Economic Assessment of Rapid Land-Building Technologies for Coastal Restoration

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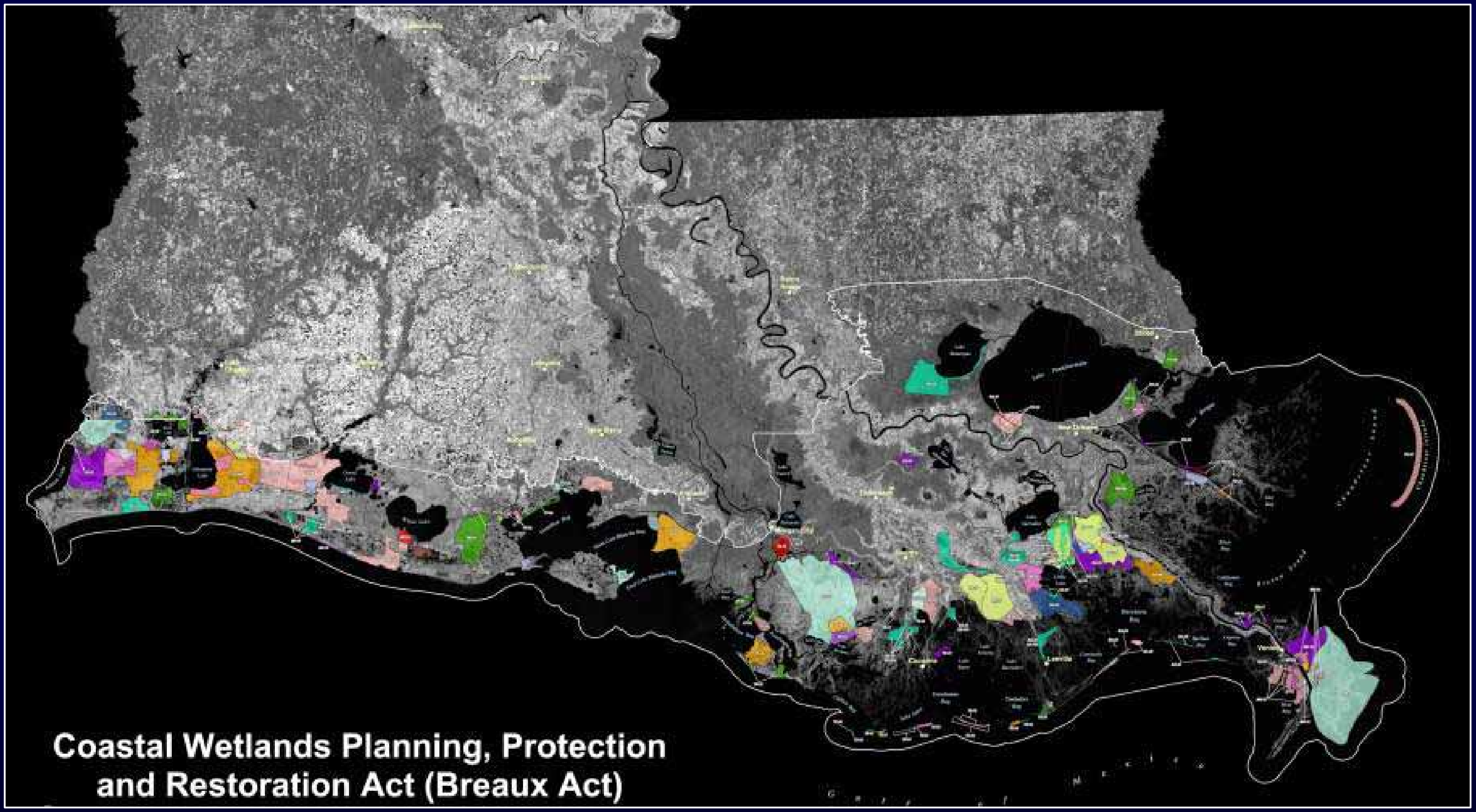
Research Background

- 2005-2007: Role of economics in coastal restoration
- 2008-2009: Evolution of benefits and methodologies
- 2010-2011: Examine challenges of time and uncertainty

<u>Efficiency</u>*: How do the benefits of restoration compare to the costs?



Benefit-Cost Analysis vs. Cost-Efficiency

$$\textbf{B-C Ratio} = \frac{\text{Total Benefits (\$)}}{\text{Total Costs (\$)}}$$

$$\textbf{CE (\$ / unit)} = \frac{\text{Total Cost (TC)}}{\text{Total Benefits (TB)}}$$

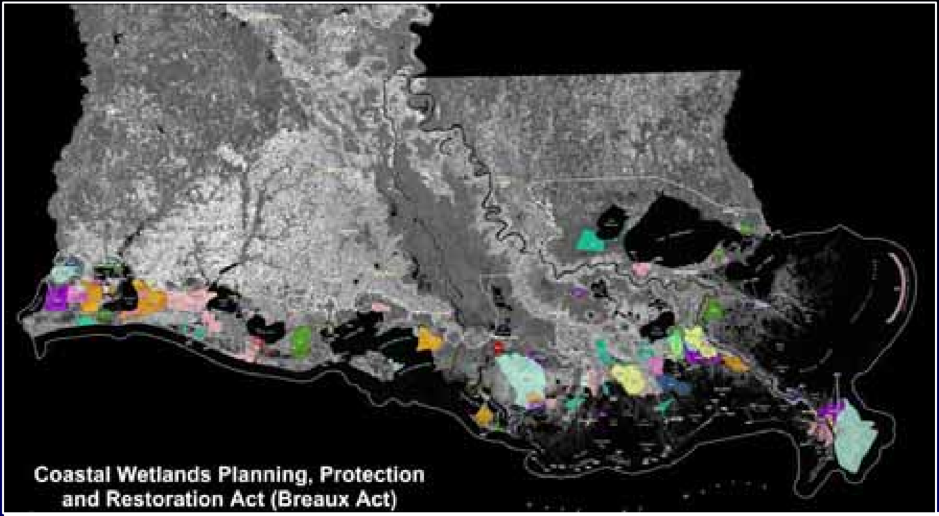
...where:

TC = \$ Project Construction + \$ Operation & Maintenance
TB = Benefits of Project (usually expressed in non-monetary units)

Primary Criteria

"...coastal wetland restoration projects in Louisiana (will) provide for the long-term conservation of such wetlands... based on the cost-effectiveness of such projects in creating, restoring, protecting, or enhancing coastal wetlands..."

(Public Law 646: CWPPRA, Sec. 3952 1(b)).



A Focus on Cost-Efficacy in CWPPRA

(Aust, C. 2006)

- ***How is it calculated?***
- ***How is it affected by project attributes?***
- ***Has it been a factor in project selection?***

Wetland Value Assessment (WVA)

1) Eight Community Level Habitat Models:

- Fresh/intermediate marsh
- Brackish marsh
- Saline marsh
- Barrier islands/headlands
- Swamp
- Forested ridges
- Bottomland hardwoods

2) Weighted Variables of Habitat Quantity/Quality:

V_1 - % emergent vegetation

V_2 - % open water SAV

V_3 - edge and interspersion,

V_4 - % shallow open water

V_5 - salinity levels

V_6 - aquatic organism access

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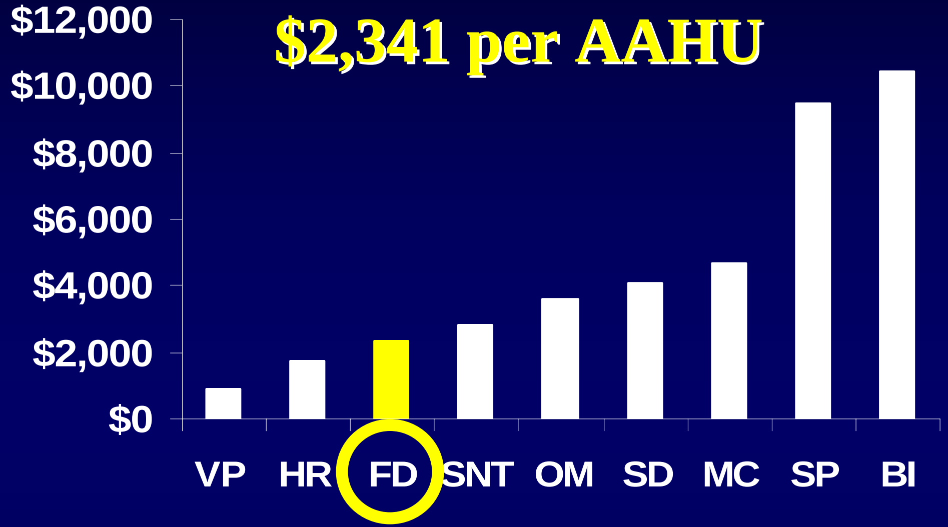
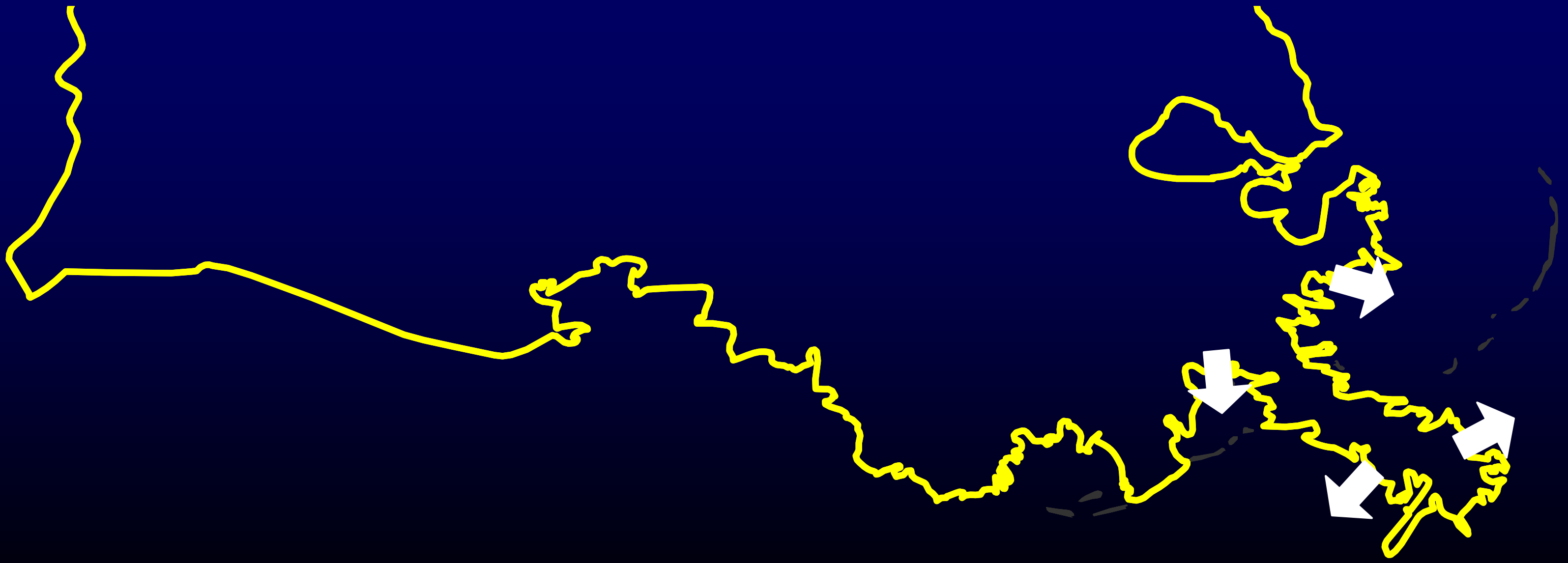
V_n

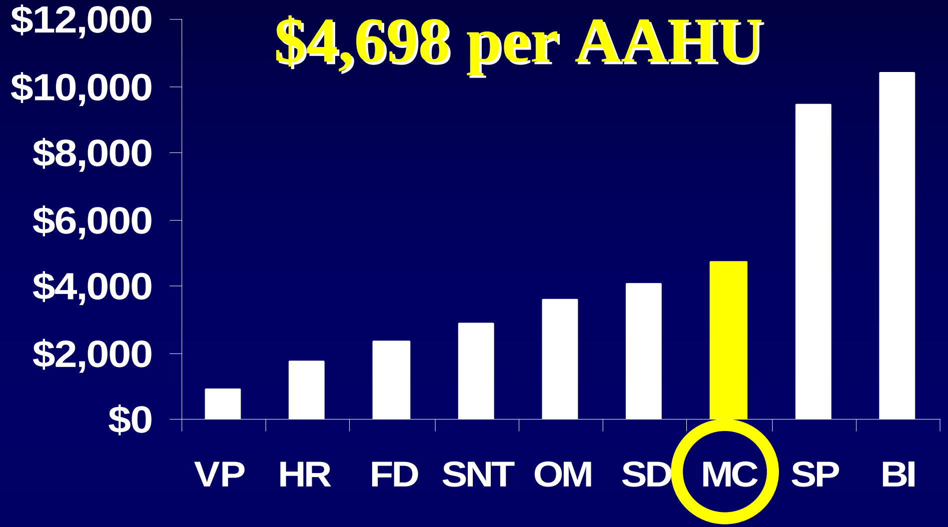
Avg. Annual Habitat Units (AAHU)

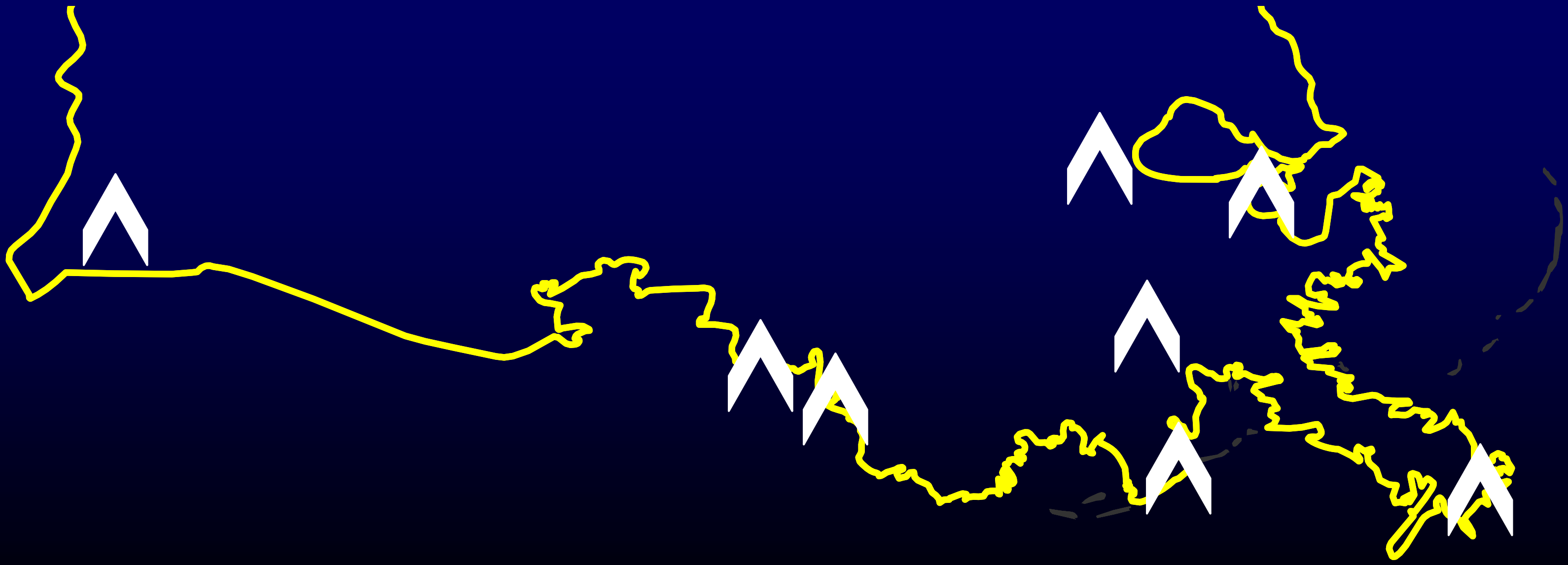
Freshwater Diversion (9%)



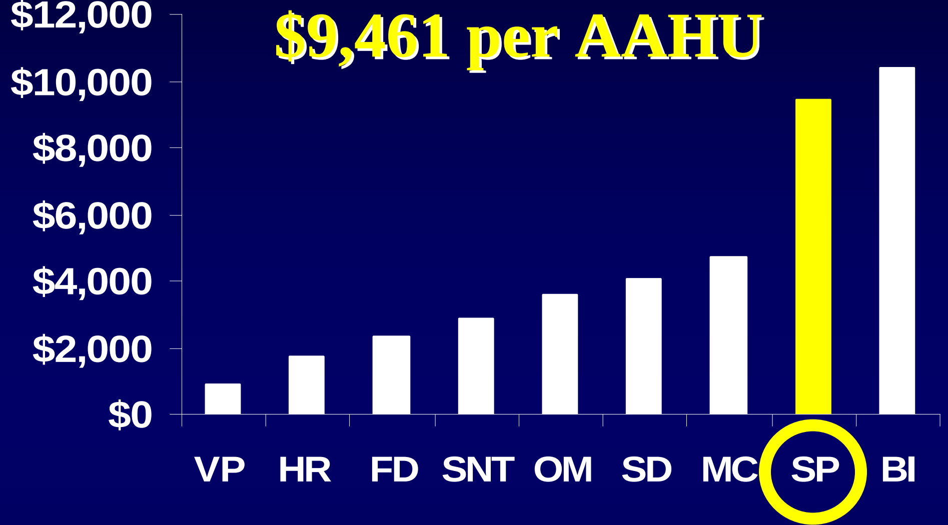


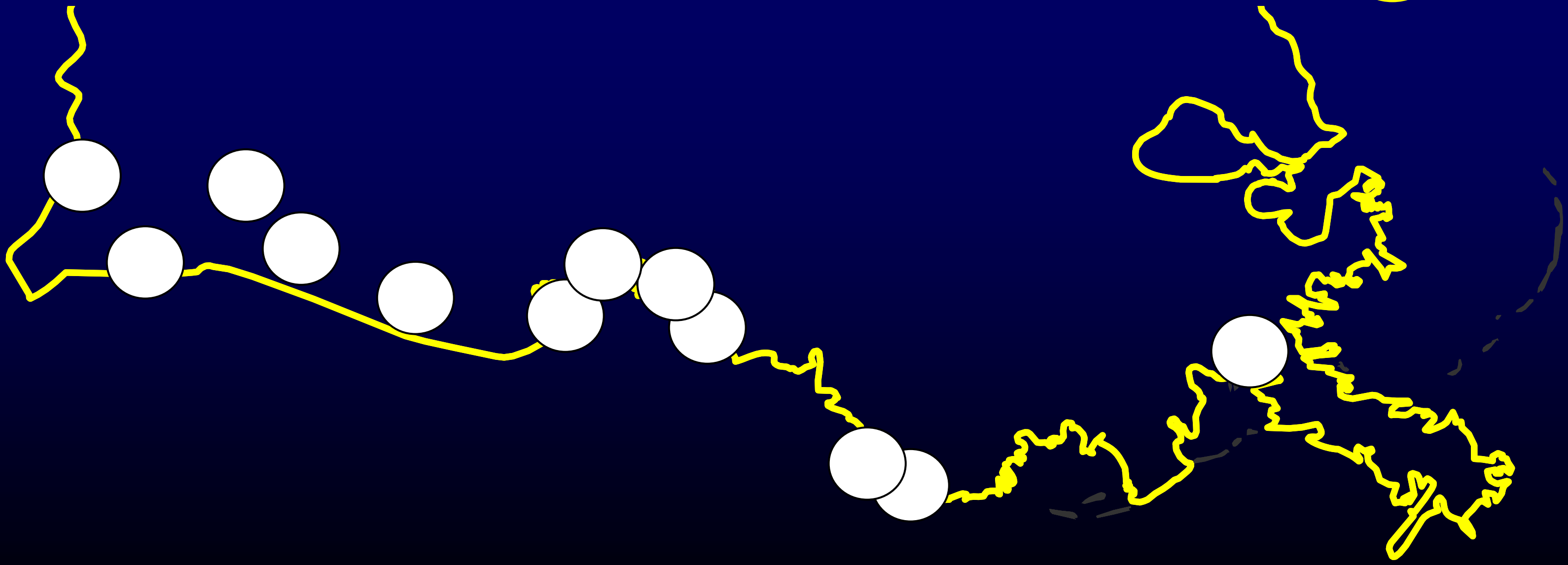
Marsh Creation (10%)



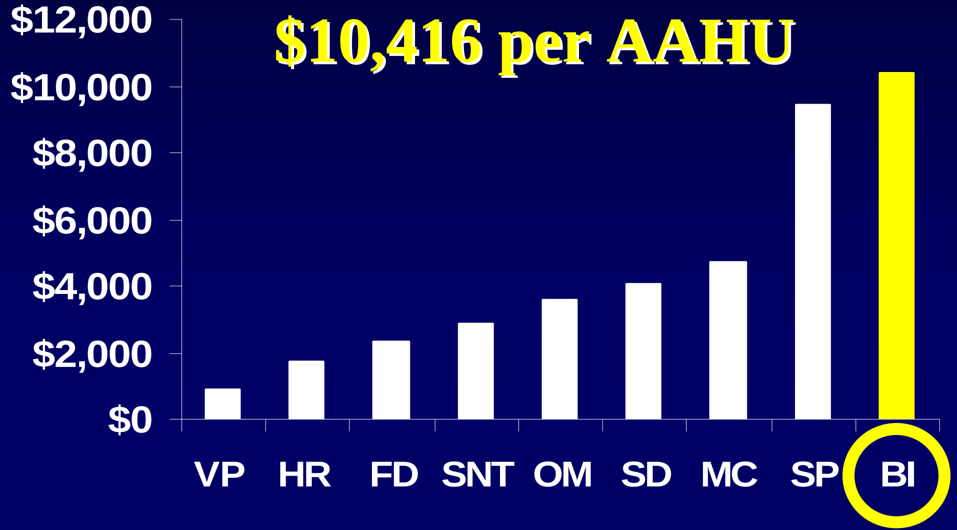


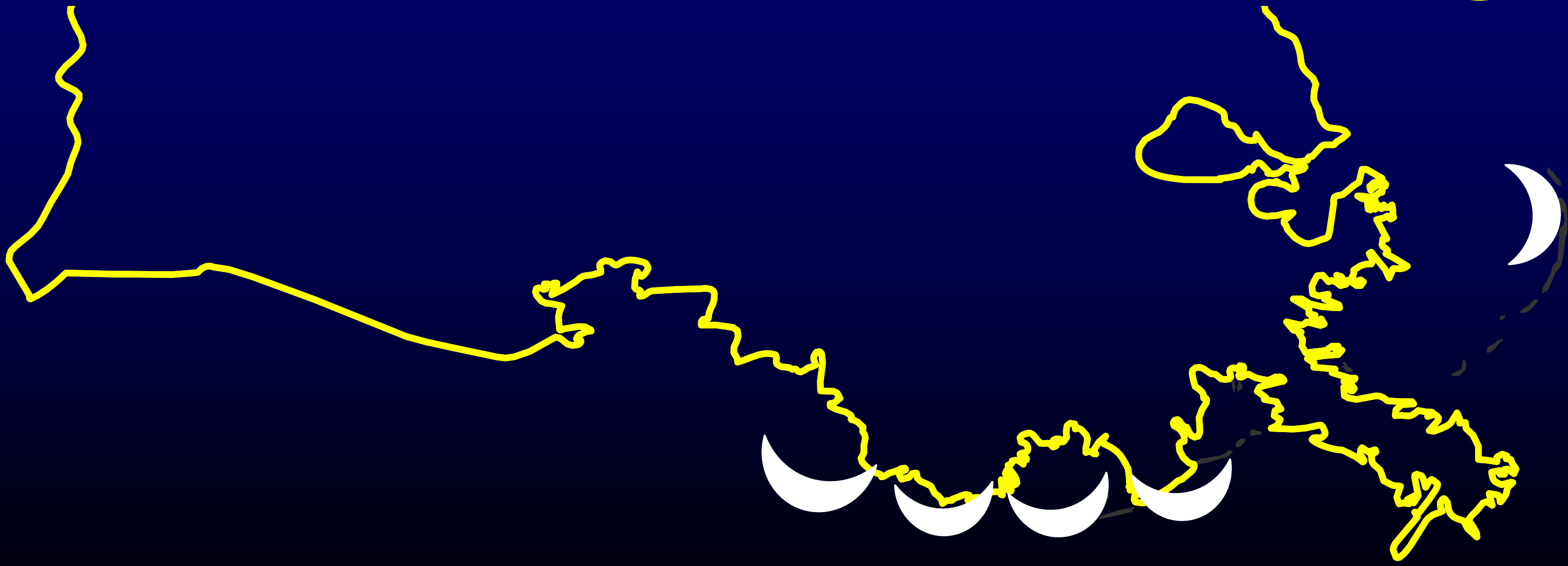
Shoreline Protection (27%)



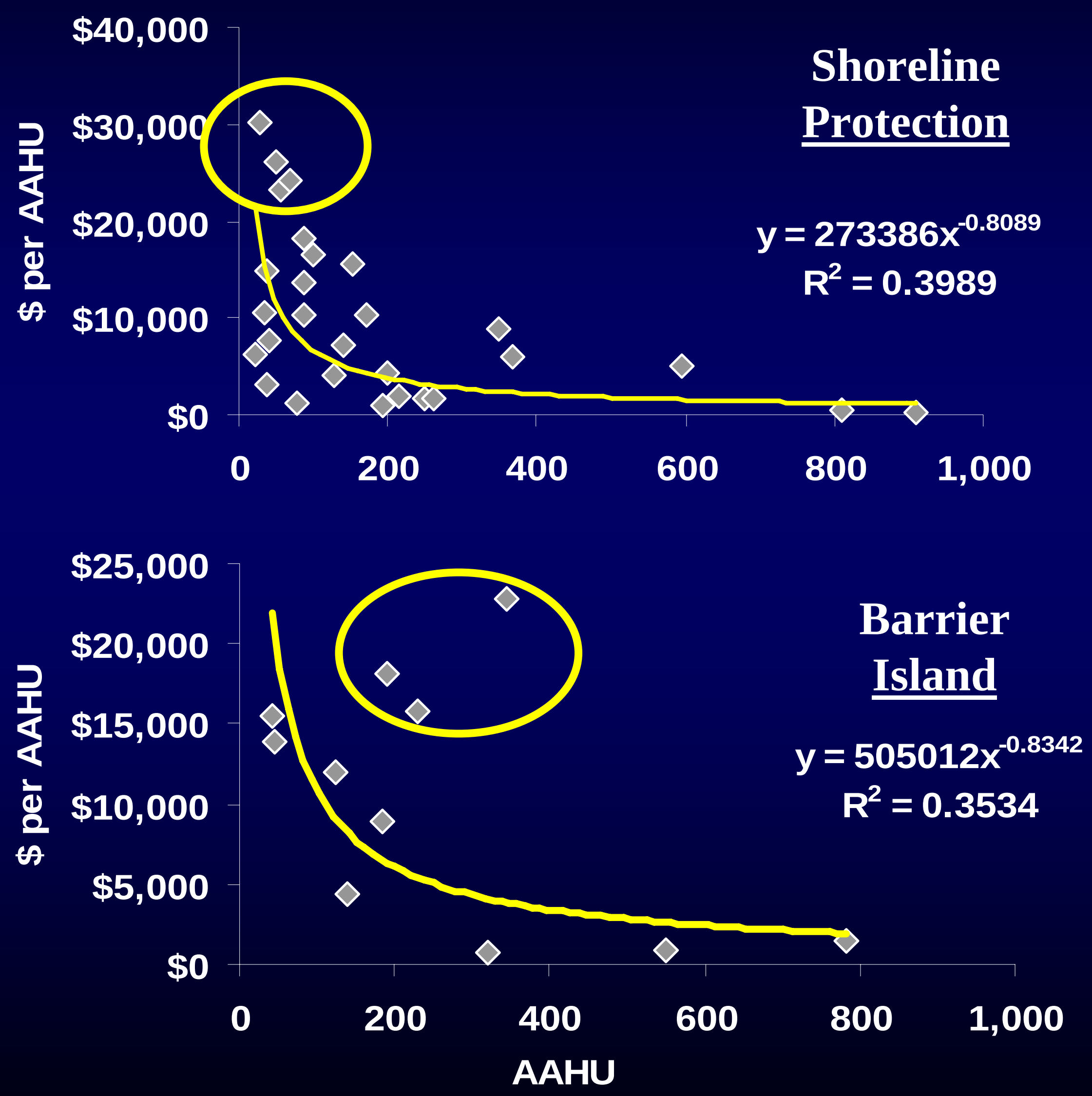


Barrier Island Restoration (10%)

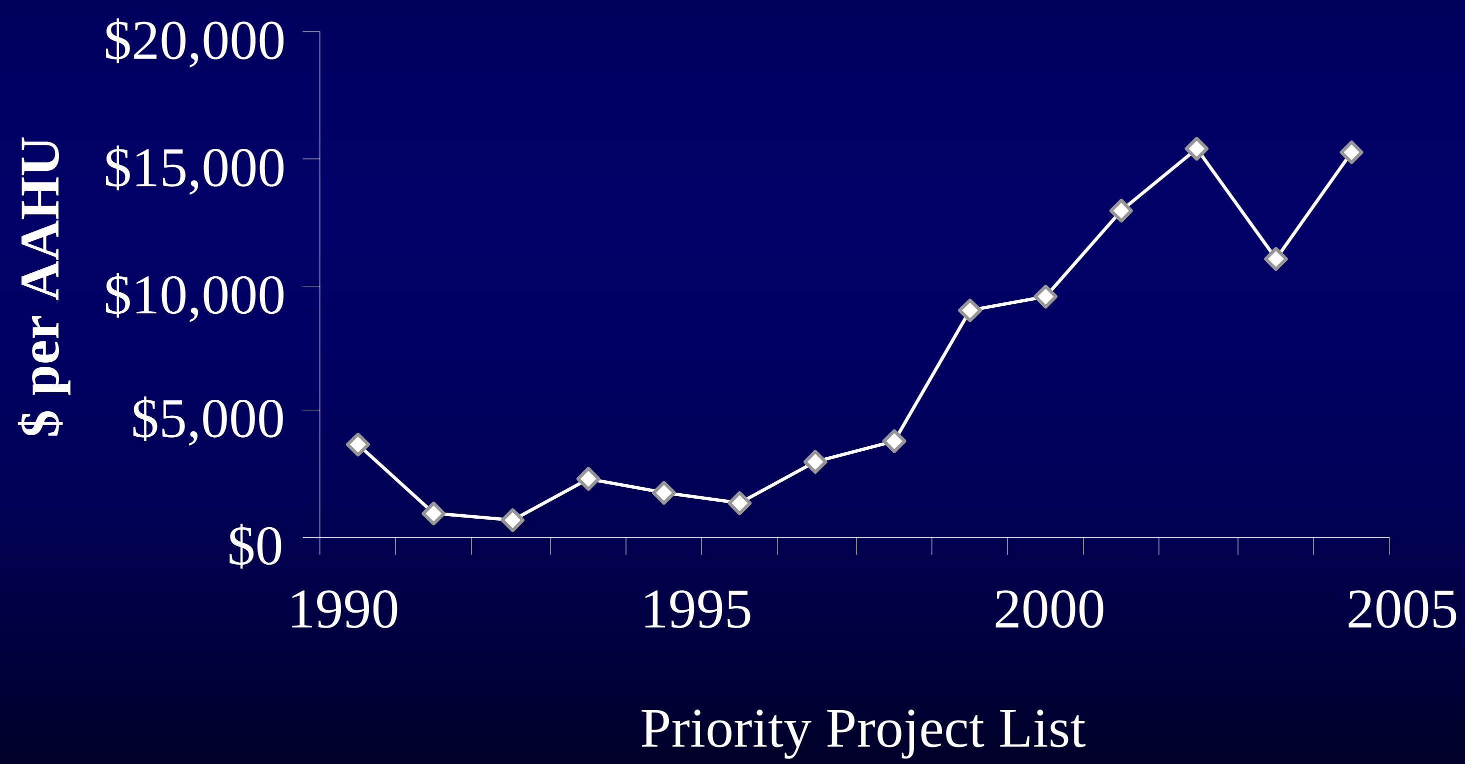




Closer Look at "Expensive" Project Types:



How have costs changed over time?



What is driving project selection?

- **Evaluated 160 projects from 350 candidates (1990 – 2005)**
- **Binary Logit Candidate Selection Model**
  Selection = *f* {CE, Total Cost, Criticality, Size, Type, Pop.)

Variable	**Pr.>z; (α=0.05)**
Cumulative Wetland Loss	not significant
Population	not significant
Total Area of Project	not significant
Total Cost of Project (FFC)	significant (-)
Cost Efficacy ($/AAHU/) Years 1-5	significant (-)
Cost Efficacy ($/AAHU) Years 10-15	significant (+)
Technology (Rapid-Land Building)	significant (+)

Program focus and benefits are changing

- Recognition of the magnitude of the crises has influenced benefits

- Katrina and Rita changed everything.
  - Post-K/R, focus shifted toward more hurricane protection, i.e., more human-focused

  - General recognition that time has become critical

  - Increased emphasis on land-building (CWPPRA, CIAP, CPRA)

Restoration Options:
Freshwater Diversions

"FWD are excellent options for protecting an existing marsh, but as a reconstructive tool, they aren't the first choice." – Penland (2005)

…ns alone." – CPRA Master Plan

Restoration Options:
Rapid Land Building

"Pumping sediments…can build marsh quickly…However, wetlands that are built via pipeline may not function in the same ways as wetlands built through natural processes…pumping in sediment is expensive…"
– CPRA Master Plan

Considering Restoration Options:

Freshwater & Sediment Diversions

- Mimics nature's way of building new land; expected to be "high-quality" land
- More "sustainable", continuous delivery of water/sediment.

  - But will it actually deliver what we expect?
  - Will the sediment remain where it is directed?
  - Will enough sediment be delivered?
  - Will the project be supported by stakeholders?
  - Is the process too slow for our immediate needs?

Tradeoff: Do the benefits of this more natural method outweigh the risks of waiting for this land to be restored?

Considering Restoration Options:

Rapid Land Building

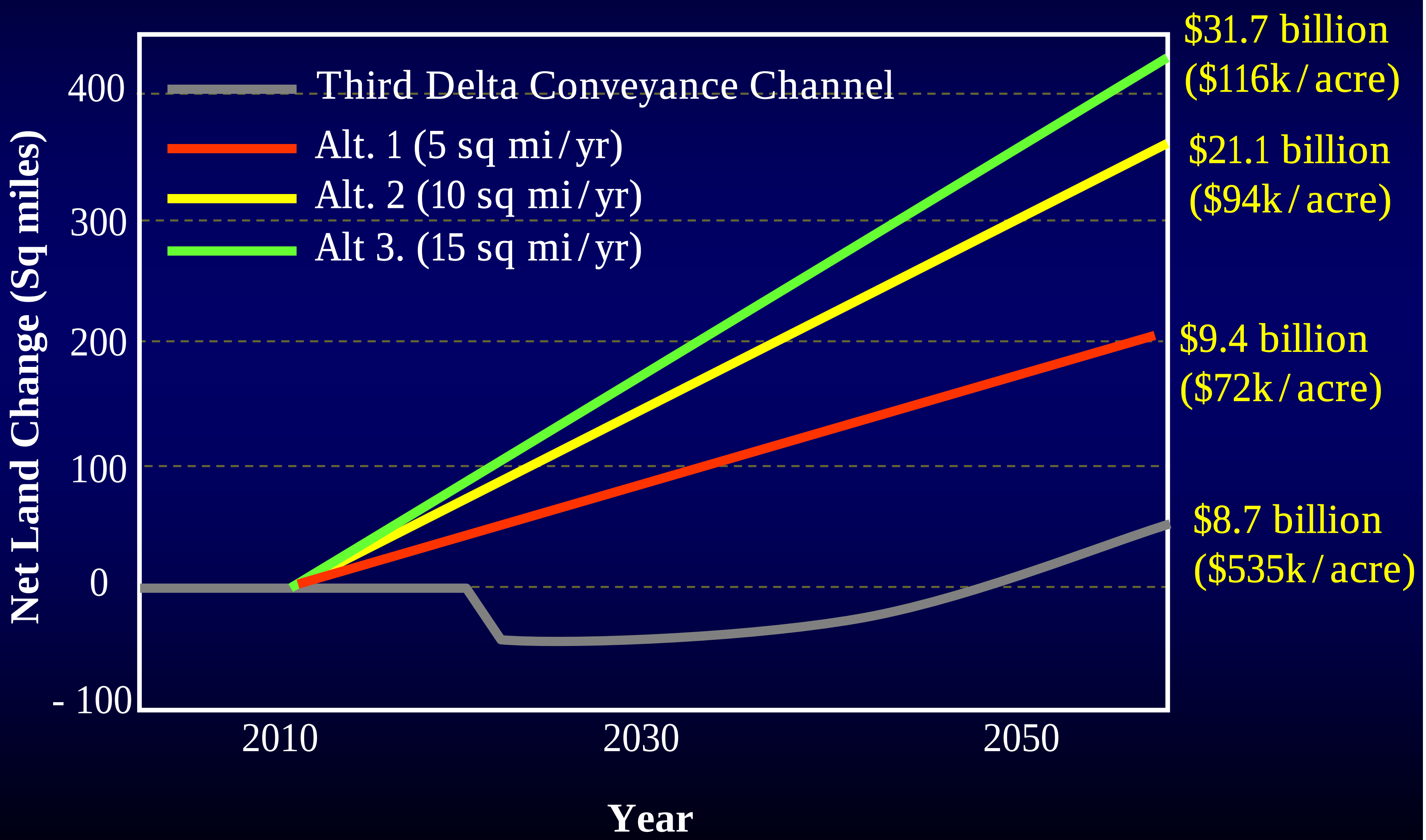
- Builds land quickly, more precisely-targeted
- Earlier benefits may mean less risky benefits

    - But is it "low-quality" land?
    - Will it "stick"?
    - Is there enough sediment?
    - Is it too expensive?
    - Are there unintended consequences?

Tradeoff: Does the risk reduction by moving benefits up in time outweigh the potential liabilities of land restored using this technology?

Diversions vs. Rapid Land Building?

SOURCE: Figure 5.26, Change in Land versus no action conditions for restoration projects
Phase 2 Reconnaissance-Level Evaluation of the Third Delta Conveyance Channel Project
CH2MHILL 2006



Expanding the Comparisons

- Compared to FWD, RLB projects frequently dismissed as too expensive
- Alternative accounting of costs and benefits might yield different results
- Benefits: shifting focus towards quantitative (net acres, cubic yards)
  = f (technology, restoration trajectory, scale, etc.)
- Cost = f (distance, source material, MOB, depreciation, land rights, etc.)

Risk and Time

- What are the risks?
  - Technology may not work as expected.
  - Storm activity may affect land-building efforts.
  - Benefits may be dependent on project scale.
- What about time?
  - The probability that benefits will be delivered in any given year likely depends on the probability that certain progress was made the prior year, which depends on its prior year, etc.
  - What if some major weather event occurs between years 0 and t that significantly affects project efforts?
  - Time value of money: discounting
  - ***Is an acre of wetland built today worth more than one built tomorrow? …in 1 year?... in 20 years? ….in 1500 years?***

Current Work

- Sensitivity analysis with varying risk (storm landfall probabilities and project scale) and variable (Gamma) discount rates

- Generic characterization of cost and benefits by technology (from surveys to bids to actual project expenditures)

- Case-study scenarios to illustrate tradeoffs between and within technology

Future Contributions

- Generic cost functions by for RLB and FWD projects
- How do cost constraints change under consideration of the full range of costs and benefits (e.g., economic and environmental)?
- How does the incorporation of time and uncertainty into the decision-making process affect the feasibility of RLB projects compared to more traditional methods?

Evolution of Restoration Spending in LA

(Actual, Requested, Projected, & Estimated)

• **1990**	**CWPPRA**	$625 million (Constructed) $913 Million (Eng/design)
• **1998**	**COAST 2050**	$14 billion (estimated need)
• **2002**	**LCA Plan**	$14 billion (requested)
• **2004**	**WRDA**	$1.9 billion (authorized)
• **2005**	**CIAP (OCS $)**	$540 million (allocated)
• **2007**	**GOMESA (OCS $)**	$210 million/yr thru 2017 $650 million/yr after 2017 (projected)
• **2008**	**CPRA**	$100 billion (estimated need)

Integrating Restoration and Protection

(Projected Shortfall)