

A Novel Holistic Framework For Improving Adaptation Planning

Case Studies and Lessons Learned from California

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Adaptation Challenges



- › Current erosion mitigation is often piecemeal and implemented in an emergency
- › Adaptation is local, but solutions need regional perspectives
- › Lack of regional authorities
- › Limited dollars for adaptation planning and implementation
- › Community vision and public trust resources often not considered
- › Need a holistic consideration of our coastal resources and community identity
- › When do we change from one adaptation strategy to the next?

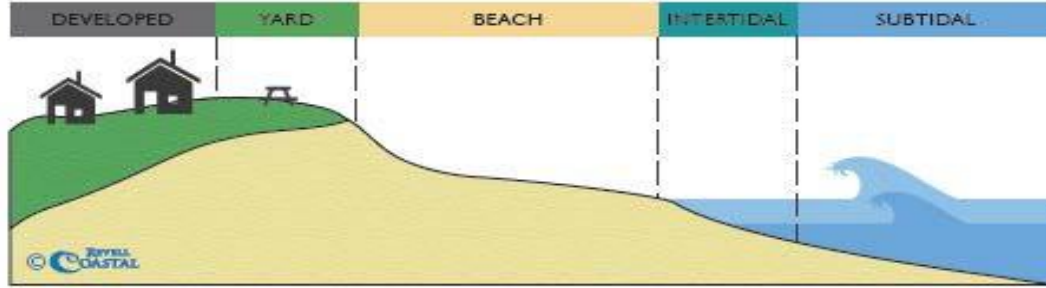


Typical Evaluation

- › Development/Infrastructure = \$3 million, armoring is \$250K
 - › Beach Recreation = How many x how much \$?
 - › Ecology = Value of a sea otter, sea turtle, salmon, shorebird \$?
 - › Human Health = Blue Mind, Forest Bathing \$?
-
- › \$? = hard, missing data, don't know = \$0
 - › So existing coastal management decisions
 - › \$3 million > \$250K + \$0? + \$0? + \$0? = armor development/ squeeze out beaches



What Needs to Be Considered



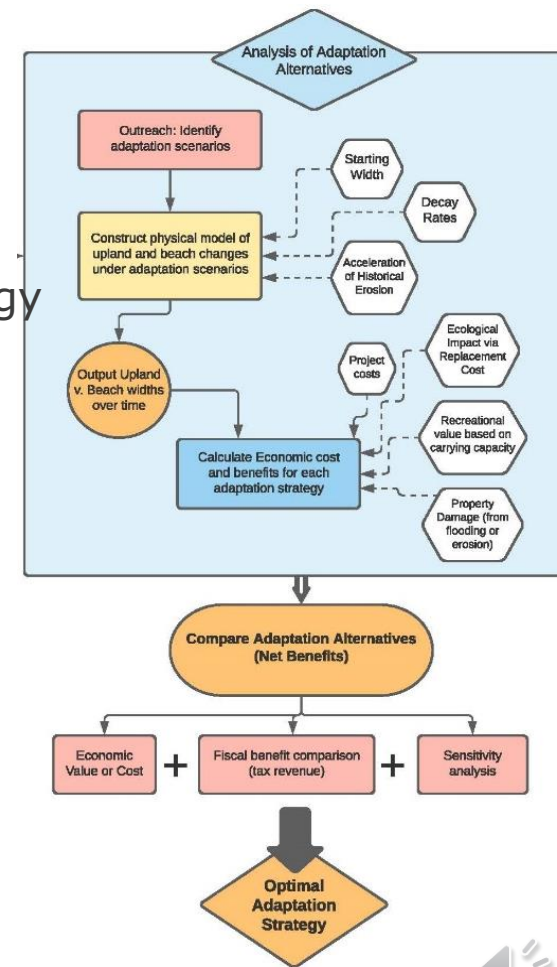
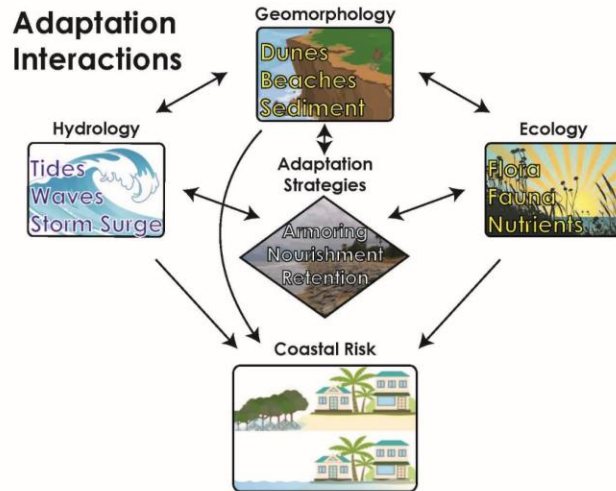
- › Developed – Private and Public Infrastructure
- › Recreation – Beach, Intertidal, and Subtidal
- › Ecosystem Services – Flora & Fauna, Water Quality, Mental Health (Replacement Cost)
- › Economics – Costs, Revenues, and Fiscal Impacts (Net Benefits)

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Adaptation Framework

- Evaluates physical changes to the coast over time
- Values development, infrastructure, recreation, and ecology
- Compares baseline to adapted conditions over time
- When do we shift from one strategy to the next?



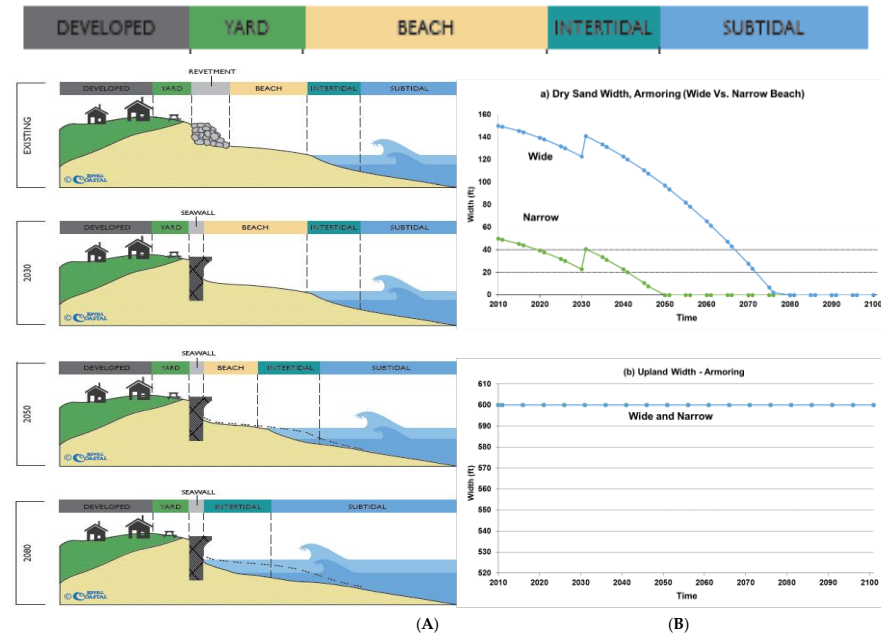
Imperial Beach

➤ Adaptation Strategies Considered

- Armoring from Revetment to Seawall
- Managed Retreat
- Expanded Groins
- Nourishment
- Living Shoreline Dune / Cobble Restoration

➤ Methodology

- Beach width vs. upland
- Changes in beach width tied to economics over time
- Recreation and habitat valuation (net benefits)
- Narrow vs. wide beach as a sensitivity analysis
- Hybrid managed retreat approach of buy out/lease back

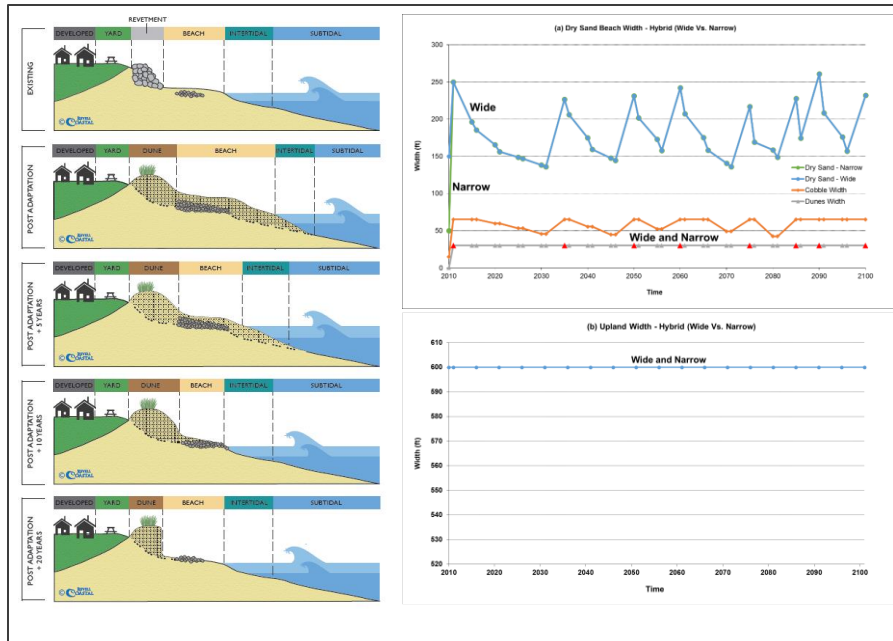


Upland protected
Dry sand beaches disappear 2050–2075
Only damp sand beaches by 2035–2065



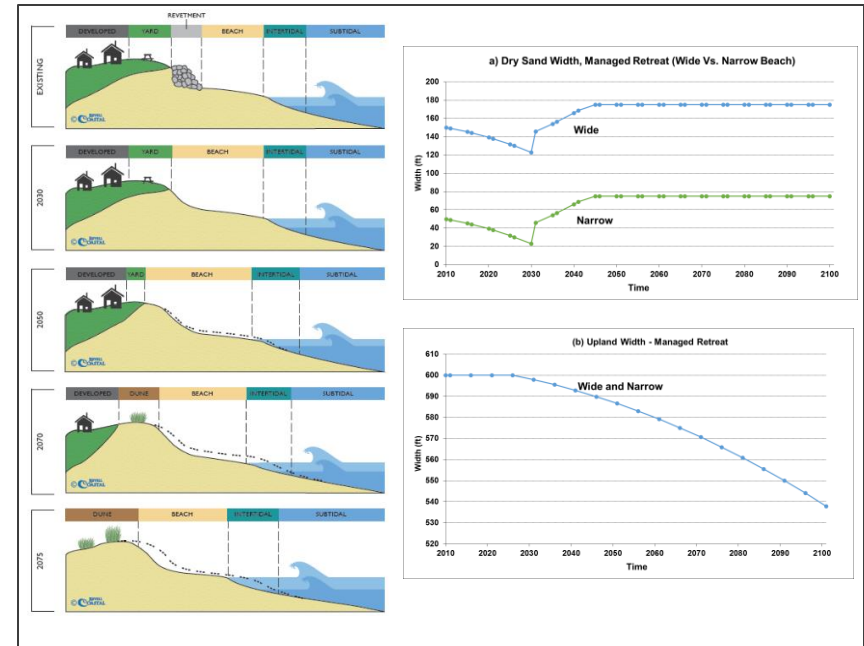
Adaptation Comparisons

Living Shoreline



8 Reconstruction cycles by 2100

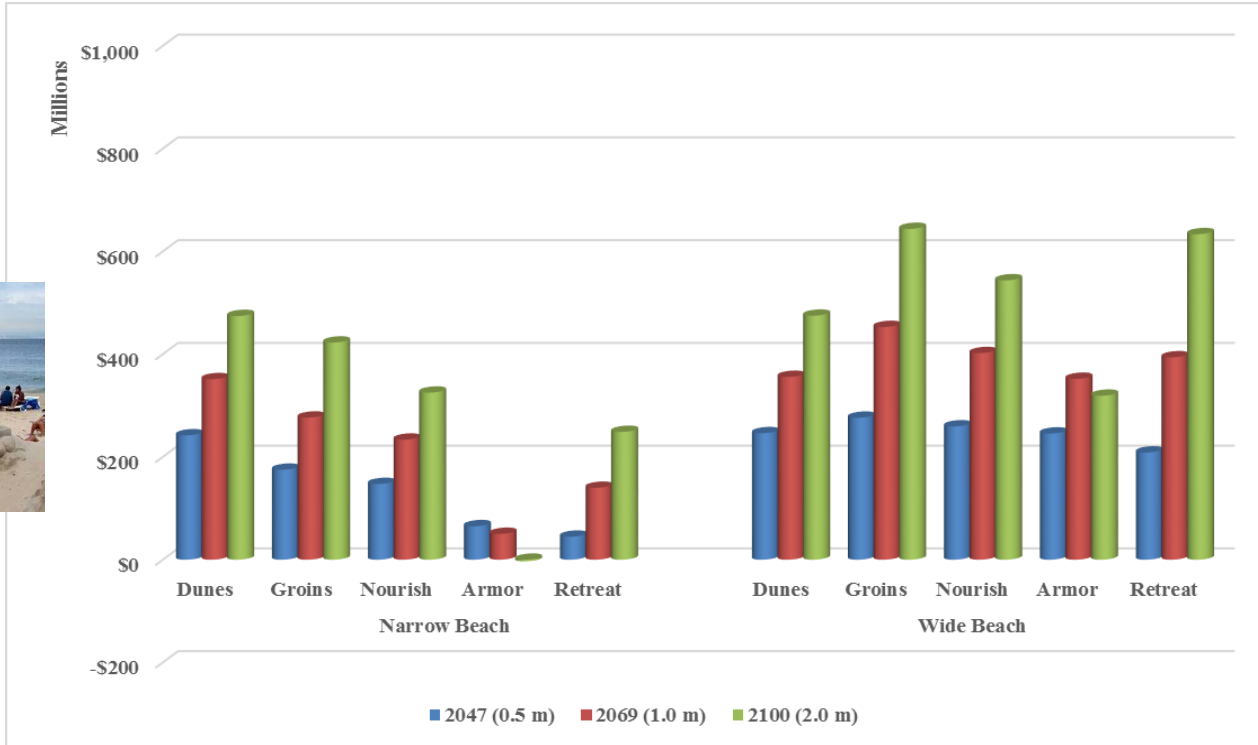
Managed Retreat



Beach is maintained
Development eroded up to 3 parcels inland

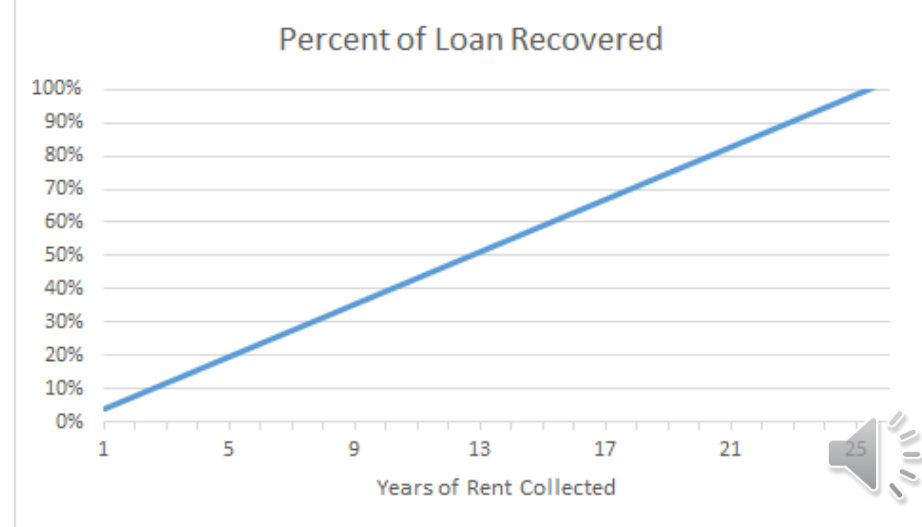


Net Benefits through 2.0 m of SLR



Policy Approach—Fee Simple Acquisition with a Lease Back Option

- Initial work showed with property tax exemption, and current rental and interest rates, the City could recover its investment in about 30 years
- Options:
 - Exempt Property Tax
 - Transfer of Development Rights
 - Public Subsidy
 - NGO Acquisition
 - Short-Term Vacation Rental



Santa Cruz—West Cliff Drive



- Adaptation Strategies Considered
 - Emergency Armoring (BAU)
 - Coastal Recreation and Sand Backpass
 - Protection Focused
 - Managed Retreat

➤ Methodology

- Change in beach width and recreational use tied to reduced time within tide windows
- Monte Carlo: Probability based on 10,000 iterations of SLR and adaptation timing to identify positive net present value compared to BAU

Costs

- Implementation and maintenance
- Lost recreation values

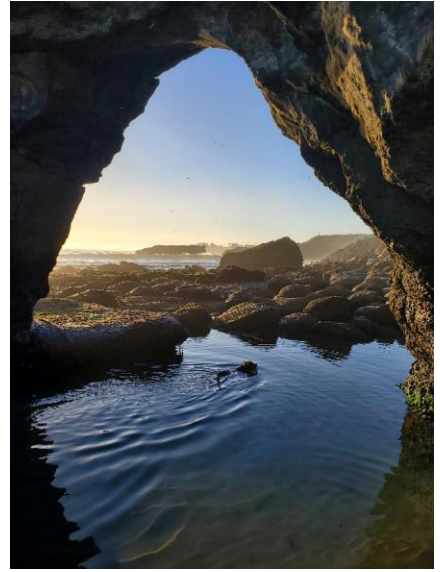
Benefits (compared to BAU)

- Gains in recreation value
- Avoided costs and damages



Major Findings WCD

- Recreation Focused Actions—enhancing surf and beach recreation along with recreational trail showed highest benefit and probability of success
- Business as usual costs the most in the long term
- Managed Retreat and Protection Focused better if undertaken before SLR gets above about 9 inches



Lessons Learned

- › Framework provides a scalable adaptation planning approach to systematically integrate recreation and ecosystem services into traditional cost benefit analyses
- › This approach leads to higher ranking of public trust-oriented adaptation approaches and identifies when they become more cost effective
- › Hold-the-line armoring is not a long-term answer for smaller communities that depend on the beach for their identity and livelihoods
- › The key adaptation question is do we invest a lot up front to realize public trust benefits, or pay a lot more in the long



Resources and Contact

Revell et al. 2021. A Holistic Framework for Evaluating Adaptation Approaches to Coastal Hazards and Sea Level Rise: A Case Study from Imperial Beach, California
Water 2021, 13(9):1324; <https://doi.org/10.3390/w13091324>.

Special Issue [Adaptation to Coastal Climate Change and Sea-Level Rise](#)

Resilient Coast Santa Cruz

<https://www.cityofsantacruz.com/government/city-departments/city-manager/climate-action-program/west-cliff-drive-adaptation-and-management-plan>

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