Levee-Related Habitat Review

Delta Stewardship Council

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EXECUTIVE SUMMARY

The Delta Stewardship Council (Council) has undertaken the development of a Delta Levee Investment Strategy (DLIS) intended to guide State investments in flood risk reduction. While investing in levee improvements to reduce risk, the State has both an opportunity and an obligation to enhance habitats to provide a net benefit to both terrestrial and aquatic species, and to mitigate for the adverse environmental impacts of levee projects.

The extent and character of Delta habitats have been altered dramatically over the past 150 years, but remain essential to fulfill important ecological functions in the watershed. They form the basis for terrestrial and aquatic food webs, provide essential wildlife habitat and migratory corridors, filter nonpoint source pollution, and improve water quality.

The Council must ensure that the DLIS helps to implement the Delta Reform Act and the Delta Plan. The Delta Reform Act of 2009 established the Council and defined its mission: to achieve the coequal goals of water supply reliability for California and ecosystem restoration in the Delta, in a manner that protects and enhances the values of the Delta as an evolving place (Water Code section 85054). The Delta Reform Act required the Council to develop the Delta Plan and defined certain types of projects and programs as "covered actions" regulated by the Delta Plan. The Delta Plan includes 14 policies, including one that calls for levee projects to incorporate habitat benefits, where feasible, and another requiring the use of the best available science and adaptive management.

Restoration Mandates and Constraints

In addition to the Delta Reform Act, other previous legislative mandates require Delta levee projects to provide habitat improvements. Water Code section 12314(c) instructs the California Department of Fish and Wildlife (CDFW) to consider the value of riparian and fisheries habitat along riverine corridors. Water Code sections 12314(d) and 12987(d) require that state-funded Delta Levees Special Flood Control Projects, designed to improve project and non-project Delta levees, must be consistent with a net long-term habitat improvement program (aka enhancement) and have a net

benefit for aquatic species in the Delta. However, implementation of levee-related habitat projects faces various regulatory and liability constraints, due in part to the need to balance flood risk reduction and habitat improvement.

Purpose and Approach

While the DLIS appropriately focuses on flood risk reduction as the primary purpose of state levee investments, this levee-related habitat review is intended to provide guidance in ensuring that those investments will also contribute to long-term improvement of river corridors with net benefit for fish and wildlife. Another goal of this review is to provide information about how much different habitat improvement options cost, specifically those habitat options that can be linked with flood risk reduction projects. The cost analysis focused principally on habitat enhancement projects conducted through the Delta Levees Special Flood Control Projects Program (Special Projects Program).

Through coordination with other agencies and stakeholders, we obtained descriptions of completed levee-related habitat improvement projects (hereafter, projects) and associated reports on monitoring that has been conducted within the Delta. Information about fourteen levee-related projects was obtained from a query of sixteen interviewees and fourteen additional contacts provided by interviewees. Project effectiveness was evaluated in terms of: 1) the project stated objectives, performance measures, monitoring, and results; and 2) whether or not a project could be shown to benefit aquatic and/or terrestrial species.

For the purposes of this report, Council staff used the same habitat classifications and definitions as the California Department of Water Resources' (DWR's) FloodSAFE Environmental Stewardship and Statewide Resources Office (FESSRO). FESSRO identifies four different levee-related habitat types: freshwater marsh (tidal and non-tidal), shaded riverine aquatic (SRA), riparian forest and scrub shrub.

Analysis

Our review of habitat projects found that the majority of reports used vegetation monitoring as a means of measuring success. This finding was not unexpected because, prior to the adoption of the Delta Plan in 2013, adaptive management, including monitoring and assessment of project effectiveness for fish and wildlife, was not required or funded for every levee-related habitat project in the Delta. Vegetation coverage is an indicator of habitat, and is widely used as one of the ways to track progress in

ecosystem restoration. However, the Delta is a highly altered ecosystem and the relationships between vegetation coverage and benefits to target species are more complex than in systems that are closer to their historical ecological structure and function. Therefore, research and monitoring related to fish and wildlife response, as well as vegetation monitoring, is needed to determine whether projects are providing benefits to target species. Because fish and wildlife monitoring data were not available for most projects and existing data are inconsistent across projects, we were unable to compare the effectiveness of different types of habitat improvement projects. Instead the report summarizes lessons learned from monitoring reports and through interviews with experts about which habitat designs may provide greater benefits to target native species.

Similarly, we experienced problems trying to accurately assess the costs of different habitat options associated with levee/habitat enhancement projects. Cost information for the habitat component of levee projects is rarely broken out from the risk reduction component (i.e., levee construction or habitat improvements), making it impossible to cleanly parse out and compare costs of different types of habitat improvements. As a result of this limitation, our analysis presents the total costs of projects (i.e., the cost of not only the habitat component but the construction of the flood risk reduction component) broken down broadly into different habitat enhancement project types, like setback levee projects versus projects involving riparian planting within levee riprap.

Project Design Considerations

Despite our inability to draw conclusions regarding the effectiveness of different habitat improvement designs, our review of project monitoring reports did result in some observations regarding effectiveness that can inform future projects. The review suggested a need for caution when applying lessons learned from other parts of the Central Valley to project design in the Delta, due to its unique estuarine and deltaic habitats and highly altered physical state. For example, the distance to setback levees for maximum environmental benefit for the Sacramento River is estimated to be between 1 and 3 times bank-full channel width (Larsen et al. 2012). In many parts of the Delta, a setback distance of three times bank-full width would equate to hundreds of feet (Diagram D1), which would be a challenge to achieve in places where the landward side of the levee is composed of deeply subsided peat soils. In such subsided areas, setback levees are often infeasible since it would require substantial import of fill material, which is cost-prohibitive. Additionally, there are many other challenges in doing a setback levee project that are not just unique to the Delta which include: finding willing landowners to provide the land for the setback, which may result in permanent loss of active farmland; complications

in protecting existing structures, easements, and utilities; and increased cost and time necessary for project design and permitting.

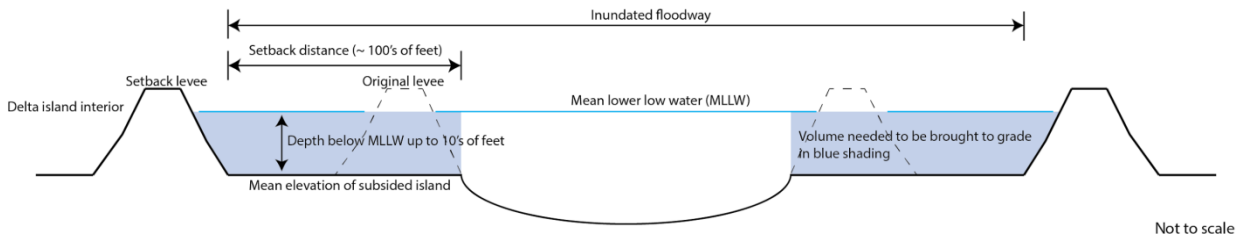

Diagram D 1. Setback levee on deeply subsided Delta Island.

Given the high cost of setback levees where Delta islands are at subtidal elevations, modifying existing levees into "extra-wide" levees (DPC 2012) may be a more cost-effective option and may be more likely to be supported by landowners. Extra-wide levees allow the levee to be graded to create a waterside slope that ranges from subtidal to supratidal elevations where installation of riparian habitat, SRA, tidal marsh, and channel margin habitat can occur. In lieu of or in combination with a setback levee or extra-wide levee, a planting bench on the waterside levee slope may be installed to provide the appropriate depths and elevations for establishing channel margin habitat. These benches may be stabilized with riprap covered with soil and riprap mix that can support tidal marsh and/or riparian vegetation (Diagram D2).

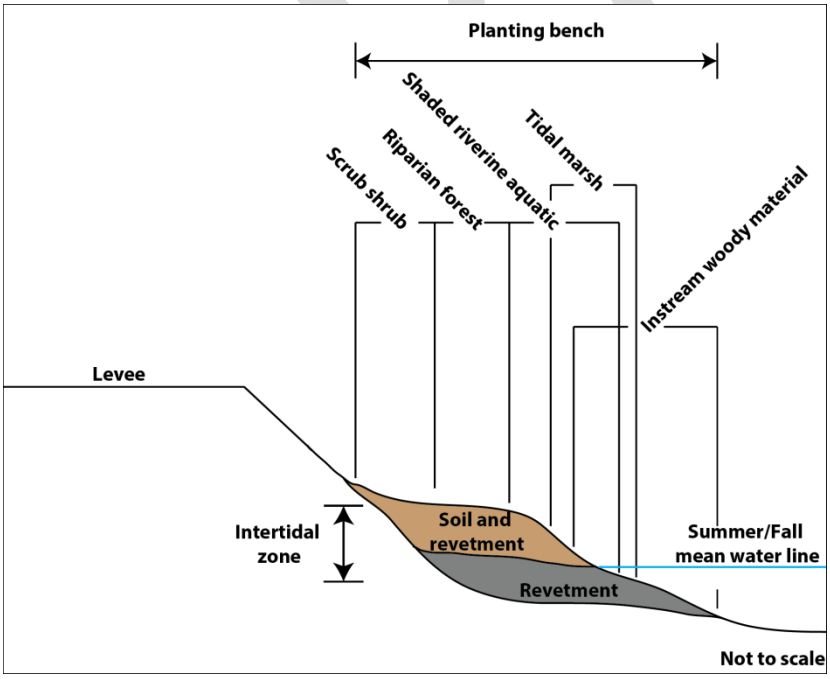

Diagram D 2. Planting bench on waterside toe of levee.

Planting on and near existing levees is generally inexpensive and conceptually would provide ecosystem benefits. Fish monitoring conducted along the Sacramento and American Rivers has shown increased occupancy of native species at sites with planting benches compared with adjacent riprapped banks lacking vegetation (Fishery Foundation of California 2006; FISHBIO 2015). In locations with especially high water velocity and steep bathymetric gradients at the waterside levee-slope, planting vegetation on the levee slope, with riprap as needed, may be a more feasible enhancement option than benches.

Cost Analysis

We assessed cost ranges of multi-objective levee projects that included both risk reduction aspects and habitat improvements using data provided to us by DWR staff. In the past, Delta levee construction projects that incorporated habitat elements on-site generally involved planting of trees within riprap. The costs for these multi-objective projects ranged from approximately $7 million to $26 million per linear mile. The true costs of restoring riparian habitat on levees is still uncertain, since improvement to the structural component of the levee for flood risk reduction purposes is usually the fundamental driver of these multiple objective projects, and the scale of construction work will be different dependent on engineering design considerations.

DWR established the Bulk Credit Program in 2012 which provides off-site mitigation credits exclusively for reclamation districts (RDs) participating in the Delta Levees Program. These mitigation credits were negotiated for a lower price than retail and purchased from Westervelt's Cosumnes Floodplain Mitigation Bank. Habitat credits include shaded riverine aquatic habitat, riparian forest, scrub-shrub, and freshwater marsh.

Setback levees have been constructed by DWR along portions of Sherman Island and Twitchell Island. The total costs of these setback levees projects were approximately $5.5-11.4 million per linear mile (in 2015 dollars). Future setback levees planned in the Delta are expected to be more expensive. The total cost of the proposed setback levee in West Sacramento (Southport Project) is predicted to cost an average $67 million per linear mile (USACE 2014), while future construction of setback levees along the southern portion of Twitchell Island will cost an estimated $14.5 million per mile (DWR pers. comm. 2015). The cost of the setback levee for the Southport Project is substantially larger than DWR's past Delta setback levee projects because it includes the cost of land acquisition with urban entitlements in

areas zoned and priced for housing and the newly constructed levees will be fully setback from the existing levees.

Table 1. DWR Bulk Credit Program Costs

Habitat Type	**Cost Information**	
Shaded Riverine Aquatic Habitat	$61	Per linear foot
Riparian Forest	$62,295	Per acre*
Scrub-shrub	$62,295	
Freshwater Marsh	$120,000	

Source: DWR website (available at http://www.water.ca.gov/floodsafe/fessro/environmental/dee/dee_prog_mit.cfm)

*Includes required buffer acreage that comprises the mitigation bank

One major cost consideration unique to constructing setback levees in the Delta is that peat soils which make for poor, unstable foundations for new levees. There are options to stabilize and prepare these peat soils to adequately support new setback levees, such as dynamic peat compaction or soil mixing. However, those options are quite expensive and may add many millions of dollars per mile of new setback levee, as is estimated for the planned setback levee along the southern portion of Twitchell Island mentioned above.

Next Steps

Based on the findings of the review, we recommend taking the following steps to ensure that effectiveness can be better evaluated in the future.

1. **Apply the Adaptive Management Framework to Future Projects.** Projects proponents need to apply an adaptive management framework to future projects to facilitate scientific learning and reduce uncertainties, including evaluating how well the habitat-related aspects of levee improvements contributed to the establishment of ecosystem processes and the recovery of targeted species. This will require adequate funding for pre-project assessments (if feasible) as well as routine maintenance and post-project monitoring for some years following construction.

2. **Track the Incremental Cost of Habitat Improvements.** Better cost accounting of the habitat element of levee projects is necessary to better understand how funds have been invested to improve habitat in the Delta. For example, costs could be segregated by bidding construction and habitat components separately following the practice of the Sacramento Area Flood Control Agency (SAFCA). SAFCA does not bid/solicit levee improvements and habitat improvement projects in the same bid package, providing cost segregation and flexibility in selecting the qualified and experienced contractors to implement the habitat improvement component of a multi-objective project.
3. **Carefully Consider the Tradeoffs Associated with Onsite and Offsite Mitigation.** While offsite mitigation for the environmental impacts of Delta levee projects often has practical advantages, it is important to ensure that mitigation takes into consideration life history requirements of native species. For example, degradation of channel margin habitat along migratory corridors for salmon should be mitigated on-site or at least elsewhere along the same migratory corridor. Our review indicated there are opportunities to promote on-site habitat improvements for levee projects that can also protect and enhance flood risk reduction, including the use of planting benches and extra-wide levees, if willing landowners can be found.
4. **Use Landscape-scale Planning to Guide Project Siting and Design.** In general, larger and more complex habitats will serve to benefit a wider array of wildlife (Brown 2003, Herbold et al. 2014). Regardless of the size of an improvement site, projects should not be planned independently of one another, but viewed in a landscape context. For example, efforts should be made to link together fragmented patches of riparian forest to incrementally build towards large contiguous habitat corridors.
5. **Measure Fish and Wildlife Response through a Standardized Regional Monitoring Program.** By promoting a regional monitoring framework (e.g., the CDFW-led Interagency Ecological Program Tidal Wetlands Monitoring Project Work Team), instead of developing monitoring protocols on a project-by-project basis, it will become easier to compare results across projects and improve understanding of the effectiveness of different habitat improvement options. Regional monitoring also supports program-level adaptive management and a landscape-scale approach, as described in *Recommendation 4*. Monitoring, research, and modeling should be linked and designed to close important knowledge gaps at relevant time and space scales (Fish and Flows 2015). Additional and long-term funding is needed for this programmatic monitoring.

DRAFT

6. **Continue to use the DLHAC as a Venue to Discuss the Incorporation of Effective Habitat Improvement Components into Levee Projects.** The Delta Levees and Habitat Advisory Committee (DLHAC) is a regular standing meeting of representatives of DWR, CDFW, Delta RDs, Delta engineers, and other Delta stakeholders. Since the group involves many Delta RDs and their engineers, it represents an opportunity for RDs to collaborate with state agencies to plan and adaptively implement and manage habitat projects under their jurisdiction.

Council staff looks forward to collaborating with agencies and stakeholders to further explore the issues raised in this review and jointly implement the next steps.

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