

Final Evaluation Findings

San Francisco Bay
National Estuarine Research Reserve

September 2007 to June 2015

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Executive Summary

The Coastal Zone Management Act requires the National Oceanic and Atmospheric Administration's Office for Coastal Management to conduct periodic evaluations of the performance of state programs participating in the National Estuarine Research Reserve System. This evaluation examined the operation and management of the San Francisco Bay National Estuarine Research Reserve by the San Francisco State University of California, the designated lead agency, for the period from September 2007 to June 2015. The evaluation focused on three target areas: program administration, habitat management and restoration, and climate resilience.

The findings in this evaluation document will be considered by the NOAA Office for Coastal Management in making future financial award decisions concerning the reserve. The evaluation came to these conclusions:

Accomplishment: The San Francisco Bay Reserve has strengthened its core partnerships, including improving communication and identifying joint priorities through the advisory board and building new partnerships that support the reserve's mission.

Accomplishment: The San Francisco Bay Reserve has begun to build a stewardship program with the addition of a half-time stewardship coordinator and is conducting research to improve stewardship practices of rangeland that will inform both management of reserve lands and rangelands in the greater region. The reserve also developed a partnership with the San Francisco State University Institute of Geographic Information Science that will bring new capabilities and resources to the reserve.

Accomplishment: The San Francisco Bay Reserve education program has successfully incorporated the reserve's oyster research project and System-wide Monitoring Program data into educational programming, engaging high school students in field work to learn more about how water quality affects oysters in the bay.

Accomplishment: The San Francisco Bay Reserve research program has successfully brought together partners to better understand the dynamics of the bay through projects such as Mud on the Move and Olympia Oyster Restoration, and the information is being used to inform coastal management decision-making in the region.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve and its core partners to continue to build and strengthen their relationships.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve, through the management planning process, to strategically identify the niches where the reserve and its sector programs could maximize their impact and best fit within the

multitude of organizations in the San Francisco Bay area. The reserve should also consider its role in priority initiatives from participating, to coordinating, to leading.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve to work with China Camp State Park and other partners to develop and implement an adaptive strategy for San Pedro Road that meets the multiple objectives of community access and marsh migration, serving as a model for other such projects across the nation.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve to develop coastal trainings and other communication mechanisms to bring its cutting-edge research and stewardship information, particularly around habitat restoration and climate resilience, to local governments and other regional, state, and federal agencies.

This evaluation concludes that the San Francisco State University of California is adhering to the programmatic requirements of the National Estuarine Research Reserve System in the operation of the San Francisco Bay National Estuarine Research Reserve.

Program Review Procedures

The NOAA Office for Coastal Management evaluated the San Francisco Bay National Estuarine Research Reserve in fiscal year 2015. The evaluation team consisted of Carrie Hall, evaluation team lead; Pam Kylstra, evaluator, Michael Migliori, site liaison; John Rozum, coastal land use specialist; and Erika Washburn, manager Lake Superior National Estuarine Research Reserve. The support of the reserve staff was crucial in conducting the evaluation, and this support is most gratefully acknowledged.

NOAA sent a notification of the scheduled evaluation to the president of San Francisco State University, published a notice of “Intent to Evaluate” in the *Federal Register* on April 16, 2015, and notified members of California’s congressional delegation. The evaluation process included a review of relevant documents and a survey of stakeholders, which helped identify three target areas for the evaluation: program administration, habitat management and restoration, and climate resilience. A site visit was conducted and the evaluation team held meetings with staff members and group discussions with stakeholders and program staff members about the target areas. In addition, a public meeting was held on Monday, June 8, 2015, at 4:00 p.m. at the Bay Conference Center, Romberg Tiburon Center, 3152 Paradise Drive, Tiburon, CA 94920, to provide an opportunity for members of the public to express their opinions about the implementation of the reserve. Stakeholders and members of the public were given the opportunity to provide written comment via email or U.S. mail through Friday, June 19, 2015. No written comments were received. The NOAA Office for Coastal Management then developed draft evaluation findings, which were provided to the reserve for review, and the reserve’s comments were considered in drafting the final evaluation findings.

Final evaluation findings for the national estuarine research reserves highlight each reserve’s accomplishments in the target areas and include recommendations, which are of two types:

Necessary Actions address programmatic requirements of implementing regulations of the Coastal Zone Management Act. These must be carried out by the dates specified. Failure to address necessary actions may result in a future finding of non-adherence and the invoking of interim sanctions, as specified in the Coastal Zone Management Act §312(c).

Recommendations are actions that the office believes would improve the program but which are not mandatory. The state is expected to have considered the recommendations by the time of the next evaluation or dates specified.

Evaluation Findings

Program Administration

Core Partnerships

Recently, the reserve has worked to strength its relationships with key partners, including the Solano Land Trust, Romberg Tiburon Center, California State Parks, and Friends of China Camp State Park. Both the reserve and Romberg Tiburon Center have new leadership and the organizations are moving forward with energy and enthusiasm. The reserve manager and staff have successfully worked toward addressing a program suggestion in the previous evaluation findings to improve joint planning and identification of joint priorities and increased communication.

The Romberg Tiburon Center has been building its capacity to grow private support for the center. At the time of the evaluation site visit, a new faculty position, director of the Geography and Environment Department's Marine and Coastal Conservation and Spatial Planning Laboratory in the Institute of Geographic Information Science, had been created. In addition, the center recently received a \$5 million endowment for interdisciplinary research projects. The new faculty position and funding source provides new opportunities for San Francisco State students to engage in work at the reserve. At the time of the site visit, the dean was soon to be transitioning to another position, and he emphasized that his strongest recommendation was to increase the reserve's engagement with and support of students. Both the dean and Romberg Tiburon Center director expressed support and interest in increasing multidisciplinary student engagement.

The Romberg Tiburon Center entered into a memorandum of understanding with the Smithsonian Institute to participate in the establishment of a Marine Global Ecological Observatory in San Francisco Bay. The Smithsonian's new Marine Global Earth Observatory Network is a long-term, worldwide research program focused on providing policy makers with the science to support innovative solutions and advance management and protection of ocean and coastal ecosystems. The agreement brings together the resources of the Marine Global Ecological Observatory in San Francisco with the reserve's long-term monitoring program and the center's long-term water quality and weather monitoring station. Through the new partnership, the observatory has been a key partner in recent efforts of the West Coast reserves to support Olympia oyster restoration. In addition, the reserve has been working with the network to establish a new water quality monitoring station coincident with the reserve's auxiliary weather station in Richardson Bay.

The reserve entered into a memorandum of understanding with the Institute for Geographic Information Science, co-located in the College of Science and Engineering in May 2015. The agreement calls for the development of joint research projects, sharing of equipment, for the stewardship coordinator to act as a liaison between the organizations, for the institute to

provide GIS training for reserve staff, and the potential development of a long-term budget allocation from the reserve to the institute to help support its services to the reserve. The strengthened relationship has already enhanced the reserve's research and GIS-related capabilities and should create opportunities for the reserve to engage students in addressing coastal management issues.

In addition, the reserve strengthened its capacity to engage in partnership building activities and participating in climate resilience funding opportunities through the hiring of a part-time Coastal Resilience Specialist a month before the evaluation site visit. The focus of the Coastal Resilience Specialist is agency outreach and reserve planning around issues involving tidal wetland sustainability in the face of sea-level rise and integrating reserve research and monitoring into the context of regional tidal wetland restoration activity.

The reserve also successfully addressed significant management challenges during the evaluation period. Due to the economic downturn and state budget shortfalls, California proposed closing China Camp State Park in 2012, even though over 500,000 people visit the state park annually. The reserve worked closely with the Friends of China Camp State Park and California State Parks to come to an agreement to have the park managed by the Friends of China Camp State Park, with oversight from State Parks, enabling the park to remain open to the public. This agreement also enabled the reserve to continue to be able to provide educational programming on site and access to research and monitoring sites.

The reserve also worked closely with the Solano Land Trust to resolve outstanding issues and complete a management plan for Rush Ranch that incorporates the latest scientific knowledge on grazing and wetland impacts. Solano Land Trust and the reserve recently worked to create a split stewardship coordinator position that is half-time Solano Land Trust and half-time reserve. The stewardship coordinator position has helped bridge the gap between the organizations. In addition, the reserve and Solano Land Trust regularly work together to provide educational programming.

The Office for Coastal Management commends the reserve for strengthening its core partnerships and building new ones that support the reserve's mission. The Office for Coastal Management encourages the reserve and its core partners to continue to build and strengthen their relationships.

Management Plan

With the hiring of new staff, it is timely that the reserve also be due for the development of a new five-year management plan. In its management plan development process, the Office for Coastal Management encourages the reserve to both deeply engage with its recently reinvigorated advisory board in the management planning process and consider developing a process to gather input from a wider group of partners. The San Francisco Bay area has many pressing coastal management issues and many organizations involved in attempting to address those issues. Broadening the partners the reserve engages with could assist with further

defining the niches where the reserve can have the most impact and identifying opportunities where organizations could work together or share information and make a bigger impact.

The reserve has many opportunities to lead and contribute to addressing coastal management issues in the Bay area. The Bay area also has many potential partners engaged in a multitude of efforts that overlap or could overlap with reserve activities. The evaluation team found that the reserve had the potential to be pulled in many directions and faced the potential of taking on too much and being less effective. The management planning process can be used to prioritize opportunities and should identify the criteria against which future opportunities will be evaluated so that the reserve can focus its limited staff on high priority opportunities. In addition, the reserve should also identify a balance for regional work while maintaining onsite priority work.

Based on the priorities of the new management plan, the Office for Coastal Management encourages the reserve to continue building relationships with new partners. The office acknowledges that the reserve has limited staff and encourages the reserve to focus on priority partnerships that will have the maximum impact in furthering the goals of the new management plan. During the evaluation site visit, stakeholders noted the opportunities and value of building new relationships with the duck hunting community, local governments and communities in and around the reserve, wastewater treatment plants, Bay Area Council, and Pacific Gas and Electric (interested in carbon sequestration), and to strengthen the reserve's link to the State Coastal Conservancy and San Francisco Bay National Estuary Program.

Staffing and Sector Integration

During the latter part of the evaluation period, the reserve hired a new manager and a Coastal Training Program coordinator, filled a long empty administrative staff position with a half-time high level administrative staff person, and created a new joint stewardship position with the Solano Land Trust. The reserve's new staff positions have provided opportunities to grow and improve the reserve's programs and build relationships with partners. The new high-level administrative staff position allowed the reserve to hire someone with experience within the university working on grants management and budgeting. This expertise has helped ease the administrative burden on other reserve staff members. For example, the administrative staff member worked with the research coordinator to develop a budget forecasting system that integrates the reserve's grants. To better address the reserve's administrative needs, the center has also provided increased staff support to help support grants management and budgeting needs. Unfortunately, since the site visit, the Coastal Training Program coordinator left, and so a new coordinator will need to be hired.

The evaluation team noted opportunities for staff to build their working relationships and strengthen cross-sector integration. The management planning process should provide a timely opportunity to focus reserve efforts on identified issue areas and to identify how reserve sectors will work together to address priority issues. The reserve might also wish to consider having staff members develop succinct annual work plans that lay out annual goals and tasks

for each team member. The work plans could provide clarity on responsibilities, be used as a tool for balancing workloads, and provide a framework for evaluating new opportunities that come up during the year. The work plans could be complemented by professional development plans that identify training needs

Research Advisory Board

The research and monitoring program also has an advisory board. The reserve should explore broadening the membership of this advisory board to include participation from the social science fields, including economics. In addition, the Office for Coastal Management encourages the reserve to use the advisory board to develop the research plan within the broader management plan and to reach out to other scientists to advertise the reserve's research needs.

Sharing Research and Stewardship Results

During the evaluation, stakeholders discussed the value of providing opportunities to share research and stewardship results and build relationships among key partners. The Office for Coastal Management encourages the reserve to consider venues to share research and stewardship results with coastal decision makers and the public. For example, a symposium could be used to bring together coastal managers and coastal decision makers, build relationships between reserve sites, and bring local residents to learn more about the reserve. Several stakeholders mentioned that there could be opportunities to better share information between the Solano Land Trust and California State Parks, a symposium could provide a venue for sharing information on mutual priorities such as restoration. A symposium could also be part of the annual Romberg Tiburon Center's open house to capitalize on existing planning efforts and opportunities for outreach to the local community. Alternatively, or in conjunction, coastal training workshops could be developed to provide coastal decision makers and core partners with the results of research and stewardship actions conducted at the reserve.

Accomplishment: The San Francisco Bay Reserve has strengthened its core partnerships, including improving communication and identifying joint priorities through the advisory board and building new partnerships that support the reserve's mission.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve and its core partners to continue to build and strengthen their relationships.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve, through the management planning process, to strategically identify the niches where the reserve and its sector programs could maximize their impact and best fit within the multitude of organizations in the San Francisco Bay area. The reserve should also consider its role in priority initiatives from participating, to coordinating, to leading.

Habitat Management and Restoration

During the site visit, the evaluation team heard from reserve partners that the reserve's restoration and habitat management research projects were highly valued by land managers and regulators. Stakeholders also noted that there were opportunities to ensure that other land managers and coastal decision makers in the region were aware of the results of the reserve's restoration and habitat management research results so that they could incorporate this new knowledge into their work.

Rush Ranch

The reserve and Solano Land Trust have worked together to create a "state of the art" management plan that incorporates cutting-edge grazing science and adaptive management techniques that will use reserve and land trust data. The Elkhorn Slough Coastal Training Program coordinator designed a training hosted at Solano Land Trust that brought together experts on grassland management to share best practices. Based on the experts' advice, the Solano Land Trust has modified its grazing rotation system, is changing its fencing, and has limited cattle grazing in the marsh. The land trust is also testing and incorporating new management techniques to improve perennial grasses and keep invasive weeds down. The stewardship coordinator and land trust successfully conducted an experiment to change the diet of the cattle so that they now eat the invasive purple starthistle. It is hoped that this will result in reduced herbicide use and labor. At the time of the site visit the land trust was also in its second year of using fire as a tool to maintain grasslands. The results of these efforts are being monitored, and a decrease in invasive species has been seen. In addition, the land trust received funding from the Natural Resources Conservation Service to test adding compost to the land to see if it is taken up by native grasses. Future plans include investigating the possibility of re-introducing Pronghorn Antelope and Tule Elk to grasslands in the Portrero Hills region, of which Rush Ranch is a part. The land trust is also conducting a feasibility study to look at reintroducing native elk to Rush Ranch. The land trust hopes to expand successful grassland management practices to other ranches. The Office for Coastal Management commends the reserve and Solano Land Trust for working together to implement and scientifically test best grassland management practices.

During the evaluation period, the reserve also hosted a graduate research fellow who studied the rarity of an endemic wetland thistle. The fellow found that Pepperweed negatively affects the native Suisun thistle. Based on these research results, the land trust has prioritized the control of Pepperweed in the vicinity of existing Suisun thistle plants and limited the widespread use of pesticides to carefully targeted application in those most sensitive areas where Suisun thistle and Pepperweed coexist. The fellow's work is also expected to help guide restoration plans for Rush Ranch and Suisun Marsh more broadly.

The education coordinator partnered with the land trust to create a tidal docent program and educate the volunteer docents on the importance of tidal marshes and tidal marsh restoration.

The volunteer docents now lead public tours focused on the tidal marshes. The land trust is interested in working with the reserve to expand this program and educate more trainers.

Wetland Restoration

Many organizations in the San Francisco Bay region are involved in undertaking numerous wetland restoration projects and looking to prepare the region for climate change and sea level rise. China Camp State Park and Rush Ranch are two of the few remaining historic wetlands in the bay whose habitats have largely been protected from development and alteration and are heavily utilized as reference sites against which enhanced, restored, or created wetlands are evaluated. Once the Bay had 190,000 acres; now 16,000 historical tidal marsh acres remain. At the time of the site visit, the Solano land trust had four wetland restoration projects in the permitting phase.

Tidal marsh restoration at Rush Ranch provides a unique opportunity to conduct comparison studies with the ranch's relatively intact 1,000 acres of tidal marsh (largest remnant marsh in the Suisun Marsh region). The land trust and reserve are working on the Goat Island project, which will convert approximately 80 acres of diked land to tidal marsh. Solano Land Trust staff stated that the reserve's scientific expertise and relationship with the Bay Conservation and Development Commission had been very helpful in working through the permitting process. After the restoration, the area will continue to be monitored, and the project has been designed to allow the marsh to migrate with sea level rise. Sentinel site benchmarks will be installed, and a sentinel site plan is being developed for the area. The area also has a weather station, and the U.S. Geological Survey installed an Eddy Covariance Flux Tower in the area to monitor carbon sequestration for an indefinite time. The restoration site is publically accessible, and the reserve is considering how the coastal training and education programs can capitalize on the project.

Water Quality

The reserve's system-wide monitoring program is helping to inform the development of nutrient impairment criteria for the Suisun Marsh on which Rush Ranch borders. The San Francisco Bay Regional Water Quality Board requested the reserve's assistance in conducting a local assessment. The reserve was able to collect and compare data on dissolved oxygen and nutrient concentrations at First Mallard Slough, which is cut off from free water exchange, and Second Mallard Slough, which has more open water. It is hoped Second Mallard Slough will be able to serve as a baseline for the region. The reserve research coordinator is working with partners to develop indicators of impairment and to refine a conceptual framework for developing nutrient numeric endpoints for Suisun Marsh. Stakeholders that the evaluation team met with noted the importance of having over seven years of monitoring data for developing total maximum daily loads and that they hoped the reserve would do more nutrient monitoring.

Habitat Mapping

During the evaluation period, the reserve completed a baseline habitat map for China Camp State Park. The baseline map for China Camp has been used in several research and management applications, including guiding establishment of transects for long-term vegetation monitoring and sentinel site monitoring, directing external researchers to tidal wetland areas of interest for their studies, and prioritizing restoration planning efforts for tidally muted areas with distinctive habitat characteristics. The reserve is also working on completing a habitat map for Rush Ranch. This habitat map will be part of a pilot test for the reserve system using a drone to collect habitat data. This work will be carried out in fall 2016.

China Camp Road

North San Pedro Road is a county road that traverses the park and connects neighborhoods. The road blocks the natural hydrodynamics for a marsh area on the interior side, except during high tides when the water floods over the road. The reserve and park are interested in pursuing a project to assist the county and state parks with redesigning the road as an adaptation demonstration project that also restores the interior marsh area. The area could also be developed as a sentinel site to continue to monitor changes over time. Stakeholders noted that the nearby community of Santa Venetia is very engaged in efforts to protect their community from flooding and could be a potential partner in the project. At the time of the site visit, the reserve was looking at using the sea level rise modeling capacity of Our Coast Our Future and working with a professor of economics to conduct an economic analysis of the benefits of redesigning the road and restoring the marsh. The Office for Coastal Management also encourages the reserve to work with China Camp State Park and other partners to develop and implement an adaptive strategy for North San Pedro Road that meets the multiple objectives of community access and marsh migration, serving as a model for other such projects across the nation.

Habitat and Restoration Training

The Coastal Training Program has offered a number of trainings throughout the evaluation period, including Introducing Green Infrastructure for Coastal Resilience, as well as the Tidal Wetland and Restoration Field Trip Series: Hamilton and Sonoma Baylands, and Eden Landing Tidal Wetland Restoration Field Workshop. The coordinator partnered with the Tijuana River Reserve in 2014 to provide training and technical assistance on green infrastructure and hosted a training, Green Infrastructure: Enhancing Flood Protection Using Natural Shoreline Restoration Design Approaches. The Coastal Training Program also participated in several market analyses and needs assessments with a focus on restoration, including the Land Managers Needs Assessment Web Survey, March 2012, and Planning for Salt Marsh Sustainability in Central California, February 2012.

Accomplishment: The San Francisco Bay Reserve has begun to build a stewardship program with the addition of a half-time stewardship coordinator and is conducting research to improve stewardship practices of rangeland that will inform both management of reserve lands and

rangelands in the greater region. The reserve also developed a partnership with the San Francisco State University Institute of Geographic Information Science that will bring new capabilities and resources to the reserve.

Recommendation: The Office of Coastal Management encourages the San Francisco Bay Reserve to work with China Camp State Park and other partners to develop and implement an adaptive strategy for North San Pedro Road that meets the multiple objectives of community access and marsh migration, serving as a model for other such projects across the nation.

Climate Resilience

The reserve is engaged in a number of efforts across sectors to better understand and provide research and information regarding climate resilience. Stakeholders noted that the reserve fills an important niche in understanding how natural systems are responding as the region has been more focused on the urban interface. San Francisco Bay is also the site of a very large restoration effort as tens of thousands of acres of commercial salt ponds are being restored and a number of smaller restoration projects are taking place. Managers and scientists are trying to understand whether the Bay-fringing marshes will survive in the face of accelerating sea level rise and how our understanding of marsh sustainability can help to inform the vulnerability of restored tidal marshes, including those being constructed for shoreline protection. The goal is to use this scientific understanding to improve coastal decision making in this active area.

The reserve has been successful in bringing together researchers and coastal decision makers to conduct projects to better understand how the Bay will respond to climate change and sea level rise and to transfer that information to coastal decision makers. Reserve staff members were described by partners as neutral, trusted, respected, and as a bridge between partners. Another stakeholder described the reserve's research as critical for state parks as it fills important gaps and helps staff make informed resource management decisions. The reserve's research and stewardship efforts have also informed the bayland community's effort to revise the Bayland Ecosystem Habitat Goals Update to reflect the changing environment caused by climate change and sea level rise. Although the reserve's science and data are used by a number of coastal decision makers, there are opportunities to further ensure that local governments and other regional, state, and federal agencies have access to the latest monitoring and research results. This is a focus of the Coastal Resilience Specialist in conjunction with other members of the staff. In addition, the Coastal Training Program should consider its role in regional outreach and training related to climate resilience and whether it should take a larger role in bringing together agencies in developing a stronger, more coordinated outreach and training strategy.

Sediment – Mud on the Move

The reserve led a National Estuarine Research Reserve System Science Collaborative Project, Mud on the Move, focused on developing a standard method for collecting data needed to run ecological forecasting models that predict marsh response to sea level rise. The project began in 2013 as an effort to assist the regional tidal marsh management and regulatory community in

understanding and addressing issues related to marsh plain sediment transport in the estuary, particularly focusing on how to evaluate the responses of tidal wetlands to decreasing sediment supply. At the time, several competing models were being used to model marsh response to increased rates of sea-level rise and decreased sediment supply. Managers and stakeholders in the Bay area had expressed confusion over which model they should use. The reserve was able to compare these competing models by taking the innovative approach of developing a research protocol for gathering sediment concentrations transported across the marsh plain (rather than gross sediment estimates from open water near the marsh). These actual sediment concentrations were then plugged into each different model to compare how model predictions varied with the same sediment concentrations but different sea-level rise scenarios. Thus, in a collaborative and non-threatening manner, participants in the project tested a protocol for more accurately assessing sediment transport across the marsh plain while comparing the response of the different competing models.

The project was also designed to address a need in the national system for a national approach to data interpretation and translation. To ensure the method would be widely accepted, implemented, and readily understood, the project included members of the regional and national scientific and tidal marsh management communities in protocol development. The project was organized into a technical team of applied scientists who are engaged in testing the modified protocol, monitoring, and modeling; stakeholders that include local and regional decision makers and landowners; and a collaboration team that linked stakeholder needs and perspectives with the applied science process.

After successfully completing the project, the reserve received a grant to work with the modelers and five other reserves to transfer knowledge of how to apply the ecological forecasting approach. The transfer effort included training webinars and documents to guide other reserves in the process of creating ecological forecasting products for their sites.

The results of this project have led to new understandings about how sediment is transported over the marsh plain. This enhanced understanding of water and sediment flow across the marsh has provided unexpected insights on related issues. For example, when California State Parks was developing its oil spill response plan, it prescribed putting oil booms in front of channel mouths to prevent oil from coming up into the marsh. However, at high tides, the study results showed that water enters the marsh by flooding across the marsh plain and exiting through the channel mouths. Consequently, this knowledge suggests that oil could actually get trapped in the marsh by booming the channel mouths under periods of high tides.

The results of the project are helping coastal decision makers as they seek to manage the combined impact of rising sea levels and a reduction in sediment inputs to the Bay. The project results were cited as very valuable by reserve stakeholders, including the Bay Conservation and Development Commission and State Parks.

NASA Research Opportunities in Space and Earth Sciences (ROSES)

Building on the project further, the reserve helped initiate a successful NASA Research Opportunities in Earth and Space Sciences project, “Forecasting Coastal Habitat Distributions through Fusion of Earth Observations, Process Models and Citizen Science: A Climate Change Adaptation Tool for the NOAA National Estuarine Research Reserve System.” The project brings together satellite data with in situ observations with the Marsh Equilibrium Model that predicts dynamic rates of mineral and organic accretion based on two primary variables: total suspended sediment and peak aboveground biomass. The projects look at the elevation response of four marsh zones: unvegetated, low, middle, and high marsh, which are incorporated into the spatial model to produce maps for assessing habitat sustainability and potential for landward migration. The Coastal Training Program helped develop a stakeholder engagement process and hosted a workshop with local and national partners to determine the most useful products for decision-making activities. Rush Ranch served as the pilot site and was chosen based on its habitat diversity, rich plant productivity data sets, active stakeholder-based planning, and involvement in the California King Tides citizen-science photo documentation program. The application was designed to help coastal decision makers evaluate their coastal management decisions and generate maps to communicate rates and extent of inundation and changes in coastal vegetated communities to help reserve staff and their communities understand future resilience and vulnerability of habitats at local to regional scales.

Local Coastal Decision Maker Trainings

To better understand the training needs of coastal planners, the Coastal Training Program was one of 15 organizations to partner with the University of Southern California Sea Grant to conduct a climate change adaptation needs assessment of coastal planners in California. A report, “Rising to the Challenge: Results of the 2011 California Coastal Adaptation Needs Assessment,” was published. In 2013, the Coastal Training Program partnered with Elkhorn Slough Reserve to conduct a Climate Change Adaptation Training Needs Assessment to help guide the program’s future activities.

Over the evaluation period, the reserve has conducted a number of trainings and workshops to support climate change adaptation efforts in the region. Examples of trainings not already mentioned in this section include the following:

- 2011 Data and Tools for Incorporating Climate Change Impacts into Community Planning and Project Design
- 2012 Resources for Coastal Climate Change Adaptation
- 2014 Communicating Coastal Climate Impacts to Diverse Audiences
- 2014 Communicating Climate Change: Climate Engagement Strategies and Problem Solving

Olympia Oyster Restoration

The reserve's research coordinator and Elkhorn Slough research coordinator co-led a NERRS Science Collaborative-funded project titled, "Managing for Resilience in the Face of Climate Change: A Scientific Approach to Targeted Oyster Restoration in San Francisco Bay and Elkhorn Slough, California." The project was also a partner with the University of California Davis, State Coastal Conservancy, Smithsonian Environmental Research Center, and California Department of Fish and Wildlife. Along the West Coast, there have been increased restoration efforts for Olympia oysters over the past decade. To address a need for a better understanding of oyster response to changing climate conditions, the project combined stakeholder input with field monitoring and laboratory experiments to allow for evaluation of oyster responses to relevant environmental factors. The project looked at many aspects of Olympia oyster ecology, including field studies of recruitment patterns and timing, population surveys, and environmental monitoring, as well as lab studies of oyster tolerance to stressful conditions. As part of the project, the partners have also worked to create a more standardized regional database tracking Olympia oyster-related information such as monthly recruitment and annual bay oyster survey results. The results of the project have also been used in the design of restoration projects at Eden Landing, owned by the California Department of Fish and Wildlife, and San Rafael, a site owned by The Nature Conservancy.

A resource, "A Guide to Olympia Oyster Restoration and Conservation," was developed that identifies key environmental conditions that affect Olympia oysters in central California. Availability of hard substrate, abundance of phytoplankton, and relatively warm water temperatures are identified as important factors for supporting sustainable oyster populations. Low salinity, low dissolved oxygen, warm air temperatures, and abundant predatory oyster drills are found to be the most important stressors negatively affecting oysters. In general, stressors already facing oysters today appear likely to exert more influence over Olympia oysters in coming decades than emerging climate-related stressors. Using data on oyster attributes and environmental conditions, the authors evaluated 21 sites in San Francisco Bay and Elkhorn Slough for their restoration and conservation potential.

Through a science collaborative transfer grant the project was expanded to include Tijuana River, South Slough, and Padilla Bay, where sites of interest for restoration or conservation were scored based on indices of oyster and environmental attributes. Results were summarized in a guidance document for stakeholders and a site evaluation table that can be updated over time. In addition, the project jump-started biological monitoring at the seven sites. The Marine Global Ecological Observatory, a partner in the project, noted that it would be looking to use the results more broadly and compare them with other regions, such as the Chesapeake Bay. A stakeholder from the observatory also noted that they hope to partner with the reserve on an oyster ecology citizen-scientist project they had just initiated.

The education program developed a pilot Watershed Water-Quality Monitoring Program with a veteran science teacher from Redwood High School in Larkspur. The program focused on the high school science teachers in Marin and Solano Counties. The education coordinator added

an oyster-monitoring component to bring in cutting-edge research to high school students. Students get to participate as citizen scientists by looking at settlement plates and counting oysters. The revised “Oyster and Climate Monitoring” program now incorporates multiple field and lab visits, utilizes complementary lesson plans using student-collected and System-wide Monitoring Program data, engages students directly in the practice of science, and collects valuable monitoring data for the reserve. The program directly aligns with Next Generation Science Standards, supports NOAA’s interest in citizen science, and meets the needs as determined by the education needs assessment process. The project has now run for several years and has been expanded to Tamalpais High School in Mill Valley.

The education coordinator was the work group leader for the development of the Estuaries 101 high school curriculum and an active leader in the development of the Middle School curriculum, and is currently part of a science collaborative transfer grant-funded project to integrate science collaborative research into additional Estuary 101 lessons. From July 2012 to July 2014 the education coordinator counted 1,104 contact hours with high school science students, primarily through the Oyster and Climate Monitoring Program. These numbers do not include student time spent on the reserve project under supervision of their classroom teacher.

Blue Carbon

The reserve has contributed to new knowledge about carbon storage in tidal wetlands through extensive sediment coring through three separate initiatives: pioneering work published in 2012 by Dr. John Callaway; a National Estuarine Research Reserve System-led comparison of carbon storage and monitoring techniques across nearly a dozen reserves; and an emerging effort by the Smithsonian to characterize coastal carbon sequestration on a larger scale. In 2014, the reserve began a collaborative project led by the U.S. Geological Survey to measure flux of carbon dioxide and methane across the marsh surface at Rush Ranch. Carbon flux measurements are difficult and expensive to collect and will complete the first ever such data set of carbon flux in a tidal marsh system. Results of the sediment coring projects at Rush Ranch have led to new research and monitoring projects nationwide and offer useful sources of information for future assessments of carbon storage and carbon credit valuation.

San Francisco Bay Sentinel Site Cooperative

The reserve is a founding partner of the San Francisco Bay Sentinel Site Cooperative, which is also led by the NOAA Office for Coastal Management, Gulf of the Farallones National Marine Sanctuary, and Bay Conservation and Development Commission. Other entities including Stanford University and the U.S. Geological Survey also contribute data.

The cooperative was created to provide information to San Francisco Bay area communities and resource managers and planners to help them address vulnerability to sea level rise and associated challenges such as degraded water quality and wetland loss. The cooperative secured a two-year Sea Grant fellow who is co-mentored by the reserve manager and the director of the West Coast regional office of the NOAA Office for Coastal Management.

As a founding member, the reserve has taken on a leadership role and is seeking ways to engage a variety of partners and develop short-term and long-term products. The reserve is providing robust support to the science component of the sentinel site cooperative. As the cooperative matures and is able to provide more research results and data, this will open opportunities for deeper engagement with the Coastal Training Program and education program to translate the science and bring it to coastal decision makers and teachers and students.

King Tides

Reserve staff members have collaborated on the King Tides Photo Initiative to link data to public outreach and education. The reserve and a number of other government agencies and nonprofit partners developed the initiative, which kicked off in 2012. The education coordinator regularly conducts marsh walks during King Tide events. Tickets sell out fast and members of the public learn about marsh response to sea level and sea level rise research while directly experiencing a King Tide event. The Coastal Training Program coordinator is on the leadership team for the initiative and assists with publicity. The initiative encourages the public to take photographs of the flooding in recognizable locations. The research team collects data on sediment transport and deposition to the marsh during King Tides to improve understanding of marsh response to sea level rise. One stakeholder stated that “California King Tides is incredible” and had garnered lots of press attention, while another noted that the project was the best example of the reserve partnering with others to get information out.

Lifting the Fog

To help local decision-makers understand the multiple new tools, models, and guidance developed to address the impacts of coastal climate change, the reserve partnered with the Tijuana River Reserve, Gulf of Farallones National Marine Sanctuary, Office for Coastal Management, The Nature Conservancy, and Coravaii LLC to “Lift the Fog” around shoreline change models and sea level rise tools. The Coastal Training Program coordinator helped develop and lead two workshops. The first was a tool development workshop that invited participants from the tool- and model-development community and intended end-users to explore ways to help end-users navigate the different planning tools and data available to them, as well as identify gaps and inform tool developers of future adaptation needs.

A second workshop included an interactive tool café with stations for tool exploration; a panel session for direct interaction between tool developers and decision-makers and end-users; and a discussion of communication strategies for sea level rise decision-support tools. Workshop participants were a diverse mix of practitioners attending the California Adaptation Forum, including federal, state and local agencies; consultants; nonprofit organizations; and academia.

Teacher Trainings

The education coordinator has also conducted a number of teacher workshops, including a series between July 2012 and July 2014; the education program had 783 contact hours with educators completing professional development workshops, with the majority the workshops focusing on coastal implications for climate change. The workshops improve teachers' willingness and confidence to teach about the subject, thereby increasing climate and science literacy.

Our Coast Our Future

The reserve also received a science collaborative grant to fund Our Coast Our Future, a multi-partner project that produced a suite of coastal flooding projections for over 40 combinations of anticipated sea level rise and storm conditions from Bodega Bay south to Half Moon Bay. The projections are available on interactive maps overlaying infrastructure and ecosystem vulnerabilities at <http://data.prbo.org/apps/ocof>. The maps provide coastal planners and emergency responders with visual-based information to understand, visualize, and anticipate local impacts from sea level rise and storms.

Accomplishment: The San Francisco Bay Reserve education program has successfully incorporated the reserve's oyster research project and System-wide Monitoring Program data into educational programming, engaging high school students in field work to learn more about how water quality affects oysters in the bay.

Accomplishment: The San Francisco Bay Reserve research program has successfully brought together partners to better understand the dynamics of the bay through projects such as Mud on the Move and Olympia Oyster Restoration, and the information is being used to inform coastal management decision-making in the region.

Recommendation: The Office for Coastal Management encourages the San Francisco Bay Reserve to develop coastal trainings and other communication mechanisms to bring its cutting-edge research and stewardship information, particularly around habitat restoration and climate resilience, to local governments and other regional, state, and federal agencies.

Evaluation Metrics

Beginning in 2012, national estuarine research reserves began tracking their success in addressing three evaluation metrics specific to their programs. The evaluation metrics include a five-year target and provide a quantitative reference for each program about how well it is meeting the goals and objectives it has identified as important to the program.

The goals and objectives for Metrics 1 and 3 are from the national performance measurement system as described in National Estuarine Research Reserve System Performance Measurement

Guidance (July 2011). The goal and objective for Metric 2 is based on the San Francisco Bay National Estuarine Research Reserve Management Plan 2011–2016.

METRIC 1

Goal: Scientific investigations in the reserve improve understanding and inform decisions affecting estuaries and coastal watersheds.

Objective: By 2017, improve understanding of the effects of climate change and other environmental stressors on estuarine and coastal ecology, ecosystem processes, and habitat function.

Strategy: The research coordinator will conduct and coordinate basic and applied scientific investigations in the reserve and will work to ensure that results of reserve research and monitoring—collectively known as “science products”—are made readily available. Research products include publications, technical reports, manuals, and proceedings that are based on research results. Monitoring products include publications, technical reports, manuals, assessment reports, inventory products, and survey products. This strategy, to make science products readily available, will be accomplished by facilitating permits for site activities, providing access to monitoring data, providing feedback on experimental designs, encouraging coordination with other complementary studies, and assisting researchers with data collection and infrastructure deployment and maintenance. Resulting science products will be recorded in the NERRS research database.

Performance Measure: Between 2012-2017, number of science products based on research and monitoring in reserve sites by reserve staff and other researchers made readily available.

Target: Between 2012-2017, 25 science products based on research and monitoring in reserve sites by reserve staff and other researchers made readily available.

First Year Results: 11 science products

Second Year Results: 8 science products

Third Year Results: 4 science products

Discussion: The reserve has completed 23 of 25 science products and should easily be able to exceed its five-year target in the next two years.

METRIC 2

Goal: Increase knowledge and understanding of the Bay, other northern California estuaries and coastal habitats, especially around the topics of climate change, water-quality, and habitat restoration.

Objective: By 2017, science teachers who participate in reserve trainings will better understand estuarine science, including potential local effects of climate change, water-quality and water-quality data, and how to incorporate restoration projects into science curriculum. They will also have access to lesson plans and other support to aid teaching about these topics in their classrooms.

Strategy: The reserve's Education Program offers professional development programs for science teachers with content (including curriculum support) primarily focused on climate change, water-quality, and restoration science. Pre and post-workshop evaluations are conducted to measure improvement in understanding of estuarine science and how science teachers intend to use the workshop content.

Performance Measure: Between 2012-2017, number of contact hours of professional development provided for science teachers around the topics of climate change, water-quality, and restoration science.

Target: Between 2012-2017, 1,400 contact hours of professional development provided for science teachers around the topics of climate change, water-quality, and restoration science.

First Year Results: 661 contact hours with science teachers

Second Year Results: 391 contact hours with science teachers

Third Year Results: 496 contact hours with science teachers

Discussion: The reserve has already exceeded its target of 1400 contact hours.

METRIC 3

Goal: Scientific investigations in the reserve improve understanding and inform decisions affecting estuaries and coastal watersheds.

Objective: By 2017, improve understanding of the effects of climate change and other environmental stressors on estuarine and coastal ecology, ecosystem processes, and habitat function.

Strategy: Improving understanding and informing decisions affecting estuaries and coastal watersheds relies on having long-term monitoring data that is high quality, consistently collected and publically available. The reserve will implement the National Estuarine Research Reserve System's System-Wide Monitoring Program (SWMP) following standard procedures and protocols as outlined in "System-Wide Monitoring Program Plan" (September 2011). Data will be submitted to the Centralized Data Management Office by required deadlines with

proper QA/QC. SWMP data will be incorporated into education and training programs and/or materials.

Performance Measure: Percent of SWMP data sets submitted annually to Centralized Data Management Office that meet established standards for QA/QC.

Target: 85% of SWMP data sets submitted annually to Centralized Data Management Office meet established standards for QA/QC.

First Year Results: All data complete and submitted on time

Second Year Results: All data complete and submitted on time

Third Year Results: All data complete and submitted on time.

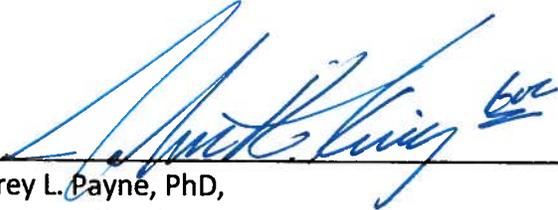
Discussion: The reserve continues to remain on track and has met its target all three years.

Conclusion

For the reasons stated herein, I find that the San Francisco State University of California is adhering to the programmatic requirements of the Coastal Zone Management Act and its implementing regulations in the operation of its approved San Francisco Bay National Estuarine Research Reserve.

These evaluation findings contain four recommendations that must be considered before the next regularly scheduled program evaluation. Program recommendations that must be repeated in subsequent evaluations may be elevated to necessary actions.

This is a programmatic evaluation of the San Francisco Bay National Estuarine Research Reserve that may have implications regarding the state's financial assistance awards. However, it does not make any judgment about or replace any financial audits.

A handwritten signature in blue ink, appearing to read "Jeffrey L. Payne", with a stylized flourish and the letters "JLP" written below it.

Jeffrey L. Payne, PhD,
Director, Office for Coastal Management

A handwritten date "7/21/16" in blue ink, positioned above a horizontal line.

Date

Appendix A: Response to Written Comments

No comments were received.