# The Economics of Coastal Erosion: Risks, Costs, Strategies



**ASCE EWRI Annual Water Resources Seminar**
**April 8, 2016**

# Risk Tolerance

- Do we want to know the answers?
  - Equity and sustainability implications
- Are we committed to transparency?
  - All options have to be on the table to gauge the relative benefits of any particular approach to resiliency
- Are we asking the right questions?
  - Need sound analysis & good data
- Magnitude of risks
  - Relative to benefits that are vulnerable

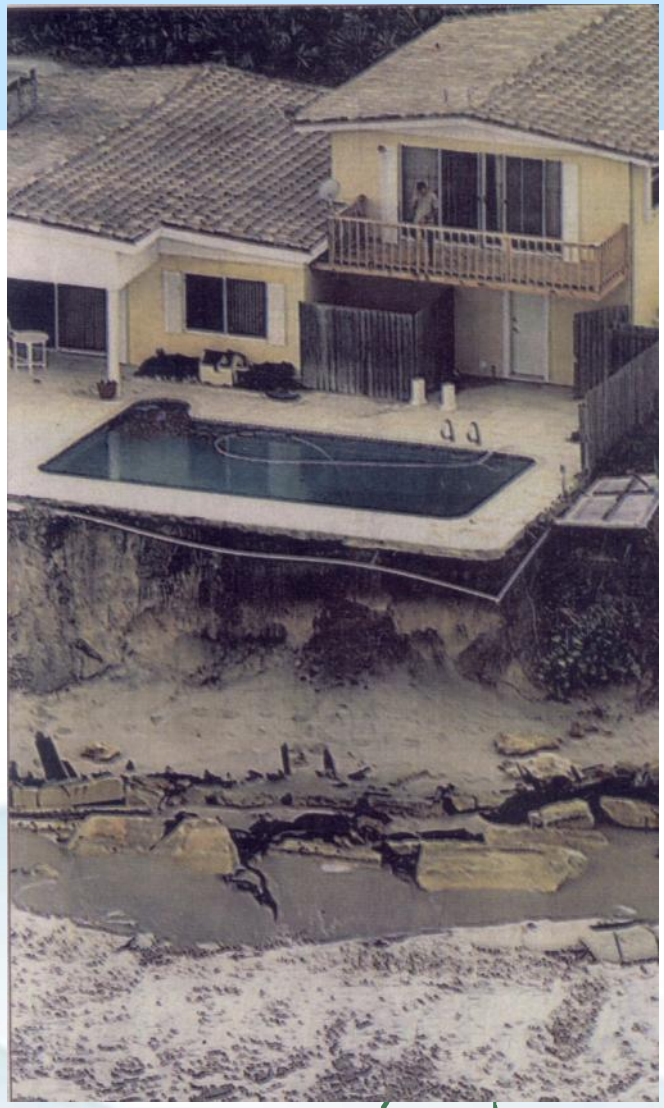
# Risk-aware vs. Risk-averse

- Changing the dialogue
  - Research has found that public works directors and water utility managers among the most risk-averse individuals (for good reason)
  - Adopting public health approaches to risk analysis strategies and techniques
    - Identify the issues, quantify likelihood and degree of impact, prepare
  - All engineering estimates have risk; climate change is another risk

# Transparency

- Are we ready to look in the basement?
  - Political expediency
  - Resiliency requires acknowledging the issues
- Honesty in options at hand
  - Risk-aware vs. Risk-averse
  - Compare a full deck of cards

# Transparency



# Resiliency Options

- Ownership Based Strategies
  - Conservation/rolling easements
  - Land buy-outs/Planned Retreat
- Incentive Based Strategies
  - Transfer/purchase development rights
- Beach Nourishment
- Armouring/Sea Walls
  - Elevating infrastructure (Seattle model)

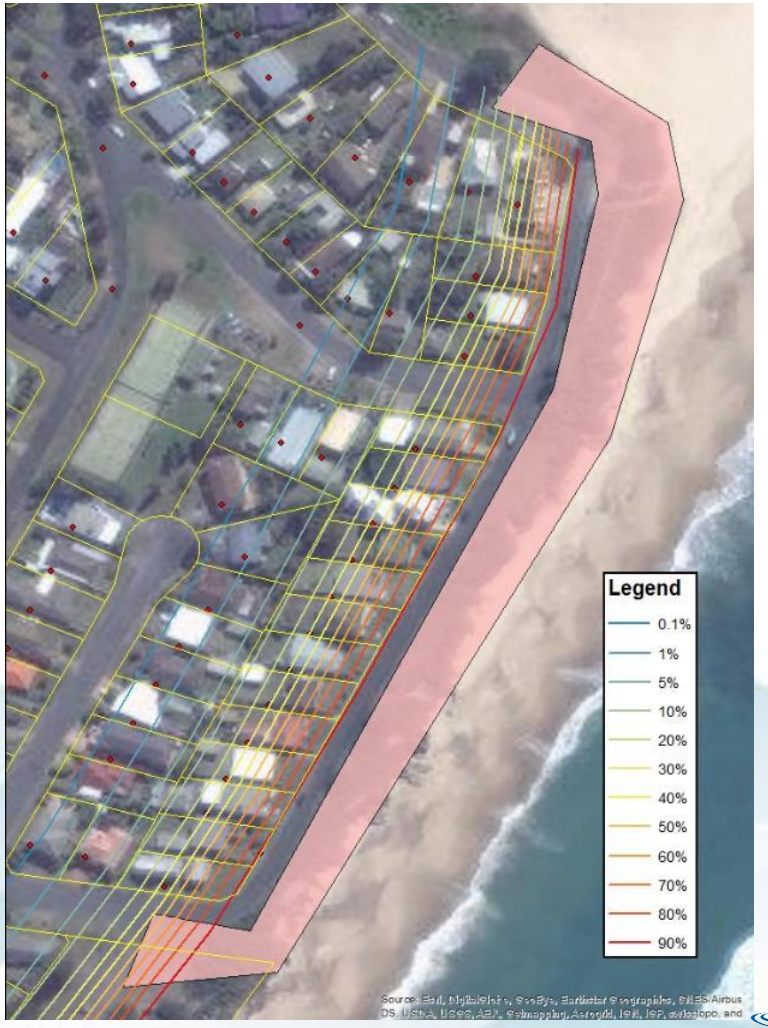
# Robust analysis

- Engineering analysis
- Experienced coastal engineers needed to assess location-specific risks
  - Need sound analysis & good data
  - Hydrogeology and wave energy are different in each community
  - Can’t simply move up to the next contour

# Robust analysis of risk/hazards

Hazard lines

Probabilistic Risk Profiles



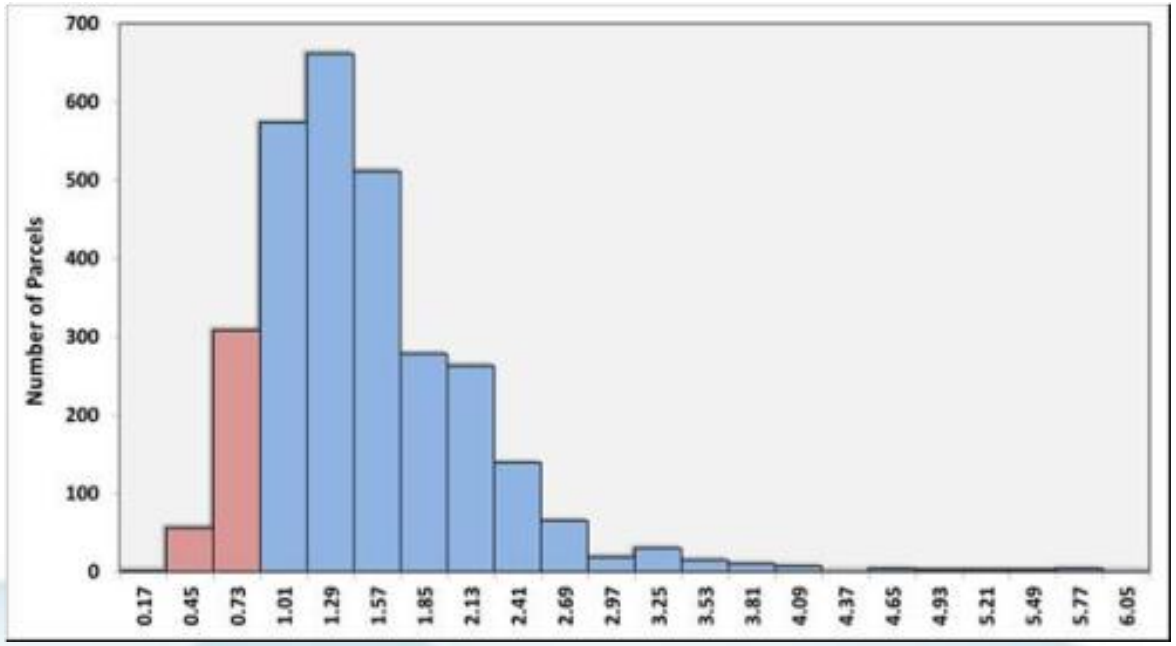
# Robust Analysis

- Economic Analysis
  - Averages mask important outcomes
- Public values for environmental and social amenities
  - Community uses: intangible value of “beach town”
- Experienced economists needed to assess nuanced impacts of alternative strategies
  - Market response will reveal externalities eventually

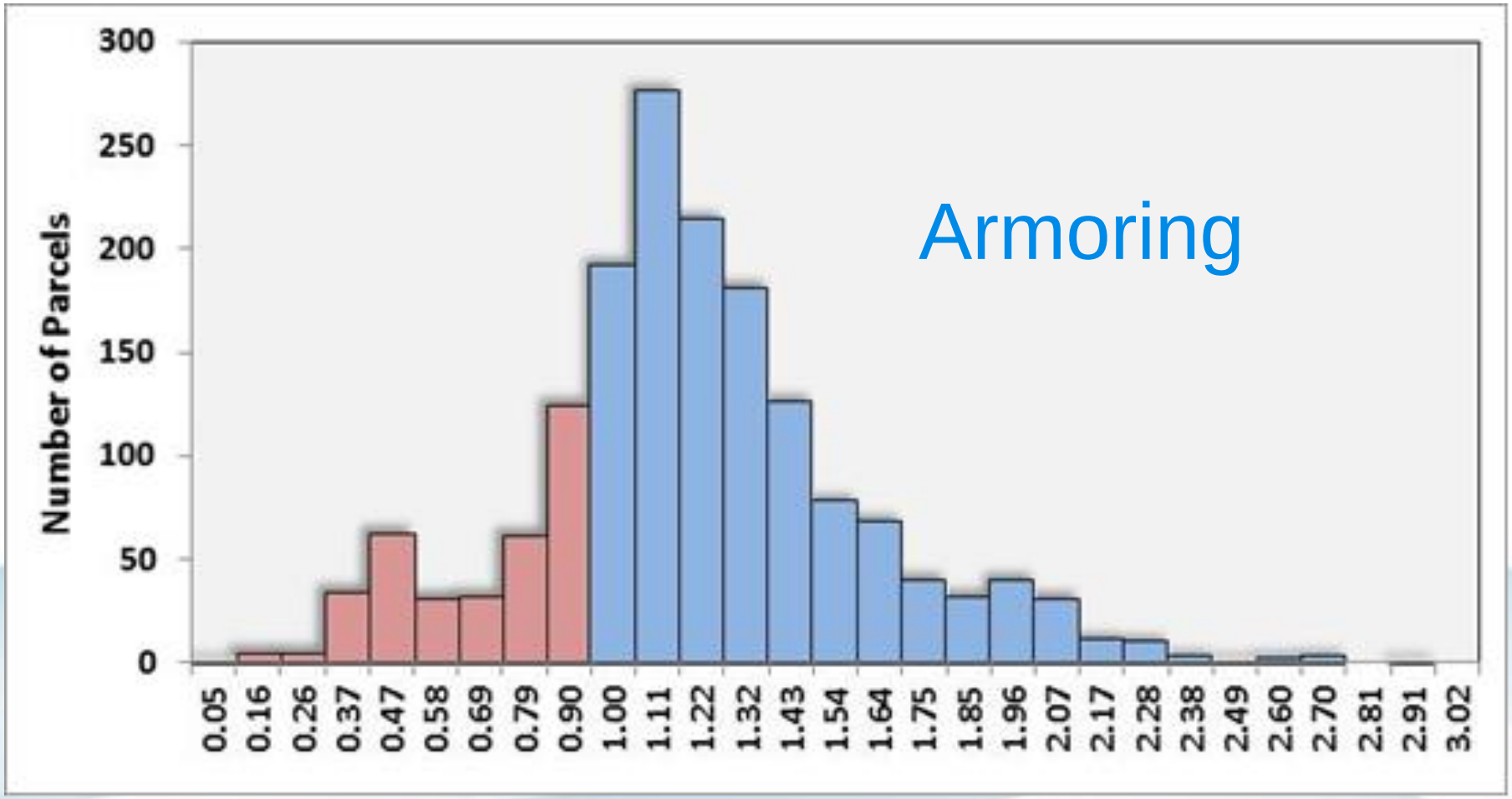
# Wide Variation in Results

- Averages mask important details
- The cost benefit ratio of Transfer of Development Rights (TDRs) for all parcels in Okaloosa County averages 1.69, while armoring averages 1.15
- Out of 3,000 parcels in the CHHA, TDR's are viable for all but about 350, while armoring is viable for 1,311

TDRs



# Wide Variation in Results



# Why This is Important Now

- Coastal changes over time reflect dynamic processes
- Impacts are place-sensitive; can't be generalized:
  - Infrastructure
  - Natural Resources
  - Private Assets
  - Quality of Life
- Shift the focus from costs to benefits

Using Army Corps line

| | Martin | | Okaloosa | |
|---|---|---|---|---|
| **Number of Cost-effective Strategies** | Current CHHA - Number of parcels | Future CHHA- Number of parcels | Current CHHA - Number of parcels | Future CHHA- Number of parcels |
| **0** | 14% | 86% | 3% | 74% |
| **1** | 8% | 3% | 9% | 2% |
| **2** | 29% | 5% | 27% | 4% |
| **3** | 34% | 6% | 41% | 13% |
| **4** | 14% | 1% | 18% | 5% |
| **5** | 0% | 0% | 1% | 1% |
| | 100% | 100% | 100% | 100% |

# Changing the Dialogue

1.1 – Base Case, Business as Usual
2.2 – Planned Retreat: Opportunistic Purchase
2.3 – Planned Retreat: Acquisition Yr 1
2.4 – Planned Retreat: Easement Acquisition Yr 1
3.1 – Beach Nourishment: Move PRP
3.2 – Beach Nourishment: Hold PRP
4.1 – Revetment
4.2 – Revetment & Limited Beach Nourishment
4.3 – Revetment & Beach Nourishment

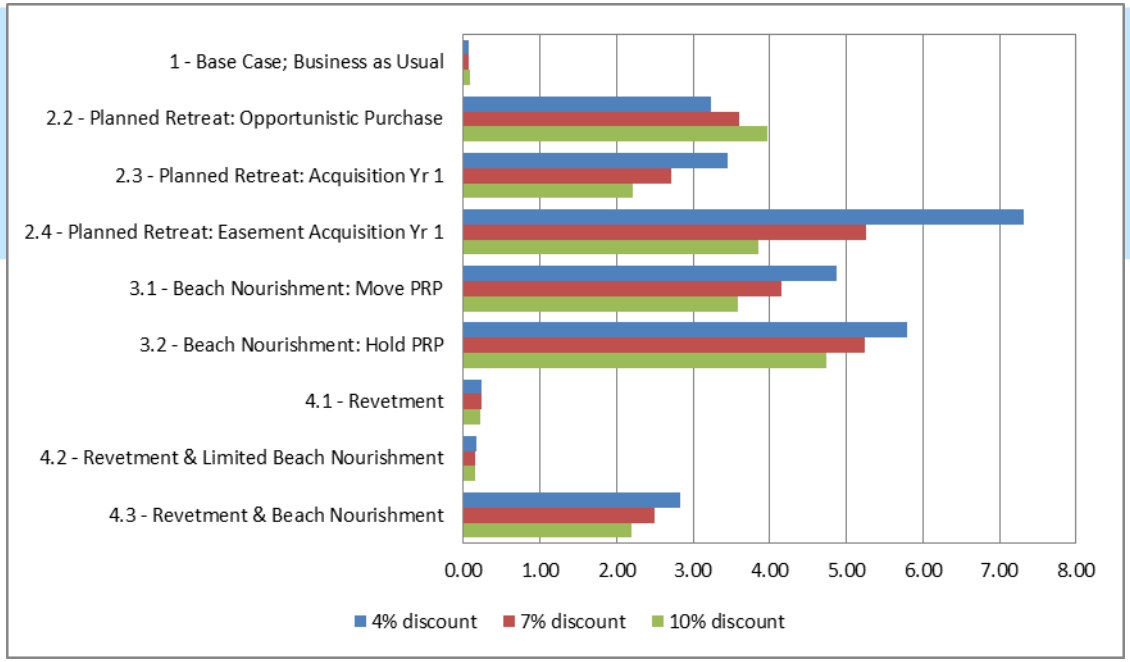
# Changing the Dialogue

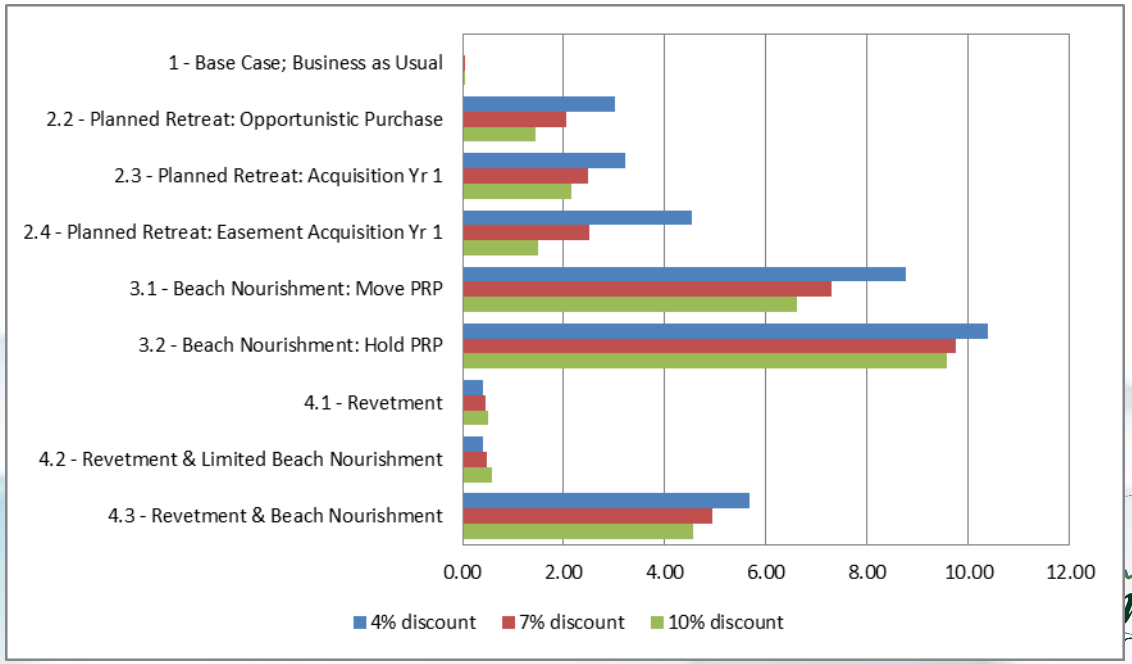
## Adaptive management

- Shifting costs into future budgets limits options available to future generations
- Helps establish current priorities for funding

## Equity and sustainability considerations

- Intergenerational transfers warrant different discount rates
- Different time frames for analysis



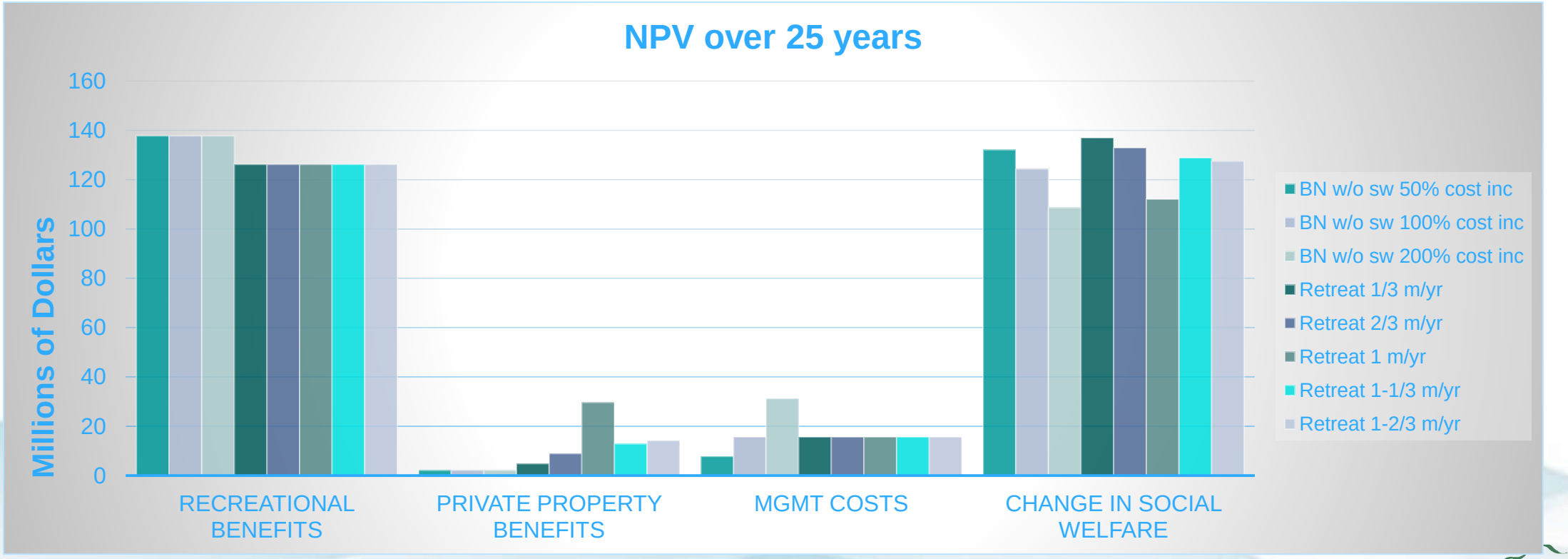



# Coastal Erosion Risks

- Perceived risk is spending money unnecessarily
- Actual risks are values that drive economy
  - Beach-related activity and commerce
  - Insidious costs –transportation routes, municipal services infrastructure, institutional assets
    - Increased Maintenance and Repair
    - Relocation of Coastal Infrastructure
    - Business interruptions
  - Increased materials costs
    - Enhanced drainage systems
    - Design Specs/Materials design to withstand adverse weather conditions

# Magnitude of Risks – Loss of Benefits

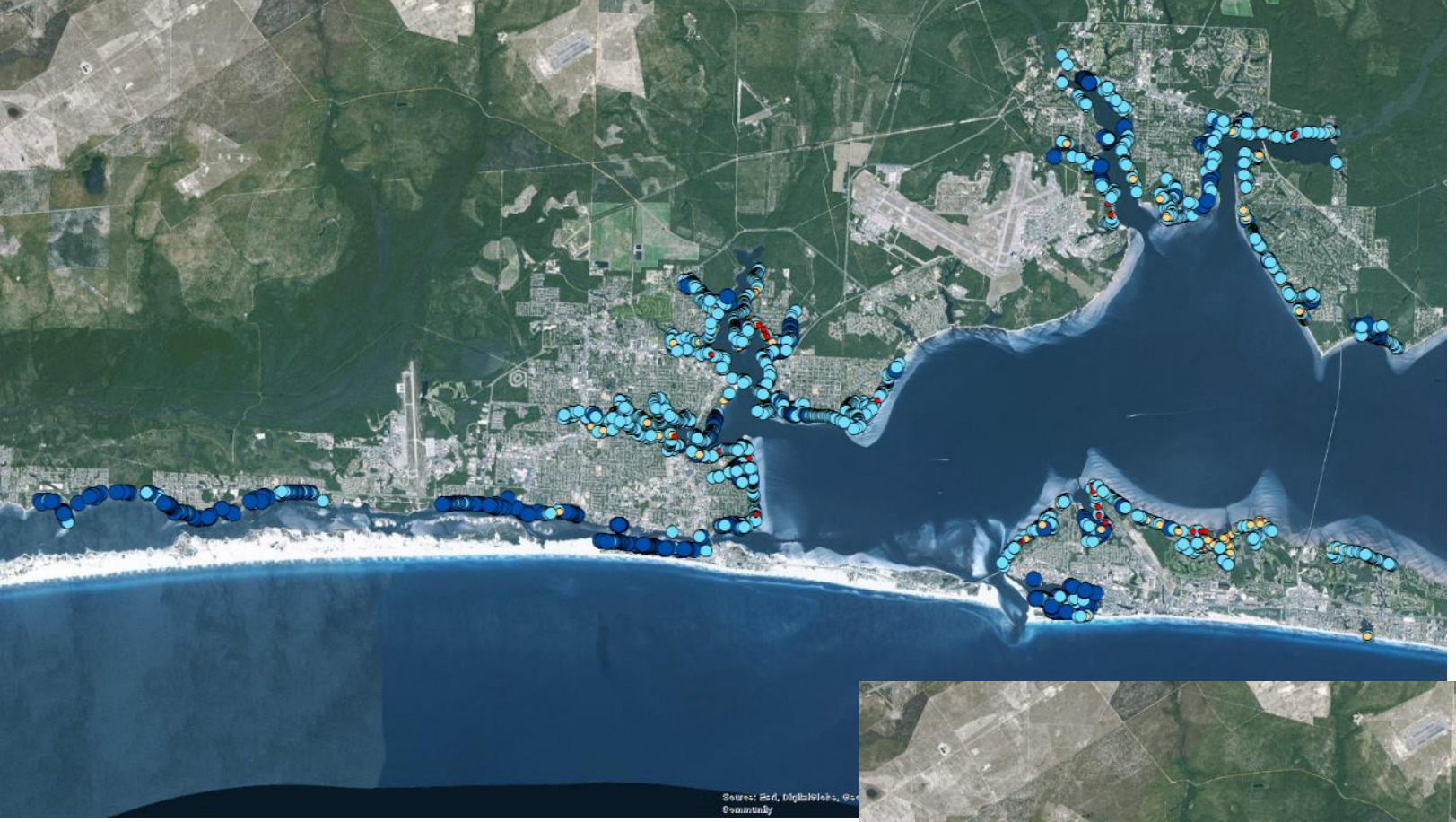
NC study found that property values drop 30% with loss of beach width in a community GA study found that nonmarket values (value of beach for recreation, aesthetics, and other use and non-use values) exceeded value of property by orders of magnitude




Source: Landry (Univ of Md), Keeler (E Carolina), Kriesel (UGA),2003. Economic Evaluation of Beach Erosion Management Alternatives

# Cost-Benefit Analysis: Findings in Florida

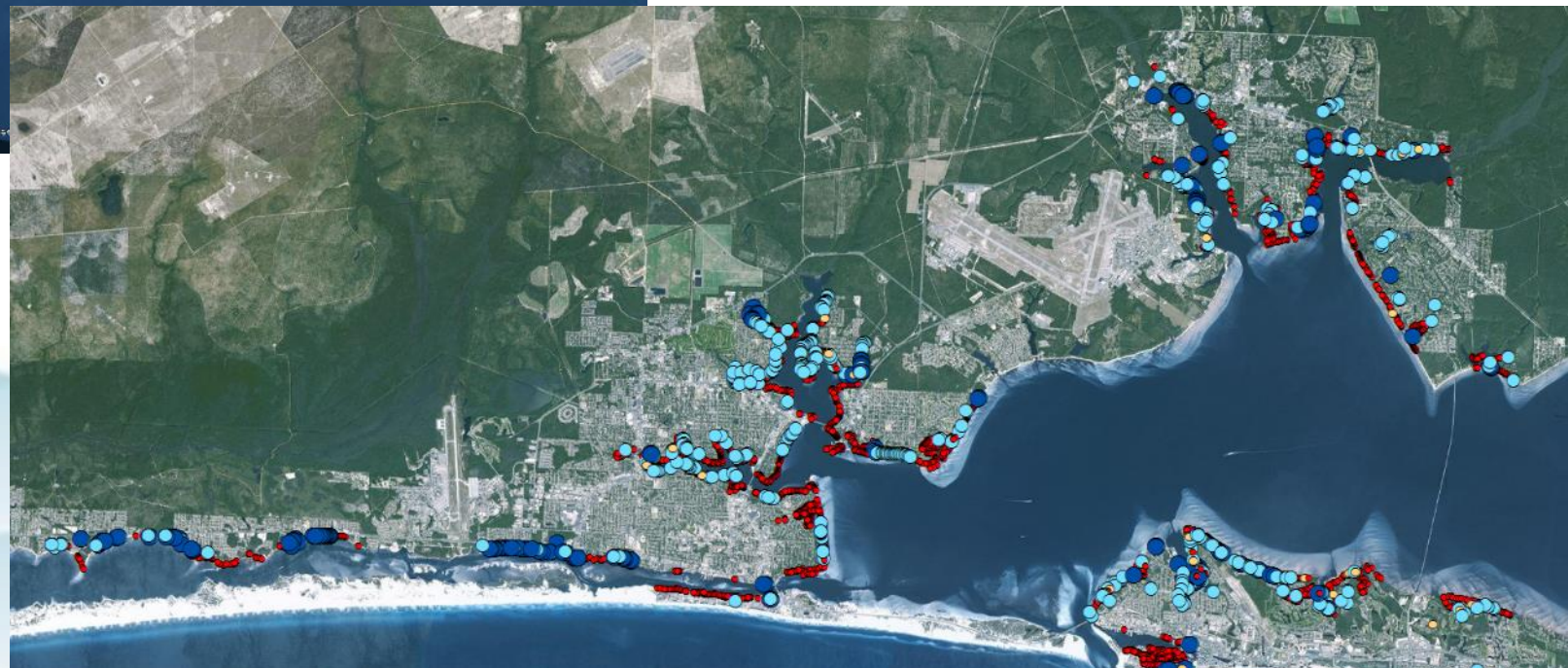
- Properties near amenities have greatest current flexibility to pursue multiple avenues of coastal resiliency
  - Amenities include beaches, open land, conservation areas and parks
  - Those properties contribute most to assets that communities value highly
- Land use type is not as important to benefit-cost ratio as location of the parcel
- The retirement or relocation of development rights offers a powerful tool for coastal resiliency
  - But only if development rights are treated as a valuable resource by the community



LEGEND

- 0
- 1
- 2 to 3
- 4 or more

Current ^



Future >

# Florida Findings: Strategies

- Ownership-based approaches (property acquisition and rolling easements) have the highest returns, but have fewer applicable candidates
- Incentive-based strategies (TDRs and PDRs) are a good option for most property types and parcels
  - Flexibility in regulations is key to success
- Physical protection showed positive benefit ratios, but no parcels showed high returns

# Broader Implications

- Bloomberg article – Foreign Affairs
  - Cities are key to managing climate change
  - Incorporating resiliency into plans
    - Planting trees & mangroves
    - Modernizing transportation - bike-sharing programs, electric buses, fuel-efficient taxi fleets
    - Retrofitting existing buildings with LED lighting
  - Attracting private capital
    - Companies are becoming more eager to provide capital for infrastructure projects for a share of the resulting revenue

# Thank you!