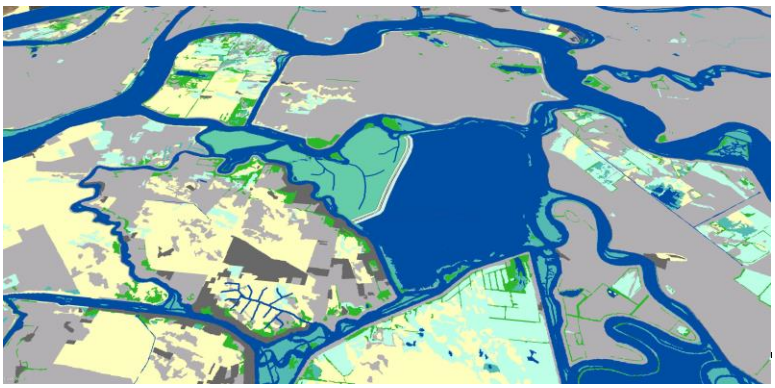
FRANKS TRACT FUTURES?



Exploring a Multi-Benefit Restoration Approach
to Increase Resilience in the Central Delta Corridor

Summary of Technical Reports
& Early Stakeholder Input

California Department of Fish & Wildlife
March 2018

CONTENTS

1. Executive Summary

[4-pages including graphics and maps—TBD last minute]

2. Introduction

Franks Tract is located in the heart of the Delta near the confluence of the Sacramento and San Joaquin Rivers. This 3,300 acre flooded island is a hot spot for invasive plants and native fish predators, not to mention a hydrodynamic conduit for saltwater intrusion into waterways used to convey freshwater supplies to cities and agriculture. Franks Tract is also one of the least subsided, and largest, islands in the Central Delta and a strong candidate for partial restoration.

Islands with conditions like Franks Tract are a microcosm of many of the larger problems pervading the inner Delta and confounding efforts to save endangered fish. While Delta smelt and other native fishes are in serious decline, reducing their risk of being lost to non-native predators or at the state and federal water-project intake pumps, enhancing habitat and food production, and increasing resilience to drought and climate change effects, could still help.

Current estuarine fish habitat restoration plans around the Delta focus on the Yolo Bypass and the North Delta Arc near Cache Slough. Restoration efforts have avoided major changes to the subsided and flooded islands of the central Delta because it is such a challenging environment. Altered waterways, aging levees, subsided landscapes, invasive species, and human uses all interact to make this a difficult part of the Delta to try to establish conditions more supportive of native fish.

Over the years, state and federal agencies have investigated and suggested a variety of alternatives for improving conditions at Franks Tract. Most proposals have been made from the perspective of water supply, and have suggested building various gates and operating them to protect water quality at the pumps. Yet, few if any of these former proposals have addressed long-term sustainability and native species needs.

This report summarizes recent steps on multiple levels to explore the possibilities for making Franks Tract less of a troublemaker for natural resource and water quality managers. Over the last 18 months, the Department of Fish and Wildlife (CDFW), working with other state agencies, has developed a conceptual restoration approach that would divide Franks Tract in two: restoring about 1,000 acres of varied marsh, channels, and edges needed by Delta smelt and deepening and reshaping the other 2-3,000 acres into healthier open water habitat (see Section 3). This division, including a new berm, would have the added benefit of blocking salinity intrusion into the central Delta.

As this conceptual restoration approach evolved, CDFW and its state partners went through the following stages.

- Analysis of potential changes to local hydrodynamics, Central Delta water quality, and to conditions in surrounding channels frequented by boaters, anglers and hunters (see Section 4).
- Analysis of the feasibility of actually constructing the project (see Section 5).
- Consultation with California State Parks, the owner and manager of most of Franks Tract.
- Review of State Parks' initial concerns about the project (see Section 6).
- Preliminary survey of how local boaters, anglers, hunters, and communities use Franks Tract.
- Review of local communities' initial concerns about the project, and their proposed modification of the concept (see Section 6).

This report summarizes what was found at each of these stages. In so doing, the report's goals were to confirm that the Franks Tract project is feasible, which it is, and to provide a strong foundation for proceeding to the next level. The next level would involve moving from conceptual to actual design of the restoration project, and into a more detailed balancing of state resource management priorities, stakeholder concerns, and local recreational uses and economics. Once a more detailed plan is developed, the project would proceed through an EIR process and seek funds for construction and maintenance.

Throughout this ongoing process, it is the intent of state agencies to be collaborative and considerate of local concerns to the greatest extent feasible within the constraints of meeting its water quality and native fish protection objectives, and in keeping with community engagement goals in CDFW's Delta Conservation Framework.

In sum, this report invites Delta stakeholders to consider a bold, sustainable change in the heart of the Delta. Developing a more detailed restoration plan and approving funding for this ambitious Franks Tract project would clearly benefit native fish, the Delta ecosystem, and California's water supply. It could also potentially improve recreational opportunities and flood protection for local communities. Whatever its final configuration, the project would be a necessary first step in transforming a hotspot of Delta problems into a new landscape that can adapt to drought and rising sea levels.

[graphic: aerial photo of the Tract? – maybe add locational map]
Caption: The Franks Tract restoration approach has multiple benefits. It would create open water habitat suitable for Delta smelt, reduce smelt entrainment through Franks Tract toward the export pumps, reduce invasive aquatic weeds, reduce predation on native fishes, improve food webs for native fishes, limit salt water intrusion into local and state water supplies, improve water quality in the south and central Delta, and create a system that can evolve naturally, regardless of human management, levee failures, or sea level rise.

Setting

Franks Tract (3,330 acres) and Little Franks Tract (330 acres) are two flooded islands located in northwest Contra Costa County. The former is bordered by Webb Tract to the north, Mandeville Island to the east, and Bethel Island and Holland Tract to the south. The western extent of the area along West False River consists of Little Franks Tract.

The islands were likely named after John C. Franks, owner of Franks Dredging Company and a fleet of dredges. Franks purchased and reclaimed various Delta properties between 1898 and 1902, including Franks Tract. Since 1959, the California Department of Parks and Recreation has owned most of the Tract.

Franks and Little Franks Tract were once part of a larger tidal marsh that included Bethel Island, Bradford Island, Jersey Island, and Webb Tract. False River, a large blind tidal slough at the time, drained the marsh. In the natural setting of the marsh landscape that once permeated the Delta, channels were often narrow and shallow. Native estuarine fish like Delta smelt found food and sheltered habitats in these channels, marsh edges, and adjacent open waters.

Humans diked, drained, and reclaimed Franks Tract marshlands between 1902 and 1906. This kind of reclamation fundamentally altered its character by creating the islands and tracts noted above and

eliminating, or straightening and connecting, its historic dendritic dead end channels. The increase in channels and their interconnectedness, along with subsequent flooding of subsided islands like Franks and Little Franks Tract, has doubled the amount of open water habitat in the Delta, changed tidal circulation patterns, reduced residences times, and increased flow velocities. These changes also reduced food web production, shelter and habitat complexity for aquatic species throughout the Delta.

On Franks and Little Franks, the reclaimed land was used for farming of potatoes, beans, asparagus, sugar beets, onions, seed crops, small grains, and corn. Peat was also harvested for national distribution. In February 1937, portions of the levee surrounding Franks Tract gave way, flooding the farmland. Local landowners soon reclaimed the Tract, but in February of 1938 the False River levee broke, flooding Franks Tract again. After that, it was never reclaimed. Little Franks Tract survived the 1937 and 1938 floods, but flooded in January 1982 and was also not reclaimed. During World War II, the Navy used the area for bombing practice.

Franks and Little Franks Tracts are currently tidal shallow water habitats surrounded by remnant levees. They are managed as a 3,532-acre State Recreation Area. Due to the limited land base, lack of public access, exposure to strong winds, and shallow fluctuating water level, recreation use is limited primarily to anglers, waterfowl hunters, and boaters. Proximity to this large open water area has led to the growth of small communities and marinas on neighboring Bethel Island. Those with boats use breaks in surrounding levees (and connections between historically unconnected waterways) to access fishing and hunting areas, and as shortcuts to other waterways and points of interest.

While boaters, hunters, and anglers clearly value the open waters of Franks Tract, the ecological and water quality problems of this island are starting to impinge on the greater Delta and California water uses. Today, both Franks and Little Franks are full of non-native submerged and floating aquatic weeds. In terms of hydrodynamics, Franks Tract also now connects many waterways that were never connected in the vast historic marshlands of the Delta. Most problematic is the direct connection provided by Franks Tract between the lower San Joaquin River near Jersey Island and Old River through False River. This allows salt water and fish to be drawn into the south Delta. Most of the fish currently in Franks Tract are non-native fish species, particularly bass and sunfish. The prevalence of invasive plants and predatory bass make the area poor habitat for native species such as Delta smelt and juvenile salmon.

[graphic: fishing tournament photo; locational map]

Caption: Franks Tract is the engine that supports the Bethel Island community and economy. Since it was flooded it has become a recreational focal point for the central Delta, used by boaters, water-skiers, fishermen and waterfowl hunters. Today the Sacramento-San Joaquin River Delta is ranked in the top 10 black bass fishing waters in the United States. In 2016, one hundred and thirty-three bass tournaments were conducted from Bethel Island and the surrounding marinas. The question now, for those trying save native species and protect the "value-added" by alien species (such as bass fishing), is whether and how management actions can enhance both resources? Reconciling these historic and current uses of Franks Tract will require participation of all interests.

Current State Goals for Delta Smelt Resilience

The Franks Tract restoration approach is based on the goals, objectives and actions recommended in the Delta Smelt Resiliency Strategy completed by the State of California in July 2016.

The Strategy is a science-based document prepared by the state to address both immediate and near-term needs of Delta Smelt voluntarily, and to promote their resiliency to drought conditions as well as future habitat variations.

The Strategy relies on intensive interagency science modeling and research conducted in 2015 and compiled in the Interagency Ecological Program Delta Smelt Management, Analysis, and *Synthesis* Team Synthesis Report. The research helped articulate a suite of actions to benefit Delta smelt that can be implemented in the near future. State agencies in line to implement this Strategy include the Department of Water Resources, the Department of Fish and Wildlife, the Division of Boating and Waterways, or others. A team of state and federal agencies, water contractors and NGOs (called the Collaborative Science and Adaptive Management Team) developed an assessment framework that will be used to assess the outcomes of these actions individually and synergistically over time.

The Strategy's primary objective is positive population growth (>1) for the Delta smelt. Goals for achieving this objective are:

Goal 1: Improved Delta smelt vital rates including:
- Higher population growth rates.
- Higher fecundity levels.

Goal 2: Improved habitat conditions including:
- Increased habitat area
  - Increase of small dendritic channels in restored marsh
  - Increase of shallow turbid areas along channel margins
- Improved habitat quality
  - Increased food resources
  - Higher turbidity
  - Reduced levels of invasive species (e.g. weeds, predators).
  - Reduced levels of harmful algal blooms.

These goals build on Delta smelt conceptual models developed by the MAST Team (IEP 2015), and are consistent with several other models developed to date (Miller 2011). The models have a tiered structure with Delta smelt performance (e.g. survival, growth, condition, fecundity) determined by habitat attributes, environmental drivers, and landscape attributes (see chart).

Many of the Strategy's recommended near-term management actions for making Delta smelt more resilient are reflected in the restoration and renewal proposal for Franks Tract, and addressed in the associated engineering feasibility study and hydrodynamics modeling work. Findings are explored in the following pages (see also Appendix ##). According to this preliminary evaluation, the Franks Tract restoration approach would benefit all life stages of the smelt, and improve habitat conditions (food availability, turbidity/visibility, and predation risk).

[graphic: one of the conceptual model diagrams from the MAST report redrawn??].

Prior State and Federal Goals

Various past investigations and plans developed on the part of those planning for Delta water quality and ecological health offer some important context for this new restoration approach, and call out Franks Tract as an key target for improvement.

In the late 1990s, the CALFED Bay-Delta Program, a cooperative interagency effort composed of 25 state and federal agencies, began a comprehensive analysis of potential solutions to the ecosystem restoration, water quality, water supply reliability, and levee system integrity problems of the San Francisco Estuary. In August 2000, CALFED issued a programmatic record of decision that identified three interrelated projects in the north and central Delta to improve water quality and fish protection. These included modifications to Franks Tract, creation of a Through-Delta Facility (a water diversion corridor, isolated facility or tunnel), and reoperation of the Delta Cross Channel (gates and a channel used to move high quality Sacramento River water south to the water projects). See map.

The purpose of these three interrelated salinity improvement projects was to:

- reduce the tidal mixing of waters from the western Delta into Franks Tract and the central Delta;
- isolate the freshwater corridor along Middle and Old Rivers from the western Delta waters;
- increase the transfer of water from the Sacramento River to the central Delta, thus improving flow conditions in the western San Joaquin River.

At the time, it was clear that reducing tidal mixing and the interconnectedness of some channels and flooded islands, especially Franks Tract, could improve Delta circulation patterns and water supply reliability. It was suggested that such steps would also reduce fish entrainment and salinity levels at the water supply diversion and export facilities of the Contra Costa Water District, the State Water Project, and the Central Valley Project. These concepts and ideas remain relevant to the current restoration approach.

Franks Tract was, and remains, central in these and other Delta fixes proposed in the past because it has such a strong effect on flow patterns based on its connections to the rest of the Delta by False River, Fisherman's Cut, Old River, Holland Cut, Sand Mound Slough, and Piper Slough. The CALFED effort also included "the Flooded Islands Investigations" by the Department of Water Resources. These investigations identified Franks Tract as the most effective place, among three flooded islands examined, to make modifications aimed at improving water quality in the south Delta. Proposed modifications included constructing and operating one or more operable barriers in and around the Franks Tract area. Investigations also examined the effects of such modifications on channel velocities, circulation, and water residence time in Franks Tract and the central Delta.

One of the alternative approaches further examined involved installing an operable barrier on West False River. The alternative aimed to create a longer path for salt water to reach south Delta export facilities via Old River. In general, when tidal flow in False River is unimpeded, Franks Tract acts to inject salt in the Delta and creates a shorter path for saline water to the export facilities. With the tidal flow in False River blocked, the high-salinity water is instead shunted on the flood tide farther up the San Joaquin River, and around Bradford Island and Webb Tract.

It should be noted that since CALFED first proposed this barrier, it has actually been installed and later removed. After years of drought, installation of the 2015 emergency salinity barrier was a last resort.

While it blocked some salinity intrusion, it failed to produce all of the hoped-for benefits (see sidebar p. #).

Early data and modeling results from these previous flooded island and Delta conveyance investigations (see References) helped inform the development of the current Franks Tract Multi-Benefit Restoration Approach. The latter suggests a more permanent, more natural solution than expensive emergency barriers or operable gates, addressing some of the same challenges by reconfiguring the landscape and disconnecting channels from critical freshwater flow paths.

[graphic p. 9 graphic from the conveyance summary report might be interesting to include if it fits in with larger corridor planning too?]

[graphic: BEV photo of false river emergency barrier – place in sidebar with the long caption/barriers next section?]

Emerging Delta Conservation Framework and Central Delta Corridor Partnership

The restoration and renewal approach described in the following pages suggests a bold, sustainable change in the heart of the Delta that is in keeping with current and emerging state priorities. The project offers a model of the kind of larger scale approach based on natural physical processes recommended in the 30-year *Delta Conservation Framework* and *A Delta Renewed* (see Section3).

The Delta Conservation Framework goals that this restoration vision addresses are as follows:

GOAL C: Develop multi-benefit focused conservation and land management solutions to balance environmental and human needs.

GOAL D: Conserve ecosystems and their ecological processes to promote function to benefit society and natural communities, and improve conditions for species recovery.

The restoration approach proposed for Franks Tract also compliments a larger conservation vision being explored by the Central Delta Corridor Partnership. The Partnership's vision includes controlling invasive species, improving habitat for endangered Delta smelt and salmon populations, and supporting recreational boating, fishing, wildlife viewing, and waterfowl hunting, among other priorities.

The Central Delta Corridor Partnership consists of the owners of public, and publically financed lands, interconnected throughout the central Delta from north to south, forming a conservation lands corridor. In the north and northeast areas, the corridor is characterized by lakes, floodplains, and tidal wetlands within the Stone Lakes National Wildlife Refuge, Cosumnes River Preserve, and the Cosumnes-Mokelumne river confluence. Southward, the corridor encompasses deeply subsided islands (Staten, McCormack-Williamson Tract, Bouldin, Webb, Holland, Bacon, Twitchell, Sherman, and Decker) and the flooded Franks Tract State Recreation Area.

[Sidebar anywhere in section 1]

PROBLEM:

Declining Delta smelt

Delta: The Delta smelt is a small (120 mm), short-lived (1-2 years), native fish that only occurs in the San Francisco Estuary. This semi-anadromous species spawns in fresh water and rears in fresh to brackish water. The Delta smelt's continued existence is dependent upon its ability to successfully grow, develop, and survive in the Estuary. Once abundant, it is now rare. Steep declines in its population in the early 1980s lead to its federal and state listing as an endangered species in 1993. Despite a rebound during the wet period in the late 1990s, a more widespread pelagic organism decline (POD) of four open water species followed in 2002, including further drops in smelt abundance. A jump in abundance of all life stages in 2011, however, showed that the Delta smelt population can still rebound when conditions are favorable for spawning, growth, and survival. Scientists attribute Delta smelt declines to a variety of factors. Primary management efforts to protect smelt and other POD species have focused on maintaining adequate outflows, reducing water diversion losses, and restoring habitat.

Franks Tract: This large flooded island in the central Delta currently epitomizes conditions unfavorable to Delta smelt and other native fishes such as salmon. Rather than offering shallow marshes and plentiful zooplankton – good smelt habitat and food -- invasive plants that reduce turbidity and harbor predatory fish plague the Tract. In addition, tidal flow through the Tract can move turbid water in the lower San Joaquin River into the Tract and Old River. Elevated turbidity can facilitate the movement of any smelt that now occur seasonally on Franks Tract toward the export pumps. In recent years, fish trawls in Franks Tract and the surrounding region have yielded very few Delta smelt, largely because their populations are so low (see data from "Station 901"). However, Franks Tract is still part of a major migration corridor for this endangered estuarine fish.

FIX: More open water habitat adjacent to channel margins, more dendritic channels in marshes and food supply; fewer predators and invasive weeds.

3. Restoration Approach

Over the last 18 months, the California Department of Fish and Wildlife (CDFW) has developed a conceptual approach for how to restore and renew Franks Tract and Little Franks Tract. This approach is based on past investigations, consultation with scientific experts in the region, near-term actions called for in the Delta Smelt Resiliency Strategy, new recommendations from the San Francisco Estuary Institute's *A Delta Renewed*, and CDFW's long-term Delta conservation vision outlined in the *Delta Conservation Framework.* The conceptual design approach described below also includes some preliminary modifications to address early stakeholder input. Subsequent input and local concerns (see Section 6, p. #) would be addressed as part any more detailed planning process if the project is approved for further development.

The goals and objectives of CDFW restoration approach for Franks Tract are:

Biological

- Enhance habitat conditions for Delta smelt and other native fish species.
- Minimize habitat conditions for non-native fish and invasive plant species (submerged or floating aquatic vegetation (SAV/FAV)).
- Create elevations to foster establishment large area of emergent marsh vegetation.
- Minimize entrainment of Delta smelt into Old River and South Delta.

Physical

- Modify tidal circulation to create conditions similar to historic condition (pre-reclamation) so that tides both enter and exit primarily through False River.
- Create pilot channels that can be extended and shaped by natural tidal processes.
- Eliminate tidal flow through Franks Tract into Old River.
- Create conditions to enhance turbidity through wind wave action both onsite and downstream.

Water Quality

- Limit salinity movement through Franks Tract to Old River
- Increase residence time

The objective of the restoration and renewal approach for Franks Tract is to establish a large area of intertidal marsh with channels, eliminating the existing open water and submerged aquatic vegetation in the restored area. Accomplishing this would require filling the restored area. Franks Tract is currently subsided. Water depths at the lowest tide range from 6-8 feet (MLLW). Re-establishing tidal marsh and associated channels would require raising selected areas 8-10 feet.

In general terms, the CDFW restoration approach would divide the Tract in two, building a berm so that marsh could evolve on one side, and enhancing open water habitat on the other. The approach would restore more than 900 acres of intertidal habitats, marsh and channels within Franks Tract and Little Franks Tract. About 2,200-2,600 acres of shallow and deep open water habitat, with some recreational access, would remain on the Tract. The approach would also block False River permanently, improving water quality conditions and reducing salinity intrusion in the Central Delta.

Key Elements of the Design

- A large berm across Franks Tract.
- A small berm that blocks the West False River, preventing tidal circulation with the eastern side of Franks Tract and Old River.
- 20 million cubic yards of fill material, dredged from the Tract and/or sourced from Decker Island.
- Raised bed elevations approximately 1-3 feet above sea level (NGVD) to produce mid-marsh within 170-acre and 61-acre areas of Little Franks Tract, as well as over a 748-acre area in the western portion of Franks Tract bounded by the new berm.
- Channel features in the new mid-marsh plain.
- High marsh, with an elevation range from 2-5 feet above sea level (NGVD), along the berm.
- Deepened and enhanced open water habitat on up to 2,600 acres on the south side of the berm.

The current approach builds on an earlier alternative design, which set the levee further east and included a much larger fraction of Franks Tract. Based on the hydrodynamic model, this variant produced changes in tides and regional salinity similar to those of the newer design. The earlier design didn't however, prove as advantageous for native fish because it left large areas of shallow water dominated by aquatic weeds and did not include any significant tidal marsh and habitat complexity. The newer approach creates three dead-end channels in the restored marsh to focus tidal energy and increase exchange between the marsh plain and adjacent open water.

To size the higher order channels in Franks Tract, CDFW used guidelines from the Dutch Slough design by Environmental Science Associates. The bed of the tidal channels was positioned at existing grade almost everywhere, which will reduce costs, maintain some variability, and produce elevations typical of restoration designs. By comparison, the restoration design for Little Franks Tract is relatively simple, with existing bathymetry near the breaches and gradual slopes upward toward the northeast and southwest.

The final configuration may be subject to refinement based on more detailed planning including stakeholder and management input. See also Section 6.

[graphic: conceptual design map + intertidal cross section?]

Rationale for Re-establishing Tidal Processes on Flooded Islands –Delta Renewed Applied

Over the last decade, the San Francisco Estuary Institute has developed the technical and scientific basis for a suggested approach to restoring the Delta with support from CDFW. Based on input from twelve academic and government science advisors, three sequential reports outline the Delta's past and present conditions, and suggest restoration approaches focused on harnessing the remaining natural physical processes in this much-altered and re-engineered system for the future. The Franks Tract restoration approach applies the recommendations in *A Delta Renewed*, and its users guide, for flooded islands and former marsh.

As described above, a key component of the proposed restoration project is to re-establish a physical heterogeneity of aquatic habitat to the site. Achieving this habitat heterogeneity and complexity will also require the re-establishment of blind channels that help drain the tidal marsh and provide food web nutrients that can flush into larger channels to support native fish species such as Delta smelt.

CDFW applied the restoration metrics shown in the sidebar opposite/below in developing a conceptual restoration approach for Franks Tract. Metrics are drawn from "Landscape Configuration & Scale Guidelines" and "Physical Process Guidelines" set forth in *A Delta Renewed.* The guidelines were also used in building the State's 30-year *Delta Conservation Framework*.

Achieving all of these metrics before sea level rises so dramatically that the new marshes can't keep pace naturally is critical and time is short (Baylands Goals Climate Change Update 2015**).** Marshes maintain themselves naturally in relation to sea level by trapping inorganic matter in the form of sediment and accumulating organic matter as plants decompose. The amount of sediment passing through, or resuspended, in the Delta has been decreasing over the last decade (both because historic hydraulic mining deposits are finally washing out of the estuarine system, and because eroded sediment is now trapped behind dams, levees, rip rap and concrete). As sediment supply is so low, vertical accumulation via the breakdown and build up of organic matter (such as eventually forms peat) is becoming increasingly important for marsh sustainability.

The Franks Tract restoration approach both adds inorganic sediment and provides intertidal elevations necessary for organic plant growth in an effort to speed natural adaptation to changing conditions and long term resilience.
[Hartman cross-section graphic?]

[extended 2-page sidebar with SFEI graphics – very dense]

Applying Delta Renewed Metrics to Franks Tract Restoration Approach

Marsh metrics and guidelines

*1) **Marsh patch size:** Tidal marshes should be as large as possible, to support a range of ecosystem functions.*

The Franks Tract restoration approach would restore marshes in three areas to create two significant marsh patches, together totaling more than 900 acres. The larger patch would be more than 800 acres in size, which is large enough to support a significant portion of an extensive blind channel network and the maximum density of California black rails, a rare bird species used as a barometer of marsh health. At 170 acres, the smaller patch is not large enough to support a significant channel network, but would still be expected to support nesting black rails and tricolored blackbirds and contribute to the local foodweb, among other ecosystem functions.

*2) **Marsh nearest large neighbor distance:** Restoration plans should aim to decrease the nearest neighbor distance of Delta marshes and increase the proportion of marshes that occur in close proximity to large marshes, taking into account the dispersal distances of native animals.*

The large marshes created by the Franks Tract approach will dramatically reduce the nearest large neighbor distance for nearby marshes, including those in Sand Mound Slough and at Mandeville Tip, as well as the planned restoration at Dutch Slough. The Franks Tract restoration would be within reach of rails dispersing from all three of these sites, allowing for increased levels of genetic and demographic connectivity and improved meta-population viability. The restored blind channels embedded within the Franks Tract marsh network would also be located less than 15 km from Sherman Island, potentially

allowing juvenile salmon from the Mokelumne and San Joaquin rivers to move between the two sites in less than a day on their way out of the Estuary.

3) ***Marsh core area ratio:*** *Marshes in the Delta should have more core habitat than edge habitat, because core habitats experience unique abiotic conditions, are less accessible to many predators of marsh wildlife, and are more buffered from human disturbance in the modern landscapes.*

The relatively large and compact marshes created in the Franks Tract approach will create more than four times more core habitat than edge habitat.

4) ***Marsh-water ratio:*** *Increasing the ratio of marsh to open water habitat through restoration projects has the potential to increase the availability of marsh-derived primary productivity to support the aquatic foodweb.*

By expanding the amount of marsh habitat and decreasing the amount of open water, the Franks Tract restoration approach will nearly quadruple the local ratio, from less than 1:10 to more than 3:10.

Channel metrics and guidelines

1) ***Blind channel creation:*** *Previous reclamation activities have homogenized the Delta landscape by eliminating marshes, deepening major channels, and increasing the interconnectedness of the system. Many formerly blind channels are now connected to each other via cuts, reducing the variability in local habitat conditions.*

The Franks Tract restoration approach would reverse this trend by disconnecting False River from the flooded part of Franks Tract and blocking the False River between Franks Tract and Webb Island. In addition to the more than 2.85 miles of new low-order blind channels to be created within the restored Franks Tract marsh, approximately 2.5 existing miles of False River will be converted from a flow-through channel to a blind channel. Together these actions will increase the blind to flow-through channel ratio.

2) Blind channels should be long and branching: *Blind tidal channels naturally develop a dendritic, branching form, with multiple channel orders. This geometry increases the length of edge between marsh and channel; contributes to heterogeneity in physical variables, such as residence time, depth, temperature, turbidity and velocity; and influences predator-prey dynamics and search patterns. Appropriate geometry between small/shallow branches and larger/deeper ones can also enhance the size, diversity and resilience of resident wildlife where branches intersect. In more general terms, blind channels that terminate within wetlands allow exchange between the marsh and deeper channel habitat, providing a kind of capillary system nurturing the marsh and slow-moving water where fish can find refuge.*

By restoring three low-order dendritic branches (totaling more than 2.75 miles in length) off of the larger False River blind channel, the Franks Tract Restoration approach should help recover this functionality. Blind channels should also be longer than the average tidal excursion length to recover hydrodynamic complexity and increase residence time along the full length of the channel The re-established False River blind channel network is expected to be longer than the local tidal excursion length, allowing for the creation of residence time gradients.

*3) **Channels embedded in marshes:** Connectivity between tidal channels and tidal marshes is critical for the exchange of energy, nutrients, organic and inorganic material, and organisms (areas subject to this kind of intertidal exchange have decreased by 98 percent in the Delta). Channels embedded in tidal marshes contribute to gradients in physical attributes like residence time, velocity and turbidity. Smaller branches of channels also likely provide resource subsidies from the marsh to organisms like Delta smelt thought to be restricted to larger channels.*

The Franks Tract restoration approach would create new marsh plains by raising elevations to intertidal levels with sediment, and facilitate the establishment a new channel system to support the functions described above. By embedding channels within the marsh, the Franks Tract restoration approach will also increase the tidal marsh-water edge length. The 2.85 miles of pilot low order interior channels in the marsh plain would be expected to create at least 5.70 miles of associated marsh edge. As even smaller channel branches form off of the pilot channels as expected then the length of marsh edge will be even higher.

[graphics- SFEI graphics from delta renewed and historical ecology:
DR- p, 55 - blind versus branching channels diagram with fish
HE- p. 148 - connected versus unconnected channels -beefing up the connections around FT and possibly labeling on a second layer FT or shading it pale blue or darker white to call it out
DR-p. 49 map but with changed key and coloration emphasizing subsidence and unique opp at FT in Central Delta]

[Sidebar anywhere in section 3:]

PROBLEM:

Infestation by Invasive Submerged and Floating Aquatic Vegetation

Delta: Invasive aquatic plants have far-reaching impacts on the Delta ecosystem and are now widespread. The total invaded area of the Delta has increased greatly from a previously recorded 9,000 acres in 2004. In the Delta, the total area invaded by submerged and floating aquatic vegetation increased from 12,400 acres in 2014 to 15,600 acres in 2015 (Khanna 2015 and 2017 in press). Aquatic plants change shoreline habitat by slowing water velocities and increasing water clarity, conditions which further their spread. This dense mat of vegetation can also offer predatory fishes places to hide and hunt. Meanwhile, native species like Delta smelt, who like to stay in open water, are more vulnerable to attack in clearer waters. Such effects can propagate up and down the food chain, affecting the entire ecosystem. Invasive aquatic plants also impede boat travel and often require mechanical removal or chemical spraying to control. Prolonged drought has likely increased shallow habitat with slow moving water idea for aquatic weeds. A new threat to emerging marshes is water primrose (*Ludwigia hexapetala*), whose area has quadrupled in the central Delta since 2004.

Franks Tract: Submerged aquatic weeds in the Central Delta increased each year 2014-2016, while floating aquatic weeds have declined over the last decade due to aggressive treatment (Khanna 2017 in press). More specifically, Franks and Little Franks Tracts are heavily vegetated by aquatic weeds including Curly-leaf pondweed *(Potamogeton crispus),* Brazilian waterweed *(Egeria densa)* and water hyacinth *(Eichhornia crassipes)*. Recent drought conditions may have promoted this growth. When the emergency barrier was installed and removed in 2015, changes in the movement of water within the Tract also changed the orientation and location of weed patches (see map), worsening it in some areas and clearing it up in others. The state has been spraying Franks Tract with the aquatic herbicide fluridone since 2006, targeting *egeria.* Over the last five years, measures of native plant species diversity indicate some promising results of continued herbicide management (see p, #). At present, however,

aquatic weeds remain a key reason that Franks Tract is a food-poor and predator-rich native fish habitat. **FIX:** Change topography, deepen some areas and raise others so that conditions are not conducive to submerged and floating aquatic vegetation. Remove existing aquatic weed populations and continue control of their re-emergence into the future.

[Graphic: photos and 2014-2016 maps of sav in FT from Khanna paper –Fig 11, p. 27)

4. Hydrodynamic Modeling

After developing the conceptual design approach for Franks Tract restoration, CDFW engaged its partners in conducting an engineering feasibility study, as well as hydrodynamic modeling to assess how the project would affect and respond to Delta water flow dynamics, including flow direction, velocity, hydraulics, and salinity. The California Department of Water Resources performed 3-D hydrodynamics model runs necessary to assess these potential impacts for CDFW and documented them in a December 2017 report (see Appendix X). Major findings are summarized below.

DWR has since done some additional model runs, with and without several smaller barriers in different waterways, and to assess in a very preliminary way evolving local proposals for changes to the conceptual design. While some general findings of these additional runs are included below, the work will be more appropriately developed in the next round of more detailed design.

The modeling work included the following:

- Analyzing velocities in and around the restoration site during and after construction, to help determine materials and construction requirements.
- Describing the likely need or benefits of hydraulic structures in remnant channels to control velocities outside the main body of Franks Tract.
- Predicting changes in tidal and net flows caused by the project.
- Anticipating salinity impacts of the project and one alternative design relative to current conditions.
- Assessing the sensitivity of regional salinity results to the presence of submerged aquatic vegetation.
- Analyzing the synergy between this project and three additional restoration projects that were considered most likely to cause an interaction (Dutch Slough, Prospect Island, and McCormack-Williamson Tract).

The main conclusions of model simulations of project impacts are:

1. The restoration causes local changes in flow, particularly tidal flow. The most substantial increases occur in Fisherman's Cut and on Old River between the San Joaquin River and Franks Tract.
2. Restoring Franks Tract reduces salinity intrusion into the mid-Sacramento-San Joaquin Delta. It potentially increases salinity on the main stems of the San Joaquin River, particularly between Jersey Point and San Andreas Landing.
3. The project may increase the water cost of California State Water Resources Control Board Decision 1641 compliance at San Andreas Landing, but this is more likely in conjunction with other projects that affect Delta Cross Channel flow.
4. The changes in hydrodynamics brought about by the project would result in an appreciable drop in entrainment of Delta smelt from sites west of Franks Tract.
5. Aquatic weeds inhibit circulation on Franks Tract but do not limit freshening of the central Delta as they did during the 2015 West False River emergency drought barrier installation. Weeds were important in 2015 because Franks Tract still received higher salinity water from Fisherman's Cut and False River leakage. The salinity mid-tract never got diluted by cleaner water from the eastern channels because of a curtain of weeds, and ultimately made its way

south through Holland Cut. The current restoration approach isolates eastern Franks Tract and Holland Cut from these sources of saltier water.

In general, the restoration project reduces False River flows and isolates the tidal pumping region from the Old River fresh water corridor. The project would also shield regions upstream of the restoration site from ocean saltwater intrusion, and freshen parts of the Central Delta. In other words, the restoration approach would have significant positive impacts on hydrodynamics and few negative impacts.

More detail on the hydrodynamic modeling results is provided below.

[graphics from modeling report to be pulled in with text below-- EA suggests Figs 21, 31, Fig 38-39-40 some text below might end up in captions to graphics, or in big sidebars like the one in the mock up called The Nozzle Effect]

Velocity Studies

Simulations were performed around the restoration site during peak tides in energetic periods to identify near-maximum tidal velocities for five purposes.

. To identify velocities on the marsh plain and in the dendritic channels supplying them, to help determine stable fill materials.
. To identify the largest currents in nearby waters that would affect construction and navigability.
. To determine velocity changes post-project.
. To identify peak velocities affecting closure of the main berm.
. To determine whether barriers, weirs, or other structures were needed on False River and Piper Slough to control velocity, and to maintain hydraulic separation between False River and Old River for Delta smelt, as suggested in the CDFW restoration approach for Franks Tract.

One early goal of the Franks Tract restoration approach was to promote through-flow in Piper Slough to avoid very long water residence times. However, study results suggest that velocities in the slough are within a tolerable range and have little effect on salinity over the greater region. Given this result and the construction economics, as well as the reliance of local communities on this slough for access to Franks Tract and other recreational destinations, the combination of complete blockage of False River with a berm and no structure on Piper Slough was retained for all subsequent simulations.

While the modeling only showed minor changes in velocity for Piper Slough from the restoration approach, the potential for erosion or scour along Piper Slough adversely affecting levees protecting Bethel Island may need to be investigated in more detail as part of future planning.

Modeling also explored whether the project might change tidal velocity through Fisherman's Cut. Results suggest it would increase velocity, but not as much as emergency barrier did in 2015.

Modeling also evaluated velocities in the stretch of Old River between the San Joaquin River and Franks Tract to determine velocity patterns that construction crews might encounter in late-stage construction of the main berm, and to examine navigability changes and scour potential in this channel following closure. Maximum velocities were found to be slightly stronger on flood than ebb. They reached three feet per second (ft/s), which is lower than during the extreme low-flow drought conditions of 2015, but higher than the 2.0–2.5 ft/s typical of base conditions. Such flows over a limited area may affect staging of the project but should not affect its feasibility.

Regional Impacts on Water Levels, Flow, Salinity

The Franks Tract restoration approach affects tidal energetics in the area around the Tract and changes the ways that salinity intrudes into the central Delta. DWR performed 600-day simulations using actual tidal and flow data from 2009–2010 to probe the changes that would occur in hydrodynamics and salinity over a full salinity-intrusion season.

Water Levels

Modeling results indicate the project would have only a small effect on tidal water levels. The change would be about 3-5 percent, limited to stations monitoring water quality for D-1641 near Franks Tract. Stations on the San Joaquin River upstream of Jersey Point, near Three Mile Slough, may experience small increases; most other areas may experience small decreases. Peak water levels will change in the same way. While effects appear minimal, a more detailed look may be required as the restoration approach evolves to address local flood protection concerns.

Although amplitude and peaks will not change much, some locations will experience significant changes in phase (timing) because the tides have to take a more circuitous route around Franks Tract. Larger (3-hour) lags will develop immediately at the restoration site. In other words, even though tidal range on both sides of the project will not change much, high tide will arrive up to three hours later on the east side and this will produce instantaneous differences in water levels on the two sides.

Flow

The project is expected to affect tidal range and net flows in the region around Franks Tract. Figure ## indicates the magnitude of these changes, with red arrows indicating locations of increase and blue arrows indicating locations of decrease flow. *Tidal range* is measured as the July 2009 to September 2009 average difference between tidal maximum and tidal minimum discharge. For instance, a location that averages -40,000 cubic feet per second (cfs) on ebb tide and +50,000 cfs on flood tide has a tidal range of 90,000 cfs. *Net flow* is the average of tidally filtered flow over a longer period (March 2009 to August 2010).

Salinity

The restoration design eliminates tidal pumping from False River, an important mechanism of salinity intrusion into the mid-Delta. Figure # is a conceptual illustration of how tidal pumping works based on model simulation results prepared during 2015 emergency barrier planning. On flood tide, a jet of higher salinity (red) water is seen entering Franks Tract from False River on a flood tide through an aperture sometimes referred to as a nozzle. Water quality in this jet is heavily influenced by that of the San Joaquin River at Jersey Point which is saltier than most of the Delta and Franks Tract. The return flow from Franks Tract is fresher — the salty jet of water will have mixed out somewhat and the ebb flow is drawn radially from a broader area so it includes more of the ambient water in Franks Tract. Even if the volume of flow is the same in both directions, the asymmetry between a salty flood and fresher ebb adds up and causes a net transport of salt into the Delta — like a bus that travels both north and south, but carries many more passengers in the southern direction.

As mentioned above, the restoration project reduces False River flows and isolates the tidal pumping region from the Old River fresh water corridor. Regions upstream of the restoration site are shielded from ocean saltwater intrusion and the mid-Delta becomes fresher. The reduction in conductivity mid-Delta can be more than 100 micro-Siemens per centimeter (µS/cm), which is a large relative improvement for these channels. Downstream of the restoration site, and on the main stems of the

Sacramento and San Joaquin rivers, the response varies between insignificant and degradation. Where increased salinity occurs, it is generally similar on a scale of absolute units to the upstream improvements, but smaller in relative terms. These changes can still be important if they occur at stations that are the controlling locations in D-1641 or contractual compliance.
[graphic: salinity change map here or associated with the text above/or nozzle effect caption?]

Water Costs
Decision 1641 is a state water quality standard requiring adequate freshwater flows to be released from upstream reservoirs to keep the low salinity zone (2 ppt isohaline) in a certain range of positions within the Delta. Depending on the time of year, this range of positions either protects agricultural water quality or estuarine health and habitat quality for native fish. To investigate the potential impact on D-1641 compliance, Figures ## shows time-series plots of tidally filtered salinity at D-1641 locations, converted to units of specific conductance. The plots include the base case with no project (labeled "Base"), the case with restoration ("Restore") and two sensitivity studies involving SAV ("Restore + SAV") and interactions with other restoration sites ("Multi- Restore"). In dry and critical years, Emmaton and Jersey Point are also frequently the stations limiting D-1641 compliance. Their locations are not expected to benefit from improved water quality. The neutrality of the project at these sites over several years is thus promising, and suggests that there may be little additional water cost arising from the project at these traditionally limiting locations. On the other hand, San Andreas Landing, which usually represents a fairly achievable water quality objective, becomes salty enough to warrant vigilance (the dry year objective is 580 µS/cm). The increase at San Andreas Landing becomes particularly important when considering interactions between Franks Tract and other projects that may alter cross-channel flow.
[explanatory TBD graphic will help with understanding this]

Entrainment
When fish are drawn by certain flow conditions into the south Delta water export facilities -- where they are either lost, screened or rescued and relocated -- this mechanism is referred to as entrainment. Some larger life stages of salmon can survive entrainment; smaller life stages of smelt, for example, usually do not. To explore the potential effect of the Franks Tract restoration project on entrainment of fish at the export facilities, particle tracking simulations were performed under high and low export hydrology scenarios from 19 sites around the Delta. (Particles are used as surrogates equating early life forms of endangered and threatened fish like Delta smelt, as well as the plankton particles and turbidity they follow). The simulations confirm that the project reduces entrainment of particles originating from Jersey Point and other western sites, but not from locations upstream on the San Joaquin River east of Franks Tract. When particles are entrained, the route they take to the export locations is circuitous and requires more time. The particle tracking results indicate that the project brings about an appreciable drop in entrainment from sites west of Franks Tract.

Submerged Aquatic Vegetation
Franks Tract is currently infested with submerged aquatic vegetation including the invasive curly pondweed, Brazilian *egeria*, and water hyacinth. Analysis of both the base and future geometry of the Tract suggests that the presence of the infestation affects both the current hydrodynamics of Franks Tract, as well as circulation that might be expected during construction of the proposed restoration project.

First, the submerged weeds produce drag on flow entering Franks Tract from False River. Second, they form a curtain where it meets remnant channels on the east side of Franks Tract. The curtain inhibits

lateral (east-west) mixing between Old River water entering from the north and water in the body of Franks Tract, reducing the influence of cleaner Old River on Franks Tract salinity. During the 2015 emergency barrier installation, the reduced freshening in Franks Tract affected water moving into Holland Cut and points south (California Department of Water Resources 2017, in preparation).

With the restoration, submerged weeds dampen circulation velocity in east Franks Tract just they do under base conditions. However, the influence of submerged aquatic vegetation on system-wide salinity is lower than its influence under base conditions or during the emergency barrier installation. The key here is geometry of the Tract itself. The main berm reinforces the connection between Old River and Holland Cut while cutting off saltier sources from the west. Since Old River becomes the only major source of water in this region, vegetation no longer regulates competition between west and east to influence water quality reaching Holland Cut.

On the "non-restored" side of Franks Tract, dredging and deepening to generate fill material for the restoration should reduce aquatic vegetation and related drag on circulation.

Impacts on Other Restoration Projects

A number of restoration projects are planned for the Delta in the near future. Stakeholders were interested in possible interactions between the proposed restoration in Franks Tract and several large projects that are in a more advanced state of design and implementation including Dutch Slough, Prospect Island, and McCormack-Williamson Tract. Modeling examined salinity differences between single and multiple restorations. In the central Delta, Franks Tract alone would reduce salinity; and all three other projects, already well underway, would increase salinity. Results suggest that if all four together went ahead, Franks Tract would still have a positive effect in terms of reducing or offsetting central Delta salinity. See Figure ## (44-45)

Impacts of a Local Borrow Pit for Fill

Obtaining and delivering fill comprises a major cost for the Franks Tract restoration project. One idea vetted to reduce cost was to borrow material from the east side of the Tract to fill the restoration area on the west side. The deepening required could be considerable because of the presence of peat in the borrow area. Based on data presented in the feasibility study, it is expected the borrow pit might need to be as much as 25 feet deep. Deepening the eastern portion, however, could have many benefits to the larger habitat improvement project. Deeper water prevents SAV establishment and improves navigability. In terms of recreational impacts, the deeper water could reduce largemouth bass but increase striped bass, and shift waterfowl species to those favoring deeper water. In terms of hydrodynamics, however, the borrow pit would have a nearly negligible impact on regional salinity.

[sidebar anywhere in section 4]

PROBLEM:

Salinity Intrusion-Protecting Water Quality During Drought

Delta: During drought and dry summer months, salt water from ocean tides intrudes farther into the Delta – closer to drinking water intakes-- because there isn't as much freshwater flowing downstream from rivers, runoff and reservoir releases to push it back out. When major reservoir levels are drawn down, snowpack is low, and so many Delta channels are connected to others, few options remain except to build multiple temporary barriers across key channels to keep the tides out. The state first built such barriers in the Delta during the mid-1970s drought — two in 1976 and six in 1977. In 2015, following up

on modeling suggesting that a single obstruction might be less disruptive to fish habitat while still protecting water supplies, the state built the most recent barrier across the False River. The West False River is the biggest, most direct channel between tides coming up the San Joaquin River and the water export pumps at the southern end of the Delta (through Franks Tract). Other pathways for salinity intrusion are smaller and more meandering. Engineers estimate the 2015 barrier kept 29 billion gallons in upstream reservoirs, instead of releasing it to maintain water quality at drinking water and irrigation intakes downstream. However these temporary rock walls impede natural physical and biological processes still at work in the Delta ecosystem and fail to provide long term, permanent solutions to salinity intrusion problems. In addition, extended droughts and rising sea levels due to climate change will only exacerbate salinity intrusion into the Delta.

Franks Tract: The West False River is the biggest, most direct channel between tides coming up the San Joaquin River and the water export pumps at the southern end of the Delta (through Franks Tract). Other pathways for salinity intrusion are smaller and more meandering.

FIX: Adding new levees and repairing old levees, as well as the addition of sediment to raise elevations and create tidal marsh, would change the tidal prism and exchange through Franks Tract, and improve water quality in the central and south Delta.

[photo –False River emergency barrier 2015]

Caption: The emergency salinity barrier placed across the West False River in 2015 consisted of 150,000 tons of rock. The barrier was 750 feet across the top and 120 feet wide at the base. Installation and removal cost taxpayers approximately $37 million. Building these kinds of barriers 7-8 times in the droughts ahead would pay for the entire Franks Tract restoration, which is a permanent, more sustainable solution.

5. Engineering Feasibility

The environmental engineering firm of Moffatt & Nichol was retained by the Metropolitan Water District of Southern California to provide an engineering feasibility assessment for restoration of Franks Tract State Recreation Area in collaboration with CDFW and CDWR. The firm focuses on scientific research projects that protect and restore fish, wildlife, and the Delta's ecosystem. Moffat & Nichol completed their engineering feasibility study, using some of the modeling results provided by the DWR hydrodynamics study, in 2017 (see Appendix #).

The assessment evaluates options for construction, including feasibility and engineering constraints, sources of fill material, schedule for construction, and unit rates. Evaluation of these options led to a rough cost estimate. The schedule for the construction depends on the source(s) selected for the fill material but is estimated to take four to six years as a minimum.

The general conclusion is that the project is feasible to construct; that the scale of the construction costs ranges from $300-$650 million; and that using local material dredged from Franks Tract, perhaps supplanted as needed by some Decker Island material, is the least cost alternative.

Sources & Quantity of Fill
Sources for materials to raise elevations of Franks Tract for restoration include 1) Decker Island, 2) reusable tunnel material and 3) dredge material from deepening of the Port of Stockton Deepwater Channel. A fourth possible source was identified later in the feasibility analysis: dredged material from Franks Tract itself (deepening one area to raise another). The project will require an estimated 20 million cubic yards (mcy) of material.

Table 6-1: Gross quantities for project fill areas

Area	170 AC	61 AC	748 AC	Embankment	Total
Fill (cy)	2,394,000	696,000	10,706,000	2,058,000	15,854,000
Consolidation (cy)	505,000	158,000	2,119,000	478,000	3,260,000
Total (cy)	2,899,000	854,000	12,825,000	2,536,000	19,114,000

[note-we will need to change the word embankment to berm in this table for consistency]

Fill Source 1: Dredged Material from Franks Tract
Dredging from one side of Franks Tract to fill another, and using materials from Decker Island to augment the process as needed, presents the lowest cost alternative. The precise dredge and fill locations within the Tract might depend on the final design, however obtaining the material itself at no cost from a nearby location results in a lower haul cost. One challenge is that the majority of the material that would be dredged is peat, and when handled could lose water, integrity and mass. This might increase handling time and costs and not provide consistent fill material. Costs might increase from estimates if more dredging is required to move material to the north side of the containment berm. Another challenge is that it is not feasible to pump peat. Crews of loaders, trucks, backhoes, and dozers will be needed to get the dredged material into final position, assuming the placed material eventually consolidates enough to operate this equipment.

Fill Source 2: Decker Island
The highest cost option is to use Decker Island, a site offering both materials dredged from other

projects and deep underlying deposits of coarse sand. The big advantage to Decker is that the material is readily available and equipment used for earlier projects could be put back into operation. The disadvantage is the high cost of the material. Later analysis suggests that a combination of Decker Island materials and a local borrow pit offers a preferred combination of materials at a reasonable cost. A further option might be for public interests to buy Decker Island and restore it as part of the Franks Tract project, or develop it as a support site for other long-term restoration efforts.

Fill Source 3: Ship Channel
The dredge materials from the Clifton Court Forebay and the Stockton Ship Channel presented the second lowest cost alternative in the feasibility study. While this option combines the win-win of necessary dredging and fill material for Franks Tract, a number of other constraints made it a less viable option.

Fill Source 4: Reusable Tunnel Material
The state is considering building pipelines or tunnels through the Delta to convey high quality, Sacramento River water more directly to water export pumps and intakes. Reusing the material dug out to create the tunnel(s) at Franks Tract was the third best option in terms of total cost, but uncertainty over timing and extent of the tunnel project is a drawback.

Sediment Delivery
Sediment delivery to the construction site is a key factor in estimating the costs of the Franks Tract restoration project. The feasibility study explored a variety of methods for delivering sediment, ranging from a slurry pipeline system to a combination of barges, off-loaders, dredgers and powerful hydraulic pumps. Other delivery methods include hauling sediment by truck to the site, a pneumatic conveyance system (hopper/pump), and a conveyor belt system. Many options require the use of low pressure grade (LPG) vehicles capable of moving on soft marshy surfaces.

Constraints
Construction activities associated with restoration work at Franks Tract include dredging and the excavation of fill material; screening, transport and placement of the material on site; and finally grading and finishing to achieve design profiles and elevations. Each of these construction activities may be subject to several constraints. Some of these relate to sourcing of materials, while other constraints relate to the environment, general construction, and the physical setting of the project. Constraints evaluated in the feasibility study included the potential impacts of currents, waves, and water depths on vessel operations; erosion threats to berms and marsh edges during construction; and variables such as existing structures, ground conditions, public safety, and adverse weather conditions. Despite all these constraints, the project was deemed feasible to construct.

Cost Analysis

Cost estimates for restoration of Franks Tract are based on sourcing of materials from 1) Decker Island, 2) reusable tunnel material; 3) dredge material from deepening of the Port of Stockton Deepwater Channel; and 4) dredge material from within Franks Tract itself. Other source locations evaluated were omitted due to unit costs, insufficient quantities of material, or distance from the project site.

Summary of unit costs

Source	Unit Cost (cy)	Rough Order of Magnitude Cost Estimate
Decker Island	$34.03	$650,530,365
Reusable Tunnel Material	$31.85	$608,535,650
Stockton DWSC Dredge Material	$19.72	$376,786,250
Franks Tract Dredge Material + Decker Berms???	$16.45	$314,381,817

General Work Plan - Lowest Cost, Most Feasible Alternative

The lowest cost alternative identified in the engineering feasibility study is to use a combination of material from Decker Island and Franks Tract to build the project elements. The work would involve the following three major steps:

1. construction of a permanent containment berm
2. construction of a temporary island near the containment berm for offloading and staging fill
3. dredging material from Franks Tract, placing it on the island, and then distributing the material using heavy equipment into the new marsh zone.

Two initial elements of the project – construction of the berm and a temporary island -- require the use of Decker Island material. The Decker materials will be dry and allow the containment berm to be built without disappearing into the peat, mud, and water. Similarly, constructing an island where dredge materials can be delivered and offloaded will require materials with a dry consistency. The island would be about five acres in size and 6-7 feet above sea level, to keep it above the water line and provide a stable enough platform to operate low pressure grade (LPG) dozers, excavators and trucks.

In general, daily operations would consist of dredging Franks Tract on the south side of the berm and hauling dredged material by hopper barge to the island where it will be offloaded by a derrick barge, and then spreading the material in the right places as fill.

Necessary in-the-water equipment would include one dredge for dredging, one dredge for offloading scows, and three dump scows or barges in rotation to move materials around. Dredges would be 26 cubic yard clamshell dredges equipped with environmental buckets. Anticipated production would be approximately 4,000 tons (2,500 cy) per ten-hour shift. On a two-shift operation, two 4,000-ton hopper barges at each location could be used to move a total of 16,000 tons (10,000 cy) per day.

The first work activity would be to construct the berm. This would be accomplished by dredging a channel, approximately 200 foot wide to a bottom depth of 18 foot to allow the derrick and material barges to access the channel. The dredged material, which will be mostly peat, would be side cast and stockpiled within the fill material. The access channel would be excavated from the east to the west along the total length of the barrier. This will require excavation of approximately 3.15 million cubic yards of peat.

Once a channel is open on the east side of the barrier, crews can begin placing material on the berm itself with a second derrick spread. Material will be offloaded by a derrick/crane barge along the berm.

Once the barrier has been constructed, both derricks will move to locations where material can be offloaded from barges and spread by dozers, or as an alternative the material can be liquefied and pumped off to various locations.

The entire project, given various water level constraints and environmental windows protective of fish, would likely take 4-6 years to complete and include considerable engineering challenges depending on the amount of peat involved. More detailed analyses could clarify these challenges before construction, but the main conclusion remains that the project is feasible. While the expense could turn out to be greater than other planned restorations around the edges of the Delta, conditions in these areas are easier to work in and the scale of the Franks Tract restoration approach is much greater. This project would engineer a major change in central Delta hydrodynamics, addressing issues beyond just habitat restoration, including water quality and entrainment of fish from the pumps, and predation.

[photo caption –comparison to other restoration costs - TBD?]

Typical tidal restoration projects in the Delta and Suisun Marsh are running $20-$30,000 dollars per acre, including land acquisition, planning, and construction, where new levees or significant infrastructure are not involved. Twitchell Island Levee setback??? ….

6. Communities, Regional Economy, and Other Considerations

The restoration and renewal of Franks Tract will not be feasible without careful consideration of the interests of its owners, neighbors, and local communities, as well as state interests. The property is owned by the state and is a designated State Recreation Area. State priorities for smelt resilience and water supply quality are clear, as are the purpose and goals for the State Recreation Area. At the same time, the effects of the restoration approach on the local economy and recreational opportunities that have developed around this long -flooded island must also be considered.

Impacts on Park Management

Most of Franks Tract is a State Recreational Area. These areas are selected, developed, and operated by California State Parks to provide outdoor recreational opportunities. The declaration of purpose developed for Franks Tract SRA, and approved by the State Park and Recreation Commission in 1966, is to permanently provide water-related recreational activities so that the recreational, scenic, historic, and scientific values of the area may be enjoyed by the public. The most current plan for management of the Franks Tract State SRA is dated 1988. Given the potential magnitude of the changes to the SRA as a result of the restoration proposal, it is likely that either an amendment to the existing General Plan, or a new management plan that accounts for these changes, would be needed.

The 1988 General Plan for the Franks Tract SRA describes resource management policies; proposed uses, facilities and interpretive programs; and physical, biological, ecological, cultural, esthetic and recreational resources. In terms of its recreational value, the plan recognizes that Franks Tract is an open waterway with no land-based facilities and that the development of marinas around the perimeter of Bethel Island has increased boating activities and the demand for recreational facilities. The plan identifies fishing, waterfowl hunting, and navigation through the Delta by recreational boating traffic as key existing recreation uses of the area. The plan proposes creation of islands in order to provide additional facilities for boat-in recreation use including picnicking, beach use, wildlife viewing and camping. The plan specifically identifies waterfowl hunting as a recreation use that should continue in the area. California State Parks administers a waterfowl hunting blind permit system at Franks Tract from October through January.

In addition to the significant demand for recreation at the Franks Tract SRA, the General Plan recognizes the following state policy priorities concerning natural resources.

- Control exotic invasive species to perpetuate native plant communities.
- Protect and reestablish riparian and freshwater ecosystems through development and implementation of a management plan.
- Restore altered natural habitats not being used or proposed for recreational facilities as nearly as possible to conditions that would exist had natural ecological processes not been disrupted.
- Develop specific management programs when appropriate for animal species that are threatened, endangered, or of special concern.
- Perpetuate recreational values at Franks Tract, with active department involvement in land and water use decisions that may impact water features in SRA.

As part of preparing this report State Parks has been consulted regarding the consistency of the 1988 General Plan with the changes proposed in the Franks Tract restoration approach. Preliminary review suggests that several of the resource management policies for the unit are consistent with the current

restoration proposal, including control of invasive species and re-establishment of natural ecosystems and freshwater marshes that support threatened and endangered species. Proposals to fill and create marsh and upland areas, however, are different from early 1988 general plan proposals (never implemented) to construct islands within Franks and Little Franks Tract for the purpose of supporting low-intensity, boat-in recreational use including beaches and recreational facilities for camping and picnicking in designated areas.

At this time, State Parks recognizes that its General Plan for the recreation area is now 30 years old, and that the goals and proposals in the plan for Franks Tract likely warrant review and evaluation given current conditions, management context, scientific knowledge of the Delta, and the proposed restoration of Frank Tract.

State Parks supports the concept of restoring portions of Franks Tract SRA in order to benefit native fish species and to minimize habitat for non-native fish and plant species. However, State Parks is concerned that the restoration approach doesn't accommodate recreation use in any intentional way. It is not clear yet, for example, whether the creation of tidal marsh would preclude waterfowl hunting or eliminate some of the waterfowl blinds in the SRA. State Parks currently issues 30-40 permits, each listing 1-4 hunters, annually to place temporary waterfowl hunting blinds in the Franks Tract SRA.

State Parks is interested in exploring how both existing uses, as well as other low intensity and passive recreation opportunities, might be accommodated into the restoration design. State Parks would like direct participation in further development of restoration plans and designs if the restoration project moves forward. This would include development of specific plans that meet habitat restoration objectives, and address the Department's goals for recreation use of Franks Tract and the interests of local communities. Current State Parks supervision, patrol, and management of the SRA is provided by the Gold Fields District based in Folsom. Occasional current patrols (2-4 times per year) would not be adequate if there was increased recreational use resulting from the restoration.

State Parks has a few additional concerns that it hopes to see clarified in any final restoration plan. These include addressing the additional cost of managing public use in new upland areas, which are likely to create problems such trash, fires and illegal camping. The restoration project also needs to clearly identify which agency or entity will be responsible for maintaining the substantial berms or levees that would be created with this restoration.

Impacts on the Local Community

Any proposed changes to Franks Tract and Little Franks Tract will affect those who live, work and play in the area. In an effort learn more about how the area is currently used, CDFW reached out to many of these people, using a landscape research team from UC Davis.

All aspects of the UC Davis research showed that human use is pervasive on Franks Tract and Little Franks Tract. The major uses are fishing, recreational boating and the associated service industries that have developed around these uses, such as marinas, shops and restaurants. All these uses, as well as the unincorporated towns of Bethel Island and Discovery Bay emerged and developed with the creation of the open water tract in 1938. Thus any changes or reclamation of Franks Tract are bound to affect current uses and adjacent communities.

Research results also indicated that cultural uses occur throughout Franks and Little Franks Tracts but are concentrated along the main navigation corridors. Fishing, some of which is conducted along remnant levees, is consistent throughout the year, with upticks in the shoulder seasons of fall and spring. Boating use is highest in the summer months. Hunting is another major use, which is seasonal (fall and winter) due to regulations. Approximately 65 seasonal hunting blinds are configured in a grid pattern. Blinds and hunters traverse the Tract to get to designated hunting zones. Little Franks Tract sees significantly less use. Hunting is prohibited and shallowness discourages most types of recreational boating. Therefore use is limited to non-motorized boats, such as kayaks, as well as specialized shallow-keeled fishing boats. [graphic: hunting blinds grid/seasonality chart]

The research team also provided local stakeholders and the public at large an opportunity to offer feedback on the CDFW draft restoration approach. Stakeholders were informed that this is a preliminary study for a restoration project that would only move forward if deemed feasible and funding is available. They were also informed that while there are flexibilities in restoration design, management and sequencing, core biological and physical objectives must be met in order for the project to gain the necessary agency approvals. Stakeholders were also informed that the study has no sway over the reduction of Delta exports.

Stakeholder outreach research included a variety of methods: a survey, interviews, stakeholder workshops, participatory mapping exercises, fieldwork, and a review of existing use/recreational studies (see also Impacts on Parks above) for the area. These mixed methods enabled CDFW to corroborate findings and develop a multifaceted understanding of stakeholder preferences. The survey yielded almost 650 responses, the majority from boaters and anglers. The team also interviewed marina owners, maintenance district personnel, anglers, hunters, ranchers, fish biologists, those conducting biogeophysical monitoring in the area, law enforcement and others. The team also held workshops with anglers, business owners, and Bradford and Bethel Island residents. Research also included ground-truthing and direct observation of site conditions, as well as use of photography to reveal various landscape features that were challenging to see from the water, levee, or land.

Findings

Current human uses of Franks Tract and Little Franks Tract are numerous and occur throughout the year. This area is one of the most populated and publicly used tracts, flooded or dry, in the Delta.

The survey, combined with a review of seven previous recreation studies done by various agencies between 1985 and 2011, yielded three major insights related to usage patterns:

1. Use of the Tract, particularly for boating, is highest in the summer months. Those who identified as business owners, researchers, and law enforcement all indicated a year-round presence on the landscape. Hunters, anglers, and boaters, on the other hand, all exhibited use patterns based the seasonality of these activities. See chart.
2. Residents and recreational users have by-and-large been resistant to large-scale planning efforts in this region, especially those that alter flow or compromise navigability. Exceptions include the Franks Tract State Recreation Area Optimum Plan, which was prepared for the California Department of Parks and Recreation (DPR) by the East Bay Regional Park District (EBRPD), as well as the 1988 General Plan for Brannan Island and Franks Tract State Recreation Areas (see above). Both planning initiatives contained comprehensive efforts to identify and integrate the needs and desires of the public.

3. Navigability in and around Franks Tract directly affects recreation and the economic health of the local communities (Bethel Island, Oakley and Discovery Bay) as well as broader, regional users of the Tract (such as from San Francisco Bay and areas adjacent to the Delta), as well as bass tournament anglers from throughout the country

Other findings were as follows:

Navigable water and access to it is a primary stakeholder concern.

- Franks Tract is a major hub for water-based transportation in the Bay-Delta.
- The Tract is vital to the regional economy, which has emerged based on the open water and the livelihood and recreational amenities it provides.
- Property values on Bethel Island are determined by proximity to fast water, i.e. open waterways in which there are no speed limitations.

The boating community is a strong stakeholder and includes:

- Yachters, waterskiers/wakeboarders, kayakers, kite sailers.
- Water based developments: Discovery Island and Delta Coves
- Boat-based anglers (the majority in Franks Tract and Little Franks Tract)
- Marinas and service industry (restaurants, gas stations, repair shops, storage, etc.)

As the siting of proposed tidal habitat restoration is flexible within Franks and Little Franks Tracts, as long as water quality is improved for smelt and other fishes, early stakeholder involvement offers an opportunity for adjustment before the more formalized EIR process.

- Most stakeholders strongly objected to the location and configuration of the proposed tidal marsh restoration areas in Franks and Little Franks Tract because it would block some marina and boat traffic to residential areas. Alternative configurations are possible that will have less impact on local communities and economies. Some but not all local interests concur that water quality has to be maintained or increased.

Increasing project amenity value to local residents and users might bring it more public support.

- Beach creation and anchoring locations are seen as highly beneficial to residents, boaters and boating based businesses (a finding that is consistent with past recreational planning surveys and the Tract's General Plan).
- Levee improvements are supported by local residents and maintenance agencies.
- Channel dredging is supported by boaters and local residents.
- Increased fishery health across all native fisheries (not just Delta smelt); improvements to declining sport fish that are not deemed detrimental.
- Waterfowl habitat improvements are supported by hunters, as long as blind system is minimally modified.
- Aquatic weeds are recognized as a nuisance, but there is concern about the effects of current spraying and management, especially on prized sport fish species such as black bass. A design scheme that could reduce weeds in crucial navigation corridors would be appreciated. However, weed presence in certain areas supports the world-class bass fishery.

Participatory mapping and discussion sessions with local community members on the potential layout of restoration areas and potential project amenities resulted in the creation of a local proposal. This locally

proposed conceptual design seeks to balance biological and physical objectives with the desires of the boating and fishing community, affiliated business, and homeowners whose property values are determined by proximity to fast water. The local proposal features a somewhat smaller 2.5-mile-long primary levee across the center of Franks Tract, smaller levees along much of Piper Slough along the north side of Bethel Island, and a rock groin levee. This proposal would create 165 acres of upland areas and 855 acres of tidal marsh habitat. See map.

This locally proposed conceptual design is now being reviewed for hydrodynamic differences by DWR, but preliminary results suggest it would have lower water quality and salinity intrusion reduction benefits than the CDFW approach.

Finally, it should be acknowledged that 220 of 575 survey respondents indicated that they preferred the area to be left as it is.

Recommendations

Outreach results suggest that the local community is wary of significant change to the region as well as any top-down decision-making that does not take their interests into account. As such, local communities are highly interested in being involved in the design and planning process for any potential changes to Franks and Little Franks Tract.

Meetings and conversations about this proposed restoration approach have begun to build trust and more open communication between state agencies involved in restoration efforts and the general public. Stakeholders are now interested in collaborating on next steps.

Future planning activities should apply guidance in the Delta Conservation Framework. Among other goals, the Framework calls for integrating regular stakeholder communication and socio-economic considerations into Delta conservation planning, and for developing multi-benefit conservation and land management solutions to balance environmental and human needs.

[include graphic Brett provided – drawn over aerial photo?]

7. Conclusion and Next Steps.
[NOTES BELOW -– to be written up later]

It is possible to structurally reverse changes to recover historic form and function.

From an engineering perspective it is technically feasible to restore intertidal habitat.

Restoration if designed appropriately can provide resiliency to climate change, both sea level rise and potentially more frequent and longer droughts.

Habitat improvements as described in A Delta Renewed can be achieved through the conceptual design evaluated and possibly the locally preferred plan.

Restoration that restricts tidal flow through Franks Tract to Old River can improve Central and South Delta water quality and reduce entrainment of Delta smelt into the South Delta.

Restoration can improve habitat quality within Franks Tract for native fishes while eliminating submerged and floating aquatic weeds and reducing predator habitat.

Detailed restoration planning must take into account the social, economic, and recreational interests of the affected local communities and user groups.

Restoration is generally consistent with the existing Management Plan for Franks Tract State Recreation Area.

The effort aligns with a number of the goals outlined in the Delta Conservation Framework

Next Steps

Develop a detailed restoration plan, based on a variety of scenarios considering restoration design and community and use group interest alternatives.

Develop a detailed restoration plan that aligns with the Delta Conservation Framework .

The detailed restoration plan should:

- Achieve habitat enhancement for Delta Smelt and other native fishes
- Improve water quality in the central and south Delta
- Maintain or improve recreational opportunities in Franks Tract
- Maintain navigational access consistent with habitat and water quality enhancement
- Eliminate or significantly lowers need for aquatic weed control in Franks Tract
- Increase resilience of Franks Tract and adjacent areas to effects for climate change

Convene a facilitated advisory group of local community interests (boating, fishing, economic, land owners, and hunting), local government, State Parks, and other interested stakeholders (CCWD, water contractors, other in Delta water users, etc) to participate in development of the plan.

Provide hydrodynamic modeling to support for the planning process.

Integrate as appropriate with the development of the Central Delta Corridor Partnership's development of a Regional Conservation Strategy.

Complete environmental review for implementation of a Franks Tract restoration approach by December 2020.

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