M E M O R A N D U M

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Subject:	Summary of Findings and Potential Restoration Actions
Copy(ies) To:	Coastal Conservancy, USFWS, NMFS, DFG, VAFB, PRBO, TNC

INTRODUCTION

Estuaries on the Central California coast provide critically important habitat for a variety of rare, threatened and endangered species. Audubon California, as part of its Important Bird Area Program, is seeking to facilitate restoration and sustainable management of these natural resources. The Santa Ynez Estuary has been previously identified by the California Coastal Conservancy and other agencies as providing a significant opportunity for ecologic restoration because of its scale, location, and public ownership within Vandenberg AFB. The goal of this project is to identify restoration opportunities to enhance the ecologic value and ensure sustainability of native habitats in the lower Santa Ynez River corridor and estuary downstream of the 13th Street Bridge (approx. three miles) to benefit migratory and wintering shorebirds, wading birds and waterfowl, marsh dependant species such as the Savannah Sparrow, riparian woodland dependant songbird species such as the Southwestern Willow Flycatcher, and resident and migratory aquatic species such as the Tidewater Goby and Southern Steelhead.

In 2009 Audubon California retained PWA to provide advice on the feasibility of restoration actions within and immediately upstream of the estuary. Because these potential restoration actions are also likely to benefit biodiversity in general and steelhead restoration efforts now being advanced, the Nature Conservancy, the California Department of Fish and Game, California Coastal Conservancy, and US Fish and Wildlife Service joined with Audubon California to support this study in 2010. As part of this effort, a stakeholder process was begun to both advise this project, and to initiate a discussion of restoration opportunities among federal, state and local agencies, landowners and other key stakeholders and to engage community members in a broader visioning process.

This report documents historic changes in land uses, hydrology and lagoon functioning to identify potential restoration opportunities to improve the ecological health of the Lower Santa Ynez River Estuary. This assessment summarizes what we know about the functioning and evolution of habitats on the lower river based on existing available information and field data collected under this contract in the period of October 2009 to July 2010. We use this information to articulate a conceptual model that link potential restoration actions with desired ecologic outcomes based on our understanding of how the lagoon opens and closes, and how the lower river and floodplain are responding to anthropogenic change. These conceptual models provide an initial basis for evaluating possible restoration actions and their

potential to reverse negative trends. An initial assessment of climate change impacts examines a future under a no action alternative based on 1.4 meters of sea level rise and increases in temperature over the next 100 years. Finally we identify a suite of potential restoration actions, discuss opportunities and constraints of the various strategies, and then outline additional studies and work programs that are needed to implement some of these restoration strategies and fill some of the data gaps.

2. FINDINGS AND POTENTIAL RESTORATION ACTIONS

2.1 SUMMARY OF FINDINGS

Wetland habitats of the estuary and lower river have developed and persisted over a long period of time by sediment deposition and erosion shaped by large floods events and rising sea levels.

Historic Changes

1. Over the last 150 years human activities, especially dam construction, have significantly affected river flows in the entire watershed. The most important changes to wetland habitats and ecologic processes have resulted from changed river inflows and sediment loads from the watershed combined with changing hydraulic and geomorphic effects from bridge causeways. These process changes have led to alteration of sedimentation and erosion patterns and converted wetland habitats to upland.
2. Upstream dam construction now controls 47% of the watershed's annual runoff, has reduced the frequency and duration of lagoon breaching as well as the magnitude and frequency of flood events that have the most important role in sustaining and renewing a mosaic of wetland and estuarine habitats within the estuary and lower river.
3. These habitats have been further altered by the construction of road and rail causeways and bridge crossings that limit the natural migration of deltaic river channels during flood events that renew the mosaic of sandflats, salt marsh, and channel diversity. Specifically, construction of the 13th St and 35th St bridge causeways (and remnants) have simplified the deltaic river floodplain that transitions into estuarine habitat, concentrating flood flows in a single fixed path instead of allowing multiple meandering braided channels to develop and migrate during large flood events. The impact of Floradale causeway likely has similar impacts but was not assessed in this study.
4. Analysis of the early historic maps show that over the last 140 years it appears these combined affects have reduced the area of lagoon influenced salt marsh habitat by about 60-100 acres.
5. Over the last 140 years, it appears that the riparian forest has grown in acreage over the lower portions of the study site. However, since roughly 1970, the riparian forest seems to have become a relict climax forest with little to no recruitment or age diversity.
6. Between 1929 and 2005, dunes became vegetated and stabilized. On the north bank west of the railroad, dune elevations increased by nearly 20 feet and expanded in width by about 250 feet.

Changes to Physical Processes and Habitats in the Lagoon and Beach

7. Alterations in seasonal inflow affect the timing and duration of lagoon mouth opening and closing.
8. Extensive pickleweed salt marsh plains have persisted at the margin of the lagoon at elevations of about 8.5 to 11.5 ft corresponding to the typical summer and late fall lagoon levels.
9. Opening of the lagoon mouth occurs when river inflow and wave overtopping is sufficient to fill the lagoon and overtop the beach berm. The beach berm elevation varies seasonally and dictates the maximum seasonal lagoon water surface elevation. In 2010, at the time of the first winter breaching the berm elevation was at about 13.5ft NAVD.
10. When the first winter floods breach the beach berm scouring is sufficiently powerful to erode a deep channel through the beach allowing for full tidal exchange for up to several months in the

lagoon. With full tidal exchange the low tide level in the lagoon drops to 4.2 ft NAVD exposing up to 150 acres of intertidal sandflat and mudflat habitat.

11. Shorebird abundance, diversity, and distribution in the estuary is limited by the amount of open sand and mudflats, which is a function of the timing and duration of lagoon opening.
12. Over-wintering shorebirds responded strongly in the period following breaching of the beach berm when sand and mud flat habitats were exposed.
13. The response of migratory shorebirds from March through April and from July through October was minimal due to the prolonged inundation of sand and mud flat habitats.
14. As flows diminish the beach sill rebuilds vertically, reducing tidal action and elevating lagoon water levels. Flows over approximately 10 cfs will continue to maintain a shallow channel across the beach. However, at flows less than about 10 cfs the channel is completely closed off.
15. The impacts of the El Niño events of 1997-98 were of greater magnitude than the 2010 event with thalweg elevations of the beach channel scoured to 2.5 to 3.0 feet as opposed to 2010 (4.2 feet NAVD). This would expose greater expanses of sand and mudflat habitats. The El Niño related eroded approximately 20,000 cy from a dune near the lagoon breach.

Changes to Physical Processes and Habitats in the Lower River

16. Upstream diversions and groundwater pumping have reduced summer base flows likely diminishing the connection between the riparian and the river.
17. Sedimentation, probably enhanced by the 35th Street causeway and sill and possibly associated with the 1969 flood, has created a wedge of sediment upstream of the 35th St Bridge remnants which may have raised the floodplain and initially raised the channel thalweg.
18. The channel has subsequently downcut through the floodplain terrace, potentially in response to bedload reduction due to sand mining or sediment impoundment in the watershed. Since 1970, there has been about 15 ft of downcutting of the river channel thalweg at the 13th St bridge that is observed for approximately 5,000 feet downriver.
19. In addition to the incision documented since 1970, a knickpoint or steeper point in the slope identified in the thalweg (deepest point of the channel bottom) has either flattened or migrated upstream and the channel slope has become flatter, decreasing almost two fold from approximately 0.13% to 0.07%.
20. Maximum lagoon water levels inhibit riparian forest growth below elevations of 13.5 feet NAVD.
21. Maximum lagoon water levels currently backwater nearly to 13th Street Bridge providing some evidence that future incision is limited.

Future Projections of Climate Impacts

22. Future climate changes in the next 100 years are projected to increase temperature by 1.5 - 4.5 degrees Celsius (2.7 – 8.1 F) and elevate sea levels by 4.6 feet. Model outcomes on changes in wave climate, El Niño frequency and precipitation are inconclusive.
23. Increases in temperature will likely lead to an increase in groundwater pumping and further reduction in riparian health potentially increasing stream temperatures.
24. Projected sea level rise will erode the shoreline and result in a migration of the barrier beach landward. Assuming that adequate sediment remains on the beach, the berm crest elevations will increase and will in turn elevate lagoon water levels. Estuary habitats are likely to migrate inland and upslope converting salt marsh to mudflats, and low lying coastal scrub to salt marsh.

2.2 POTENTIAL RESTORATION ACTIONS

Wetland habitats and estuarine processes in the Santa Ynez estuary could potentially be restored by managing inflows to the estuary and by physical modifications to restore natural processes. Such restoration opportunities will require significant involvement of stakeholders, additional analyses and engineering design; as well as undergoing the appropriate permitting and environmental review.

1. The longevity of the potential restoration actions is in part dependent on the future balance between water and coarse sediment from the watershed and sandshed.
2. Climate change and the rates of sea level rise will affect beach berm crest elevations and lagoon water levels. The long term success of restoration efforts at this site will require management of sediment and water supply as well as local topography and structures.

Flow Management Opportunities

3. Develop a predictive model of lagoon openings and closings that could be used in designing a water inflow management regime that would optimize availability of intertidal shorebird habitat and steelhead passage during the migration seasons. Sources of water for such releases could come from wastewater discharge and/or dam releases.

Physical Modifications – Lagoon Restoration Opportunities

4. Removal of the 35th St bridge remnants, grading of a secondary channel (~25,000 cy), and potentially removal of an estimated 300,000 cy of accumulated sediments would allow the river channel to migrate as it did in the past and restore approximately 50 acres of sandflat and saltmarsh habitat. This would also create more diversity of channel morphologies, refugia for shorebirds, and reduce erosion of Vandenberg AFB property along the north bank.
5. Regrading and removal of sediments along the north bank upstream of the 35th Street bridge between 300,000 and 500,000 cy would restore approximately 40 to 50 acres of salt marsh or sand/mud flat habitat.
6. Vegetation removal from the dunes would increase the natural blowing sand and likely restore wider meanders on the west side of the railroad and improve shorebird habitat. This could be added as another phase to the current invasive vegetation management program on VAFB.
7. Reengineer of the railroad bridge to increase the span and reduce the embankment would permit more natural river migration along the historic floodplain.
8. Reconnecting the Dune Swale Pond to the estuary at lower lagoon levels (<10.5 ft NAVD), could require approximately 10,000 cy of excavation and add nearly 15 acres of sand flat, mudflat habitat while improving circulation and salt marsh habitat. This may have a minor benefit of reducing some of the flooding in Ocean Beach County Park.

Physical Modifications - Floodplain Restoration Opportunities

9. Grading terraces adjacent to the river channel could allow regeneration of about a one mile long riparian woodland corridor. These elevations should be graded at the 10,000 cfs or the 5 year flow elevation which would suggest grading down 7-8 feet along the incised channel.
10. Grading a secondary channel down to elevations of a 5 year flood event near the incision would provide groundwater to the northern portion of the flood plain and improve riparian forest recruitment. This would require grading a secondary channel between 2500 and 6000 feet long by 100 feet wide would require the removal of between 40,000 cy and 75,000 cy.
11. Connecting the former Vandenberg AFB sewage treatment ponds and reconnecting them to the river and floodplain could improve their habitat value for avian species, reduce maintenance costs and improve floodplain recruitment of riparian woodland. Given the documented incision, and previous engineering of the site, the feasibility of this restoration strategy should be investigated further with consideration of the physical and geomorphic processes operating in the study site.

Monitoring

12. Expanding the analysis described in this report will require further monitoring of the lagoon including reestablishment of the stream gage at 13th St, water and beach levels in the lagoon.
13. Any implemented restoration action should be monitored especially after 5+ year flood events.