Beach-Dune System Susceptibility Assessment
New Jersey Coastline

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Beach Dune Susceptibility Assessment
The GIS-based beach-dune system susceptibility assessment began in 2007 to evaluate the performance potential of the oceanfront beach-dune system, identifying weaknesses in the system and highlighting areas that may be vulnerable to storm damage.

The assessment has been performed for all of Ocean County and Brigantine Island. Future assessments will include Cape May County and selected portions of Monmouth County.

Each assessment includes:

- An electronic susceptibility report
  - Web based report summarizing methodology and the results
- An electronic data package
  - All developed digital data (GIS shapefiles, metadata, geodatabases)
- Physical and electronic maps –
  - Three to five maps illustrating the results (42” x 112”)

Summary of the Assessment
How can the Assessment be utilized?

- Highlight potential problem spots in the beach-dune system

- Make more effective and efficient use of taxpayer money and municipal resources by focusing dune maintenance and enhancement activities in areas of need

- Improve protection of beach-front homes and back-beach properties

- Evaluate the effectiveness of previous maintenance and enhancement efforts

- Aid in the enforcement of dune and shore-zone ordinances and regulations

- Aid in emergency and rapid-response planning using the prediction of where dunes are more likely to fail from severe storm activity

- Justify the preservation of a beach and dune environment that is aesthetically appealing to beach-goers.
Incorporates advanced spatial analytical techniques
- GIS (Geographic Information Systems)
- LiDAR (Light Detection And Ranging) data
- Photogrammetry (Use of vertical aerial photography to perform analysis)
- RTK-GPS surveying (verification)

Utilizes the knowledge and expertise of CRC staff experience
- Storm Survey experience (39 years)
- NJBPN (24 years)

Post storm surveys and analysis
- RTK-GPS and Total Station Survey of storm damage and calculation of sand losses create a real-life testing of the assessments validity and facilitates improvements in methodology and technique.
• Incorporates advanced spatial analytical techniques
  • GIS (Geographic Information Systems)
• Incorporates advanced spatial analytical techniques
  • **LiDAR (Light Detection And Ranging)**

• **LiDAR is the key component to the Beach Dune Assessment**
  • LiDAR for the entire coastal region is currently only available for 2000 & 2005
  • Used to make 3D surfaces of the beach-dune system
  • Many of the major datasets used in the assessment are derived using LiDAR.
• Incorporates advanced spatial analytical techniques
  • Photogrammetry (Use of vertical aerial photography to perform analysis)
• Incorporates advanced spatial analytical techniques
  • RTK-GPS surveying (verification)
    • Dune Delineations
    • Vegetation
    • Storm Damage
• **Beach Dune Assessment** incorporates *US Army Corps of Engineers SBEACH (Storm-induced Beach Change)*
  - Simulates storms for 2-year, 5-year, 10-year, 20-year, 50-year storm events using Federal Emergency Management Association (FEMA) based storm parameters
  - Beach dune assessment extracts profiles from LiDAR and runs them through SBEACH+

• **SBEACH storm simulations** provide a real comparison value to fuzzy susceptibilities…
  - Projects dune recession
  - Volume change
  - Dune breach vulnerability points

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![Beach Dune Assessment Diagram](image-url)
• Post storm surveys and analysis
  - RTK-GPS and Total Station Survey of storm damage and calculation of sand losses create a real-life testing of the assessments validity and facilitates improvements in methodology and technique.
Post storm analyses will help evaluate the accuracy of the dune assessment model. Calculating actual dune loss after large storm events will help test and improve future versions of the dune assessment.

Sequence of pictures taken over 2009 into 2010. Notice the position of the large bush in each of the three photos.
General Concepts – Fuzzy Logic

• The Logic of Approximate Reasoning…
  Similar to uncertainty in human experiences
  • Alternative to traditional notions of "crisp" logic (true / false; yes / no)

• Can Express Partial or Intermediate “Truth” of a Hypothesis
  • Elements Have Partial, or Degrees, of True-False “Membership”
  • Membership assigned, or calculate by some mathematical function

• To what degree is something True or False?
Extent of NJ State-Wide Dune Assessment

Northern Ocean County
Manasquan Inlet to Barnegat Inlet
Completed May 2007

Long Beach Island
Barnegat Inlet to Little Egg Inlet
Completed June 2006

Brigantine Island
Little Egg Inlet to Absecon Inlet
Completed Summer 2010

Absecon Island
Absecon Inlet to Great Egg Inlet
Completed Winter 2010-2011

Cape May County (5 Separate Islands)
Great Egg Inlet to Cape May Point
To Be Completed Fall/Winter 2011-2012
• CRC pilot dune assessment (2007)
  • Focused on dune recession
  • Consisted of 490 250-ft wide bins
  • Used susceptibility strips representing best and worst case scenario

10-Year Storm Event
20-Year Storm Event
50-Year Storm Event
Beach Dune Susceptibility Assessment

Beach-Dune Susceptibility Verification Northern Ocean County

High...

Medium...

Low...
• Completed in (2009)
  • Focused on changes in dune volume as opposed to recession
  • Consisted of 439 250-ft wide bins
  • Used susceptibility strips representing 2.5, 10, 20, and 50 yr storms
  • Included pre and post beach fill beach-dune analysis
November 2009 Northeast Storm - NJ

- Tropical Depression Ida combines with a coastal low to form Northeast storm
  - Four day storm event
  - Wind gusts 30-40 mph
  - Near-shore swell heights exceeding 14 ft.

Satellite view of storm formation

Storm track illustrating rainfall from the remnants of Hurricane Ida combining with a coastal low off the Atlantic Coast
Disaster Summary for FEMA -1867-DR, NJ

- **Declaration Date:** 12/22/2009

- **Incident Type:** Severe Storms and Flooding Associated with Tropical Depression Ida and a Nor’easter

- **Incident Period:** Nov 11-15, 2009

- **Public Assistance:** Atlantic, Cape May and Ocean Counties. Direct Federal assistance is authorized.

- **Note:** The 11/2009 Storm was classified as approximately a 10-year storm event
Beach Dune Susceptibility Assessment

Harvey Cedars, Long Beach Island, NJ - 1962 Storm

March 8th, 1962

Dune System Breach & Overwash

0 0.125 0.25 0.5 0.75 1 Miles

Fall 2003

Prepared by: The Richard Stockton College of New Jersey, Coastal Research Center, July 2008
Completed in (2010)

- Focused on changes in dune volume
- Consisted of 126 250-ft wide bins
- Used susceptibility strips representing 2-, 5-, 10-, 20-, and 50 yr storms
- Included pre and post beach fill beach-dune analysis
Central Region:
- Hotel Region is the major area of concern. The lack of a dune system coupled with considerable wind deflation, make this a very susceptible area.

Southern Region:
- Severe scarping occurs but no significant breaching occurs in a major storm event.

Northern Region:
- Seawall built in 1996 as a result of long-term erosion, any dune system is problematic. North of this is the Forsythe Wildlife Preserve.
Surf City, Long Beach Island, NJ

Dune Crest-Axis Elevation…
Before and After Replenishment

Surf City
Zonal
Analysis
Bins

Dune and Beach Elevation…
Before and After Replenishment
Surf City, Long Beach Island, NJ

Dune and Beach Erosion Before and After Replenishment
Harvey Cedars, Long Beach Island, NJ
Future of the Beach-Dune Susceptibility Assessment

- Future assessments will include Cape May County and selected parts of Monmouth County.
- Minor changes in methodology and results in response to feedback.
- New LiDAR and aerial photography will enhance future analysis and allow for reconnaissance studies.

Other Potential future research analyses stemming from the Assessment

- Socio-Economic impact studies
  - Combine storm susceptibilities with storm relates economic impacts.
- Flood Mapping
  - Combine beach-dune failure points with flood prone areas.
Thank You... Questions?
Comments?

The Richard Stockton College of New Jersey Coastal Research Center
www.stockton.edu/crc