OPERATIONAL LANDSCAPE UNITS FOR SF BAY
Using nature’s jurisdictions to plan for sea level rise

Briefing to the Implementation Committee of the CCMP
SFEI + SPUR
May 23, 2018

Funded by:
SF Bay Regional Water Quality Control Board
Marin Community Foundation
Moore Foundation
Goals of today

• Introduction (or update) to the Operational Landscape Units project

• How it could fit within actions of the CCMP
A new look at the Bay

- Create spatial framework to guide nature-based adaptation strategies for sea-level rise
- “Nature’s jurisdictions”
- Pairing problems with adaptation measures in appropriate places
Project Rationale

1. Processes that govern the shoreline happen at the **Bay scale**. Too large and complex for individual projects.
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2. Need to **divide up the Bay** into smaller manageable pieces: Sea level rise won’t stop at city boundaries.

3. Risk of the **wrong type** of actions in the **wrong places**, less resilience, and not all the benefits.

4. Opportunity to maximize **multi-benefit, nature-based solutions**. More resilience, most co-benefits, more adaptable over time.
HOW CAN THIS BE USED?

- A resource to assist environmental review and permitting
- Guidance for restoration practitioners
- Inform local and regional vulnerability analyses and adaptation actions
Defining OLU Boundaries
OPERATIONAL LANDSCAPE UNITS: Defined

Areas of the **Baylands and their watersheds** that are expected to support a coherent suite of **upland, intertidal, and subtidal ecosystem functions** as appropriate for **their location in the Bay**, along with the physical processes of **water and sediment** needed to sustain these functions.

Adapted from Verhoeven et al. 2008
STEEP HEADLANDS + SMALL VALLEYS

ALLUVIAL PLAIN

WIDE ALLUVIAL VALLEY
AREA OF ANALYSIS

● Back boundary
  ○ Baylands + 5 m SLR + Transition zone with SLR

● Side boundaries
  ○ Drainage divides, tidal sheds
Influence of wave height on critical depth of resuspension
Why do we need another way of splitting up the Bay?

- Watersheds
  - Poorly defined in flat Baylands

- Bayland Goals segments
  - Based on historical wetlands
  - Next step called for in BEHGU

- County boundaries
  - Often split creeks
Characterizing OLUs
Watershed inputs

- Sediment loads
- Freshwater (Rivers and Creeks)
- Nutrients
- Creek-Bay Interfaces
- Head of Tide zones
Marshes & Tidal Flats
Wave Heights

100-yr Hm0 (ft)
- 0.0 - 16
- 17 - 22
- 23 - 27
- 28 - 33
- 34 - 46

Data: FEMA / AECOM
Shoreline Inventory

<table>
<thead>
<tr>
<th>Class</th>
<th>Percent</th>
<th>Miles</th>
</tr>
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<tbody>
<tr>
<td>Engineered Levee</td>
<td>6%</td>
<td>170</td>
</tr>
<tr>
<td>Berm</td>
<td>40%</td>
<td>1,215</td>
</tr>
<tr>
<td>Shoreline Protection Structure</td>
<td>6%</td>
<td>175</td>
</tr>
<tr>
<td>Embankment</td>
<td>19%</td>
<td>558</td>
</tr>
<tr>
<td>Transportation Structure (major roads, railroad)</td>
<td>10%</td>
<td>313</td>
</tr>
<tr>
<td>Natural Shoreline</td>
<td>2%</td>
<td>66</td>
</tr>
<tr>
<td>Wetland</td>
<td>16%</td>
<td>486</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
<td>20</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100%</strong></td>
<td><strong>3,012</strong></td>
</tr>
</tbody>
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Open Space
Low-density residential

Small-lot residential with mixed use
Low-density commercial and industrial

Job-dense suburban centers
High-density downtowns
Pairing OLUs with Adaptation Measures
Adaptation measures

Nature based measures (examples)
- Oyster Reefs, Eel grass
- Mudflat recharge
- Beaches (sand, cobble, shell)
- Marsh restoration (various)
- Warping in polders
- Horizontal levees
- Preparing transition zone

Regulatory, Financial, Policy tools
- Easements
- Building restrictions
- Policy changes
- Zoning changes or overlays
- Buyouts
- Transfer of Development Rights
- Temporary use?
<table>
<thead>
<tr>
<th>Problem</th>
<th>Cause</th>
<th>Example measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave overtopping or erosion of levee with wide foreshore</td>
<td>Large waves reach levee</td>
<td>Marsh, fine beach, horizontal levee</td>
</tr>
<tr>
<td>Waves overtopping or erosion with narrow foreshore</td>
<td>Close to deep water</td>
<td>Coarse beach</td>
</tr>
<tr>
<td>Combined flooding</td>
<td>Loss of floodplain</td>
<td>Retention basins, setback levee</td>
</tr>
<tr>
<td>Combined flooding</td>
<td>Channel conveyance</td>
<td>Tidal restoration, geomorphic channels</td>
</tr>
<tr>
<td>Loss of marsh area</td>
<td>Wave erosion of scarp</td>
<td>Coarse beach, oyster reef</td>
</tr>
<tr>
<td>Loss of elevation capital</td>
<td>Low accretion rate</td>
<td>Strategic placement</td>
</tr>
<tr>
<td>No space to migrate marsh</td>
<td>Development up to levee</td>
<td>Horizontal levee</td>
</tr>
<tr>
<td>Subsided areas behind levee</td>
<td>Diking and draining of marshes</td>
<td>Reconnect to creeks, warping</td>
</tr>
</tbody>
</table>
Vulnerability

Data from BayWave
Physical Processes & Drivers

Also **sediment load**
(see large map)
Conceptual phasing of measures triggered by sea-level rise, rather than a chronological timeline (adapted from Goals Project 2015).
TECHNICAL FEEDBACK

- Technical Advisory Committee
  - Peter Baye, Coastal Ecologist
  - Mark Stacey, UC Berkeley
  - Roger Leventhal, Marin County Flood
  - Kristina Hill, UC Berkeley
  - Andy Gunther

- Regional Advisory Committee
  - Luisa Valiela, EPA
  - Naomi Feger, RB2
  - Lindy Lowe, formerly BCDC
  - Matt Gerhart, SCC
  - Caitlin Sweeney, SFEP
  - David Lewis, Save the Bay
• Develop a primer on how bayshore projects can be designed and optimized to achieve multiple benefits

• **Develop a system for describing the variety of shorelines around the estuary**

• Based on steps 1 and 2, develop guidelines for nature-based adaptation measure that increase resilience of the Estuary
Possible Ties to the CCMP

Action 14: Characterize shoreline

Action 1: Watershed-scale approach
THANK YOU

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Thanks to our team:  
Katie McKnight, Sam Safran, Letitia Grenier
Laura Tam, Sarah Jo Szambelan, SPUR

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SF Bay Regional Water Quality Control Board (thank you!)

RESILIENCE.SFEI.ORG
**Action 1**

*Develop and implement a comprehensive, watershed-scale approach to aquatic resource protection.*

**Task 1.1**

Develop a written framework that explains the need for watershed-based aquatic resource protection.

**Task 1.2**

Develop criteria to evaluate watersheds that could be used to pilot the framework.

**Task 1.3**

Plan and initiate the pilot project with a steering committee of local, regional, and federal agencies.

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CWA Section 404 guidance, proposed Section 401 procedures, and SWRP guidance provide core federal and Ca state rationale, plus opportunities to standardize methods for evaluation and tracking.

SCVWD One Water Program with established watershed monitoring (Coyote Creek), plus Marin County holistic approach to climate change adaptation (upper Richardson Bay) are two possible starting points with willing partners for pilot projects.

OLUs can provide the spatial template for multi-jurisdictional, multi-benefit, adaptive resource planning and management; both candidate pilot venues are aligned with proposed OLUs.
Task 1.1

*Draft argument for a framework.*

- Watershed management around the Bay is conventionally parsed among four environmental objectives: flood control, water quality control, water supply, and habitat conservation.
- These four objectives have inherent conflicts necessitating tradeoffs that can only be defined and resolved at the watershed scale.
- The resolution of conflicts among the plans requires their coordination from inception to implementation.
- Coordination will require a shared vision of watershed health that can be translated into numerical metrics of status and trends.
- Population growth and accelerating climate change increase the need for coordination to assure that management actions, including regulatory review and permitting, are timely and effective.
- Without coordinated, watershed-based management of aquatic resources, their planning will lag ever further behind environmental change, and eventually fail.
- Operational Landscape Units (OLUs) can serve as the spatial template to implement the framework.
Task 1.2

*Emerging criteria to assess watersheds.*

- Watersheds can be assessed based on status and trends for selected metrics relative to target conditions for compatible objectives (SFEP SotER, SCVWD One Water).

![Graph showing percent of target condition and metrics of condition.

Gray area is difference between target and existing conditions.

Could represent one or more OLUs or whole region.

Width of bar is relative to metric importance.}
Task 1.2
Details from watershed approach to compensatory mitigation

Metric might be the width of tidal marsh relative to needed width to protect shoreline from Bay waves.
Task 1.3

Plan and initiate the pilot project.

- Candidate pilots (Coyote Creek and upper Richardson Bay) focus on water quality, flooding, sediment supply, and aquatic/wetland/riparian habitat connections between the Bay and local watersheds, in the context of climate change.

- Candidate pilots do not focus on water supply, land development, recreation, or other social aspects of watershed health, except perhaps through compensatory mitigation for unavoidable impacts. Social aspects can be added to the framework as goals and metrics are decided.

- Candidate pilots ignore terrestrial habitats and species. Linkage to terrestrial ecology may be possible through HCP/NCCP of USFWS and CDFW (Coyote Creek) and One Tam of TLC (Richardson Bay).

- OLUs are scientifically sound. How to use them to align policies and programs must be decided.

TLC: California State Parks, Marin County Parks, Marin Municipal Water District, National Park Service, Golden Gate National Parks Conservancy
Action 1
*Develop and implement a comprehensive, watershed-scale approach to aquatic resource protection.*

Policies to protect water quality, water supplies, habitat, and to manage flood risks

Policies to protect habitat, navigation, and to manage sea level rise