

Policy Summit
"One California, One Coast"

Nature Based & Hybrid Adaptation Measures

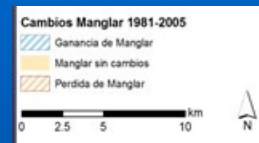
Dr. Claudia Avendano

Claudia Avendano,
Vice President
Coastal Adaptation Planning
Coastal Environments La Jolla, CA

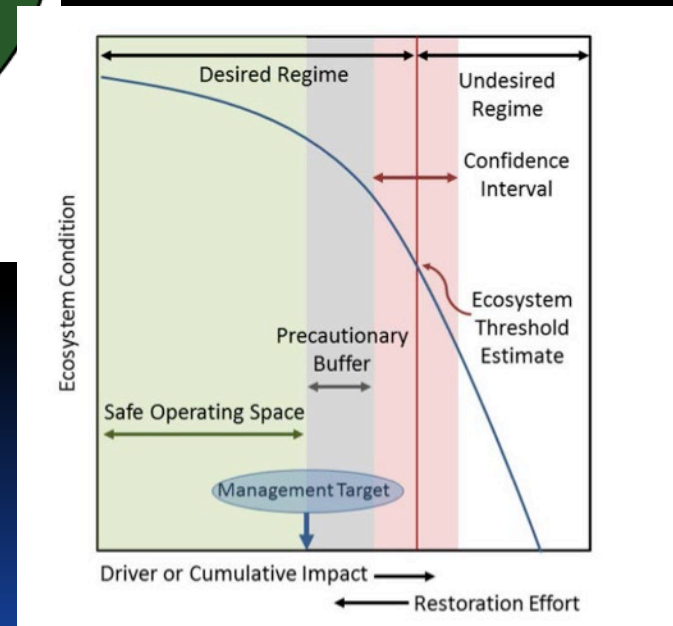
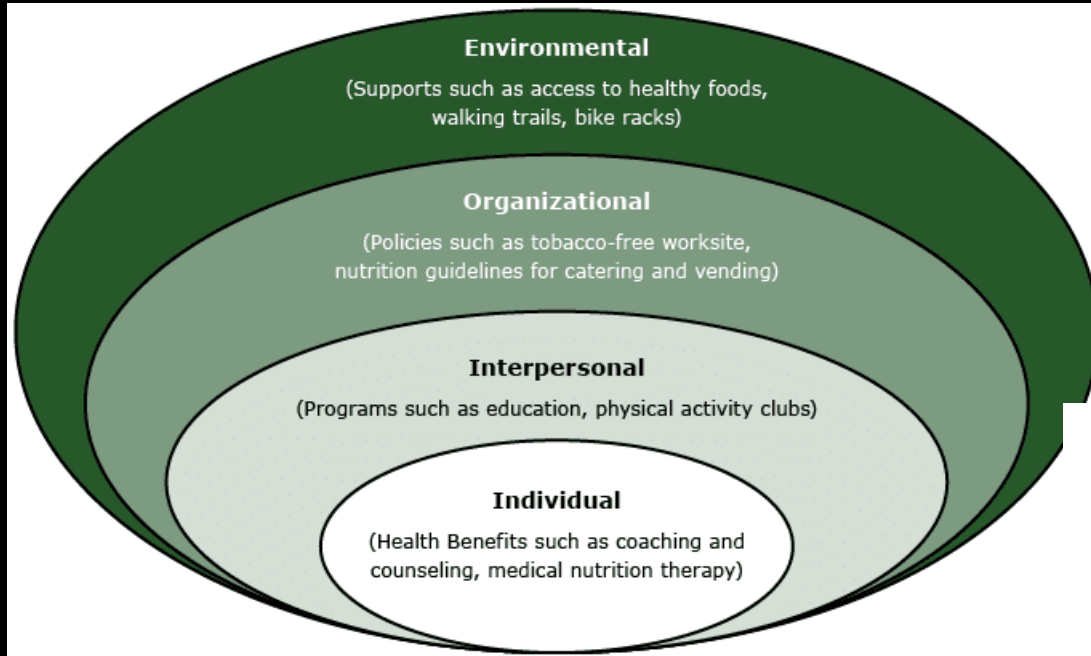


USC

Living shoreline is the shoreline that is alive,
Is a shoreline that moves, that changes, that gives life,
That sustains life
CPM



Optimal Health of the Socio-Ecological System



The levels of influence from the socio-ecological model with examples of intervention strategies recommended in Prevention Partners' Work Healthy America and the CDC Worksite Health Score Card. https://www.researchgate.net/figure/The-levels-of-influence-from-the-socio-ecological-model-with-examples-of-intervention_fig1_308713352

(DPSIR) Analysis Climate Change: System State

- Current Stage: Brackish water two open mouths

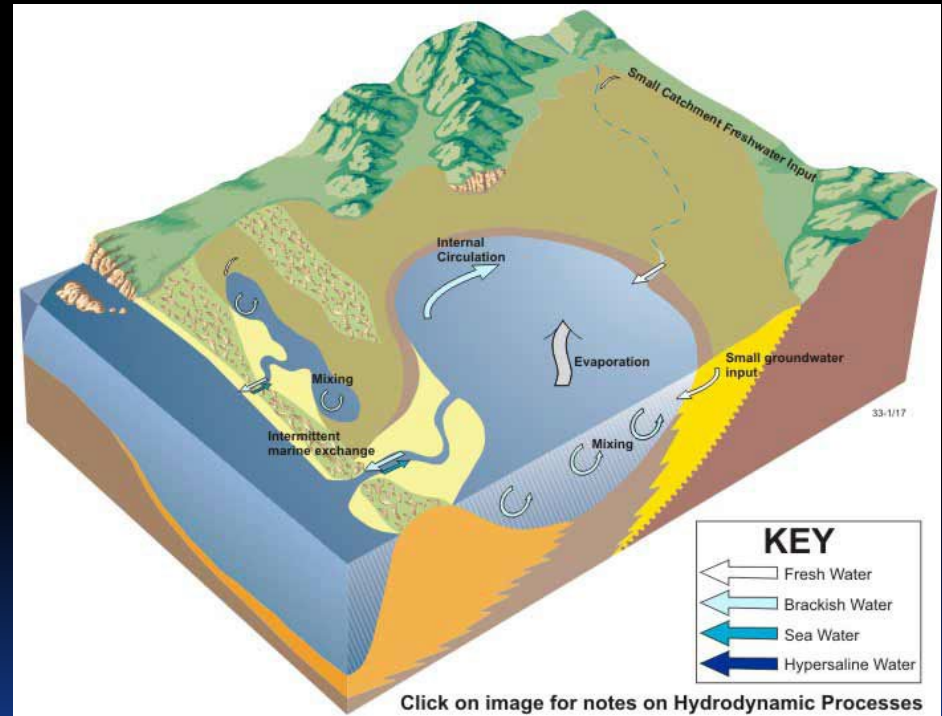
- Sandbar closure
 - Fresh water raining season
 - Hyper salinity dry season



- Dune Erosion
- Sediment Deficit
- Coastal Retreat



- Sand bar rupture
 - Change to marine conditions



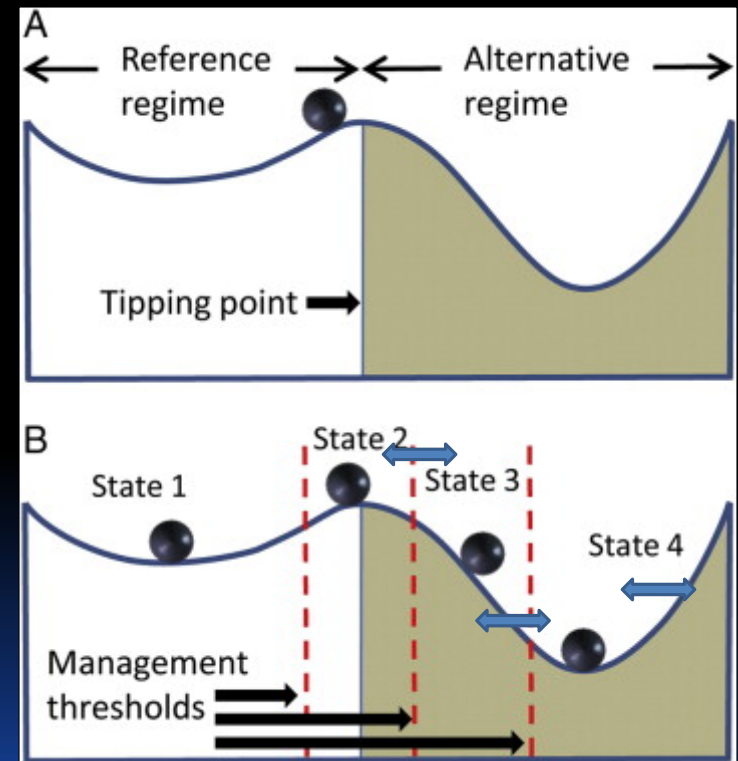
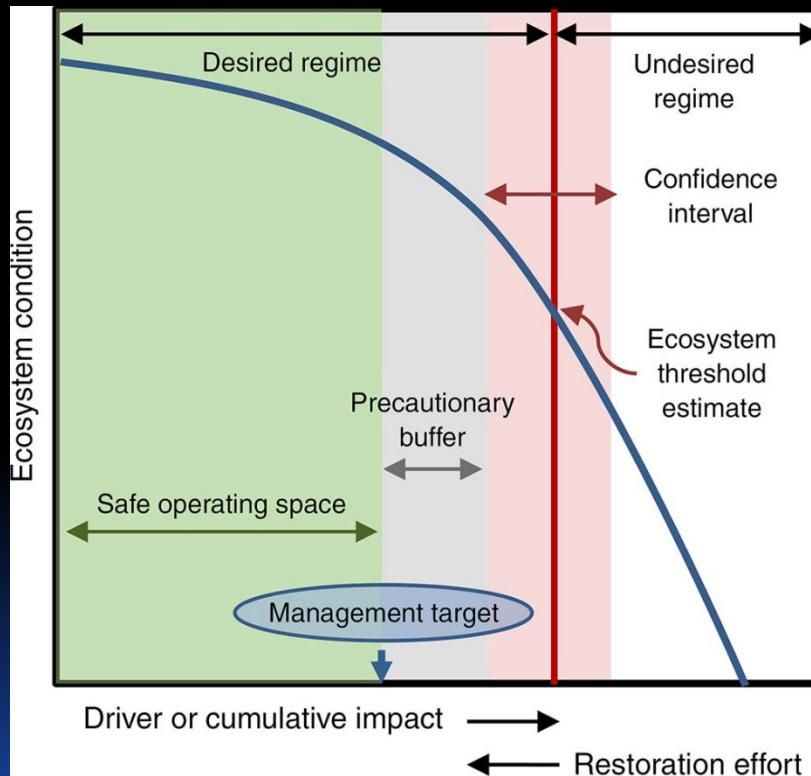
Tipping Points and Turning Points

Tipping Points:

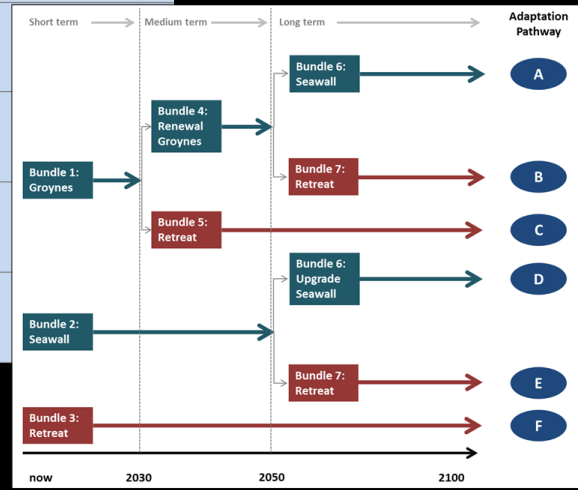
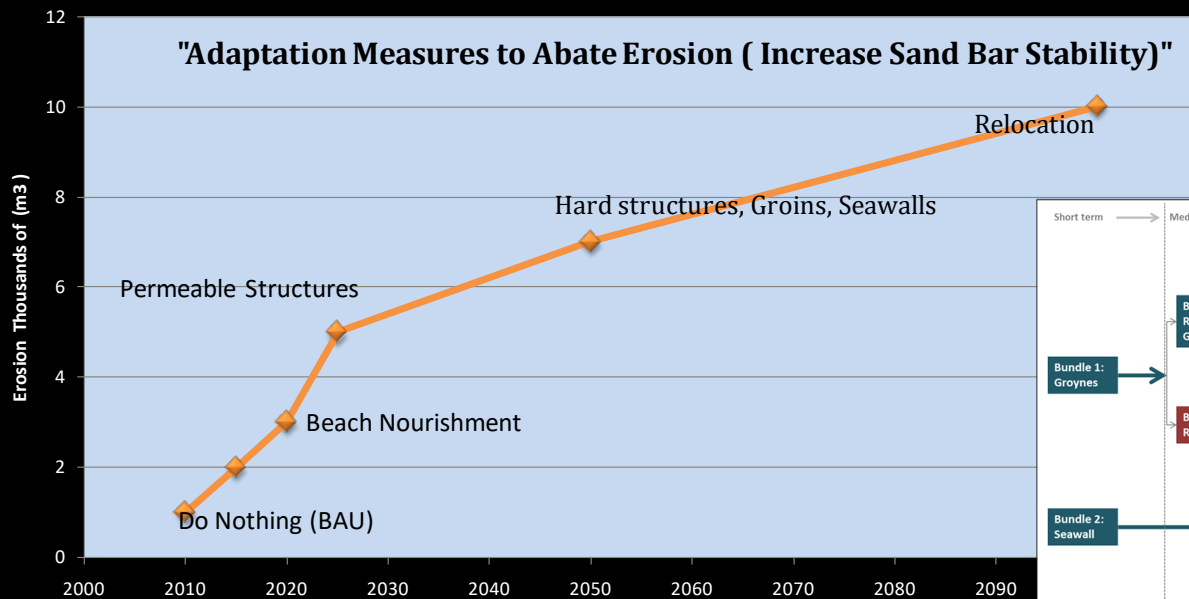
Permanent changes in natural system state

Turning Points:

Permanent changes in anthropogenic system state



Inventory of Adaptation Measures Sandbar Stability



- Linear progression?
- Modular combination?
- What is more efficient?

GREEN - SOFTER TECHNIQUES

Living Shorelines

VEGETATION ONLY - Provides a buffer to upland areas and breaks small waves. Suitable for low wave energy environments.

EDGING - Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.

SILLS - Parallel to vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.

BREAKWATER - (vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.

GRAY - HARDER TECHNIQUES

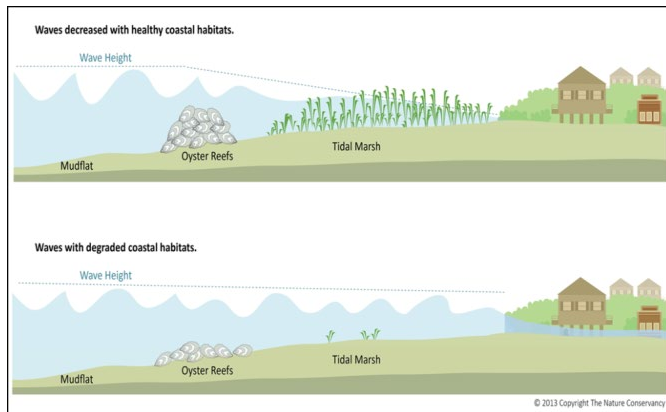
Coastal Structures

REVTMENT - Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with existing hardened shoreline structures.

BULKHEAD - Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for high energy settings and sites with existing hard shoreline structures.

Examples Adaptation Measurements World Wide (IV)

**Integrated Adaptation Measurements,
Multiple and Combined Adaptation Measurements
Scalable Adaptation Measurements,**



Adaptation Measures Mangrove Resiliency

Objectives:

To reduce mangrove exposure to erosion and to preserve or increase total mangrove coverage

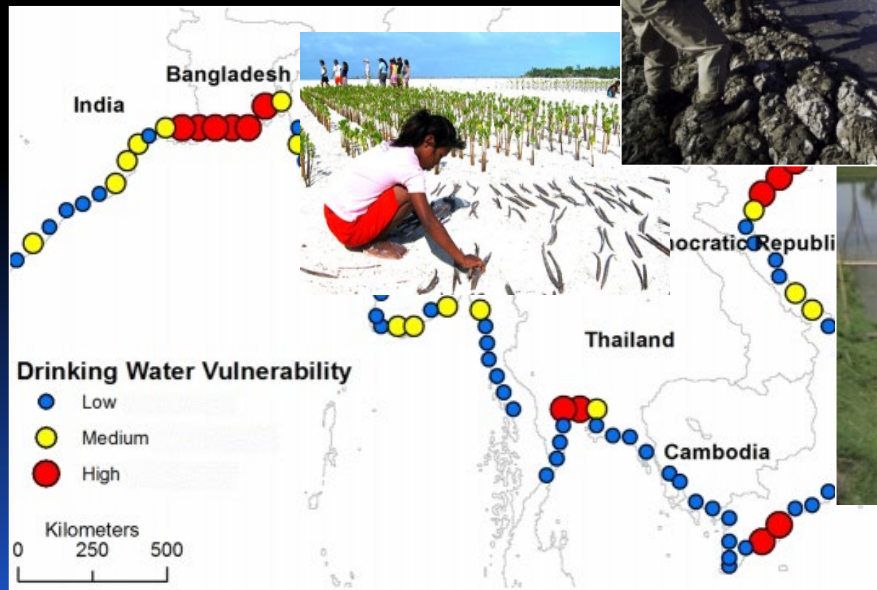
Bio-fencing

Replanting

Seeding

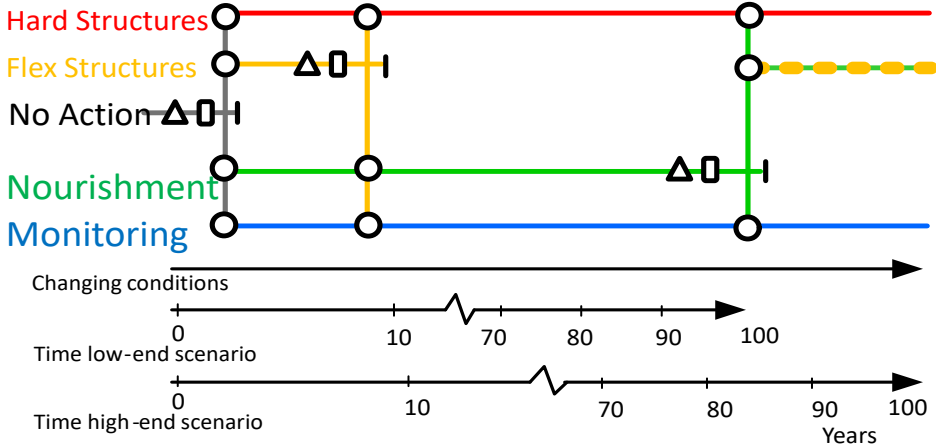
Restoration

Preservation



Scoring Adaptation Measures and Creating Sandbar Stability Pathways

An Adaptation Pathways Map for the Sandbar Management



- Transfer station to new policy action
- | Adaptation Tipping Point of a policy action (Terminal)
- Policy action effective
- △ Trigger
- Decision node

Time horizon 50 years, high-end scenario

Time horizon 100 years, low-end scenario

Pathway	Costs	Benefits	Co-benefits
1 ○	+++	+	0
2 ○ ○	+++++	0	0
3 ○ ○	+++	0	0
4 ○ ○	+++	0	0
5 ○	0	0	-
6 ○ ○	++++	0	-
7 ○ ○	+++	0	-
8 ○ ○	+	+	---
9 ○	++	+	---

Pathways that are not necessary in the low-end scenario

Inventory of Adaptation Measures Sandbar Stability

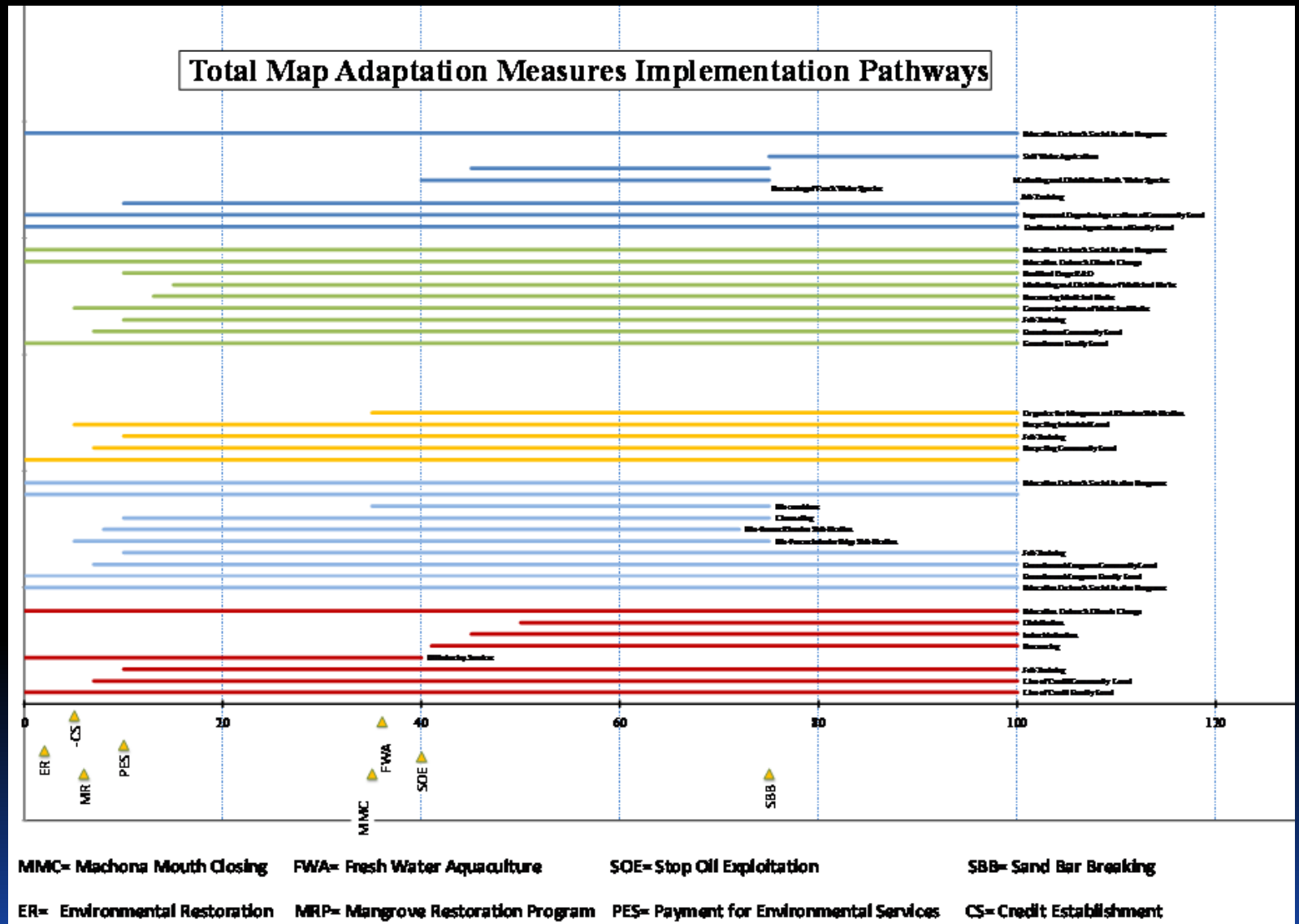
Shoreline Management Policy	Type of Strategy	Adaptation Measure
Protect	Technical and structural	Coastal engineering alternatives to reduce exposure of existing socio-ecologic assets to erosion hazard: <ol style="list-style-type: none"> Sand dune stabilization Beach nourishment Groins Artificial headlands Offshore breakwaters and reefs Seawalls Revetment Piles/excavation to rock Coastal engineering works to reduce flood exposure: <ol style="list-style-type: none"> Dykes and levees Raising of land levels Flood barriers Management of rainfall/runoff / floodways and/or retention basins Prevention of seawater backup into storm sewers
	Information and education	Education of residents about climate change, associated risks and impacts, and possible adaptation measures (e.g., how to help themselves in an emergency)
Reallocate	Risk diversification Technical and structural Planning and regulatory—adaptive design	<ol style="list-style-type: none"> Insurance to cover unavoidable impacts Intra-agency risk-sharing initiatives between organizations/agencies Land use diversification to spread risks Engineering approach to reduce flood hazard: Lifting existing dwellings Reduction of dependence on services during floods Changes in/upgrades of existing infrastructure such as roads, bridges, drains, sewer, water, etc. (e.g., floating roads, liftable bridges, raising infrastructure) Improved design/engineering standards for new assets and major refurbishments (e.g., to accommodate more intense rainfall in storm water systems, required upgrades when renovating or extending existing buildings): Relocating facilities (e.g., community halls, recreation facilities) and infrastructure (e.g., alternate transport routes via higher land) Relocating residents and businesses from high-risk areas Evacuation of residential areas Buyback of coastal properties Grants for demolition of homes Relocation subsidies, e.g., low-interest loans for houses and other structures (septic systems, utility connections) Rezoning of areas (e.g., coastal buffer zones) Managed retreat (decommissioning or removal of assets, e.g., boat ramps) Business as usual (accepting losses) Closing of recreation areas (e.g., beaches and foreshores) Loss of coastal conservation areas Owners of private infrastructure bearing losses (new development or redevelopment)
Avoid	Planning and regulatory	<ol style="list-style-type: none"> Rezoning of areas (e.g., coastal buffer zones) Changing location of new developments and infrastructure
Adapt	Planning and regulatory—adaptive design Technical and structural	<ol style="list-style-type: none"> Changes to local planning scheme to account for increased risk (e.g., flooding)/conditions of consent (e.g., improved design standards, minimum floor height, time-limited consent) Improved design standards for public infrastructure (e.g., storm water, transport) Rolling easements, allowing property owners to build on land at risk on the condition that structures will be removed if and when threatened by coastal erosion or inundation Engineering works, e.g., raising land levels/infill
Accept	Planning regulatory Technical and structural Information and education	<ol style="list-style-type: none"> Business as usual (accepting losses) Property owners bearing the losses Engineering works (see also above) to allow development/construction of new infrastructure accepting the risk Modular homes and movable dwellings and infrastructure Floating houses Water-resistant and waterproof construction to withstand flooding Informing property owners or purchasers of policies relating to coastal adaptation that could affect their land if a new development is proposed when acquiring property title

Objective: To delay Tipping Point occurrence until

- Fisheries
- Population
- Mangroves
- Communities

Are resilience enough to withstand the permanent change of system state at CPM lacunae system from estuary to a bay

Cumulative Implementation of Adaptation Measures



Total Map of Adaptation Measures showing calculated timing for implementation

Top Ten Adaptation Measurements (9) & (10)

Modification of Agricultural practices: Polyculture, Hydroponics ,
heat resistant poly-crops crops, drought resistant crops, salinity resistant Mangles,
Dynamic crop calendar.



Associated Vulnerability:
Local Economy fully dependent in weather conditions
and suffering substrate salinization



Top Ten Adaptation Measurements⁽⁸⁾

Sustainable management plan for Fisheries and aquaculture transforming the activity from an artisanal to an industrial but sustainable ecological and economic level



Associated Vulnerability
All Economic activities in the area
are weather dependent



Top Ten Adaptation Measures



Vulnerability:
Compromised Health and Integrity of the
Mangrove and Wetlands
Mangrove Erosion
Floods
Substrate Salinization



5) Mangrove and Wetlands Management Plan

- A. Including innovative strategies to mitigate effects of climate change
- B. Reforestation and stabilization of Wetlands Edge to slow down erosion and aid Mangrove landward migration
- C. Biofences to slow down erosion and facilitate Mangrove landward migration

Oc. Claudia Edith Avendano

**Doctor of Policy Planning and Development
cavendan@usc.edu**

International Coastal Adaptation Planner

Principal Investigator Adaptation Measures as part of the Consortium
Thetis, Coastal Environments, CMC

Thank You!