Future Conditions coastal hazard modeling and mapping

Presented by

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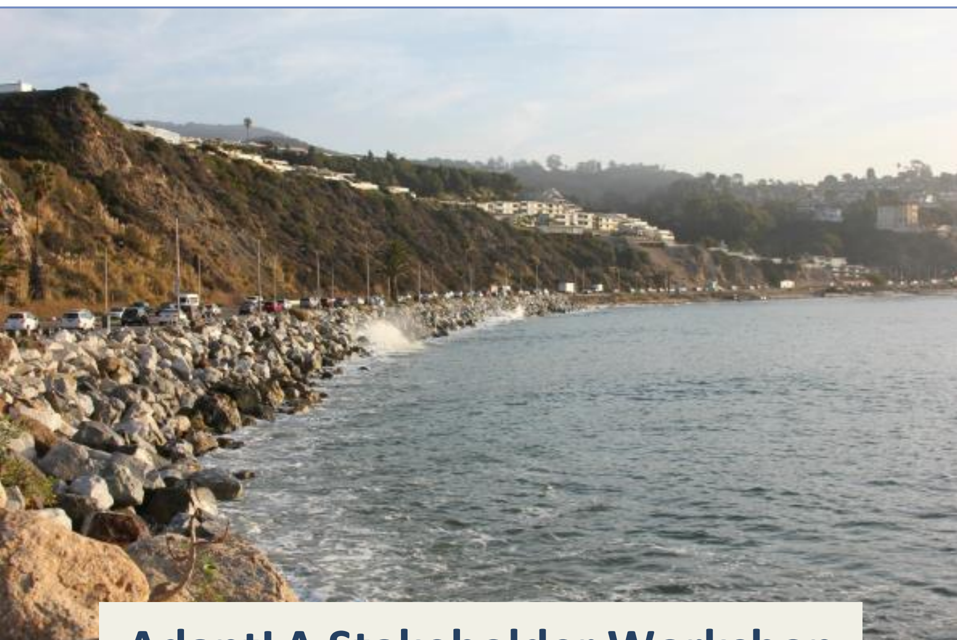
Environmental Science Associates, Inc. (ESA)

On behalf of the physical processes team

(USGS, TerraCosta-Scripps, ESA)



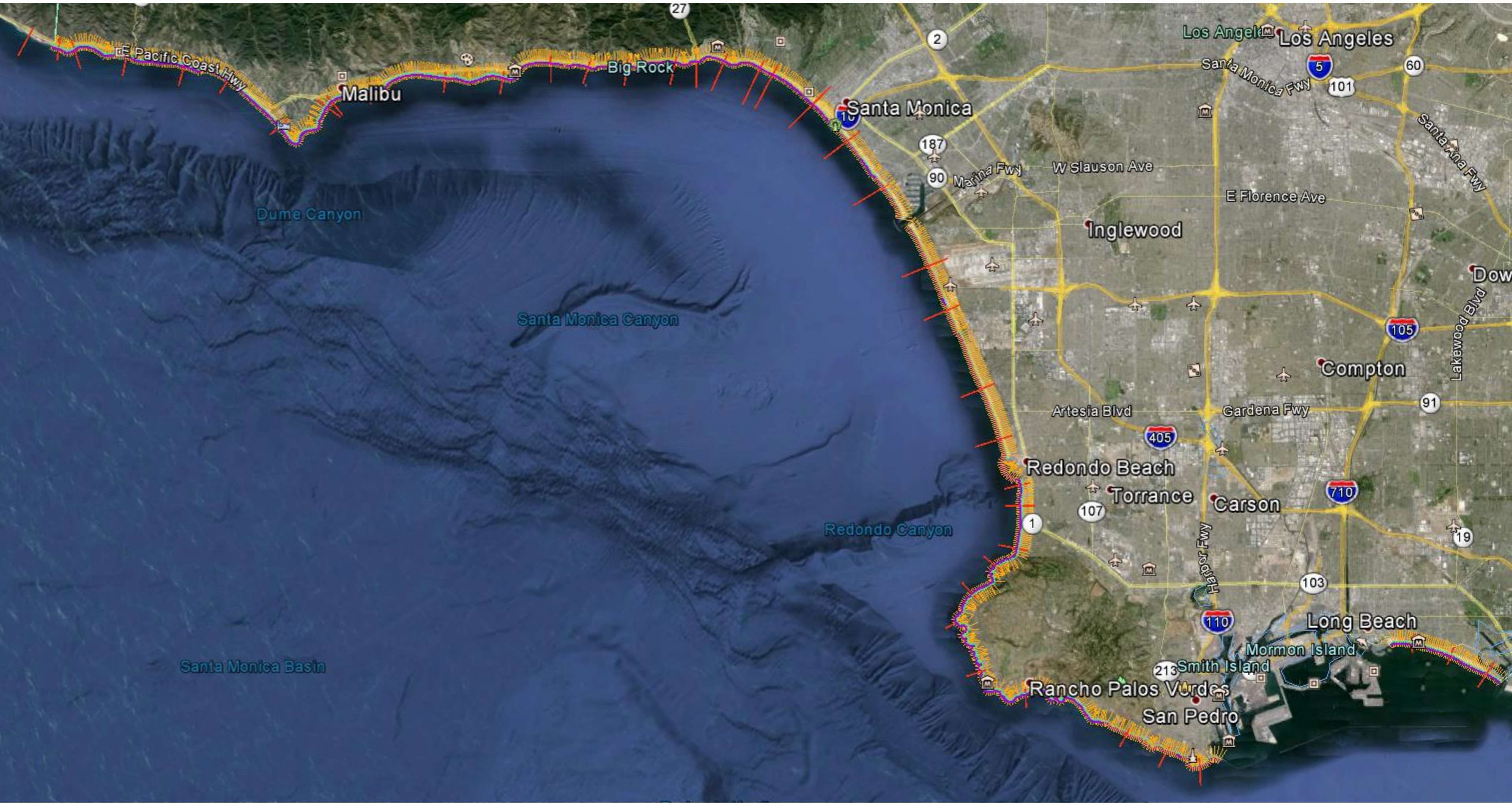
AdaptLA Stakeholder Workshop

October 21, 2015

Annenberg Community Beach House

Santa Monica

Study Area – Los Angeles County Coastal Floodplain



Overview – potential discussion items

Schedule – Complete by September 2016

Deliverables –

- Brief technical report
- GIS shape files
- List of known infrastructure exposed to mapped hazards

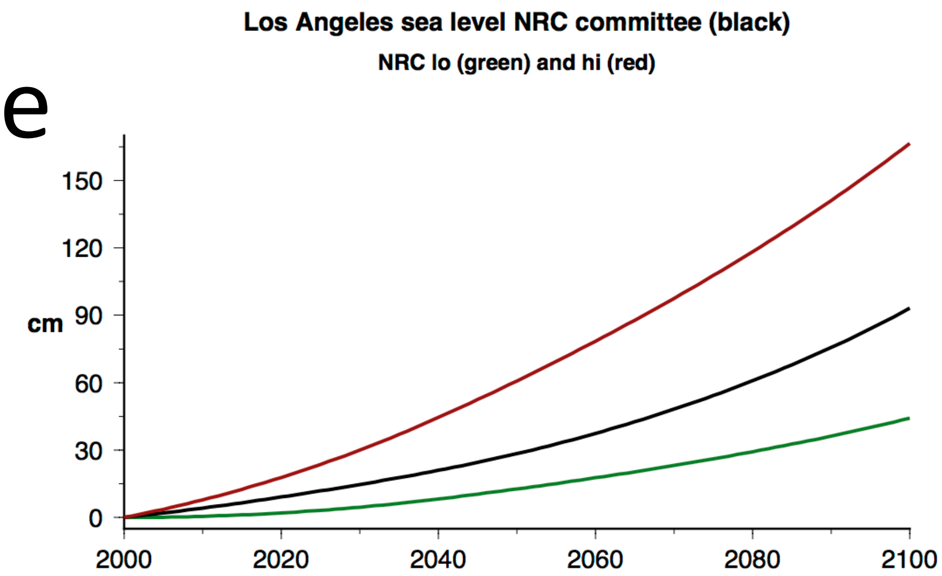
Use of outputs – under discussion:

- Requires GIS system and operator, or
- Web-viewing options

Coastal armoring (seawalls) are a consideration:

- Where are they ?
- How effective is the armoring ? Will they be maintained ?
- What happens to the shore in front of the seawalls ?
- How to address in mapping ?

Sea Level Rise



Los Angeles, California
(change from year 2000 in cm)

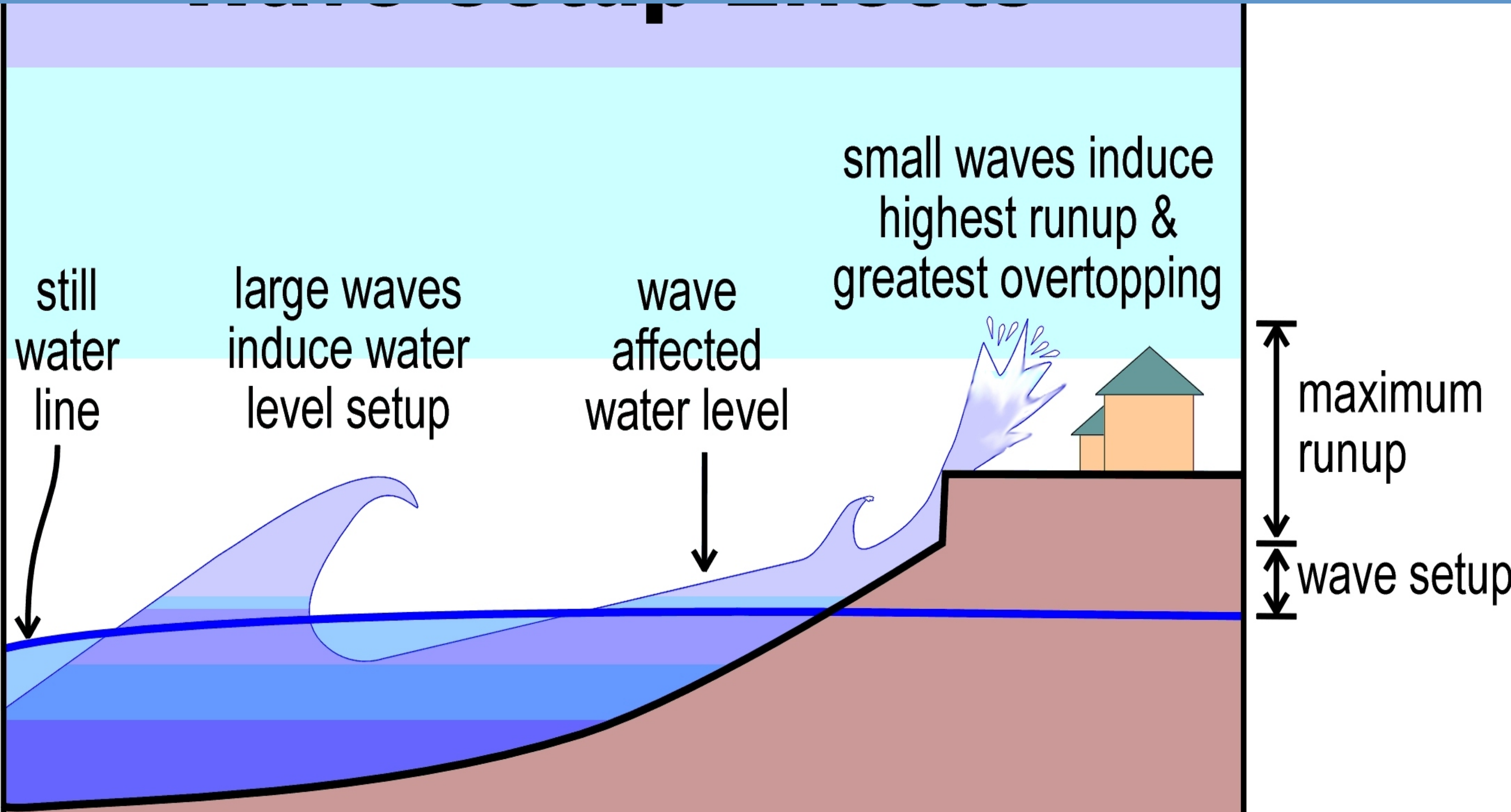
SOURCE:
National Research Council, 2012, table 5.3

Year	Low	Middle (committee)	High
2000	0.0	0.0	0.0
2030	4.6	14.7	30.0
2050	12.7	28.4	60.8
2100	44.2	93.1	166.5

Coastal Flooding

- Coastal Flood Source
  - High ocean water level
    - Direct to harbors with surface water connection
    - Via groundwater to low-lying backshores
  - Wave runup, can overtop natural and built coastal barriers, especially when eroded / damaged, and reach backshore areas
- Estuarine flood source
  - Combined flooding – rainfall runoff and groundwater, high receiving waters, reduced drainage
- Local rainfall – direct precipitation
- Fluvial flooding – creek and river flows (sometimes culverts)

Total Water Level (response parameter) depends on the simultaneous Ocean water levels and incident waves (forcing parameters)

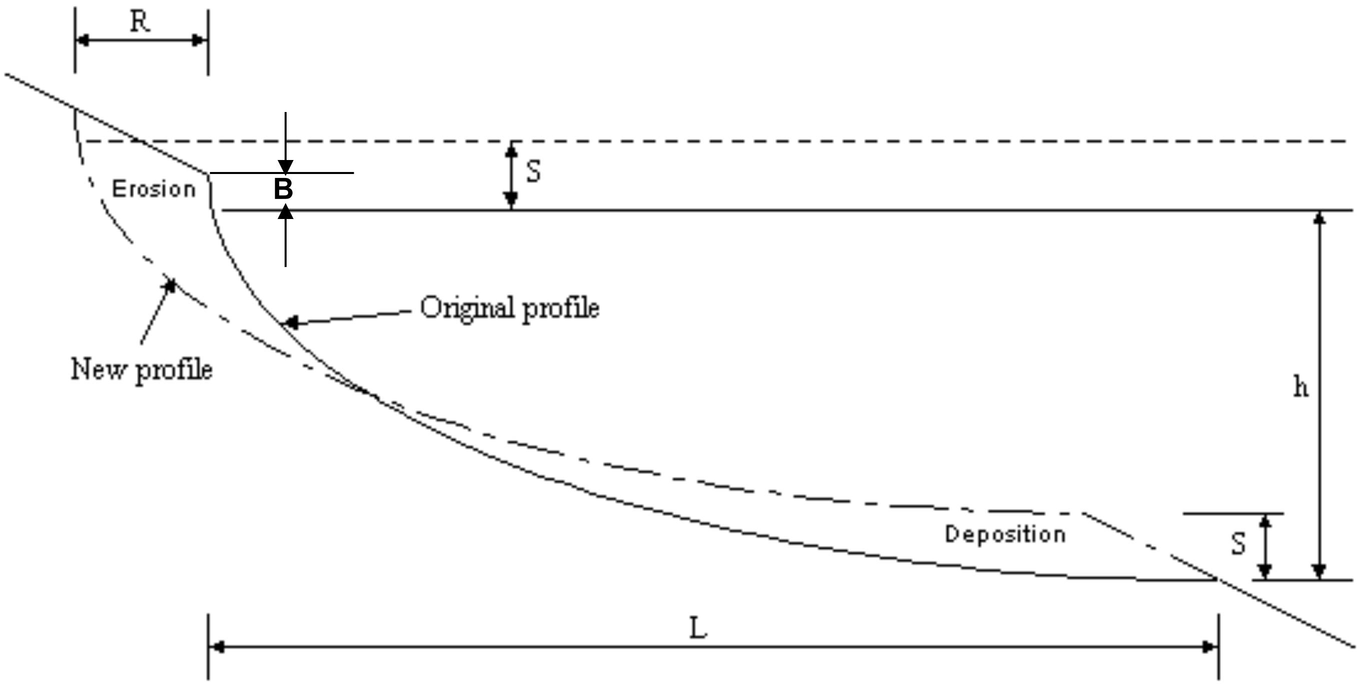


Some water level components are affected by meteorology and climate conditions also associated with waves. Therefore there is a non-random probability that high water levels and waves will occur at the same time….but not all the time

Sea-Level Rise - Shoreline Response

Applied geomorphology is required to predict shore response.
Sea level rise induces shore transgression, with the water-shaped shore migrating up and inland. The result is dependent on:

- shore geometry,
- sediment type and supply,
- back shore conditions,
- rate of sea level rise, and
- hydraulic power.



$$R = S\left(\frac{L}{h+B}\right)$$

S = sea level rise
R = recession
h = depth of active profile
L = length of active profile
B = berm height

source: estuary-guide.net

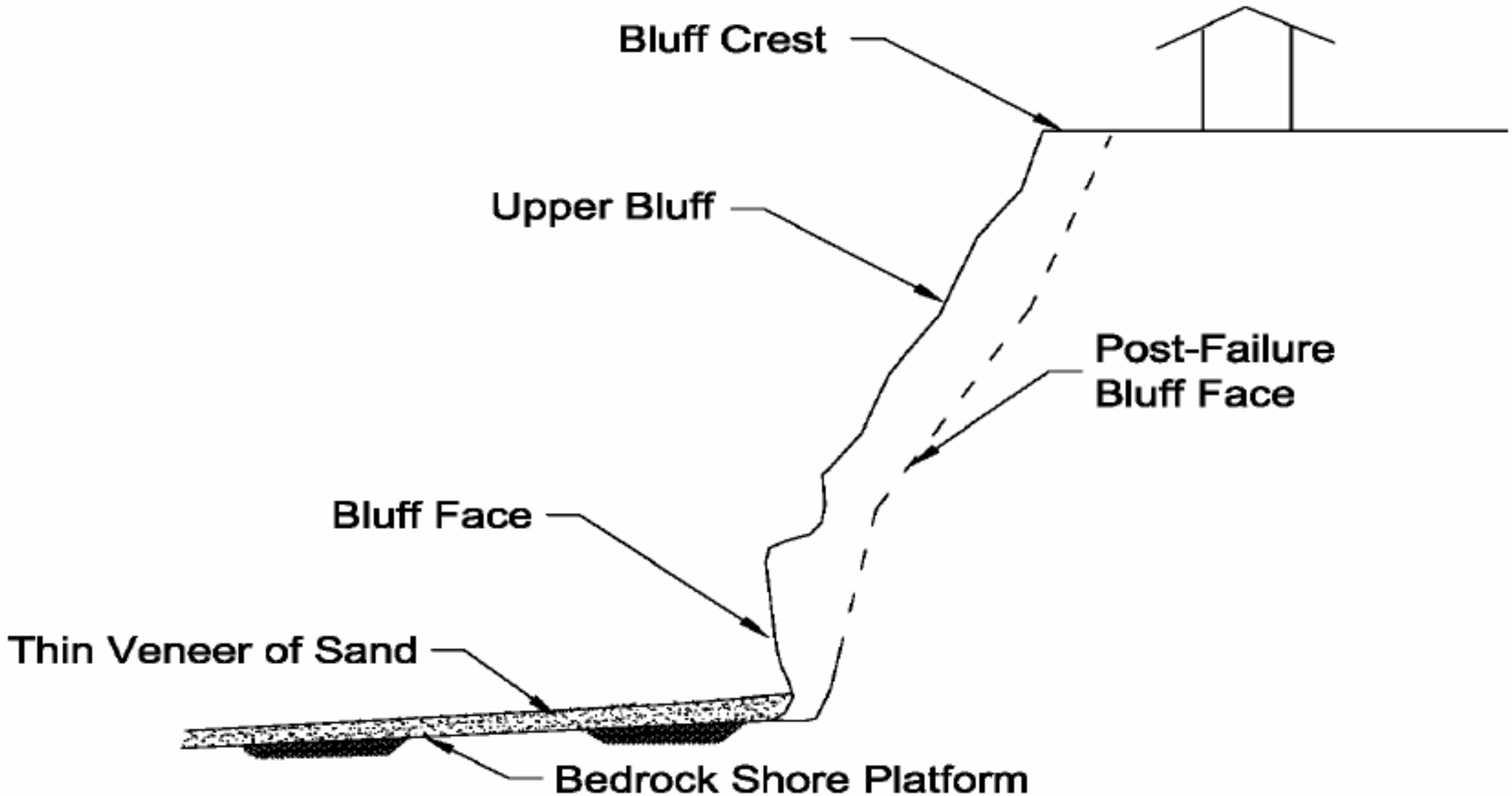
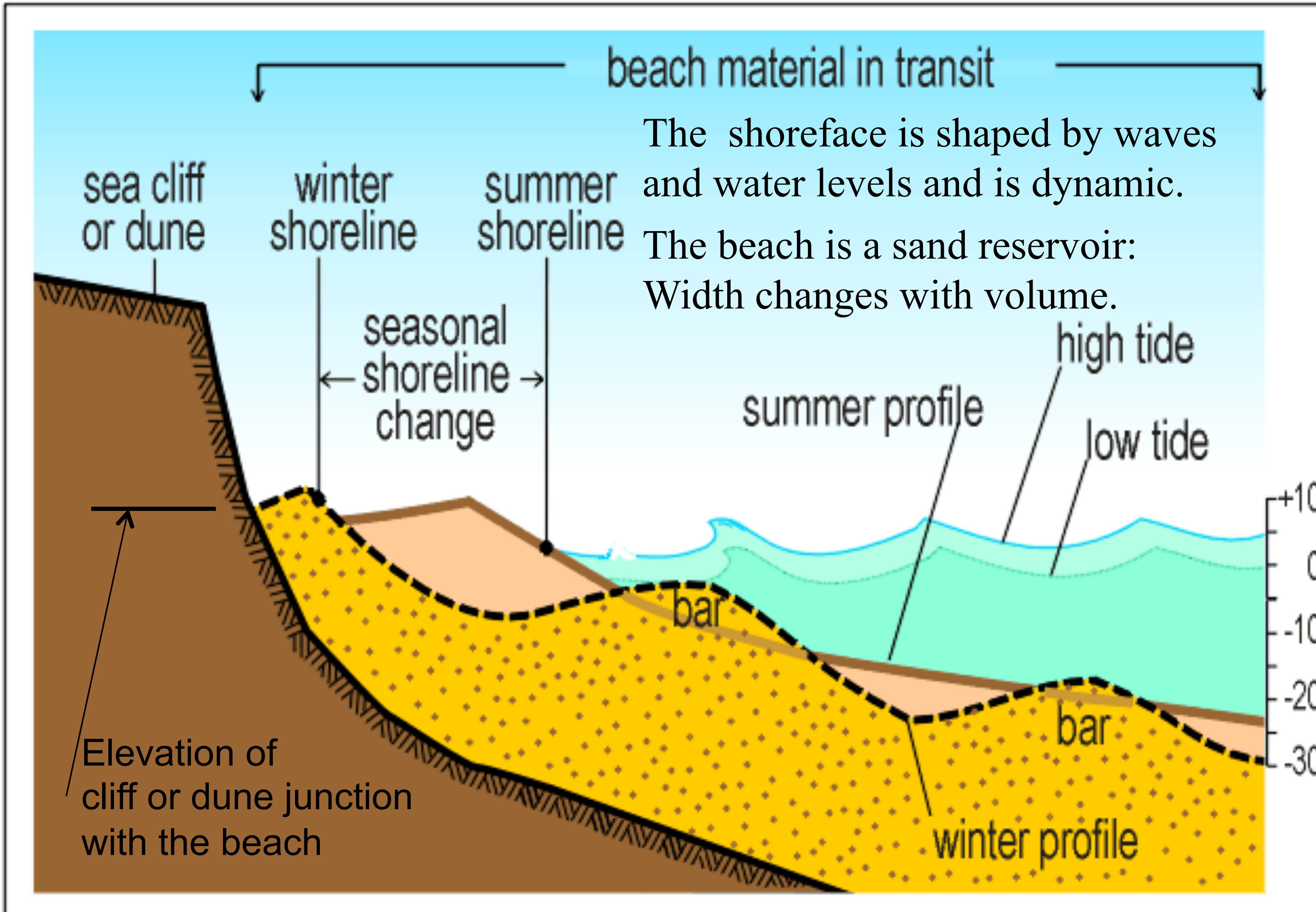
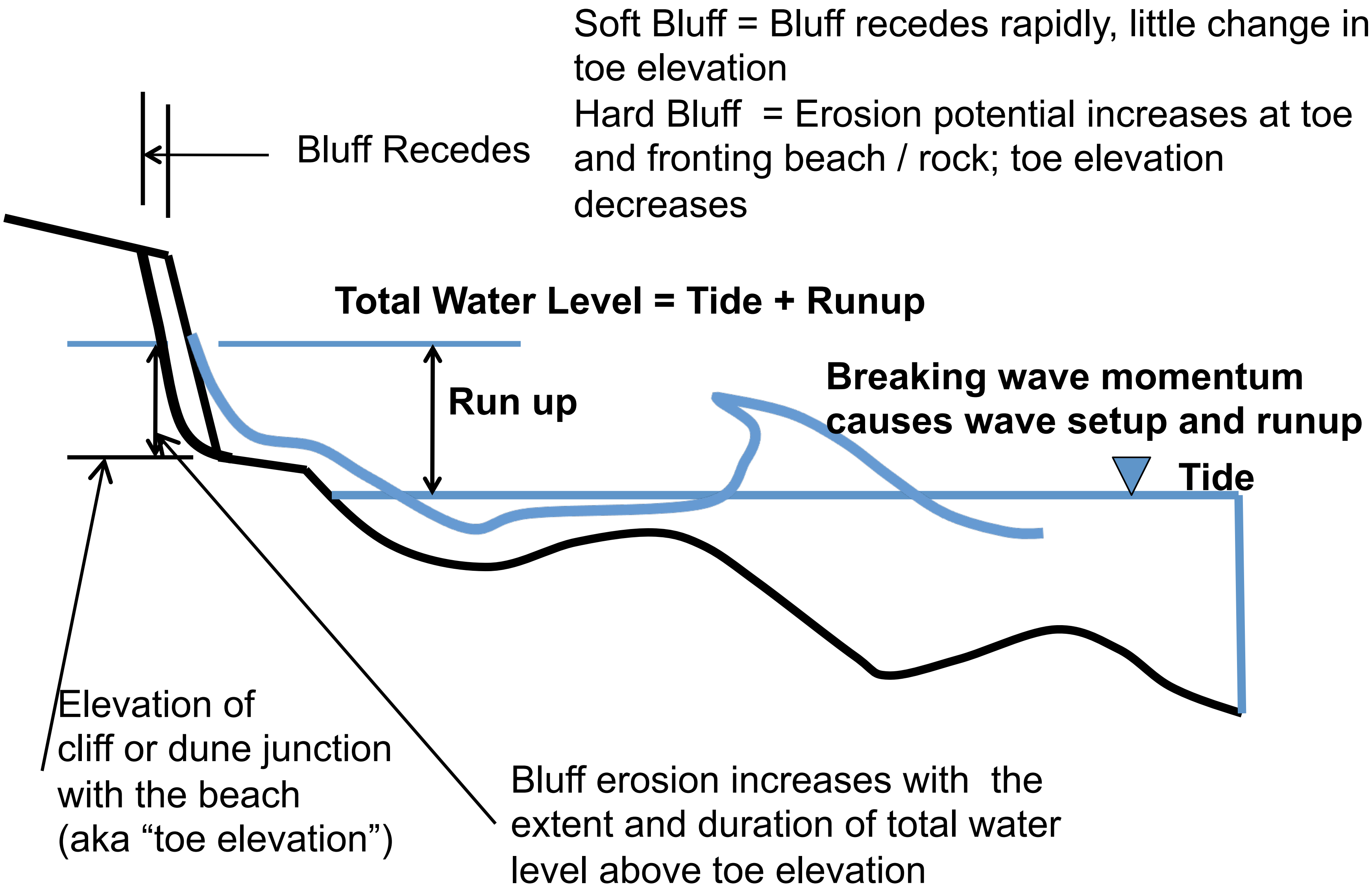


Figure D.4.6-31. Typical Erodible Bluff Profile Fronted by Narrow Sand-capped Beach

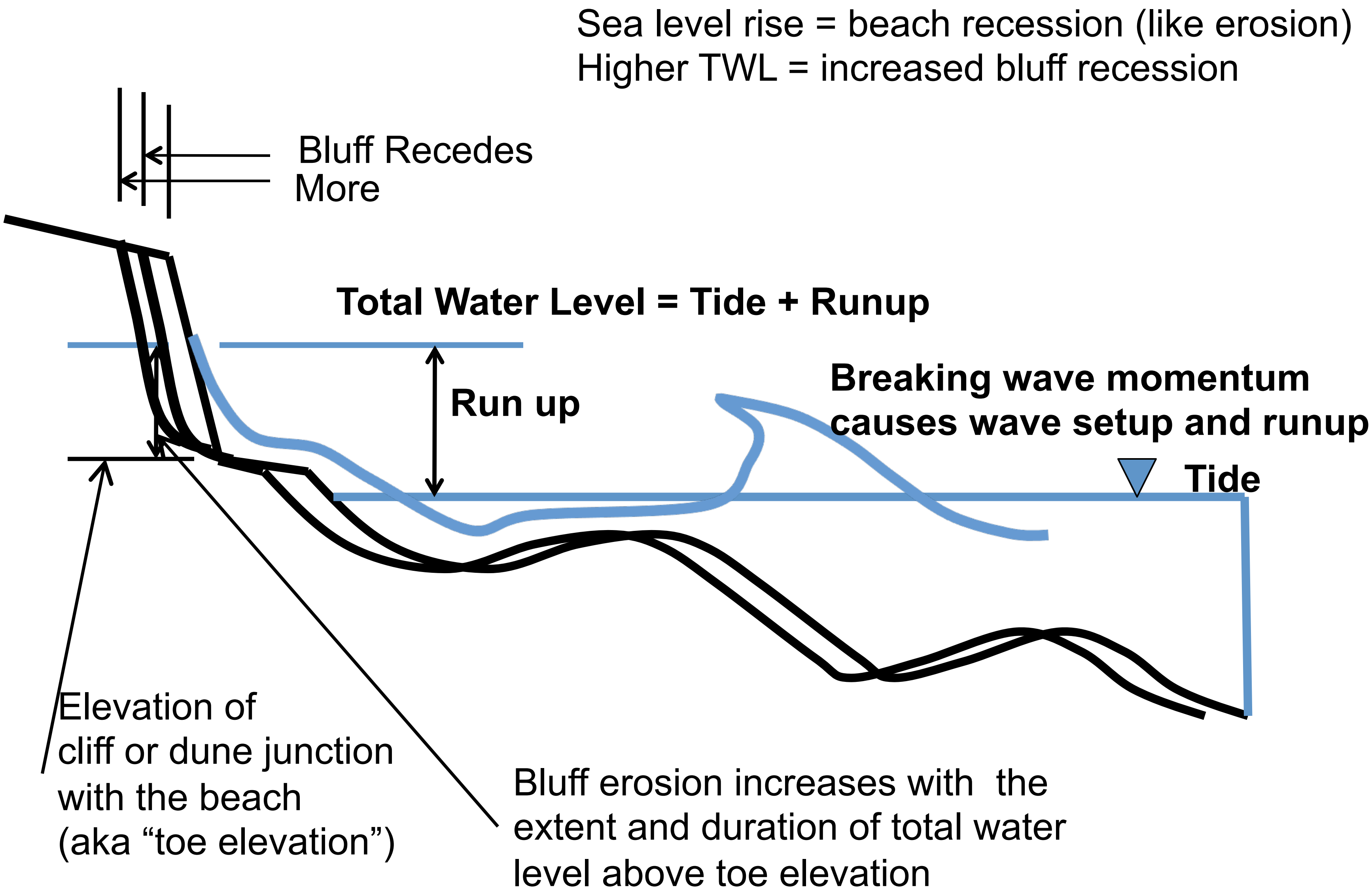
Source: FEMA, Guidelines for Pacific Coast Flood Studies, 2005

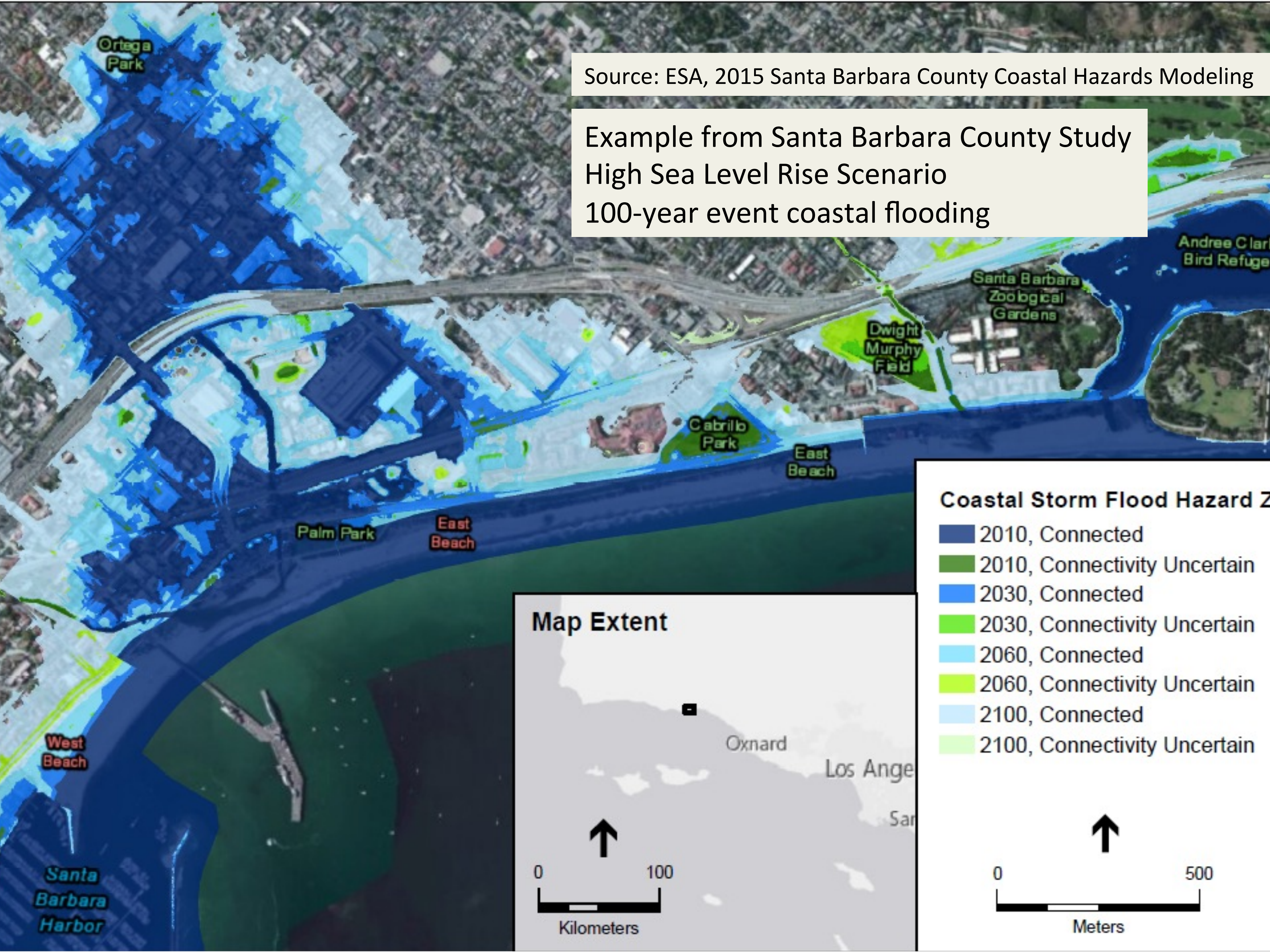

beach material in transit
The shoreface is shaped by waves and water levels and is dynamic.
The beach is a sand reservoir: Width changes with volume.
sea cliff or dune
winter shoreline
summer shoreline
seasonal shoreline change
high tide
summer profile
low tide
+10
0
-10
-20
-30
bar
bar
winter profile
Elevation of cliff or dune junction with the beach

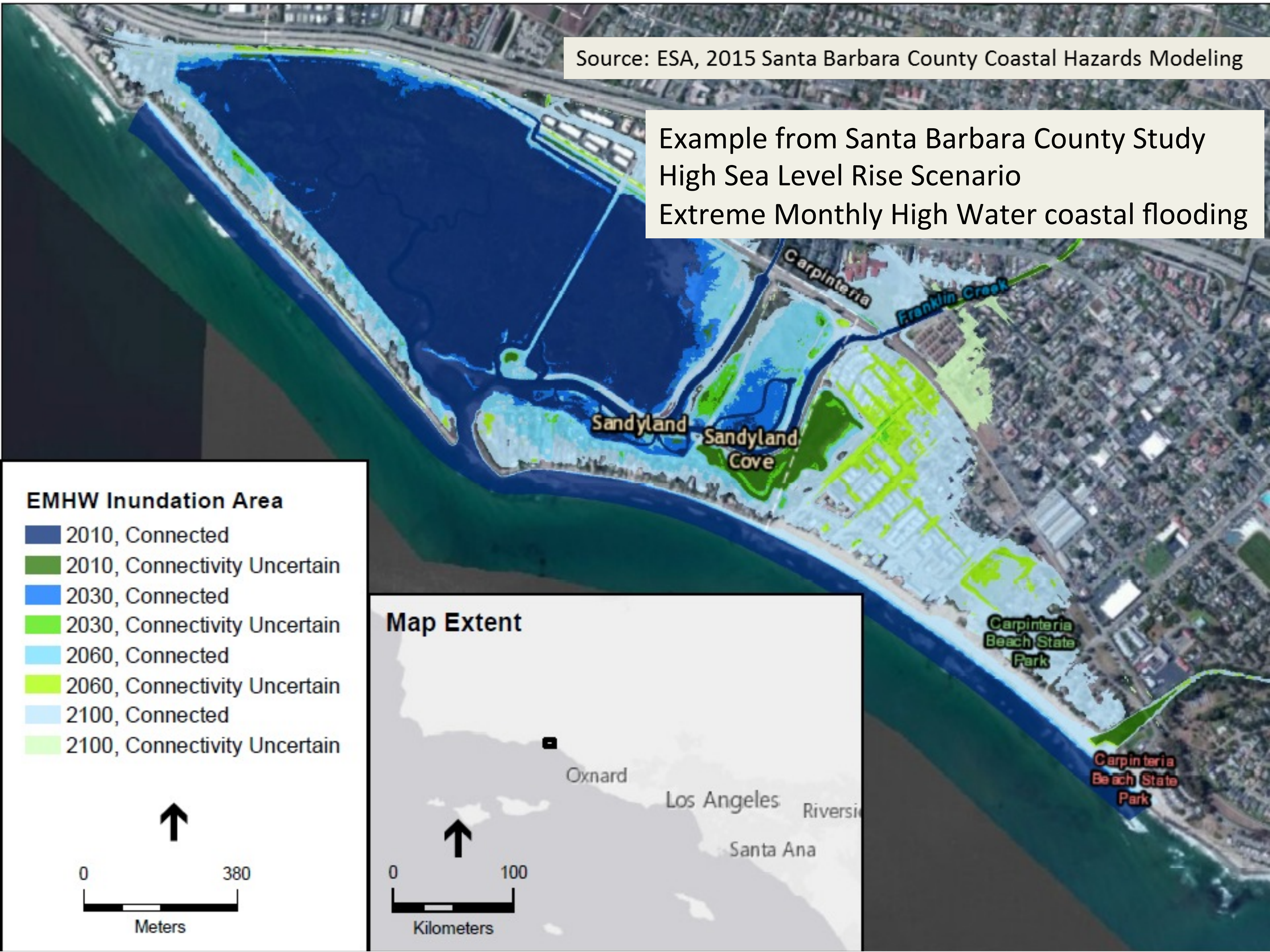
Conceptual Model of Bluff Erosion

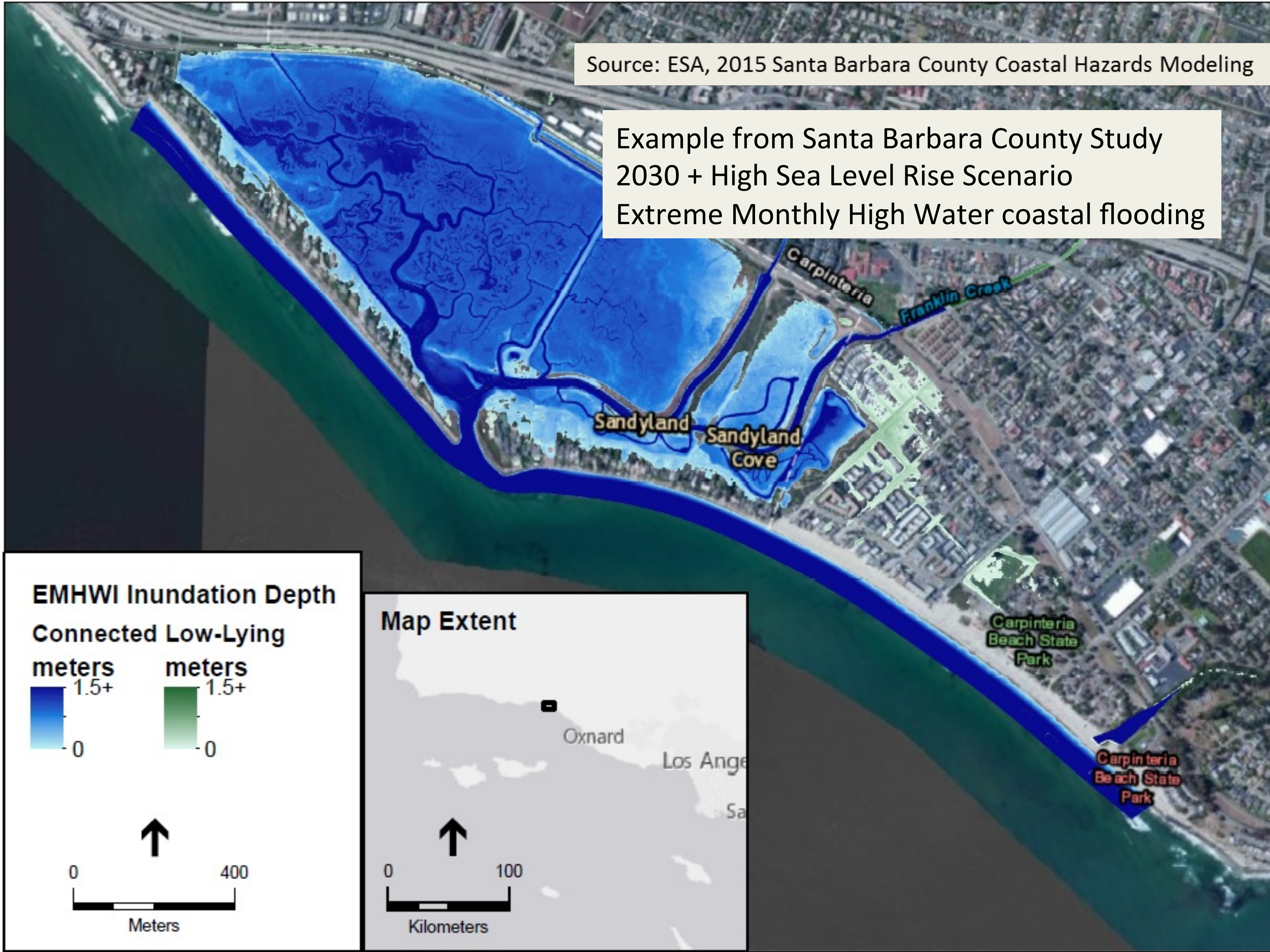


Sea Level Rise Increases Erosion



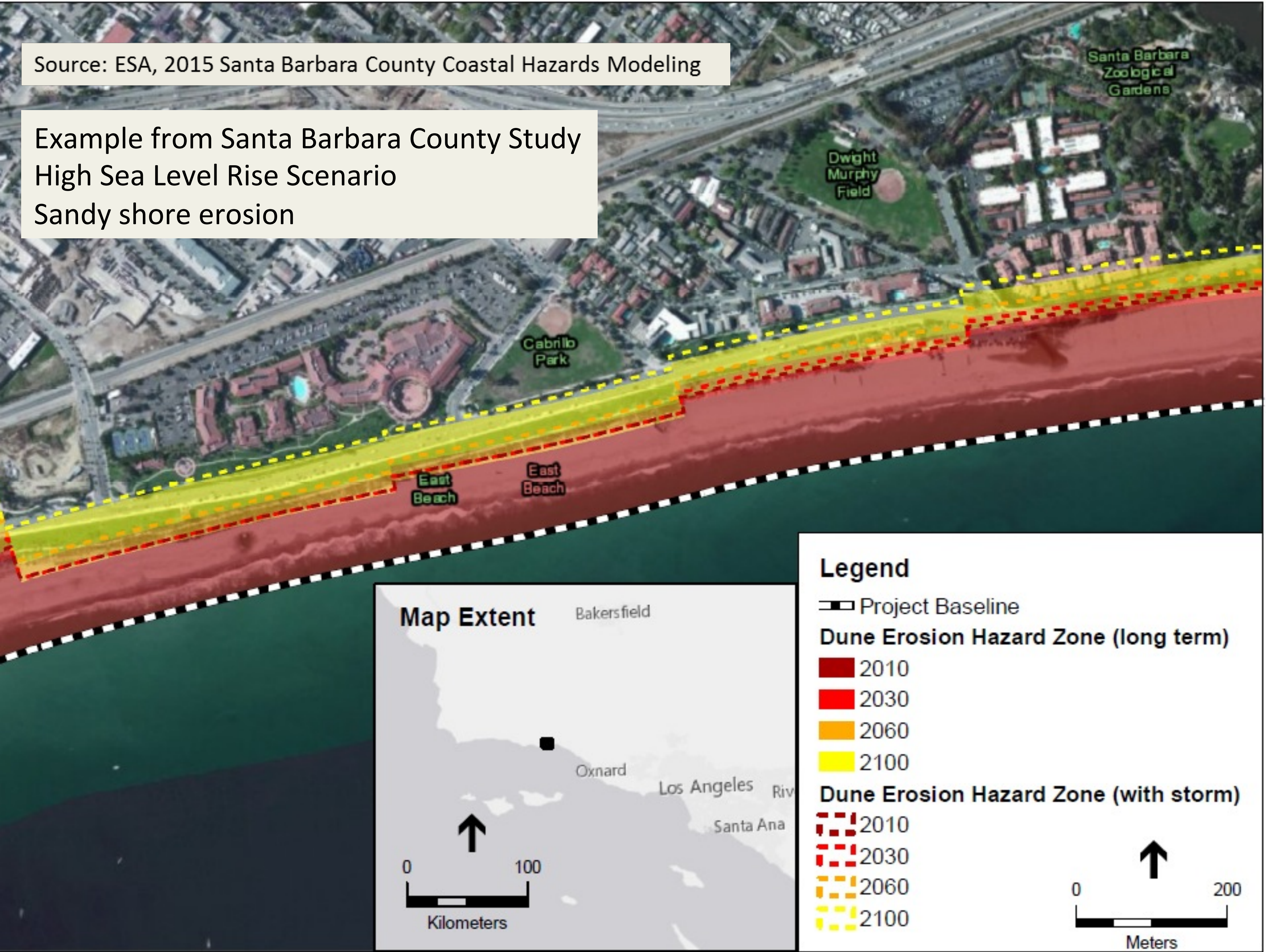

Source: ESA, 2015 Santa Barbara County Coastal Hazards Modeling
Example from Santa Barbara County Study
High Sea Level Rise Scenario
100-year event coastal flooding
Ortega Park
Andree Clar
Bird Refuge
Santa Barbara Zoological Gardens
Dwight Murphy Field
Cabrillo Park
East Beach
Palm Park
East Beach
West Beach
Santa Barbara Harbor
Map Extent
Oxnard
Los Ange
Sa
0
100
Kilometers
Coastal Storm Flood Hazard Z
2010, Connected
2010, Connectivity Uncertain
2030, Connected
2030, Connectivity Uncertain
2060, Connected
2060, Connectivity Uncertain
2100, Connected
2100, Connectivity Uncertain
0
500
Meters

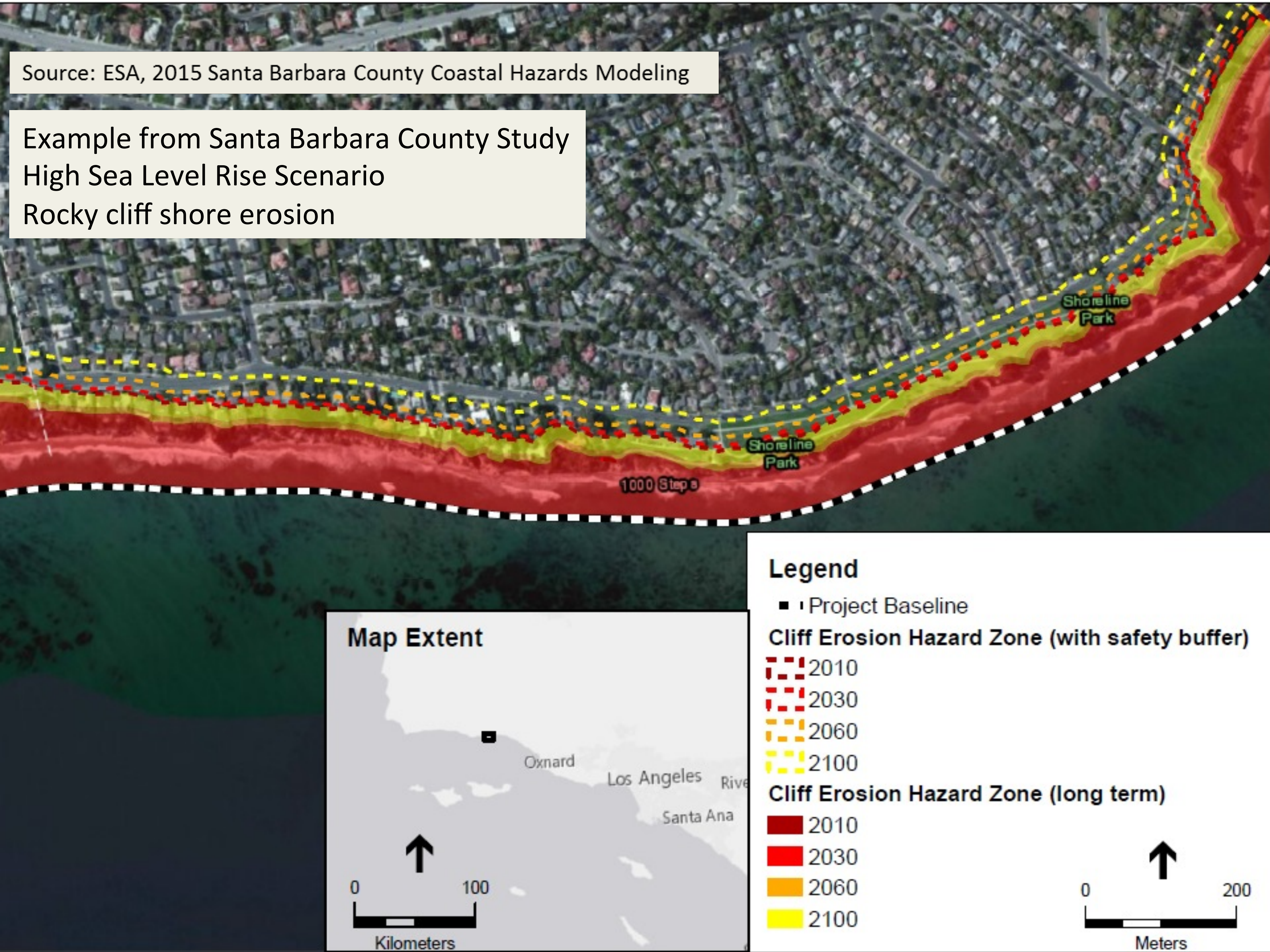

Source: ESA, 2015 Santa Barbara County Coastal Hazards Modeling
Example from Santa Barbara County Study
High Sea Level Rise Scenario
Extreme Monthly High Water coastal flooding
Carpinteria
Franklin Creek
Sandyland
Sandyland Cove
Carpinteria Beach State Park
Carpinteria Beach State Park
EMHW Inundation Area
2010, Connected
2010, Connectivity Uncertain
2030, Connected
2030, Connectivity Uncertain
2060, Connected
2060, Connectivity Uncertain
2100, Connected
2100, Connectivity Uncertain
0
380
Meters
Map Extent
Oxnard
Los Angeles
Riversi
Santa Ana
0
100
Kilometers


Source: ESA, 2015 Santa Barbara County Coastal Hazards Modeling
Example from Santa Barbara County Study
2030 + High Sea Level Rise Scenario
Extreme Monthly High Water coastal flooding
Carpinteria
Franklin Creek
Sandyland
Sandyland Cove
Carpinteria Beach State Park
Carpinteria Beach State Park
EMHWI Inundation Depth
Connected
meters
1.5+
0
Low-Lying
meters
1.5+
0
0
400
Meters
Map Extent
Oxnard
Los Ange
Sa
0
100
Kilometers

Source: ESA, 2015 Santa Barbara County Coastal Hazards Modeling

Example from Santa Barbara County Study
High Sea Level Rise Scenario
Sandy shore erosion




Source: ESA, 2015 Santa Barbara County Coastal Hazards Modeling
Example from Santa Barbara County Study
High Sea Level Rise Scenario
Rocky cliff shore erosion
Shoreline Park
Shoreline Park
1000 Steps
Legend
Project Baseline
Cliff Erosion Hazard Zone (with safety buffer)
2010
2030
2060
2100
Cliff Erosion Hazard Zone (long term)
2010
2030
2060
2100
0
200
Meters
Map Extent
Oxnard
Los Angeles
Santa Ana
0
100
Kilometers

Speaker: Bob Battalio

Professional Civil Engineer (CA,WA,LA,OR)
Coastal Processes training from UC Berkeley, 1985
Chief Engineer, Vice President @ ESA, San Francisco
Engineering Criteria Review Board, BCDC

Practices Coastal Zone Engineering and Management

Vice President, California Shore and Beach Preservation Association (Non profit)

Surfer