Integrating Regional Sediment Management and Sea Level Rise Adaptation

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ACRONYMS AND ABBREVIATIONS

AMM	Avoidance and Minimization Measure
AB	Assembly Bill
BEACON	Beach Erosion Authority for Clean Oceans and Nourishment
Caltrans	California Department of Transportation
CCANA	California Coastal Adaptation Needs Assessment
CCC	California Coastal Commission
CDP	Coastal Development Permit
CEQA	California Environmental Quality Act
CIP	Capital Improvement Plan
CNRA	California Natural Resources Agency
USACE	U.S. Army Corps of Engineers
CBA	Cost-Benefit Analysis
COG	Council of Governments
CSMW	Coastal Sediment Management Workgroup
CZMA	Coastal Zone Management Act
FEMA	Federal Emergency Management Agency
HMP	Hazard Mitigation Plan
JPA	Joint Powers Authority
LCP	Local Coastal Program
LG	Local Government
LHMP	Local Hazard Mitigation Plan
MOA	Memorandum Of Agreement
MOU	Memorandum Of Understanding
NBSD	Nature-Based Shoreline Design
NOAA	National Oceanic and Atmospheric Administration
OPC	Ocean Protection Council
RCD	Resource Conservation District
RCC	Regional Climate Collaborative
RSM	Regional Sediment Management
RSMP	Regional Sediment Management Plan
SLR	Sea Level Rise
SPMD	Sediment Placement and Management District
TMDL	Total Maximum Daily Load
USGS	U.S. Geological Survey
WRDA	Water Resources Development Act

EXECUTIVE SUMMARY

Source: Glenn Beltz, Flickr. https://flic.kr/s/aHsjTzfuDw

Sediment is one of California's most overlooked and underutilized adaptation resources. From fine-grained silts that nourish coastal wetlands to coarse sands and cobbles that stabilize beaches and shorelines, sediment plays a critical role in enhancing the physical and ecological resilience of coastal systems and addressing key elements of regional coastal climate adaptation. Despite years of work culminating in the 2021 Coastal Sediment Master Plan Report, Regional Sediment Management Plans (RSMPs), regional climate adaptation efforts and broader climate adaptation strategies remain siloed, often developed independently by engineering and planning teams with minimal integration.

As sea-level rise (SLR) accelerates and natural disasters intensify, a strategic shift is needed to treat sediment as a foundational element of climate resilience. This report includes a review of RSMPs across California, BEACON's member agencies' climate vulnerability assessments and local adaptation planning efforts, and the results of a statewide practitioner survey. This report identifies integration gaps, implementation barriers, and opportunities for improved coordination. This summary reviews key findings of this effort, provides targeted recommendations, and outlines next steps for improving the integration of sediment management and climate adaptation across California's coast.

KEY FINDINGS

1. Sediment-Adaptation Planning Disconnect: Climate adaptation and sediment management have historically been addressed separately, developed by different professional sectors with limited coordination. RSMPs are often technical and single-issue, focused on flood control and dredging, while the adaptation plans reviewed are more policy-oriented and geared toward land use and community planning. As a result, few regions fully integrate sediment considerations into local coastal land use (Local Coastal Program) or sea-level rise (SLR) planning frameworks. RSMPs also tend to lack implementation detail and often omit funding and permitting pathways (Section 2.2).

This divide is further reinforced by institutional roles: adaptation planning is usually led by municipal or county long-range planners, while sediment management falls under flood control districts and harbor authorities. There is a gap in geographic scale-regional planning for RSMPs versus local focus for adaptation efforts-which can lead to poor alignment in practice. Surveyed agencies confirmed this gap, with many adaptation practitioners reporting unfamiliarity with sediment planning tools or strategies.

Further RSM planning is also fragmented among levels of government, including federal, state, and regional and local agencies, with state and federal agencies coordinating through the CSMW, but regional and local agencies pursuing planning and implementation independently, often with little interaction with CSMW.

2. Governance and Permitting Barriers: Jurisdictional complexity and regulatory misalignment present significant barriers to integrated sediment and adaptation planning. Climate adaptation and sediment management are typically handled by different departments within local and regional agencies, resulting in fragmented responsibilities and limited coordination. Permitting processes are complicated by agency mandates that often conflict, creating procedural inefficiencies. These institutional barriers are exacerbated by high permitting costs, extended timelines, and unresolved logistical challenges related to sediment transport, sorting, and storage. Survey data confirmed that permitting hurdles and lack of interdepartmental alignment hinder the implementation of sediment strategies and limit their inclusion in climate adaptation frameworks (Section 4.3; Table 1; Table 17).

3. Sediment Variability: Most RSMPs rely on "average annual" sediment budgets that assume consistent harbor bypassing rates of sand, which downplays the importance of episodic events and the role of diverse sediment sizes in adaptation. This approach limits consideration of sediment delivery variability and post-disaster surpluses - key opportunities for enhancing coastal resilience. Non-sand materials such as muds, cobbles, boulders, and reef-building substrates remain underrepresented in RSM and adaptation planning, despite their potential to reduce coastal hazards and support habitat restoration. Techniques such as channel dredge discharge relocation and sediment backpassing are similarly underused, often excluding adaptive, nature-based features that could improve delivery efficiency and reduce transport losses. Survey results show that practitioners are increasingly exploring broader sediment

options, but most RSMPs lag in formalizing these approaches (Sections 2.2.3 and 3.3; Table 3; Table 12; Figure 14).

4. Transportation, Sorting, and Storage: Logistical barriers remain a major limitation in effective sediment use across California's coast. Most RSMPs lack planning for stockpile sites, transport routes, and sorting infrastructure. A core challenge is efficiently moving sediment from source to receiver sites, especially when mixed grain sizes require sorting or when opportunistic storage is needed. These added costs and coordination gaps limit timely adaptation. To improve readiness, RSMPs should include transport strategies and integrate sediment inventories into long-term planning (Section 2.2.2; Table 2; Table 14).

5. Funding: Many RSMPs fail to quantify the role of sandy beaches as coastal protection infrastructure, focusing instead on tourism. Any use of economic investigations evaluated to support funding requests, including CBA, should incorporate holistic efforts to quantify ecosystem services, and fully account for the range of multiple 'services' provided by sandy beaches. California beaches buffer communities from storm-driven flooding, providing public safety, ecological, and recreational value - critical benefits often omitted from federal cost-benefit analyses and local adaptation planning (Sections 3.4 and 3.5; Table 7; Table 8; Table 15). Techniques such as channel dredge bypassing and backpassing are underutilized and rarely evaluate nature-based adaptation strategies that could improve delivery, storage, coastal resilience and reduce longshore transport costs compared to offshore sources. While RSMPs list potential funding pathways, traditional funding by the Army Corps of Engineers, flood control districts, and competitive grants limit implementation. Survey feedback underscores limited staff capacity and inconsistent funding tools across jurisdictions. Quantifying the flood protection role of beaches is now essential to unlock state and federal resilience funding.

6. Governance and Jurisdictional Challenges: Despite recommendations across RSMPs, no new regional sediment governance bodies have formed since their adoption (Section 2.2.1, Section 5.1; Table 1, Figure 6, Table 19). Joint Powers Authorities (JPAs) and Memoranda of Understanding (MOUs) are frequently suggested but remain largely unimplemented. BEACON, a long-standing JPA, demonstrates the value of regional forums for raising awareness, coordinating advocacy, and fostering dialogue among elected officials. However, BEACON also illustrates key limitations: it lacks any mandated authority, cannot enforce jurisdictional commitments, and excludes critical entities like harbor districts from decision-making. This fragmentation hinders the creation of enforceable, cross-boundary sediment strategies, limiting integration of RSM with broader climate adaptation planning.

7. Outreach and Understanding Deficits: Public and political understanding of sediment's role in resilience remains limited across all levels of government (Section 4.3.5). Existing outreach has focused more effectively on climate change impacts and adaptation planning, but sediment rarely features in those efforts. Continued outreach with regional sediment managers through surveys and workshops is essential. Native American Tribes and historically underrepresented communities are often left out of sediment-related discussions,

undermining equity and buy-in for RSM efforts. While climate adaptation outreach has improved awareness and funding, RSM-specific education lags behind, with little visibility, limited metrics, and weak engagement outside technical circles.

RECOMMENDATIONS

1. Update and Align RSMPs with Adaptation Planning: To improve implementation and relevance, RSMPs must reflect current climate realities and planning frameworks.

- Integrate sea-level rise, disaster-driven sediment variability, and habitat restoration into RSMPs.
- Use sediment surpluses from high-flow or post-disaster events or from excess dredge volumes as opportunities for adaptive placement or integrated into living shorelines.
- Coordinate RSMP updates with LCPs, LHMPs, CIPs, and other climate planning frameworks to ensure consistency and accountability.
- Utilize beach monitoring datasets to support monitoring for climate adaptation pathways

2. Expand Consideration of Sediment Types and Sources: Many RSMPs focus narrowly on sand, ignoring the utility of a broader sediment range.

- Broaden grain size considerations to include silts, muds, cobbles, and boulders.
- Investigate innovative manufactured materials like eco-concrete.
- Reconnect coarse sediments from debris basins to coastal systems, especially after disasters.
- Develop and maintain standardized regional sediment inventories linked to project and habitat needs.

3. Enhance Interregional Governance and Collaboration: Governance fragmentation is a key barrier; broader and more representative collaboration is needed.

- Expand the CSMW to include local jurisdictions and all existing regional RSM governance collaborations as part of the signatories to a new MOU of federal and state agencies
- Expand all regional governance bodies to include adaptation planners, harbor districts, Tribes, public works, transportation agencies and historically underrepresented groups.
- Support new interregional coalitions to advocate for sediment-related policy and funding, NCCSCC and SoCal SCSC.

- Consider expanded participation with regional climate collaboratives focused on broader climate adaptation issues such as Central Coast Climate Collaborative (4C), or Santa Barbara Regional Climate Collaborative.
- Support knowledge exchange through shared technical capacity, inventory, and monitoring frameworks.

4. Streamline Permitting and Regulatory Integration: Permitting challenges remain a major barrier to implementation.

- Establish a statewide framework of permit conditions for sediment reuse projects, covering construction, monitoring, timing and placement methods.
- Develop programmatic EIRs and templates to reduce project delays.
- Apply "Cutting the Green Tape" principles and leverage Coastal Act Sections 30233(b) and 30233(d) to support beneficial reuse and adaptive permitting.

5. Integrate Sediment into Climate Resilience Frameworks: Sediment management must be fully embedded in the broader landscape of adaptation planning.

- Require the inclusion of sediment strategies in LCPs, General Plans, LHMPs, and adaptation plans, including Statewide Guidance and the SLC's plans and programs.
- Cross-train planners and engineers to promote planning integration at every stage of the planning phases.
- Use scenario planning to address sediment needs under extreme events and climate futures.

6. Quantify Multi-Benefit Outcomes: To secure long-term funding, sediment strategies must demonstrate value beyond engineering metrics.

- Quantify multiple benefits, including the full range of flood protection, ecosystem services, and such as storm and flood protection, coastal natural resources restoration, and recreational and cultural benefits in expanded cost- benefit analyses.
- Frame beaches and dunes as public infrastructure eligible for resilience and infrastructure grants.
- Promote the use of ecosystem service valuation in sediment project planning and assessment.

7. Support Pilot Projects and Adaptive Implementation: Pilot projects can test and demonstrate innovative sediment reuse strategies.

- Implement scalable pilots that explore sediment sorting, storage, transport, and reuse.
- Use monitoring data from storm impacts and shoreline changes to inform placement strategies.

- Align pilot projects and routine flood control activities with long-term adaptive strategies, including living shoreline maintenance cycles.

8. Elevate Outreach, Equity, and Public Understanding: Increased awareness and equitable engagement are essential for successful implementation.

- Launch targeted outreach to Tribes, underrepresented communities, and local officials, including inland communities.
- Highlight success stories and build support through transparent performance tracking.
- Promote equitable funding structures that reduce disparities across jurisdictions.

CONCLUSION AND NEXT STEPS

Sediment is a critical climate adaptation resource. To leverage it, California sediment managers must break down professional silos, align with adaptation planning, streamline permitting pathways, reinforce regional coordination, and expand funding models. Key next steps include:

- Launching cross-jurisdictional demonstration projects
- Creating permitting templates for adaptive sediment strategies
- Embedding sediment metrics in benefit-cost modeling
- Developing outreach indicators and tracking systems
- Advancing regional sediment inventories and logistics plans
- Promoting beaches as frontline infrastructure

With strategic investment, unified policy, and inclusive governance, sediment can be elevated to a foundational pillar of California's adaptive resilience strategy.

1 BACKGROUND

Source: California Coastal Records Project

Governance of sediment management has been a challenge for decades, in California and beyond. Complex and conflicting regulations, and a lack of coordinated implementation of state and federal priorities has led to poor integration and lackluster solutions. However, several key requirements for critical policy and regulatory reform have aligned, as listed below.

Sediment is increasingly being recognized as a key resource. The atmospheric river and bomb cyclone erosion events experienced in California and Santa Barbara and Ventura counties in 2023 and 2024 served to sharpen the focus of regulators at all levels of government, and to drive a search for innovative solutions.

Additionally, sediment availability is soon to be at the highest level in recent years, at exactly the time there is the greatest desire for this sediment for sea level rise and erosion management. Recent moves to remove dams and impoundments structures (Klamath, Elwha Matilija, Rindge, Cleveland National Forest) illustrate recognition of the need for comprehensive sediment management, including restoring watershed sources. These features capture terrestrial sources of sediment, particularly cobbles, that are critical to limiting erosion

of the nearshore environment, and their removal will change the playing field. Additional sources of sediment arise through lagoon restoration projects, debris flows from natural disasters and debris basin cleanouts, and offshore sand sources. Additionally, the US Army Corps of Engineers has indicated greater willingness to incorporate beneficial reuse of sediment from navigational dredging activities.

Furthermore, there is increasing evidence and acknowledgement of the secondary impacts of hard protective structures, and an enhanced level of support for nature-based solutions.

Longshore transport has been disrupted by coastal armoring, meaning that those sediments that do reach the coast are not able to move where nature intended. The negative impacts of hard structures on adjacent beaches have also been recognized.

The State of California has provided historic levels of funding in the past five years for coastal resilience, which should continue for the next five years with the passage and implementation of Proposition 4, the “Climate Bond”. Alignment of these factors provides an opportunity to highlight the ineffectiveness of the existing sediment framework, and to suggest alternative management and funding arrangements that integrate sediment management with climate planning.

2 REVIEW OF CALIFORNIA COASTAL SEDIMENT MANAGEMENT PLANS

Cobble Placement during construction of Surfer's Point Living Shoreline Project Phase 1. Photo courtesy of Paul Jenkin

2.1 COASTAL SEDIMENT MANAGEMENT PLAN BACKGROUND

The California Coastal Sediment Management Workgroup (CSMW) was established in 1999 with a goal to address coastal sedimentation and erosion issues and to "restore and protect beaches, wetlands, and other coastal environments by restoring natural sediment supply to those areas and optimizing the use of sediment from ports, harbors, and other opportunistic sources" through the development of a Sediment Master Plan (SMP). The CSMW was led by the US Army Corps of Engineers (USACE) and the California Natural Resources Agency (CNRA). CNRA member groups included the California: Ocean Protection Council; Division of Boating

and Waterways; Department of Parks and Recreation; California Coastal Commission; State Lands Commission; State Coastal Conservancy; California Geologic Survey; Department of Fish and Wildlife; and San Francisco Bay Conservation and Development Commission.

In its original formation, the CSMW was primarily a collaboration between federal and state agencies, with little local or municipal engagement, and its primary focus was on finding sand to nourish beaches. In 2003 and 2004 a series of regional public workshops were held to share the goals with the public, to gather information on local sedimentation and erosion issues, identify ongoing sediment management activities and support coordination and cooperation.

The series of workshops highlighted that different parts of the state have different sediment concerns, varying at a local level and requiring local knowledge and expertise to address. Thus, one of the major outcomes of these meetings was a decision to separate the California coast into littoral cells or sandsheds for sediment planning purposes. This led to a host of statewide scientific research on sediment impoundment behind dams and coastal armoring structures as well as the development of individual littoral cell sediment budgets using average annual navigation dredge volumes. Some of these efforts led to foundational studies such as Patsch and Griggs (2003) using dredge data as a proxy for long-term sediment budgets, Willis and Griggs (2003) and Limber et al. (2008) work on defining littoral cell boundaries and identifying littoral cut-off diameters—i.e., the grain size below which sediment is no longer part of the active coastal transport system—and Warrick et al. (2008) study in Imperial Beach, which found that a small number of storm events account for the vast majority of sediment delivery from rivers to the coast.

These led to the development of Coastal Regional Sediment Management Plans (CRSMPs), (Figure 1–Figure 3). The CRSMPs were subsequently developed over the course of a decade, between 2008 and 2018 (Figure 4). These plans were developed with multiple sponsors and funding including the US Army Corps of Engineers, NOAA, and in several collaborative regional planning efforts, led by scientific and engineering consultants working with local government planning staff with funding the California Department of Boating and Waterways (now the Division of Boating and Waterways, within State Parks).

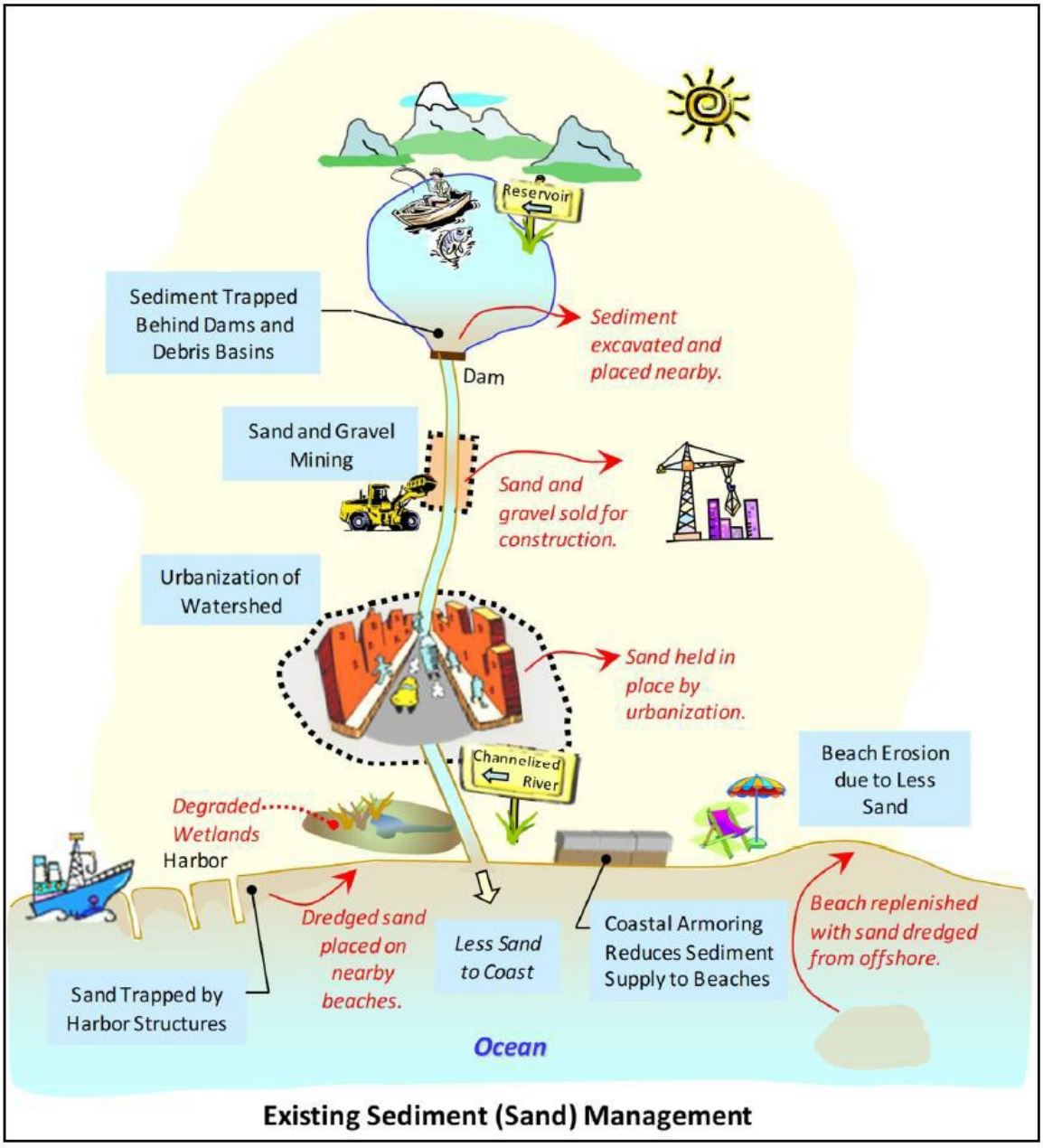


Figure 1. A depiction of "coastal sediment management without regional cooperation" on the top, as shown in the California Sediment Master Plan Report (2021).

Throughout these plans, the general focus is on the average annual sediment budget, as reflected in dredging costs, erosion rates, and sedimentation. This use of the annual average does not capture extremes, often caused by storm events, and sometimes in the form of disasters that require immediate actions. This is a notable limitation of the CRSMPs.

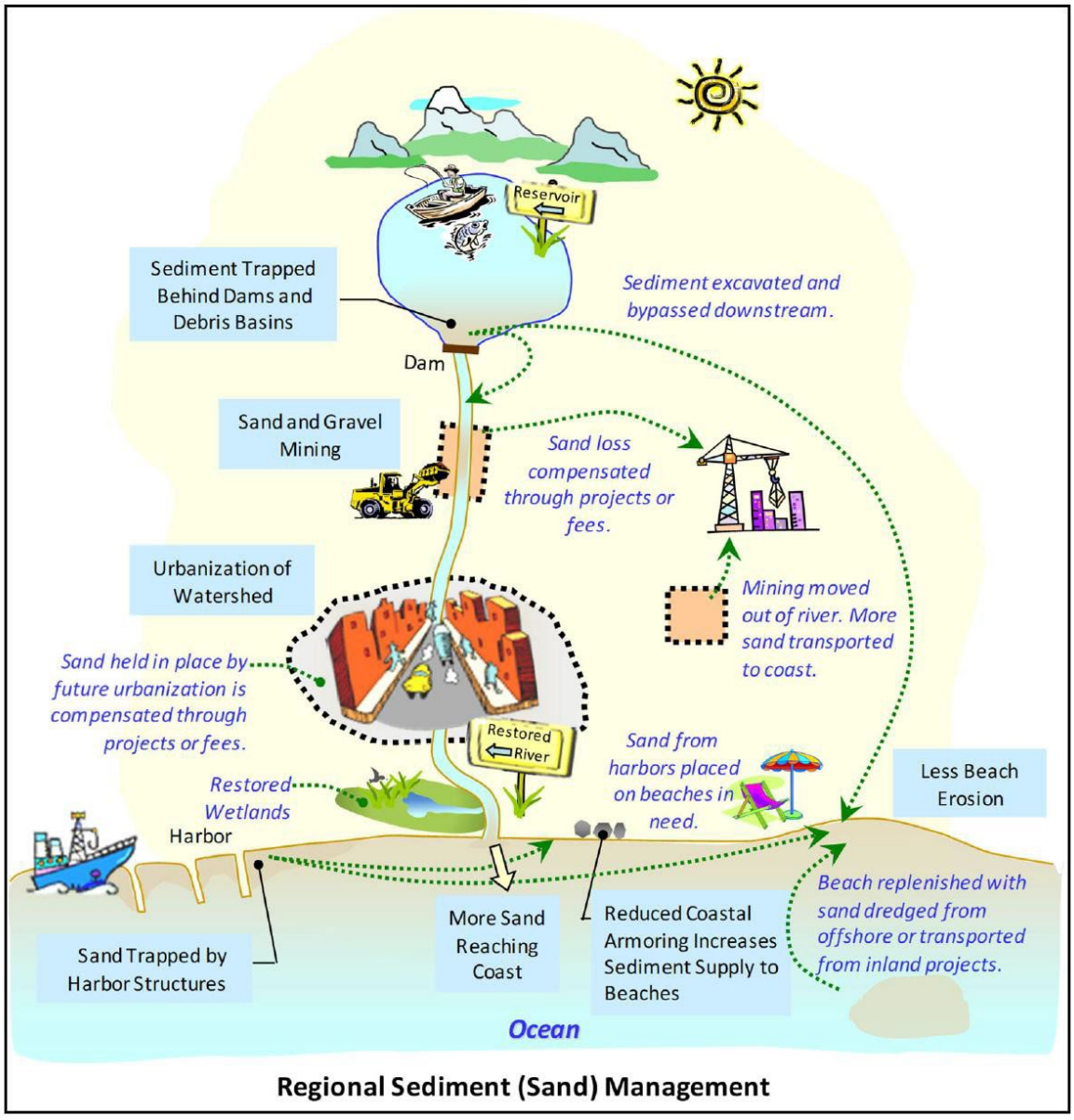


Figure 2. A depiction of "a regional approach to CA coastal sediment management", as shown in the California Sediment Master Plan Report (2021).

Most CRSMPs typically include:

- Sediment budget based on average annual dredge volumes.
- Recommendations for potential local governance structures to support Plan implementation.
- Evaluation of physical sandshed conditions, such as erosion hotspots, sedimentation, and sand transport dynamics within the Plan area, including sediment sinks or retention structures such as dams and coastal armoring.

- Identification of known and potential sediment sources and receiver sites that may benefit from Regional Sediment Management (RSM).
- A cost-benefit analysis related to sediment management activities within the Plan boundaries.
- Review of sensitive species and habitats located in the Plan area.
- A public outreach strategy designed to engage key stakeholders and the broader community.
- Recreational use descriptions for beaches including beach visitation estimates and descriptive assessments of beach usage, e.g. surfing.
- Geospatial data layers that represent physical and ecological information for integration into CSMW's geospatial database.

Across the plans, sediment is consistently identified and utilized as a tool to adapt to climate change, with a strong focus on how to use sand dredged from harbors and navigational channels for beach nourishment projects through sediment bypassing (sending sand down the littoral drift). The scope of sediment management in the plans can be narrow – use of fine grains and cobbles is only considered in some of them. Many of the plans do not consider RSM strategies beyond the traditional framework of navigational dredging and nourishment via bypassing. Some innovative strategies include sediment back passing (moving sand up the littoral drift, to keep it within the littoral cell) and nature mimicking living shoreline approaches, such as enhancing beaches with offshore reefs, assessing and implementing managed retreat, living shorelines, tidal marsh creation, and upstream restoration. These approaches that use natural ecological systems to address climate adaptation or resilience based upon the best available science are termed natural infrastructure, as defined in (3) of subdivision (c) of Section 71154 of the California Public Resources Code.

However, the logistical framework to implement projects, including financing cost benefit analyses, governance, grain size, sediment sources, and permitting roadmaps is variable across the plans and largely localized in individual jurisdictions. An exception most recently is the North-central California region, which completed a stakeholder evaluation process to develop an appropriate governance structure and incorporate recommendations from four CRSMPs (Sonoma-Marin, San Francisco Littoral, San Francisco Central Bay, and Santa Cruz). Led by NOAA's Greater Farallones National Marine Sanctuary, the process resulted in a Coastal Resilience Sediment Plan with site-specific and regional recommendations and the formation of a North-central California Coordination Committee (NCCSCC) in 2019. Since its inception the NCCSCC, a 17-agency collaborative encompassing the outer coast of Sonoma, Marin, San Francisco, and San Mateo counties, has implemented RSMP recommendations including: forming research collaborations to fill data-gaps, securing major funding from state and federal sources, developing guidance documents to improve permitting efficiency for coastal sediment management projects, and forming an advisory committee for project planners to seek streamlined agency feedback.

Figure 3. Geographic range of California's CRSMPs, as shown in the California Coastal Sediment Master Plan Report (2021).

California's science and policy positions on climate planning changed drastically over the course of the decade that the RSMPs were written. As such, the more recent plans tend to address sea level rise in a more comprehensive way. In 2008, Governor Schwarzenegger issued an executive order requiring state agencies to consider 4.6 feet of sea level rise in planning projects, and when the first RSMPs came out, the state had only just begun to consider SLR. In 2009, when the Southern Monterey Bay and BEACON CRSMP's were published, sea level rise science was not fully included into policy, but by 2018 when the most recent plan was published, inclusion of sea level rise in state policy was required. Thus, the degree to which sediment management was integrated into climate adaptation planning varied depending on when the RSMPs were written.

Recent literature highlights the need to improve implementation of RSMPs through better coordination and regional capacity building. Goodrich et al. (2020) note that despite the statewide development of RSMPs, actual implementation has lagged due to permitting

complexity, lack of dedicated funding, and inconsistent agency engagement. They point to BEACON and other regional groups as important platforms for collaboration, pilot project delivery, and information-sharing. These findings reinforce the value of aligning sediment management with interjurisdictional sea level rise adaptation planning on the Central Coast.

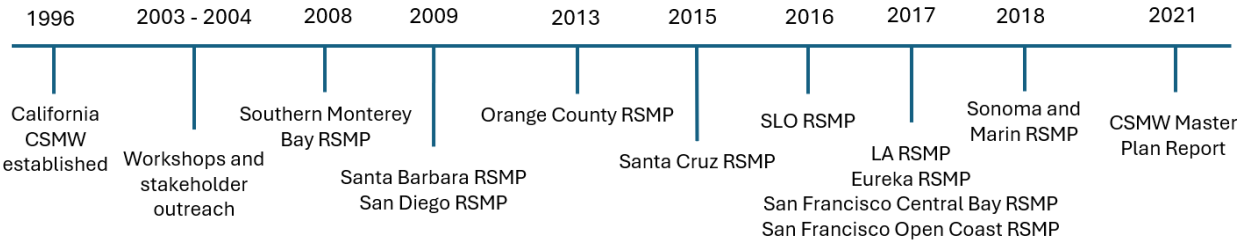


Figure 4. Timeline of activities stemming from the Coastal Sediment Management Workgroup, including workshops, RSMP development, and culminating in the 2021 Master Plan Report.

2.2 RSMP REVIEW

This project conducted a comprehensive review of the RSMPs based on a set of themes to compare the similarities and differences as well as the strengths and weaknesses across the reports to identify best practices and knowledge gaps, particularly on how governance and financing have evolved. The team identified eight key themes related to regional sediment management and assessed each of the eleven RSMPs to compare how the plans addressed each of the key themes. The themes include:

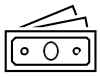
Governance: How is regional sediment management governed? Are multiple options presented? How are stakeholders involved in developing the governance structure? How are decisions made about sediment regionally? At a jurisdictional level?

Sediment sources: Does the plan identify diverse sediment sources and sinks to consider in regional sediment management projects?

Projects: Does the plan identify sediment management projects that will address current erosion and future climate change concerns using sediment from within the region?

Sea level rise: How is sea level rise considered in the plan? Is it integrated throughout the background, the recommended actions, and plans? Is sediment used as a tool to adapt to climate change?

Grain size: Is sediment of various grain sizes considered? Are cobbles and fine- grained sediment such as silt and mud considered in addition to sand?



Financing: How will regional sediment management be funded? Does the plan present a variety of financing options? Does the plan outline steps necessary for the region to generate funds for implementation of identified projects?

Staffing: Does the plan recommend staffing levels for implementing the regional sediment management plans?

Economics of beach nourishment: Does the plan assess whether beach nourishment is economically viable through cost-benefit analyses, surveys of beach usage, coastal protection value of the beach, or cost estimates of beach nourishment?

High level findings illustrate that all eleven plans successfully identify a range of local sand sources, that can be used in addressing regional beach erosion problems. This includes estimates of sources and sinks of sediment and current littoral cell budgets based on dredge volumes, and identification of areas of particular erosion concern.

Beyond identifying sediment sources and specific areas of erosion concern, however, the degree to which they provide logistical frameworks for governing the movement of sediment, financing the movement of sediment, dealing with unsorted sediment and utilizing a range of grain sizes, and using sediment to adapt to climate change is highly variable. The eight RSMP themes are all discussed in more detail below.

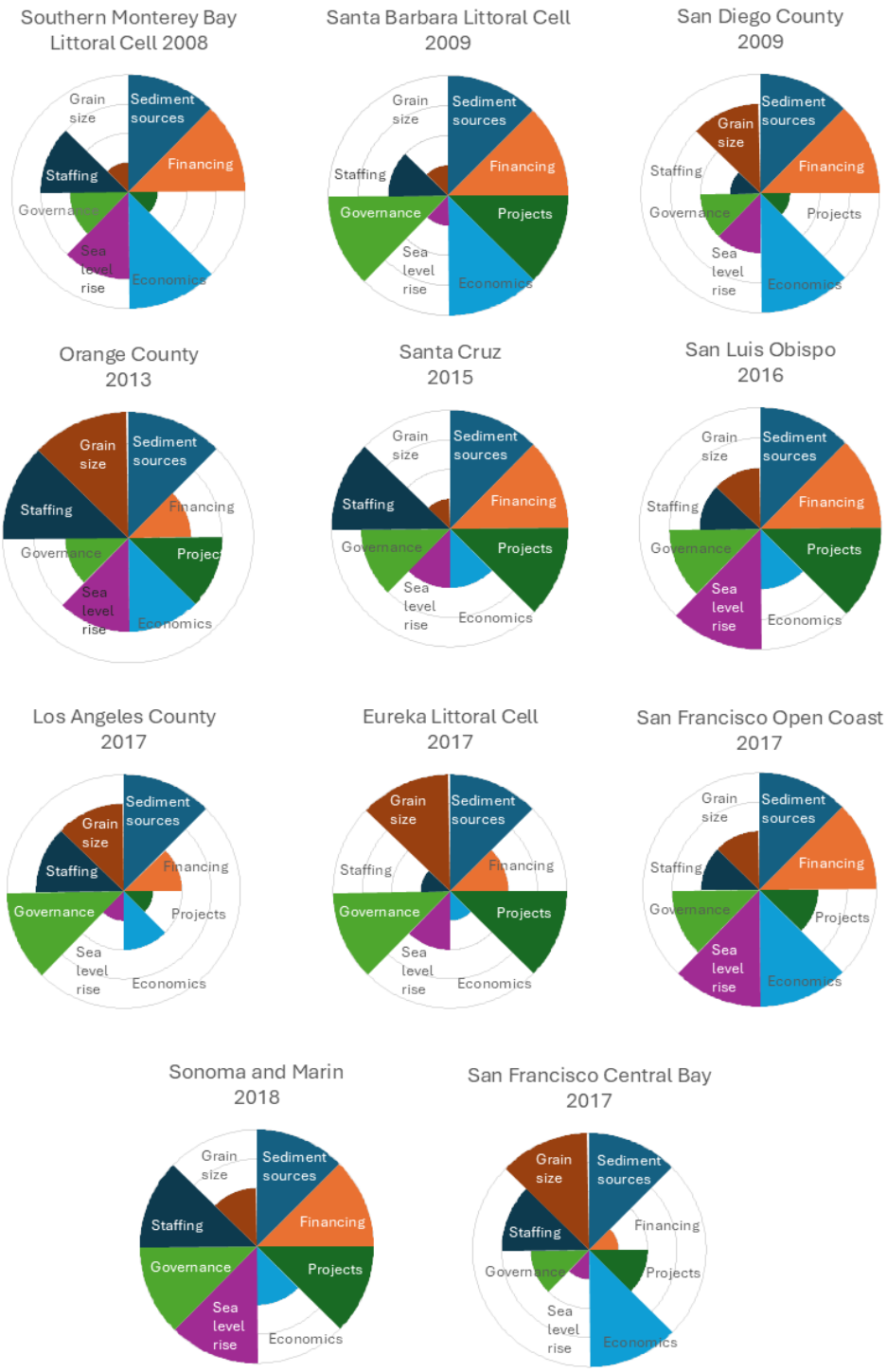


Figure 5. Pie charts of the eleven different regional sediment management plans, showing degree of development across eight different categories: sediment sources, financing, projects, economics, sea level rise, governance, staffing, and grain size.

These different categories in Figure 5 are explored more in depth in the following section, with excerpts from well-developed plans highlighted to explore best practices.

2.2.1 Governance Structures, Challenges, and Opportunities

All the regional sediment management plans (RSMPs) included in this review discuss governance options to some degree, except for the Santa Barbara Littoral Cell RSMP, which already has a formalized governance, the BEACON Joint Powers Authority (JPA), established in 1986. BEACON has 1.5 dedicated staff with a board of directors that includes elected officials for each of the jurisdictions. BEACON has eight jurisdictions including the Cities of Goleta, Santa Barbara, Carpinteria, Ventura, Oxnard, and Port Hueneme, as well as the Counties of Santa Barbara and Ventura. In 2020, BEACON approved bylaws for a Science Advisory Committee (SAC) and selected the first 12 members. The committee began meeting starting in 2021 to review how best available science could be adopted into RSMP activities in the BEACON region. In December 2021, the SAC and BEACON adopted a Research Agenda which highlighted some of the key data gaps and expanded the types of monitoring needed to include not only physical shoreline data, but also coastal ecology, as well as human uses, and economic data needs.

The BEACON governance structure is recommended as a governance model in several other plans, including Southern Monterey Bay, Orange County and San Diego. While recommending specific governance structures is a step in the right direction, stakeholder support is key to long-term success. Santa Cruz and the two San Francisco Bay plans present governance options to be determined by stakeholders. The remaining plans suggest possible governance structures with procedural group approaches (committees, existing departments and staff members) to engage stakeholders and determine the appropriate governance structure through that process (Figure 6).

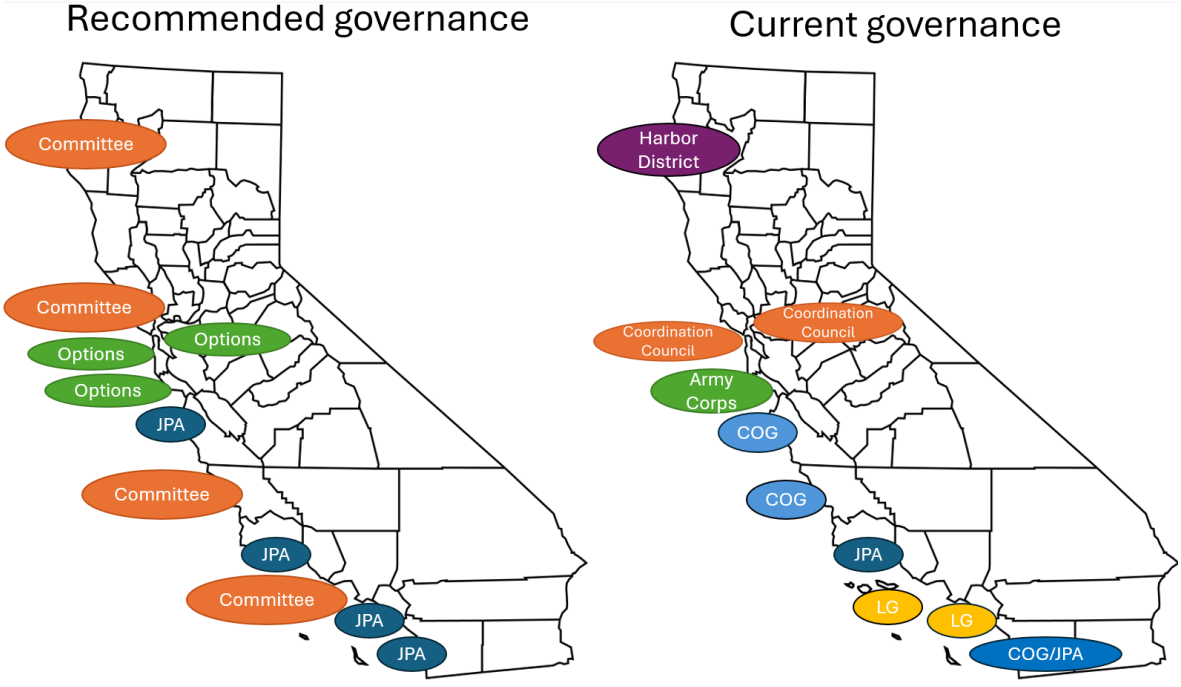


Figure 6. Governance recommendation of each regional sediment management plan when written compared to current status.

The BEACON JPA was identified in several plans as the jurisdiction having the most developed governance structure due to its proven history of successful RSMP implementation. Among the other plans, those structures that provided the most flexibility and allowed for most substantial stakeholder co-design were identified. Rather than recommending specific governance structures, these plans laid the foundation for stakeholder-driven governance structures through formation of committees and enhanced coordination and stakeholder engagement (Table 1).

Most recently, progress toward enhanced regional collaboration was identified in the North-central California region, which based on a stakeholder evaluation process began developing a governance structure incorporating recommendations from four CRSMPs (Sonoma-Marin, San Francisco Littoral, San Francisco Central Bay, and Santa Cruz). Led by NOAA's Greater Farallones National Marine Sanctuary, the process resulted in a Coastal Resilience Sediment Plan with site-specific and regional recommendations and the formation of a North-Central California Coordination Committee (NCCSCC) in 2019. Since its inception the NCCSCC, a 17-agency collaborative encompassing the outer coast of Sonoma, Marin, San Francisco, and San Mateo counties, has implemented RSMP recommendations including: forming research collaborations to fill data-gaps, securing major funding from state and federal sources, developing guidance documents to improve permitting efficiency for coastal sediment management projects, and forming an advisory committee for project planners to seek

streamlined agency feedback. Based on the NCCSCC success, in 2024, five southern California counties formed a voluntary regional collaboration on sediment management.

Table 1. Summary of how the eleven RSMPs addressed governance.

			Governance structure
More Developed	Santa Barbara	2009	This is the only plan reviewed which does not discuss governance structure, though it is actively governed by a JPA. Many of the other plans reference the BEACON governance structure as a model.
Less Developed	San Luis Obispo	2017	The San Luis Obispo County RSMP appoints The San Luis Obispo County of Governments (SLOCOG) to appoint a CRSMP Policy Advisory Committee who will seek input from stakeholders and subsequently make recommendations to The SLOCOG Board. The LA County CRSMP highlights the existing Departments of Beaches and Harbors and Public Works and recommends a staff program manager to be dedicated full time to CRSM issues and coordinate between existing departments, and with the cities of Long Beach and Santa Monica which manage their own beaches. The Eureka Littoral Cell RSMP recommends the creation of a Joint Regional Sediment Management Committee (JRSMC) which would coordinate and make recommendations for the CRSMP. The Plan recommends The JRSMC establishes a Memorandum of Understanding to lay out the structure and Management role of representatives on The committee, which should include the Humboldt Bay Harbor and Conservation District as well as local municipalities and tribes. Similarly, The Sonoma and Marin RSMP, which is the most recently published Plan, reviews governance options recommended by other RSMPs and suggests an open process to determine a governance structure driven by stakeholders and local governments. After the completion of the Sonoma and Marin RSMP in 2018, which is the most recently published Plan, stakeholders from that region as well as the San Francisco Littoral, San Francisco Central Bay, and Santa Cruz RSMPs held a working group process in 2019 to review recommended governance structures outlined in the RSMPs and select an appropriate structure for the outer coast of Sonoma, Marin, San Francisco, and San Mateo counties. The result was the formation of the North-central California Sediment Coordination Committee in 2019, a 17-agency collaborative of local, state, and federal agency staff led by a steering committee of Greater Farallones National Marine Sanctuary, National Park
	Los Angeles County	2017	
	Eureka	2017	
	Sonoma and Marin	2018	

		Service, and the California State Lands Commission that works to advance regional sediment management and implement recommendations of the four CRSMPs.
Santa Cruz San Francisco Open Coast San Francisco Central Bay	2015 2016 2017	The Santa Cruz JPA puts forward four governance options, including status quo, increased stakeholder engagement, a governance structure led by an existing agency, such as a local university, and then establishing a JPA modeled after BEACON. Though the RSMP presents these options it makes no recommendation. Similarly, the San Francisco Open Coast Littoral Cell RSMP puts forward four governance options (Status quo, Coordinating Network, Existing Jurisdiction(s) as the Lead CRSMP Agency, Special District including Geologic Hazard Assessment District and Joint Powers Authority) but makes no recommendation. The San Francisco Central Bay RSMP presents a cursory discussion of several governance challenges but puts forward no options nor recommendations.
Southern Monterey Bay San Diego County Orange County	2008 2009 2013	The Southern Monterey Bay CRSMP and the San Diego RSMP, as well as the Orange County RSMP, published in 2013, all discuss the existing governance structures of associated governments and recommend establishing a joint powers authority, modeled after the BEACON JPA. The San Diego region is governed by the San Diego Associated Governments (SanDAG) Shoreline Committee and the Southern Monterey Bay region identified the Associated Monterey Bay Area Governments (AMBAG).

Note: Color indicates depth of consideration, with darker green signifying greater depth.

2.2.2 Sediment Sources

The plans each listed a variety of sediment sources. Each plan scored equally high, as they all included a range of options tailored to the region. Sources collected across the plans were listed below. All the RSMPs list sediment sources available within the littoral cell(s), each of the sediment sources came with its own set of challenges (Table 2). The challenges tended to be named in the plans with few solutions. A major challenge applying to almost all sediment sources was determining efficient means to transport sediment from source to receiver site. Most of the RSM plans focused on navigation bypass sediments which simply dredge the navigation channel and place sediments downcoast. Few plans identified sediment back passing or moving sediment upcoast to sediment starved locations, or opportunistic sediment actions requiring moving sediment from the watershed down to the coast.

Sediment size was another challenge, particularly locations that hold sediment not naturally sorted through fluvial or marine transport (such as debris basins, construction materials, and

sediment behind dams). Contamination was identified as a challenge, particularly for harbor dredged sediments. These challenges are summarized below, as they relate to each of the sources (Table 2). Cross-jurisdictional cooperation poses an additional challenge, as sediment sources often don't exist in the same jurisdiction as receiver sites, requiring collaboration and cooperation across political boundaries.

On the regional level, one long-term need is to find stockpile locations where sediment can be temporarily staged, sorted, tested, and then re-used opportunistically. With high value coastal land values, the challenge to identify and acquire land is difficult. In the BEACON region, following the 2018 Thomas fire debris flow disaster it became apparent that there was not a big enough area to handle stockpiling emergency clean-up sediments. Having an interim holding facility near a source and receiver sites could allow more time for sediment testing, sorting, planning, permitting, and community outreach to deploy the sediment in a strategic way. Sediment management could be integrated into community planning around disaster recovery and adaptation planning particularly in areas with erosive beaches and debris-laden floods. As one survey respondent said:

> *"We already have stormwater infrastructure, channels, basins, etc., but the community planning has not integrated the sediment-handling aspects we need space to stockpile and sort material, and we need beach receiver sites that have access and sediment nourishment as part of their design". (Raaf, 2025)*

Table 2. Summary of the sediment sources in the RSMPs and their associated challenges.

Sediment sources	**Challenges**		
	Sorting	**Contamination**	**Transportation**
Sediment traps in creeks	√	√	√
Debris basins	√		√
Dams (Matilija and Rindge)	√		√
Rivers	√	√	√
Sand dunes			√
Construction excavated material	√	√	
Reservoirs		√	√
Harbor dredge material	√	√	√
Lagoon sediments	√	√	√
Offshore sand			√
Beach backpassing			√
Flood protection channels	√	√	√
Cliff erosion	√		√
Navigation channels bypassing		√	√

2.2.3 Sediment of All Sizes (mud, silt, sand, cobbles)

Some RSMPs included a range of grain sizes more than others. The primary focus of most plans was sand, but some plans included non-sand sediments such as mud and cobbles. While sand is the ideal sediment size for maintaining beaches, sediment overall is in short supply in many places, due to impoundment behind dams, debris basins, and coastal armoring and becoming increasingly limited as sea levels rise. As such, the best practice in RSMPs is to include as wide a range of sediment sizes as possible, from mud to cobbles (Table 3). Sediment size classes are defined in Table 4.

Table 3. Summary of how the eleven RSMPs address grain size.

			Grain Size
More Developed	Orange County	2013	The Orange County CRSMP discusses the grain size envelopes of the various beaches and receiver sites in the region and discusses the grain sizes of potential sediment sources and includes the use of cobbles in the recommended activities. The Eureka Littoral Cell and the Central San Francisco Bay CRSMP both include non-sand management strategies which are primarily related to fine grain sediment spreading as a path to marsh restoration. Inclusion of fine sediment management practices in these plans is likely because these regions are home to the largest estuaries in the state of California. However, estuarine environments with fine sediment exist along the coast of the whole state and best practice would be to include fine sediment management practices in each coastal sediment management plan.
	Eureka	2017	
	San Francisco Central Bay	2017	
	San Diego County	2009	The San Diego CRSMP discuss the grain size envelopes of the various beaches and receiver sites in the region, and discuss the grain sizes of potential sediment sources as well, inclusive of non-sand grain size. Similarly, the LA County CRSMP discusses debris basins as non-viable sources of sediment due to distance from the coast, but also introduces a dam in Malibu with mixed grain sizes and significant sand content as a possible source.
	Los Angeles County	2017	
Less Developed	San Francisco Open Coast	2016	The SLO, San Francisco Open Coast, and Sonoma/Marin CRSMPs each mention grain size, note it as a data gap, but do not include discussions of grain size envelopes of receiver sites or grain sizes of potential sources.
	San Luis Obispo	2017	
	Sonoma and Marin	2018	
	Southern Monterey Bay	2009	The BEACON, Southern Monterey Bay, and Santa Cruz CRSMPs are focused on sand only and contain little to no information regarding grain size. While Southern Monterey is almost entirely sandy beaches, Santa Cruz and the BEACON region both could utilize other grain sizes such as cobbles in their plan.
	BEACON	2009	
	Santa Cruz	2015	

Note: Color indicates depth of consideration, with darker green signifying greater range of sediments

Table 4. Grain size classification of sediment using the Wentworth grade scale.

Millimeters (mm)	Micrometers (μm)	Phi (ϕ)	Wentworth size class	
4096		-12.0	Boulder	
256		-8.0	Cobble	Gravel
64		-6.0	Pebble	
4		-2.0	Granule	
2.00		-1.0	Very coarse sand	
1.00		0.0	Coarse sand	
1/2 0.50	500	1.0	Medium sand	Sand
1/4 0.25	250	2.0	Fine sand	
1/8 0.125	125	3.0	Very fine sand	
1/16 0.0625	63	4.0	Coarse silt	
1/32 0.031	31	5.0	Medium silt	
1/64 0.0156	15.6	6.0	Fine silt	Silt
1/128 0.0078	7.8	7.0	Very fine silt	
1/256 0.0039	3.9	8.0		
0.00006	0.06	14.0	Clay	Mud

Muds and silts can be used in estuarine sediment management supporting marsh habitat restoration, as shown in Figure 7. Sand can be used for beach nourishment and dune creation. Cobbles can be used for creating natural erosion resistent shorelines. These various sediment sizes are sorted in systems where there is natural movement and distribution of sediment (e.g. in connected watersheds), but when natural movement of sediment is interrupted by, e.g., development and flood control structures, natural sorting does not occur. Thus, sediment from debris basins or behind dams will likely be poorly sorted by grain size.

While treatment of a wide range of sediment size is ideal, certain parts of the coast inherently have more diverse landforms and grain sizes. For example, the Santa Barbara littoral cell is home to beaches, cliffs and several estuaries, with sediment supplied by rivers, creeks and cliff erosion, while the Southern Monterey Bay littoral cell is essentially one long sandy beach with sand supplied from the Salinas River and erosion of the beaches and dunes.

Both Orange County and San Diego County have both implemented Sand Compatibility Opportunistic Use Programs (SCOUP). SCOUPs involve ranking previously utilized sediment sources using a three-fold classification system (suitable for direct placement, nearshore placement and unsuitable for beach nourishment) and matched with suitable receiver sites identified in the CRSMP. As such, these two plans laid the groundwork for further sediment management related to grain size. The Sonoma Marin, San Luis Obispo and Southern Monterey Bay plans all recommend exploring implementation of SCOUPs as a possible future step, and a

stakeholder comment in the Santa Barbara plan inquire about development of a SCOUP. After development of the Southern Monterey Bay and BEACON RSMPs, SCOUPs are under development in those jurisdictions. The City of Monterey established a regional SCOUP program and EIR in 2019 but has never gotten a CDP or had another jurisdiction adopt the program, although the City of Marina is working on integrating it into their LCP policies. The Santa Barbara County BeachSMART program is developing a SCOUP program. SCOUPS have not been implemented in the Sonoma Marin or San Luis Obispo regions since the RSMPs were written. Recently, Los Angeles County approved a SCOUP program[1].

BEACON had previously permitted a 5-year opportunistic nourishment program between 2005 and 2010 but it was only activated twice largely because dry years occurred in the permit window (see Section 5.3.2). The 2018 debris flows caused by the Thomas fire and flood events generally followed the locations identified in the opportunistic nourishment program, but sediment was placed under an emergency permit. The large volume of sediment from the recent disasters in the BEACON region illustrated the limited capacity of the 2 County receiver sites to accommodate the large volume. The Santa Barbara County BeachSMART is evaluating alternative receiver sites and placement methods. The intention is to consider and evaluate feasibility of alternative sites, establish a SCOUP program, and update the RSMP. For more discussion please see Section 5.4.

[1] https://beaches.lacounty.gov/coastal-resilience/scoup/

Figure 7. Images of cobbles (top left), fine sediment (top right), and sand (bottom) being utilized for enhancing coastal resilience.

An important limitation to note is that presently, most sediment management permits typically restrict the maximum percentage of fines up to 25%, based on federal and state agency 'rule of thumb' and regular practice. It also has a maximum grain size limitation. This threshold has eliminated sediments from beach disposal within Santa Barbara County's activities in the past and significantly reduced the supply of cobbles. The County is currently working with regulatory agencies through the BeachSMART initiative to reconsider these rules.

2.2.4 Inclusion of Sea Level Rise Considerations

Inclusion of sea level rise in the eleven CRSMPs varied largely based on the timing of the plan creation. The first round of CRSMPs in Southern Monterey Bay, BEACON, and San Diego barely mentioned sea level rise. However, in 2013, California's Assembly Bill (AB) 691 required trustees of state lands where average granted land revenues were greater than $250,000 annually, to prepare and submit an assessment to the California State Lands Commission (Commission) on how the local trustee proposed to address sea level rise. Since many of these trustees were ports and harbors with ongoing navigational dredging, sea level rise began being integrated into the CRSMPs. Beaches and coastal sediment are both public trust resources,

and so after 2013, managers of these resources were required to consider sea level rise. Thus, RSMPs written after the passage of AB 691 generally have a more thorough approach to integrating sea level rise into sediment management.

While including SLR considerations into regional RSMPs is ideal, certain jurisdictions have made significant investments into SLR adaptation planning, which has historically been separate planning processes at a jurisdictional level, while RSMP's tended to include multiple jurisdictions and consider more of a navigation or flood control focus at a larger regional littoral cell or sand shed scale.

Another consideration is political geography and the intensity of urban development, where there may be competing influences. It is typically easier from both a practical and political perspective to plan for sea level rise on less developed coastlines with less dense development. Conversely, there may not be the same level of urgency for management of sediment to support beach-related tourism and recreation in more rural areas.

For example, Los Angeles County has developed a Sea Level Rise Vulnerability Assessment and the San Francisco Bay Conservation and Development Commission has supported a Regional Shoreline Adaptation Plan. While these topics may be missing from the RSMP's, that does not signify neglect. Rather, this highlights the need to combine RSMP with SLR and climate adaptation plans to operationalize the recommendations delivered through RSMPs. In Table 5, the darkest green category contains plans that have fully and deeply integrated sea level rise considerations into sediment management planning while the lightest shade of green includes plans that have little to no mention of SLR.

In the past five years, BEACON has been coordinating with its member agencies on local climate coastal adaptation efforts. BEACON is currently coordinating with the City of Santa Barbara, with funding from the California Coastal Commission, to develop the Regional Coastal Adaptation Monitoring Program (RCAMP) to inform local adaptation planning decisions, including planning triggers, milestones, and other planning and implementation thresholds.

Table 5. Summary of how the eleven RSMPs incorporate sea level rise.

			Sea Level Rise
More Developed	San Francisco Open Coast San Luis Obispo Sonoma and Marin	2016 2017 2018	The SLO CRSMP has a section on changes in sea level, a section on how sea level rise will induce flooding and erosion, a section on sea level rise adaptation, and the topic sea level rise is present throughout the presented list of potential CRSM activities. Similarly, the San Francisco Open Coast CRSMP has a section on sea level rise and timeframe of the plan and a section on climate change impacts to the region, as well as sea level rise embedded in the geomorphic modeling of hazard zones and discussed thoroughly throughout the plan. The Sonoma and Marin CRSMP also has a section on sea level rise and sea level rise is discussed thoroughly and embedded throughout the plan.
	Southern Monterey Bay Orange County	2009 2013	The Southern Monterey Bay RSMP has a section on predicted sea level rise that gives specific estimates of future shoreline erosion rates on the region's coastline. The OC CRSMP has a section on water levels which discusses sea level rise, a section on how sea level rise impacts beaches and it also includes a recommendation on performing a study to assess beach sustainability with sea level rise.
	San Diego County Santa Cruz Eureka	2009 2015 2017	The San Diego and the Eureka RSMP both mention sea level rise but do not explicitly consider it in its recommendations or analyses. The Santa Cruz RSMP has a section on changes in sea level but does not explicitly consider sea level rise in its recommendations. However, the plan does point to numerous other sea level rise studies level in the region.
Less Developed	Santa Barbara San Francisco Central Bay Los Angeles County	2009 2017 2017	The Santa Barbara Littoral Cell RSMP (2009) makes a cursory mention of sea level rise in Table 2, noting briefly that shoreline recession rates in areas of high erosion may further accelerate. Similarly, The Central San Francisco Bay RSMP, written nearly a decade later (2017), makes one mention of sea level throughout the report, even though the Bay Area is central to California's vulnerability to sea level rise. Likewise, the LA County CRSMP (2017) makes only cursory mentions to sea level rise, though it does make a recommendation to locate offshore sand for beach nourishment in a future with higher sea levels.

Note: Color indicates depth of consideration, with darker green signifying greater depth.

2.2.5 Projects

The plans all recommend specific regional sediment management projects to address erosional hotspots (Table 6). However, not all the plans specifically recommend projects that address future climate change concerns using sediment from within the region.

The RSMPs from Santa Barbara, Santa Cruz, San Luis Obispo, Eureka, and Sonoma and Marin each recommend sediment management actions that use regional sediment to reduce future climate erosion risk. Furthermore, each of these five plans identify sediment management actions beyond beach nourishment and shoreline hardening, including enhancing beaches with offshore reefs, assessing and implementing managed retreat, tidal marsh creation, and upstream restoration.

The Orange County, San Francisco Central Bay, and San Francisco Open Coast plans either do not mention climate change or mention it briefly, but do include creative adaptation strategies that address future climate erosion risk.

The San Diego, Southern Monterey Bay, and Los Angeles County RSMPs do not address sea level rise and climate change and only suggest traditional sediment management such as beach nourishment. Current implementation efforts in San Diego and Los Angeles counties incorporate coastal adaptation and nature-based solutions (NBS) projects, such as living shorelines and dune and sandy beach restoration.

Table 6. Summary of how the eleven RSMPs consider projects that utilize sediment to reduce erosion risk and coastal hazard acceleration.

			Projects
More Developed	Santa Barbara Santa Cruz San Luis Obispo Eureka Sonoma and Marin	2009 2015 2017 2017 2018	In the Santa Barbara RSMP, many suggested RSMP actions are related to using sediment within the county to reduce impacts of climate change, including utilizing sediment behind dams and in debris basins as well as some beach restoration actions. The Santa Cruz RSMP presents a list of RSMP options for various areas within the county, most of which are related to climate adaptation. Actions include managed retreat, beach nourishment, and cliff stabilization among others. The San Luis Obispo lists RSMP actions and some mention sea level rise. Listed projects include a beach sustainability study, a sediment management plan for a reservoir in the county and developing a sand compatibility and opportunistic use program. The Eureka RSMP lists several ways to use various types of sediment to prepare for climate change including coastal dune enhancement, tidal marsh restoration, creating soft shorelines within the bay, and dike rehabilitation. The Sonoma and Marin RSMP lists various climate adaptation strategies involving sediment, including managed retreat, watershed and beach restoration, and living shorelines
	Orange County San Francisco Open Coast San Francisco Central Bay	2013 2016 2017	Suggested projects are scattered throughout the Orange County RSM. They are mostly related to beach nourishment and use of dredge materials, but there is also a mention of emptying debris from the Prado Dam and allowing it to re-enter the watershed and a sea level rise beach sustainability study. The San Francisco Open Coast RSMP includes brief mentions of SLR and climate change, but most of the projects are essentially climate adaptation strategies. The plan includes mentions of beach restoration. Similarly, the San Francisco Central Bay RSMP includes no specific mention of climate change, though many of the projects are related to climate adaptation, including habitat restoration, living shorelines, and watershed connectivity.
Less Developed	San Diego County Southern Monterey Bay Los Angeles County	2009 2009 2017	The San Diego RSMP includes sediment management approaches for various categories of sediment sources. It includes no mention of sea level rise and is primarily focused on how to utilize sand for beaches most effectively. The Southern Monterey Bay RSMP includes several strategies but none of them specifically address climate impacts. The three options presented are beach nourishment, stopping sand mining, and allowing dunes to retreat. The LA County RSMP includes no mention of climate change within the adaptation strategies.

Note: Color indicates depth of consideration, with darker green signifying greater depth.

2.2.6 Economics of Beach Nourishment

Benefits

Notably, the two plans that are least developed are from Eureka and Sonoma/Marin, which are in the northern part of the state where there are many remote beaches and less high-density beach tourism. As such, the lack of information on costs, visitation and benefits of beach nourishment may be due to regional geography and patterns of development and recreational use, rather than an oversight of the plans themselves (Table 7). Of the more developed (dark green) plans, the San Diego and Southern Monterey Bay RSMPs are the only two that include beach recreation and coastal protection services in their cost benefit analyses. The San Diego RSMP estimates coastal protection benefits using a method developed by King et al. (2007) and the Southern Monterey Bay RSMP does not include information on the methods used to determine coastal protection services of beaches. The remainder of RSMPs focus on beach recreation only. Quantifying the role of beaches in coastal protection is critical to supporting integration of regional sediment management and climate adaptation planning and is recommended as best practice. This natural infrastructure protection benefit should be a requirement if proponents are seeking funding from the Federal government for sediment management projects.

Beaches also provide ecological benefits, such as habitat provision, nutrient cycling and water filtration. There are limitations to the extent to which these can be effectively incorporated into benefit cost assessments of beach replenishment, due to the absence of underlying biophysical information. Recent work, though identified by the BEACON SAC Research Agenda highlights some of the emerging science that could inform the timing, and intensity of placement. BEACON supports the incorporation of more holistic cost benefit analysis, incorporating accounting and valuation of so-called ‘non-market’ goods and services more broadly as part of ecosystem services accounting and valuation.

However, the current standard of practice in the RSM Plans is that the primary focus on recreational benefits of beaches omits important factors that should be considered in a holistic benefit cost analysis.

Costs

The costs of beach nourishment depend on volume, frequency, and method of sand application as well as sand unit costs. These unit costs have multiple dimensions and may include purchasing the sand from commercial suppliers. Unit costs are typically higher for small opportunistic projects. Mobilization costs for large dredging and nourishment costs may exceed one million dollars, before considering permitting and design costs, but the volumes moved may have a lower unit cost.

Importantly, cost benefit analysis included in the existing documents do not consider the potential cost advantages of leveraging channel dredge bypassing. Bypassing provides sediment to the downcoast beaches and maintains littoral transport. Beneficial reuse of the sand that is removed for navigational reasons also has a lower incremental cost than sourcing sand from elsewhere. It is important for regional collaboration to maintain the federal navigation funding and the increasing incremental costs of such ongoing programs with their potential benefits.

Cost–Benefit Analysis

Best practices in the economic assessment of nourishment options are to quantify the ratio of the benefits and costs of a project, known as calculating the benefit cost ratio (BCR). The BCR can be compared across different sediment management options. Projects that have ratios higher than one are considered cost-effective, but higher ratios may be required depending on the source of funding and agency practices and standards. BEACON has supported the expansion in the types of benefits to be included in CBA evaluations. BEACON supports the use of more holistic and broad accounting of ecosystem services. For example, the US Army Corps of Engineers (the Corps) requires a BCR of above 2.5, while using a discount rate of 7% per annum.[2] This rate heavily discounts benefits in the far distant future, when the most severe climate change impacts are expected, so it can disadvantage nourishment projects. Such a discount rate may be appropriate for nourishment projects in which the added sand often stays for as short as a matter of months to years before traveling down the littoral cell (Griggs, 2024). Analysis of fate of beach nourishment in San Diego revealed that sand stayed on the beach for about four years. Additional funding rules limit the full consideration of the recreational benefits of nourishment projects, as the Corps has a larger focus on mitigation of flood and erosion impacts. Without conducting studies of sufficient detail to establish costs and benefits to allow calculation of the BCR for the different alternatives, this case can't be made. Examples of sediment management strategies throughout the plans with BCRs higher than one include:

- Central San Francisco Bay: Nourishment at McNears, Baker Beach, Crown Beach, and Albany Bulb. B:C = 19.1, 1.1, 5.2, and 8.1, respectively
- San Diego Plan: sediment is dredged from offshore and delivered to the coast at a rate of approximately 500,000 cubic yards per year. B:C = 1.2.

[2] [1] https://www.congress.gov/crs-product/R44594

Table 7. Summary of how the eleven RSMPs include economics of sediment management actions through quantification such as cost benefit analyses.

Economics of Beach Nourishment and Sediment Management Actions			
More Developed	Santa Barbara	2009	The BEACON CRSMP does an extensive economic analysis of the present value of beach nourishment at all the beaches within the littoral cell, with benefit determined by beach usage and amenities at each beach. Similarly, the Southern Monterey Bay CRSMP does a comprehensive assessment of the value of beach nourishment, taking into account recreational benefits as well as coastal protection services provided by beach nourishment. The SANDAG CRSMP calculates benefit cost ratios for several different management/ nourishment scenarios, with benefits also including recreation and coastal protection. Similarly, the SF Open Coast CRSMP calculated the net economic benefit of the various management alternatives by comparing recreational benefit and project cost, and the San Francisco Central Bay CRSMP calculates cost benefit ratios of beach nourishment at the most popular beaches in the region.
	Southern Monterey Bay	2009	
	San Diego County	2009	
	San Francisco Open Coast	2016	
	San Francisco Central Bay	2017	
	Orange County	2013	Orange County CRSMP performs an estimate of the value of recreation at county beaches but does not compare this to the costs of the suggested management approaches. Similarly, the SLO CRSMP estimates recreational value of the beaches but does not compare this to the costs of the CRSMP projects
	San Luis Obispo	2017	
Less Developed	Santa Cruz	2015	The Santa Cruz CRSMP does not address the economic costs or benefits of beach nourishment and suggests such an analysis as a possible future study, though it does quantify beach usage throughout the region. Similarly, the LA County CRSMP presents beach use statistics and presents a rough estimate of the total value of all the beaches in the county and the economic loss of county-wide beach deterioration, but does not present any figures on value or project costs at any individual beach.
	Los Angeles County	2017	
	Eureka	2017	The Eureka CRSMP does not address costs or benefits associated with beach nourishment or any other recommended strategy. The Sonoma and Marin Plan does not address costs or benefits either and identifies this as a data gap.
	Sonoma and Marin	2018	

Note: Color indicates depth of consideration, with darker green signifying greater depth.

2.2.7 Funding Sources and Revenue Raising Potential

A wide variety of funding sources could be used to support CRSMP projects and efforts. All the plans mention the challenge of fundraising for CRSMP actions with most listing possible funding sources. Many of them highlight the primary role that funding from the U.S. Army Corps

of Engineers has historically played in funding navigational dredging, though it is noted that USACE primarily funds are "limited to projects where there is a federal interest" and typically require 30-50% local support. Importantly, in 2023 the USACE established a goal of increasing the use of beneficially reused sediment to 70% of dredge material by 2030, which will shift the playing field. If 70% of sediment is required to be directed to beneficial reuse, cost comparison of disposal options will not be compared with inexpensive offshore disposal, but rather against other beneficial uses of sediment. With this change and the local cost share there may be more creative opportunities to use this sediment in adaptation planning. Thus, while innovation and creativity will be required to meet this goal, this newly established priority may open new opportunities for beneficial reuse in California RSMP.

In Table 8, the darkest green section includes plans that identify numerous, varied, and specific funding sources. The next shade includes plans that make general suggestions about potential funding sources but do not present specific recommendations. The lightest green shade includes a plan that mentions funding challenges but does not present suggestions or recommendations.

Table 8. Summary of how the eleven RSMPs funding sources for sediment management projects.

			Funding Sources
More Developed	Southern Monterey Bay	2008	The BEACON CRSMP identifies several funding mechanisms to support sediment management activities. These include transient occupancy taxes, beach parking fees, and sales taxes, property taxes, snack bars, and mitigation fees. The Southern Monterey Bay CRSMP identifies numerous federal and state agencies that may be able to support sediment management strategies, as well as several local fundraising options. Similarly, the Santa Cruz CRSMP identifies the USACE, the USFWS, CA Department of Boating and Waterways, CA State Coastal Conservancy, and local funding sources. The Sonoma Marin CRSMP lists these same potential funding sources, in addition to the US EPA, the California Ocean Protection Council, regional sales taxes, parking fees, and development impact fees. The San Diego CRSMP identifies regional sales taxes, rental car fees, transient occupancy taxes, property tax assessments, parking fees, development impact fees and inland sediment transport offset funds as possible funding mechanisms. Similarly, the SLO CRSMP identifies transient occupancy taxes, property taxes, sales taxes, and geological hazard abatement districts. The plan quantifies the potential revenue and assesses feasibility for each. The San Francisco Open Coast Plan identifies the CA DBW, the USACE, geologic hazard abatement districts, transient occupancy taxes and sale taxes as possible funding sources.
	Santa Barbara	2009	
	San Diego County	2009	
	Santa Cruz	2015	
	San Francisco Open Coast	2016	
	San Luis Obispo	2017	
	Sonoma and Marin	2018	
Less Developed	Orange County	2013	The Orange County CRSMP makes some vague suggestions (e.g. “establish funding stream to accommodate incremental RSM costs”) but does present specific options to establish such a funding stream. Similarly, the LA County CRSMP suggests “collaborating with state and federal authorities” to access funding for CRSM but does not elaborate. The Eureka CRSMP identifies the primary funding partner to be the USACE and discusses some of the opportunities and challenges related to USACE funding for navigational dredging, but does not make specific recommendations or suggest alternatives.
	Los Angeles County	2017	
	Eureka	2017	

	San Francisco Central Bay	2017	The Central SF Bay CRSMP mentions funding challenges throughout the report but does not put forward suggestions or recommendations for how to develop funding sources.

Note: Color indicates depth of consideration, with darker green signifying greater depth.

2.2.8 Staffing

The plans make a variety of suggestions on staffing needs for RSMP endeavors. Four plans recommend hiring at least one person. The LA County and Southern Monterey Bay plans each recommend establishing and hiring a single dedicated staff position to handle RSM projects, and the Sonoma/Marin and Orange County plans both recommend creating at least one staff position to implement the plan.

The other plans make more general suggestions. The Santa Cruz plan suggests creating one short-term staff position and subsequently one or more long-term RSM staff positions. The Central SF Bay plan implies that BCDC staff can take on RSM activities. The SLO plan suggests seeking funding to support staff to implement the plan but does not specify how many staff positions will be required. Similarly, the SF Open Coast Plan alludes to staffing needs but does not specify how many people will be required and if this means creating new staff positions. The BEACON plan recommends hiring "staff" but does not say how many positions this will be. The Eureka and San Diego plans make no mention of specific staffing needs.

Across all these plans, the typical minimum staffing recommendation is one full-time person, with additional staff positions if funds permit. The plans vary on whether the RSM staff is a new position or a reallocation within an existing unit. Plan review alone is not enough to determine whether staff positions were ever created and filled. A retrospective analysis of advertisements and employment numbers is outside the scope of this review. RSM staffing in the BEACON region includes 1.5 full-time employees and consultants according to specific project need and grant funding. The qualifications of the staff needed for RSM projects tend to be scientists or engineers with a project management background with experience in flood control and navigation. These skills differ than the skills of staff who are heavily involved in adaptation planning, which tend to be more planning, policy, and community outreach focused. Some cross training or capacity building may likely be required to bridge this gap.

Most recently along with the formation of the North-central California Sediment Coordination Committee in 2019 (which encompasses the Sonoma-Marin, San Francisco Littoral, and northern half of the Santa Cruz RSMPs as well as the outer coast of the San Francisco Central Bay RSMP), GFNMS allocated staff time to lead the steering committee and secured grant funding for an additional staff at 0.25 full time.

The BEACON Board of Directors has approved new funding for similar part-time administrative and grants staff to support program development and expansion of its projects and related science support activities.

3 BEACON VULNERABILITY AND ADAPTATION PLAN REVIEW

Source: California Coastal Records Project

BEACON provided access to an online data repository that included a tabulated internal review of vulnerability and climate adaptation plans completed in each of the BEACON member agencies, along with additional documents related to specific projects. These municipalities include Goleta, the City of Santa Barbara, Carpinteria, the City of Ventura, Oxnard, Port Hueneme, The County of Santa Barbara, and the County of Ventura. The documents included Local Land Use Plans, Sea Level Rise Vulnerability Assessments, Climate Adaptation Plans, Sustainability Plans, Corps and California Coastal Commission permits, among others, with lengths reaching up to more than 250 pages. Table 9 shows an overview of the count and range of years for these documents. Funding sources for development of these documents include the California Coastal Commission, the State Coastal Conservancy and local governments. More specific information on the documents included in this analysis can be found in Appendix A.

Table 9. Summary of the documents received from BEACON and reviewed for each jurisdiction.

Jurisdiction	n	Range of years	Planning (GP, LUP, LCP)	Sediment management	Climate adaptation	Climate vulnerability	Climate mitigation
Goleta	13	2003 - 2023	0	9	1	2	1
City of Santa Barbara	28	1982 - 2022	6	3	8	7	4
Carpinteria	23	1996 - 2002	7	7	2	7	0
City of Ventura	4	2018 - 2022	0	0	2	1	1
Oxnard	5	1982 - 2016	2	1	1	1	0
Port Hueneme	6	2019 - 2021	4	1	0	1	0
County of Santa Barbara	15	2010 - 2023	1	6	2	3	4
County of Ventura	30	2009 - 2022	7	3	10	10	0

To review the range of documents, a combination of AI guided by staff developed a customized Microsoft 365 Copilot Agent tailored for vulnerability and climate document analysis. This involved designing custom prompt structures that aligned with the key objectives of the analysis (Section 2.1). The agent was iteratively refined through prompt engineering to ensure it met the criteria for extracting relevant insights and summarizing key findings effectively, with special focus to financing and sediment management considerations. To optimize the agent's performance and improve the clarity of results, the workflow was structured into two distinct reporting phases, allowing the agent to process and generate outputs in more manageable sections. This segmentation ensured that the analysis remained coherent, accurate, and aligned with project goals. The search terms used in the AI analysis are listed below:

- Sediment management
- Debris flow
- Ebb
- Offshore
- Nourishment
- Dredge/Dredging
- Deposition
- Beneficial reuse
- Opportunistic
- Source
- Sand
- Coastal Act Section 30233(d)
- Cobbles
- Mud
- Fines
- Silt
- Debris
- Erosion
- Funding
- Financing
- Governance
- Flood control
- Levee
- Cost-benefit/benefit-cost
- BEACON
- Recreation
- Surf

Once the initial AI-generated reports were produced, human reviewers conducted a quality assurance review, assessing the output for relevance, accuracy, and completeness. Based on their feedback, the Copilot Agent was reconfigured, adjusting prompts and refining its analytical approach to enhance precision and alignment with expectations. With the optimized agent in place, the Copilot Agent was deployed across the entire document set, ensuring that all materials were processed consistently and efficiently, delivering a final set of structured summary reports that supported the project's objective of assessing funding, governance, and use of coastal sediment in regional climate documents. Human reviewers then utilized the AI-generated summaries to assess the way the documents addressed the RSMP themes defined in Section 2.1.

The agent-led analysis provided an assessment that is limited both by the selection of source documentation (focused on documents provided by BEACON, and located from municipal and CSMW databases), and by the date of completion of the documents. For example, RSMPs that were developed later in the process reflect changes in understanding and policy direction that were not possible to incorporate into the earlier RSMP documents (e.g. sea level rise guidance). Summaries in this section should not be interpreted as a reflection of the full range of sediment management and climate resilience actions of any of the named municipalities, but as a review of the provided policy and planning documents, as well as others identified based on professional knowledge.

High level findings from this analysis indicate that some jurisdictions within the BEACON region have sediment management more effectively integrated into their coastal climate adaptation planning documents than others. For example, the City of Santa Barbara and Ventura County had the most relevant documents (of those provided by BEACON) and included sediment management considerations in a relatively comprehensive manner. While some jurisdictions have more coverage of RSMP themes in their coastal climate documents than others, none of them fully address all themes identified.

Additionally, this process revealed that sediment is consistently identified and utilized as a tool across the BEACON region to adapt to climate change, but the logistical framework to implement such projects, including financing, cost benefit analyses, governance, grain size, and sediment sources are variable and largely localized in individual jurisdictions (Figure 8). This is a similar finding to that in the statewide RSMP review, themes discussed more in depth in the following pages.

The main limitation of this analysis is that the documents included were limited to those provided by BEACON, which spanned up to 2023, and may not be fully reflective of all climate-related actions either during the period of coverage, or in subsequent years. Climate documents created after 2023 by any of the jurisdictions were not included. Thus, gaps identified in this report may be filled by work done between 2023 and 2025 or are ongoing in the BEACON jurisdictions. Additionally, the documents provided by BEACON were sorted into jurisdictional folders upon their delivery. Integral did not move or modify the jurisdictional

assignment of any of these documents and the following findings assume that the jurisdictional sorting done by BEACON was accurate.

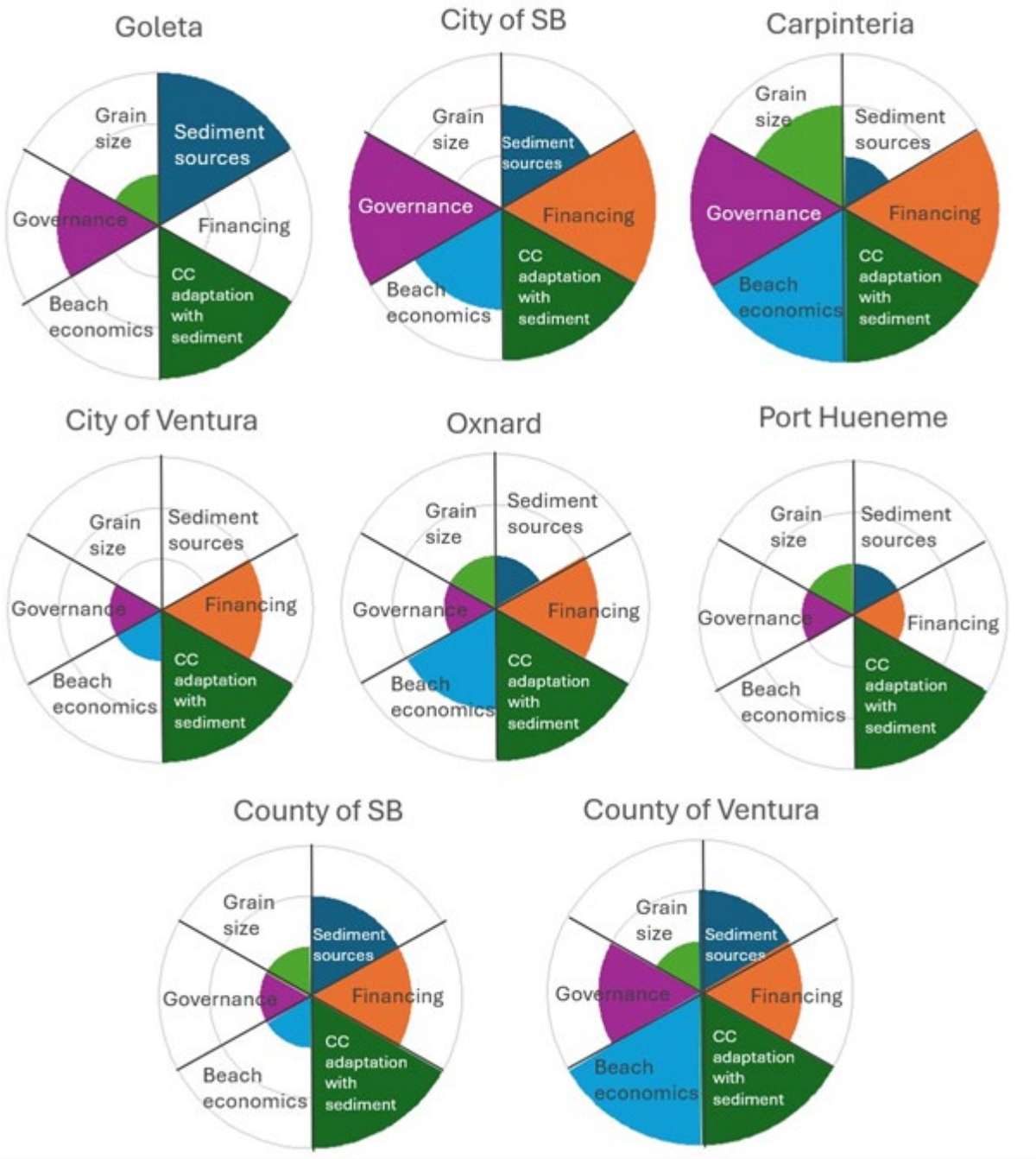


Figure 8. Summary of representation of regional sediment management themes across the climate vulnerability and adaptation assessment documents from the BEACON region.

3.1 GOVERNANCE OF SEDIMENT MANAGEMENT

Table 10. References to governance of sediment management in the BEACON region climate documents

	Jurisdiction	Governance Structure
More Developed	**City of Santa Barbara**	1. BEACON mentioned as the central organization managing the beach enhancement program. 2. BEACON mentioned as a collaborating agency. 3. BEACON mentioned as a regional collaborative entity for shoreline management . 4. Explicitly mentioned in reference to the Coastal Sand Management Plan. 5. Mentions BEACON as a Joint Powers Agency used to implement sediment management and discusses regional consensus-driven sediment management policy and guidance. 6. Mentions BEACON as a Joint Powers Agency involved in coastal erosion management. 7. Governance mentioned in the context of updating the Coastal Regional Sediment Management Plan. 8. Mentions of BEACON updating the Coastal Regional Sediment Management Plan.
	Carpinteria	1. Mentions of BEACON throughout and discussion of regional sediment management and coastal governance. 2. Mentions BEACON relating to projects and programs addressing coastal hazards. 3. Mentions of BEACON regarding beach nourishment planning. 4. Mentions of BEACON's role and jurisdiction in addressing coastal erosion and beach nourishment. 5. Mention of BEACON regarding regional management of beach sediment. 6. Mentions coordination with BEACON to protect City resources from coastal hazards. 7. Explicit mentions of BEACON.
Less Developed	**County of Ventura**	1. BEACON extensively referenced throughout. 2. BEACON mentioned in the context of regional shore protection. 3. BEACON mentioned as a Joint Powers Authority. 4. BEACON mentioned as a Joint Powers Agency.
	Goleta	1. BEACON is the primary entity in the document which describes BEACON's beach nourishment demonstration project at Goleta Beach. 2. BEACON mentioned in the context of the program to place beach replenishment material at multiple sites including Goleta Beach County Park. 3. BEACON is mentioned as part of the governance structure dealing with coastal management issues. 4. BEACON mentioned in the context of implementation of sediment

	management. 5. BEACON mentioned as a joint powers authority whose members consist of the local government agencies in Santa Barbara and Ventura Counties', including mentions of previous BEACON permits for beach nourishment.
Oxnard	1. BEACON mentioned as one of the entities with whom the City should coordinate adaptation planning at a regional level under the proposed "Community Scale Adaptation Planning" policies.
City of Ventura	1. Explicitly mentioned as "Beach Erosion Authority for Clean Oceans and Nourishment" partnering with the City to apply for grants and manage the Surfer's Point Managed Retreat Project.
Port Hueneme	1. Governance mentioned as "The City shall work with expert agencies (e.g., United Water Conservation District, Fox Canyon Ground Water Management Agency, the Ventura County Watershed Protection District, and/or BEACON)".
County of Santa Barbara	1. The need for unified governance mentioned

The documents from the City of Santa Barbara and Carpinteria mention the BEACON JPA extensively in the context of projects and programs for sediment management (Table 10). The County of Ventura and Goleta documents have several mentions of sediment governance. Oxnard, the City of Ventura, and Port Hueneme each have only mention of governance frameworks for sediment management. The County of Santa Barbara does not touch on this topic across the documents. Overall, the explicit representation of governance of sediment is variable across the reviewed climate documents, and particularly weak in the County of Santa Barbara and the southern cities within the region despite active ongoing work by flood control and planning departments.

3.2 SEDIMENT SOURCES

The sediment sources identified as adaptation resources across all the provided climate adaptation planning documents are listed in Table 11. While Goleta has fewer documents than other jurisdictions in the region (n = 13, Table 9), a wide range of sediment sources were listed across those documents (n = 7). These sources included sediments from within the city limits (e.g. flood control channels and creeks in the Goleta Slough) as well as sediment from other municipalities (e.g. dredged sand from the Santa Barbara Harbor). Using sediment on Goleta Beach was mentioned many times in the documents due to past placements by BEACON and of debris flow sediment on Goleta Beach after the Thomas Fire and mudslides of 2018.

The City of Santa Barbara and the counties of Santa Barbara and Ventura also listed a variety of sediment sources, including sediment from debris basins, creeks, harbor dredge, construction, and the Matilija Dam. The City of Santa Barbara mentions sediment from creeks in Goleta Slough, but other than that these plans all focus on sediment within their own jurisdiction.

Finally, Carpinteria, Oxnard and Port Hueneme plans all list only one sediment source, each within their jurisdictional boundaries. The City of Ventura plans do not identify sediment as a climate adaptation resource.

Table 11. Sediment sources included as an adaptation resource in the BEACON adaptation planning documents

	Jurisdiction	Sediment Sources
More Developed	Goleta	1. Beneficial reuse of sediment from debris basins for beach nourishment 2. Sediment from creeks is removed and beneficially reused for beach nourishment at Goleta Beach 3. Beneficial reuse of dredged sand from Santa Barbara Harbor for beach nourishment at Goleta Beach 4. Offshore dredging and beach nourishment components while attempting to maintain natural sediment flow patterns through a permeable design 5. Beneficially reusing suitable sediment removed from flood control channels for beach nourishment 6. Beneficially reusing dredged material from flood control activities for beach nourishment at Goleta Beach 7. Reusing debris flow sediments for beach nourishment 8. Goleta Slough (ie Lagoon) is a sediment source, when dredged, sediment can be used for replenishment at Goleta Beach
	City of Santa Barbara	1. Beneficial reuse of harbor dredge material for beach nourishment 2. Sedimentation in the Goleta Slough from Carneros and Tecolotito Creeks 3. Sediment basins and removal programs but do not specifically address beneficial re-use opportunities. 4. Using surplus sand from upland construction projects to replenish six designated beaches along the South-Central Coast
	County of Santa Barbara	1. Beneficial re-use of sediment dredged from upstream debris basins 2. Beneficial reuse of dredged sediments in marsh restoration and beach nourishment projects, demonstrating cost-effectiveness and ecological benefits. 3. Use of dredged sediments for beach nourishment 4. Increased sediment fluxes from watersheds due to more intense storms and wildfire
	County of Ventura	1. Beneficial reuse of sand dredged from Channel Islands Harbor 2. Debris basins 3. Matilija Dam sediment 4. Sediment yield of Calleguas Creek
Less Developed	Carpinteria	1. Debris basins in the Carpinteria Valley 2. Carp Marsh is a sediment source, when dredged, sediment may be used for beach replenishment.
	Oxnard	1. Sand that accumulates in the Channel Islands Harbor sand traps
	Port Hueneme	1. Port Hueneme sediments which are physically compatible with Hueneme Beach for nourishment
	City of Ventura	1. Sand removal at Pierpont Beach

This comparison illustrates that, based on the materials reviewed, some jurisdictions are more actively considering a broad range of sediment types to adapt to climate change than others, and some agencies are considering sediment as a regional resource more than others. As identified in the BEACON RSMP, sediment is a valuable shared resource, and integrating regional management of sediment into future regional adaptation planning documents will be essential. The history of events in the region likely influenced the trends shown in Table 11, given that Goleta Beach and Carpinteria were regional receiver sites of Thomas Fire sediment from the debris flows. This is discussed more in Section 5.3.

3.3 SEDIMENT OF ALL SIZES

Five of the eight jurisdictions mention non-sand sediment sizes as a climate adaptation resource in their planning documents (Table 12). Carpinteria, Goleta, and the two counties each consider cobbles to be a climate adaptation resource, and Port Hueneme mentions silty sands. These plans mention coarse cobble materials as useful for maintaining beaches, reducing erosion and incorporated into living shorelines. However, debris basins are identified as "starving" beaches of coarse sediments in the Carpinteria documents. Cobbles which were once present in Carpinteria have been largely eliminated by construction of debris basins, and other creek barriers as well as seasonal construction of the City's storm berm changing the natural cobble sorting and transport.

The example of a cross-shore cobble delta created by debris flow sediments impounded sand, recreating a recreational beach, is identified as a potentially successful temporary shoreline protection method (see Section 5.2). While these plans identify the challenge of debris basin and its effect on coarse grain material and identify it as useful for shoreline projects, actionable plans are not presented. The absence of this linkage is a key limitation of both sediment management and adaptation planning processes and hinders implementation. Notably, while this approach is absent from the reports, it did happen in Santa Barbara and Ventura counties, using BEACON designated beaches to determine receive sites. This highlights that the documents analyzed to not necessarily capture the entire history of sediment management in the BEACON region. The current effort by SB County BeachSMART and BEACON to retrofit debris basins and expand receiver sites is a step in improving this linkage.

Table 12. Mentions of all sediment sizes as an adaptation resource in the BEACON climate documents.

	Jurisdiction	Grain Size
More Developed	Carpinteria	1. Beach nourishment using sand and cobbles to create living shorelines 2. Sediment debris basins contain coarse materials, which are essential for storm buffering on beaches 3. Need for large grain sediments, cobbles, mud
Less Developed	Goleta	1. Touched on in context of debris placed on Goleta beach
	Port Hueneme	1. Sediment types such as silty sands and their compatibility with beach materials
	County of Santa Barbara	1. The cobble berm at Goleta Beach Park, formed by flood control debris as a successful, low-cost alternative to traditional shoreline protection methods
	County of Ventura	1. The beneficial reuse of cobbles and other coarse sediment materials as a component of a comprehensive sediment management strategy
	Oxnard	1. Touched on in context of placement of silt and sand mixture from dredging operations
	City of Santa Barbara	n/a – sand is the only focus
	City of Ventura	n/a – grain sizes not discussed

3.4 ECONOMICS OF BEACH NOURISHMENT

The total estimated spending on beach recreation is just below $113 million annually, generating $916,800 in sales taxes for County and City governments and agencies, and $2.3 million in transient occupancy taxes (Table 13), from the Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment.[3] Across the planning documents, the County of Ventura and Carpinteria each have extensive discussions of cost-benefit analyses of coastal adaptation options, as well as discussion of beach valuations, including recreational value of the beach, and for Ventura County, recreational value of surfing (Table 14). The City of Santa Barbara and Oxnard also have numerous mentions across documents of cost benefit analyses and the recreational value of the coast. The two counties both have scant discussion about the economic value of beaches for erosion protection. Goleta and Port Hueneme do not include these concepts at all.

[3] Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment. 2019

Table 13. Data on economic and tax revenue impacts from spending associated with beach recreation.

Site	Yearly Attendance	Source	% surfers	Value of Surfing	Total Recreational Value
North Coast	1,170,000		38%	$46,352,800	$64,628,000
Rincon	350,000	BEACON	75%	$17,062,500	$20,562,500
La Conchita	40,000	BEACON	25%	$650,000	$1,850,000
Mussel Shoals	10,000	BEACON	90%	$585,000	$625,000
Hobson	90,000	Interviews	76%	$4,446,000	$5,310,000
Rincon Parkway North	100,000	BEACON	30%	$1,937,000	$4,745,000
Faria County	100,000	Interviews	46%	$3,003,000	$5,155,000
Rincon Parkway South	30,000	BEACON	55%	$1,072,500	$1,612,500
Mondos	210,000	BEACON	80%	$10,920,000	$12,600,000
Emma Wood	240,000	CA State Parks	43%	$6,676,800	$12,168,000
Central Coast	1,410,000		46%	$36,510,500	$70,442,500
C Street	400,000	BEACON	97%	$25,116,000	$25,660,000
San Buenaventura	500,000	CA State Parks	4%	$1,300,000	$20,500,000
Oxnard Shores	50,000	BEACON	15%	$487,500	$2,187,500
Silverstrand	410,000	BEACON	33%	$8,794,500	$19,782,500
Port Hueneme	50,000	BEACON	25%	$812,500	$2,312,500
South Coast	470,000		16%	$6,110,000	$21,150,000
Point Mugu	470,000	CA State Parks	20%	$6,110,000	$21,150,000
County Total	3,050,000		100%	$88,973,300	$156,220,500

Note: The total estimated spending on beach recreation is just below $113 million annually, generating $916,800 in sales taxes for County and City governments and agencies, and $2.3 million in transient occupancy taxes. From the Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment.

Table 14. Mentions of economics of beach nourishment as a resource in the BEACON climate documents.

	Jurisdiction	Economics (how to keep beaches)
More Developed	Carpinteria	1. Implicit mentions of cost benefit analysis related to economic evaluation and avoided costs to protect property through beach nourishment. 2. Explicit mention and implicit discussions of cost benefit analysis throughout involving economic impacts and adaptation strategies. 3. Explicit mention of cost benefit analysis in context of evaluating adaptation strategies (page ES-10). 4. Explicit mentions of cost benefit analysis throughout and implicit discussions throughout when evaluating adaptation strategies, also identifying recreation as a key public trust use vulnerable to sea level rise 5. Explicit mentions regarding the importance of considering cost-benefit when implementing mitigation actions. 6. Explicit mentions of funding and costs and comparison of project costs to potential damage 7. Explicit mention regarding sediment management practices evaluating beneficial reuse options based on cost-benefit analyses with explicit mentions throughout in context of recreational amenities, opportunities, value, tourism, and activities, referencing surf breaks as vulnerable resources.
Less Developed	County of Ventura	1. Economic benefit analysis for beach nourishment projects discussed with extensive discussion of recreational value of beaches. 2. Recreation mentioned as a key aspect of coastal value and project benefits. 3. Mention of "benefit/cost analysis" with recreation extensively discussed, including economic benefits of beach recreation and surfing mentioned as a higher-value recreational activity, with detailed economic valuation. 4. Benefit cost analysis mentioned throughout . Recreation value mentioned and surfing is noted as contributing to the non-market benefits of beaches. 5. Cost benefit analysis mentioned a method for prioritizing mitigation actions. 6. Cost benefit analysis mentioned through discussion of 'fiscal impacts' and used to quantify losses/values and estimate/compare adaptation costs. 7. Cost benefit analysis mentioned as prior work informing the vision and as a recommended next step: 'Economic assessment', 'Evaluate fiscal impacts', 'Economic Analysis'.

Jurisdiction	Economics (how to keep beaches)
City of Santa Barbara	1. Cost benefit analysis explicitly mentioned as the core methodological framework of the entire document with beach recreation explicitly mentioned as an important value and specifically analyzed as a "non-market impact" 2. Cost benefit analysis explicitly mentioned in multiple sections with detailed analysis of costs and benefits of adaptation strategies 3. Includes a Benefit-Cost Analysis estimating economic impacts and the cost-effectiveness of adaptation strategies 4. Recreation is listed as a benefit of the Surfers Point Managed Shoreline Retreat Project and is implicitly one of the core goals of the projects (see page 4 regarding coastal access). 5. Recreation explicitly mentioned as valuable activities potentially impacted by beach narrowing with economic consequences 6. Recreation explicitly mentioned as economic benefit of maintained beaches
Oxnard	1. Recreation mentioned throughout as a key public value and use of the coast protected under public trust doctrine and California Coastal Act 2. "Recreational value in the form of beach attendance" is mentioned as a factor included in the net benefits calculation. Also implicitly referenced through discussions of beaches, coastal access, harbors, etc. 3. Mentioned "beach recreation" as a key benefit whose value is considered in the cost-benefit analysis. Also implicit in discussions of beach access and attendance. 4. Cost/Benefit Analysis is mentioned as the title for the analysis evaluating adaptation strategies, detailing what net benefits include and exclude. Also implicitly referenced through net benefits/costs discussions for various adaptation strategies. 5. Cost-benefit analysis described as method used to compare sea level rise adaptation strategies by evaluating economic trade-offs.
City of Ventura	1. Recreation explicitly mentioned throughout as a key economic and cultural activity along Ventura's coastline, including recreational boating, surfing, park visits, fishing, and paddleboarding 2. Recreation explicitly mentioned as a significant economic activity; "Beaches, museums, the harbor, the neighboring Channel Islands, and downtown areas attract over a million visitors annually"
County of Santa Barbara	1. States that "The County will qualitatively evaluate the costs and benefits of potential adaptation strategies"
Goleta	n/a – not explicitly discussed in the context of coastal climate adaptation, though mentioned explicitly in the context of emissions reductions
Port Hueneme	n/a – not mentioned in any context

3.5 FUNDING SOURCES

The City of Santa Barbara and Carpinteria identify a wide range of potential funding sources for climate adaptation activities (>8), the County of Ventura and City and Oxnard each identify several (2-4), and Port Hueneme only identifies the Army Corps of Engineers as a possible funder (Table 15). Funding options do not appear in the documents from Goleta or the County of Santa Barbara. Importantly, this exercise identifies some funding sources that did not emerge from the RSMP analysis: public-private partnerships and a Harbor Preservation Fund.

Table 16 contains the funding opportunities identified across the RSMPs and the climate documents. These mechanisms span across several categories: federal funding, state funding, and taxes and fees. While federal and state funding could pay for RSMP activities, these options either rely on legislation or one time grant funding, which may not be a reliable source of future funding. Utilizing fees or taxes to fund RSMP activities would be a more flexible and sustainable alternative, providing new continuous funding streams.

Notably absent from this list is the USACE Harbor Navigational Trust Fund, which is created by a Harbor Maintenance Tax Fund (HMTF) charged against the value of imports and domestic cargo arriving at U.S. Ports that have federally-maintained harbors and channels. This tax is deposited into the trust fund, which is then used to fund maintenance dredging, dredge disposal areas, and construction of jetties and breakwaters.

Table 15. Mentions of funding sources for adaptation in the BEACON climate planning documents.

	Jurisdiction	Financing
More Developed	**City of Santa Barbara**	1. Local agency contributions 2. Developer participation/development impact fees 3. Grants to fund opportunistic beach fill projects 4. Opportunistic funding 5. Integration into existing budgets 6. Current revenue 7. State loans 8. Federal funding 9. Bond financing 10. Harbor Preservation Fund 11. Grants from the California Coastal Commission and the Coastal Conservancy 12. Public-private partnerships 13. Local contributions
	Carpinteria	1. State and federal grants 2. Local assessments 3. Cost-sharing arrangements 4. Development impact fees 5. Federal, state, and local funding sources for infrastructure improvements 6. Legislature's initial funding for AB 691 assessments 7. Local assessments 8. Potential mitigation fees
Less Developed	County of Ventura	1. Transient Occupancy Taxes (TOT) 2. Parking fees 3. Sales taxes 4. Potential mitigation fees.
	Oxnard	1. Grant funding from the State 2. Mitigation fees for seawall projects
	City of Ventura	1. Grants 2. Leveraging city budgets to fund strategic projects
	County of Santa Barbara	1. Cap and trade funding 2. Proposition 68 funding
	Port Hueneme	1. Army Corps of Engineers
	Goleta	n/a - Funding for climate mitigation efforts is discussed but not for climate adaptation or sediment management

Table 16. Funding sources identified across the RSMs and climate documents.

Funding opportunities	Background and examples
Federal Funding Agencies	
U.S. Army Corps of Engineers	Continuing Authorities Program (CAP): allows USACE to study and construct projects without additional authorization from Congress. Project costs are generally capped at $5–10M federal expenditure General Investigation (GI) Study: USACE conducts a feasibility study that may recommend a larger project for authorization (i.e., a project costing more than CAP program funding limits)
The U.S. Fish and Wildlife Service	Cooperative Conservation Initiative: provides funding for projects that restore natural resources and establish or expand wildlife habitat. A 50% match is required of the project sponsor Cooperative Endangered Species Conservation Fund: provides funding for implementation of conservation projects or acquisition of habitat that will benefit federally listed threatened or endangered species. The required match by the local sponsor for this program is 25% of estimated project cost (in-kind contributions are accepted).
NOAA Marine Sanctuaries	Settlement funds are received for violations involving disturbance of the seabed. These funds must be used to protect and restore Sanctuary habitats, and could potentially be used for evaluation, planning and implementation of projects related to retention of beach habitat.
U.S. EPA	Wetland Program Development Grants: Provide eligible applicants an opportunity to conduct projects that promote the coordination and acceleration of research relating to the causes, effects, extent, prevention, reduction and elimination of water pollution. WPDGs assist state, tribal, local government agencies and interstate/intertribal entities in building programs to protect, manage and restore wetlands. Such funding could be utilized to implement sediment management activities.
State Funding Agencies	
California Department of Boating and Waterways (now CA State Parks)	Public Beach Restoration Program (PBRP): Provides the vehicle for the legislature to support restoration, enhancement, and maintenance of California beaches (CDBW and SCC, 2002). In many cases, state money has been used to leverage federal Corps funding. Beach Erosion Control Program: focuses more on structural solutions such as groins or breakwaters, but the newer PBR focuses more on restoration projects such as beach nourishment. The PBR program can fund beach restoration and nourishment projects, or feasibility or research studies.

Funding opportunities	Background and examples
California Coastal Commission	Coastal Development Permit (CDP) process: establishes special conditions on individual permits requiring mitigation fees. For example, The Coastal Commission and SANDAG entered into a cooperative agreement through which a Public Recreation Beach Impact Mitigation Fund was established to make money available for projects that enhance public recreational access. The fund consists of fees collected by the Coastal Commission as mitigation for the adverse impacts on public recreational use of the region's beaches, used to implement projects that provide public recreational improvements, including but not limited to public beach access, bluff top access, viewing areas, public restrooms, public beach parking, and public trail amenities.
California Coastal Conservancy	Funding from SCC grants ranges from $10,000 to several million dollars depending upon fund availability and the "need, significance, and urgency of the project." Potentially relevant funding programs include: Urban Waterfronts, Wetlands, Site Reservation, Resource Enhancement, and Case Studies. Another potential source of future funding for CRSMP implementation is fees collected by the CCC through the Coastal Development Permit process. For example, in the San Diego region the CCC and SANDAG entered into a cooperative agreement by which a Public Recreation Beach Impact Mitigation Fund (seawall fees) was developed to make money available for projects that enhance public recreation access. Availability of SCC grant money depends entirely on the availability of funds.
California Ocean Protection Council	The Ocean Protection Council (OPC) is another state agency that may provide funding for RSM projects, primarily for planning and feasibility studies. The OPC ensures that California maintains healthy, resilient, and productive ocean and coastal ecosystems for the benefit of current and future generations. The OPC is committed to basing its decisions and actions on the best available science, and to promoting the use of science among all entities involved in the management of ocean resources. Similar to SCC, OPC funding is related to bond initiatives and proposals must align with the strategic plan of the agency.
Taxes and Fees	
Sales taxes	One proposal, considered for San Diego County by SANDAG several years ago, was a 0.25 percent quality of life increase in the sales tax rate. State law allows such funds to be used for a variety of projects to improve the quality of life in a region and could be used to support beach restoration.
Transient occupancy taxes	City of Solana Beach recently increased its transient occupancy tax levied on short term rentals to 13%. The City used some of the proceeds from this increase to create a fund to finance beach restoration.

Funding opportunities	Background and examples
Property taxes/ad valorem taxes	Taxes levied on the price of a good or service that are equal to a certain percentage of the price. These taxes are typically assessed on real estate such as Real Estate Transfer taxes when a property exchanges hands. Ad Valorem taxes are commonly used in the State of Florida.
Real estate transfer tax	Orange County currently levies a property transfer tax (similar to Florida's real estate transfer tax) of $1.10 per $1000 on all sales of private property in the county. Orange County Coastal Regional Sediment Management Plan percent goes to cities (e.g., San Clemente). This money is dedicated to general fund revenues. This rate is consistent with the vast majority of cities/counties in the state though a few cities in Alameda County such as Berkeley ($16.10), Oakland ($16.10) and Piedmont ($14.10) charge significantly higher rates. Although raising the property transfer tax and dedicating some or all of this is possible, it is likely to be less politically feasible than other solutions.
Tax levied on sporting goods	In 1993, the Texas State Legislature passed a bill for the revenue source for state and local parks to a draw from the general sales tax attributable to sporting goods. Park funding comes from a portion of Texas general sales tax revenue that is 'attributed' to sporting goods.
Mello Roos (special districts to obtain additional funding)	Bond proceeds in Mello-Roos Districts are for the purpose of "public land improvements." Because it takes a 2/3-majority vote of residents within a given boundary to establish a Mello- Roos District in an existing territory, it is unlikely that a significant percentage of coastal communities are Mello-Roos Districts. It is necessary to further investigate the environmentally fragile coastal zones that may qualify for Mello-Roos funding to determine if they fall within a Mello-Roos District.
User fees	Beach parking fees are sometimes discouraged, particularly by the California Coastal Commission. Since day trippers spend much less than overnight visitors and much of this spending takes place out of town (e.g., on gas or food), they generate very little tax revenues for local communities. To limit revenue collection to "free riders" who come from out of town as well as to increase the political viability of such a move, parking fees could be limited to non- residents by giving residents decals. This can include parking or beach-use fees, which are often levied on visitors, but not required of local residents. Many communities charge for parking in beach areas.
Rental car fees	A daily fee on rental cars in a county follows a similar philosophy to TOTs, which raise funds by leveraging fees or taxes on visitors.
Development impact fees	Development Impact Fees on residential, commercial, and industrial development could be considered to help fund regional sediment management needs. Studies could be prepared to demonstrate the impact

Funding opportunities	Background and examples
	new development has on sediment transport through coastal watersheds to the beaches in order to determine an appropriate cost sharing distribution.
Sediment impoundment fees	Water districts or other agencies are charged a small sand mitigation fee for disrupting sediment flow in a watershed by, e.g., dams and flood control structures
Cost sharing among beneficiaries	In 1996 a group of homeowners in Capitola whose property fronted the cliff decided to form a Homeowners' Association, which could use membership dues to fund hazard mitigation efforts that benefit participants. From this group of residents, a proposal was presented to the Capitola City Council to form a Geological Hazard Abatement District (GHAD).
Special assessments for high risk properties	Private property at high-risk of erosion damage would be required to pay a special fee that would not be required of other properties that are not at risk and proportionally higher than those that are at moderate or low risk. In Florida, for example, the state assesses a tax based upon the distance of the structure from the beach.
Fees on leases of public beaches	A number of beaches in California have snack bars or restaurants which are owned by the city or leased to a private company. Fees on lessees could fund sediment management. For example. the City of San Clemente collects several hundred thousand dollars a year from rentals at its pier restaurants.
Inland sediment transport offset funds	A fund could be set up to cover incremental costs associated with implementation of the opportunistic sand programs (e.g. the additional cost of transporting sediment to an appropriate receiver or storage site, as opposed to using it for other purposes such as fill or aggregate). The matching fund could take many forms. The matching fund could utilize existing or new funding sources, including use of any of the funding sources listed above, or an entirely new and separate funding source for regional sediment management. The coastal cities could impose a supplemental fee for the issuance of grading permits within their jurisdiction. If set aggressively enough (i.e., high fee) then this fee could be used as an incentive for project sediment suppliers to place suitable inland sediment on local beaches by making it more expensive to do otherwise.
Public private partnerships	A Public-Private Partnership (PPP), also known as a P3, is a long-term collaboration between a government and a private sector entity to deliver a project or service, often involving private funding and revenue generation. PPPs are often used for large-scale infrastructure projects like roads, bridges, hospitals, and public transportation, but can also be used for other services. The private sector typically

Funding opportunities	Background and examples
	finances the project upfront, and then recovers its investment through fees charged to users or taxpayers over the life of the contract.

Historically, a number of west coast ports have been 'donor' ports, generating more in HMTF revenue than they require in expenditure on dredging, particularly the Port of Los Angeles and Port of Long Beach.

Whilst beneficial reuse by the Corps is permitted, and more recently, encouraged, the additional incremental costs associated with that reuse into say dune restoration verses open water disposal are borne by the non-federal sponsor of a nourishment project. Lack of local funding capacity to provide match or fund the difference limits the use of one of the most affordable and obvious sources of sediment.

3.6 INCLUSION OF SEDIMENT MANAGEMENT CONSIDERATIONS IN CLIMATE ADAPTATION MEASURES

All of the BEACON region jurisdiction climate documents provide a variety of ways to use sediment to adapt to climate change and sea level rise (Table 17). Each jurisdiction had several sediment management considerations spread across their climate adaptation documents, from beneficial reuse of dredge sediments to habitat restoration and living shorelines to opportunistic use of sediment from debris basins and dam removal.

Table 17. Summary of the sediment management uses considered in the climate adaptation planning documents in the BEACON region.

Jurisdiction	Sediment as Climate Adaptation
Carpinteria	• Beach nourishment using sand and cobbles to create living shorelines. • Redirecting sediment currently exported from the watershed to replenish beaches. • Potentially modifying debris basin cleanout practices and using mud placement in the Carpinteria Salt • Marsh to increase sediment discharge.
Goleta	• Emergency sediment removal and beach disposal activities following debris flows. It emphasizes the beneficial reuse of sediment for beach nourishment. • Annual desilting program and beach nourishment at Goleta Beach, highlighting sediment testing and monitoring to ensure suitability for beach placement and performance. • Regional sediment management through the reuse of sediment from debris basins for beach nourishment. It emphasizes the need for strategic sediment placement and ongoing management. • Sediment management placement activities, including desilting operations and beach nourishment, and their impacts on local ecosystems.

Jurisdiction	Sediment as Climate Adaptation
Oxnard	• Beach nourishment as a "soft armoring" adaptation strategy beneficial for both storm protection and recreation. • Maintaining the natural littoral transport system interrupted by harbor construction: sand that accumulates in the Channel Islands Harbor sand traps is dredged and placed downcoast at Hueneme and Silver Strand Beaches.
Port Hueneme	• Reuse of harbor dredged material for beach nourishment, separating suitable material for beach nourishment from unsuitable material that requires contained disposal. • Sediment types such as silty sands and their compatibility with beach materials and the placement of suitable dredged material onshore or nearshore to nourish beaches, while unsuitable sediments are disposed of at a designated site.
City of Santa Barbara	• The importance of dredging for maintaining the harbor and replenishing downcoast beaches. It mentions the use of dredged spoils for beach replenishment and the need for monitoring shoreline processes to manage sand budgets effectively. The City is responsible for harbor dredging, with federal funds authorized for this purpose. • This report details the sediment composition, primarily sand, found to be uncontaminated and suitable for beach nourishment. The sediment is managed by the Army Corps of Engineers, with environmental commitments to minimize impacts. • Discusses sediment augmentation projects using dredged material to restore marshes, with sediment sourced from nearby dredging projects. The responsibility lies with multiple agencies, including USGS and local authorities. • It mentions the management of sediment by dredging and placement as part of the city's efforts to manage erosion and flooding impacts. The responsibility for sediment management is implied to be part of the city's adaptation planning efforts. • The report details sediment management activities, including dredging and beach nourishment. It discusses the types of sediment used, such as clean and suitable grain size, and the responsibility of the city to ensure compliance with environmental standards. • Sediment types, such as sandy sediment, and the management of dredged materials. It highlights the responsibility of the Corps in monitoring and ensuring the suitability of sediment for beach nourishment. • Details on sediment types, such as fine sand, and the management of dredged materials for beach replenishment. It outlines the responsibility of the Corps in ensuring sediment compatibility and

Jurisdiction	Sediment as Climate Adaptation
	environmental compliance.
City of Ventura	• Managed Retreat Strategy for Surfers Point/Promenade with multiple phases and seeking grant funding. • Need for sediment augmentation and the management of sediment flow to support coastal dune habitats in adapting to sea level rise. • Removal and relocation of nuisance windblown sand at Pierpont Beach, managed by the Public Works department. The city explores opportunities to relocate removed sand to other sections of City and State Park beaches prone to sand loss.
County of Santa Barbara	• Maintenance dredging of Santa Barbara Harbor and beneficial reuse of the dredged material to be placed on East Beach, either on the beach itself, within the surf zone, or in the nearshore area. • Sediment augmentation projects, including the sourcing and application of sediment for habitat restoration, and the challenges associated with sediment composition and distribution. • Dredging program for Santa Barbara Harbor, detailing the removal and placement of sediment to maintain navigation channels • Flood control operations
County of Ventura	• Beneficial reuse of dredged materials for marsh restoration and beach nourishment. The projects illustrate the importance of understanding sediment sources, grain size, and transport dynamics. They demonstrate how aligning regional dredging projects with restoration needs can lead to efficient and cost-effective solutions, reducing the need for disposal and mitigating negative impacts on the environment. Successful projects also point out the value of coordinating various permits and agencies. • Need for sediment (sand and cobbles) to mitigate erosion and restore dunes to protect existing infrastructure. • The Ventura Harbor dredging highlights the ongoing need for sediment management and a commitment to balancing navigation with environmental protection. Beneficial re-use of dredged material is a key aspect of the plan, with suitable material slated for beach replenishment. The project incorporates mitigation measures to minimize potential environmental impacts, including pre- and post- dredging surveys for invasive species and sensitive habitats. The success of beneficial re-use depends on careful monitoring and management to ensure material suitability and to avoid unintended consequences. The project emphasizes a collaborative approach, engaging various agencies and stakeholders in the permitting process. The multi-year schedule and phased approach allow for monitoring and adaptive

Jurisdiction	Sediment as Climate Adaptation
	management. • The potential for beneficial reuse of dredged material is mentioned in the context of beach nourishment and coastal restoration projects. Several jurisdictions highlight opportunities for integration with existing sediment management plans and ongoing projects (like the Ormond Beach Restoration and Access Plan), which demonstrates an understanding of the interconnectedness of sediment management and hazard mitigation. The importance of maintaining natural systems and considering green infrastructure as mitigation strategies is evident throughout.

4 SURVEY DESIGN FOR OUTREACH TO RSM AND ADAPTATION PLANNERS

4.1 STATEWIDE ONLINE SURVEY – TARGETED AT COASTAL JURISDICTIONS, PLANNING DEPARTMENTS AND PUBLIC WORKS

4.1.1 Survey Design and Delivery

In partnership with Integral, BEACON developed and distributed an online survey to assess the current disconnects between regional sediment management and coastal adaptation planning across coastal California. The survey was distributed to a curated list of 252 federal, state, and municipal sediment management and coastal adaptation planning practitioners on October 31st, 2024, with four follow-up communications sent through December 18th, 2024. Survey recipients included both public sector, academics, and private consultants chosen in

consultation with BEACON, Coastal Conservancy, and ASBPA and CSBPA members residing in California, current and former CSMW staff, and RSMP authors.

Survey Design

To ensure each participant only responded to questions relevant to their professional expertise and experience, the survey employed branching logic. For example, specific questions asked each respondent about knowledge of individual regional sediment management plans with questions varying based on how many plans the respondent indicated that they had experience developing or implementing. This approach allowed for more detailed questions based on respondents' specific involvement with regional sediment management plans, while maintaining relevance and engagement throughout the survey.

Total Responses and Completion Rate

The survey received 87 responses, for a response rate of 34.5%, which is above the target rate of 20-30%, and well above the average for emailed surveys, which can be below 10%. The completion rate was 82%, resulting in 55 completed surveys that took an average of 35 minutes to complete. This rate is also considered excellent given the complexity of the responses requested and reflects the branched design and effort in development. These responses provided a robust dataset for analysis of current challenges and opportunities in integrating regional sediment management with coastal adaptation planning.

4.1.2 Survey Respondents

The survey highlighted information on personal roles, organizational roles, current governance strategies, and updated implementation status on regional sediment management plan recommendations to gather a complete and up-to-date picture of RSM and SLR planning and implementation.

Field of Expertise

Survey participants represented a diverse cross-section of California's regional sediment management and coastal management stakeholders (Figure 9), including those involved in planning and permitting (27%), coastal zone management (24%), engineering (10%), flood management (4%), and elected or appointed officials (1%). The remaining responses included coastal and marine scientists, educators, public safety, ecologists, economists, lawyers, hazard assessment and coastal resilience professionals, and researchers.

Figure 9. Area of technical expertise among survey respondents (N=79).

The survey captured perspectives across California's coastal jurisdictions (Figure 10). Approximately half of the total sample work in government, with 22% being affiliated with local city or county government, 17% with the federal government, and 12% with state government. Approximately one-third of participants were affiliated with consulting firms (19%), academia (9%), and regional planning authorities (2%). The remaining 19% of survey respondents listed being retired or affiliated with multiple different sectors; for instance, 4% of survey respondents listed being affiliated with both local city and county governments as well as regional planning authorities.

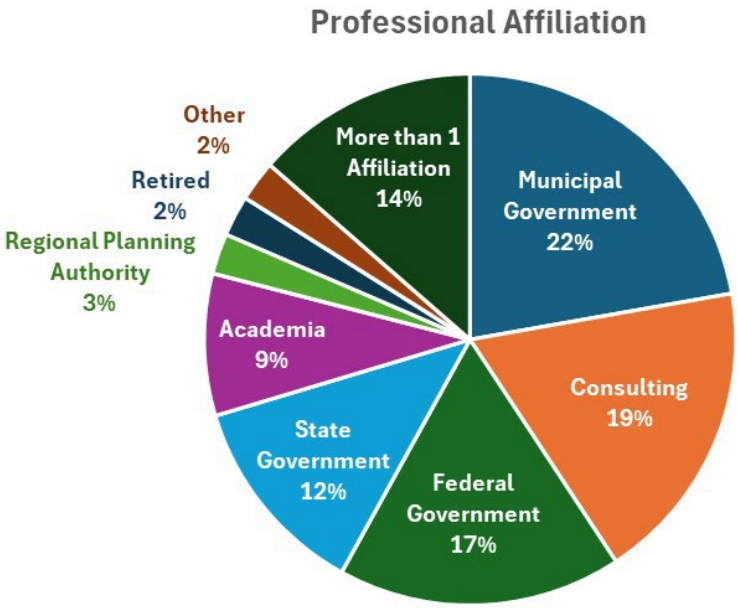


Figure 10. Affiliation of survey respondents by management sector (N=81).

Years of Experience

Respondents had an average of 16.5 years of experience working in regional sediment management and an average of 13 years of experience working in coastal adaptation planning. Most respondents reported having worked in both regional sediment management and coastal adaptation planning, with 9% of respondents reported working only in regional sediment management and 3% of respondents reporting working only in climate adaptation planning.

Those that reported working in only one of the two sectors appeared to have less experience on average than those who have worked in both, with those having experience only in regional sediment management having an average of 7.4 years of experience and those only in climate adaptation management having an average of 8.0 years of experience. This likely reflects duration of employment, as respondents within the survey sample with longer careers will have had the opportunity to work across multiple aspects of coastal management. Additionally, this is consistent with the fact that RSM planning began several years before sea level rise vulnerability assessments and adaptation planning.

Region

Survey respondents not only had a diverse range of experience in different sectors, but they also had a diverse range of experience in littoral cells along the California coast (Figure 11). When asked what regional-level coastal geography they currently work, 27% of survey respondents listed working in all littoral cells, this is likely representative of members in the original CSMW. Of respondents who focus their work on a specific littoral cell, 37% of respondents listed currently working within Santa Barbara, 13% listed Oceanside, 7% listed

San Francisco, and 4% listed Los Angeles. Other littoral cells listed by respondents includes Laguna, Mission Beach, San Pedro, Santa Cruz, Monterey, Humboldt, Eureka, Bodega Bay, and Point Reyes.

Respondents also had a diverse range of experience having worked on or with RSM plans.

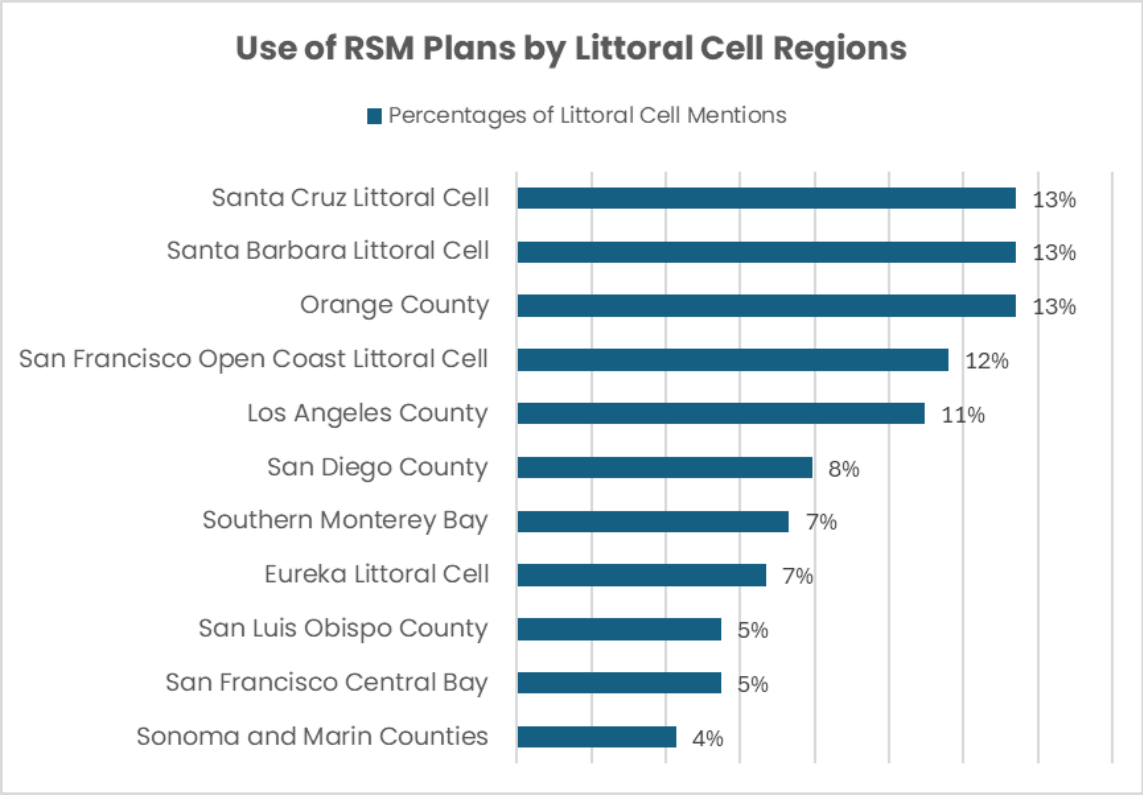


Figure 11. Use of RSM plans by littoral cell regions.

The three most-used RSM plans include Santa Cruz, Santa Barbara, and Orange County. All of these RSM plans had a wide range of use by different RSM practitioners all over the state. For instance, the Santa Cruz Littoral Cell plan has been used or worked on by professionals as far north as Eureka and as far south as Imperial Beach.

4.2 SURVEY RESPONSES

4.2.1 Current Sediment Management and Climate Adaptation Strategy Alignment

Most survey respondents (70%) reported working for organizations in which sediment management and climate adaptation strategies are either mostly aligned (38%) or in total alignment (32%), despite the deficiencies identified in the documents reviewed in Section 2

(Figure 12). This may reflect improvements in alignment since the date of publication of reviewed documents, or the fact that the CRSMP and climate adaptation planning documents do not fully reflect the day-to-day public works activities or the true level of integration within the respective organizations.

When describing specific integration efforts within their organizations, respondents frequently mentioned the beneficial use of dredged materials as a key strategy. For instance, a planning and permitting official at the U.S. Army Corps of Engineers explained that there is a “big focus on beneficial use of dredged material (navigation dredging), regional sediment management, and engineering with nature to adapt to climate change.” This integration extends beyond federal agencies to private sector organizations as well. A flood manager at Moffatt & Nichol described their firm's efforts to "push [to link] beneficial reuse of dredged material to flood management [and] resiliency."

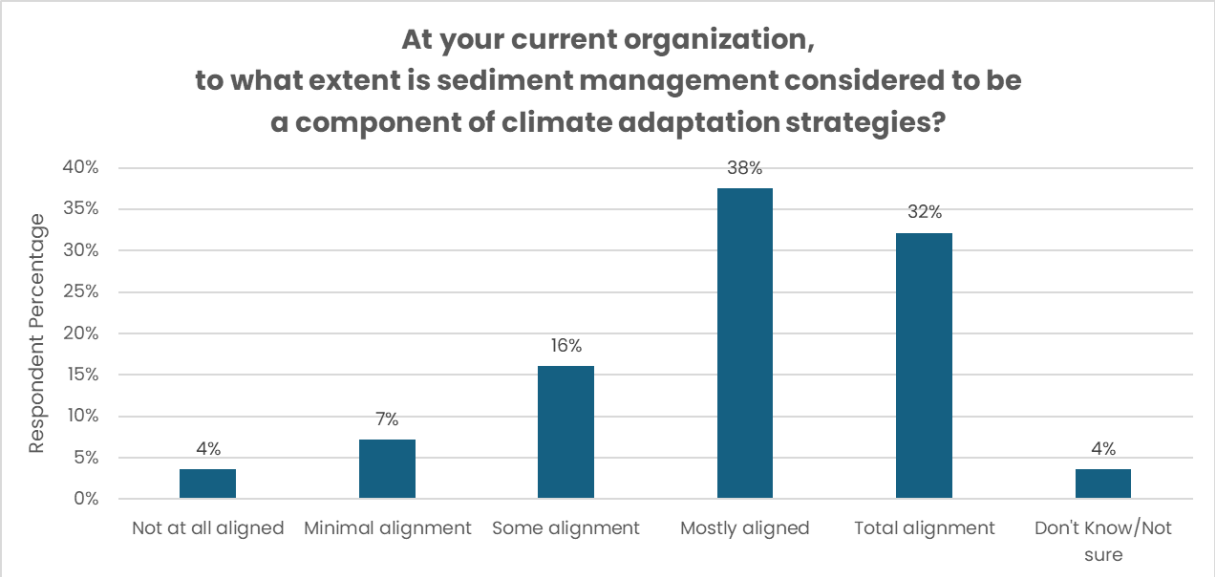


Figure 12. Alignment of regional sediment management and climate adaptation within respondent organizations

Of those respondents who selected working for an organization that has either no alignment or minimal alignment, all were affiliated with federal or local government entities (Figure 13). For instance, one Coastal Zone Manager at the California Coastal Commission approached the question from a personal perspective rather than an organizational one, stating they "have not been directly involved in climate adaptation."

Some respondents indicated that their organizations were in transitional phases regarding the integration of climate adaptation strategies. A planning and permitting professional at Ventura County Public Works Agency Watershed Protection anticipated near term improvements in alignment with climate adaptation strategies, explaining:

> *"with the completion of the Local Coastal Program and sea-level rise assessments [for the city of Oxnard], policies will be developed to address the risks of sea-level rise."*

When asked the same question, a coastal zone manager at the Ocean Protection Council noted that the organization is currently working to change its lack of alignment by implementing

> *"coastal adaptation projects [as well as] research around effective coastal adaptation strategies."*

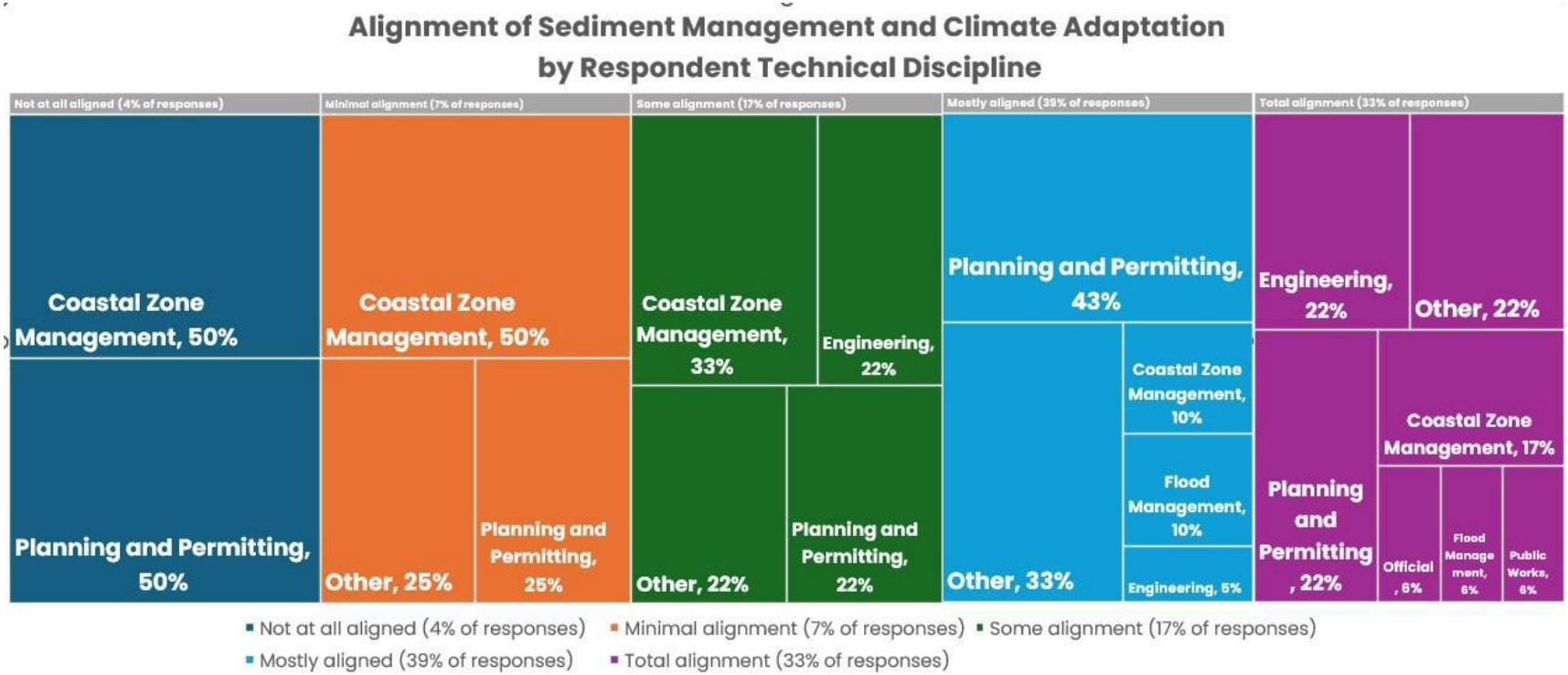


Figure 13. Perceived alignment of Sediment Management and Climate Adaptation, by Respondent Technical Discipline.

Note: The above graph illustrates the relationship between survey respondents' technical expertise and the extent to which they believe their organization considers sediment management a component of climate adaptation strategies. The categories that encompassed all survey respondents included the following: Planning and Permitting, Coastal Zone Management, Public Works, Flood Management, Engineering, Finance and Accounting, Elected or Appointed Official, and Other. The "Other" category consisted of 31% of respondents, 40% of whom are researchers, 25% coastal scientists, 15% coastal resilience practitioners, 10% educators, 5% economists, and 5% law practitioners.

Sediment Sizes Considered

According to the survey, sand, cobbles, fines, silt and gravel were the most frequently considered sediment in sediment management decisions (Figure 14). Of respondents that selected "other", they listed eco-concrete, boulders, and reef. Whether a reef would be considered a sediment would depend on the composition and integrity of the substrate materials.

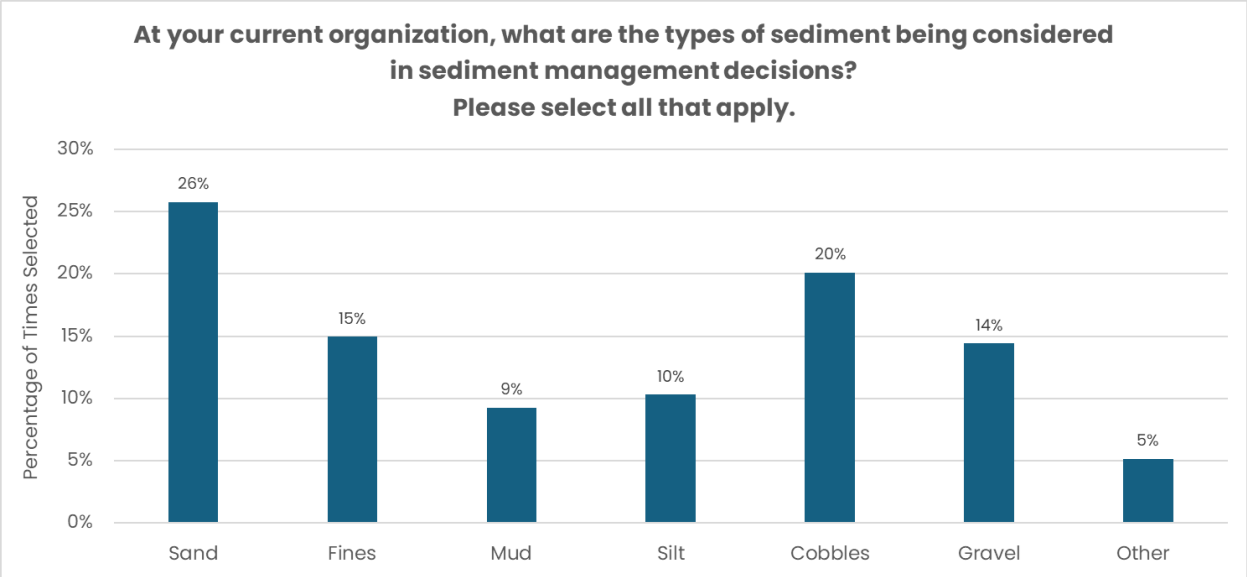


Figure 14. The types of sediment being considered in sediment management decisions.

Regional Sediment Management Plan Experience

Almost three quarters (73%) of survey respondents either used or helped create RSM plans in their current or previous roles (Figure 15). This number included both those who assisted in preparation of the RSMP, but may not be involved in implementation, and vice versa.

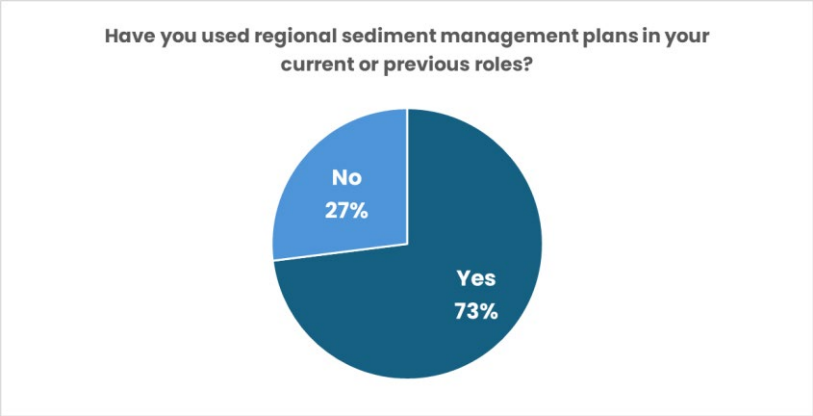


Figure 15. Percent of survey respondents that have and have not used regional sediment management plans in their current or previous roles

Of those that indicated that they had experience working with RSM plans, about half stated that their experience was with RSMPs was within littoral cells located in southern California (Figure 16), including Santa Barbara, Ventura, Los Angeles, Orange, and San Diego counties. About 40% stated their experience with RSMPs was in central California (including San Francisco open coast and Central Bay, Santa Cruz, Southern Monterey Bay and San Luis Obispo counties). 13% stated their experience was in northern California (Eureka, Sonoma and Marin counties).

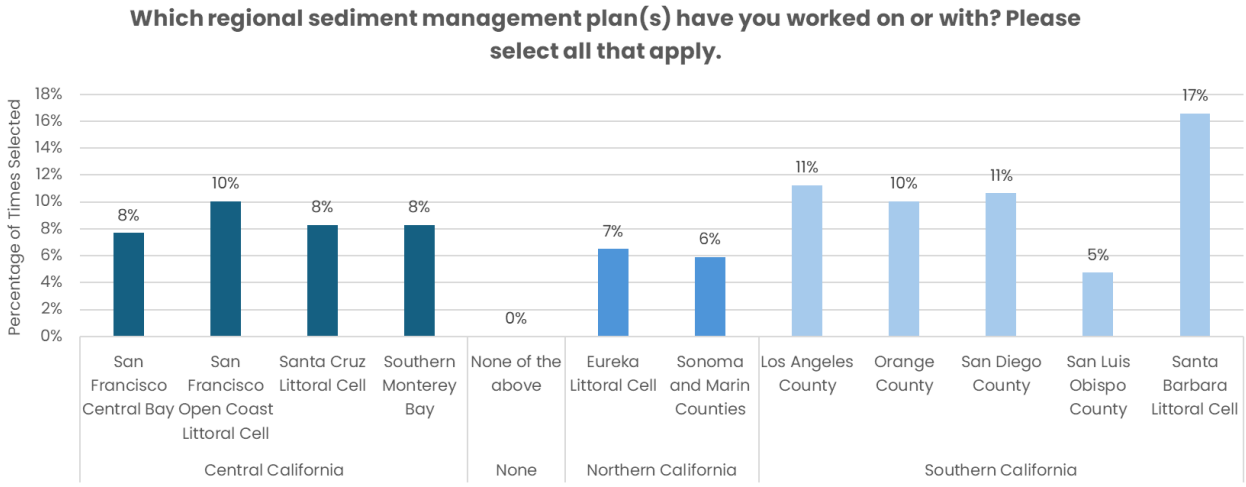


Figure 16. The RSMPs worked on by the survey respondents.

Note: There were 47 total responses.

4.2.2 Governance Processes

When asked what elements a part of their organization's structure and operation are, 22% of survey respondents selected formal governance, 19% selected planning and implementation documents, and 13.5% selected meetings and voting (Figure 17).

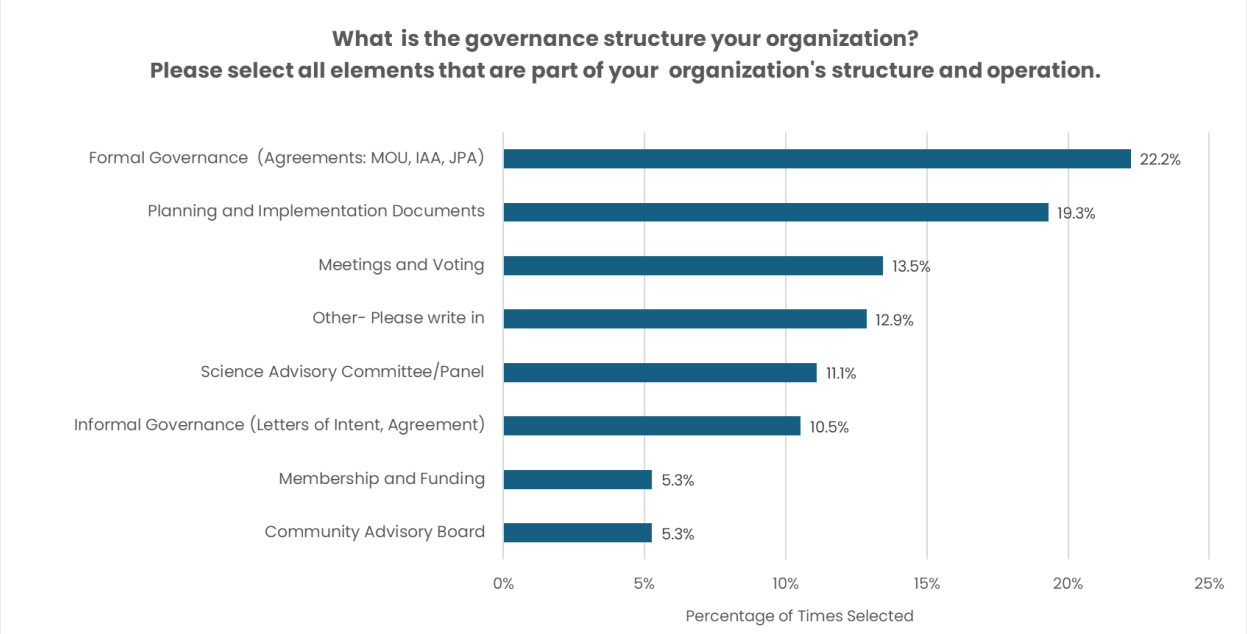


Figure 17. The governance structures utilized by survey respondents.

Based on elements that their organization has; respondents were asked to list each component as a strength or a weaknesses of their organization's governance structure and processes (Table 18). Overall, respondents listed more supporting than limiting components. The most commonly listed supporting factors were in the categories of ***formal governance*** **and** ***planning and implementation documents*****.**

Table 18. Qualitative statements around supporting and limiting components of governance elements and operations (all quotes from survey).

Supporting	Limiting
Formal Governance	
• *Allows for the community to take a proactive role in the actions taken by the City.* • *Commits federal government to aiding non-federal partners that would otherwise not have the funds to address regional sediment management and climate adaptation problems* • *Enabling legislation to fund coastal protection/restoration/access/adaptation projects* • *As a JPA, BEACON successfully functions as a government agency* • *Cost sharing capabilities* • *Ability to initiate and codify policies* • *Clear parameters to follow; It's clear to all how decisions are made and who will pay for what* • *Formal structure has provided a platform for seeking funding and development of regional coastal management policies.*	• *Time and process delays* • *Sometimes hard to achieve in a timely way to realize beneficial use projects*
Informal governance	
• *Flexible, provide clarity to relationships with partners* • *flexible support* • *Land ownership* • *Bring people together to get things done*	• *Time and process delays* • *Sometimes hard to achieve in a timely way to realize beneficial use projects*
Membership and funding	
• *Providing money to help achieve partner goals* • *all the local policy bodies at the table* • *Manage the Shoreline Preservation Working Group - members are elected officials, government agencies, NGO's that work in the space; jurisdictional membership fees support Regional beach sand projects and monitoring*	• *SANDAG is made up of 18 cities and the County of San Diego. 8 cities have coastlines. 10 do not. Non coastline cities think that coastal management is not their issue. Only a*

Supporting	Limiting
	coastal city problem. A more focused organization (e.g., coastal city JPA) maybe a better model.
Meetings and voting	
• *Best available science is the goal for project approaches* • *Strong technical analysis and collaboration, value driven* • *Ensures best available science is included in federal decision- making, with members from academia, high levels of USACE, and direct involvement of USACE leadership.* • *large group of employees with multidisciplinary background* • *We provide science products to help decisionmakers* • *Best Available Science* • *we have a good understanding of coastal processes and sediment dynamics, lead discussions at TACs and Working groups* • *Strong set of biologists on board that participate in local resilience planning efforts* • *best available science* • *Experience, Knowledge, agency leadership*	• *None listed*
Community advisory board	
• *We are part of coalitions in several regions that represent a variety of interests* • *Includes wide range of voices*	• *Some community advisory boards struggle to accomplish their goals due to multiple differing opinions of how to reach those goals causing a stalemate.*
Planning and implementation	
• *Much effort and thought is given to development of project staff reports and restoration and mitigation designs and monitoring* • *Depends on project* • *Standardized procedures and processes for planning and what should be included in planning documents.*	• *Funds are not always available and hold up plans/implementation*

Supporting	Limiting
Transparent and comprehensive • *project history* • *Forward-looking* • *HDR provides a wide range of consulting support including, pre-planning, community engagement, grant funding, developing EIR documents, vulnerability and hazards analysis, climate adaptation planning, and resilience planning.* • *The City has staff with the technical expertise to manage the development and adoption of planning and implementation documents. In addition, there is often sufficient grant funding available to contract with technical experts as needed.* • *depends on the LCP or policy but as a mechanism is a strength* • *because our agency leads the region in SLR adaption & RSM* • *Lay the foundation for implementation* • *rigorous planning and engineering analyses* • *CAP, Coastal Vulnerability Assessment and Fiscal Impact Report (SLR Adaptation), Community Wildfire Protection Plan* • *site specific project parameters (grant agreements)* • *CEQA lead and role* • *Sediment Management policies and regional beach sand nourishment projects including env and design documents, contracts* • *Its the foundation and framework from which we operate and do our work* • *Its good to have a plan* • *The Corps process, while cumbersome, can lead to funding to implement*	

4.3 BARRIER ANALYSIS

Respondents were asked to identify obstacles, the structural and operational barriers to implementation of regional sediment management (RSM) project implementation (Figure 18).

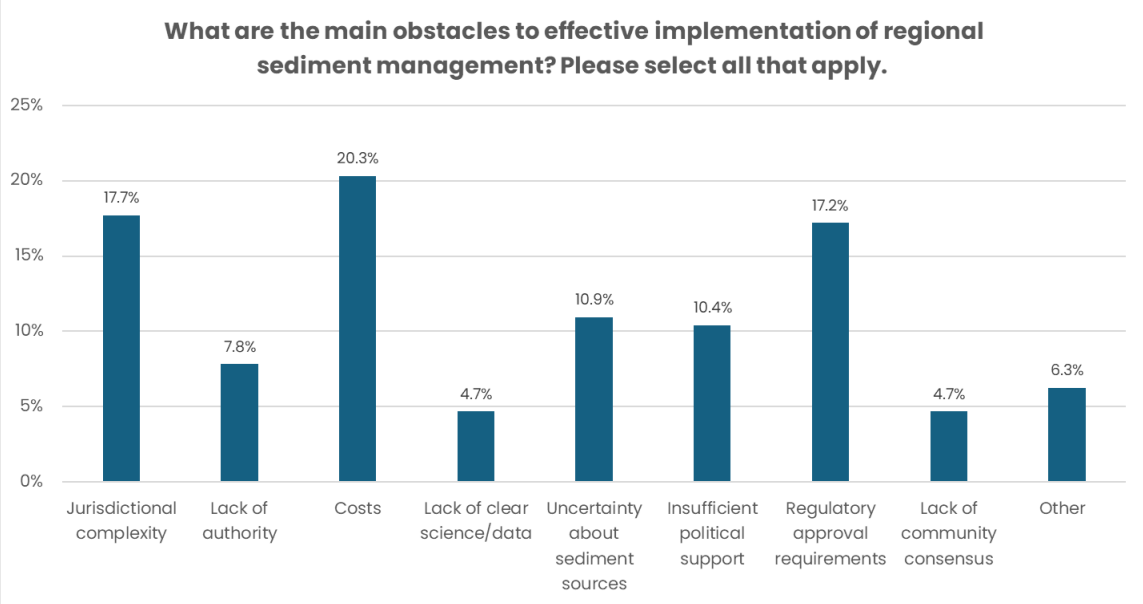


Figure 18. Main obstacles to effective implementation of regional sediment management.

Responses collected by the survey suggested that the most significant obstacles that regional sediment management practitioners faced are costs (unspecified) (20.3%), jurisdictional complexity (17.7%), and regulatory approval requirements (17.2%) with more than half of respondents selecting at least one of these as barriers to the effective implementation of regional sediment management. These barriers likely indicate a deeper structural governance disconnect between the two policy objectives (implementing effective RSM projects with coastal adaptation planning), including institutions that inhibit or disincentivize collaboration, a misalignment in policy prioritization on a state and federal level, and complex and inefficient regulatory processes.

4.3.1 Costs

According to the survey, RSM practitioners face financial challenges in effective implementation of regional sediment management. One example of how high costs act as an obstacle to RSM program implementation was in the transportation costs of sediment. The limited availability of dredging equipment exacerbates these financial challenges, as mobilization costs are a substantial component of smaller dredging projects.

In addition to the costs of implementing projects, according to previous research, the costs of permitting also poses a barrier to using sediment in living shoreline projects (Goodrich et al., 2023).

4.3.2 Capacity

Regional sediment management practitioners also mentioned facing limitations on staff availability to work on and effectively implement regional sediment management programs at both the state and local level. This is not only the case for organizations like BEACON, but also for state and federal government staff members.

4.3.3 Jurisdictional Complexity

Sediment management becomes more complex when multiple jurisdictions are involved. This type of jurisdictional complexity is not unique to sediment management; in fact, Kat Jones discusses jurisdictional complexity as an impediment to effective implementation of wildfire management practices. Like wildfire management, managing sediment effectively

> *"...requires cross-boundary co-management efforts involving multiple actors who represent different levels of governance (federal, tribal, state, local) and types of ownership (federal, private, municipal, etc.)" (Jones et al., 2024).*

The implications of jurisdictional complexity were highlighted by respondents throughout the survey. Collaboration and coordination between organizations across jurisdictions has been challenging and often lacked staff capacity and a shared actionable strategy (Educator at University of California, Santa Barbara). Initiating and maintaining collaboration between different agencies

> *"...is difficult because each organization has different goals."*

For instance, when implementing regional sediment management projects, organizations must deal with the federal government, the California Coastal Commission, and multiple state regulatory agencies. The challenge also lies in the fact that

> *"they don't always agree among themselves" (Ulibarri et al., 2020).*

In addition to regulatory and policy complexity, management of sediment across jurisdictional boundaries complicates funding arrangements, as many of the financing mechanisms are dependent on location-based special districts or ad-valorem property tax assessments. Use of these funds outside the area in which they are collected can face regulatory challenges, and establishing such funds may require support from the majority of residents in multiple jurisdictions, at the same time.

4.3.4 Regulatory Considerations and Agency Limitations

Managing sediment across jurisdictions has notable regulatory challenges as well, including a complex permitting process. Navigating these regulatory requirements can be time-consuming

and costly, for any single jurisdiction much less multiple jurisdictions. This complexity delays essential projects and hinders progress; for example, one challenge cited in the survey is

> *"the time it takes to get through CEQA and NEPA processes and obtain regulatory approvals" (southern California Consultant).*

This is a barrier to regional sediment management activities that have been identified in previous research. In Goodrich et al. 2024, though, a number of "interviewees recognized the importance of permits for protecting the environment," they also noted that "obtaining them takes a long time and is expensive." Participants in this study "reported that in some cases, permitting costs sometimes prohibited sediment management activities from moving forward" at all (Goodrich et al., 2023).

Each agency has its own mandate at different scales. For example, a federal agency directive focusing on maintaining navigation varies drastically from a local flood control agency balancing flood protection with species protections or a parks district focused on recreational use. Within agencies, long range climate planners focus on policy improvements while public work engineers focus on project implementation typically prioritized in a 5-year Capital Improvement Plan. One retired coastal processes consultant described permitting agencies as being "siloed single-mission 'thematic'" agencies, suggesting that the variety of goals and missions across regulatory agencies is hindering the ability to manage sediment and plan for climate change. This consultant suggested that an "Agency of Coastal Adaptation" may be an effective solution.

4.3.5 Political Will and Capacity

Another obstacle is the lack of policy and financial support for RSM programs at the local, state and federal level. This lack of political priority and support may reflect the lack of understanding of effective regional sediment management among non-technical groups and the public in general who may observe beach closures and increased construction traffic. For instance, there is a

> *"perception that the sand just washes away after the first storm" (SANDAG Planning and Permitting official).*

4.4 RECOMMENDATIONS FROM SURVEYS

When asked what the main obstacles to effective implementation of regional sediment management were, respondents highlighted costs, regulatory approval requirements, and jurisdictional complexity (Figure 19). These results highlight funding, decision-maker support, sediment inventories, and regulatory and permitting requirements.

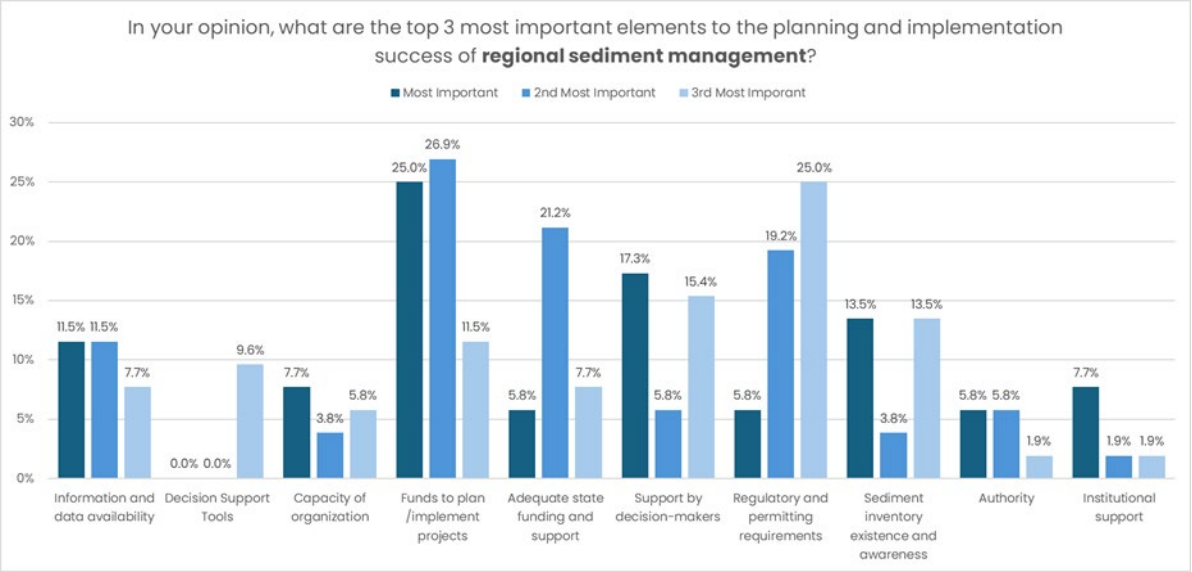


Figure 19. The most important elements to the planning and implementation success of regional sediment management

4.4.1 Collaborative Governance

Survey respondents proposed different strategies to overcome jurisdictional complexity challenges and improve collaboration among different agencies, ultimately allowing for the facilitation of regional sediment management and coastal resilience planning integration. This aligns with the 2023 California Coastal Adaptation Needs Assessment (CCANA), where only 10% of respondents said there had been sufficient collaborative coastal management effort. Although this survey has a somewhat different focus to the current study and associated survey instrument, there is considerable alignment on key themes and recommendations. The fact that the 2023 CCANA reports that many of the same issues (i.e. funding, staff capacity) are consistent with those identified in surveys conducted in 2011 and 2016 indicates that there is a pressing need for reform.

Experts specifically suggested involving a more diverse range of expertise in decision-making processes. For instance, one recommendation was to formally integrate the participation of beach ecologists into the development of best management practices, particularly for beach replenishment projects. Another recommendation to overcoming the hurdle of the jurisdictional complexity and inter-organizational collaboration was establishing a separate "interregional collaboration group" to discuss and advocate for resources to execute coastal initiatives, thus creating a forum where diverse stakeholders can align their strategies and resources (SANDAG Regional Planning Authority).

4.4.2 Funding and Political Support Strategies

Both the political and financial support of the state will be a crucial component to effective RSM and Coastal Adaptation planning integration and implementation. This theme that

> *"nature-based/living shoreline project and sediment is currently under supported/not funded by State programs"*

was reflected in responses throughout the survey (Engineering Consultant). This overall lack of financial support may be in part due to a lack of political support. The lack of funding was also highlighted by a majority of respondents to the 2023 CCANA survey, who identified the following barriers to adaptation:

- *Lack of funding to implement a plan (62%)*
- *Insufficient staff resources to analyze and access information (60%)*
- *Lack of funding to prepare a plan (51%).*

The survey responses offered a few different ideas that may be used to address the current funding and political support challenges. One planning and permitting SANDAG official suggested exploring the "state purchase or long-term lease of hopper dredge equipment" as a more cost-efficient sediment transportation option. Another planning and permitting official at Orange County Parks suggested developing an interregional collaboration group that could more effectively advocate for increased funding to support regional sediment management projects.

While gaining political support is important, it requires the support of the public. Lack of social acceptability was also identified by 40% of respondents to the 2023 CCANA survey as a key barrier to adaptation. An example of locations in which RSM implementation has lacked public support is in the City of Carpinteria. Public outcry over truck traffic, water quality and beach closures have caused political challenges for knowledgeable and supportive elected officials. One concrete step mentioned often by survey respondents was promoting programs and campaigns that prioritize public education on coastal processes. This will ultimately allow agencies to

> *"Continue to address the source of sediment deficiency and impediments to longshore transport (dams, seawalls, coastal development, etc.)" (Planning and Permitting Consultant).*

Increased public education and outreach was also identified as a key strategy by 57% of respondents to the 2023 CCANA survey.

4.4.3 Regulatory Reform Recommendations

Survey results identified regulatory approval requirements as the third most selected obstacle to effective implementation of regional sediment management initiatives. According to a Coastal Zone Manager at the California State Lands Commission, one promising approach is to develop a clear and concise permit streamlining process similar to the Long

Term Management Strategy's Dredging Materials Management Office and NOAA's North-Central California Sediment Coordination Committee's 2024 Efficient Permitting Roadmap: A guide to the regulatory process for sediment management on the North-Central California Coast (https://nccscc-noaa.hub.arcgis.com/pages/2a3cf233bb5f4fc89d68a8401b59527 5). This recommendation builds on existing successful models that have demonstrated effectiveness in coordinating multi- agency reviews and approvals. Although figures are not cited, the 2023 CCANA survey report noted that some respondents cited frustrations with the Coastal Commission regarding the regulatory process.

Survey respondents also emphasized the need for regulatory frameworks that can adapt to changing coastal conditions. A permitting and planning representative from SANDAG specifically noted that "more regulatory flexibility on the grain size allowed to be used on beaches" would improve the effectiveness of regional sediment management initiatives.

Easing regulatory hurdles and complexities would allow for more effective implementation of coastal management initiatives.

4.4.4 Recommendations for CSMW

Survey respondents also recommended steps for the next version of the Coastal Sediment Management Workgroup.

Better Outreach and Engagement

Expert Practitioners

Survey respondents consistently highlighted the need for the California Sediment Management Workgroup (CSMW) to better engage with regional and local sediment management practitioners.

According to a representative from the City of Carpinteria Public Works Department, the CSMW needs to take a more interactive approach to engaging with stakeholders to identify priorities and challenges where the CSMW can focus its resources. By

> *"interviewing agency staff and other stakeholders to understand their priorities and how the CSMW can benefit or support the work that they are already doing, as well as future goals,"*

the CSMW can more effectively direct its staffing and funding resources where it is most needed.

Additionally, several respondents recommended the CSMW offer a more diverse range of expertise than is currently involved in discussions around RSM planning. A researcher and educator at California State University Channel Islands emphasized the importance of

"engaging researchers, policymakers, and practitioners" in CSMW activities. A Coastal Zone Manager at the State Coastal Conservancy similarly recommended that

> *"decisionmakers and environmental groups, tribes, etc., concerned about habitat impacts"*

be included in these conversations as well.

The survey revealed that there is not currently sufficient effective engagement with local elected officials and staff. For instance, a planning and permitting representative at the U.S. Environmental Protection Agency recommended that, moving forward, the CSMW actively conduct "appropriate and frequent outward facing messaging to state officials on climate resiliency via smart sediment management" be a priority. This messaging would not

> *"focus on sediment, but rather [on] adaptation needs."*

General Public

In addition to better engaging with professional regional sediment management practitioners, survey respondents also emphasized the importance of the CSMW's role in engaging with the general public. The CSMW has the opportunity to actively involve community members in the discussion around regionally effective sediment management practices. By doing so, the CSMW can strengthen its relevance, effectiveness, and impact in advancing regional sediment management practices.

One concrete step that could be taken in this direction, recommended by an engineering consultant, is to distribute "regular updates and [commit to] ongoing engagement" with the public. An example of ongoing engagement may include "host[ing] occasional meetings to extend education on sediment management regionally" (Planning and Permitting for the City of Oxnard). Taking steps towards "better communication of activities and [project] results over time" will allow the CSMW to have a more impactful presence by better understanding and addressing public concerns (Engineering Consultant). As discussed in Section 4.4.2, greater public awareness and support will be reflected in political support, both of which being crucial components to the successful implementation of regional sediment management.

Another component of public engagement is promoting, implementing, and effectively communicating the impacts of projects with beneficial, tangible impacts; in other words, focusing on "implementing pilot projects that could be readily adopted with limited resources" would be a step in this direction (Researcher at Regional JPA). Ultimately, the

> *"general public needs to be shown what [regional sediment strategies] can work and what [strategies do] not [work] for certain regions" (Official at the San Mateo County Harbor District).*

In other words, it is recommended that the CSMW demonstrate and effectively communicate the benefits of effective regional sediment management strategies and ideally sediments role in adaptation planning.

More Diverse Involvement

Survey respondents emphasized the need for greater diversity of expertise within the Coastal Sediment Management Workgroup (CSMW). Specifically, a coastal zone manager at the California Coastal Commission recommended expanding beyond the current focus on engineering and geology to include the perspectives of "ecologists/biologists in sediment suitability decisions, [such as for] appropriate uses of sediment, beach nourishment design and planning, and protection, restoration, and enhancement of beaches and watersheds."

An engineer from the California Coastal Commission offered structural advice, suggesting the CSMW should "limit participation from agencies to one or two key staff members for a core workgroup that is trying to get things done and expand to larger field when it's more about general awareness, coordination and idea dissemination." This approach provides an opportunity to balance efficiency with inclusivity.

Broader Educational Resource and Data Repository

Throughout the survey, survey respondents suggested the CSMW act as an educational resource and data repository for both regional sediment management practitioners and the general public. A representative from Santa Barbara County Flood Control District specifically noted that "previous documents prepared by CSMW are no longer available online" and recommended that this valuable information be restored and made accessible again. A researcher and educator from California State University Channel Islands also highlighted the importance of greater "report accessibility" as a means of facilitating more effective engagement with stakeholders as well. Lastly, the need for consistent "webpage maintenance" was specifically noted by a planning and permitting representative from the USACE San Francisco District. Ultimately, it will be important to use the CSMW as a "continued space to share technical information [and] identify opportunities for matching sed[iment] needs w[ith] sources" (California Coastal Commission Ecologist)

In addition to providing a platform in which to store sediment management resources, survey respondents also requested that the CSMW play a role in highlighting or promoting "research around sediment best practices" (Coastal Zone Manager at Ocean Protection Council).

Additionally, the CSMW should "supporting re-evaluating littoral cell function given SLR and adaptation needs" (Engineering Consultant). It would be beneficial for the CSMW to "include (1) coarser sediments (gravels, cobble, boulder lag deposits) and (2) collect data on littoral sediment thickness (depth to bedrock, hardpan) and (3) characterize littoral shores in terms of morphometrics - that is, geometry and dynamics of functional" (retired consultant).

These sediment management resources provide important context, baseline data, and lessons learned that can inform current and future RSM projects as well as how to integrate them into adaptation planning at a local and regional scale.

Project Selection

Survey respondents highlighted the importance of strategic project selection and clear goal definition. For instance, a Coastal Zone Manager pointedly recommended that the CSMW "broaden focus beyond expensive and temporary beach nourishment projects." Expanding beyond traditional beach nourishment requires repeated investments often for temporary results. CSMW could explore approaches to sediment management that are more effective, larger scale and longer-term especially if the projects are identified as natural adaptation infrastructure.

Complementing this perspective on project selection, a planning and permitting professional at the US Environmental Protection Agency emphasized the importance of "clear goals for implementation of regional projects." They noted that successful implementation "may require prioritization based on readiness, funding, and public interest among the various coastal programs."

Restructure

The current structure of the CSMW presents opportunities for reorganization to better accommodate the nuances throughout California's extensive and varied coastline. A planning and permitting professional at the San Francisco Bay Regional Water Quality Control Board recommended " that the CSMW be broken into subcommittees to focus on regional management. California is a very large state making statewide sediment management very challenging." This observation points to the limitations of a centralized approach when addressing such geographically diverse coastal systems. The success of the "Long-Term Management Strategy for the [San Francisco] Bay" provides a compelling model for how regionally focused efforts can be successful.

Funding & Staffing

Survey respondents identified funding and staffing as important needs that must be met for the future effectiveness and success for the CSMW. A key recommendation emphasized the need for financial stability through "consistent funding and staffing," coupled with "a concerted effort to educate and coordinate with the agencies that permit sediment removal" (Coastal Zone Manager at BEACON). Another approach to increasing and efficiently using funding called for the CSMW to "identify and prioritize creative and pragmatic approaches to increase sediment budgets through deeper collaboration" (Planning and Permitting Consultant). Both recommendations highlight the importance of inter-agency cooperation in maximizing the CSMW's ability to maintain its ability to facilitate regional efforts to protect, enhance and restore California's coastal beaches and watersheds (CSMW Home Page 2025).

5 FOUNDATIONS OF SUCCESSFUL SEDIMENT MANAGEMENT

5.1 GOVERNANCE STRUCTURES AND PROCESSES

Various governance structures currently existing for implementing RSM programs. Survey responses and a literature review were used to identify what governance structures and processes are currently used and working well for California RSM, and what structures and processes might be adopted to improve RSM.

5.1.1 Joint Powers Authority

Joint Powers Agreements (JPAs) is a type of formal governance mechanism that enables public agencies to collaborate on shared initiatives (Table 19). When two or more public agencies establish a JPA, they create an entirely new legal entity separate from the member organizations— distinguishing JPAs from more informal and limited governance structures (Kincaid & Stager, 2015). Authorized under California's Joint Exercise of Powers Act (Government Code Title 1, Division 7, Chapter 5), these entities allow agencies to "jointly exercise any power common to the contracting parties" for specific purposes (*California Code*). JPAs effectively serve as vehicles for resource sharing, program implementation, infrastructure development, and service delivery across jurisdictional boundaries. JPAs are often “created in order to jointly share a common power, implement a program, build new facilities, or deliver a service” (Marin LAFCo). An additional component of JPA formation involves establishing a clear financial structure, determining whether members must

contribute funds, whether these contributions will be equal or varied, and the underlying basis for funding allocations (Kincaid & Stager, 2015). This governance structure has been successfully implemented throughout California in various contexts, including the West Contra Costa Transportation Commission, Port Hueneme Water Agency, and the Pajaro Regional Flood Management Agency (West Contra Costa; Pajaro Regional Flood Management; Luoma 2017). Additionally, it is "worth noting that not all JPAs are regional. Many are formed for narrow, specific purposes. For example, JPAs are commonly used to form joint insurance and risk management programs" (Higgens 2020). BEACON is a prime example of a JPA being used for sediment management, and, to some extent, for climate adaptation via beach nourishment and sediment management for climate resilience. As described in Section 2.2.1, outside the BEACON region, other RSMPs have also recommended JPAs as governance structures, inspired by the BEACON model.

Table 19. Supporting and limiting factors for a joint powers authority

Supporting	Limiting
• *Framework Promotes Cooperation*. Promotes inter-jurisdictional cooperation by creating a framework in which entities can pool resources, coordinate efforts, and eliminate redundant actions or overlapping services (Nevada County Grand Jury, 2022) • *Promote Efficiency*. This collaborative framework ultimately leads to reduced expenses and time managing multiple voter initiatives across jurisdictions (Nevada County Grand Jury, 2022). • *Diverse Financing Opportunities*. Provides the ability to raise immediate and upfront funding by issuing revenue bonds (Bernstein, 2020). JPAs may also raise revenues from dues paid by member agencies as well as impact fees from development projects. • *Protect Members from Liability*. "California law states that members are responsible for a newly formed joint powers agency's debts, liabilities, and obligations unless their JPA specifies	• *Lack of Transparency*. Vertical model JPAs (i.e., JPAs "formed with the same organization and controlled by a single authority instead of several") do not contain "the same checks, balances, and accountability as horizontal model JPAs," and are more vulnerable to corruption (Nevada County Grand Jury, 2021). • *Circumnavigate Voter Approval*. To avoid risk of defaulting on unpaid debt, JPAs could internally use the organization's general fund or other internal sources without voter approval (Nevada County Grand Jury, 2021). • *Lack of Public Support.* Expansive projects may inevitably spark frustration by taxpayers and residents of counties who are paying for activities in other counties .(Bernstein, 2020) • *Regulatory Restrictions*. "A JPA will need to provide proper notice to both the Secretary of State and Controller each time the agreement is amended. If it fails to give proper notice of its creation through a JPA or of an

otherwise. Thus, JPAs commonly state that members do not intend to be liable, either jointly or severally, for the new agency's liabilities, debts, and obligations, shielding members from individual liability for the agency's actions" (Kincaid & Stager, 2015).

amendment of its JPA, it is prohibited from issuing bonds or incurring debts until the proper filings are complete."

- *Reporting Requirements*. Report all receipts and disbursements. Additionally, they may need to comply with additional statutory compliance requirements should they elect to invest funds and or issue bonds.

5.1.2 Council of Governments

Councils of government (COGs) are essentially general-purpose JPAs (Higgens 2020). More specifically, COGs are a type of regional planning agencies that represent member city and county governments to provide cooperative planning, coordination, and technical assistance in addressing cross jurisdictional challenges (*What are Councils of Governments?*). While the adoption of JPAs are officially authorized by state law, COGs are formed "following discussion and negotiation on common goals and objectives" (*What are Councils of Governments?*). These organizations have a wide range of responsibilities, all of which are determined by its member jurisdictions and agencies. Such responsibilities include transportation planning, air and water quality planning, waste management, and regional housing assessments. Most COGs, especially those "in larger urban or metropolitan areas, are largely funded from state and federal sources" (*What are Councils of Governments?*). This includes federal funding, sales taxes, service fees, and membership dues (*Funding & Programming*) (*What is the Fresno Council of Governments?*).

One example of a COG is the Southern California Association of Governments (SCAG), which covers six counties, 191 cities, and more than 19 million people (SCAG). Other examples of COGs include the Association of Bay Area Governments (ABAG), which covers nine counties and 100 cities, and the Association of Monterey Bay Area Governments (AMBAG), which includes 18 cities and 2 counties, and the San Diego Association of Governments, which is both a metropolitan planning organization and a council of governments, that brings local decision-makers together from the region's 18 city councils, County supervisors, as well as non-voting representation from state and regional transportation and water authorities to develop solutions to regional issues such as transportation and adaptation.

The SanDAG Shoreline Preservation Working Group has several active projects related to sediment management including: shoreline Photo Monitoring; Nearshore Habitat Inventory; Regional Shoreline Monitoring Program; Sand Compatibility and Opportunistic Use Program; Coastal Regional Sediment Management Plan; and Regional Transportation Infrastructure Sea Level Rise Assessment and Adaptation Guidance. They have also been the catalyst for two

major Regional Beach Sand Projects. In 2001 offshore sand was place on 12 beaches and in 2012 another nourishment project was placed on 8 local beaches.

5.1.3 Memorandum of Understanding/Agreement (MOU/MOA) and Letters of Intent (LOI)

Memorandums of understanding (MOUs), and Memorandums of Agreement (MOAs), have been used in RSM and coastal adaptation planning. These types of agreements can range from non-binding agreements "to comprehensive agreements committing parties to specific actions and funding obligations" Unlike some formal agreements, MOUs "do not create separate entities from their members" (Kincaid & Stager, 2015), whereas MOAs are legally binding agreements. Letters of interest (LOI's) are similar to MOU's in that they are non-binding agreements parties can use to enter into a transaction (Table 20).

The North-Central California Coastal Sediment Coordination Committee (NCCSCC) represents a distinct governance model for regional sediment management, formally established through Letters of Intent (LOIs) signed by its member organizations. Led by a steering committee comprised of the Greater Farallones National Marine Sanctuary (GFNMS), the National Park Service, and the California State Lands Commission, the NCCSCC brings together 17 federal, state, and local agencies from Sonoma, Marin, San Francisco, and San Mateo counties. Its core mission is to enhance regional coordination on sediment management, thereby improving coastal resilience across its jurisdiction. The committee operates based on seven guiding principles of sediment management and provides essential information and resources to its members and the public. Key outputs include the Permit Efficiency Roadmap, a guide designed to simplify the regulatory process for coastal projects, and the Coastal Agency Review for Sediment (CORESED) forum, which acts as a "one-stop shop" for project proponents to engage with multiple agencies concurrently to discuss regulatory considerations for restoration and sediment management initiatives. This collaborative structure, formalized through LOIs, allows the NCCSCC to directly address cross-jurisdictional challenges and foster a more efficient and coordinated approach to coastal sediment management.

Table 20. Supporting and limiting factors for MOUs/MOAs/LOIs

Supporting	Limiting
• *Flexibility*. For many, the fact that MOUs are a step down from a formal contract is why they are so useful (Adobe). This is beneficial because, if any party finds the objectives and goals are not being met, the agreement can easily be terminated (Corporate Financial Institute). Similarly, LOIs are generally less rigid and legally complex than formal agreements. This allows for easier adjustments to goals, activities, or membership as regional needs evolve or new opportunities arise, without requiring extensive legal review or renegotiation. • *Clarity*. Ensures that all participants are in agreement on the partner roles and activities, thereby decreasing misunderstanding and conflicts (Corporate Financial Institute) • *Lower Barrier to Entry*: The process of signing an LOI is typically less cumbersome and time-consuming than negotiating a full legal agreement. This encourages broader participation from diverse agencies, as it requires less bureaucratic overhead and upfront commitment, making it easier for new members to join.	• *Lack of Legal Enforceability*: The primary limitation is that MOUs and LOIs are generally not legally binding contracts. This means there are typically no formal mechanisms to compel participation, enforce specific actions, resolve disputes, or hold parties accountable if they fail to meet their stated intentions. Success heavily relies on continued good faith. • *Restrictive Funding Opportunities*. MOUs do not have the authority to raise revenues by issuing bonds. Additionally, MOUs are a non-binding provision that simply states that parties will be expected to contribute financial resources needed to develop the contemplated project(s). Given the provisions are not binding, the parties really are not bound to provide contributions (Kincaid & Stager, 2015). Similarly, LOIs often do not include formal mechanisms for pooled funding, guaranteed financial contributions, or dedicated resource allocation from member agencies. This can limit the scope, scale, and long-term sustainability of committee activities, often relying on voluntary staff time or external grants secured by the lead entity. • *Lack of Liability Protection for Members*. "Generally, an MOU/MOA does not offer the same protection as" other governance structures (Kincaid & Stager, 2015).

5.1.4 Regional Climate Collaboratives

Regional climate collaboratives (RCCs) are a relatively new type of regional entity that is largely focused on adaptation and work on sharing information, lessons learned and leveraging their networks to support fundraising initiatives around climate change. The first RCC's were created in 2023 through a grant program administered by the California Strategic Growth Council. Through that grant program. RCC's are networks of a range of stakeholders that may including public agencies, Native American Tribes, community-based organizations and non-profits, businesses, and academic institutions, working together to facilitate the development and implementation of climate mitigation and adaptation strategies, leverage resources, share expertise, and promote equitable adaptation (University of San Diego). Their present capacity allows application for and receiving funding, but they have limited regulatory power (Table 21).

RCCs consist of common characteristics. First, participants share adjacent or overlapping boundaries. Second, participants share and benefit from the same systems (i.e., natural, social, economic, economic, infrastructure, and so on). Lastly, while state or federal representatives and staff may participate, collaborations rise primarily out of local concerns and goals (Georgetown University). Some examples of RCCs include North Coast Resource Partnership (7 counties), Central Coast Climate Collaborative (6 counties), San Diego Regional Climate Collaborative (1 county, 19 municipalities), and the Santa Barbara County Regional Climate Collaborative with subcommittees focused on Clean Energy; Natural Lands, Working Farms & Regenerative Agriculture; and Sea Level Rise Adaptation. The Central Coast Climate Collaborative and the Santa Barbara Collaborative are supported by member dues, while others are supported by grants from the Strategic Growth Council.

Currently, however, most of the RCC's are more about sharing and leveraging and lack any official governance authority, with agencies and members either paying dues and/or volunteering time of interested and dedicated staff members that are more often associated with planning departments and/or sustainability offices.

Table 21. Supporting and limiting factors for regional climate collaboratives.

Supporting	Limiting
• *Promotes Diverse Stakeholder Collaboration*. Membership may include both non-profit, public, and private organizations (California Strategic Growth Council). • *Climate Focus.* Focuses on addressing community climate resilience (Alliance of Regional Collaboratives for Climate Adaptation).	• *Collaboration.* Difficulties integrating climate goals into daily operations when working with local entities. • *Limited Capacity.* Limited staffing and time to dedicate to regional climate initiatives. • *Limited Funding.* Limited financial resources. • *Communication with Public.* Challenges in effectively communicating goals to the public. • *Data Gaps.* Gaps in research, data, and analysis needed to inform decision-making and achieve meaningful regional impact.

Source: https://www.adaptationclearinghouse.org/resources/regional-collaboratives-for- climate-change-a-state-of-the-art.html

5.2 FINANCING MECHANISMS

5.2.1 RSM Funding

To date, the funding mechanisms used and suggested for regional sediment management have been limited to those listed in Table 8. Primary sources include USACE Navigation Dredging Program, the California Department of Boating and Waterways (now State Parks) recreational boating fees, BEACON dues, and Flood Control funding. The following sections describe possible paths to expansion of RSMP funding.

5.2.2 Climate Adaptation Funding

Fully integrating sediment management into climate adaptation planning is a critical step in increasing funding for sediment management projects. Sediment management has been primarily funded by the Corps and the Division of Boating and Waterways (within CA State Parks). Climate adaptation, on the other hand, has been funded by a wide array of sources, both federal and state. Better integration of RSM into climate adaptation may open more opportunities for funding.

Several thorough reports have already been developed to explore the possibilities for funding and financing climate adaptation in California, including:

- Proposed Funding Pathways for Adaptation to Climate Change in California (Roberts et al., 2021)
- Paying for Climate Adaptation in California: A Primer for Practitioners (AECOM, 2018)
- Climate adaptation finance and investment in California (Keenan, 2019)

AECOM (2018) developed a comprehensive list of funding and financing tools, highlighting the benefits and drawbacks of each (Table 22).

Table 22. Funding and financing tools for climate adaptation in California, with key benefits and drawbacks, adapted from AECOM (2018).

Key characteristics of different funding and financing tools			
Tool	**Who Pays**	**Key Benefits**	**Key Drawbacks**
Funding tools			
Grants	Federal, state, local funds/taxpayers	Money raised from broader geographies (e.g. federal level) can be invested locally Can be used to attract additional funding	High capacity needed to apply for and manage and report on funds Redirects money that could be used for other purposes
Assessments	Property owners	Costs linked to benefits Flexible geography Not considered a tax under Prop 26	Extensive documentation of benefits required Approval requires support of a majority of affected property owners
Taxes			
Ad valorem property tax for voter-approved debt	Property owners	Potential for significant funding	Requires two-thirds approval of district's registered voters
Parcel tax	Property owners	Can be regional in scale Flexible use	Requires two-thirds approval of district's registered voters Flat rate is regressive
Tax-increment financing (TIF)	Property owners	Not subject to Proposition 13* limitations	Issuance of TIF bonds requires 55% voter approval in district Requires redirecting future property tax revenue Dependent on anticipated increases in value; limited for highly built-out areas

Key characteristics of different funding and financing tools			
Tool	**Who Pays**	**Key Benefits**	**Key Drawbacks**
			Requires district property owners to voluntarily allocate increment to the district
Mello-Roos tax	Property owners	Low approval thresholds for new development Boundaries do not need to be contiguous Tax could be based on relative risk- reducing benefits	If more than 12 registered voters, requires two-thirds approval of district's registered voters
Other taxes (e.g. sales, gas, hotel, utility users, business license)	Residents, businesses, visitors	Typically general taxes, which require only a simple majority for cities and counties to levy (less than two-thirds threshold for special taxes) or two- thirds of legislature for state general taxes	Can be regressive
Fees			
Property related fees: water, stormwater, and wastewater fees	Users	Majority protest threshold for publicly owned utilities is lower than other voter approval thresholds Privately owned water utilities are exempt from Proposition 218* (these deliver water to roughly 20% of the state's residents) Not considered a tax under Prop 26*	Publicly owned utilities subject to Proposition 218; Funds raised must directly support operations and dates cannot be tiered to address affordability issues. Private utilities' rate setting is regulated by California Public Utilities Commission
Non-property-related fees: gas, electric	Users	Not subject to Prop 218* No voter approval required, not considered a tax under Prop 26*	Funds raised must directly support operations; Rate setting regulated by CPUC for privately owned utilities or by elected boards for publicly owned utilities
Developer impact fees	Developers, Property Owners	Can be used to ensure new development is resilient No voter approval required; not considered a tax under Prop	Ties to market conditions which are often cyclical and difficult to forecast Requires new

Key characteristics of different funding and financing tools			
Tool	**Who Pays**	**Key Benefits**	**Key Drawbacks**
		26*	development/major redevelopment to manifest resilience at a meaningful scale
Other user fees (e.g. transit fares, tolls)	Users	Fees charged to those who use and benefit from the services	Participation of disadvantaged and vulnerable communities may be limited without affordability programs
In lieu fees	Developers, Property Owners	A mitigation sponsor collects funds from permittees in lieu of providing permittee-responsible compensatory mitigation required under a regulatory program. The sponsor uses the funds pooled from multiple permittees to create one or more sites to compensate for aquatic resource functions lost as a result of the permits issued.	Requires new development/major redevelopment to manifest resilience at a meaningful scale. Increased cost to coastal landowners and developers
Sand/Recreation Mitigation Fees	Developers, Property owners	Fees are placed on permit applicants for coastal development and/or coastal armoring projects to compensate the public for lost recreation opportunity. These fees could be used for sediment management.	Requires new development/major redevelopment to manifest resilience at a meaningful scale. Increased cost to coastal landowners and developers
Lease fees	Businesses	Lessees of state lands pay a fee associated with their lease application. These fees could be used for sediment management.	Increased costs to businesses
Private Involvement			
Business Improvement districts	Businesses, consumers	Useful for district-wide infrastructure that could benefit from economics of	Limited revenue generation Require contiguous boundaries

Key characteristics of different funding and financing tools			
Tool	**Who Pays**	**Key Benefits**	**Key Drawbacks**
		scale (e.g. stormwater infrastructure) Contributes private revenues to public or shared goods	
Enterprise revenues (e.g. naming rights, concessions)	Businesses	Contributes private revenues to public good Effective for funding operations and maintenance expenses	Limited revenue generation Commercialization of and less public control over public space
Incentives (e.g. exemptions, discounts)	Businesses, Developers, Property Owners	Encourages investment that may not otherwise occur	Jurisdictions forfeiting potential revenue sources
Community benefit agreements	Businesses, Developers, Property Owners	Can involve communities in the planning and development process	Can be time and resource intensive to determine and address community needs and negotiate between key players
Regulations (e.g. building codes)	Businesses, Developers, Property Owners	Passes upfront costs to the private consumer, placing less burden on the public to invest in adaptation needs/disaster bailouts Institutionalizes building standards that account for future risk	Requires regulatory action by appropriate state agency Can deter development
Financing tools			
Bonds			
Municipal bonds (general obligation bonds, revenue bonds)		Commonly used	Subject to voter approval requirements
Private activity bonds		Encourages private sector	Limited application and amount
Pay for success financing (e.g. environmental bonds)		Transfers risk of achieving intended outcomes from public sector to private sector	Limited use to date Significant monitoring and evaluation required

Key characteristics of different funding and financing tools			
Tool	**Who Pays**	**Key Benefits**	**Key Drawbacks**
Green bonds		Social impact investor appeal Publicizes commitment of spending towards environmental purposes	Limited use to date Lack of standardization of what it means to be "green" Administrative complexity
Insurance linked securities (catastrophe bonds, resilience bonds)		Less or no correlation with markets adds investor appeal	No resilience bonds as of 2017
Loans			
Federal loans		Commonly used Applicable dedicated loans for transportation and water infrastructure	Dependent on authorization from Congress
Revolving loan funds		Dedicated state programs focused on water and infrastructure programs	Sustainability of programs dependent on loan repayments
Program related investments (PRIS)		Flexible application	Requires alignment of philanthropic goals with adaptation and resilience

*Key California legislation

California Proposition 13 (1978): People's Initiative to Limit Property Taxation

This is one of the most significant and long-lasting pieces of legislation in California's history, especially when it comes to property taxes and public funding. It was passed by voters in June 1978 and drastically changed how property taxes are assessed and collected in the state.

Proposition 13 limits property tax rates to 1% of a property's assessed value, plus any voter-approved local taxes or assessments. Properties are assessed at their purchase price, not current market value. The assessed value can increase by no more than 2% per year, regardless of how much the property's market value rises. Property is only reassessed to market value when it changes ownership or undergoes significant improvements.

California Proposition 218 (1996): "Right to Vote on Taxes Act"

This is a constitutional amendment approved by voters and significantly changing how local governments levy taxes, assessments, fees, and charges. Its purpose is to protect taxpayers by requiring voter approval for certain local government revenue increases and to limit how local agencies impose property-related charges. Key provisions are that general taxes (used for any purpose) must be approved by a majority vote of local voters in general elections and that special taxes (for specific purposes) require a two-thirds voter approval. It applies to cities, counties, and special districts. The legislation also restricts assessments, requiring that local governments must clearly identify the specific benefit to the property and notify property owners and allow a protest ballot procedure (a majority protest can block the assessment). No assessments are allowed for general public benefits—only for specific, direct benefits to the property. Finally, the legislation required that property-related fees and charges must be proportional to the cost of service provided to the property, can't be used to fund general government services (e.g., police or fire), and that for services like water, sewer, and refuse collection, a majority protest process applies. Some fees may also require a majority vote of property owners or two-thirds voter approval.

California Proposition 26 (2010): Supermajority Vote for Certain Taxes and Fees

This proposition sought to amend the California Constitution to require a two-thirds supermajority vote in the legislature to impose certain new taxes and fees, including those labeled as "fees" but intended to generate revenue. The proposition was approved by voters, thereby raising the threshold for imposing certain taxes and fees. It reclassified certain fees as taxes, thereby subjecting them to the two-thirds legislative approval requirement. It potentially increased the difficulty for local governments to impose or increase fees for services, as these would now require a supermajority vote.

This list includes the variety of funding categories available for climate adaptation in the state. It can be used as a starting point to assess and weigh options as funding opportunities are considered. Importantly, in November 2024, **California Proposition 4** was passed, which allowed the state to issue $10 billion in general obligation bonds to fund climate and water projects. The Proposition 4 funding will be well aligned with BEACON's mission of using sediment management to address erosion concerns as it includes funding for coastal resilience and sea level rise, flood planning, and nature-based solutions (Figure 20).

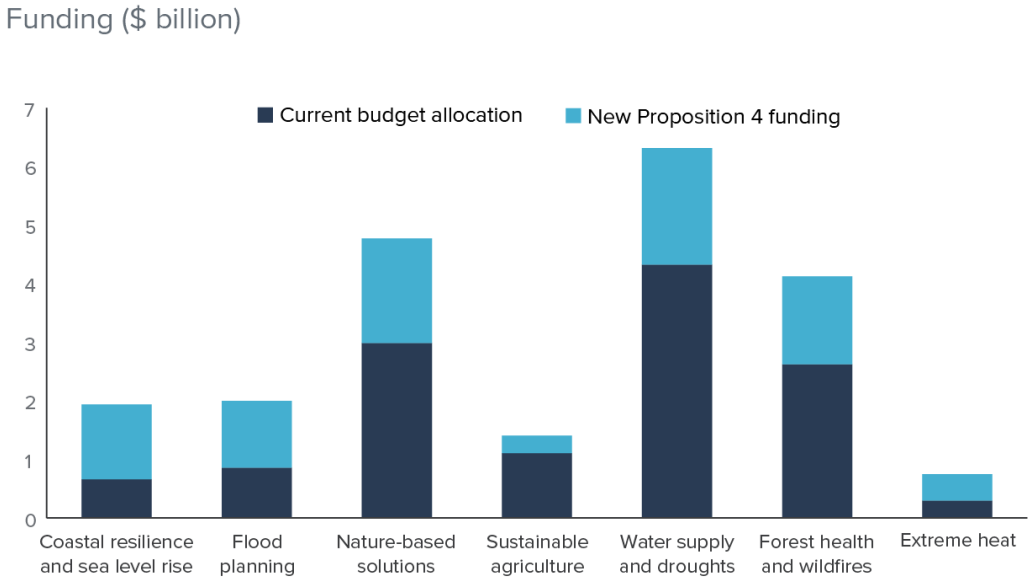


Figure 20. Proposition 4 funding categories. Source: Public Policy Institute of California.

As an overarching concept, funding sources should be matched to the demands or costs both in terms of scope and timing. The funds should be spread across as large a number of sources or payees as possible. They should have sufficient longevity, or through investment allow for streams of ongoing funding, such that capital repayments and operational and maintenance costs can be covered over the entire life of the project. They should also align the beneficiaries of a given project with the means of raising revenue, noting that there may be multiple beneficiaries of the same project. For example, cleaning of debris basins may reduce inland flooding, while also providing finer sediment for raising elevations near the shoreline to reduce flooding there, or provide sand for beach replenishment. Financing mechanisms should also be equitable. It should be noted that even with ad-valorem taxes that are equitable in principle, the increases in property values in coastal regions of California over the past decades have created a class of long-term residents who are asset-rich, but do not have sufficient free capital resources for additional fees and charges.

To weigh the pros and cons of various funding and financing options, multi-criteria decision analysis frameworks can be used. This process involves developing a list of criteria and evaluating the strength of each option on the criteria to ultimately come up with a weighted score for each option. For example, Keenan (2019) developed a useful framework for selecting which funding strategy or strategies to pursue for climate adaptation in, shown in Table 23.

Table 23. Example of weighted scoring of funding strategies for climate adaptation based on pre- determined criteria, adapted from (Keenan, 2019).

Rank	Funding strategy	Source	Revenue generation	Cost	Long-term sustainability	Flexibility	Timing	Trade-offs for other needs	State political feasibility	Local political feasibility	Admin. complexity	Equity burden
1	Local property tax increment from Infrastructure financing districts	4	4	4	5	4	4	5	4	4	5	4
2	Community facilities district	4	4	4	4	4	3	5	4	3	3	4
3	USACE CAP 103 Program	4	4	5	3	3	4	4	5	4	3	4
4	State property tax increment from Infrastructure financing districts	4	4	3	4	4	3	5	3	4	3	4
5	General obligation bonds	4	4	4	4	3	3	2	4	3	4	5
6	Cal-and-trade program funding	4	4	4	3	3	4	3	3	3	4	4
7	State resilience G.O. bond	4	4	4	4	3	3	5	3	3	5	4
8	State sales tax increase	4	4	4	4	4	3	1	4	2	4	3
9	Hotel assessment	4	4	5	3	4	3	2	4	2	5	4
10	Increased parking revenues	4	4	4	3	3	3	2	4	1	4	4
11	Assessment district	4	4	4	4	4	3	3	5	1	1	4
12	USACE general investigation	4	4	4	4	3	1	3	3	3	2	4
13	Philanthropy	4	2	4	2	4	2	5	4	4	4	4
14	Historic tax credits	4	3	4	2	1	3	4	4	4	5	4
15	Tax/fee on marina use	4	1	4	4	4	4	3	4	1	4	4
16	Cruise tickets surcharge increase	4	1	3	4	4	3	4	4	5	4	4
17	Advertising	4	1	2	3	4	4	4	4	2	4	4
18	RM3 bridge toll funding program	4	4	4	4	3	2	1	1	2	3	3
19	Vehicle license fee increase	4	3	3	2	4	3	1	4	1	4	4
20	Parcel tax	4	3	4	2	4	3	2	4	2	4	1

Rank	Funding strategy	Source	Revenue generation	Cost	Long-term sustainability	Flexibility	Timing	Trade-offs for other needs	State political feasibility	Local political feasibility	Admin. complexity	Equity burden
21	**Naming rights**	4	1	4	2	4	5	5	4	2	3	4
22	**Congestion pricing**	1	4	3	4	3	2	2	2	1	1	2
23	**Public-private partnership**	4	5	1	3	4	3	4	5	1	3	2
24	**Utility user tax surcharge**	4	3	2	3	4	2	1	3	1	5	3
25	**Transit impact development fee**	3	1	1	3	2	4	1	4	2	5	4
26	**Transportation funding**	3	5	3	3	3	1	2	1	3	1	5
27	**Real estate transfer tax increase**	5	3	3	3	3	3	1	4	1	1	3
28	**Surcharge on event tickets**	4	1	1	3	5	3	2	4	1	4	3
29	**Environmental impact bonds**	2	1	3	2	5	2	2	4	2	2	4
30	**Sale/lease increment of port assets**	3	2	3	5	4	2	1	1	1	3	4
31	**Regional gas tax**	4	5	1	1	3	2	1	2	1	2	2
32	**Increased ferry charges**	4	1	1	2	5	2	3	2	1	4	3
33	**Hazard mitigation grants**	2	1	3	1	1	1	3	1	3	4	2
34	**Pension plan investment**	3	3	3	1	5	1	2	1	2	2	3
35	**Geologic Hazard Abatement Districts**	3	1	1	3	5	1	5	3	1	1	4
36	**Infrastructure trust bank**	5	2	1	1	3	2	2	1	1	1	5
37	**Transit pass transfer fee**	1	1	1	1	1	1	1	1	1	1	1
38	**Resilience bonds/ insurance value capture**	1	1	1	1	1	1	1	1	1	1	1

5.3 BEACON CASE STUDIES OF INTEGRATED RSMP AND ADAPTATION PLANNING

This section is divided into two sections, case studies and opportunities. The case studies section includes the successful managed retreat project at Surfers Point, some summary of the lessons learned and successes at Goleta Beach and Carpinteria. The opportunities in the BEACON region are vast, and this section will discuss a few of the opportunities ahead.

5.3.1 Surfers Point Living Shoreline

The Ventura River mouth, famous for its popular surf break, has experienced a receding shoreline at an average rate of 1.5 ft per year since the late 1990s causing degradation of a bike path owned by the State and a parking lot operated by the Ventura County Fairgrounds. This deteriorating infrastructure became a safety hazard, so in 1995 the City of Ventura began developing plans restore the beach. The Surfers' Point Managed Retreat Project was created in 2005 after years of negotiation and coordination by city planners, state and local organizations. The project involved relocating the degraded bike path and parking lot, establishing a 65-foot retreat zone, and restoring a natural cobble and sandy beach area and vegetated dunes using cobbles from Santa Paula Creek and sand from Calleguas Creek and Pierpont dunes to widen the beach and build dunes (Figure 21 and Figure 22). Native dune vegetation was planted and maintained largely by Surfrider Foundation volunteers.

The City of Ventura also engaged in beach renourishment and planted sand dunes with natural vegetation with the help of local volunteers. Seeds were harvested from nearby Emma Wood State Park. Management of Surfers' Point is currently carrying out Phase 2 along the eroding downcoast section that expands the Phase one design by realigning the bike trail and retreating the parking lot then restoring cobbles, and sand to recreate dunes with bioswales to capture and filter storm water runoff and reduce erosion.

The project required permits from the California Coastal Commission, a Coastal Development Permit (CDP), and permits from the US Army Corps of Engineers and the Central Coast Regional Water Quality Control Board. It also included significant dialogs (and an MOU) with Ventura County Fairgrounds who controlled/managed the ocean front parking lots and have allowed the space to allow the relocation and realignment of the parking lots and bike path and make room for the cobble and dune living shoreline.

Phase 1 cost a total of about $4.5 million, with $1.6 million provided by the California Coastal Conservancy and with completion in 2012. Phase 2 has an estimated cost of $18 million, with $16.2 million provided by the California Coastal Conservancy (venturariver.org). Phase 2 is scheduled to be completed in 2025.

Figure 21. Aerial imagery of Surfers Point in Ventura before and after construction of Phase 1 of the managed retreat project.

Source: https://www.climate.gov/news-features/climate-case-studies/restoring-surfers-point.

Figure 22. Surfers Point, effectiveness of living shoreline with and without dunes in the kite boarding area during a large storm wave event in 2015. Source: Paul Jenkin

5.3.2 BEACON South Central Coast Beach Enhancement Program

The BEACON SCCBEP program was an opportunistic sediment management program that allowed for the deposition of suitable upland or offshore materials onto selected beaches in Santa Barbara and Ventura Counties. Examples of upland materials sources included debris basins, private and public construction projects that generate excavated material, and sand acquisition from sand quarries. Examples of offshore material sources were dredging from Santa Barbara Harbor and offshore borrow sites. The program covered five beaches to potentially receive such material. The selected beaches were:

- Goleta Beach (Santa Barbara County)
- Ash Avenue Beach (City of Carpinteria)
- Oil Piers (County of Ventura)
- Surfers Point (City of Ventura)
- Port Hueneme Beach (City of Port Hueneme)

In July 2002, BEACON certified a Mitigated Negative Declaration environmental document for SCCBEP. The SCCBEP included multiple permits including:

- Federal: US Army Corps of Engineers; USFWS for all beaches
- State: CA Coastal Commission; CA State Lands Commission; Regional Water Quality Control Board (RWQCB) for all beaches
- Local: City Permit – Port Hueneme for Port Hueneme Beach; City Permit – Carpinteria for Ash Avenue Beach; County Permit – Santa Barbara for Goleta Beach; City Permit – Ventura for Surfers Point Beach.

The planning and permitting phase of the SCCPEB covered more than five years (2000-2005), and was funded by CA Department of Boating and Waterways and a federal grant through the California Sediment Management Workgroup (CSMW) to complete environmental documents, designs for sand placement on beaches and securing

permits to allow the placement of predetermined maximum quantities of sand per year, on each of the listed beaches. The implementation phase of the SCCBEP allowed for placement of suitable opportunistic material on the permitted beaches during the five-year permit life (2005-2010). During this time two (one small and one medium-sized) pilot projects were implemented.

- November 2005 approximately 3,000 cubic yards of sand from Santa Barbara harbor West Beach was placed on Goleta Beach.
- 2010 approximately 50,000 cubic yards of sand from the Santa Barbara harbor was backpassed to Goleta Beach. About 1/3 of that sand was trucked from West beach and the remaining 2/3 barged from the Santa Barbara harbor.

The original permit was not renewed or extended past the initial five years.

5.3.3 Goleta Beach County Park Slough and Beach

Goleta Beach has been eroding for many years Beginning in the 1997 to 1998 El Nino and progressing for several years resulting in a complete armoring Goleta beach. By the mid-2010s, there was little to no beach fronting Goleta Beach County Park.

At the same time, Goleta Slough has been trapping sediment due to a combination of many factors, both human and climate related. Santa Barbara County Flood Control District and BEACON have made periodic efforts to place sediments on Goleta beach to reduce flooding in the Slough and address beach erosion.

The Santa Barbara County Flood Control District have multiple permits (Permit: 4-21-0379) for an ongoing sediment removal and flood carrying capacity improvement program for Los Carneros and Tecolotito creeks within the upper Goleta Slough area, and a five-year permit from 2012 – 2017, followed by a ten-year extension through 2027 (Permit: 4-11-069) for removal of sediment from the lower reaches of Atascadero Creek, San Jose Creek, San Pedro

Creek, and the main channel of Goleta Slough on an as-needed basis. The stated purpose of the program is to maintain existing flood water carrying capacity in the two creeks to reduce potential flooding of adjacent developed areas, residences, roadways, and the Santa Barbara Airport, and to provide sediment for beach nourishment. Sediment is tested and all suitable excavated sediment is placed in the surf zone at Goleta Beach County Park. If the sediment does not meet testing criteria, it is taken to an upland disposal site either outside of the coastal zone or at a site within the coastal zone permitted to receive such fill.

5.3.4 Thomas Fire Debris Flow Disaster and Sediment Management

In December 2017 the Thomas Fire engulfed the hills upslope from Santa Barbara and Montecito. In January 2018, torrential rain spurred debris flows that took 23 lives in Montecito, filling and overflowing regional debris basins. In the years following the Thomas Fire, debris basins were emptied and sediment was placed on Goleta Beach and Ash Avenue in Carpinteria to maintain storm preparedness and reduce flood risk levels. These placements were done under emergency permits but generally followed the South Central Coast Beach Enhancement Project (Figure 23). The difference in the sediment placement at each beach showed the benefits of regional sediment management projects.

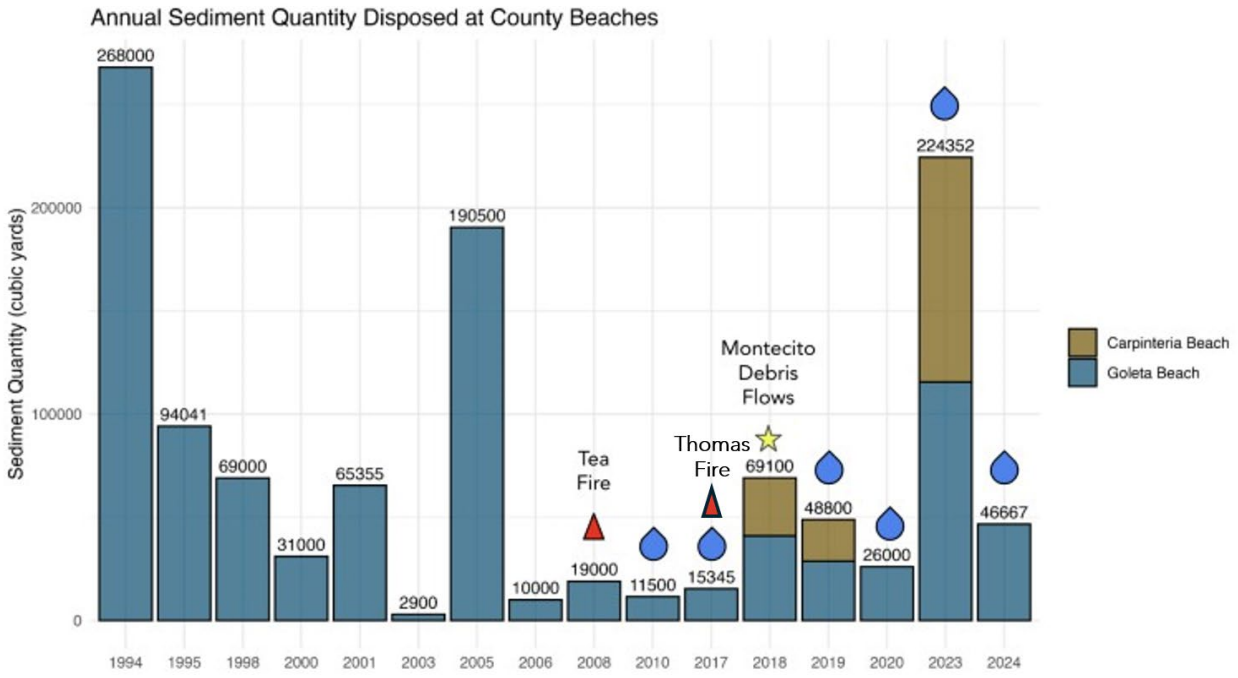


Figure 23. Adapted from Finding Balance in Our Managed Beaches: Policy Recommendations to Mitigate Emergency Sediment Disposal Impacts in Santa Barbara County (Bren School Debris Basin Report, 2025). From data provided by SBCFCD, the annual sediment quantity (in cubic yards) disposed at Goleta Beach and Carpinteria from 1994 to 2024 is visualized in a bar graph. The red triangle represents a fire event, blue raindrops indicate years with heavy precipitation events, and the 2018 Montecito debris flows are signified with a yellow star

Goleta Beach

Placement of Montecito debris flow cobbles and sediments were placed in a cross shore delta, mimicking a natural flood deposit that served to retain sand moving along the coast and restoring a sandy beach to what had previously been backed only by a revetment (Figure 24 – Figure 27).

Figure 24. Images of the sediment deposited at Goleta Beach from the Montecito debris flow.

Figure 25. Aerial image of Goleta Beach 2/19/2016 showing eroded conditions.

Figure 26. Aerial image of Goleta Beach on 8/19/2019 showing effectiveness of cobble groin at retaining sand

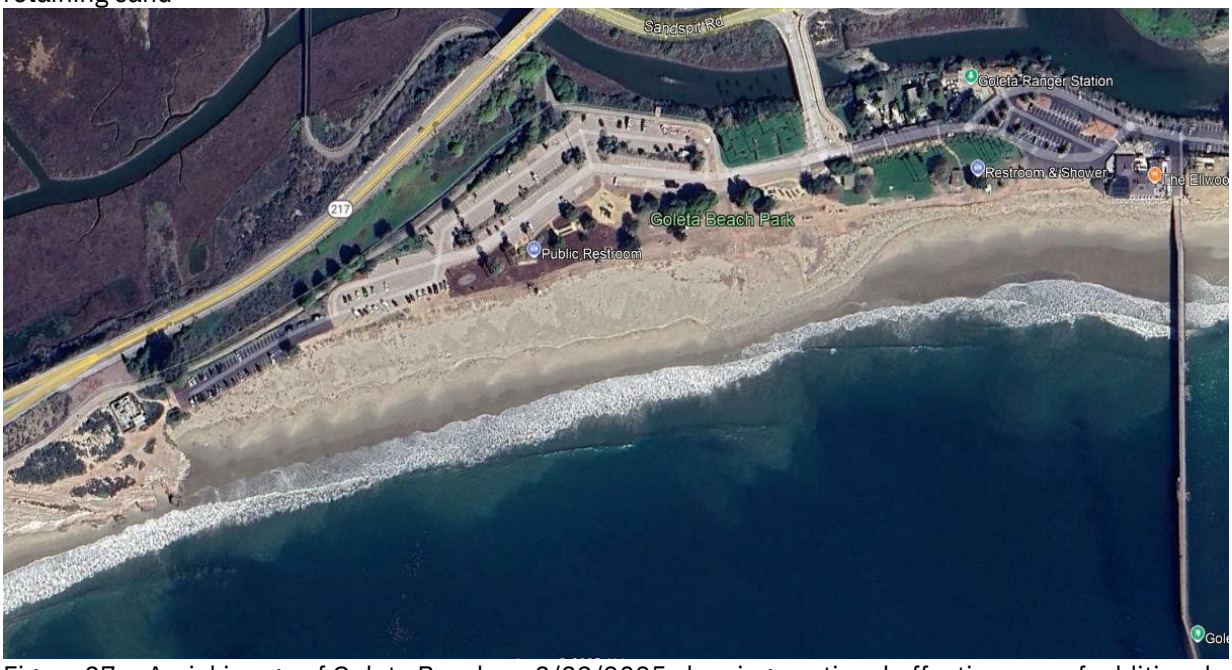


Figure 27. Aerial image of Goleta Beach on 2/23/2025 showing continual effectiveness of additional cobble placement as part of county flood control maintenance operations with the cobbles at beach migrating down coast

Goleta Beach and Carpinteria Opportunistic Nourishments and Turbid Plume Dynamics

Warrick et al. (2025) evaluated the environmental implications of beneficially reusing fluvial sediments, focusing on coastal plume formation from nourishment projects at Goleta Beach. Sediments trapped by flood-control structures upstream of Santa Barbara's littoral cells can be used for beach nourishment, but concerns remain about the effects of fine-grained fractions on water quality and nearby marine ecosystems. To address this, Warrick et al. applied both remote sensing techniques and hydrodynamic–sediment transport modeling to examine the dispersal and persistence of turbidity plumes. This dual approach provided insight into both surface plume expression and the underlying physical drivers of sediment transport.

The study showed that plume direction and extent are primarily controlled by wave height, wind speed and direction, and sediment settling velocity. Larger waves generated eastward plumes through strong longshore currents, while sustained easterly winds periodically caused plumes to move westward for several kilometers, at times reaching upcoast protected areas. Finer sediment fractions were slower to settle, prolonging turbidity in the nearshore zone. Although models and observations agreed on general patterns, they diverged on threshold conditions for plume reversals, with observations suggesting westward transport could occur under lower wind speeds than the model predicted. This discrepancy was attributed to the simplified model treatment of winds and waves and the lack of representation of background westward currents in the Santa Barbara Channel.

Placement method also proved important. Hydraulic dredging created higher nearshore concentrations over shorter durations, while trucking (drag-and-haul) projects lasted longer but generated lower far-field turbidity. These findings suggest that careful consideration of placement style and project timing can reduce ecological risks, especially to nearby marine protected areas such as the Campus Point and Naples State Marine Conservation Areas.

Although most fine sediment in the Santa Barbara Channel derives from natural river discharges during storm events, nourishment-derived plumes differ in timing and persistence, often occurring during fair-weather periods and lasting weeks. This distinction underscores the importance of considering nourishment-related turbidity as a separate management issue from natural sediment fluxes. Warrick et al. (2025) demonstrate how targeted monitoring and modeling can inform adaptive placement strategies that integrate beneficial reuse of sediment with the protection of ecological resources. Within the BEACON region, this case study illustrates a transferable framework for linking regional sediment management with coastal adaptation planning, balancing the need for nourishment with safeguards for sensitive marine habitats.

Figure 28. Image of sediment debris flow placement at the end of Ash Avenue in Carpinteria

5.3.5 Santa Barbara County Debris Basin Best Practices Manual

The BEACON Debris Basin Best Practices Manual (December 2024) offers guidance for planning, designing, and maintaining debris basins in Santa Barbara County, especially in areas affected by wildfire and steep terrain. It focuses on how to better protect communities from flooding and debris flows while also allowing natural sediment delivery to beaches and maintaining fish passage as shown in Figure 29. The manual highlights the importance of thoughtful site selection, basin design that mimics natural stream conditions, and regular maintenance. It also encourages collaboration with regulatory agencies early in the design process and suggests funding options from FEMA and California state OES programs.

The manual includes detailed case studies of four debris basins that have already been retrofitted to improve their performance and reduce environmental impacts:

- **Cold Springs Creek** (retrofit completed in 2024)
- **Gobernador Creek** (retrofit completed in 2008)
- **Maria Ygnacio Creek** (retrofit completed in 2019)
- **Romero Creek** (retrofit completed in 2022)

Each retrofit project aimed to improve sediment transport, reduce the chance of flooding, and allow fish and other wildlife to move through the creeks more easily.

The modification of debris basins should continue to be closely monitored to determine project effects and performance evaluation against project goals. The Beacon supported debris basin modification projects are intended to be monitored as pilot project and further evaluation efforts are expected to be completed.

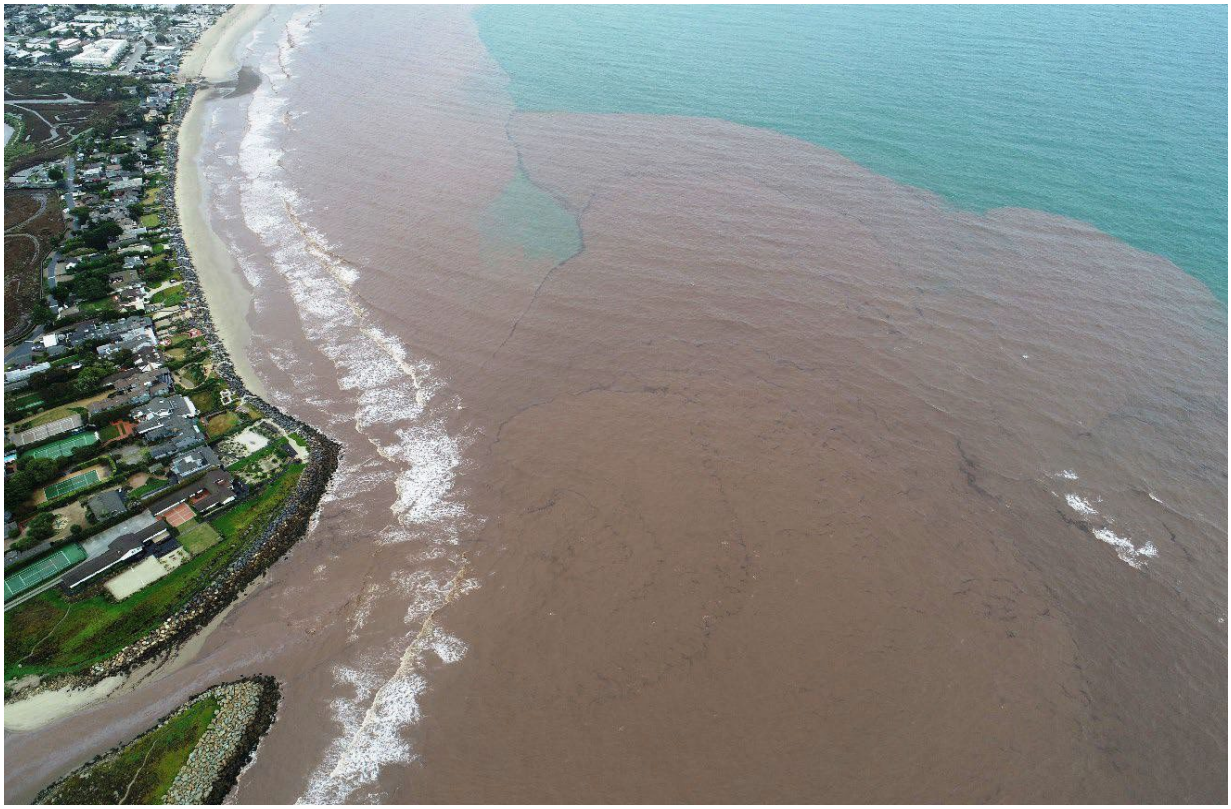


Figure 29. Sediment Transport to Downstream Beaches post rain event. Source: Santa Barbara County Flood Control District 2019

5.4 OPPORTUNITIES

5.4.1 Matilija Dam Removal

The Matilija Dam, on the Ventura River, located in Ojai California, was built to provide water supply, but has been non-functional for decades due to sediment build- up behind the dam, which has impounded 9 million cubic yards of sediment (fines, sand, and cobbles, Figure 30. In 2004, a proposal to remove the dam was approved, and years later, in 2016, the Design Oversight Group agreed on a new project approach for sediment management: transport of all

sediment downstream to support beach replenishment. Under the current proposal, the Matilija Dam removal will be completed in phases, starting as early as 2030.

First, improvements for flood protection and future sediment transport will be established downstream of the dam. These improvements include replacing bridges over the river to allow for higher peak flows. Then, initial dam removal activities will prepare the dam and upstream reservoir for initial sediment release. During the dry season, two 12-foot diameter tunnels will be drilled through the base of the dam near the pre-dam creek channel. The tunnels would be opened just prior to a large storm event, which must be sufficient in magnitude and duration to move millions of cubic yards of stored sediment from behind the dam downstream to the Ventura River, estuary, and Pacific Ocean. The initial flush is expected to initially restore the creek channel through the dam area and reservoir sediments. The continued transport of fine sediment and the slower transport of coarser sediment deposits that have accumulated in the reservoir will occur next. Modeling (by Integral) shows fine grain sediment moves through the estuary system quickly, sand over a few years, and cobbles over a few decades.

Once an adequate quantity of sediment has been flushed from the dam site, the dam will be removed in one season by lowering it incrementally. After dam removal, sediment transport would be restored. Habitat restoration in the floodplain and estuary would be accomplished by managed natural recruitment and non-native plant control followed by monitoring.

Funding for the Matilija Dam removal has received several grants. Table 24 details dates, funding, and amounts of recent grants. Most project funding has been from organizations associated with wildlife (WCB, NFWF, CDFW, SCC) due to the historic presence of southern steelhead, an endangered species, in the Matilija Creek watershed (a tributary to the Ventura River). In the mid 1900's, it was estimated that 3000 – 6000 southern steelhead occupied the larger Ventura River basin and current estimates hover in the single digits. While dam removal has sediment management implications, the funding history of this project illustrates that ecosystem-based habitat restoration projects may have a variety of co- benefits, opening up funding sources beyond those traditionally associated with sediment management.

Figure 30. Matilija Dam. Source: Ventura County Star

Table 24. Funding sources for components of the Matilija Dam Removal project.

Year	Funder	Description	Amount
Dec 2016–2020	Resources Legacy Fund/Open Rivers Project		$707,500
May 2017	California Department of Fish and Wildlife	65% Design Planning Project	$3,300,504
Sept 2017	National Fish and Wildlife Foundation	Estuarine and Coastal Modeling	$278,002
May 2019	California Department of Fish and Wildlife	Santa Ana Bridge Replacement	$13,426,938
May 2020	California Wildlife Conservation Board	Design	$5,025,000
March 2021	State Coastal Conservancy	Camino Cielo Bridge Design/CEQA	$735,000
2017–2021	NGO	Strategic Project Support	$1,426,000
February 2023	California Wildlife Conservation	Design	$4,300,000

Board

Source: Venturariver.org (not exhaustive)

5.4.2 Carpinteria Living Shorelines

To protect its coastline from risks associated with sea-level rise, flooding, and erosion, the City of Carpinteria has recently undertaken the Carpinteria Living Shorelines Project. The project aims to implement a nature-based flood defense along the city beach to increase shoreline resilience and protection. The project proposes to utilize vegetation, sand and cobbles to nourish the existing beach and create a dune system along the beach to serve as the first line of defense during a large storm event. Several potential sediment sources have been identified including the nearby debris basin. Past research (BEACON 1989, Barnard et al 2009) has identified potential sediment locations in the region.

Sediment from channels and debris basins within the Carpinteria Marsh and watersheds may also be available and are being considered as part of any future maintenance. Foothill debris basins may also be used as sources – currently, they are emptied into landfills, but with the necessary permits, such material especially cobbles and coarse grained sediments could be used for construction in the living shorelines project. Finally, opportunistic use of sediment derived from local construction projects is also identified as a potential source. This work is supported by a $1.62 million grant from the California State Coastal Conservancy. This project is considered an adaptation project that may require ongoing maintenance. Connecting the routine flood control sediment management practices with this longer term adaptation strategy would be an excellent example of integrating RSM with adaptation.

5.4.3 Oil Piers Artificial Reef

The Oil Piers Artificial Reef is a proposed project by the USACE to address beach erosion intensified by the removal of the historic Oil Piers near Rincon Island. The original pier structure had served to reduce wave energy and trap sediment, helping to maintain beach width in a naturally sediment-limited area. In response to public concern over resulting erosion and loss of surf, the proposed artificial reef aims to replicate sediment retention and wave-modifying functions using a submerged rock or reef structure. Notably, the project concept integrates surf recreation with coastal protection, seeking to improve surf quality while reducing beach loss. A recreational surf break was explicitly included as part of the reef's design objectives, reflecting growing interest in multi-benefit coastal infrastructure. The Oil Piers Artificial Reef remains a potential pilot study in sediment management that balances engineering, ecology, and recreation.

5.4.4 Mugu Submarine Bypass

Mugu Canyon is a submarine canyon in California, on the northern border of the Zuma Littoral Cell and the southern border of the Santa Barbara Littoral Cell. The Zuma littoral cell extends from Hueneme Canyon in the west to Point Dume in the east (Figure 31). The main sediment supplies in the Zuma Littoral cell include sea cliff erosion and sediment delivered from small streams in the Santa Monica Mountains. Historically, sand migrated across the head of the Mugu Canyon into the Zuma Cell from the Santa Barbara cell. However, the canyon headwall has migrated landward in recent years, leading to an increase in sediment lost into the Mugu Canyon, which now captures all the send leaving the Santa Barbara cell, and resulting in a narrowing of downcoast beaches (Griggs and Patsch 2018), including narrowing of Zuma Beach which is heavily trafficked and one of the most visited beaches in the region. Continuous nourishment with sediment otherwise lost into the Mugu Canyon has been suggested as a possible solution to erosion which is expected to accelerate with sea level rise. Research suggests that the minimum amount of sediment needed for nourishment to mitigate erosion over the next 55 years is roughly equivalent to the amount of sediment that can be sustainably captured from Mugu Submarine Canyon without accelerating headwall erosion (Vruggink 2025). This could be executed through a sand bypassing system at the mouth of the Submarine Canyon, which is being explored as a possible solution by sediment managers.

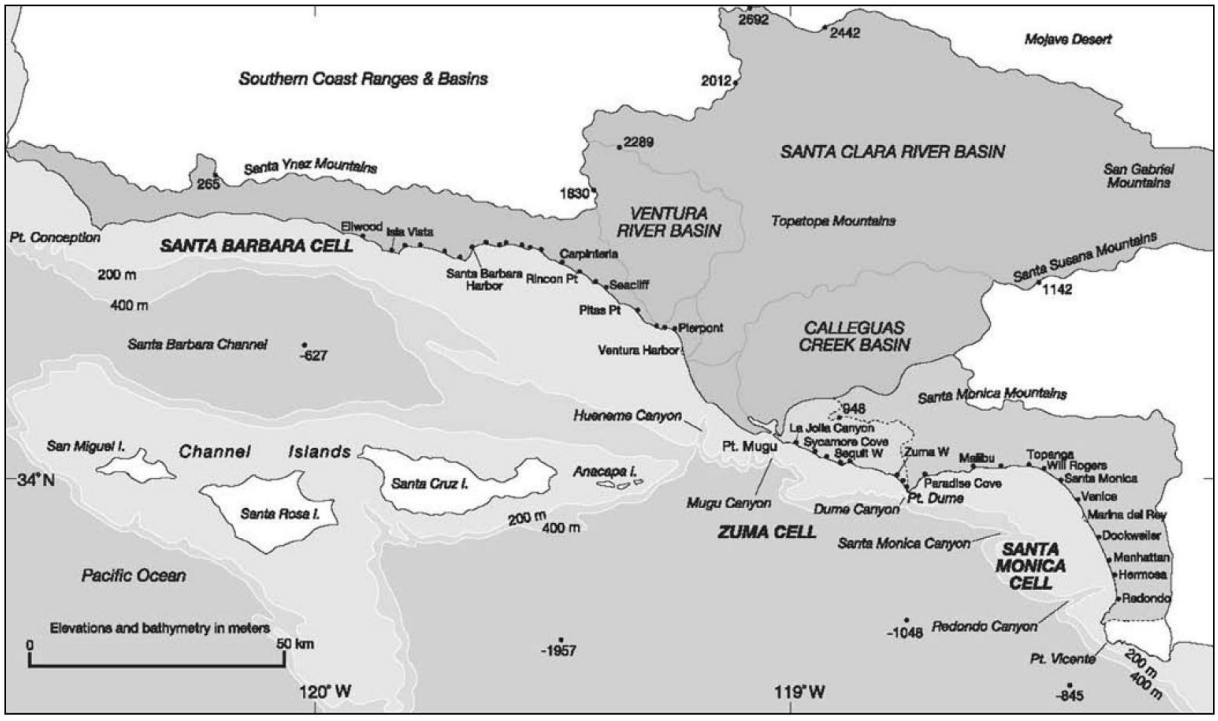


Figure 31. Southern California littoral cells and watersheds including the Mugu Canyon and Zuma Littoral Cell. Map does not include the full extent of the SBLC which reaches up to the Santa Maria River mouth, north of Pt. Conception. Source: Zoulas and Orme (2008).

6 DISCUSSION

A range of topics emerge from the RSMP and climate document analysis, interviews, and Integral's background knowledge and research. We separate them into three themes of collaboration and coordination, project implementation, and funding and support.

6.1 COLLABORATION AND COORDINATION

A key theme identified in this project revolves around a need for greater collaboration, both within agencies and between coastal managers at all levels of government and across all disciplines. Harbor districts, long range planners, public works, floodplain administrators need to work together. Regional climate collaborators working on wildfire need to collaborate with sediment management agencies. Disaster recover needs to coordinate with long range planners. Adaptation planning outreach needs to educate communities on sediment (sizes, placement, etc), and better engage Tribes, recreational users, boaters, historically underrepresented populations to build support for beaches and access.

Survey respondents mention the need for integrating ecology into RSMP, to effectively manage sediment as climate change progresses, planners, engineers and ecologists need to talk to each other and co-develop projects and plans.

The survey results called for coordination on the key topics of funding and permitting. Respondents mentioned the need to develop "regional funding coordination to support projects throughout Southern California" and an "interregional collaboration group to

advocate for more funding." Respondents also mentioned the need for a "region wide regulatory permitting to allow for cross boundary actions like beach replenishment, offshore sand sourcing, and better river sediment management upstream (to improve sediment flow downstream)". Better integration of state regulations with local policies, operational plans and higher level planning documents can facilitate improved regional sediment management. This can involve leveraging state regulations for RSMP in local coastal programs, coordinating regional planning documents, LHMPs and streamlining the permitting processes while aligning priority funding goals.

6.1.1 California Coastal Act Section 30233(b) and 30233(d)

Part B of Section 30233 from the California Coastal Act states:

> *"Dredging and spoils disposal shall be planned and carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Dredge spoils suitable for beach replenishment should be transported for these purposes to appropriate beaches or into suitable longshore current systems."*

Part D of Section 30233 states:

> *"Erosion control and flood control facilities constructed on watercourses can impede the movement of sediment and nutrients that would otherwise be carried by storm runoff into coastal waters. To facilitate the continued delivery of these sediments to the littoral zone, whenever feasible, the material removed from these facilities may be placed at appropriate points on the shoreline in accordance with other applicable provisions of this division, where feasible mitigation measures have been provided to minimize adverse environmental effects. Aspects that shall be considered before issuing a coastal development permit for these purposes are the method of placement, time of year of placement, and sensitivity of the placement area."*

These parts of the Coastal Act, written in 1976, have already laid the groundwork for integrating beneficial reuse of suitable dredge and flood control sediment into Local Coastal Plans. However, the degree to which planning documents reference and leverage this part of the Coastal Act is inconsistent. Across the 130 documents provided by the Client, Section 30233 is referenced in only 11 of them (8%). Across these eleven documents, Section 30233 is mentioned in the following contexts:

- **2009 Goleta Parks Monitoring Report**: Requests a coastal development permit to use dredge materials on Goleta Beach, and references 30233(b) as justification
- **1982 Santa Barbara LCP:** Section 30233 present but subsection (d) not specifically referenced

- **2015 Santa Barbara Harbor Dredge Federal:** Permit to put dredge from Santa Barbara Harbor in West Beach instead of offshore and states that doing so is more cost effective and in compliance with Section 30233.
- **2016 Santa Barbara Harbor Master Plan**: Mentions that dredging West Beach to replenish downcoast beaches is consistent with 30233.
- **2019 Santa Barbara Complete Certified LUP**: Restates the CCA text in policy 4.1-8
- **2019 Santa Barbara City LCLUP Update:** "All diking, dredging, and filling activities shall conform to the provisions of Sections 30233 and 30607.1 of the Coastal Act…When feasible, spoils should be deposited in the littoral drift, except when contaminants would adversely affect water quality or marine habitats, or on the beach". This is focused on protecting against poor quality sediment rather than utilizing high quality sediment.
- **2019 Santa Barbara County Coastal Hazards**: includes the CCA policy at the beginning of the document
- **2022 Santa Barbara Copy of F6a**: Approval of Santa Barbara Harbor dredge to be used for beach nourishment as it is in alignment with 30233a and b
- **2017 Ventura County Coastal Area Plan:** Mentions that projects within 100 feet of a wetland may be required to carry out the provisions of Section 30233 (b and c)
- **2018 Ventura Harbor Dredge**: Presents a plan to use a dredge to place on beach in compliance with Section 30233.
- **Ventura County 2021 Coastal Area Plan**: Mentions the policy but does not describe how Part b can be leveraged for regional sediment management

As LCPs across the state are being updated to incorporate sea level rise and coastal hazards, more specific details should be added to the local policy and will be a crucial nexus to streamlining RSM and adaptation planning as well as the expedite coastal development permits. Comprehensive integration of this Coastal Act Section into regional planning documents may support the development of innovative regional sediment management projects. Furthermore, the language in the Coastal Act could be strengthened to require beneficial re-use of sediments. Presently the Act uses "should" and "may" for sections 30233(b) and 30233(b), respectively, but that language could be changed to "shall" to require such activities. Details could include specific types of sediment and living shoreline projects that would be preferred and thus expedited.

6.1.2 California Cutting Green Tape Initiative

In 2020 the State of California identified "Cutting Green Tape" as a signature initiative to increase the pace and scale of environmental restoration. California has a proud tradition of strong laws that protect our environment from the effects of development and resource extraction. Unfortunately, projects that are beneficial to the environment can be slowed by the

same processes and procedures that are designed to protect it. Cutting Green Tape seeks to remedy this problem, providing a CEQA statutory exemption for projects primarily aimed at restoring fish and wildlife, subject to qualifying criteria.

Complex and overlapping permitting processes can result in fewer and smaller actions being taken at a slower pace and a greater expense. Much like the familiar term, "red tape," "green tape" represents the extra time, money, and effort required to get environmentally beneficial work done because of inefficiencies in our current systems. Cutting Green Tape means improving regulatory processes and policies so that this work can occur more quickly, simply, and cost-effectively.

The summary report, Cutting Green Tape: Regulatory Efficiencies For A Resilient Environment, made recommendations to streamline the regulatory process for environmental restoration, and one of the recommendations is specifically focused on the coastal zone:

- **Recommendation 11**: Exercise Coastal Commission authorities to advance restoration consistent with efficiencies authorized by SWRCB, CDFW, and CEQA.
- **Proposed Solution**: Coastal Commission explores and utilizes efficiencies within their authorities to advance small- and large-scale restoration that are consistent with and/or complementary to existing and planned efficiencies authorized by SWRCB, CDFW, and CEQA.
- **Other Considerations and Notes**: A particular consideration in any proposed solution is that the diffuse nature of how the Coastal Act is administered under individually approved, separate Local Coastal Plans might make it challenging to apply statewide. One alternative that was considered during stakeholder input was to develop new legislation amending the California Coastal Act to exempt habitat restoration projects from the definition of development. This recommendation looks to allowances in the existing statute for projects that do not have a potential significant adverse effect, similar to what is stated in the CEQA Class 33 exemption criteria for small projects.

  Another alternative was for the commission to consider a coastal development permit exemption for projects meeting CEQA Class 33 criteria. This was advanced as consistent with Section 30610(e) of the California Coastal Act, which states that a permit is not required for a category of development that the commission has found to have "no potential for any significant adverse effect, either individually or cumulatively, on coastal resources or on public access."

This initiative paired with recommendations for leveraging and strengthening Section 30233(b) and 30233(d) of the Coastal Act could potentially ease the permitting burden of RSMP projects in the BEACON region.

6.1.3 Integrating Sediment Management into Local Climate Adaptation Planning Documents

A reliable and cost-effective source of sediment is critical to the effective implementation of many climate resilience options, particularly nature-based solutions. By considering beaches and natural habitats such as dunes and wetlands as "natural infrastructure", RSM practices could potentially benefit from expanded funding opportunities.

To date, policy documents such as Local Coastal Plans, Climate Impact Plans, and Local Hazard Mitigation Plans include limited discussion of potential sources of sediment. These plans should all cross- reference the relevant Regional Sediment Management Plans. In some cases, multiple RSMPs may be relevant, as interjurisdictional sediment movement may be the most cost-effective option.

The availability of sediment sources and sediment sizes should also be used in the initial feasibility assessment of adaptation options and development of desired futures, to ensure that communities have realistic expectations for the viability of options that are reliant upon sediment availability and delivery costs. Public education of the variety of sediments naturally found on beaches, dunes, and wetlands would improve public perception when cobbles, which have been largely removed from the sediment system by watershed alterations start reappearing.

6.1.4 Leveraging Existing Guidance

The Efficient Permitting Roadmap for Coastal Sediment Management, developed by NOAA's Greater Farallones National Marine Sanctuary (GFNMS) in collaboration with the 17 agencies of the North-Central California Sediment Coordination Committee, serves as a comprehensive guide to streamline the permitting process for nature-based coastal resilience projects along the Northcentral California coast (Figure 32). By consolidating information from federal, state, and local agencies, the roadmap facilitates the application of sediment in projects like dune restoration, which are essential for combating sea level rise, erosion, and flooding. The guide emphasizes the importance of sediment in enhancing coastal resilience and provides a user-friendly framework to navigate the complex multi-agency permitting landscape, supporting stakeholders in implementing sustainable coastal management practices.

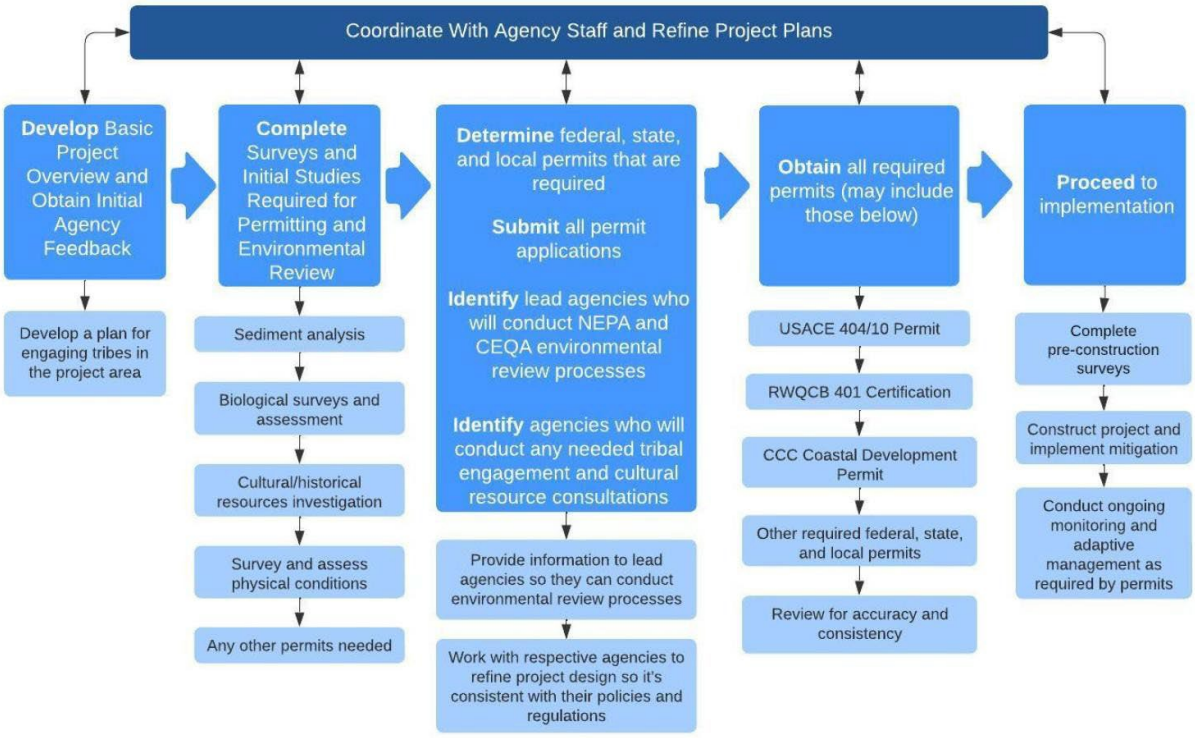


Figure 32. Flowchart depicting an overview of an efficient regulatory process. An overview of the regulatory process from the pre-application stage to formal permit applications to project implementation with the likely steps that will be required by project managers and agencies to complete each phase.[4]

6.2 PROJECT IMPLEMENTATION

The RSM plans all discuss possible projects in a high level, theoretical way. However, many of the plans do not contain roadmaps to accomplish the project, including elements such as specific funding sources, staff capacity, permitting requirements and jurisdictional coordination. This level of detail will be necessary to implement any project and should be included in the plans.

As evidenced by the RSMPs and climate documents, there is a clear silo separating sediment management and climate adaptation planning with several contributing factors. Primarily, the Coastal Sediment Management Workgroup, which ultimately created the RSMPs was established in 1999 by the USACE and the California Natural Resources Agency (CNRA).

[4] Project planners are generally responsible for carrying out each step of the process shown below, however, it is the responsibility of specific agencies to lead the environmental review process, initiate tribal engagement, and conduct the necessary consultations (e.g. for potential impacts to listed species, cultural or historic resources, protected habitats, etc.). From The Efficient Permitting Roadmap for Coastal Sediment Management, developed by NOAA's Greater Farallones National Marine Sanctuary (GFNMS) in collaboration with the 17 agencies of the North-Central California Sediment Coordination Committee

Navigation is a primary mission of the USACE and CNRA's main goal for the CSMW was protection and restoration of beaches. Thus, the RSMPs are strongly focused on coastal engineering and do not deeply integrate factors such as ecology and socioeconomics. Additionally, early RSMPs were largely driven by a goal of using sediment management to solve navigational dredging and beach erosion concerns, without consideration of adapting to future climate impacts. In the years since CSMW's inception, climate change has become a major concern in California and beyond and integrating sediment management and climate adaptation planning is a critical next step.

For example, in 2022, after completion of the last RSMP in 2018, AB 691 Synthesis Report: Proactively Planning for Sea Level Rise Impacts on Granted Public Trust Lands was published. This summary report outlines actions to be taken by the state, the state lands commission, and trustees of state lands to support alignment with AB 691. Some RSM-related recommendations of this report included:

> *6.4.4 Create a "no net loss" policy for beaches."*
>
> *6.4.12 Develop strategies to address impacts of hard armoring on public trust lands and explore opportunities to transition to hybrid or nature-based shoreline protection when and where feasible*
>
> *6.4.13 Ensure sediment management practices evaluate beneficial reuse options based on cost-benefit analyses that include ecosystem service valuation, recreational value, and damage reduction benefits.*

Aligning with these recommendations will facilitate integrating climate adaptation planning and sediment management practices. Moving RSM beyond traditional beach nourishment approaches will be essential as climate change and sea level rise accelerate into the next century, and creative use of sediment to meet the challenge of rising sea levels and stronger storms can be a part of the state-wide solution. Below are listed several specific examples taken from the collection of RSMPs that highlight holistic or creative approaches to using sediment as a climate adaptation tool.

- **Sonoma and Marin RSMP Regional Recommendation:** Coastal bluffs and beach zones throughout the region are eroding, threatening key infrastructure and transportation assets. Long-term solutions at these locations may involve moving vulnerable infrastructure inland (managed retreat). Identify areas where managed retreat will allow for restoration of natural coastal processes, including the use of phased approaches. Look at applying sediment management actions to support and inform adaptation pathways with a clear definition of "adaptation pathways".

- **Sonoma and Marin RSMP Regional Recommendation**: Take a holistic, watershed approach to understand sediment budgets and dynamics, and identifying areas of restoration to improve downstream water quality and encourage natural sediment transport.
- **San Luis Obispo Recommendation**: At present there is not a dredging program at Port San Luis. Instead, the Port District relocates sand 500 ft away, using an 8-inch pump, that provides just enough space for the sport launch. The channel is continually filled with sand, and the result is that the design water depth at some moorings was once 22 ft but is now 18 ft. As a consequence, there is a need to dredge sand rather than relocate it. One RSM measure would be to move it to Pismo Beach. Supporting efforts could include continuing local funding, seeking project partners, and adding the project to local legislative platforms.
- **San Luis Obispo Recommendation**: Like development setbacks provided on the coast, setbacks on stream floodplains can also serve to protect the public interest. Clear examples of threatened development on low-lying river and stream floodplains already exist in the county. Flooding is expected to get even worse with increases in future sea levels. Setback and other limits on stream and river floodplain development have the potential to minimize these ongoing and future flood pressures.

Approaches like these are the role models for integrating RSMP and climate adaptation planning. Furthermore, by integrating management activities across these two critical axes, a wider range of funding sources will be available to support projects that meet both goals.

The San Diego and Orange County SCOUPs can provide inspiration and guidance on expanding opportunistic use of sediment with a range of grain sizes. For example, the City of Oceanside (San Diego) has a permit to place up to 150,000 yards of sand on the shoreline annually and has a stockpile at El Corazon Yard. Similarly, Del Mar has a permit to place up to 180,000 cubic yards over 5 years, and the plan includes details on truck routes from source to receiver sites. City of San Clemente has permit to place up to 300,000 cubic yards at four beaches. The City of Monterey has a permitted Opportunistic Beach Nourishment Program that was conceptually developed to implement across Southern Monterey Bay, however since the program and supporting environmental documents have only been certified by the City of Monterey, and no specific CDPs have been applied for, the program has had no application thus far. Potentially though it could facilitate harbor sediments to be placed on adjacent Del Monte Beach and dunes to reduce erosion risk.

While SCOUPs are critical for obtaining permits for opportunistic use, they do not necessarily solve all logistical challenges – sediment is not always available when it is needed and vice versa. Stockpile sites can bridge this gap by collecting sediment when it is available and allowing it to be used later. Another challenge is that sediment often needs to be sorted based on grain sizes, so that permit requirements can be met. Often beach placement requires less than 25% fine grained material, while wetland placement requires higher fine composition.

Some of the size requirements also limit large material like cobbles from being used resulting in this material being sold or trucked to landfills.

BEACON can look to Australia for examples of successful implementation of RSMP including development impact requirements and sediment transportation methods. In Gold Coast, Australia, development on any site identified on the coastal erosion hazard overlay map as 0 to 500 m west of a seawall is required to return excess sand excavated during construction to the beach. The regulation states that sand must be:

- Cleaned using a 20mm sieve to remove all material other than clean sand; and
- Delivered and deposited to a beach as directed by Council; and
- If the sand excavated on the site exceeds 1,500 cubic meters, a supervisor appointed by Council shall be employed for the duration of the sand excavation and deposition at the expense of the applicant.

In addition, the region has invested in the Surfers Paradise Sand Backpass System at the northern end of the City with the installation of a 7.8 km pipe, which has several discharge/nourishment locations to relocated sediment from the entrance of a navigation channel , south to nourish eroding beaches, upstream of the predominant littoral drift (Figure 33). This system is integrated into an existing sand bypass system on Southport Spit and it works because there is a breakwater and pumping jetty that captures the sand, so they're partially reverting bypass sand as backpass sand. While investing in the pipeline requires upfront funding, reduced maintenance and operations costs of the pipeline made it a cost- effective option when compared to alternatives such as trucking sand and transporting dredged sand by barge. At the southern end of the City, sand arrives across the state border due to the Tweed River Sand Bypass Project, which includes another sand bypass jetty and periodic dredging.

Figure 33. Diagram of the sand backpassing system in development in Gold Coast, Australia.

This project highlights some of the opportunities that the BEACON, and more broadly, California's need for better sediment transportation techniques. Presently, when sediment is beneficially reused in the state, it is typically transported from source to receiver site with truck trips, which limit the volume of sediment that can be transported and are also expensive. As the Gold Coast example shows, developing permitted infrastructure for sediment transportation may provide long term cost savings. Furthermore, Coastal California has existing infrastructure that could potentially be utilized for sediment transport. A prime opportunity across Southern California are the rail lines along the coast. Collaboration with the rail lines could enable sediment to be transported in large volumes and at low cost. Barges could also work. With either of these techniques, there would still be the logistical challenge of the first and last mile transport to and from the rail line, but sediment could be moved long distances along the coast for a cost much less than using truck trips, and with reduced

greenhouse gas emissions. Rail locations adjacent to the coast are typically armored and should be identified where sidecasting sediment could be done to feed it into the littoral system. This method could easily replicate natural landslide deposition over a limited spatial extent (Figure 34). This could be relevant to both bypassing and backpassing of sediments. Existing infrastructure that could transport sediment is currently limited to the coastal zone of the BEACON region, more likely to be feasible for sand bypassing or back passing operations from harbors than transportation of debris from inland basins to the coast.

Figure 34. Landslide in Big Sur illustrating one natural process that delivers sediment to the coast.

6.3 FUNDING AND SUPPORT

An array of funding and financing tools exist to pay for climate adaptation in California, as presented in Section 5.2. This section discusses some strategic considerations that may optimize outcomes of financing strategies in the BEACON region.

6.3.1 Beaches as Natural Infrastructure

In other states, defining nature as natural infrastructure has enabled new sources of funding to flow for nature-based risk reduction. In 2022, the first-ever award for coral reef restoration to protect people after a disaster was issued by FEMA's Hazard Mitigation Program (FEMA 2023). On the barrier coral reef offshore from San Juan Puerto Rico, FEMA HMP funds were issued to fund development of a mix of artificial reef substrate and living coral that work together to protect the shoreline. Additionally, three artificial reefs will be placed nearshore to improve marine safety by reducing rough surf and dangerous currents around the public beach. $3 million was allocated for the first phase, out of $38.6 million for the overall initiative.

Dating back to 2015, California has established ecosystems as natural infrastructure with the passage of AB 1482 (Gordon). This bill promotes the use of natural systems and "natural infrastructure" when developing physical infrastructure to address climate adaptation, and defines "natural infrastructure" as:

> "using natural ecological systems or processes to reduce vulnerability to climate change related hazards, or other related climate change effects, while increasing the long-term adaptive capacity of coastal and inland areas by perpetuating or restoring ecosystem services. This includes, but is not limited to, the conservation, preservation, or sustainable management of any form of aquatic or terrestrial vegetated open space, such as beaches, dunes, tidal marshes, reefs, seagrass, aquifers, parks, rain gardens, and urban tree canopies."

Several years later, in 2019 AB 65 (Petrie-Norris) amended the definition of natural infrastructure and used the definition of "natural infrastructure" as being eligible for federal funding through FEMA and other funding sources in the Government Code Sections that it amends.

Thus, using existing legislation and incorporating beach, marsh, dune ecosystems into California's Local Hazard Mitigation Plans may enable FEMA funds to be issued to support their restoration and management.

6.3.2 California Climate Resilience Districts

In 2022, California enacted Senate Bill 852 (SB 852), introduced by Senator Bill Dodd and co-sponsored by Insurance Commissioner Ricardo Lara. This legislation authorizes local city and county governments to establish Climate Resilience Districts (CRDs). These districts are empowered to finance and implement projects aimed at mitigating climate change impacts, including such as wildfires, sea-level rise, extreme heat, extreme cold, drought, and flooding. While CRDs are authorized to pursue a variety of financing mechanisms, CRD are structured to utilize tax increment financing (TIF). A 2020 report by Strategic Economics in support of S.B. 961 (2018) reviewed the effectiveness of tax increment financing in California, finding that the

limited revenue potential of tax increment financing tools limits their effectiveness. However, CRD may utilize a broad range of existing funding mechanisms.

S.B. 852 established California's first CRD, Sonoma County Regional Climate Protection Authority (SCRCPA).4 SCRCPA was initially created in 2009 to coordinate countywide climate protection efforts, but it did not have funding authority. S.B. 852 provided SCRCPA with the authority to pursue sustainable funding sources to support the district. To date, SCRCPA has not been able to secure funding, even with the additional authority provided through CRDs. SB 852 empowers communities and regions to establish collaborative local entities that can cross jurisdictional boundaries and focus resources on the most pressing climate issues identified locally. It also creates a structure to coordinate and leverage local, state, federal, and private funding in a way that maximizes impact across jurisdictions. As RSM projects are linked into adaptation plans they may become eligible for these new and emerging funding mechanisms.

6.3.3 Equity Considerations

An overarching challenge for funding RSMP is ensuring social equity. Coastal California currently has one of the most intense housing crises in the nation, and many of the options put forward for funding regional sediment management activities could exacerbate that problem, by relying on ad-valorem taxes that provide incentives for maintaining and increasing property values. This can provide a negative feedback loop, whereby adaptation actions are considered necessary due to exposure of valuable public and private built infrastructure, but then the suite of available adaptation alternatives is constrained by a desire to preserve coastal real estate and hospitality assets within the hazard zone. Development impact fees or sediment transport offset funds could both increase the cost or regulatory burden of building new housing. Increasing property taxes would also make homeownership even further out of reach for the many renters in coastal California.

Furthermore, many of the funding mechanisms that use fees or taxes to fund sediment management require passage by ballot measure. Wealthier constituents may have a greater capacity to afford measures that increase their tax burden to fund sediment management actions that preserve the beach amenity and protective values of sediment in front of their own properties. This could result in innovative and creative sediment management approaches being concentrated in wealthy communities. Research on the social equity of financing nature-based solutions suggests a framework of considering place, process, and payment when assessing whether payment schemes exacerbate or ameliorate disparities (Thompson et al., 2023).

Another equity consideration is in how demographics and recreational users are used in calculations of beach usage. By focusing only on number of visitors and value of real estate protected from flooding, the beaches with highest value are likely be disproportionately located in high income coastal communities and areas. The Ventura County Adaptation Plan breaks beach visitation into surfer and non-surfer populations, while the other plans that

quantify the value of beach visitation do not break it down by population or recreational use at all. Equity could be considered in the design of financing models through polling to determine income levels of beach visitors and assessing the relative spending on beach visitation as a portion of income. Additionally, instead of determining protective value of the beach by calculating the dollar value of real estate protected from flooding and erosion interventions that add sediment to beaches or dunes, as per USACE guidance, the plans could:

- Use the number of dwellings or residents, rather than asset values, to rank protection options.
- Weight protection of real estate by the inverse of census block income levels within the jurisdiction or relevant project area, such that damage to buildings in lower income census block groups is given greater weight in an assessment.
- Quantify the amount (length, area or replacement cost) of public infrastructure protected from flooding by the beach or dunes (e.g. miles of roads, infrastructure) or the park areas protected from flooding and erosion.

7 CONCLUSIONS, RECOMMENDATIONS, AND NEXT STEPS

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CONCLUSIONS

California's coastal regions and inland watersheds are increasingly vulnerable to the impacts of climate change, and effective sediment management has emerged as a critical component of addressing these challenges. Recent storms have underscored the urgent need for a cohesive and adaptive approach to sediment management that not only responds to immediate concerns but also anticipates and adapts to projected long-term climate impacts. The growing recognition of the value of nature-based solutions including restoring beaches, dunes, and wetland habitats as "natural infrastructure" alongside more traditional engineering approaches offers a promising path forward. However, the success of these efforts hinges on the ability to implement them in a coordinated and sustainable manner.

For decades, the state has struggled with fragmented governance and funding for sediment management. The California Sediment Management Working Group (CSMW), established in the late 1990s, created a foundation for sediment management through regional sediment management plans (RSMPs), but these plans have not reached their full potential. Although these plans offer innovative concepts for managing sediment, they have often lacked the necessary technical specificity, including detailed roadmaps for implementation, clear permitting processes, and strategies for cross-jurisdictional coordination. This lack of integration has hampered their ability to effectively support climate adaptation planning at the local and regional levels.

This report highlights several key challenges and opportunities for improving sediment management in the face of climate change. A significant finding is that while RSMPs have initiated valuable conceptual work, they have not sufficiently addressed the practical elements required to implement these ideas. This includes the need for specific coordination between agencies across jurisdictions, comprehensive permitting procedures, and the identification of practical funding sources. Furthermore, the integration of ecology and socio-economic factors into sediment management remains a critical gap. As California faces more frequent and severe climate events, it is imperative that regional sediment management plans not only account for environmental needs but also consider social and economic impacts, ensuring that the solutions are equitable and inclusive. These RSM plans must become integrated into long term adaptation planning to expand funding opportunities and align with community visions.

California's legislative landscape is evolving to support these shifts. For example, the recent passage of Senate Bill 852 (SB 852) and the establishment of Climate Resilience Districts (CRDs) empower local communities to take proactive measures against climate change. These districts provide a mechanism for local governments to establish cross-jurisdictional collaborations, thereby facilitating integrated, region-wide solutions that address both sediment management and climate adaptation. Similarly, the growing acceptance of natural infrastructure, as evidenced by bills like AB 1482 and AB 65, highlights a shift toward using ecosystems like beaches and wetlands as integral components of climate resilience strategies. As local jurisdictions update their Local Coastal Programs, additional details added to facilitate RSM projects should align with CCA Sections 30233(b) and 30233(d). These legislative and policy frameworks offer a foundation for aligning sediment management with broader coastal preservation and restoration goals, may streamline implementation and integrate with local and regional climate adaptation efforts. Developing regular local and regional permits that address climate changes, including response to more extreme storm and rainfall disasters, and their increasing frequency, as a way to avoid emergency permitting and ensure that integrated solutions are implemented as part of disaster recovery.

However, challenges remain. Chief among them is securing consistent, long-term funding for sediment management, particularly as many of the funding mechanisms available are fragmented, one time grants, or reliant on voter approval. The survey results revealed a clear need for more coordinated funding strategies, such as the creation of regional funding coordination systems and the development of interregional collaboration groups that could advocate for and facilitate access to funding. The current reliance on local taxes and fees, particularly in wealthier communities, risks exacerbating disparities in access to climate adaptation resources, potentially leaving low-income or underserved communities at a disadvantage with less access to beaches.

Ensuring that funding mechanisms are equitable is paramount to ensuring that all communities—regardless of wealth—benefit from sediment management and climate adaptation efforts.

The social equity challenges associated with sediment management funding underscores the need for a more inclusive planning process. The interconnection between sediment management and broader climate adaptation goals to address sea-level rise, extreme weather events, and habitat restoration requires collaboration across a range of sectors. Planners, engineers, ecologists, and social scientists must work together to develop comprehensive solutions that consider the ecological, economic, and social dimensions of each project. Education about sediment (sizes, transport, changes, etc) is increasingly important to include in outreach efforts. This collaborative approach is essential for developing practical, actionable adaptation plans that can be implemented on the ground.

At its core, the challenge of sediment management in the face of climate change is a governance issue. The state's fragmented approach to sediment management, with its reliance on siloed planning, funding, and permitting processes, is not well-suited to the scale of the climate crisis. Moving forward, it will be essential to break down these silos and foster a more integrated and collaborative governance framework that supports cross-jurisdictional coordination, enhances stakeholder education and engagement, and streamlines administrative processes. This includes aligning local and state regulations, integrating sediment management into local climate adaptation plans, and providing clear guidance on the permitting processes for sediment-related projects.

Furthermore, the practical details of sediment management—such as sediment transport, storage, and sorting—must be more clearly addressed in regional sediment management plans and communicated to the public. As highlighted by the findings in this report, while the RSMPs provide a high-level overview of potential projects, they often lack the specificity needed for implementation. This includes clear identification of funding sources, staffing needs, and coordination mechanisms between agencies. As climate impacts accelerate, the state must ensure that regional sediment management plans are not just aspirational but are actionable, with concrete steps that can be taken to mitigate and recover from storm impacts in real-time and adapt over time.

In conclusion, California stands at a pivotal moment in its approach to sediment management. The state has laid the groundwork for more integrated, resilient, and sustainable sediment management strategies, but much work remains to be done. By fostering greater collaboration between local, state, and federal agencies, integrating sediment management with broader climate adaptation planning, and addressing funding and equity challenges, California can unlock the full potential of its sediment management strategies. The path forward requires a shared commitment to overcoming governance challenges, securing funding, and ensuring that all communities benefit from climate resilience efforts. Through thoughtful planning and coordinated action, California has an opportunity to lead the nation in developing innovative, effective sediment management strategies that will safeguard its coastlines, ecosystems, and communities for future generations.

7.1 RECOMMENDATIONS

This section summarizes key recommendations to improve the alignment of Regional Sediment Management Plans (RSMPs) with climate adaptation strategies, based on findings from document review and stakeholder surveys. These recommendations are grounded in the findings presented in previous sections and reflect the full range of physical, institutional, and policy challenges.

1. **Update and Align RSMPs with Adaptation Planning:** To improve implementation and relevance, RSMPs must reflect current climate realities and planning frameworks.
   - Integrate sea-level rise, disaster-driven sediment variability, and habitat restoration into updates of the RSMPs, with a focus on the sections identified as lacking in the plan review (Figure 5).
   - Use sediment surpluses from high-flow or post-disaster events as opportunities for adaptive placement, such as release of inland storage sites into streams near the coast during seasonal storm events, particularly if there is a 1% chance rain event, or enhanced on-shore deposition or after landslides and rocks slides along roads.
   - Coordinate RSMP updates with LCPs, LHMPs, CIPs, and other climate planning frameworks, including State Sea Level Rise Guidance and State Lands Commission policies and programs to ensure consistency and accountability.
2. **Expand Consideration of Sediment Types and Sources:** Many RSMPs focus narrowly on sand, ignoring the utility of a broader sediment range.
   - Broaden grain size considerations to include silts, muds, cobbles, boulders.
   - Investigate the use of innovative manufactured materials, such as eco-concrete.
   - Reconnect coarse sediments from debris basins to coastal systems, especially after disasters.
   - Develop and maintain standardized regional sediment inventories linked to project and habitat needs.
3. **Enhance Interregional Governance and Collaboration:** Governance fragmentation is a key barrier; broader and more representative collaboration is needed.
   - Expand the CSMW and regional governance bodies to include adaptation planners, harbor districts, Tribes, public works, and historically underrepresented groups.
   - Establish interregional coalitions to advocate for sediment-related policy and funding, including inland cities and communities that use the coast for recreation.
   - Support knowledge exchange through shared technical capacity, inventories, and monitoring frameworks

4. **Regulatory Streamlining and Policy Integration:** Permitting challenges remain a major barrier to implementation.
   - Update planning policies to leverage Coastal Act Sections 30233(b) and 30233(d) to support beneficial reuse and adaptive permitting as well as developing a “no net loss of beaches” policy.
   - Apply "Cutting the Green Tape" principles and establish a statewide framework of permit conditions for sediment reuse projects, covering construction, monitoring, and placement methods.
   - Develop programmatic EIRs for RSM projects and templates to reduce project delays.
5. **Integrate Sediment into Climate Resilience Frameworks:** Sediment management must be fully embedded in the broader landscape of adaptation planning.
   - Require the inclusion of sediment management strategies in LCPs, General Plans, LHMPs, and adaptation plans.
   - Cross-train planners and engineers to promote integration at every stage of the planning cycle.
   - Use scenario planning to address sediment needs under extreme events and climate futures.
6. **Quantify Multi-Benefit Outcomes:** To secure long-term funding, sediment strategies must demonstrate value beyond engineering metrics.
   - Ensure sediment management practices evaluate beneficial reuse options based on cost-benefit analyses that include ecosystem service valuation, recreational value, and damage reduction benefits.
   - Frame beaches and dunes as public infrastructure eligible for resilience and infrastructure grants.
   - Develop strategies to address impacts of hard armoring on public trust lands and explore opportunities to transition to hybrid or nature-based shoreline protection.
7. **Diversify funding opportunities for RSM projects:** Establish long-term, flexible, and diversified funding mechanisms that integrate RSM with adaptation, ecosystem restoration, and hazard mitigation planning.
   - Quantify the total value of sediment-based adaptation including the flood protection, habitat, and recreation benefits of beaches and living shorelines in cost-benefit analyses to access resilience funding.
   - Establish cross-jurisdictional and flexible funding models by creating shared, adaptable funding tools that support phased RSM projects across regions and agencies.

  - Position sediment projects as climate Infrastructure treating sediment-based solutions like living shorelines as infrastructure eligible for climate, resilience, hazard mitigation, and disaster recovery grants.
  - Utilize navigational funding from the US Army Corps of Engineers for backpassing and bypassing projects, to leverage existing funding for dredging and nourishment activities.
  - Use existing enforcement and impact fees such as sand mitigation fees for coastal armoring into a set aside fund for implementing RSM projects.

8. **Support Pilot Projects and Adaptive Implementation:** Pilot projects can test and demonstrate innovative sediment reuse strategies.
  - Implement scalable pilots that explore sediment sorting, storage, transport, and reuse.
  - Use monitoring data from storms and shoreline changes to inform placement strategies.
  - Align pilot projects with long-term adaptive strategies, including living shoreline maintenance cycles.
9. **Elevate Outreach, Equity, and Public Understanding:** Increased awareness and equitable engagement are essential for successful implementation.
  - Launch targeted outreach to Tribes, underrepresented communities, and local elected officials, including Inland areas that benefit from beach recreation for this section.
  - Highlight success stories and build support through transparent performance tracking.
  - Promote equitable funding structures that reduce disparities across jurisdictions.

7.1.1 NEXT STEPS FOR CSMW

The California Sediment Management Workgroup (CSMW) is being revitalized and is poised to play a renewed leadership role in coordinating sediment management policy, science, and funding across the state. To ensure its success in this new phase, the following strategic actions are recommended:

- **Expand membership** to include long-range planners, public works agencies, harbor districts, ecologists, transportation agencies and tribal representatives to ensure broader representation and interagency collaboration.
- **Require integration of RSMPs into local and regional adaptation planning** as a condition of state-level funding. This will embed sediment strategies directly into Local

Coastal Programs (LCPs), General Plans, local and regional adaptation plans and other key policy frameworks.

- **Standardize sediment inventories** and establish a centralized, accessible data portal to track grain sizes, volumes, and placement suitability statewide. Inventories should align with habitat and project needs and be updated regularly.
- **Support the development of statewide permitting templates or a programmatic Environmental Impact Report (EIR)** to streamline project approval using certain placement methods, and monitoring for sediment reuse and coastal resilience projects.
- **Define clear state policies that prioritize beneficial reuse and natural infrastructure,** including the use of dredged or opportunistically sourced sediment for ecological restoration and flood risk reduction.
- **Promote nature-based sediment reuse strategies** that support long-term climate adaptation, including scalable pilot projects and demonstration efforts that validate effectiveness and foster replication.
- **Align routine sediment maintenance practices** (e.g., dredging, basin cleanouts) with adaptation goals. Encourage agencies to plan for multipurpose outcomes and integrate these activities into climate resilience operations.
- **Advocate for flexible, cross-jurisdictional funding mechanisms** that allow for pooled resources, cost-sharing across time, and collaboration among jurisdictions within shared sandsheds.
- **Use monitoring data** from storm impacts and long-term shoreline change to inform future sediment placement, improve site selection, and support adaptive management.
- **Leverage CSMW's platform to support federal and state legislative strategies,** enabling advocacy for resilient sediment policy and sustained funding for sediment and adaptation projects.

By implementing these actions, CSMW can help transform sediment from an overlooked resource into a strategic asset—central to California's coastal resilience, ecological health, and economic sustainability.

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9 APPENDIX A

Goleta

2003 Goleta Demo Project
2009 Goleta Parks Monitoring Report
2012 Final Adopted Goleta Energy Efficiency Action Plan
2014 City of Goleta Final Climate Action Plan
2015 Goleta Slough Inlet Modeling Study
2015 Goleta Coastal Hazard Vulnerability and Fiscal Impact Draft Report
2017 Long-term Biological Monitoring Report for Goleta Beach
2017 Goleta California Coastal Commission Permit
2018 Public Notice from USACE For Sediment Removal and Beach Disposal
2019 Goleta Beach Shoreline Monitoring Program Annual Report
2021 Goleta California Coastal Commission Permit for Sediment Nourishing at Goleta Beach
2022 Goleta Slough Long-Term Monitoring Plan Results Memo
2023 Santa Barbara Flood Control Technical Memo

City of Santa Barbara

1982 City of Santa Barbara Local Coastal Plan
2005 BEACON Performance Guidelines
2005 Santa Barbara Dredge Lease
2009 The Framework of a Coastal Hazards Model—A Tool for Predicting the Impact of Severe Storms
2012 Climate Action Plan 2017 Implementation Status Update
2012 City of Santa Barbara Sea-Level Rise Vulnerability Study
2012 City of Santa Barbara Climate Action Plan
2012 UCSB Climate Action Plan
2015 Climate Change, Coastal Hazards, and Shoreline Response Modeling in California
2015 Goleta Slough Area Sea Level Rise and Management Plan
2015 City of Santa Barbara Sea Level Rise Vulnerability Assessment
2016 Final Environmental Assessment for the Santa Barbara Harbor Dredging Program
1996 City of Santa Barbara Harbor Master Plan
2017 City of Santa Barbara Climate Plan Report Appendix C
2017 Case Studies of Natural Shoreline Infrastructure in Coastal California
2017 Coastal Storm Modeling System: CA Central Coast
2017 Appendix A: Vulnerability Studies Completed for Santa Barbara
2019 City of Santa Barbara Local Coastal Program Coastal Land Use Plan
2019 City of Santa Barbara Coastal Land Use Plan
2019 City of Santa Barbara Sea-level Rise Adaptation Plan Benefit-Cost Analysis
2019 City of Santa Barbara LCP Amendment
2019 City of Santa Barbara Local Coastal Program
2019 City of Santa Barbara Sustainability Progress Report
2019 Santa Barbara County Coastal Hazards
2020 Appendix A of the Santa Barbara Sea Level Rise Vulnerability Assessment
2020 Letter of interest to the U.S. Army Corps of Engineers

2021 Santa Barbara City Final Adaptation Plan
2021 Executive Summary of Santa Barbara Sea Level Rise Adaptation Plan

Carpinteria
1996 Carpinteria Bluffs Coastal Access, Recreation, and Open Space Mater Program
2003 City of Carpinteria General Plan/Local Coastal Land Use Plan & Environmental Impact Report
2008 Review Plan for the Carpinteria Shoreline Feasibility Study
2016 City of Carpinteria Environmental Review & Monitoring Status Report
2017 Coastal Storm Modeling System Summary of Methods
2017 Carpinteria General Plan Key Decisions Memo
2018 City of Carpinteria Coastal Vulnerability and Adaptation Report
2019 Carpinteria General Plan Chapter 4: Climate & Sea Level Rise Science
2019 City of Carpinteria Sea Level Rise Vulnerability Assessment and Adaptation Project Executive Summary
2020 Carpinteria Dune Restoration Proposal
2020 Carpinteria USACE Letter Authorization
2021 City of Carpinteria General Plan 2021 Annual Progress Report
2022 State Lands Commission Staff Report 46
2022 City of Carpinteria Local Hazard Mitigation Plan
2022 City of Carpinteria Dune and Shoreline Management Plan
2022 AB 691 Summary Report
2022 Exhibits from The City of Santa Barbara Sediment Management Program 2022 AB 691 Synthesis Report
2022 State Agency Sea Level Rise Action Plan for California
2022 EPA Environmental Justice Screening Report for Santa Barbara
2022 Appendix C of the Santa Barbara Federal Maintenance Dredging Program
2022 Environmental Assessment of the Santa Barbara Harbor Maintenance Dredging Program 2022 Coastal Commission Approval of Santa Barbara Harbor Maintenance Dredging

Ventura
2018 Conserving California's Coastal Habitat
2019 City of Ventura Coastal Area Strategic Plan Proposal
2021 City of Ventura Energy Action Plan
2022 City of Ventura Climate Change Vulnerability Assessment

Oxnard
1982 Oxnard Coastal Land Use Plan
Herzog and Hecht et al, 2023
2018 Environmental Assessment for Channel Islands/Port Hueneme Maintenance Dredging
2018 Oxnard Local Coastal Plan Update
2018 Oxnard Sea Level Rise Adaptation Strategy Report

Port Hueneme
2019 Port of Hueneme Deepening Project Supplemental Environmental Assessment
2021 City of Port Hueneme Proposed Amendment to Local Coastal Program
2021 Port Hueneme General Plan Update Final Environmental Impact Report

2021 Port Hueneme General Plan Update Final Environmental Impact Report Appendices
2021 Port Hueneme General Plan
Port Hueneme Hazard Zones

County of Santa Barbara
2010 County of Santa Barbara Sustainability Action Plan
2011 Santa Barbara County Climate Action Strategy
2013 Santa Barbara Sustainability Program and Action Plan Presentation
2015 Goleta Slough Area Sea Level Rise and Management Plan: Appendix B - Goleta Slough Inlet Modeling Study
2016 County of Santa Barbara Sea Level Rise Coastal Resiliency Project Phase 2 Final Technical Report
2017 Santa Barbara Area Coastal Ecosystem Vulnerability Assessment
2017 Santa Barbara Coastal Resilience Work Plan
2017 County of Santa Barbara Energy and Climate Action Plan
2018 Toward Natural Infrastructure to Manage Shoreline Change in California
2021 Correspondence regarding amending the Santa Barbara County Local Coastal Program
2022 USACE Request for Comment on the Draft Environmental Impact Assessment of the Santa Barbara Harbor Operations and Maintenance Dredging program
2022 Goleta Slough Long-Term Monitoring Plan Results Memo
2017 Long-term biological monitoring program for Goleta Beach
2019 Goleta Beach Shoreline Monitoring Program Annual Report
2023 Santa Barbara Flood Control Technical Memo

County of Ventura
Coastal Regional Sediment Management Plan Central Coast from Pt. Conception to Pt. Mugu
2016 Santa Barbara and Ventura County Coastal Storm Modeling System Results
2017 Cobble Berms and other Coarse But Adaptable Natural Landforms
2017 Case Studies of Natural Shoreline Infrastructure in Coastal California
2017 County of Ventura General Plan Coastal Area Plan
2018 Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment Appendix A1
2018 Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment Appendix A2
2018 Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment Appendix B
2018 Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment Appendix C
2018 Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment Appendix D
2018 Ventura Dredge Draft Environmental Assessment
2018 Ventura County Resilient Coastal Adaptation Project Sea Level Rise Vulnerability Assessment
2019 Southern California Resilience Initiative Pilot 1: Community Resilience Collaborative and Integrated Data Hub
2019 Ventura County Climate Change Vulnerability Assessment
2019 Ventura County Resilient Coastal Adaptation Project: Sea Level Rise Adaptation Strategies Report
2019 Projected Changes in Ventura County Climate
2019 Ventura County General Plan Appendix B: Climate Change

2019 Ventura County Request for SLR Vulnerability Study
2020 Heat Vulnerabilities in Los Angeles County: Resource and Methodology Assessment
2020 Coastal Adaptation Vision for Naval Base Ventura County Point Mugu
2020 Exhausted! Workers Confront Extreme Heat and Wildfire Smoke in California
2021 Ventura County General Plan Coastal Area Plan
2021 Climate Crossroads: California's Readiness to Act on Climate Resilience
2021 Ventura County Categorical Exclusion
2021 Lessons from the Woolsey Fire
2021 Budget and Staffing Plan for Climate Action Plan Implementation
2022 Budget and Staffing Plan for Climate Action Plan Implementation
2022 Ventura Harbor Dredge Permit
2022 Multi-Jurisdiction Hazard Mitigation Plan
2020 Ventura County General Plan Appendix B: Climate Change