# ECOSYSTEM-BASED MANAGEMENT IN THE MORRO BAY WATERSHED AND ESTUARY

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Lucas Earle Crandall

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COMMITTEE MEMBERSHIP

TITLE: Ecosystem-Based Management in the Morro Bay Watershed and Estuary

AUTHOR: Lucas Earle Crandall

DATE SUBMITTED: June 2017

COMMITTEE CHAIR: Adrienne Greve, Ph.D.
Associate Professor of City and Regional Planning

COMMITTEE MEMBER: Michael Boswell, Ph.D.
Professor of City and Regional Planning

COMMITTEE MEMBER: Christopher William Clark, J.D.
Lecturer of City and Regional Planning

ABSTRACT

Ecosystem-Based Management in the Morro Bay Watershed and Estuary

Lucas Earle Crandall

The following thesis discusses the implementation of ecosystem-based management, an emerging concept in the field of environmental planning and management, in the Morro Bay watershed and estuary. Ecosystem-based management offers solutions to problems associated with human interaction within the natural environment; former President Barack Obama advised by the National Ocean Council, Pew Oceans Commission Report and the US Commission on Ocean Policy, has mandated implementation of this concept in coastal and marine systems (National Ocean Council, 2016). The theory behind ecosystem-based management challenges many tenets of existing natural resource management. This thesis finds the concept of ecosystem-based management as favorable despite tradeoffs and impacts of changing status quo. The preliminary research question asked if key criteria of ecosystem-based management were integrated into existing management plans of institutions such as the Coastal San Luis Resource Conservation District, Morro Bay National Estuary Program, and the San Luis Obispo Science and Ecosystem Alliance. The study answers this question through a document analysis of three local management plans. Survey and interviews were used to assess inconsistencies between management plan goals and on-the-ground implementation in the Morro Bay ecosystem. The results were used to incorporate tenets of ecosystem-based management into the Coastal San Luis Resource Conservation District's five-year and annual strategic plan update.

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# LIST OF ABBREVIATIONS

Cal Poly – California Polytechnic State University

CCA – California Coastal Act

CCMP – Comprehensive Conservation and Management Plan

CDFW – California Department of Fish and Wildlife

CEQA – California Environmental Quality Act

CSLRCD – Coastal San Luis Resource Conservation District

CWA – Clean Water Act

CZMA – Coastal Zone Management Act

BMP – Best Management Practices

BOS – Board of Supervisors

EBA – ecosystem-based adaptation

EBM – ecosystem-based management

EO – Executive Order

EPA – Environmental Protection Agency

ESA – Endangered Species Act

HCP – Habitat Conservation Plan

LCP – Local Coastal Program

MBNEP – Morro Bay National Estuary Program

MBWE – Morro Bay watershed and estuary

MLPA – California Marine Life Protection Act

MMPA – Marine Mammal Protection Act

MPA – Marine Protected Area

MSA – Magnuson-Stevens Fishery Conservation and Management Act

NEP – National Estuary Program

NEPA – National Environmental Protection Act

NOAA – National Oceanic and Atmospheric Administration

NOC – National Ocean Council

NRCS – Natural Resources Conservation Service

POCR – Pew Oceans Commission Report

SGMA – Sustainable Groundwater Management Act

SLO – San Luis Obispo

SLOSEA – San Luis Obispo Science and Ecosystem Alliance

SMRMA – State Marine Recreational Management Area

SMR – State Marine Reserve

SPU – five-year and annual strategic plan update

TMDL – total maximum daily load

USCOP – US Commission on Ocean Policy

USFS – US Forest Service

# 1. INTRODUCTION

The past decade has seen a paradigm shift in the management of natural resources (McLeod, Lubchenco, Palumbi, & Rosenberg, 2005; McLeod & Leslie, 2007; Wendt & Maruska, 2009). Executive Order (EO) 13547 from former President Barack Obama in 2011 called for a new ecosystem-based management (EBM) approach, a holistic administrative framework that involves the participation of scientists, stakeholders and managers in an institutional network that encompasses the linkages and the boundaries of ecosystems. The National Ocean Council (NOC), Pew Oceans Commission Report (POCR) and the US Commission on Ocean Policy (USCOP) guided by 200 renowned scientists from the nation's leading institutions signed a statement advocating for a government mandated shift to EBM, and have initiated a change in nationwide policies that direct management of coastal and marine systems (NOC, 2016; McLeod et al., 2005). The ideas of EBM have been explored in the academic literature quite extensively (i.e. Agee and Johnson, 1988; Imperial, Hennessey, & Robadue, 1993; Slocombe, 1993; Slocombe, 1998; Grumbine, 1994; McLeod et al., 2005; McLeod et al., 2007). The biggest challenge for EBM implementation is establishing a functional, integrated system that includes local stakeholder knowledge and input, science and monitoring of natural resources to strengthen collaboration. The thesis evaluates local implementation of EBM and the associated challenges that arise from shifting management frameworks.

The Morro Bay watershed, in San Luis Obispo County, CA, originates as springs and ephemeral streams of the Santa Lucia Range. Where freshwater flowing from the land mixes with saltwater of the sea, the estuarine environment begins. A variety of management approaches are reflected in development that has occurred within the Morro Bay watershed and estuary (MBWE), resulting in the associated ecosystem conditions

present today. The late 20th century experienced efforts to bridge science, policy and management of the MBWE fragmented within narrowly defined elements of the ecosystem (i.e. land, estuary and coastal habitats; conservation vs. economic concerns). These efforts were driven by isolated institutions such as local governments, State Parks, Coastal Conservancy, Fish and Wildlife, Regional Water Quality Control Board and the National Oceanic and Atmospheric Administration (NOAA). As a result, collaboration within the ecosystem, a critical EBM principle, was limited and the ability to take coordinated, conservation and management actions was impaired. Tremendous strides have been made by the three most influential local entities in the MBWE, the Coastal San Luis Resource Conservation District (CSLRCD), Morro Bay National Estuary Program (MBNEP), and San Luis Obispo Science and Ecosystem Alliance (SLOSEA). There has been increasing collaboration between resource managers from state and federal institutions, public officials from local municipalities, stakeholders that live and work in the ecosystem, and scientists that study the ecosystem.

A research aim was to present results that could address sector-based management of agriculture and inform the CSLRCDs 5-year and annual strategic plan update (SPU), called for by Dr. Dean Wendt, Director of SLOSEA and Professor of Coastal Marine Sciences at California Polytechnic State University (Cal Poly) (D. Wendt, personal communication, July 15, 2016). The thesis first assessed management of the MBWE. A preliminary research question asks if key criteria of EBM are integrated into existing management plans of institutions such as the CSLRCD, MBNEP, and SLOSEA. A document analysis of local entity management plans against criteria that define EBM was intended to provide a snapshot of progress towards holistic management of the MBWE (Table 2; Table 3; Table 4). This initial effort included entities focused on management

of land (CLSRCD), estuary (MBNEP) and coastal habitats (SLOSEA). The research then narrowed its focus to strictly the CSLRCD. The strategic analysis clarifies any gaps that exist between the CSLRCDs current strategic plan and on-the-ground implementation using data from a service needs assessment survey and in-person interviews (Table 6). These analyses enabled the SPU to accelerate necessary changes for project-orientated action in the watershed while integrating tenets of EBM. While the watershed and estuary is small, the management issues are complex.

## 1.1 Morro Bay Watershed and Estuary

The geographic scope of the thesis is the MBWE in its entirety from the headwaters to the mouth near Morro Rock (Figure 1).

Figure 1. Principle watershed within thesis scope; inset shows the location of Morro Bay along the California coastline (MBNEP, 2017; Wendt et al., 2009).

The thesis uses a watershed-based model. There are instances where EBM aims to balance ecological and social "boundaries;" however, the current consensus among resource entities in the US (i.e. Natural Resources Conservation Service [NRCS], US Forest Service [USFS] and the Environmental Protection Agency [EPA]) supports a watershed-based boundary for EBM. A watershed-based model is used to define the EBM project scope because of the known connection between land-based activities and their influence on watershed and estuarine systems. The CSLRCD, MBNEP, and SLOSEA all follow a watershed-based model, allowing for integration of planning and management actions between entities.

A line of "morros," erosional remnants of ancient volcanoes, divides the watershed into two principle tributaries. Chorro Creek and Los Osos Creek are the largest systems within the MBWE. The streams enter the Bay directly, influencing the community of organisms associated with the estuary. The watershed is 48,450 acres in size, ranging in elevation from sea level to approximately 2,400 feet at the highest point of the watershed boundary. The north and east boundaries of the watershed consist of foothills and ridges of the Santa Lucia Range. The MBWE is located within a Mediterranean climate, with warm dry summers and cool wet winters. Maritime influence is pronounced with moderate temperatures and frequent fogs reaching as high as Cuesta Ridge. The average air temperature is between 50-65°F, with peak summer heat waves rarely exceeding 90°F on inland ridges. Average annual rainfall ranges from 18 inches at the coast to 35 inches on Cuesta Ridge; most of this rainfall occurs between November and April (Wendt et al., 2009).

Much of the watershed remains open space that is used primarily for agriculture and a range of public uses, including parks, golf courses, nature preserves, a military

base, and university-owned rangeland. The developed portions of the watershed include the community of Los Osos/ Baywood Park, parts of the City of Morro Bay, Cuesta College, Camp San Luis Obispo, the California Men's Colony, and various facilities of the County of San Luis Obispo. Land use includes about 60% ranchland, 19% chaparral, 7% urban areas (City of Morro Bay, Los Osos and Baywood), 7% agriculture (crops) and 7% oak savannah (MBNEP, 2017).

In the recent geologic past, cooler, wetter weather persisted in the region. Extensive coastal wetland systems were found far inland from their current reaches. The watershed is host to a number of relict species inhabiting niches moderated by the marine layer (Wendt et al., 2009). Recently published scenarios of climate change predict that the Morro Bay watershed will be refugia for a variety of plant species that will otherwise experience severe reductions in their current ranges (Loarie, Carter, Hayhoe, McMahon, Moe, Knight, & Ackerly, 2008). The watershed serves as future refugia because of the great topographic relief of the coastal mountain range, and the moderation of climate that the ocean provides. Protecting these future refugia is an essential step in maintaining biodiversity in the face of climate change (Wendt et al., 2009). The watershed is considered a globally significant hotspot for terrestrial biodiversity primarily because of the high endemism and diversity of plant species found on a variety of soils including dacite volcanic plugs (i.e. dacite manzanita [*Arctostaphylos tomentosa daciticola*]), ultramafic outcrops (i.e. serpentine manzanita [*Arctostaphylos obispoensis*]) and ancient sand dune systems (i.e. Morro manzanita ([*Arctostaphylos morroensis*]) (University of California, Berkeley [UC Berkeley], 2017). Collectively, the watershed includes serpentine ridges with a disjunct groves of Sargent's cypress (*Cupressus sargentii*) and Bishop pine (*Pinus muricata*), endemic plant communities, riparian corridors, agricultural

lands, oak savannah/grassland, coastal sage and chaparral communities, coastal dune communities and relatively limited urbanization (UC Berkeley, 2017). The watershed is habitat to species of special concern, such as the threatened California red-legged frog (*Rana draytonii*), endangered Morro shoulderband snail (*Helminthoglypta walkeriana*), California legless lizard (*Anniella pulchra*), and the Morro Bay kangaroo rat (*Dipodomys heermanni morroensis*) (MBNEP, 2017). While the watershed is recognized as viable habitat for threatened South-Central Coast steelhead (*Oncorhynchus mykiss ssp.*), populations are highly diminished due to changes in land use and invasive species such as the Sacramento pike minnow (*Ptychocheilus grandis*) (MBNEP, 2017).

The principle estuarine system was designated as a part of the NEP in 1995. The estuary is a 2,300 acre semi-enclosed body of water, which empties into the larger Estero Bay, an open coastal embayment (Figure 2). The estuary is one of only two systems, the other being Elkhorn Slough, on the entire coast of Central California with strong land-to-sea linkages (Wendt et al., 2009). The habitats within the Bay include mudflats, salt marsh, sand dunes, and to a lesser degree, emergent rocky substrata. The ecosystem hosts a suite of infaunal animals only found in estuaries. The ecosystem supports over 200 species of birds, including nesting sites for endangered species such as the western snowy plover (*Charadrius nivosus nivosus*) and peregrine falcon (*Falco peregrinus*) (MBNEP, 2017). As California has lost over 90% of its wetlands to development, the Bay and its marshes are a critical stopover along the South-Central Coast for migratory waterfowl (MBNEP, 2017). The artificial reef environment created by the jetty, and nearby forests of bull kelp (*Macrocystis pyrifera*), offer habitat for a number of threatened and endangered fish species including rockfish (*Sebastes sp.*) (Wendt et al., 2009). California sea otters (*Enhydra lutris nereis*) are present year-round, a keystone species in the kelp

forests located near the Rock (Wendt et al., 2009). Pinnipeds such as Pacific harbor seals (*Phoca vitulina richardii*) and California sea lions (*Zalophus californianus*) use the estuary mouth as a haul-out (Wendt et al., 2009).

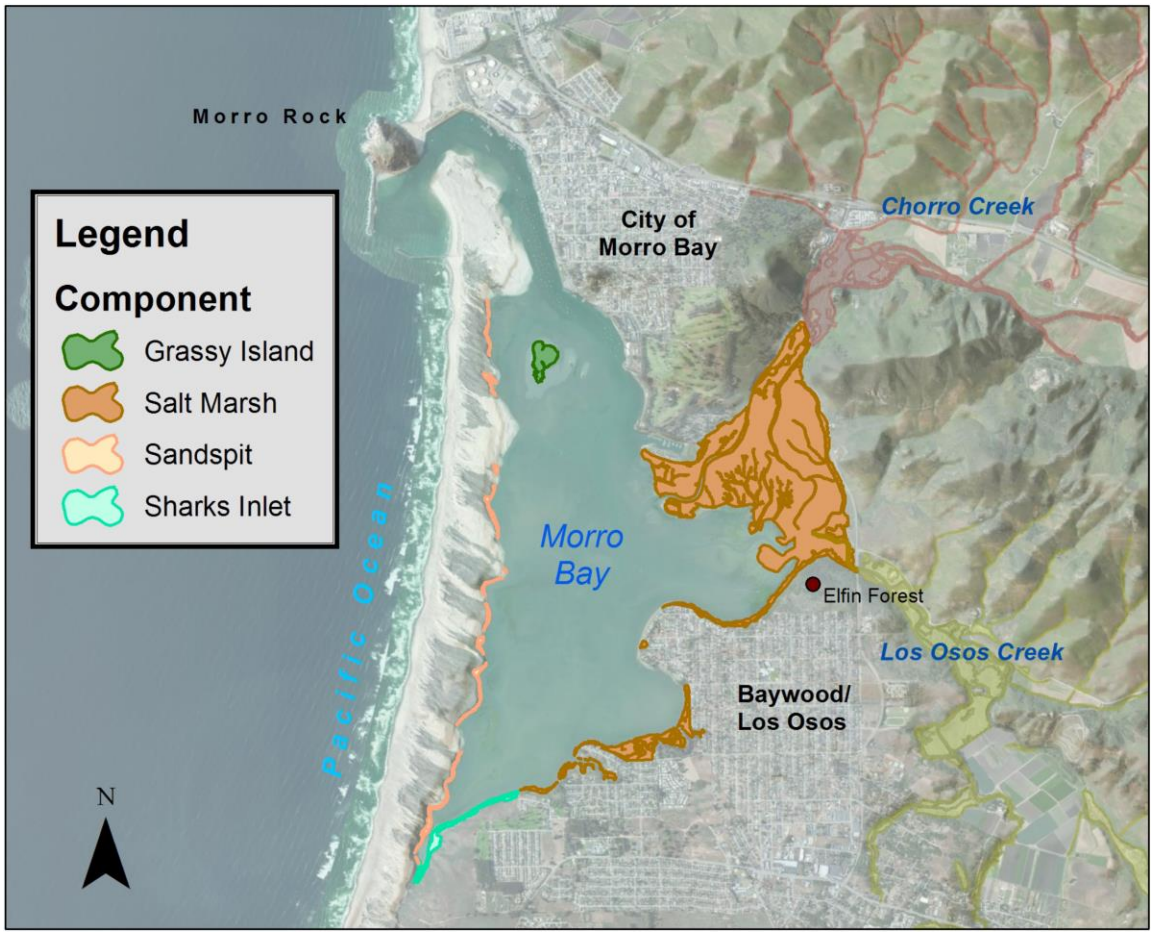


Figure 2. Principle estuarine system within the thesis scope (MBNEP, 2017).

The estuary has seen a precipitous decline in eelgrass (*Zostera marina*) beds from 344 acres in 2007 to just 10 acres by 2015; a 97 percent loss in just 8 years (Figure 3; MBNEP, 2017). Eelgrass beds serve as the primary food source for migratory waterfowl such as black brant geese (*Branta bernicla nigricans*), critical habitat for East Pacific red octopus (*Octopus rubescens*), bat ray (*Myliobatis californica*), and as nursery areas for a number of fish species such as California halibut (*Paralichthys californicus*) and leopard shark (*Triakis semifasciata*). The reason behind the decline of eelgrass is still unclear,

and is expected to be a combination of factors, primarily human disturbances leading to a bottom-up trophic cascade within the ecosystem. The unincorporated community of Los Osos began construction of a wastewater treatment facility in 2012; previously residents and businesses had relied on extensive leach fields to serve septic systems. While the extent to which the Los Osos leach fields have impacted the estuary is unknown, it is theorized that this, in addition to poor water quality from agricultural runoff in the watershed and changes in the Bay's circulation, have led to the subsequent decline in eelgrass beds (MBNEP, 2017).

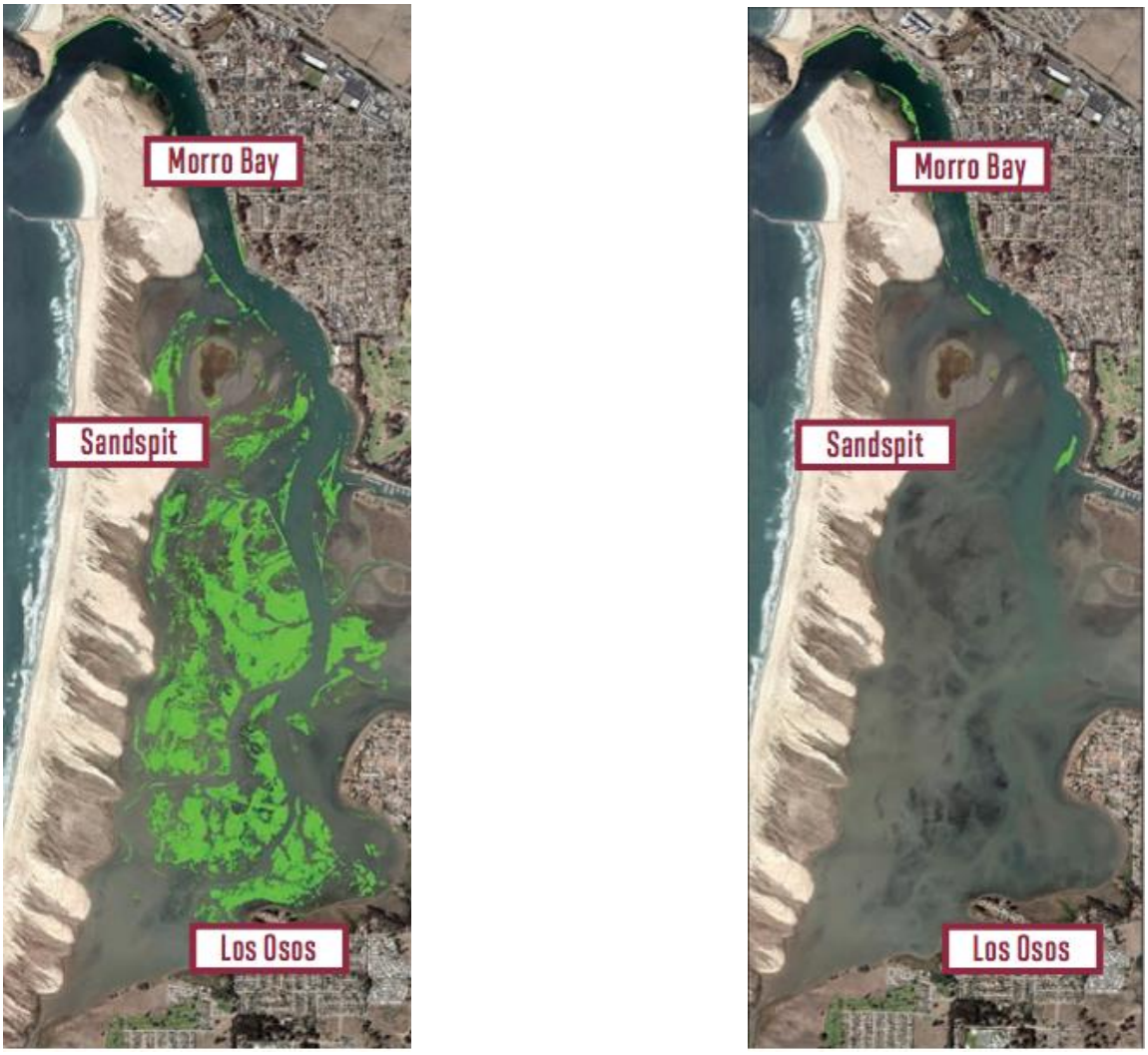


Figure 3. Decline of eelgrass (in green) Morro Bay, 2007 (left) and 2015 (right) (MBNEP, 2017).

## 1.2 Ecosystem-Based Management

Ecosystem management emerged in the 1980s as an alternative to traditional resource management approaches that focused on limited species or narrow political boundaries. Conflicts over endangered species protection (particularly the northern spotted owl), land conservation, water, grazing and timber rights in the western United States had environmentalists and scientists advocating for broader landscape-scale planning, collaboration with stakeholders, and flexible adaptive management. The term "ecosystem-based management" was later adopted to convey that management efforts are focused on human activities affecting the ecosystem; the ecosystem itself is not being managed. Many varied definitions of EBM have been developed and circulated in academia; generally, EBM is defined as recognizing the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation (McLeod et al., 2005). The NOC defines EBM in the following statement:

> "Ecosystem-Based Management (EBM) is an integrated approach to resource management that considers the entire ecosystem, including humans, and the elements that are integral to ecosystem functions. EBM is informed by science to conserve and protect our cultural and natural heritage by sustaining diverse, productive, resilient ecosystems and the services they provide, thereby promoting the long-term health, security, and well-being of our Nation" (NOC, 2016, p.1).

Important subfields of EBM include integrated landscape management and marine spatial planning. Integrated landscape management uses collaborative, regional land use planning tools to holistically address human impacts such as development

projects, natural resource extraction, and agriculture, in contrast to the sector-based solutions (i.e. fisheries management) that have failed to deliver in past decades. This is accomplished in estuaries through marine spatial planning, allotting space and coordinating actions for biodiversity conservation while allowing sustainable economic activities. Examples within Morro Bay are established spatial boundaries for aquaculture ventures such as oyster beds, creating boat traffic boundaries around California sea otter feeding areas to reduce the number of strikes, and establishing tidal energy projects with minimal impacts on preexisting natural systems. Marine spatial planning is much like land use planning in an ocean or estuary; both are critical for allocating the spatial and temporal distribution of human activities to achieve ecological, economic and social objectives that define EBM (Agardy, Davis, Sherwood & Vestergaard, 2011).

Ecosystem-based adaptation (EBA) is also an emerging subfield of EBM that offers a valuable yet under-utilized approach for climate change adaptation, especially in the face of water shortages. EBA aims to build resilience capacity of an ecosystem in the face of prolonged drought and other climate change impacts. This is especially pertinent to the MBWE that supports a thriving agricultural community dependent on limited water resources. The MBWE experienced a four-year drought, the lowest rainfall in recorded history for San Luis Obispo (SLO) County (J. Nix, personal communication, December 16, 2016). Complementing traditional actions such as technological advances in water infrastructure development, this approach uses biodiversity and ecosystem services as part of an overall adaptation strategy to help people and communities adjust to the negative effects of climate change at local and regional levels (Agardy et al., 2011).

Many federal and state natural resource entities in the US began to apply principles of EBM in the early 1990s. Locally, Cal Poly's Department of Coastal Marine

Sciences established SLOSEA with hopes to become the collaborative center for EBM in the MBWE. However, by the late 1990s, EBM fell out of favor with many resource managers in the State of California and other areas of the US. Shifts in political goals influenced a variety of EBM programs, resulting in policies that focused on meeting an immediate demand for resources favored over ecological integrity and sustainability (Mengerink et al., 2007). While EBM was declining in popularity in terrestrial systems, it gained momentum in marine systems particularly through federal policies enacted by the US Congress that called for more comprehensive management of ocean resources through USCOP. This shift can be seen in the goals of SLOSEA. Original management plans and collaboration networks were adjusted considerably to address marine resource management. In the 2000s, implementing EBM became the major focus of coastal and marine conservation efforts, after being endorsed by various prestigious scientific panels (POCR, 2003). The Scientific Consensus Statement on Coastal and Marine EBM was signed by 217 of the nation's most recognized academic scientists and policy experts and published by the Communication Partnership for Science and Sea (McLoed et al., 2005). Former President Obama's strategic action plan, calls for EBM as a foundational principle for the comprehensive management of coastal systems and oceans "…this is to be achieved through comprehensive, integrated, ecosystem-based coastal and marine spatial planning and management in the United States" (NOC, 2016, p.1). EBM had become the dominant paradigm in coastal and marine management. Despite the academic understanding of the concept of EBM, there are still relatively few case studies of successful implementation. The extent to which EBM principles, advocated by scientists, have been adopted by managers and concretely applied to local projects is unclear.

The structure of EBM is based on a goal setting framework. Defining clear and concise goals for EBM is one of the most important steps in effective EBM implementation. Goals must move beyond science-based or science-defined objectives to include social and cultural importance. The NOC calls for the creation of "suites" of goals. A single, end-all goal cannot be the solution, but instead a combination of goals and their relationships with each other should be the focus.

Table 1. Goals of EBM.

| |
|---|
| 1. To integrate ecological, social, economic, and institutional perspectives, recognizing their strong interdependences. |
| 2. To be place-based, by focusing on a specific ecosystem and the range of activities affecting it. |
| 3. To explicitly account for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species. |
| 4. To emphasize the protection of ecosystem structure, functioning and key processes. |
| 5. To acknowledge the interconnectedness among systems, such as between air, land, and sea. |

[NOC, 2016]

Once goals and objectives have been clarified, which are distinct to each project location; the project defines scope, indicators, thresholds for each indicator, risk analysis, and monitoring (Slocombe, 1998). Actions to achieve goals include creating a balance among human and ecological values, creating coordination and cooperation between entities through adaptive integrated management, the application of science to make informed decisions, defining progress towards success, and accountability (Slocombe, 1998). Typically, entities define their vision of success, whether explicitly labeled as EBM (i.e. SLOSEA) or not (i.e. MBNEP, CSLCRD) through the development of management plans. Entities use a variety of mechanisms to create accountability associated with implementation, primarily through meeting achievement reporting requirements. CSLRCD must report progress towards goals biannually to the SLO County Board of Supervisors (BOS) (J. Crabb, personal communication, August 26, 2016). MBNEP must report to Congress biannually on priority monitoring and research

needs, state and health of the estuarine zones, pollution problems and trends, and the management measures implemented (Mengerink et al., 2007). The SLOSEA leadership team meets quarterly to discuss the achievement of management goals (D. Wendt, personal communication, April 15, 2016).

General limitations of EBM include that it is challenging, time consuming, and costly for the same reasons that it is powerful and effective (Wasson et al., 2015). EBM is calling for a shift in management that can solve complex issues surrounding climate change, sustainable natural resource extraction, food and water security, and protecting biodiversity while concurrently reducing risk of disasters and conflicts (Agardy et al., 2015). A fundamental issue in the State and locally is working with outdated and long-standing regulations. California's regulations governing water rights were created in the late 1800s and early 1900s (Littleworth & Garner, 2007). Gaps in administration or research, competing objectives between management entities and governments due to overlapping jurisdictions, or obscure goals (i.e. sustainability) can often result in fragmented or weak management (Slocombe, 1998). In addition, preference of ecosystem function for human use and time constraints can often limit objectives to only those that can be addressed on a small scale and in the short-term.

The principle challenge over the last decade associated with EBM in academic research is the need for establishing meaningful and appropriate management units. The general consensus domestically (NRCS, USFS, EPA) is that watershed-based boundaries nested within larger meta-planning areas that overlap bioregional boundaries can create holistic management networks across vast landscapes. NOAA has established regional marine spatial planning units that interact with watershed-based and bioregional land use

planning units to ensure strong land-sea linkages and sound marine management (Slocombe, 1998).

In a recently published book on EBM, Judith Layzer interprets the findings of her case studies to critique the general optimism surrounding EBM. Layzer's *A (Social) Scientific Look at Ecosystem-Based Management* offers a tone of pessimism, in which differences among stakeholder groups perpetuates conflict and reduces the likelihood that EBM will conserve ecosystems.

> "In cases where policymakers deferred to stakeholders to set goals, the policies and practices that emerged appear unlikely to conserve or restore ecological health because, to gain consensus, planners skirted tradeoffs and opted instead for solutions that promised something for everyone. . . By contrast, when policymakers – elected officials, administrators, or judges – endorsed an environmentally protective goal and used regulatory leverage to prevent development interests from undermining that objective, the resulting policies and practices are more likely than their counterparts to conserve or restore ecological integrity" (Lazyer, 2008, p.284).

Layzer and other recently published critiques (i.e. Dietz, Ostrom & Stern, 2003) support findings that EBM is in many ways an elaborate approach to the tragedy of the commons, and generally is impeded by scaling-up spatial extent of a program's boundary. With larger numbers of stakeholders comes increased difficulty in organizing the governance of common-pool resources and agreeing to and enforcing rules for access, take, and investment. Large-scale ecological problems are complex, involving a significant degree of uncertainty. There are multiple interacting resources of varying

quality to be managed, and the users are diverse and may not share similar preferences or reside within a well-defined community. Layzer's critique argues that trying to coordinate numerous institutions with no single entity or jurisdiction at the helm diffuses authority in ways that can impede progress. Political officials support EBM, generally because it reduces their own political risk. While EBM is effective in certain instances, particularly in well-defined communities and at smaller spatial scales, it becomes less effective over broad regions where stakeholder input is diffuse and competing interests dissolve the integrity of the program. While Layzer states, "EBM will find a place and time…" She argues, "…against any singular panacea for social-ecological system problems" (Layzer, 2008, pp. 22-23).

### 1.3 EBM Laws

Federal, state and regional laws serve as part of the context for EBM. Legal approaches that function as regulatory framework for the implementation of EBM have not been addressed by collaborative meetings in the MBWE. Those seeking to implement EBM often envision the need for new laws and regulations (Mengerink et al., 2007). Existing environmental laws and planning processes can enable and support local EBM programs.

#### 1.3.1 Federal Laws

This subsection examines federal laws that relate to EBM including: the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), the Coastal Zone Management Act (CZMA), the essential fish habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), provisions of the Clean Water Act (CWA), and Planning Rule (2012) which guides land management in National Forests. The National Environmental Protection Act (NEPA) is also discussed.

#### 1.3.1.1 Endangered Species Act

The ESA, enforced by Federal and State Fish and Wildlife Services, constrains local, state and federal actions that might jeopardize the continued existence of endangered species and restricts private land development that might kill or harm endangered species. This remains the strongest statute for any litigation necessary to achieve EBM goals in the MBWE (Salzman & Thompson Jr, 2014). Under the ESA, Federal and State Fish and Wildlife Services develop habitat conservation plans (HCPs). In the MBWE, the Los Osos HCP is a landscape-level planning tool intended to address long-term conservation of endangered species (California Department of Fish and Wildlife [CDFW], 2017)

#### 1.3.1.2 Marine Mammal Protection Act

The MMPA was the first legislation to mandate an ecosystem-based approach to marine resource management. Under the MMPA, Congress directed that the primary objective of marine mammal management should be to maintain the health and stability of the marine ecosystem, and when consistent with that primary objective, to obtain and maintain optimum sustainable populations of marine mammals (Marine Mammal Commission, 2017).

#### 1.3.1.3 Coastal Zone Management Act

The CZMA is a federal law administered by NOAA that provides monetary incentives for states to set up coastal management programs that consider a multitude of uses. The CZMA calls upon state and federal entities to take actions to properly manage the coastal environment at an ecosystem-scale. Matching EBM components to provisions of the CZMA is a critical step to effectively utilize this Act in the MBWE.

The ecosystem-scale goals of the CZMA align with EBM spatial and temporal criteria. CZMA Section 302(b) states that "the coastal zone is . . . of immediate and potential value to the present and future well-being of the Nation" (Mengerink et al., 2007). Section 303 declares the national policy "To preserve, protect, develop, and where possible, to restore or enhance coastal resources", and includes "…protection of natural resources at an ecosystem-scale" (Mengerink et al., 2007, pp. 25-26).

1.3.1.4 Magnuson-Stevens Fishery Conservation and Management Act

The essential fish habitat provisions of the MSA are appropriate to consider as supportive to EBM in the MBWE. The loss of eelgrass beds in the bay, critical to breeding and rearing fish species, can drive regional collaborations for management on an ecosystem-scale. An example is the decline of the local commercial fishery for California halibut. "The size of the halibut population may be limited by the amount of available nursery habitat, as juvenile halibut appear to be dependent on shallow water bays as nursery areas. The overall decline in California halibut landings corresponds to a decline in shallow water habitats in Southern California associated with dredging and filling of bays and wetlands" (CDFW, 2017, pg.1). California halibut numbers were once plentiful June through July in Morro Bay, during the breeding season, only a few decades in the past; however numbers have declined following trends in the eelgrass loss (Wendt et al., 2009).

NOAA has shifted from single-species management because of its failure to achieve sustainable populations for many fisheries. NOAAs essential fish habitat provisions, under MSA now endorse fisheries-based EBM. These provisions call for integrated cooperative management of marine habitats essential for the spawning, breeding, feeding, and growth of managed species. While fisheries-based EBM, under

MSA, focuses on commercially important federal fish stocks, the management of the other marine habitats is essential for this single-sector EBM approach to be effective. Under the MSA, NOAA coordinates with other federal entities regarding conservation and enhancement of essential fish habitat. Also, the MSA sets up a consulting requirement; federal entities must "consult with the NOAA with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such entity that may adversely affect any essential fish habitat identified under this Act " (Mengerink et al., 2007, pp. 25-26). Regional councils, including local governments are to comment on and make recommendations regarding a proposed federal action, and if the proposed action will adversely affect essential fish habitat, NOAA is to recommend measures to conserve the habitat. NOAA is required to identify essential fish habitat and update the changes through an adaptive community-based planning effort supported by the best available science (Mengerink et al., 2007).

1.3.1.5 Clean Water Act

The CWA is administered by the EPA. The goal of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Mengerink et al., 2007, pp. 29-30). Under the CWA, water quality standards are created for all state waters and assessed on a recurring basis whether or not the designated water quality is attained. If water bodies or segments are impaired by pollutants, states must establish the total maximum daily load (TMDL) of pollutants necessary to achieve desirable water quality standards (Mengerink et al., 2007).

The CWA, as a statutory requirement, creates a science-based assessment and planning process. TMDL programs focus on pollutants and not other sources of environmental degradation, such as habitat damage from physical activities and

overfishing. The CWA requires managers to assess the biological, physical, and chemical integrity of the water bodies. The newer approaches to water quality management provide guidelines to integrate watershed, estuary and bay TMDLs when applicable (Mengerink et al., 2007).

Relevant sections of the CWA for this study include section 404, section 401, and section 303(d) subsection (1)(C). Section 404 is important for protecting major estuaries, river and stream mouths. CWA section 401 issues water quality licenses and permits to control and quantify point-source pollution. The inadequate enforcement of the CWA section 303(d) subsection (1)(C) and (D) to protect beneficial uses associated with aquatic habitats, including fishery resources, particularly with respect to non-point sources of pollution (including increased sedimentation from agriculture) has had measurable detrimental effects on biological, physical, and chemical integrity of the MBWE, including federally listed endangered species. A variety of factors, including inadequate staffing, training, and in some cases regulatory limitations on land uses and policy direction, have resulted in the ineffective protection of aquatic habitats. CWA section 303 offers opportunities for regulatory enforcement of agricultural runoff in the MBWE.

#### 1.3.1.6 US Forest Service Planning Rule

The Planning Rule informs land management planning for National Forests. The planning rule is a statutory requirement that outlines the procedures to revise and develop land management plans, and establishes minimum content requirements for these plans. The Los Padres National Forest Land Management Plan (Forest Plan) was updated in 2016 and includes the Cuesta Ridge Botanical Area, the headwaters of Chorro Creek and its tributaries. The Forest Plan will serve as the guiding document for the next 10 to 15

years. The Planning Rule, has a "…foundation in ecosystem-management…that supports citizen-based land management planning to benefit communities" (USFS, 2017, pp. 21162-21164).

#### 1.3.1.7 National Environmental Protection Act

NEPA provides federal statutory requirement to evaluate the relevant environmental effects of a federal project or action. NEPA coordinates actions occurring in the private sector with stakeholders and a variety of entities and institutions. A well-represented and established EBM entity, such as SLOSEA, can influence federal projects or actions that may jeopardize EBM efforts through NEPA (US Congress, 2017).

### 1.3.2 State Laws

This subsection examines the California Marine Life Protection Act (MLPA), Marine Mammal Protection Act (MMPA), the California Environmental Quality Act (CEQA) and the regulatory role of the California Coastal Commission (Commission) the Sustainable Groundwater Management Act (SGMA) as it relates to EBM. The California Environmental Quality Act (CEQA) is also discussed.

#### 1.3.2.1 California Marine Life Protection Act

Under the MLPA passed in 1999, California began a historic effort to establish a science-based, statewide network of Marine Protected Areas (MPAs). California is taking an ecosystem-based approach to the design and implementation of MPAs. Through a collaborative effort that included SLOSEA, MBNEP, CDFW and California State Parks, two MPAs, Morro Bay State Marine Reserve (SMR) and Morro Bay State Marine Recreational Management Area (SMRMA) were established in the waters adjacent to the Morro Bay State Park (California State Parks, 2017).

#### 1.3.2.2 California Coastal Act

The California Coastal Act (CCA) established the Commission permanent authority over the California coastline. The jurisdiction of the Commission generally extends inland only 1,000 yards. In SLO County the coastal zone extends further inland in several areas, including the MBWE, because of important habitat, recreational, and agricultural resources (SLO County, 2007). The Commission is tasked with of protection coastal resources, including terrestrial, estuarine and marine habitats, agricultural lands, water quality and commercial fisheries. California's coastal managers and decision makers work within existing jurisdictions and legislative authorities to manage important living coastal and marine resources while at the same time seeking to promote and maintain a healthy and productive coastal economy. Coastal managers and decision-makers in the Commission are mandated to integrate EBM into management documents (i.e. development permits, leases, regulations) to reduce the range of impacts that human uses have on coastal and marine ecosystems, and use the best available science (Commission, 2017). The Commission mediates collaboration and communication between conservation entities, planners, academia, and citizens through an ecoregional resource conservation framework (Commission, 2017).

#### 1.3.2.3 Sustainable Groundwater Management Act

On September 16, 2014, Governor Jerry Brown signed SGMA into law. The Governor's signing message states "a central feature of these bills is the recognition that groundwater management in California is best accomplished locally" (Sustainable Groundwater Management, 2017, p.1). SGMA balances scare water resources between human uses and ecosystem services through planning at the local level. The MBNEP and SLOSEA have been active in discussions regarding the Los Osos basin, including the

management of fringe areas that support groundwater recharge. SGMA may help to address overdrawn groundwater basins and the subsequent drying of Los Osos creek during summer months.

#### 1.3.2.4 California Environmental Quality Act

Like NEPA, CEQA requires state and local entities within California to follow a protocol of analysis and public disclosure of environmental impacts of proposed projects, utilizes science to inform decision-making and coordinates a variety of stakeholders. Unlike NEPA, CEQA allows feasible mitigation of impacts to the environment. SLOSEA would most commonly work through CEQA to influence projects or actions that may generate negative impacts on the broader ecosystem (i.e. decommissioning of Dyenergy's Morro Bay Power Plant; leaving the emblematic three smoke stacks as part of the City's identity) (California Natural Resources Agency, 2016).

### 1.3.3 Regional Laws

This subsection reviews local and regional policy as it relates to EBM, through establishing or amending land use and zoning ordinances in the SLO County General Plan, and integrating ordinances across Coastal Zone Land Use documents and Local Coastal Programs (LCPs).

#### 1.3.3.1 County Land Use Ordinances

Establishing new zoning regulations or amending existing land use ordinances, to protect and enhance riparian corridors offers a variety of benefits for human health and threatened or endangered species in the MBWE. It is the responsibility of the SLO County Planning Department to enact or amend land use within the County, insofar as possible, to establish a buffer along riparian corridors. The ordinance(s) must take into account that reasonable and necessary conditions ensure the protection of endangered

species habitat, and the reduction of agricultural runoff. Landowners are often incentivized for the cost of any additional infrastructure, such as cattle exclusionary fencing and off-stream water troughs that are installed through existing programs offered by the CSLRCD (CSLRCD, 2012). Amending land use ordinances in SLO County, integrated within the Coastal Zone Land Use document, supports EBM efforts for areas of the MBWE that are currently zoned for agriculture, directed at landowners resistant to participating in voluntary programs already available within the County (Mengerink et al., 2007).

#### 1.3.3.2 Local Coastal Programs

An LCP, established by the County, is generally composed of a land use plan and a policy guide. The land use plan provides spatially explicit details of permissible actions, which can occur in each part of the County, guided by policies that apply to each land use. The policy guide can be a part of an incorporated city's general plan, as is the case with the City of Morro Bay, and tend to be more geographically specific at the general plan spatial scale. Amendments can be made through the County's LCP to develop local policy that may be holding back regional efforts to implement EBM, when situationally appropriate (SLO County, 2007).

## 1.4 Local Entities

The following section briefly introduces the three most influential local entities in the MBWE that are studied as part of this thesis. Each organization has a unique history and responsibility. All three entities are non-regulatory. The principle entity with greatest influence on the land is the CSLRCD. The MBNEP collaborates to protect riparian and estuarine habitat and fulfills its purpose as the integral body for science and management of Morro Bay. SLOSEA is an EBM pilot project, developed by faculty and based at Cal

Poly. The entity's influence has not only increased collaboration in the MBWE, it leads the way for coastal science and ensuing decision making on the South-Central Coast (Wendt et al., 2009).

### 1.4.1 Coastal San Luis Resource Conservation District

In 1935, the federal government passed the Soil Conservation Act in response to the devastation of the Dust Bowl. The Act was passed to provide conservation assistance to ranchers, farmers and other private landowners. Conservationists quickly realized that the NRCS, a centrally governed federal branch of the US Department of Agriculture in Washington DC, could not be responsive to local needs, so Resource Conservation Districts were established under state law to be controlled by a county's BOS. The CSLRCD was established in 1953, and over the past 50 years has completed numerous conservation projects in the MBWE funded through grants primarily from the NRCS. The CSLRCD Director and Board, with the assistance of staff, develop five-year and annual strategic plans (CSLRCD, 2017).

### 1.4.2 Morro Bay National Estuary Program

The National Estuary Program (NEP) was created in 1987 with the addition of Section 320 to the CWA. It allows the governor of any state to nominate to the EPA administrator an estuary as one of national significance. As part of the program, NEPs develop Comprehensive Conservation and Management Plans (CCMPs) to restore and maintain the chemical, physical, and biological integrity of the estuary. The MBNEP was established in October 1995, when Morro Bay was accepted into the NEP because it was already a designated state estuary and enduring grass-roots conservation efforts by local residents demanded federal recognition. MBNEP works to protect and restore the Morro Bay estuary for people and wildlife. MBNEP is a collaborative, non-regulatory, non-

profit organization funded by annual appropriations from Congress as well as additional funding from the EPA. MBNEP brings together citizens, local governments, non-profit organizations, state and federal entities, and landowners together to support a healthy environment and vibrant local communities. The CCMP defines priority issues facing the health of the MBWE every five-years and presents annual action plans to effectively address those issues. The CCMP is the guiding management document for the MBNEP (MBNEP, 2012).

### 1.4.3 San Luis Obispo Science and Ecosystem Alliance

SLOSEA was launched in 2006 to create a "…robust and integrated program of scientific, stakeholder, and management communities that are based on the natural boundaries of the Morro Bay ecosystem, and committed to implementing EBM" (Mengerink, Schempp, & Austin, 2007, p.7). SLOSEA is funded by private foundations (David & Lucile Packard Foundation, Resources Legacy Fund Foundation, Campbell Foundation), state funding mechanisms (Cal Poly, California Coastal Conservancy, California Ocean Protection Council) and is based at Cal Poly. SLOSEA is science-focused program that examines issues of scale, institutional complexity, variability of human impact, and scientist-manager cooperation. SLOSEA engages scientific experts, resource managers, county officials and community leaders in applying innovative science to gain real-life solutions to the biggest issues facing the South-Central Coast (Wendt et al., 2009).

## 2. METHODS

The collection and processing of data necessary for assessing EBM within MBWE are described below. The logic behind each approach, repeatability and legitimacy are explained. Although the framework of EBM has been mandated by EO 13547 for management of coastal ecosystems, the intent of EBM, as outlined by the NOC, is to foster local development of integrated management human resource use while maintaining ecological integrity. Given situational differences in topography, biodiversity, size of ecosystem, extent of human use, and most importantly the high number of criteria currently used to define EBM, the NOC believes that it is neither feasible nor desirable to develop an analytical framework to assess EBM progress that covers all scenarios (Agardy et al., 2011; NOC, 2016).

### 2.1 Document Analysis

Utilizing recent literature on EBM, three overarching, analytical categories of EBM criteria were identified: ecological criteria, human dimension criteria, and management criteria. The score sheet was adapted from that developed for evaluating EBM progress in Elkhorn Slough, the other principle estuary of importance found on the Central Coast (Wasson et al., 2015). The basic EBM criteria used to describe ecological, human and management categories are held common between Morro Bay and Elkhorn Slough.

The recent study in the Elkhorn Slough derived the 17 different criteria that are commonly used to define EBM with the Miradi Adaptive Management software tool (Wasson et al., 2015). The tool highlighted key categories of ecological, human and management criteria from diverse collections of EBM literature (Wasson et al., 2015). These 17 EBM criteria are used to score (low=1 medium=2 and high=3) three local entity

management plans. A score of 51 would infer the entity's management plan is completely aligned with all aspects of EBM criteria. The final scores are reflected as the total percent to which EBM criteria are satisfied (Table 2; Table 3; Table 4).

As mentioned earlier, the three entities included in the study are considered to be the most influential in management of the MBWE: CSLRCD, MBNEP, and SLOSEA. The primary focus was on the current management plan for each entity. The CSLRCDs most recent five-year and annual SPU is from 2012; the MBNEP last updated its CCMP in 2012; SLOSEA created its most recent management document in 2009 (CSLRCD, 2012; MBNEP, 2012; Wendt et. al, 2009). Inconsistencies in the dates of management plans are taken into account; however, the differences were not determined to be detrimental to the study. The entities were still operating using these documents at the time of the document analysis.

2.2 Strategic Analysis

The strategic analysis utilizes a service needs assessment survey and interviews to overcome issues with assessing management plans. The CSLRCD, MBNEP, and SLOSEA are all non-regulatory entities. The end result of scoring management plans, even if they are found to be conceptually aligned with EBM, is that on-the-ground implementation does not always follow in due accordance. To reiterate, EBM must include land (CLSRCD), estuary (MBNEP) and coastal habitats (SLOSEA) to successfully bridge management (NOC, 2016). This is the principle idea behind inclusion of the MBNEP and SLOSEA in the document analysis; however, the goal of this thesis is to offer management insight to the CSLRCD.

The Open Standards for the Practice of Conservation recommends strategic analysis as an effective tool for assessing on-the-ground implementation, supporting

ensuing strategic planning efforts (The Conservation Measures Partnership, 2013). A strategic analysis highlights strengths, weaknesses, opportunities and threats. This method of examination seeks to improve planning and management actions within an entity. In this case, the strategic analysis addresses gaps existing between entity goals from within the CSLRCD (internal – strengths and weaknesses) and what is actually occurring outside the CSLRCD in the MBWE (external – opportunities and threats), with regards to EBM criteria. Initial data was collected through the distribution of an online service needs assessment survey, open for one month from July 13th, 2016 through August 15th, 2016. The service needs assessment survey was sent to 247 stakeholders in local governments, the agricultural community, MBNEP, SLOSEA, State Parks, Coastal Conservancy, Fish and Game, and Regional Water Quality Control Board. All of the stakeholders contacted for the survey were part of existing mailing lists for the CSLRCD. The identities of all survey respondents was kept anonymous. Survey content aims included: improve community understanding of the presence of and services potential of the CSLRCD; identify the resource conservation service needs of the population, entities, organizations and the various communities of interest within the CSLRCD; identify opportunities for grant income, partnerships and other revenue sources for resource conservation projects and services; and provide recommendations for identified service or activity enhancements and outline appropriate methods for their implementation and funding.

Additional data was collected through in-person interviews (Table 6). The interviews were semi-structured with a duration of roughly 1-hour. The interviews were centered upon collecting data that highlighted strengths, weaknesses, opportunities and threats for the CLSRCD. The content aims were specific to the individual's expertise and

knowledge of the watershed and estuary (i.e. Lexi Bell, Director of the MBNEP, was asked questions about the decline in eelgrass and the effects of agricultural runoff on estuarine and human health). The findings from the strategic analysis enable the SPU to accelerate necessary changes for project-orientated action in the watershed while integrating tenets of EBM.

# 3. RESULTS

The document and strategic analyses present results utilized for development of the CSLRCDs five-year and annual SPU. The document analysis answers the preliminary research question: Are key criteria of ecosystem-based management actively integrated into existing management plans of CSLRCD, MBNEP, and SLOSEA? Local entity management plans are scored against key criteria that define EBM. The strategic analysis clarifies any gaps that exist between the CSLRCDs current strategic plan and on-the-ground implementation with data from an online service needs assessment survey and in-person interviews.

## 3.1 Document Analysis

In the following section, the most recent management document for each entity was located and assessed for EBM criteria.

### 3.1.1 Coastal San Luis Resource Conservation District

The strategic plan from 2012, includes 5-year and annual goals for the entity. The document is initially written by CSLRCD staff; the final plan is adopted at the discretion of the CSLRCD board (CSLRCD, 2012).

Table 2. Scoring table for assessing EBM criteria in the MBWE. Criteria in first two columns are derived from a recent study gauging EBM in Elkhorn Slough, CA. The third column scores the degree to which the CSLRCDs current strategic plan satisfies the EBM criteria (low=1, medium=2 and high=3; max. score=51).

| EBM criteria | Explanation of criteria | CSLRCD (2012) |
|---|---|---|
| General criteria | | |
| Sustainability | Emphasizes maintenance of one or more aspects of the ecosystem | Medium - The strategic plan does not specifically emphasize sustainable water resource management use and groundwater use. The RCD supports traditional farming techniques, such as dairy and ranching, which are associated with high levels of greenhouse gas emissions and non-point source pollution. |

| EBM criteria | Explanation of criteria | CSLRCD (2012) |
|---|---|---|
| Ecological health | Includes non-specific goals for ecosystem health or integrity | High - Objectives are broad and non-specific. The strategic plan highlights specific concerns about sediment erosion and soil loss motivated by development and consideration of agricultural economy; and the well-being of natural systems. |
| Inclusion of humans | Recognizes that humans are elements in an ecosystem and their education and well-being are important components of management decisions | High - Engagement of diverse stakeholders and public outreach has been a key component of CSLRCD project development. This includes regional, state and federal entities, the local agricultural community and a diverse group of local stakeholders. |
| Ecological criteria | | |
| Complexity | Acknowledges that linkages between ecosystem criteria components, such as food web structure predator-prey relationships, habitat associations, other biotic and abiotic interactions should be incorporated into management decisions | Medium - The strategic plan acknowledges the value that agricultural lands, the use of scare water resources, and reduced sedimentation have to wildlife and native plant communities. However, the CSLRCD continues to push restoration goals that are single-species specific. Goals for restoration of iconic species such as the South-Central Coast steelhead and investment of grant money in research and ensuing restoration projects have been extensive. The strategic plan does not fully considered complex new predator-prey relationships that exist within the watershed. An example would be the predominance of invasive Sacramento pike minnow in Chorro and Los Osos creeks and the predation of outmigrating smolts. |
| Temporal | Incorporates temporal scale and the dynamic character of ecosystems | Medium - The strategic plan does acknowledge the historical geomorpholical dynamics of the watershed but seeks to control the system for human uses. The plan suggests artificially containing the constantly changing character of streambeds that can have deleterious effects on native flora and fauna in favor of human use. |

| EBM criteria | Explanation of criteria | CSLRCD (2012) |
|---|---|---|
| Spatial | Recognizes that ecosystem processes operate over a wide range of spatial scales | High - The CSLRCD has continued analysis of sedimentation, phosphorus and nitrogen indicators at numerous stream study sites over time to reveal high spatial variation in eutrophication of Chorro and Los Osos creeks. While the watershed as a whole is highly nutrient loaded, areas with farming and grazing near creeks are the primary cause of the eutrophic conditions in lowest stretches of the creeks. The CSLRCD continues to monitor water quality and spatial distribution of eutrophic conditions and uses this data to decide where future projects would mitigate the nutrient runoff from farms and ranches. |
| Human dimension criteria | | |
| Ecosystem goods and services | Recognizes that humans use and value natural resources, such as water quality, harvested products, tourism, and public recreation | High - The strategic plan has detailed sections to address soil preservation, water quality and quantity, the agricultural yield in the MBWE, health and safety for recreational use of the MBWE. |
| Economic | Integrates economic factors into the vision for the ecosystem | High - The strategic plan seeks to sustain and increase yields of the MBWE while protecting and restoring the ecological integrity. |
| Stakeholder | Engages interested parties in the management planning processes to find common solutions | High - The CSLRCD has a broad stakeholder base for input that extends beyond the agricultural community. The StormRewards program is targeted at urban property owners to reduce water use and increase water quality. The CSLRCD is visible at public events and emphasizes outreach. Monthly meetings are open to the public for input. |
| Management criteria | | |
| Science-based | Incorporates management decisions based on tested hypotheses | Medium - The strategic plan incorporates scientific studies conducted by CSLRCD staff, regional, state and federal entities to decide where projects will have the greatest results in mitigating negative effects of agriculture on water quality and quality, habitat protection and restoration. The managers themselves are not well versed in the hard sciences. |
| Boundaries | Recognizes that management plans must be spatially defined | High - The strategic plan defines the entity's activity in the watershed to be based upon the Chorro and Los Osos creeks in their entirety; the plan does not include the estuary. |

| EBM criteria | Explanation of criteria | CSLRCD (2012) |
|---|---|---|
| Technological | Uses scientific and industrial technology as tools needed to monitor the ecosystem and evaluate management actions | High - The strategic plan includes the use of a nitrate collecting woodchip bioreactor to reduce runoff that causes eutrophication in the estuary. A mobile irrigation lab installs state-of-the-art technology for water conservation. |
| Adaptive | Continue to improve management actions through systematic evaluation | High - A comprehensive monitoring program, with advisory input from interdisciplinary working groups, informs the staff and board on changes in ecology and watershed hydrology. |
| Co-management | Promotes shared responsibility for management between multiple levels of government and stakeholders | High - The board and staff are tasked with making planning decisions for the watershed based on information from federal and state managers with regulatory or jurisdictional authority over MBWE, as well as representatives from the regional water quality board, conservation non-profits, conservation scientists and concerned citizens. |
| Pre-cautionary approach | Manages conservatively when threats to the ecosystem are uncertain | High - The high degree of uncertainty and risk associated with large-scale engineering of a new creek channels is taken into account with regards to protecting sensitive, threatened, and endangered species such as steelhead and red-legged frogs that currently live in the watershed. |
| Interdisciplinary | Bases management on scientific understanding from several disciplines (ecology, economics, sociology) | Medium - The approved recommendations to stream channels were developed directly in response to the interdisciplinary evaluations (hydrodynamics, geomorphology, water quality, biological indicators, and socioeconomics); the plan integrates complex trade-offs prior to project development. Most of the data comes from the agriculture sciences department at Cal Poly. |
| Monitoring | Tracks changes in biotic, abiotic, and human ecosystem components for management purposes | High - Extensive monitoring datasets on habitat change, water quality, and biological communities were used to determine future conditions of the watershed, which shaped the outcome of management decisions. |
| Total percent to which EBM criteria are satisfied | | 90% |

[Wasson et al., 2015; CSLRCD, 2012]

### 3.1.2 Morro Bay National Estuary Program

The CCMP was adopted in 2012 with a five-year planning horizon. The CCMP was created by input from numerous individuals and organizations that participated in

planning processes and technical working groups. The CCMP was drafted by MBNEP staff and executive committee; the final document was approved after review for federal consistency as mandated by EO 12372 (MBNEP, 2012).

Table 3. Scoring table for assessing EBM criteria in the MBWE. Criteria in first two columns are derived from a recent study gauging EBM in Elkhorn Slough, CA. The third column scores the degree to which the MBNEPs current CCMP satisfies the EBM criteria (low=1, medium=2 and high=3; max. score=51).

| EBM criteria | Explanation of criteria | MBNEP (2012) |
|---|---|---|
| General criteria | | |
| Sustainability | Emphasizes maintenance of one or more aspects of the ecosystem | High - The vision statement of MBNEP, drafted and approved by the CCMP is "We envision a mosaic of estuarine communities of historic precedence that are sustained by natural tidal, fluvial, sedimentary and biological processes in the MBWE as a legacy for future generations." |
| Ecological health | Includes non-specific goals for ecosystem health or integrity | High - Objectives are broad and non-specific. While specific concerns about tidal erosion and marsh loss were raised with concern to development and large-scale agriculture, these were ultimately rejected by the BOS because of concerns relating to negative impacts on overall ecological health of the estuary. |
| Inclusion of humans | Recognizes that humans are elements in an ecosystem and their education and well-being are important components of management decisions | High - Engagement of diverse stakeholders and public outreach has been a key component of MBNEP. The creation and maintenance of the Morro Bay Harbor was recognized as playing a major and permanent role in the estuarine ecosystem and a representative of the Harbor District participated in the CCMP update. Increased engagement with farmers to address nutrient loading was one approved recommendation by MBNEP decision-makers. |
| Ecological criteria | | |
| Complexity | Acknowledges that linkages between ecosystem criteria components, such as food web structure predator-prey relationships, habitat associations, other biotic and abiotic interactions should be incorporated into management decisions | High – Eelgrass dieback was a main motivation for consideration of large-scale engineered alternatives because the loss of the historic harbor mouth at Sharks Inlet was initially identified as the likely driver of eelgrass loss. New science generated by this initiative revealed that causes of eelgrass loss are more complicated and involve other human-induced changes in the ecosystem; some factors such as sedimentation and eutrophication might increase if the historic mouth was engineered at Sharks Inlet. This influenced some decision-makers to reject large-scale mouth alternatives. |

| EBM criteria | Explanation of criteria | MBNEP (2012) |
|---|---|---|
| Temporal | Incorporates temporal scale and the dynamic character of ecosystems | High - A new paleoecological analysis suggested that marsh extent has been dynamic over the past thousands of years in Morro Bay and that the loss documented over the past century was preceded by a gain in marsh extent, perhaps related to European colonization; the current marsh extent falls within the natural range for the estuary. Understanding of ancient dynamics of marsh gain led to recognition that the 1850 marsh extent is not desirable or even feasible as a restoration target. Modeling of future sea-level rise impacts to marshes also led to recognition that most of the marshes in the system will not be sustainable. |
| Spatial | Recognizes that ecosystem processes operate over a wide range of spatial scales | High - Analysis of eutrophication indicators at numerous eelgrass bed study sites revealed high spatial variation in eutrophication. While the estuary as a whole is highly nutrient loaded, those areas with strong tidal exchange are only moderately eutrophic, but those with limited tidal exchange are highly eutrophic. This finding suggested that decreasing tidal exchange most likely has negative effects on water quality. Spatial scale was also explicitly considered when modeling marsh migration in the face of sea level rise, recognizing that tomorrow's marshes may be outside today's footprint. |
| Human dimension criteria | | |
| Ecosystem goods and services | Recognizes that humans use and value natural resources, such as water quality, harvested products, tourism, and public recreation | High - The socioeconomic analysis highlighted the importance of kayaking as an ecosystem service, and safe and accessible kayaking was a consideration in rejection of two of the management alternatives by the CCMP. Harbor access and channel navigability was also a major consideration when developing and evaluating alternatives to increase Bay circulation. |
| Economic | Integrates economic factors into the vision for the ecosystem | Medium - A brief and non-comprehensive economic analysis was conducted to identify the dominant market activities in the estuary, and to characterize linkages between these activities and estuarine health indicators. The economic analysis needs to more specific and include the valuation of non-market goods, cost of the restoration alternatives. The economic analysis should also be explicitly used as an important driver for CCMP decision-making. |

| EBM criteria | Explanation of criteria | MBNEP (2012) |
|---|---|---|
| Stakeholder | Engages interested parties in the management planning processes to find common solutions | High - Over one hundred stakeholders were engaged in the evaluation of restoration alternatives, with representation by resource managers, conservation organizations, regulatory entities, scientists, and community-members (residents, businesses, recreational users). Dozens of meetings were held to engage these stakeholders. |
| Management criteria | | |
| Science-based | Incorporates management decisions based on tested hypotheses | High - The final decisions and recommendations for changes in the Bay were based heavily on the interdisciplinary science evaluations. A large, active science panel of regional experts met frequently to weigh the evidence, and 12 scientific working groups contributed significantly to the project. |
| Boundaries | Recognizes that management plans must be spatially defined | High - The focus area was explicitly defined as the current and historic estuarine habitats of the estuary, although the watershed was included. MBNEP has jurisdiction to the furthest extent of the watershed used by anadromous species (steelhead) and also works to control sources of nutrients that impact the Bay. |
| Technological | Uses scientific and industrial technology as tools needed to monitor the ecosystem and evaluate management actions | High - Bathymetric change was quantified with multibeam technology and GIS change analysis, revealing high erosion rates and motivating the development of alternatives for increasing circulation in the Bay. A sophisticated network of in-situ nutrient and water quality sensors provided critical data on source and transport of nitrates in the estuary. Recent studies revealed how delicately poised water quality in the estuary is, which led to the alternative to increase tidal exchanges associated with opening the historic mouth at Sharks Inlet. |
| Adaptive | Continue to improve management actions through systematic evaluation | High - One recommendation approved by the CCMP was to use monitoring data from Cal Poly Coastal Marine Sciences Department to inform future considerations of a creating a historic the mouth at Sharks Inlet. A comprehensive monitoring program, with advisory input from interdisciplinary working groups, has begun research on this scenario for reestablishment of eelgrass beds and natural bay circulation. |

| EBM criteria | Explanation of criteria | MBNEP (2012) |
|---|---|---|
| Co-management | Promotes shared responsibility for management between multiple levels of government and stakeholders | High - CCMP staff tasked with making planning decisions for the estuary is comprised of managers with regulatory or jurisdictional authority over MBWE as well as representatives from regional conservation non-profits and estuarine scientists. |
| Pre-cautionary approach | Manages conservatively when threats to the ecosystem are uncertain | High - The high degree of uncertainty and risk associated with large-scale engineering of a new mouth at shark inlet was the major reason why the CCMP rejected the mouth alternatives. The precautionary principle was applied with regard to protecting species such as sea otters and migratory shorebirds that currently thrive in the estuary. |
| Interdisciplinary | Bases management on scientific understanding from several disciplines (ecology, economics, sociology) | High - The approved recommendations were developed directly in response to the interdisciplinary evaluations (hydrodynamics, geomorphology, water quality, biological indicators, and socioeconomics). The complex trade-offs revealed by these interdisciplinary perspectives resulted in selection of the "no action" alternative for a new estuary mouth. |
| Monitoring | Tracks changes in biotic, abiotic, and human ecosystem components for management purposes | High - Extensive monitoring datasets on habitat change, water quality, and biological communities were used to determine likely trends under a "no action" alternative and to make projections about the consequences of different alternatives. Interpretation of this data shaped management decisions. |
| Total percent to which EBM criteria are satisfied | | 98% |

[Wasson et al., 2015; MBNEP, 2012]

### 3.1.3 San Luis Obispo Science and Ecosystem Alliance

SLOSEA's formal management document was last updated in 2009. With input from student researchers at Cal Poly's Coastal Marine Sciences Department, professors and research scientists, the document was drafted by the SLOSEA support staff and approved at the discretion of the SLOSEA leadership team (Wendt et al., 2009).

Table 4. Scoring table for assessing EBM criteria in the MBWE. Criteria in first two columns are derived from a recent study gauging EBM in Elkhorn Slough, CA. The third column scores the degree to which SLOSEAs current management document satisfies EBM criteria (low=1, medium=2 and high=3; max. score=51).

| EBM criteria | Explanation of criteria | SLOSEA (2009) |
|---|---|---|
| General criteria | | |
| Sustainability | Emphasizes maintenance of one or more aspects of the ecosystem | High - The vision statement of SLOSEA, "A healthy, resilient coastal ecosystem that provides for thriving and interacting populations of plant, animal and human communities." |
| Ecological health | Includes non-specific goals for ecosystem health or integrity | High - Objectives are broad and non-specific, and the document explicitly endorses EBM. SLOSEA mentions specific concerns about invasive species and marine ecology, the fluctuation of kelp beds based on ecological interactions with consideration to large-scale commercial fishing practices. |
| Inclusion of humans | Recognizes that humans are elements in an ecosystem and their education and well-being are important components of management decisions | High - Extensive engagement of a diverse set of federal, state and regional entities, professionals in marine and estuarine science and management. SLOSEA has made efforts to reach out to the general public. |
| Ecological criteria | | |
| Complexity | Acknowledges that linkages between ecosystem criteria components, such as food web structure predator-prey relationships, habitat associations, other biotic and abiotic interactions should be incorporated into management decisions | High - SLOSEA acknowledges a suite of species, communities, and ecological systems that are chosen to represent and encompass the full array of biodiversity and abiotic factors found in the thesis scope. They are the basis for setting goals, carrying out conservation and management actions, and measuring conservation effectiveness. Conservation of the focal targets will ensure the conservation of all native biodiversity within functional landscapes. |
| Temporal | Incorporates temporal scale and the dynamic character of ecosystems | High - SLOSEA incorporates fur trapping, commercial fisheries and trawling catch data over extended periods of time to determine historic species distribution. Document includes fluctuations and interactions between keystone species such as sea otter, sea urchins and bull kelp, these in turn, shape critical habitat availability for native rockfish and ground fish. |
| Spatial | Recognizes that ecosystem processes operate over a wide range of spatial scales | High - SLOSEAs scope is broad and defined the current geographic scope as: Morro Bay estuary and the nearshore coast (to 100 fathoms) and associated watersheds from Point Lopez to Point Conception. SLOSEA includes seafloor mapping and extensive marine spatial planning in its management document. |

| EBM criteria | Explanation of criteria | SLOSEA (2009) |
|---|---|---|
| Human dimension criteria | | |
| Ecosystem goods and services | Recognizes that humans use and value natural resources, such as water quality, harvested products, tourism, and public recreation | High - SLOSEA includes 20 "human factors" that discusses sustainable use of resources that maintains ecological integrity i.e. sustainable recreational and commercial fisheries for the South-Central Coast. |
| Economic | Integrates economic factors into the vision for the ecosystem | High - Coastal marine economies within the management document of SLOSEA have historically depended on industrial (i.e. power generation facilities) and commercial fishing and processing for large amounts of revenue. SLOSEA factors in working waterfronts i.e. chandleries, bait and tackle shops, fish processing facilities, and fuel docks. SLOSEA supports Bay/Port systems that are "threatened" because of lack of understanding of the relative importance of the different economic activities, as well as thriving coastal marine economies that have seen an increase in tourism and recreation as larger contributors to the local economies. Further studies along the South-Central Coast will help distinguish between the impacts of local ecosystem dynamics and larger-scale economic trends. |
| Stakeholder | Engages interested parties in the management planning processes to find common solutions | High - The SLOSEA project team is composed of resource managers, public officials, stakeholders such as commercial fishermen councils, and scientists. |
| Management criteria | | |
| Science-based | Incorporates management decisions based on tested hypotheses | High - SLOSEA has developed and implemented collaborative fisheries research with scientifically rigorous protocols and is building the data sets to address these issues. |
| Boundaries | Recognizes that management plans must be spatially defined | High - SLOSEA recognizes that as fishing communities on the South-Central Coast and elsewhere struggle to define their future, a replicable model for spatially-specific management will be key for healthy fisheries and thriving fishing communities. |
| Technological | Uses scientific and industrial technology as tools needed to monitor the ecosystem and evaluate management actions | High - SLOSEA uses state-of-the-art technology in oceanography and marine science (i.e. remote sensing) to collect and monitor data related to various biotic and abiotic factors based on bathymetry, and hydrodynamic models developed to anticipate the impacts of likely changes in ecological integrity. Shifts in factors such as water temperature, pH, and salinity will affect habitats and the people and species that dependent upon them. |

| EBM criteria | Explanation of criteria | SLOSEA (2009) |
|---|---|---|
| Adaptive | Continue to improve management actions through systematic evaluation | High - SLOSEA has created detailed action plans that include goals, strategies, assumptions, and objectives for each target; the action plans include conceptual models. Objectives have a specific date to be completed by and a person responsible to present the findings by the specified date. |
| Co-management | Promotes shared responsibility for management between multiple levels of government and stakeholders | High - Creation of an integrated, ecosystem-based management group across jurisdictional boundaries (SLOSEA Advisory Committee) that meets regularly to share knowledge, identify key needs, and plan actions. The Advisory Committee consists of resource managers from state and federal entities, public officials from local municipalities, stakeholders that live and work in the ecosystem, and scientists that study the ecosystem. |
| Pre-cautionary approach | Manages conservatively when threats to the ecosystem are uncertain | High - SLOSEAs decision-making process is predominantly guided by marine scientists. In the recent past, scientists were often perceived as the "elephant" in the room when pushing heavy science on politicians. State and federal decision makers many times can be the largest threat to ecosystems. Federal policy calling for EBM has made politicians accepting of the recommendations made by scientists, including SLOSEA. |
| Interdisciplinary | Bases management on scientific understanding from several disciplines (ecology, economics, sociology) | High - The Advisory Committee consists of members from a variety of educational backgrounds that bring to the table a great diversity of expertise. |
| Monitoring | Tracks changes in biotic, abiotic, and human ecosystem components for management purposes | High - Evolution of SLOSEAs management goals is ongoing based on science, economics and policy, and there are clear objectives and dates to goal achievement |
| Total percent to which EBM criteria are satisfied | | 100% |

[Wasson et al., 2015; Wendt et al., 2009]

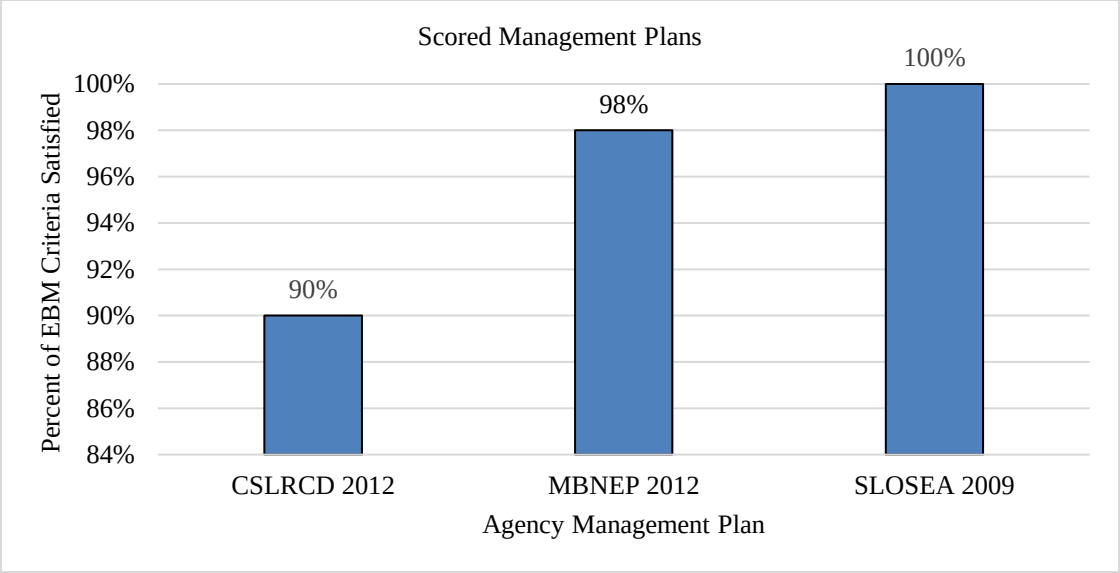

Figure 4. Scored management plans, percent of EBM criteria satisfied (CSLRCD, 2012; MBNEP, 2012; Wendt et al., 2009).

## 3.2 Strategic Analysis

The strategic analysis organizes what was learned from the service needs assessment survey and interviews into a useful form for integration into the CSLRCDs SPU.

### 3.2.1 Service Needs Assessment Survey

According to guidelines mandated by the NRCS, the primary funding source for the CSLRCD, a critical component of any SPU is to reach out to the local community for before investing the public's time and money on projects in the district's jurisdiction. The service needs assessment survey was used to determine community service priorities. Currently, the primary mission of the CSLRCD is improving and protecting soil and water resources of eight watersheds within SLO County, including the MBWE. The CSLRCD acts as a central hub for conservation, connecting communities and individuals with technical, financial and educational resources. The lands within the MBWE are facing growth and change, and the ways in which CSLRCD serves residents must

respond to shifting needs. The service needs assessment survey helped to envision how the CSLRCD can best serve SLO County.

The survey received 46 responses from the 247 stakeholders contacted. The survey results were substantial in both the number and quality of responses and are considered valid for the purpose of the needs assessment (Figure 5). The survey collected data relevant to the SPU and outperformed any other RCD service needs assessment in the State for 2016. The responses highlight the public's perception of the CSLRCDs role of protecting local water quality and water supply associated with agriculture, also of properly managing rural lands for native species. The survey respondents appear to have been informed on local issues based on their consistent and educated responses. The majority of the survey respondents appear to have been landowners and homeowners, with significant responses from the environmental and agricultural communities.

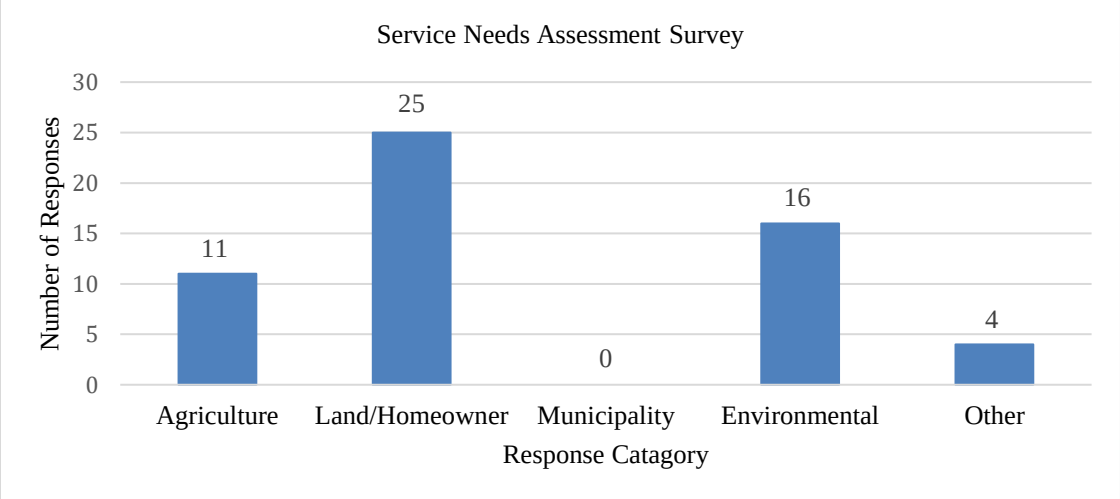


Figure 5. Service needs assessment survey results, per respondent category.

Table 5. Summary of questions and response rate for service needs assessment survey.

| Service needs assessment questions | Type | Answered | Skipped |
|---|---|---|---|
| 1. From what perspective will you be answering the survey questions? | multiple choice | 45 | 0 |
| 2. In your opinion, how would you rate the value of the services the CSLRCD provides in your area: | multiple choice | 43 | 2 |
| 3. Do you have ideas about specific conservation-related services that, as far as you know, are not currently available in your community, but would be beneficial to protecting natural resources and the area's environment? | short answer | 23 | 22 |
| 4. Select each agricultural support service with which you would like to see the CSLRCD involved: | multiple choice | 32 | 13 |
| 5. How do you feel about the water conservation services you are receiving locally? | multiple choice | 28 | 17 |
| 6. Do you support services and community volunteer opportunities such as local creek and stream cleanup and restoration projects? | multiple choice | 31 | 14 |
| 7. Do you feel the CSLRCD should be involved in: | multiple choice | 30 | 15 |
| 8. Do you support the CSLRCD involvement in: | multiple choice | 30 | 15 |
| 9. What, if any, finance mechanism(s) might you support in order to fund resource conservation services and track their effectiveness for the preservation of natural resources? | multiple choice | 30 | 15 |

The service needs assessment survey results provided a critical evaluation of the community's understanding of relevant issues within the MBWE. The responses represent a broad spectrum of the community, with varying backgrounds and expertise. The result is a comprehensive assessment of public knowledge and support through stakeholder input from the agricultural community, land and homeowners, educators, natural resource managers and government entities. The service needs assessment survey highlights key issues within the district, particularly water conservation services. A majority of survey respondents selected "Inadequate" or "Marginal" when asked about irrigation assessments, overall water conservation planning, financial incentives for water conservation, education and outreach (Question 5). Likewise, the majority of survey respondents responded "Absolutely" when asked if the CSLRCD should be involved in regional groundwater protection, storm water management, local watershed assessments, planning and partnering in regional water supply solutions/projects (Question 7). There

was strong support of the CSLRCD involvement in a range of conservation related activities (i.e. ecosystem restoration, healthy soils initiative, carbon farming) (Question 8). Survey respondents shared collective support for the community volunteer opportunities such as local stream cleanup and restoration (Question 6).

### 3.2.2 Interviews

In-person interviews with individuals involved in studying and managing the MBWE were used to address any subsequent questions that survey was unable to provide (Table 6). The content aim was to collect data relevant to perceived strengths, weaknesses, opportunities and threats of the CLSRCD.

Table 6. In-person interviews.

| Contact | Entity and/or institution |
|---|---|
| Dean Wendt (4/15/2016) | Director SLOSEA, Professor of Coastal Marine Sciences at Cal Poly |
| Crow White (9/20/2016) | EBM & Marine Spatial Planning Specialist, Professor of Coastal Marine Sciences at Cal Poly |
| Lexi Bell (12/2/2017) | Director MBNEP |
| Jackie Crabb (4/30/2016-12/16/2016) | District Manager CSLRCD |
| Jen Nix (6/15/2016-12/16/2016) | Conservation Programs Manager CSLRCD |

### 3.2.3 Strengths, Weaknesses, Opportunities and Threats

The results of the service needs assessment survey and interviews allowed for identification of the CSLRCDs internal strengths and weaknesses, and external opportunities and threats. The quotes from the service needs assessment survey and interviews are emblematic of research findings.

#### 3.2.3.1 Strengths

The service needs assessment survey found the primary strength of the CSLRCD to be the result of longstanding stakeholder trust. This is supported by an interview with District Manager Jackie Crabb.

*Jackie Crabb:*

"As a non-regulatory entity with a long history in the County, agriculturalists perceive the CSLRCD as a positive; supportive…landowners are willing to work with the CSRLCD during project coordination… and perceive the CSLRCD as a steward of the land" (J. Crabb, personal communication, October 28, 2016).

The CSLRCD has a long history of cooperation, outreach, and education in the MBWE. This trust allows the CSLRCD to access project sites for implementation of Best Management Practices (BMPs) with measurable success over the last several decades. A great example of stewardship in the MBWE that was a direct result of trust is the conservation easement established at Chorro Flats.

*Jackie Crabb:*

"The Flats capture thousands of tons of sediment each winter, before it enters the Bay" (J. Crabb, personal communication, October 28, 2016).

The CSLRCD has been developing ways to engage the County's youth in citizen monitoring programs. The CSLRCD has repositioned its stance as an agriculturally-based entity to address urban issues such as reducing water consumption, quality improvement and storm water management within incorporated communities. These ideas are summarized with quotes from interviews.

*Jen Nix:*

"Our citizen monitoring program has been in the works for quite sometime…we are looking to engage local residents as volunteers and students from local schools to collect data on water quality" (J. Nix, personal communication, October 28, 2016).

*Jackie Crabb:*

"We have had great success with our StormRewards program that aims to reduce water consumption and increase water quality. Residents of San Luis Obispo, Arroyo Grande and Nipomo received StormRewards rebates for installing BMPs on their property…the CSLRCD continues to look for ways to engage all residents of the County, not just farmers and ranchers" (J. Crabb, personal communication, September 23, 2016).

A strength of the CSLRCD is found in its ability serving a diverse set of stakeholders and offer a variety of services to local communities (Figure 6).

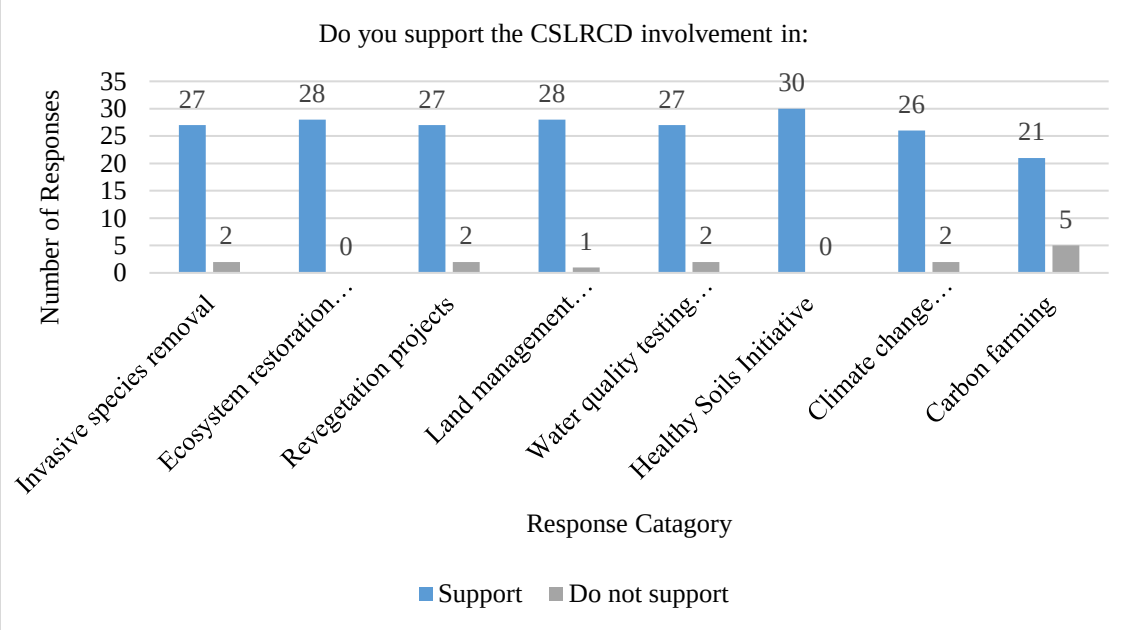


Figure 6. Question 8, service needs assessment survey.

3.2.3.2 Weaknesses

The primary weakness of the CSLRCD is funding for on-the-ground projects on agricultural lands within the watershed (J. Nix, personal communication, December 16, 2016). Funding for CSLRCD projects and ongoing operations is derived entirely from grants and contracts. The CSLRCD does not have a tax base (CSLRCD, 2017). The

CSLRCD is aware of concerns highlighted by the service needs assessment survey including public outreach, novel water conservation technology and BMPs, restoration of habitat for native species – these are difficult to address without new sources of grant funding (Figure 6).

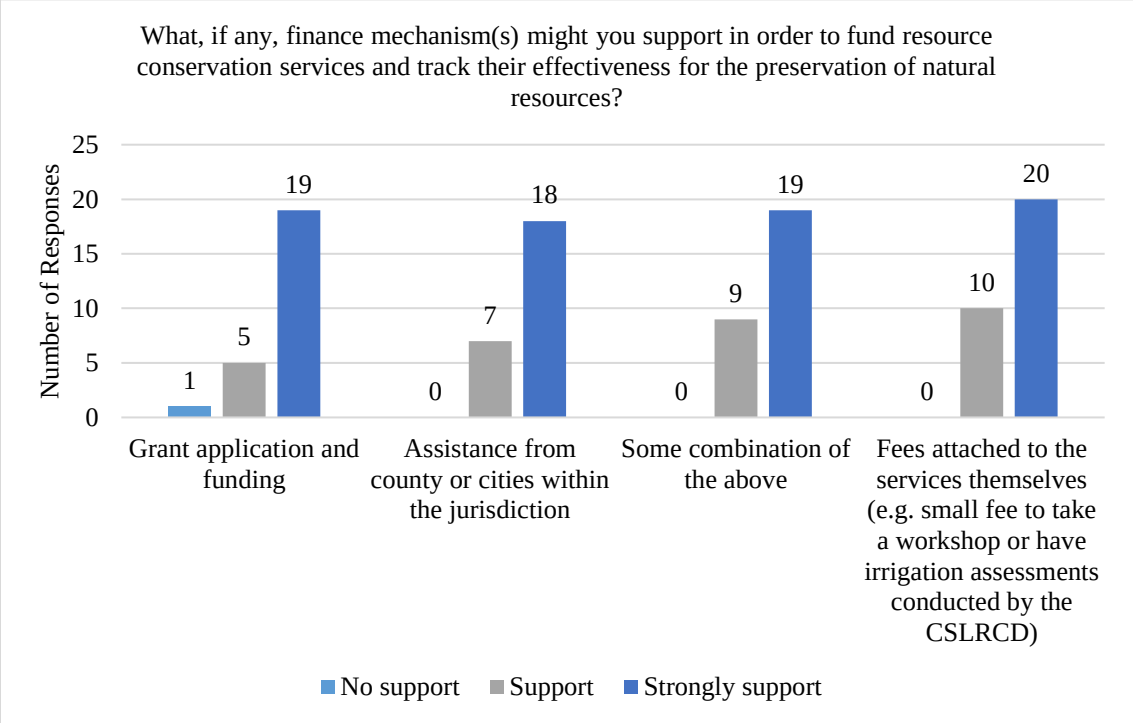


Figure 7. Question 9, service needs assessment survey.

Responses from the service needs assessment, particularly short answers to question 3, provide a voice representative of local community members and stakeholders.

*Survey response:*

"Cost benefit analysis for individual BMPs… including quantifying the costs of eroded soil and other environmental impacts" (Response 5, Question 3).

*Survey response:*

"Conservation banks or in-lieu fee programs (Response 11, Question 3)"

*Survey response:*

"Grant proposal development and designs associated with it" (Response 16, Question 3).

*Jen Nix:*

"The CSLRCD maintains strong partnerships with local, state and federal organizations and entities that provide funding and/or resources to conservation projects. Depending on available grant sources, the CSLRCD may be able to provide free planning and other technical assistance for eligible agricultural conservation projects on agricultural lands, including engineering design and permitting assistance. The CSLRCD derives its financial assistance through the NRCS and other partner programs. The number of projects on-the-ground in the watershed [MBWE] is limited by funding" (J. Nix, personal communication, December 16, 2016).

3.2.3.3 Opportunities

The service needs assessment survey contains valuable information about opportunities that exist for the CSLRCD. Many respondents mentioned the conservation of water, shown by the quotes below.

*Survey response:*

"I think that every person that wishes to change the land from original agriculture to a new venue of ag should have an Environmental Impact Study done before being allowed to plant or dig ponds that obstruct the natural flow of water on their property" (Respondent 3, Question 3).

*Survey response:*

"Further efforts to recycle and reuse wastewater" (Respondent 7, Question 3).

*Survey response:*

"There are specific programs - watershed education, water saving device distribution, etc. that lack countywide coordination or countywide coverage. Would love to see the RCD use partnerships to help cover the gaps" (Respondent 9, Question 3).

*Survey response:*

"Keep the StormRewards program funded" (Respondent 10, Question 3).

*Survey response:*

"Classes teaching methods to support groundwater recharge…" (Respondent 15, Question 3).

*Survey response:*

"Public rainwater collection, in addition to the homeowner projects. It is a shame to see good rainwater running into the gutters. (I have one of your projects at my home, and not one drop left my property last winter)" (Respondent 21, Question 3).

*Survey response:*

"Water conservation rebates for Los Osos and other parts of the county" (Respondent 22, Question 3).

Interviews with the Director of SLOSEA highlighted collaboration as the primary opportunity. The CSLRCD District Manager emphasized past successes in the MBWE and opportunities that exist for future project development.

*Dean Wendt:*

"Opportunities continue to arise for the CSLRCD to implement conservation projects on private lands and to collaborate with institutions, state and federal entities that are working towards mandated EBM guidelines" (D. Wendt, personal communication, July 15, 2016).

*Jackie Crabb:*

"The CSLRCDs projects, over the last 25 years, have captured more than 200,000 tons of soil, 400 tons of manure (455 pounds of phosphorus and 5,580 pounds of nitrogen) from entering Morro Bay. The entity has also installed 51,500 feet of riparian fencing, over 100 off-creek water troughs for cattle, improved 21,000 feet of native riparian habitat, and removed all identified barriers to steelhead migration. The projects have also significantly reduced fecal coliform (E.coli) levels in Chorro and Los Osos creeks. Both creeks are now in agreement with levels mandated by the California Department of Health and the EPA…We see a lot of opportunities for project development that will conserve our scare water resources and water quality into the future" (J. Crabb, personal communication, October 23, 2016).

3.2.3.4 Threats

The primary external threat to the CSLRCD at the time this study was conducted, was limited water resources. The County was experiencing a prolonged 4-year drought. Severely diminishing water resources had a noticeable effect on the local agricultural market. The CSLRCD staff discusses the drought in the following quotes.

*Jackie Crabb:*

"We are out of water here on the Central Coast. It has been a really tough time for ranchers and farmers. The Farm Bureau has reported a marked decrease in output of the County's main crops…strawberries and wine grapes" (J. Crabb, personal communication, October 23, 2016).

*Survey response:*

"Limit number of vineyards and agriculture" (Respondent 8, Question 3).

*Jen Nix:*

"Valuable agricultural land with limited water supplies is a major issue for stakeholders in the watershed" (J. Nix, personal communication, October 23, 2016).

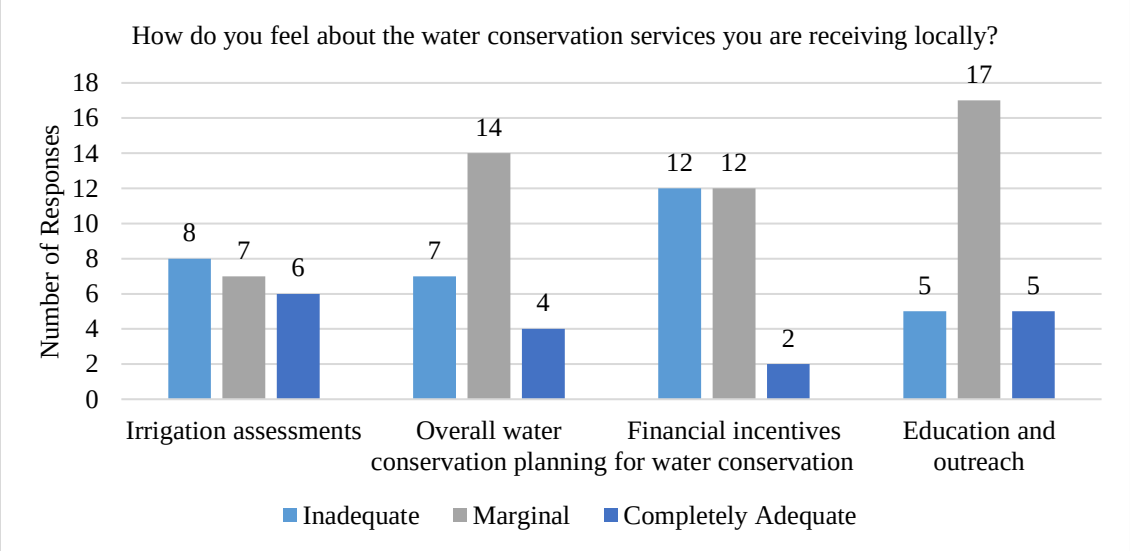


Figure 8. Question 5, service needs assessment survey.

Interviews revealed other threats to the CSLRCD to include contrasting ideologies or incongruent visions for management of the MBWE, which makes collaboration difficult between diverse groups of stakeholders. This often can be solved through educating the public. The following quotes are emblematic of this assumption.

*Crow White:*

"With a background in marine EBM, one of the toughest issues I've encountered is engaging all stakeholder groups and arriving at a consensus. Many of the local community members have only a basic understanding of environmental issues occurring within the Bay… Educating the local public is certainly a top priority" (C. White, personal communication, September 20, 2016).

*Lexi Bell:*

"Educating the local community is key to collaboration and creating future stewards of the estuary" (L. Bell, personal communication, December 2, 2016).

## 4. STRATEGIC PLAN UPDATE

A primary research goal was to inform decision-making towards the adoption of EBM tenets in the CSLRCDs SPU called for by Dr. Dean Wendt, Director of SLOSEA (D. Wendt, personal communication, July 15, 2016). The findings of the document and strategic analyses were presented to the CSLRCD staff and board members. The agenda for CSLRCD board meetings in October and December focused on finalizing the SPU. A quorum with the director present was necessary for ratifying any changes to the SPU. The five-year and annual SPU for 2017-2022 was approved by the board on December 16, 2016 (CSLRCD, 2016). Addressing limitations of sector based-management of agriculture, the entity responds to the requests of SLOSEA.

# 5. DISCUSSION

The degree to which the CSLRCD was able incorporate EBM tenets was dependent upon upholding or improving status quo of a valuable agricultural market in the watershed, especially in lieu of prolonged 4-year drought. Throughout the strategic planning process, the study remained in contact with individuals who possessed the greatest influence in developing the SPU and the future of the organization: CSLRCD District Manager Jackie Crabb and CSLRCD Conservation Programs Manager Jen Nix. The following section describes the findings of the thesis used to update the SPU, specifically attributed to the document and strategic analysis, and areas for future improvement within the CSLRCD.

Research highlighted key criteria of EBM not fully evident in the 2012 strategic plan. Four out of five areas of EBM criteria that were scored Medium (2 out of 3) for the CSLRCDs management document were addressed in the SPU: Sustainability, Temporal, Complexity and Interdisciplinary (Table 2; CSLRCD, 2016). The Science-based EBM criterion was not explicitly addressed.

Under Sustainability, "The strategic plan does not specifically emphasize sustainable water resource management use and groundwater use" (Table 2). Under the EBM criteria labeled as Temporal, the 2012 strategic plan suggests the CSLRCD has not worked with agriculturalists who are "…artificially containing the constantly changing character of streambeds that can have deleterious effects on native flora and fauna in favor of human uses" (Table 2). These two EBM criteria are addressed under "Strengthen/Expand Existing Programs and Launch New Initiatives" Goal 1 of the five-year SPU "Improve and protect groundwater basins, water storage and watersheds for

sustainability" implemented by Strategy 2 "Improve understanding about the condition of watersheds in the District and effectively utilize that information to influence policy and land management decisions" and is echoed in the annual plan "Improve and protect sustainable groundwater basins, water storage and watersheds" (CSLRCD, 2016). "We continue to work with agriculturalists to restore and maintain the dynamic [temporal] nature of the Bay's watershed" (J. Crabb, personal communication, December 16, 2016).

Under Complexity, an issue highlighted by the document analysis was that "The strategic plan does not fully considered new predator-prey relationships that exist within the watershed" concerning invasive species (Table 2). This issue was resolved through "Strengthen/Expand Existing Programs and Launch New Initiatives" with Goal 3 of the five-year SPU "Enhance the wildlife habitats for plants and animals" and the three strategies that follow (CSLRCD, 2016). This was furthered by the annual SPU under "Strengthen/Expand Existing Programs and Launch New Initiatives" as Strategy 3 "Enhance the wildlife habitats for plants and animals" addressed by ensuing priority actions (CSLRCD, 2016). "Over the next five years, we will continue to seek ways to remedy complex ecological issues such as the decline in eelgrass…when feasible using novel techniques to eradicate invasives…such as the releasing of Cape ivy stem boring/leaf-mining moths to control invasive Cape ivy in the watershed" (J. Nix, personal communication, December 16, 2016).

The five-year and annual SPU both strive to "Reduce the impacts caused by climate change and take steps to manage/adapt to the potential changes of the environment" under "Strengthen/Expand Existing Programs and Launch New Initiatives" (CSRLCD, 2016). Prior to this SPU, the CSLRCD had yet to fully acknowledge climate

change to the public nor adopted any climate adaption strategies (J. Crabb, personal communication, December 16, 2016). Most importantly, the CSLRCD highlights the underlying principle behind EBM, “Embrace Partners and the Community” in the five-year and annual SPU which speaks to the EBM criterion of Interdisciplinary (CSLRCD, 2016). The CSLRCDs new vision statement, is a direct result of this thesis, “A district with sustainable resources and enhanced ecological function” (CSLRCD, 2016).

The CSLRCD should continue to seek pathways to improve its engagement with natural sciences, through reaching out to local institutions such as Cal Poly, as the EBM criterion Science-based was found to be weak in the SPU (CSLRCD, 2016). An EBM document analysis scoresheet such as the one included within this thesis, could be applied by entities such as CSLRCD, MBNEP and SLOSEA as a capacity-building tool to highlight future areas for growth and change.

## 5.1 Concluding Remarks

EBM on the South-Central Coast has a promising future. Integrated and adaptive regional planning has brought lasting conceptual change to the way stakeholders, entities, local, state, and federal elected officials, academic scientists, and the public interact, cooperate, share information and manage the resources within MBWE.

The CSLRCD meets the requests of Dr. Dean Wendt, Director of SLOSEA, to address the limitations of sector-based management in the SPU. The MBNEP remains the voice of the estuary. SLOSEA, located at Cal Poly, is the hub for academic research of local coastal and marine-based EBM efforts along the California’s South-Central Coast. Collectively, these entities offer a case study where coastal managers collaborate and respond to EO 13547.

SLOSEA continues work with the US Congress to create sustainable coastal communities through the CZMA and other legislative and regulatory actions. SLOSEA is of keen interest to the Ocean Protection Council in California, the Joint Oceans Commission Initiative, and NOC. Research across numerous disciplines of academia, participation at conferences and workshops, interactions with local, state, and federal government officials, presentations in coastal communities in California, along the Pacific Coast, and elsewhere contribute to and enhance the institutional support of EBM for the well-being of our Nation.

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# APPENDICES

Appendix A. Service Needs Assessment Survey

## SERVICE NEEDS ASSESSMENT SURVEY RESULTS

Coastal San Luis Resource Conservation District

2016

Prepared by:

Lucas Crandall
Coastal San Luis Resource Conservation District
1203 Main Street Suite B, Morro Bay 93442
Phone 805-772-4391
cslrcd@coastalrcd.org

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RESOURCE
CONSERVATION DISTRICTS

INTRODUCTION

In order for the Coastal San Luis Resource Conservation District (CSLRCD) to properly serve the communities of the region, we want to make sure that we have community support and understanding before investing the public's time and money. We conducted this Service Needs Assessment to determine the community service priorities, identify how they will be funded and the process to put them in place. The Assessment is also part of the District's 2017 Strategic Plan.

Currently the primary goal of the CSLRCD is improving and protecting soil and water resources of the District's eight watersheds (Figure 1). The CSLRCD acts as a central hub for conservation, connecting communities and individuals with the technical, financial and educational resources they need. The communities we serve are facing growth and change, and the ways in which we serve residents must respond to changing needs. The Service Needs Assessment will help to envision how we can best serve the District in the future.

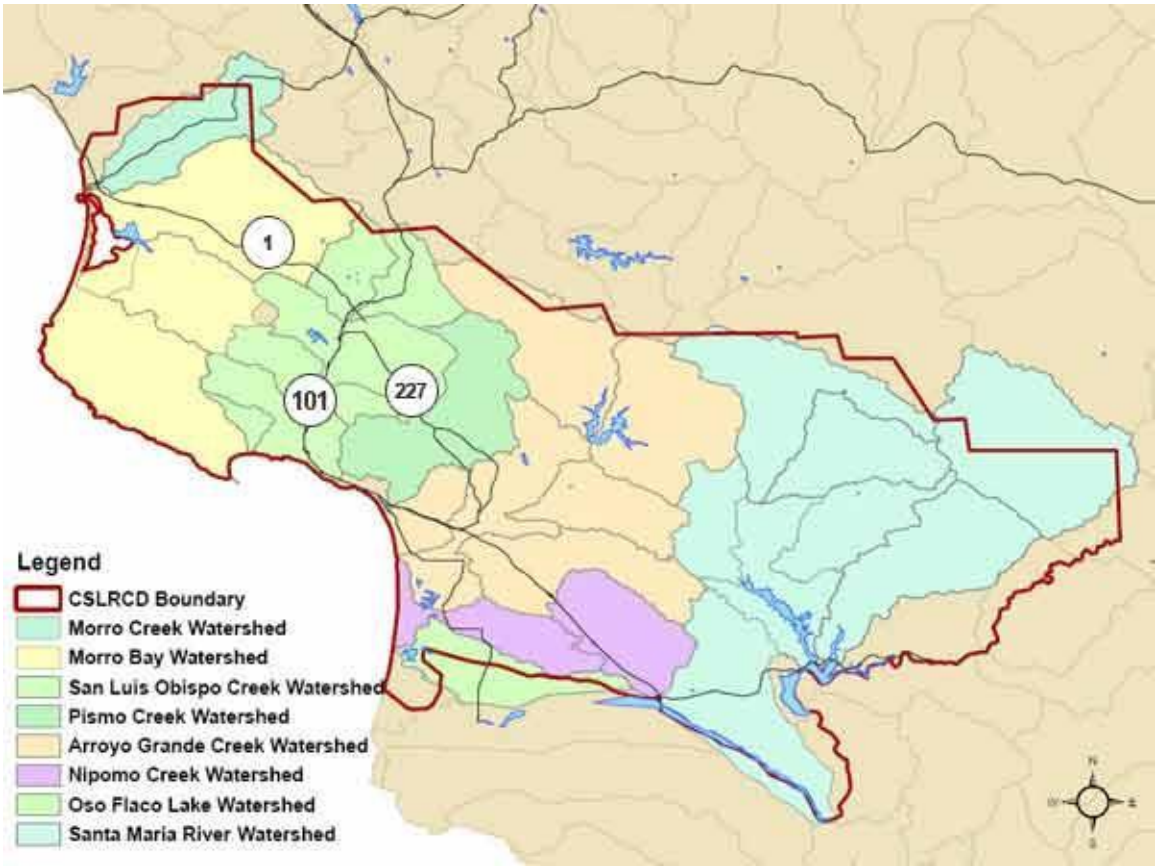


Figure 1. Coastal San Luis Resource Conservation District boundaries **(**CSLRCD, 2012).

OBJECTIVES

- Improve community understanding of the presence of and services potential of the CSLRCD
- Identify the resource conservation service needs of the population, entities, organizations and the various communities of interest within the CSLRCD
- Identify opportunities for grant income, partnerships and other revenue sources for resource conservation projects and services
- Provide recommendations for identified service or activity enhancements and outline appropriate methods for their implementation and funding

METHODS

The survey was distributed by email to 247 stakeholders in July 2016. Stakeholders included landowners and homeowners, the agricultural community, conservation and environmental groups, local government representatives, and municipalities; all living or working within the CSLRCD boundaries. These stakeholders each have direct experience with the types of services typically provided by Resource Conservation Districts, and also have an understanding of the resource conservation needs and issues of the region. The Florin Resource Conservation District (FRCD), located in Elk Grove, CA developed a similar survey format for use in acquiring data. The FRCD survey provided the basic framework for properly engaging the public on critical natural resource issues. Ten questions were used to identify natural resource issues and services provided by the CSLRCD to communities within the region.

RESULTS

The SurveyMonkey website (https://www.surveymonkey.com/r/CSLRCD1) was opened on July 13, 2016 and collected responses until August 15, 2016. The website received 46 responses. The majority of the website activity took place between July, 13th 2016 and July 20th, 2016. The survey and results are included as Appendix A.

The survey results, were substantial in both the number and quality of responses and are considered valid for the purpose of this Assessment. The responses highlight the public's perception of the CSLRCD role of protecting local water quality and water supply associated with agriculture; also of properly managing rural land for restoration of native species. The survey respondents appear to have been informed on local issues based on their consistent and educated responses. The majority of the survey respondents appear to have been Landowners and Homeowners, with significant responses from the Environmental and Agricultural communities.

## CONCLUSION

The Service Needs Assessment survey results will allow CSLRCD staff guided by a Board of Directors to evaluate community understanding of relevant issues within the District and gain public support in protecting and enhancing natural resources through education, restoration and collaboration with local stakeholders. The responses represent a broad spectrum of the community, with varying backgrounds and expertise. The result is a comprehensive assessment of public knowledge and support through stakeholder input from the agricultural community, land and homeowners, educators, natural resource managers and government agencies. Depending upon available grant funds, the staff can address issues that are valuable to both local community members and align with the RCD mission in the 2017 Strategic Plan.

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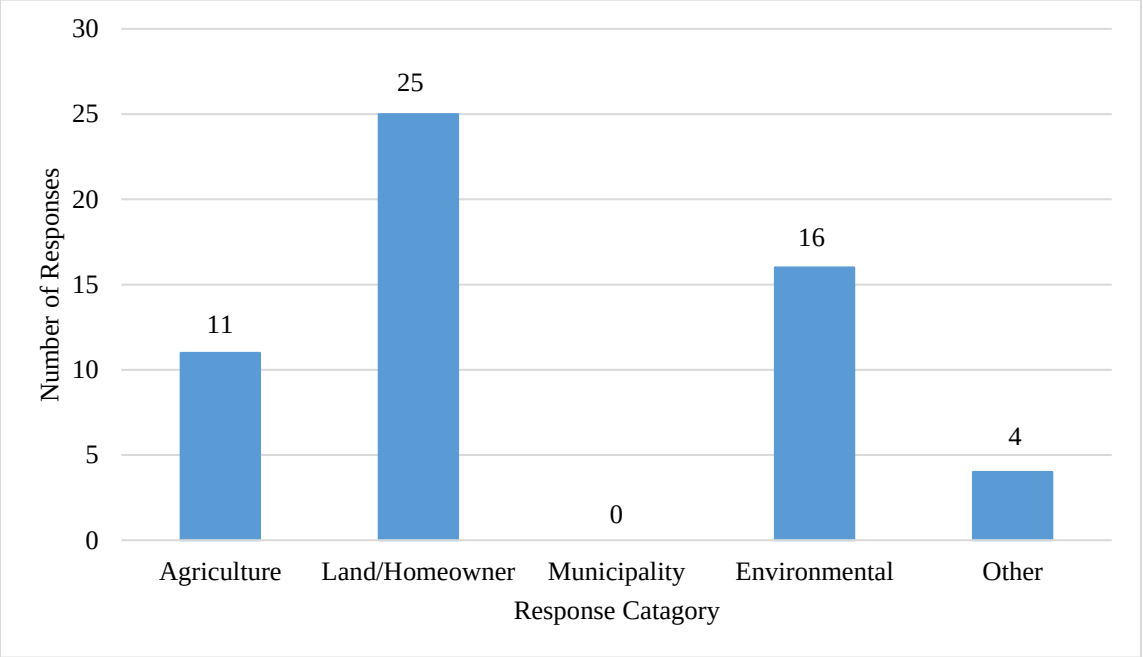
# APPENDICES

## Appendix A:

Summary of questions and response rate for service needs assessment survey.

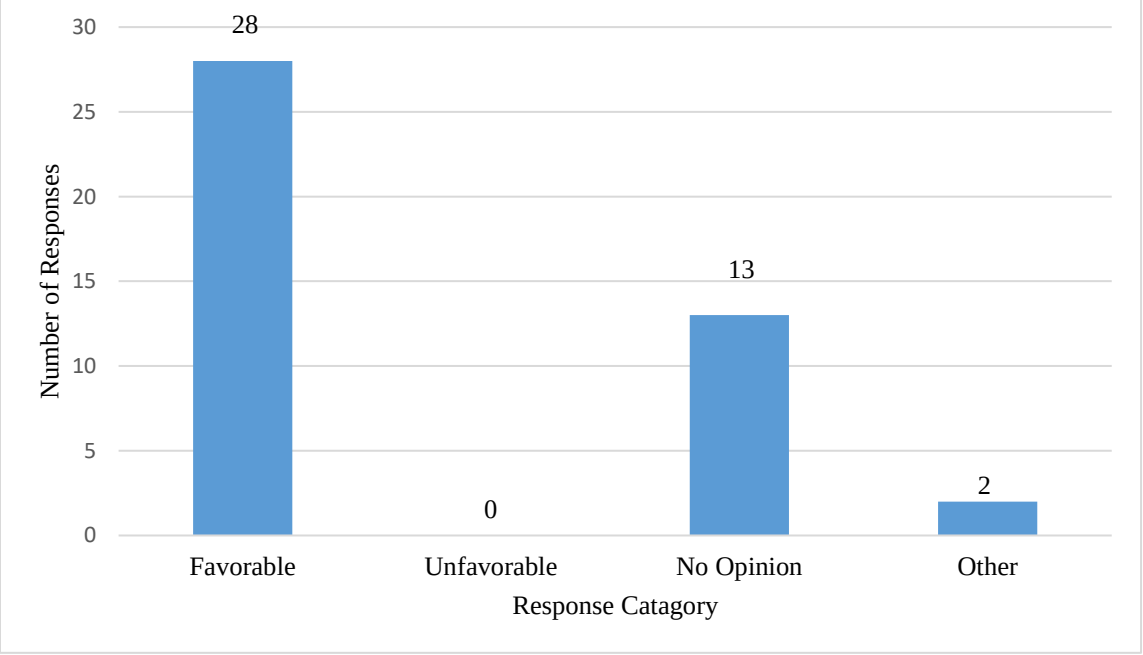
| Service needs assessment questions | Type | Answered | Skipped |
|---|---|---|---|
| 1. From what perspective will you be answering the survey questions? | multiple choice | 45 | 0 |
| 2. In your opinion, how would you rate the value of the services the CSLRCD provides in your area: | multiple choice | 43 | 2 |
| 3. Do you have ideas about specific conservation-related services that, as far as you know, are not currently available in your community, but would be beneficial to protecting natural resources and the area's environment? | short answer | 23 | 22 |
| 4. Select each agricultural support service with which you would like to see the CSLRCD involved: | multiple choice | 32 | 13 |
| 5. How do you feel about the water conservation services you are receiving locally? | multiple choice | 28 | 17 |
| 6. Do you support services and community volunteer opportunities such as local creek and stream cleanup and restoration projects? | multiple choice | 31 | 14 |
| 7. Do you feel the CSLRCD should be involved in: | multiple choice | 30 | 15 |
| 8. Do you support the CSLRCD involvement in: | multiple choice | 30 | 15 |
| 9. What, if any, finance mechanism(s) might you support in order to fund resource conservation services and track their effectiveness for the preservation of natural resources? | multiple choice | 30 | 15 |

Appendix B:




Question 1 asked: *From what perspective will you be answering the survey questions?*

Appendix C:



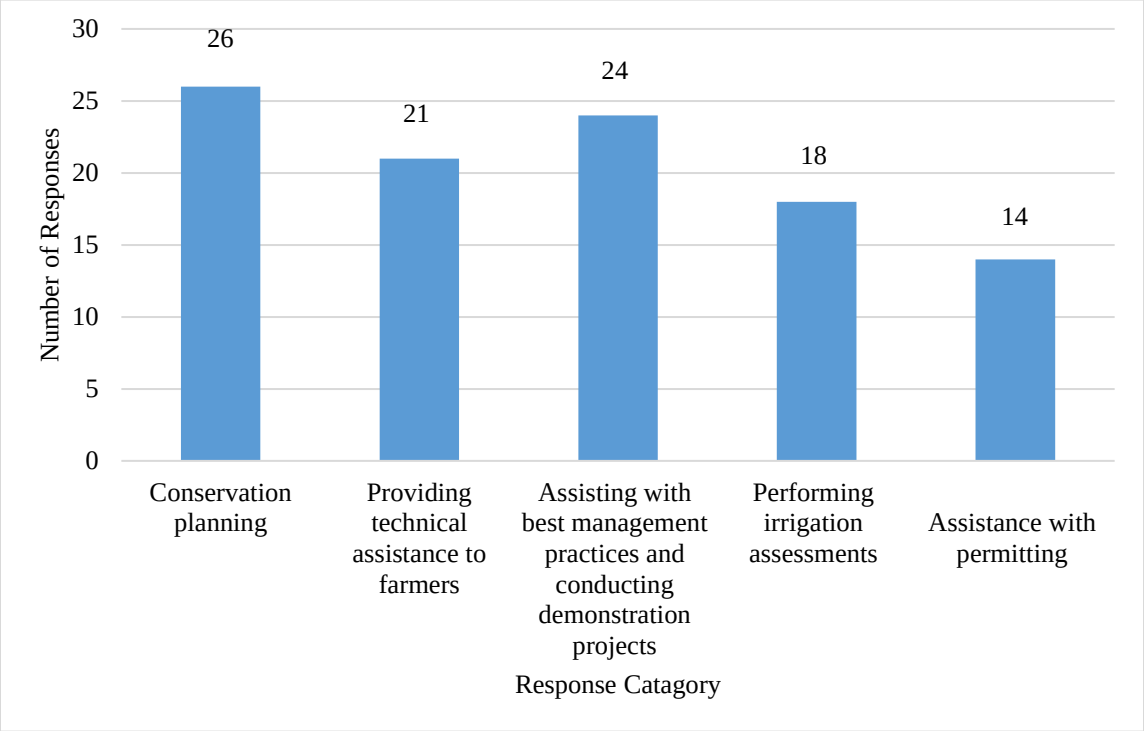

Question 2 asked: *In your opinion, how would you rate the value of the services the CSLRCD provides in your area?*

Appendix D:

Question 3 asked: *Do you have ideas about specific conservation-related services that, as far as you know, are not currently available in your community, but would be beneficial to protecting natural resources and the area's environment?*

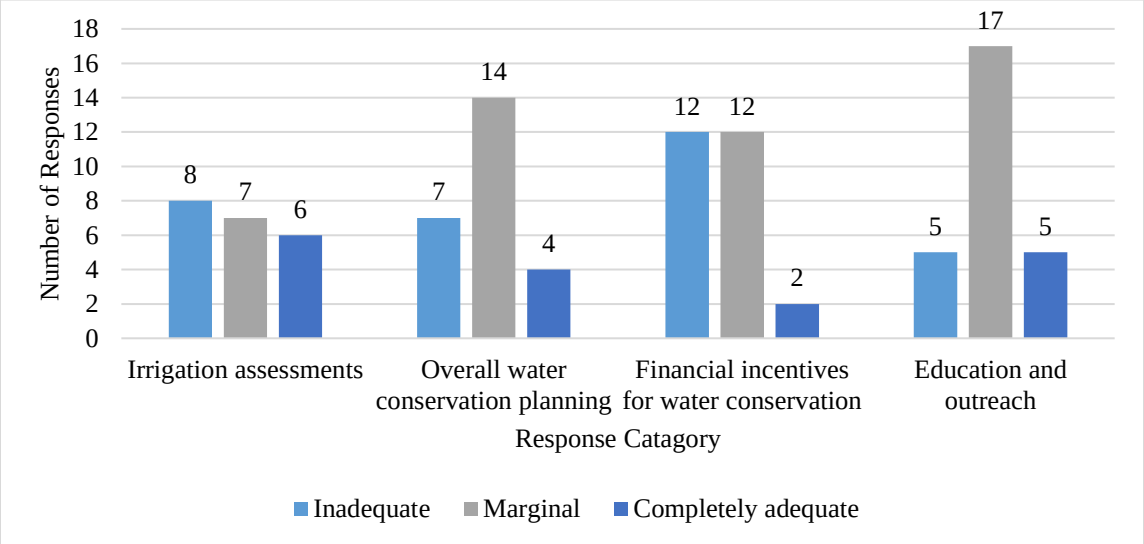
| |
|---|
| No |
| Roadside weed abatement. |
| I think that every person that wishes to change the land from original agriculture to a new venue of ag should have an Environmental Impact Study done before being allowed to plant or dig ponds that obstruct the natural flow of water on their property. |
| Farm conservation plans that match the NRCS standard. The plan is useful and the process is useful if done correctly. People get frustrated when it takes a long time to get a pllan finished. |
| Cost benefit analysis for individual BMPs for interested landowners, including quantifying the costs of eroded soil and other environmental impacts. - Information exchange opportunities for landowners |
| Oak tree removal policies. Rainwater infiltration requirements. |
| Further efforts to recycle and reuse wastewater |
| limit number of vineyards and agriculture |
| There are specific programs - watershed education, water saving device distribution, etc. that lack county wide coordination or county wide coverage. Would love to see the RCD use partnerships to help cover the gaps. |
| Keep the StormRewards program funded. |
| conservation banks or in-lieu fee programs |
| We know more information should/could be spread about how the public can interact better with wildlife - educational outreach we knows belongs to us, but we would love to partner with others on this. |
| Agricultural land trusts and other means of preserving ranch and farm land from development. |
| Maintaining good water conditions and habitat environments at the various lakes, especially Laguna Lake |
| Classes teaching methods to support groundwater recharge, i.e., key line plowing, sedimentation filters, planting of trees in vineyards to reduce sun-baked soils, animal usage in croplands to increase soil fertility |
| Grant proposal development and designs associated with it. |
| Can't think of anything right now. One of the biggest problems is that science literacy is generally poor in our society. I |
| love the signs that say "You are entering .... watershed" - it's a start. Most people don't know what a watershed is. |
| protection of property rights: as property rights go so goes everything else including conservation |
| Monitor the Salinas River regularly to maintain a healthy eco-system in this part of the County. Abundant wildlife and water quality resources make the river an important part of the CSLRCD. |
| perhaps education and demonstration projects that protect riparian buffers beyond the minimum requirements. |
| Public rainwater collection, in addition to the homeowner projects. It is a shame to see good rainwater running into the gutters. (I have one of your projects at my home, and not one drop left my property last winter.) |
| Water conservation rebates for Los Osos and other parts of the county. |
| Protection of aquatic fisheries habitat |

Appendix E:



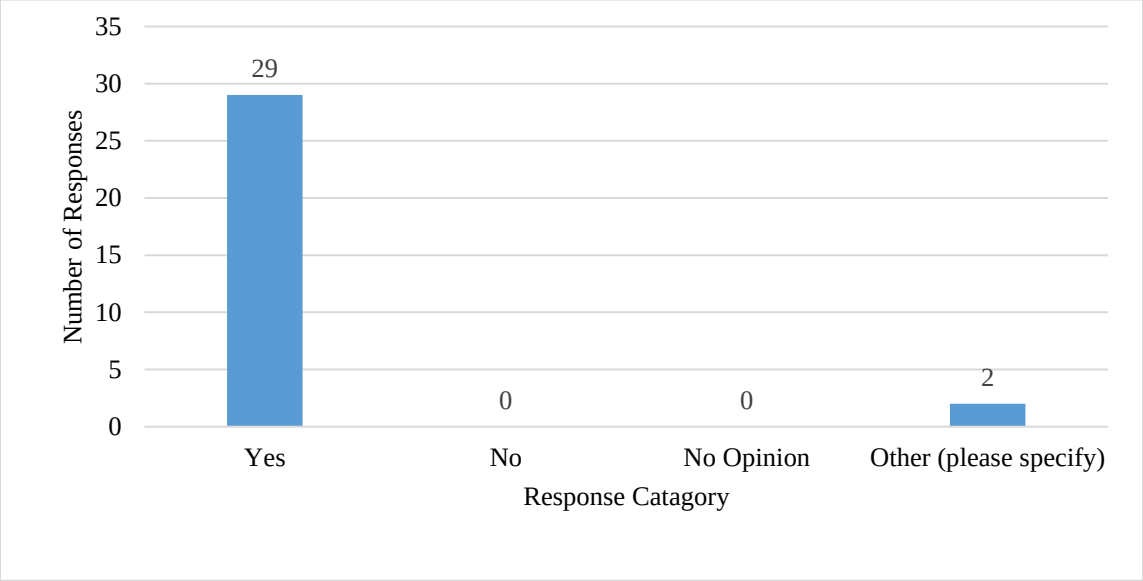

Question 4 asked: *Select each agricultural support service with which you would like to see the CSLRCD involved:*

Appendix F:



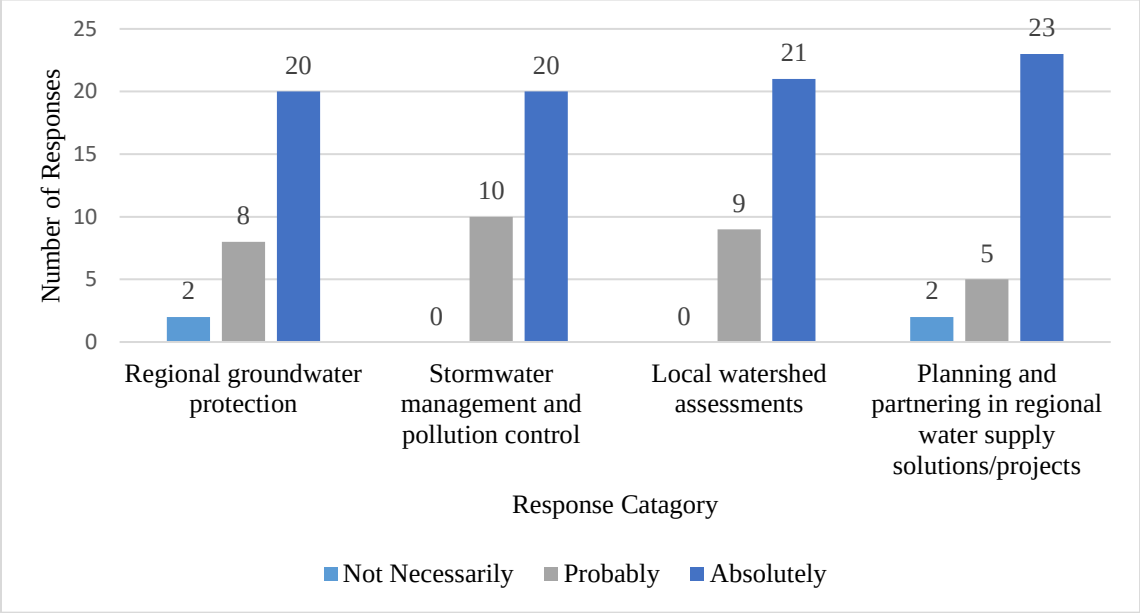

Question 5 asked: *How do you feel about the water conservation services you are receiving locally?*

Appendix G:



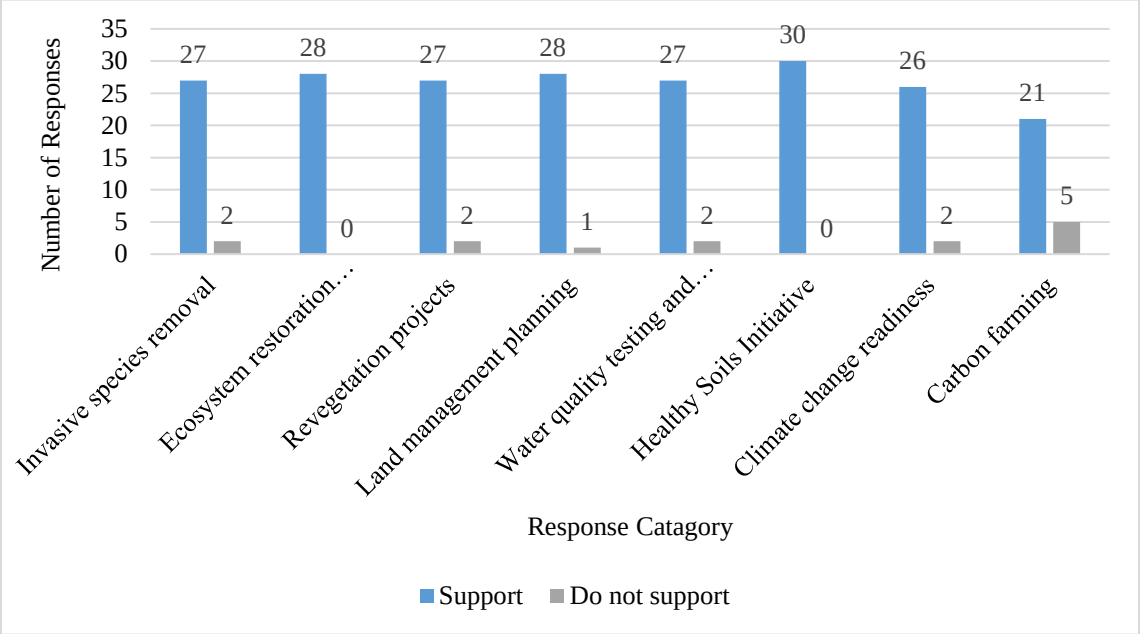

Question 6 asked: *Do you support services and community volunteer opportunities such as local creek and stream cleanup and restoration projects?*

Appendix H:



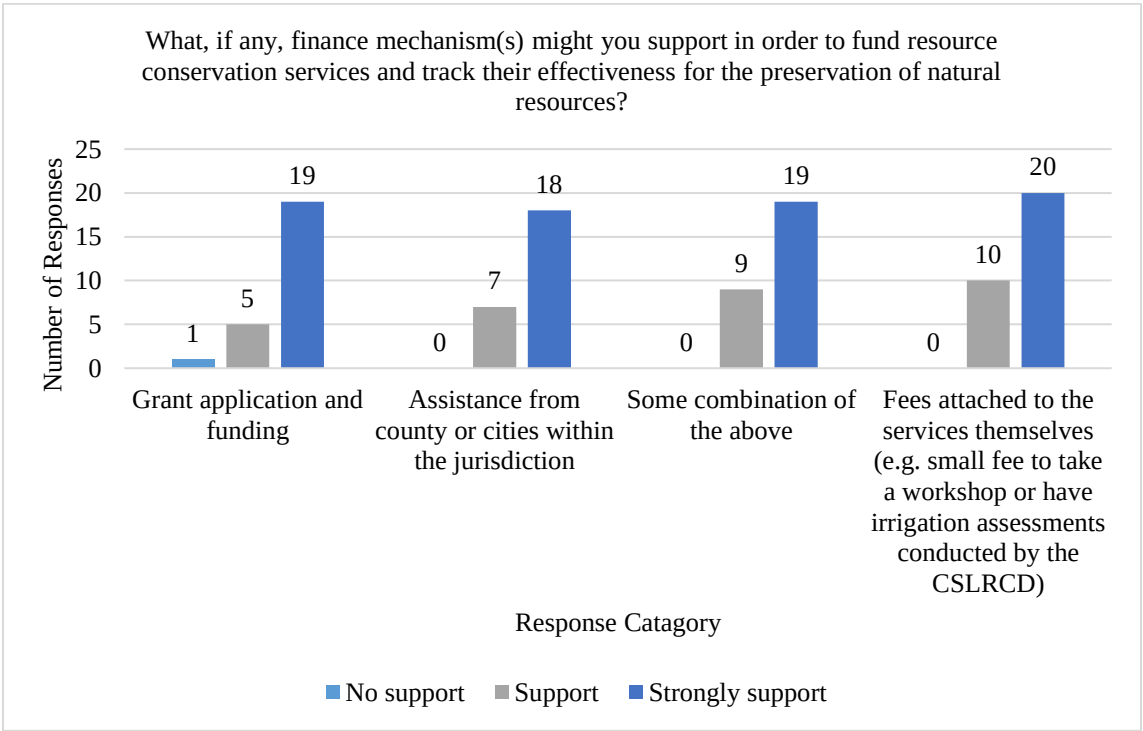

Question 7 asked: *Do you feel the CSLRCD should be involved in:*

Appendix I:




Question 8 asked: *Do you support the CSLRCD involvement in:*

Appendix J:




Question 9 asked: *What, if any, finance mechanism(s) might you support in order to fund resource conservation services and track their effectiveness for the preservation of natural resources?*

Appendix B. Final Strategic Plan Update

COASTAL SAN LUIS RESOURCE CONSERVATION DISTRICT
FIVE-YEAR STRATEGIC PLAN
2015-2020

Vision
A district with sustainable resources and enhanced ecological function

Mission
The Coastal San Luis Resource Conservation District is committed to protecting and enhancing natural resources through education, restoration, conservation, and collaboration with local stakeholders.

## 1. STRENGTHEN/EXPAND EXISTING PROGRAMS AND LAUNCH NEW INITIATIVES

Goal 1: Improve and protect groundwater basins, water storage and watersheds for sustainability.

Strategy 1: Engage in projects that support water efficiency, re-use/recycling, infiltration, volume reduction, quality improvement and storm water management.

Strategy 2: Improve understanding about the condition of watersheds in the District and effectively utilize that information to influence policy and land management decisions.

Strategy 3: Support water quality monitoring efforts.

Goal 2: Reduce the impacts caused by climate change and take steps to manage/adapt to the potential changes of the environment.

Strategy 1: Undertake and support projects that prepare for drought resiliency.

Strategy 2: Support projects that encourage land management practices resulting in soil carbon sequestration for farmers and ranchers.

Strategy 3: Foster partnerships in mitigation programs.

Goal 3: Enhance the wildlife habitats for plants and animals.

Strategy 1: Identify incentive based projects to restore plant and animal habitats.

Strategy 2: Reduce soil erosion and increase the capture of sediment.

Strategy 3: Reduce the negative impact caused by invasive species.

2. ENGAGE PARTNERS & THE COMMUNITY

Goal 1: Build partnerships that strengthen the CSLRCD's ability to reach their resource goals.

Strategy 1: Prioritize annual communication with grantors and governing bodies to relay accomplishments as well as collaborative opportunities.

Strategy 2: Look for opportunities to build capacity and collaboration with agriculturalists, agricultural organizations and natural resource organizations.

Strategy 3: Strive to identify partnerships with neighboring RCDs for projects with shared goals.

Strategy 4: Support and maintain affiliation with California Association of Resource Conservation Districts.

Goal 2: Increase the visibility of Coastal San Luis Resource Conservation District (CSLRCD) among partners and the community.

Strategy 1: Improve communications and public relations to increase the visibility of CSLRCD.

Strategy 2: Encourage CSLRCD directors to use their sphere of influence to inform relevant officials about the CSLRCD.

Strategy 3: Participate in countywide committees.

Goal 3: Capitalize on the enthusiasm and skill sets of our local volunteer community.

Strategy 1: Develop a volunteer / intern program that includes recruitment and use of volunteers / interns.

Strategy 2: Engage the volunteers in monitoring activities that benefit the environment.

3. ENHANCE CAPACITY IN ORGANIZATIONAL OPERATIONS

Goal 1: Increase and diversify funding sources and leverage funding.

Strategy 1: Prioritize funding development efforts to acquire stable and diverse funding sources.

Strategy 2: Set up processes to better cover organizational costs.

Strategy 3: Grow revenue from mission-compatible activities such as: self-supporting education programs; permitting assistance, funded research projects, and deliberate partnering.

Goal 2: Ensure that the CSLRCD has a strong and diverse Board of Directors.

Strategy 1: Create a board development committee to oversee the responsibility of nomination, training, etc.

Strategy 2: Have a succession plan for board members to promote new leadership.

Goal 3: Ensure that the CSLRCD has a diverse and talented staff.

Strategy 1: Grow staff and encourage career positions with benefits over contract labor.

Strategy 2: Have a succession plan for staff.

Strategy 3: Create time for on-going personnel workload review.

Strategy 4: Foster healthy working environments.

Goal 4: All administrative, financial and legal requirements are met.

Strategy 1: Continue to implement existing CSLRCD policies and procedures, update and improve them as needed, and develop new policies and procedures as needed to improve the CSLRCD operations.

Strategy 2: Be prepared for any audits with all documentation easily accessible.

Strategy 3: Document and maintain a cost allocation plan and develop sustainable billing rates.

COASTAL SAN LUIS RESOURCE CONSERVATION DISTRICT
ANNUAL STRATEGIC PLAN
2016-2017

## 1. STRENGTHEN/EXPAND EXISTING PROGRAMS AND LAUNCH NEW INITIATIVES

Specific priority actions described below implement the following strategies:

- Improve and protect sustainable groundwater basins, water storage and watersheds.
- Reduce the impacts caused by climate change and take steps to manage/adapt to the potential changes of the environment.
- Enhance the wildlife habitats for plants and animals.

| Action No. | Description | Who? Directors – D Staff – S Partner - P | When? | Funded? |
|---|---|---|---|---|
| 1.01 | Expand our storm rewards rebate program | S & P | 3rd - 4th qtr | Yes |
| 1.02 | Assist cities and county in developing stormwater resource plans | S & P | 3rd - 4th qtr | Yes |
| 1.03 | Continue the MIL (NRCS & County) and expand the SWEEP (CDFA) | S | 1st - 4th qtr | Yes |
| 1.04 | Begin Phase 2 of the County Watershed Management Plan | S & P | 4th qtr | No |
| 1.05 | Strengthen ARP and research ag ponds initiatives | D & S | 2nd - 4th qtr | No |
| 1.06 | Research aquifer recharge programs | S | 3rd - 4th qtr | No |
| 1.07 | Research mitigation programs | S | 3rd - 4th qtr | No |
| 1.08 | Research carbon farming and healthy soils initiatives | S | 3rd - 4th qtr | No |
| 1.09 | Expand the climate ready rangeland program | S & P | 2nd - 4th qtr | No |
| 1.10 | Develop a robust PIR | S & P | 1st - 4th qtr | No |
| 1.11 | Seek funding for Phases 2 for the Los Osos Restoration project | S & P | 3rd - 4th qtr | Yes |
| 1.12 | Develop long term plans for RCD-owned properties and seek funding for management | D, S & P | 3rd - 4th qtr | No |

## 2. ENGAGE PARTNERS & THE COMMUNITY

Specific priority actions described below implement the following strategies:

- Increase the visibility of CSLRCD among partners and the community.

- Build partnerships that strengthen the CSLRCDs ability to reach their resource goals.

- Capitalize on the enthusiasm and skill set of our local volunteer community.

| Action No. | Description | Who? Directors – D Staff – S Partner - P | When? | Funded? |
|---|---|---|---|---|
| 2.1 | Update website | S | 1st - 4th qtr | No |
| 2.2 | Update and expand our mailing list | S | 1st - 4th qtr | Partial |
| 2.3 | Biannual meeting with BOS | D & S | 1st & 3rd qtr | No |
| 2.4 | Develop a Volunteer Plan | S | 1st - 4th qtr | No |
| 2.5 | At least 4 press releases | S | 1st - 4th qtr | Partial |
| 2.6 | Annually meet with each City Council members | D & S | 2nd qtr | No |
| 2.7 | Build a relationship with the EVC, Chamber of Comm. and Farm Bureau | D & S | 1st - 4th qtr | No |

3. ENHANCE CAPACITY IN ORGANIZATIONAL OPERATIONS

Specific priority actions described below implement the following strategies:

- Increase and diversify funding sources and leverage funding.

- Ensure that the CSLRCD has strong and diverse Boards of Directors.

- Ensure that the CSLRCD has a diverse and talented staff.

- All administrative, financial and legal requirements are met.

| Action No. | Description | Who? Directors – D Staff – S Partner - P | When? | Funded? |
|---|---|---|---|---|
| 3.01 | Expand our Fee for Service Program | D & S | 1st - 4th qtr | Yes |
| 3.02 | Build a 6 month operational reserve | D & S | 1st - 4th qtr | No |
| 3.03 | Set up an equipment replacement account | D & S | 1st - 4th qtr | No |
| 3.04 | Develop a cost allocation plan that is Board approved | D & S | 1st - 2nd qtr | No |
| 3.05 | Create a new Director training program and informational packet | D & S | 1st - 2nd qtr | Yes |
| 3.06 | Develop Injury & Illness Prevention Program | D & S | 1st qtr | No |
| 3.07 | Provide staff with a Savings Incentive Match Plan | D | 1st qtr | No |
| 3.08 | Develop Organization Chart and Accounting Process/Internal Controls | D & S | 1st - 2nd qtr | Yes |

| | | | | |
|---|---|---|---|---|
| 3.09 | Develop Bidding/Procurement Policy and Statement of Qualifications | D & S | 1st - 2nd qtr | Yes |
| 3.10 | Develop/Update Travel, Retention and Fee for Service policies | D & S | 1st - 2nd qtr | Yes |