

Evaluating Coastal Hazard Management Alternatives Under Changing Environmental Conditions for Seven Delaware Bay Communities

Partnership for the Delaware Estuary

Delaware Estuary Science & Environmental Summit

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Baker

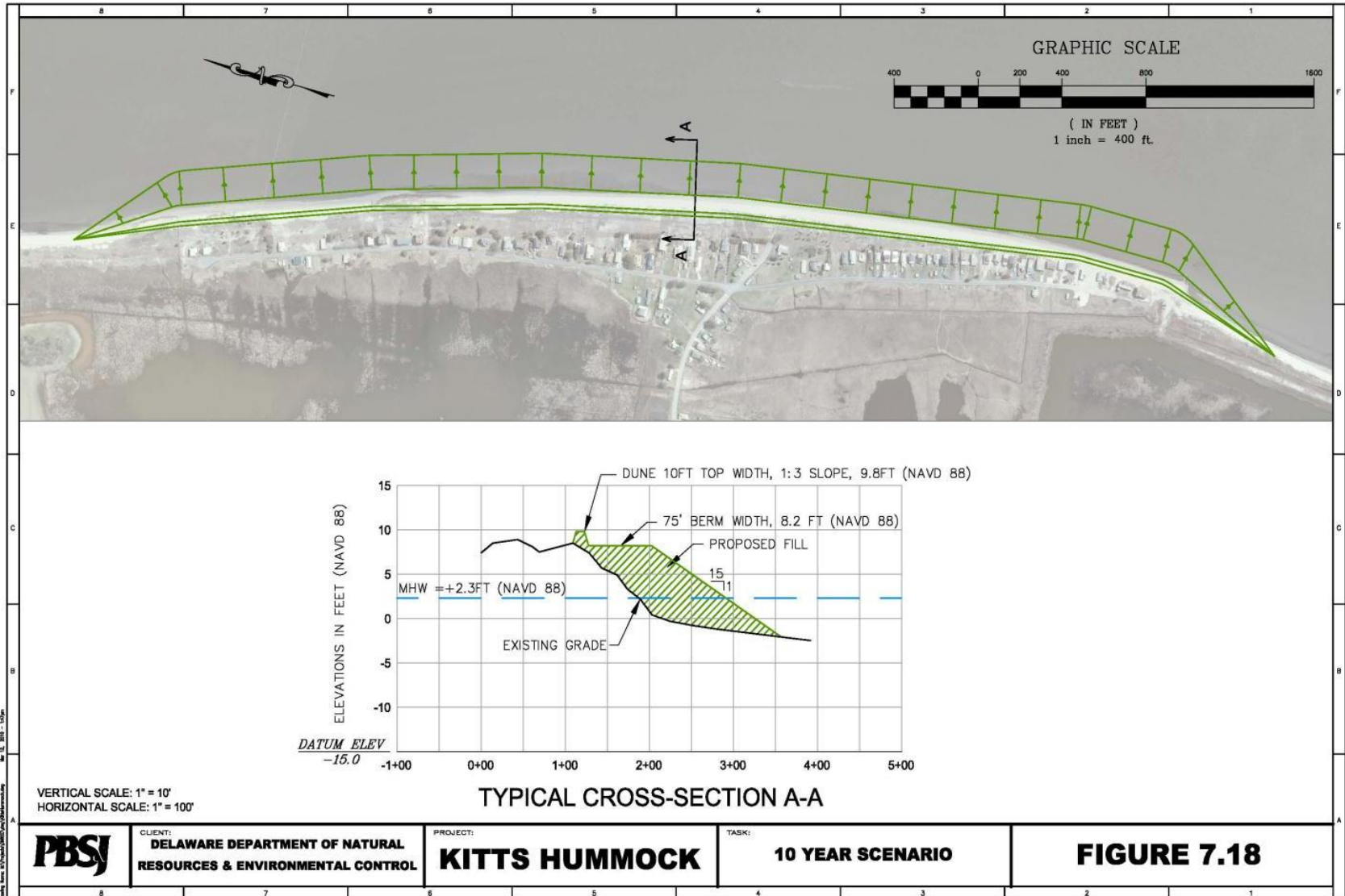
Communities at risk...



Study Framework

- Hazards Investigated:
 - Coastal Flooding – 10%-, 2%-, 1%-, and 0.2%-annual-chance events
 - Sea Level Rise – stable and accelerated rates of increase
 - Shoreline Change – varying historical shoreline change rates
- 30-year planning horizon beginning 2011
- Four *Management Alternatives* evaluated...
 - Beach Nourishment
 - Basic Strategic Retreat
 - Enhanced Strategic Retreat
 - No Action

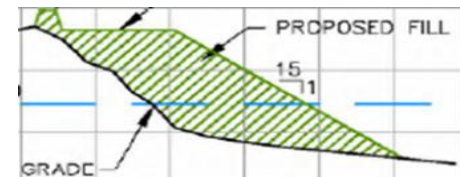
Alternative 1: Beach Nourishment (10-yr Design)



Alternative 2: Enhanced Strategic Retreat

Initially remove structure to allow a beach/dune width equal to the recommended beach nourishment templates for each community.

As additional erosion/shoreline migration occurs, additional structures are removed to maintain this beach width.



Alternative 3: Basic Strategic Retreat

Initially remove structures to allow a beach/dune width equal to the current widths in each community.

Where existing structures occupy the beach, initial removal occurs.

As additional erosion/shoreline migration occurs, additional structures removed to maintain this beach width.



Alternative 4: No Action

This alternative involves no action on the part of state shoreline managers. No beach fill or beach enhancement will occur, historic shoreline migration will cause increasing damage to structures. Houses will be destroyed unless removed by property owner.



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- Four *Management Alternatives* evaluated...
 - Beach Nourishment
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- Comprehensive economic analysis concentrates on:

4 Key Components...

Flood Damages

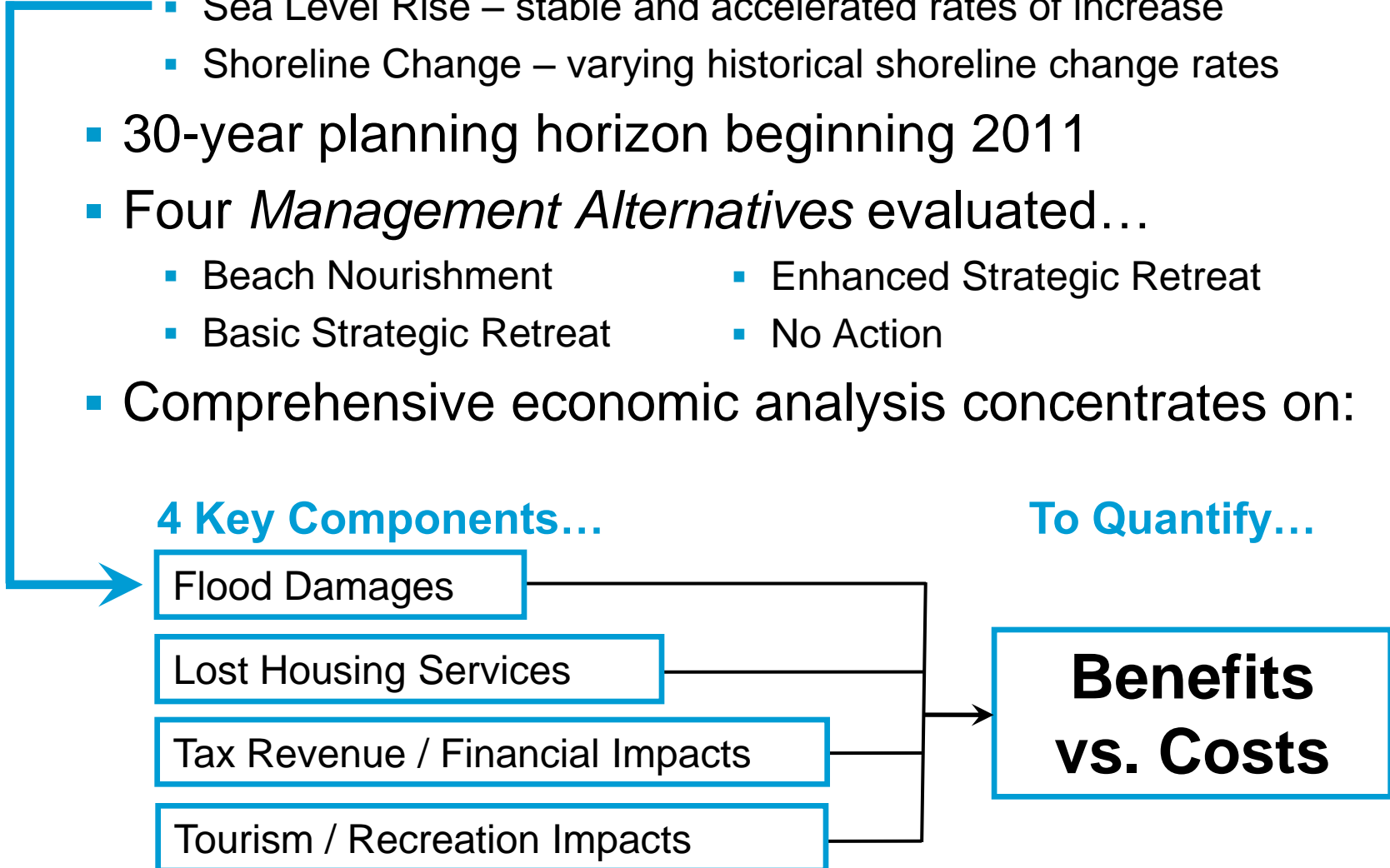
Lost Housing Services

Tax Revenue / Financial Impacts

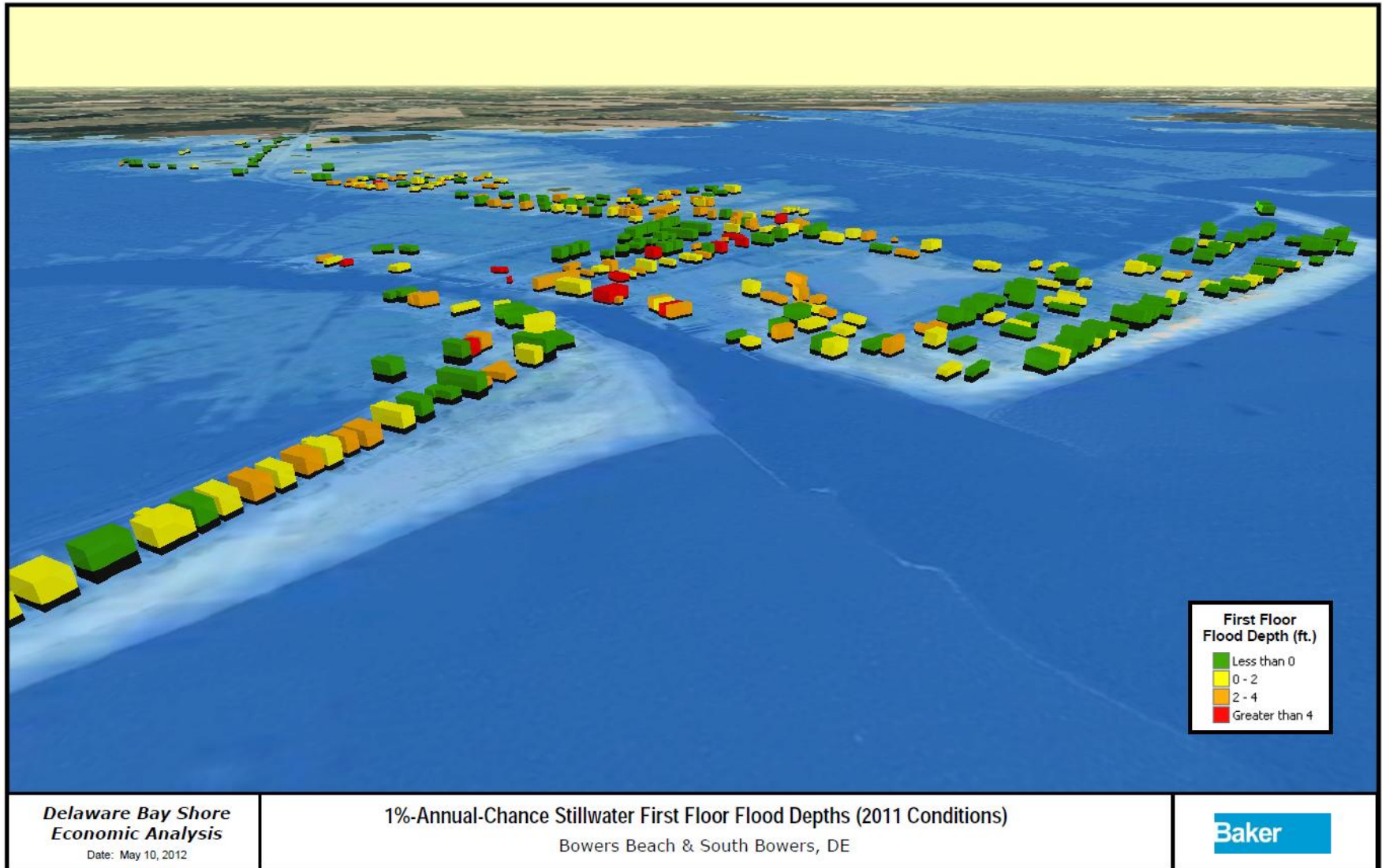
Tourism / Recreation Impacts

To Quantify...

**Benefits
vs. Costs**



- Flood Damage Assessment



Sea Level Rise Effects

- Important Considerations:
 - This is not a “sea level rise study.”
 - It is a management alternatives study which accounts for future sea level rise conditions.
 - Responsible analysis must investigate projected sea level rise based on both historical and accelerated rates of increase.
- Historical average local SLR rate = 3.33 mm/yr.

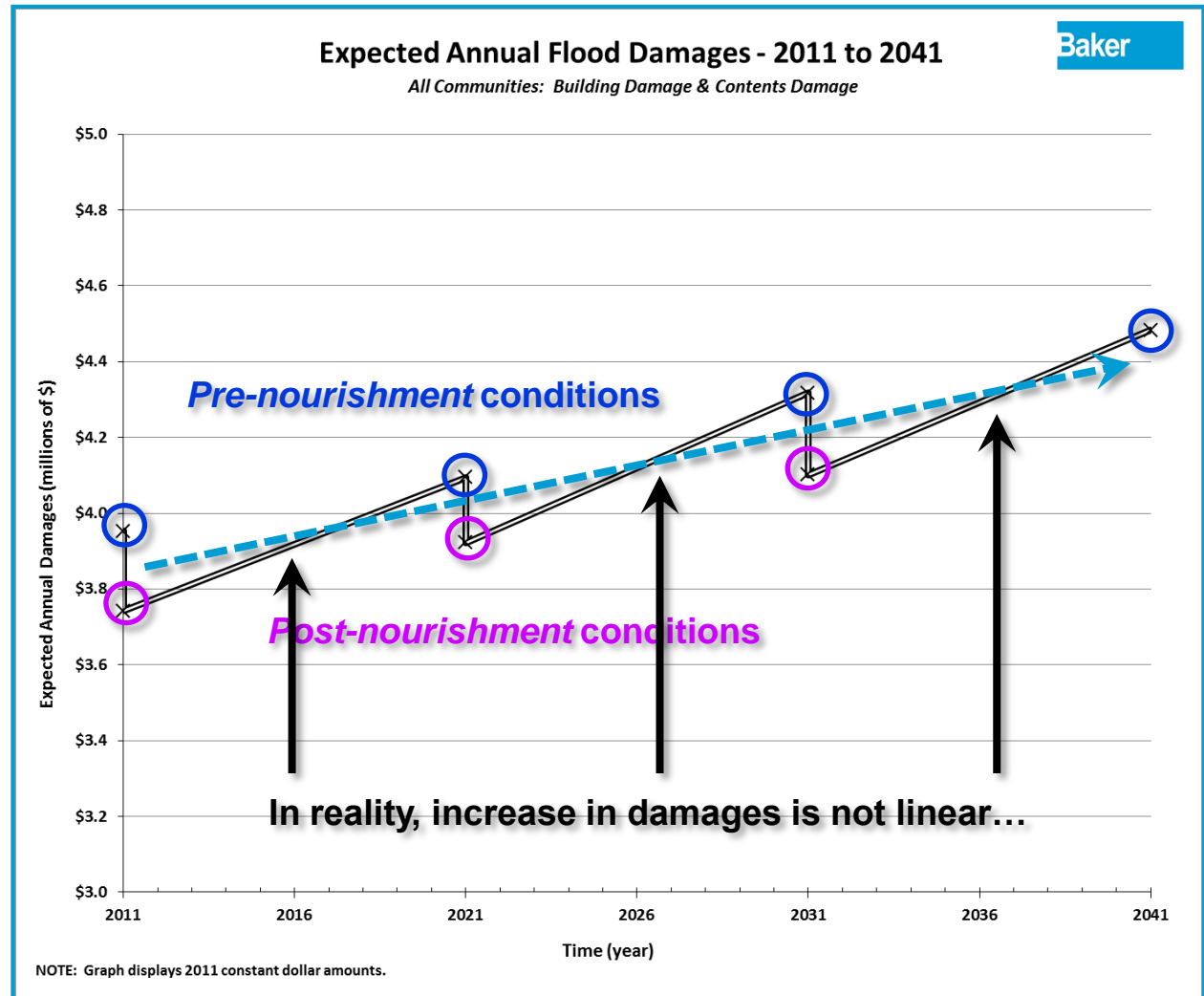
Year	Historical SLR Condition: Stable
2011	0 m (0 ft.)
2021	0.03 m (0.1 ft.)
2031	0.07 m (0.23 ft.)
2041	0.1 m (0.33 ft.)

- **Will these sea level rise changes affect expected damages...?**

Sea Level Rise Effects

- Beach Nourishment example; no structures removed.

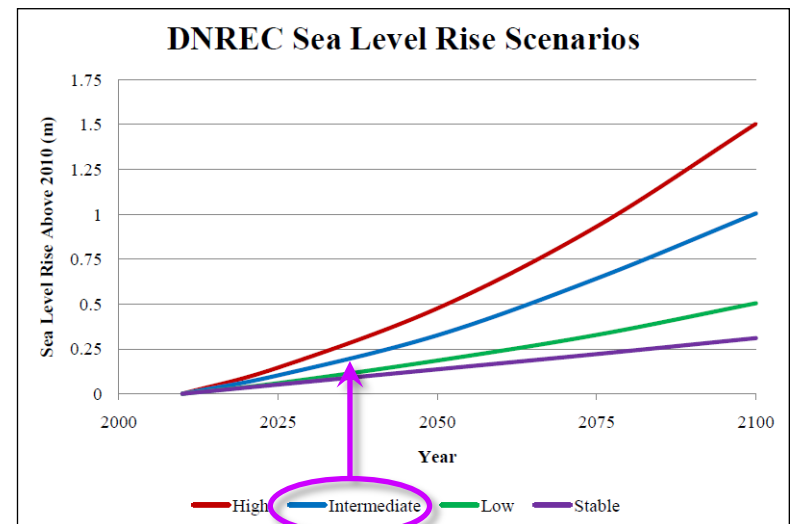
- With the beach nourishment plan in place, increases in flood damage occur due to SLR (approx. 5% over each 10-yr period).



Sea Level Rise Effects

- Important Considerations:
 - This is not a *sea level rise study*.
 - It is a study of management alternatives which accounts for future sea level rise conditions.
 - Responsible analysis must investigate projected sea level rise based on both historical and accelerated rates of increase.
- Historical average local SLR rate = 3.33 mm/yr
- Accelerated SLR impacts assessed independently

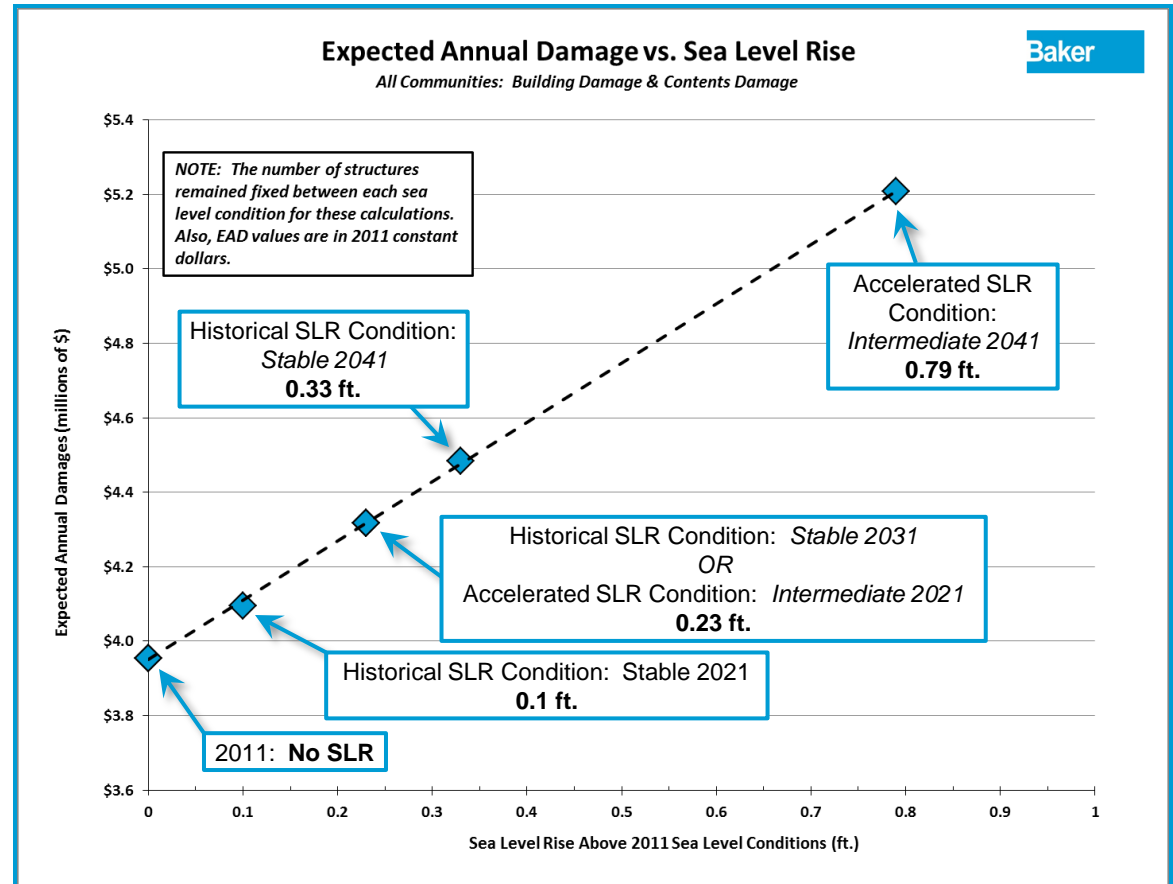
Year	Historical SLR Condition: Stable	Accelerated SLR Condition: Intermediate
2011	0 m (0 ft.)	0 m (0 ft.)
2021	0.03 m (0.1 ft.)	0.07 m (0.23 ft.)
2031	0.07 m (0.23 ft.)	0.15 m (0.49 ft.)
2041	0.1 m (0.33 ft.)	0.24 m (0.79 ft.)



Sea Level Rise Effects

- Impact of accelerated SLR on expected annual flood damages compared to historical SLR conditions:
 - 2021: + ~5%
 - 2031: + ~10%
 - 2041: + ~16%

- Observed linear relationship may not apply for longer time scales or sea level increases larger than 0.79 ft.



Conclusion

- Final results capturing changing environmental conditions expected in 2013...
- Results provide critical information to the State of Delaware for:
 - **Comparison of benefits** between alternatives and between various economic components
 - **Costs of implementation**
 - **Advancing discussion:**
Who Benefits? vs. Who Pays?
 - **Making sound planning & management decisions, but to what extent will results be integrated into decision-making?**



S. Eberbach (March 2011)

Questions, Comments?



S. Eberbach (March 2011)



Associated Press (October 2012)