NATURE-BASED SEA LEVEL RISE SOLUTIONS

Assessing the co-benefits of alternative restoration scenarios in San Mateo County

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The Natural Capital Project

November 28, 2018
ALTERNATIVE VISIONS FOR THE FUTURE
Accelerated innovation

Abandonment and renewal

Today

Connected communities

Nested watershed
SEA-LEVEL RISE

Today
Workshop ideas

- Marsh restoration
- River restoration
- Beaches
- Horizontal levees
- Oyster reefs
- Development specs and zoning requirements
- Housing
THREE SCENARIOS

1. What we might have done – armored the whole shoreline – serves as a baseline or comparison point

2. What we have done – protect existing marshes and restore as much of the salt ponds to marsh as possible.

3. What we could do next – add nature based features throughout to protect marshes and communities

Alameda Point Runway Wetland - alamedapointenviro.com

Outer Bair Island - alamedapointenviro.com - Dicklyon

Horizontal Levee – HT Harvey & Associates
## OLU SPECIFIC OPPORTUNITIES

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>- Beach</td>
<td></td>
<td>- Beach</td>
<td>- Beach to reduce scarp erosion</td>
<td>- Horizontal levee (incl. SAFER)</td>
<td>- Horizontal levee</td>
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<tr>
<td>- Natural features along arrowhead</td>
<td></td>
<td>- Horizontal levee</td>
<td>- Marsh</td>
<td>- Marsh (incl. salt ponds restoration)</td>
<td>- Marsh</td>
</tr>
</tbody>
</table>

- Horizontal levee (incl. SAFER)
- Marsh (incl. salt ponds restoration)
THREE SCENARIOS
**ASSUMPTIONS**

- All scenarios provide the same level of protection (i.e. 100-yr FEMA flood in 2050)
  - Maintenance and management of marshes will probably be needed beyond 2050.
- For scenario 2 and 3, replace hardened shoreline with marshes and beaches where appropriate
- Assume marshes keep up with SLR up to at least 2050 – as shown by Point Blue modeling.
CLARIFYING QUESTIONS ABOUT SCENARIOS?
NATURE-BASED SHORELINE SOLUTIONS

How do available SLR adaptation scenarios affect the well-being of people in San Mateo County?
ECOSYSTEM SERVICES IN SAN MATEO COUNTY
SCENARIO COMPARISONS
RELATIVE TO AN ENGINEERED COAST (S1)

<table>
<thead>
<tr>
<th>Co-benefits</th>
<th>S2</th>
<th>S3</th>
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<tbody>
<tr>
<td>Marsh habitat</td>
<td>5.4x</td>
<td>6.9x</td>
</tr>
<tr>
<td>Ridgeway rail</td>
<td>5.4x</td>
<td>6.7x</td>
</tr>
<tr>
<td>Beach</td>
<td>+0.5 km²</td>
<td>+1.7 km²</td>
</tr>
<tr>
<td>Wave reduction</td>
<td>2.2x</td>
<td>&gt;2.2x</td>
</tr>
<tr>
<td>Recreation*</td>
<td>1.0x</td>
<td>1.0x</td>
</tr>
<tr>
<td>Runoff retention</td>
<td>5.6x</td>
<td>6.8x</td>
</tr>
<tr>
<td>Carbon storage and sequestration</td>
<td>5.1x</td>
<td>6.3x</td>
</tr>
</tbody>
</table>

* Substantial variation between OLUs
ACROSS SERVICES, SCENARIOS DEMONSTRATE THAT

- Scenario 2 demonstrates the vast benefits from nature from current and planned restoration
- Scenario 3 highlights opportunities to go farther
HABITATS AND SPECIES
HABITATS AND SPECIES

- Indicator habitats and species
  - Marsh and beach habitat
  - Seal haul-out sites
  - Habitat for ridgeway rail
MULTIPLE SCENARIOS
HABITAT ACROSS OLUS & SCENARIOS

<table>
<thead>
<tr>
<th>Location</th>
<th>Marsh area (sq km)</th>
<th>Beach area (sq km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yosemite -- Visitacion</td>
<td></td>
<td>Y - V</td>
</tr>
<tr>
<td>Colma -- San Bruno</td>
<td></td>
<td>C - SB</td>
</tr>
<tr>
<td>San Mateo</td>
<td></td>
<td>SM</td>
</tr>
<tr>
<td>Belmont -- Redwood</td>
<td>8</td>
<td>B - R</td>
</tr>
<tr>
<td>San Francisquito</td>
<td>3</td>
<td>SF</td>
</tr>
</tbody>
</table>

- Scenario 1
- Scenario 2
- Scenario 3
- Scenario 3 w/ SLR
SPECIES ASSOCIATIONS
MARSH HABITAT EXPLAINS 80% OF THE VARIATION IN RIDGEWAY RAIL OCCURRENCE

S2: 19.0 sq km
S3: 23.7 sq km
S3 w/ SLR: 6.9 sq km
HABITAT AND SPECIES TAKE-HOMES

1. Continued protection and restoration is needed to protect against potential 35% losses from sea-level rise

2. Planned habitat restoration will increase marsh and ridgeway habitat by more than 5x; additional measures can maintain these benefits and increase them by 1.3x

3. SMC is uniquely situated in the Bay. SMC has nearly 10% of tidal marsh and ridgeway rail habitat, and 15% of seal haul-out sites
COASTAL PROTECTION
COASTAL PROTECTION

- Vegetation (marsh) reduces wave energy, alters protection across scenarios
- Reduce levee costs
Vegetation reduces wave impacts

- Varies
- Max diff from marsh is 2.2ft

**SAN MATEO**
SCENARIO RESULTS

 Restoration of Bair island in S2 and S3

- Wave height difference is 9 inches
COASTAL PROTECTION TAKE-HOMES

1. Tidal wetlands in the southern OLUs reduce wave height and the area at risk of damage

2. Implemented and planned restoration will have benefits. E.g. Bair Island serves to reduce wave height by 9 inches
RECREATION
VISITATION

RELATIVE TO AN ENGINEERED COAST (S1)

- Yosemite -- Visitacion
- Colma -- San Bruno
- San Mateo
- Belmont -- Redwood
- San Francisquito

Scenarios:
- Scenario 2
- Scenario 3
RECREATION TAKE-HOMES

- San Mateo County provides a wealth of recreation opportunities along its miles of shoreline and in parks and trails near the shore
- SLR protection strategies along the coastline have varying relationships with recreation
  - Marshes tend to be associated with decreased visitation
  - Beaches and trail access associated with increased visitation
RUNOFF RETENTION
RUNOFF RETENTION

Stormwater management is a Baywide issue

- Paved areas produce more runoff and increase flood risk
- Pollutants are discharged into the Bay

Natural or pervious areas (inland) and marshes (along the coast) help retain pollutants
NITROGEN RUNOFF RETENTION

- Scenario 1
- Scenario 2
- Scenario 3

Retention (kgN/yr)

- Yosemite - Visitacion
- Colma - San Bruno
- San Mateo
- Belmont - Redwood
- San Francisquito
CARBON STORAGE & SEQUESTRATION
**CARBON STORAGE & SEQUESTRATION**

- Calculates carbon storage and sequestration for natural habitats
- Carbon pools: plant (biomass), dead plant material, **soil**
- Change data: accumulation and decay rates
- Mix of local and global data (Chumra et al. 2003, Hinson et al. 2017)
CARBON STORAGE BY 2050 (TONS CO$_2$)

Yosemite -- Visitacion
Colma -- San Bruno
San Mateo
Belmont -- Redwood
San Francisquito

Scenario 1  Scenario 2  Scenario 3  Scenario 3 with SLR
CARBON STORAGE & SEQUESTRATION - TAKE-HOMES

Each year, existing and planned marshes (S2) sequester the equivalent of:

- the CO₂ emissions from 2,100 cars
- the energy used by 1,100 homes
- 12,000 acres of terrestrial forests

... while marshes persist
VARIATION ACROSS OLUS & SCENARIOS

<table>
<thead>
<tr>
<th>Marsh area (km²)</th>
<th>Beach area (km²)</th>
<th>Visitation (rel. to S1)</th>
<th>Retention (kgN/yr)</th>
<th>Carbon (tons CO₂)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yosemite -- Visitacion</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Colma -- San Bruno</td>
<td>0.6</td>
<td>1</td>
<td>30000</td>
<td>0</td>
</tr>
<tr>
<td>San Mateo</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Belmont -- Redwood</td>
<td>30</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>San Franciscquito</td>
<td>30</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Legend: Scenario 1, Scenario 2, Scenario 3, Scenario 3 w/ SLR
TAKE-HOME MESSAGES

• Because of the wealth of marsh habitat in San Mateo County, this area provides important benefits locally and Bay-wide.

• Our approach allows for quantifying the multiple benefits of protection and restoration of coastal habitats and how they vary throughout the County.

• Current and planned habitat protection and restoration provide 2-5x benefits delivered by an armored shoreline.

• Further incorporation of natural and nature-based adaptation strategies could increase these benefits.
HOW WOULD YOU USE THIS KIND OF APPROACH?

Demonstrate/educate stakeholders and voters about multiple benefits for people and wildlife of SLR adaptation strategies that include nature methods and workflows established for baseline assessments, targeted investments, insurance markets, etc. – ex. AB 691 Coyote Point SLR impacts, Plan Princeton, SB 30

Other potential decision contexts?