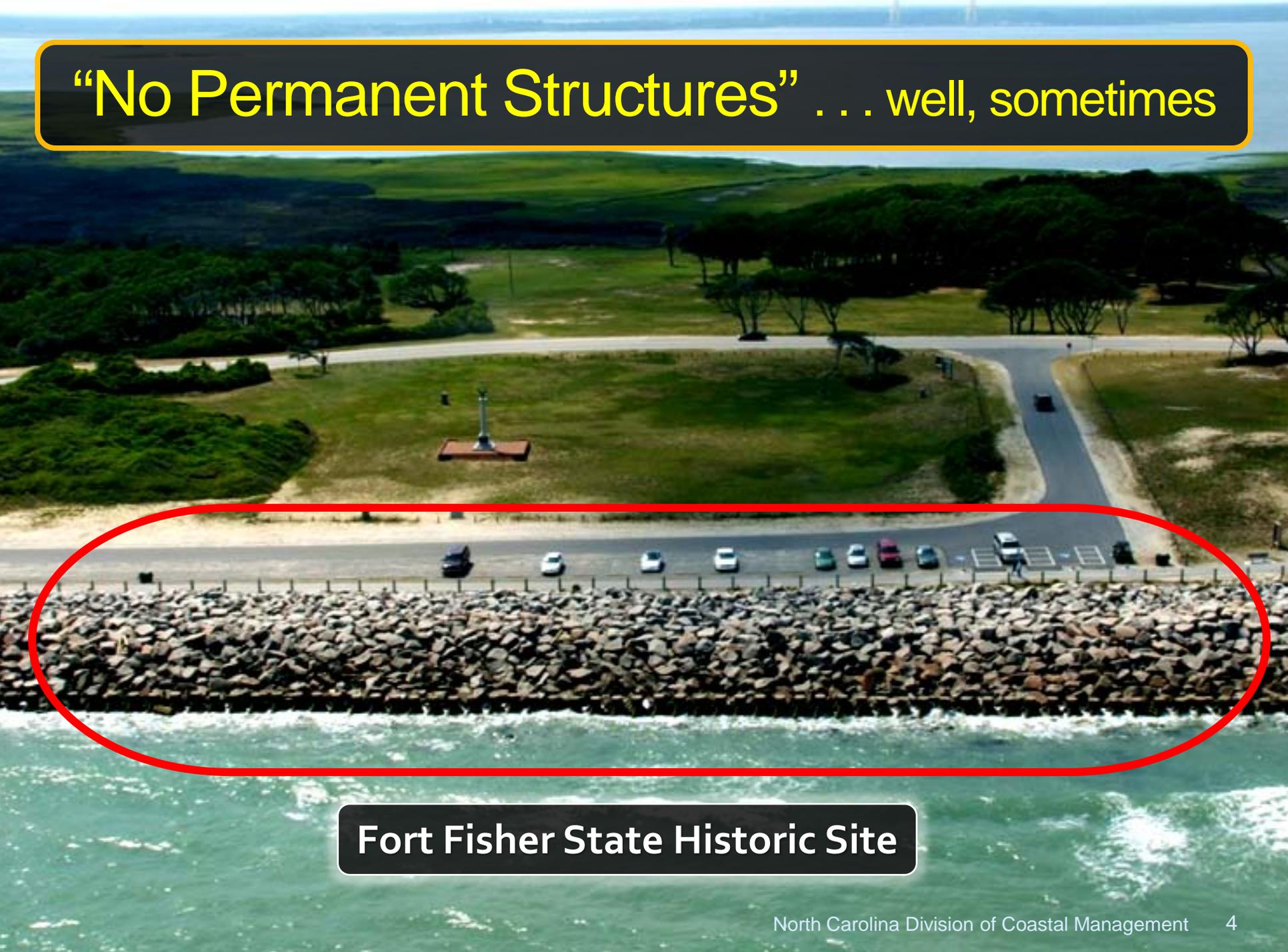
- 1984 – 1985 Oceanfront Erosion Control Rules Written
  - ❖ Permanent Structures - **No**
  - ❖ Temporary Structures - **Yes**
- 1987 – Sandbags, Sandbags everywhere
- 1990's – Communities Start Complaining

# Who Qualifies for Sandbags?

An oceanfront structure that is imminently threatened by erosion.



**“No Permanent Structures” . . . well, sometimes**

An aerial photograph of the Fort Fisher State Historic Site. The foreground shows the ocean with white-capped waves crashing against a long, low seawall made of large, dark grey stones. Behind the seawall is a paved road with several cars parked and a few people walking. The road curves to the right. In the background, there is a large, flat, green field with scattered trees and a small monument on a pedestal. The sky is clear and blue.

**Fort Fisher State Historic Site**

# Bonner Bridge Jetty at Oregon Inlet

## Southerly Migration Rates

**Since 1846 ~ 2.3 Miles  
Annual Average ~ 50 Feet**

Source: Cleary & Martin - 2001



# Fort Macon State Park

# “Temporary” Erosion Control - Sandbags

Define “Temporary”

<5,000 sqft  
2-Years

>5,000 sqft  
5-Years

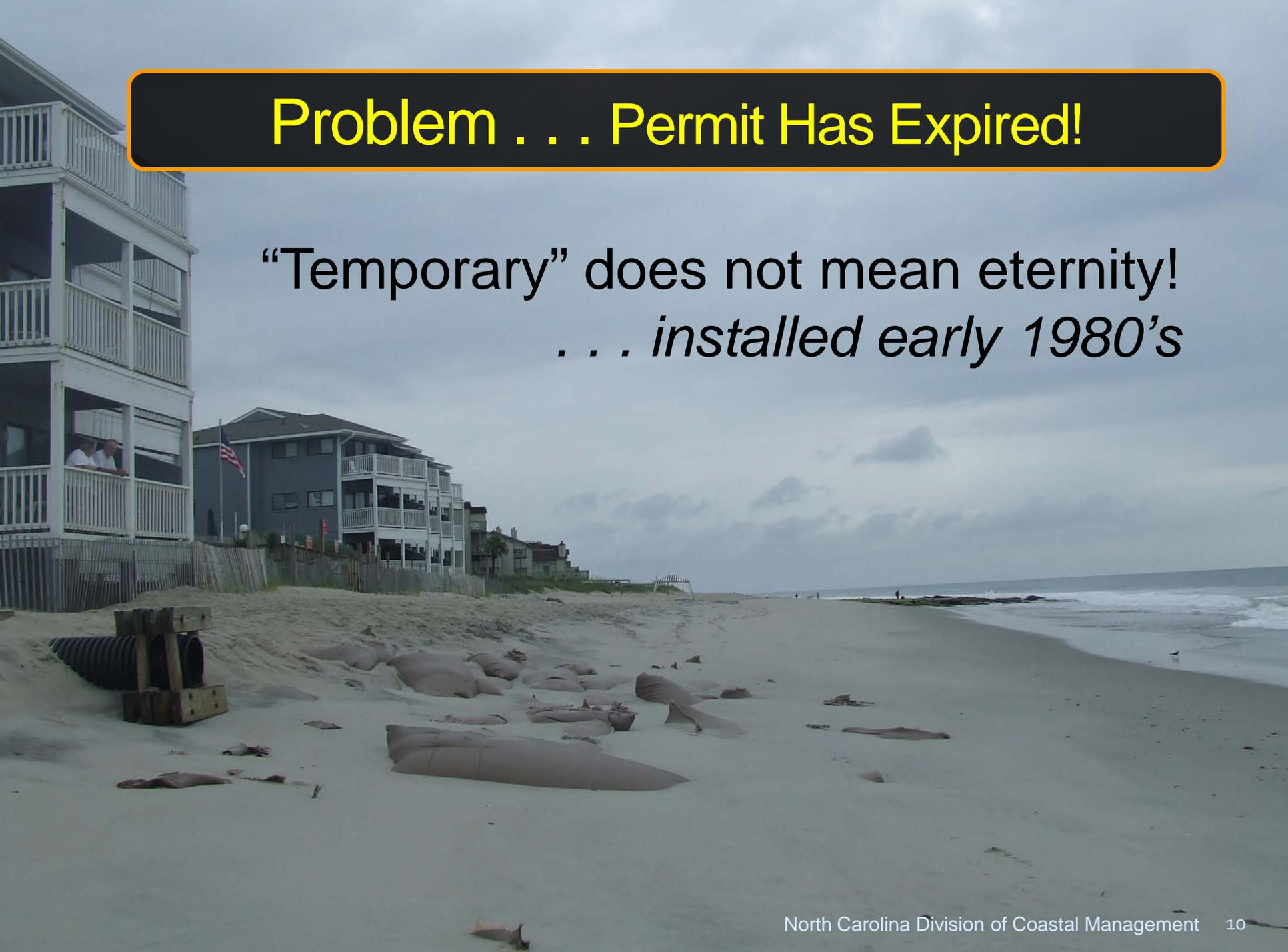
## “Temporary” – has a flexible history

- After Hurricanes Bertha & Fran (1996)
- Hurricane Bonnie (1998)
- Many variance requests (1999)
- Dare County Petition (2000) – extension expired May 2008



# Problem . . . Permit Has Expired!

“Temporary” does not mean eternity!  
. . . *installed early 1980’s*



# Summary of Problems

## Permits Expired

- Many are 10+ years old

## Impeding Public Access

- Users of the beach complain

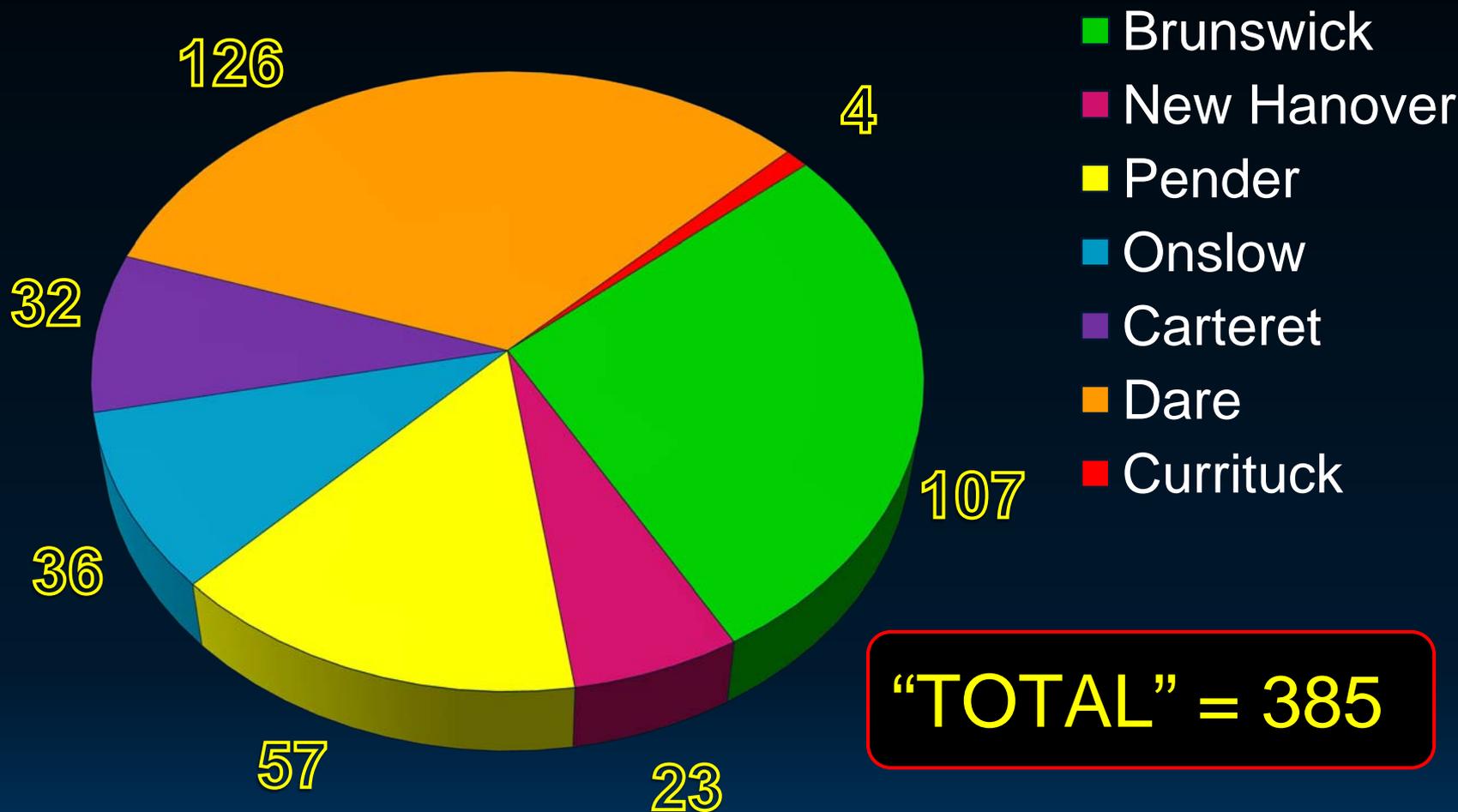
## Torn & Scattered

- Appearance
- Hazard



# May 2008 - Who is First?

## Permitted Sandbag Structures



# Are All Sandbags Created Equal?

Yes

- When permitted

*Is it time for some to go?*

Yes

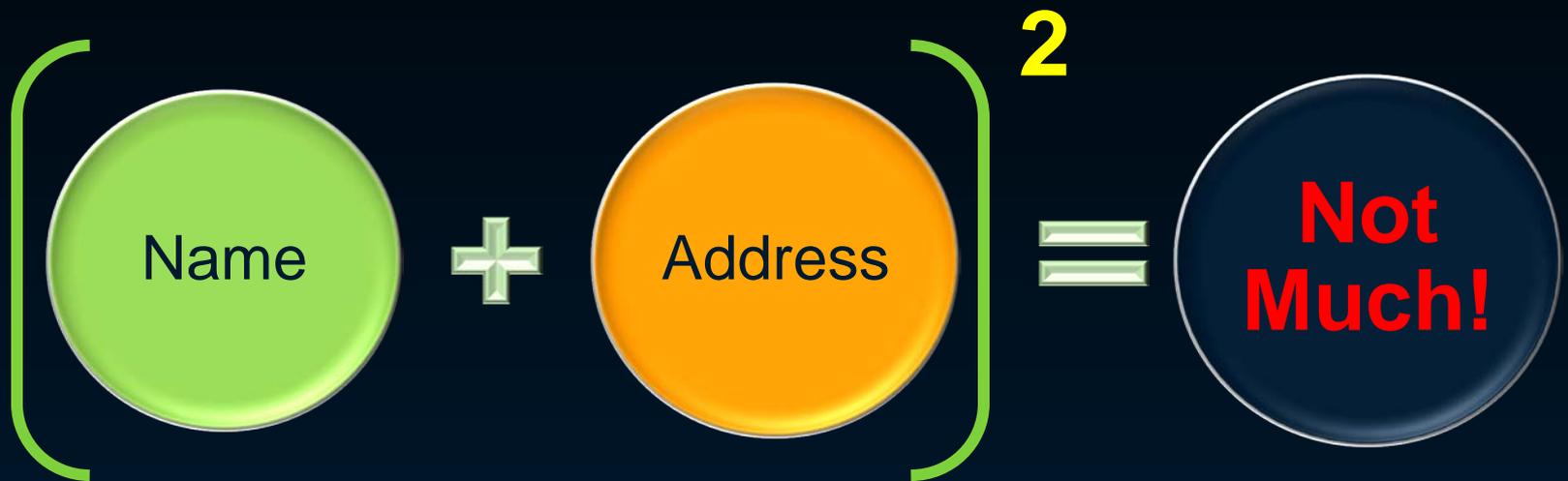
- May 1, 2008

*Can we make an impartial decision?*

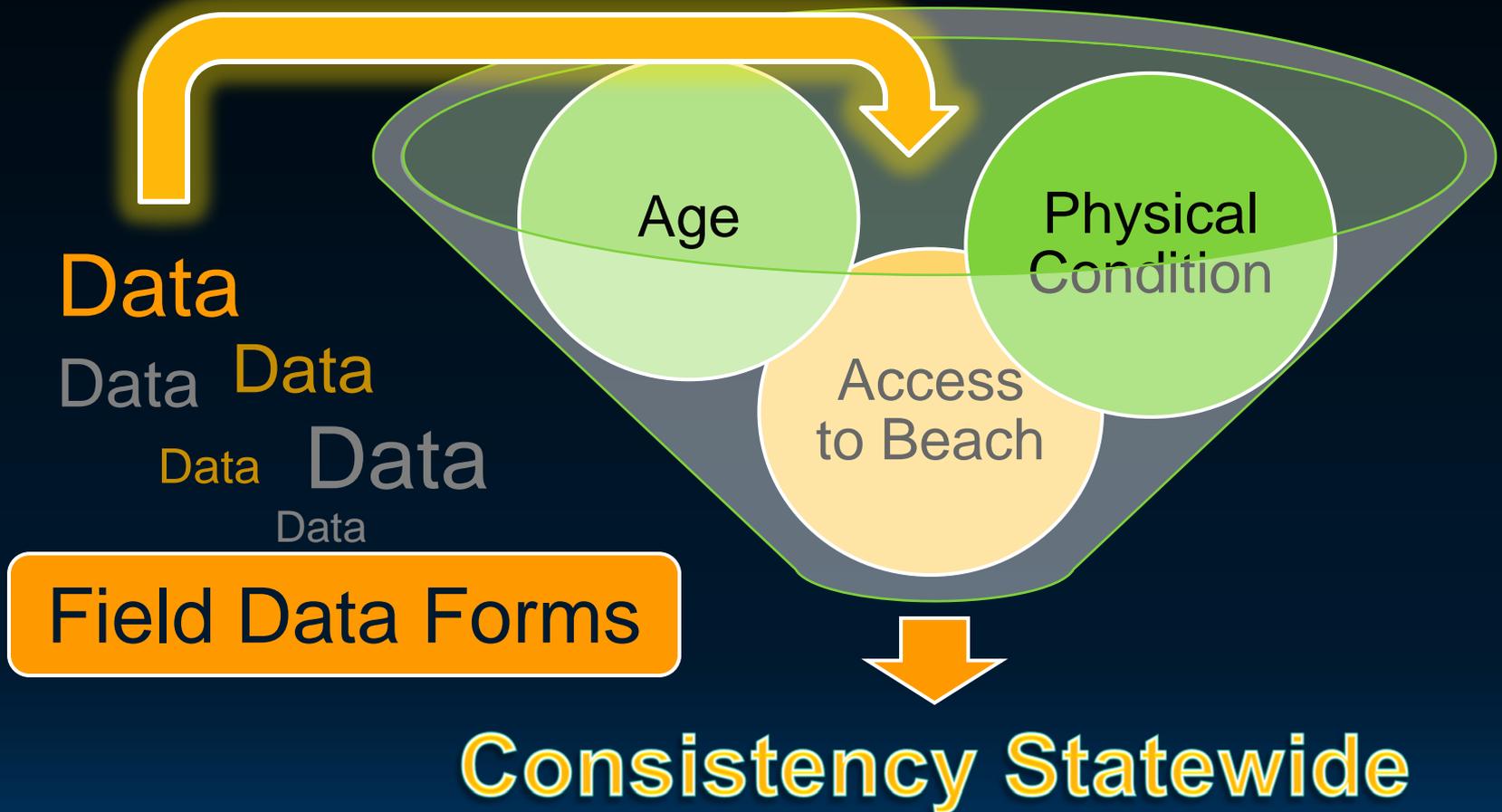
No

- Not enough data

# Well . . . What Data Do We Have?



Acquire Data . . . . By the way, did I mention we needed it yesterday!



# Field Data Forms

## Bags Sand-Covered %

Example Field Values

0 - 19.9% = 1

20 - 39.9% = 2

40 - 59.9% = 3

60 - 79.9% = 4

80 - 100% = 5

# Data Processing

Field Data Entry

UNIQUE\_ID

233

234

235

GPS Rover Files  
Corrected

UNIQUE\_ID

233

234

235

Join

Now We Have  
Data!

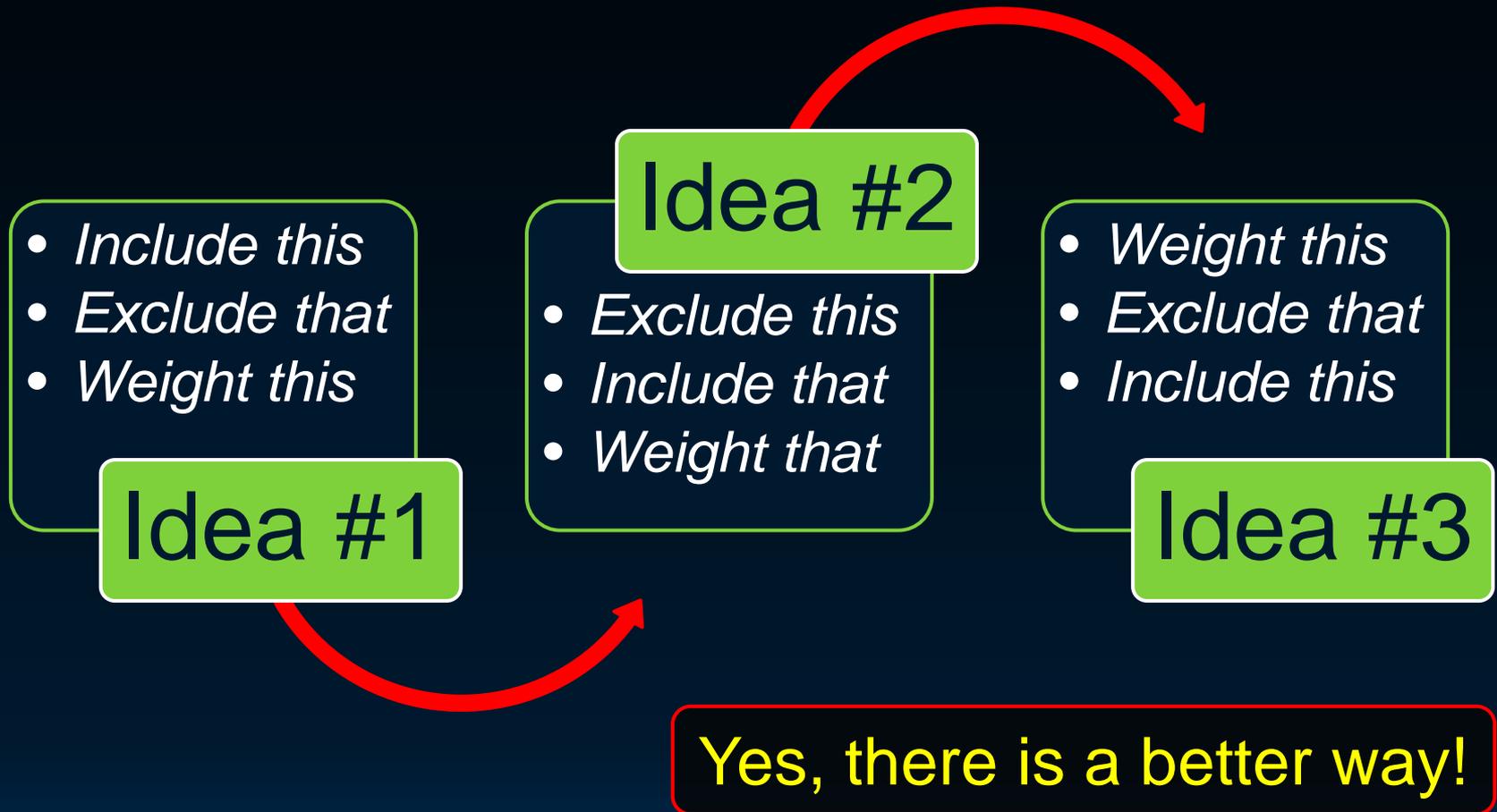
# Sandbag Removal Index (SRI)

Weight  
Attributes

$$\text{SRI} = [(\text{COL\_D} * 4) + (\text{COL\_E} * 3) + (\text{COL\_F} * 2) + (\text{COL\_G} * 1.5)] * (\text{COL\_P}) * (\text{COL\_H}) * \dots$$

UNIQUE_ID	COL_X	COL_Y	SRI
233	1	1	85
234	2	0	320
235	1	1	0
236	4	1	100
237	3	1	70

# Excel Spreadsheet Madness



# Time to Create a Decision Support Tool

IWorkspaceFactory

```
Set pFeature = pFeatureUpdate.NextFeature
Do Until pFeature Is Nothing
```

IQueryFilter

```
pFeature.value = (dbIFValue * d_weightF) + (dbIHValue * d_weightH) + (dbIJValue * d_weightJ) + (dbILValue * d_weightL) + (dbINValue * d_weightN) + (dbIPValue * d_weightP) + (dbISValue * d_weightS) + (dbITValue * d_weightT) * dbIXValue * dbIYValue
```

IFeatureCursor

```
pFeature.value(txtSRlvarFld) = strSriD & strSriF & strSriH & strSriJ & strSriL & strSriN & strSriP & strSriS & strSriT
pFeature.value(txtSRlvarweightFld) = strsrilw & strsrinw & strsrilpw & strsrilsw
```

IStatisticsResults

```
pFeatureUpdate.UpdateFeature pFeature
Set pFeature = pFeatureUpdate.NextFeature
Loop
```

# SRI Calculator - ArcGIS 9.3 (VBA)

**SRI Weight Selector**

**Sandbag Removal Index (SRI) Attribute & Weight Selector**

select SRI calculator

Use PreSet Calculator  Use Custom Calculator

select from the following attributes:

YES	NO	
<input checked="" type="checkbox"/> All	<input type="checkbox"/> All	
<input checked="" type="radio"/>	<input type="radio"/>	<b>Bag Exposure</b>
<input type="radio"/>	<input checked="" type="radio"/>	Vegetation Cover
<input type="radio"/>	<input checked="" type="radio"/>	Beach Access Impedance
<input checked="" type="radio"/>	<input type="radio"/>	<b>Sandbag Integrity</b>
<input checked="" type="radio"/>	<input type="radio"/>	<b>Age of Sandbags</b>
<input checked="" type="radio"/>	<input type="radio"/>	<b>Structure Protected (type)</b>
<input checked="" type="radio"/>	<input type="radio"/>	<b>Ownership</b>
<input type="radio"/>	<input type="radio"/>	Proximity to IHA
<input checked="" type="radio"/>	<input type="radio"/>	<b>Planned Beach Fill</b>
<input checked="" type="radio"/>	<input type="radio"/>	<b>Planned Inlet Relocation</b>

enter weight values between 0 - 100

WEIGHT	
0 - 100	
<input type="text" value="50"/>	<b>Bag Exposure</b>
<input type="text" value="0"/>	Vegetation Cover
<input type="text" value="0"/>	Beach Access Impedance
<input type="text" value="25"/>	<b>Sandbag Integrity</b>
<input type="text" value="10"/>	<b>Age of Sandbags</b>
<input type="text" value="2"/>	<b>Structure Protected</b>
<input type="text" value="4"/>	<b>Ownership</b>
<input type="text" value="0"/>	Proximity to IHA
<input type="text" value="5"/>	<b>Planned Beach Fill</b>
<input type="text" value="4"/>	<b>Planned Inlet Relocation</b>

Clear All

info

**Integrity of sandbag structure will be weighted**

**This variable represents the physical condition of sandbag structure**

**These are associated attributes:**  
[INTEGRITY], [L\_VALUE], [L\_NORM]

[INTEGRITY]  
(Compliant) structure intact  
(Non-Compliant) some damage semi-functional  
(Derelict) structure completely damaged and disfunctional

[L\_VALUE]  
(0) = Compliant  
(1) = Non-Compliant  
(2) = Derelict

[L\_NORM]  
represent [L\_VALUE] normalized (0-1)

Calculate SRI

Close

SRI Calculator (beta) v1.0 developed by NC DENR - Division of Coastal Management - Ken Richardson - 02/19/2009  
400 Commerce Ave, Morehead City, NC 28557 | ken.richardson@ncmail.net

1

2

3

Information

Select Attributes

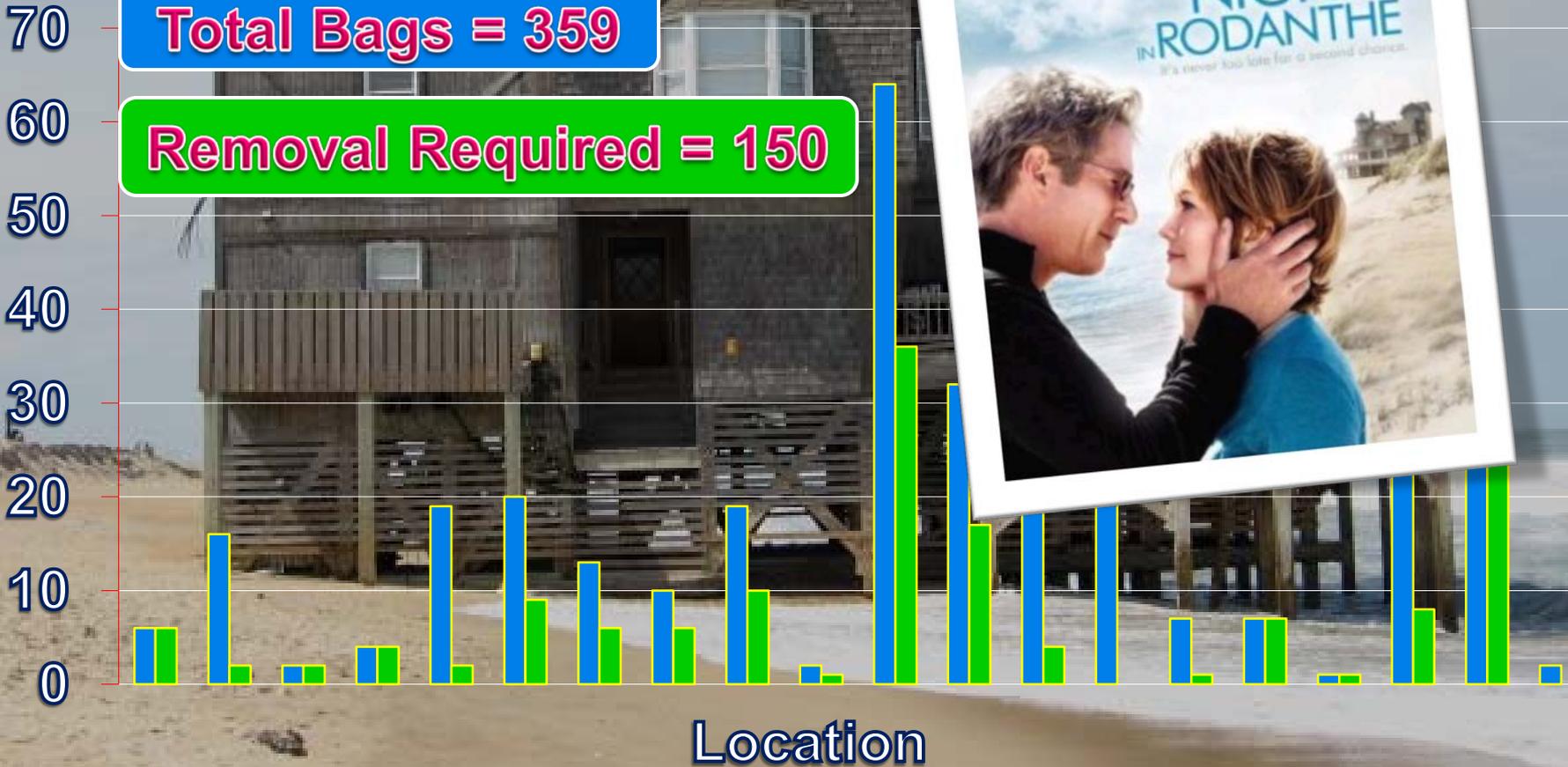
Assign Weights

Calculate!

# Results Are In

**Total Bags = 359**

**Removal Required = 150**



# Data Presented – Letters in the mail



**Oceanfront Sandbags**



Site ID: 215  
Permit No: 13355  
Permit Issued:  
12/31/1994  
Age of Bags: 13.4  
(years)

US 421, Riggings Condominiums, Kure Beach  
[more images . . . image 2, image 3](#)  
[NC Division of Coastal Mgmt. - 2008](#)

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## Current Status

- ✓ Data are made public
- ✓ Notices have been received by homeowners
- ✓ Will sandbags be removed?

Legal + Politics + Mother Nature + Economy = ?

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North Carolina Department of Environment and Natural Resources

# DCM Division of Coastal Management

## Oceanfront Sandbags:

**A Ocean Isle**  
[More results](#) [Clear results](#)  
 Ocean Isle, NC

**Oceanfront Sandbags**



Site ID: 101  
 Permit No: 43909D  
 Permit Issued: 2/8/2006  
 Age of Bags: 2.4 (years)

458 East 2nd Street, Ocean Isle Beach  
[more images](#) . . . [image 2](#), [image 3](#)  
 NC Division of Coastal Mgmt. - 2008

Map Layers (on/off)

- Sandbags:
- Static Vegetation:
- Static Setback:
- IHA (Current):
- IHA (Proposed):

*Legend*

[View Sandbags in Google Earth](#)

NOTE: Although the Division's data are considered accurate, this map should be used for informational purposes ONLY and not authoritative in any manner. For site-specific questions contact your nearest DCM office.

Due to differing *map projections*, certain Google Map layers may NOT align appropriately with DCM's data. Use with caution!

The Proposed Inlet Hazard Area (IHA) shown in this map is in "working-form" and is subject to change without notice (01/26/2009).

N.C. Division of Coastal Management . 400 Commerce Ave . Morehead City, NC 28557  
 1-888-4RCOAST . Email Us

Meanwhile

Google Map

ArcIMS

Data Download

<http://www.nccoastalmanagement.net>

# Questions



Photo by: Robbie Johnson