

TECHNICAL MEMORANDUM

Date:	October 20, 2014
To:	Charles Tyson, Reynier Fund, LLC
From:	Chad Ballard, EIT, Sam Diaz, PE, Chris Campbell, MS
Project:	14-1009 – Yolo Flyway Farms Restoration Project
Subject:	Draft Flood Conveyance Assessment

1 INTRODUCTION

The Yolo Flyway Farms Restoration Project (Project) is located at the southern end of the Yolo Bypass near the Cache Slough Complex and is within the jurisdiction of the Central Valley Flood Protection Board (CVFPB). The Reynier Fund, LLC is undertaking this Project to restore tidal interaction to the property to enhance and create habitat for special status fish. To meet this goal, the four objectives of the Project would be to:

1. Enhance regional food web productivity in support of delta smelt recovery;
2. Provide rearing habitats for out-migrating salmonids;
3. Support a broad range of other aquatic and wetland-dependent species, including Sacramento splittail; and
4. Provide ecosystem functions associated with the combination of Delta freshwater aquatic/tidal marsh/floodplain/seasonal wetland/lowland grassland interfaces that existed historically.

In meeting these objectives, a preferred design alternative has been selected. The approach to developing the preferred design followed the approach adopted for the Lower Yolo Restoration Project. The Lower Yolo Restoration Project design approach was developed collaboratively between the State Federal Contractors Water Agency (SFCWA) design team and its scientific advisory committee. The Project design promotes enhanced connectivity to tidal fluctuations through swale and wetland terrace excavation and selective agricultural berm leveling to enhance tidal marsh habitat via conversion from managed grasslands. The purpose of this report is to assess the potential hydraulic impacts of the Project design on flood conveyance in the Yolo Bypass.

2 DESCRIPTION OF PROJECT

The Project is located at the southern end of the Yolo Bypass as depicted in Figure 1. The project site comprises a 360-acre unit dedicated to tidal marsh restoration and an 80-acre unit dedicated to agriculture. Current land uses on the 360-acre unit are dominated by summertime flood irrigation of reclaimed rice fields used as pasture for cattle grazing. The 360-acre unit contains many historically wet areas (including approximately 27.5 acres of the Toe Drain) and has been managed in winter for waterfowl and duck hunting. The 80-acre unit has historically been used for rice production and is currently fallow.

The Project would increase tidal inundation of the 360-acre unit by creating two breaches on the eastern property berm along the Toe Drain (see Figure 2). One berm is located at the northern end of the property, the other at the southern end. The northern breach connects to a short swale that will allow higher high tides and elevated Toe Drain flows to enter the site from the north and gradually drain out to the south. The southern breach connects to a longer, branching swale that extends to the west and to the north to promote tidal inundation of the 360-acre unit interior. The westerly branch of the southern swale may potentially be extended to connect to the Lower Yolo Restoration Project should the two projects ultimately be integrated. The bottom elevation of both swales is 0 ft NAVD88 (-2.48 ft NGVD29) to allow for continual tidal action on the property and to limit tule colonization. The southern swales include a 100 ft wide terrace at elevation 5.0 ft NAVD88 (2.52 ft NGVD29) to enhance tidal inundation and create marsh habitat at a lower elevation that would otherwise not be provided by the limited site grading because a majority of the 360-acre unit is above 6.0 ft NAVD88 (3.52 ft NGVD29). Tidal elevations in the Project vicinity fluctuate between 2.0 ft NAVD88 (-0.48 ft NGVD29) at MLLW and 6.4 ft NAVD88 (3.92 ft NGVD29) at MHHW.

3 HYDRAULIC MODEL DEVELOPMENT

The Yolo Bypass RMA2 model developed by the USACE (2007a) for use in permitting and planning within the Yolo Bypass was used as a basis for assessing the potential flood conveyance impacts of the Project identified above.

Simulations developed to describe the flood impacts of the Project include:

- Simulation #1: Existing Condition
- Simulation #2: Proposed Project
- Simulation #3: Proposed Project plus Local Projects

Simulation #1 is existing conditions to which Simulation #2 and Simulation #3 are compared. Simulation #2 is the Proposed Project whereby activities are limited to the Yolo Flyway Farms property. Simulation #3 is a variation of Simulation #2 in which additional local projects (i.e., Lower Yolo Restoration Project [in design], Liberty Island Conservation Bank and Preserve[constructed], and Northern Liberty Island Fish Conservation Bank [in design]) impacts are considered to assess regional impacts on flood conveyance.

Table 1 describes the flood simulations configured as part of this analysis to gain an understanding of the flood conveyance impacts of the Project.

Table 1. Simulation Run Catalog

Simulation	Description
1	<i>Existing Conditions</i> <ul style="list-style-type: none"> Based on USACE Model development (2007a) Hydraulic roughness updated for current conditions to reflect post-wetland survey for the Lower Yolo Restoration Project Topographic conditions represent pre-summer 2010 conditions (i.e., before construction of the Liberty Island Conservation Bank and Preserve)
2	<i>Proposed Project</i> <ul style="list-style-type: none"> Based on Simulation #1 Updated Project roughness to reflect conversion of wild grasslands to perennial marsh Updated Project topography to reflect placement of 64,500 CY of excavated material from the 360-acre unit onto the 80-acre unit
3	<i>Proposed Project + Local Projects</i> <ul style="list-style-type: none"> Based on Simulation #2 Updated roughness and topography for local projects in the immediate vicinity of the Project

The following describes the model domain, topography, boundary conditions, and how the model was adapted to model the flood impacts.

3.1 TRUNCATED MODEL DOMAIN

For computational reasons identified in the Yolo Bypass RMA2 model documentation, the Yolo Bypass RMA2 model was truncated to the extents shown in Figure 3. The northern model boundary was 2.3 miles north of the Delhi Rd, the southern model boundary was truncated 6.6 miles south of the southernmost Stair Step.

Refinements to the model mesh, which had a nominal size of 500 ft by 500 ft, included refining the mesh and elevations along the restricted height levees around the Yolo Ranch headquarters and along the Stair Step. In areas of proposed tidal channels, which are relatively small and not streamwise to the flow in the Yolo Bypass (and thus have minimal conveyance capacity), the mesh was not refined and assumed the land elevations of the adjacent features for both the Project and local projects.

3.2 TOPOGRAPHY AND BATHYMETRY DATA

The source hydrographic data in the Yolo Bypass RMA2 model was that collected in 1997 to support the Sacramento and San Joaquin River Basins Comprehensive Study. The data was collected to produce 2

foot contours with a vertical accuracy of 1 foot and registered to NGVD29. To supplement this data, limited bathymetric data was collected in March 2005, as part of model development efforts, in the southern end of the Yolo Bypass in Liberty Island and Little Holland Tract.

Source hydrographic data was augmented with LiDAR flown by DWR in late January and February 2007 to update the land elevations of the restricted height levees only around the Yolo Ranch headquarters and along the Stair Step (see Figure 4). The LiDAR was produced with an accuracy of 1 foot horizontal and 0.6 feet vertical at 95% (and 0.5 feet at 90%). The bare earth data registered to NAVD88 was subsequently converted to NGVD29 (per VERTCON conversion of 2.48 ft).

Topography for Simulation #2 (see Figure 5) was updated to reflect the stockpiling of dirt that would result from excavation of Project swales. An estimated stockpile of 64,500 CY was uniformly spread over the 80-acre unit. This stockpile increased the elevations of this area by 0.5 ft.

Topography for Simulation #3 (see Figure 6) was further updated to reflect the cumulative effects of multiple local projects in the region, including SFCWA's Lower Yolo Restoration Project and Wildlands' conservation and mitigation projects (i.e., Liberty Island Conservation Bank and Preserve, and North Delta Fish Conservation Bank). The Lower Yolo Restoration Project, which has not been constructed, includes swale and wetland terrace excavation, selective agricultural berm leveling, and an onsite stockpile within the restricted height levee surrounding the Yolo Ranch headquarters. The Liberty Island Conservation Bank and Preserve project was constructed in summer 2010 and included degradation of the northern-most east-west Stair Step levee plus tidal marsh excavation and an onsite stockpile. The North Delta Fish Conservation Bank project, which has not been constructed, includes degradation of the southern and central east-west Stair Step levees plus minor grading activities.

3.3 BOUNDARY CONDITIONS

3.3.1 Hydraulic Roughness

The hydraulic roughness coefficients in Table 2, as adopted from the Yolo Bypass RMA2 model, were used to characterize predominant land uses in the Yolo Bypass and at the project site, namely water conveyance features, agriculture, and wildlife habitat. Water conveyance features include irrigation and drainage canals, tidal waterways, and flooded islands. Agricultural land uses include rice, other crops, and irrigated pasture. Wildlife habitat typically consists of wild grasslands, seasonal and permanent wetlands and riparian areas. The roughness coefficients were initially based on engineering judgment and later verified by the USACE during calibration simulations to the 1997 flood event.

For the Simulation #1, the hydraulic roughness assumptions correspond to the USACE calibrated values plus local updates to reflect the recently mapped emergent perennial marsh areas (see Figure 7). For Simulations #2 and #3, the roughness values are based on Simulation #1. For Simulation #2, the roughness values were updated to reflect design features of the Project, namely the conversion of wild grasslands to emergent perennial marsh below elevation 6.2 ft NAVD88 (3.72 ft NGVD29), (see Figure 8). This resulted in a conversion of 45.9 acres of wild grasslands to emergent perennial marsh. Simulation

#3 included the modifications for Simulation #2 as well as updating roughness values for the local projects (see Figure 9). These changes increased the roughness in the vicinity north of the Stair Step.

Table 2. Hydraulic roughness coefficients

Material #	Material Type	Manning's n value
1	Agriculture Fields	0.030
2	Wild Grassland	0.045
3	Open Water	0.025
4	Maintained Levee Slope	0.050
5	Bridges	0.070
6	Reeds and Rushes	0.050
7	Mixed Grassland/Riparian	0.070
8	Riparian Woodland	0.120
9	Restricted Height Levees	0.100
10	Perennial Marsh / YFF Inlets	0.050

3.3.2 Flow and Stage

For the truncated model domain (see Figure 3), the hydrology was based on the Sacramento River Flood Control Project (SRFCP) 1957 design flows for the Yolo Bypass, as further detailed in the supporting documentation (see USACE, 2007a). An inflow at the northern boundary (i.e., 2.3 miles north of the project site) of 490,000 cfs represents the combined flows over Fremont Weir, the Sacramento Bypass, and contributions from Knights Landing Ridge Cut, Cache Creek, Willow Slough, and Putah Creek. Other tributary inflows including Lindsey Slough (500 cfs), Cache Slough (500 cfs), the Deep Water Shipp Channel (DWSC) (100 cfs), and Miner Slough (10,000 cfs) were derived from the original RMA2 model. The water level at the southern boundary near Egbert Island (i.e., 6.6 miles south of the project site), which was specified as 14.1 ft NGVD29 (16.58 ft NAVD88), was also derived from the original RMA2 model based on the 1957 design flows.

3.3.3 Convergence Criteria

As taken for USACE (2007a), the following criteria were used to converge upon model solutions:

When the maximum change in computed water surface between iterations at any node in the model geometry is less than the convergence criterion, the simulation either proceeds to the next boundary condition revision or stops. The convergence criteria value of 0.0025 ft used assures that the accuracy of impact assessments featuring the comparison of computed water surface data sets is better than +/- 0.005 ft. This allows water surface contours generated from such a comparison to be viewed with confidence at an interval of 0.01 ft.

4 RESULTS

Based on the model runs outlined in Table 1 and further described above, Table 3 describes the relative difference in the design flood water surface elevation (WSE) and velocity as compared to existing conditions. To determine if any scenario resulted in a flood conveyance impact, a level of significance threshold for increases in WSE was set to 0.05 feet. This threshold considered some degree of model uncertainty given that model input data (i.e., topography) have vertical accuracies far greater than 0.05 feet (i.e., an order of magnitude greater).

Table 3. RMA2 model results

Run ID	Description
2	<p><i>Simulation #2 –Proposed Project</i></p> <p>As shown by Figure 10 and Figure 11, the Project has insignificant impacts to WSE and velocity locally and adjacent to flood infrastructure. The changes in WSE are less than the level of significance threshold of 0.05 ft.</p>
3	<p><i>Simulation #3 – Proposed Project plus Local Projects</i></p> <p>As shown by Figure 12 and Figure 13, regional scale effects are insignificant when the Project is considered in combination with local SFCWA and Wildlands projects. A minor increase in WSE downstream of the southern Stair Step is offset by an equally minor decrease in WSE upstream of the same Stair Step. The majority of these changes in WSE are less than the level of significance threshold. There are also local reductions in velocity along the west flood control levee.</p>

A sensitivity analysis was performed to assess impacts of a 1.0 ft stockpile fill thickness in the event that potential integration with the Lower Yolo Restoration Project required more excavation and subsequent stockpiling. This 1.0 ft fill thickness sensitivity run was compared to the existing conditions (see Figure 14) and was found not to have insignificant impacts on WSE.

5 SUMMARY

The Project includes wetland creation/enhancement via swale excavation within a 360-acre unit and subsequent stockpiling to a uniform depth of 0.5 ft within an adjacent 80-acre unit. The flood conveyance impacts of the Project were assessed by computing the change in WSE and velocity relative to existing conditions. , It was found that the Project does not significantly impact local WSEs or flow velocities, and therefore does not have a negative impact on flood conveyance. In addition, when neighboring local projects are considered, the Project has no significant cumulative negative impact on flood conveyance.

If the excavation associated with project features exceeds 64,500 CY, the resulting increase in stockpile elevation is expected to be minimal, due to the relatively large area over which it will be distributed. The

stockpile sensitivity simulation run demonstrated that there will not be a significant impact on flood conveyance if the fill thickness of the proposed stockpile were to be doubled from 0.5 ft to 1.0 ft.

6 REFERENCES

cbec. 2011. Prospect Island Tidal Restoration Project – Summary of Bathymetric and Topographic Data Sources. DWR Task Order SS-02, Task 2, Contract No. 4200009291. Submitted December 23, 2011.

USACE. 2007a. Engineering Documentation Report: Yolo Bypass 2-D Hydraulic Model Development and Calibration. US Army Corps of Engineers, Sacramento District.

USACE. 2007b. Yolo Bypass RMA2 Model User Guide. US Army Corps of Engineers, Sacramento District.

7 LIST OF FIGURES

Figure 1 – Project Vicinity Map

Figure 2 – Project Design

Figure 3 – RMA2 Model Domain

Figure 4 – Existing Conditions Topography

Figure 5 – Proposed Project Topography Modifications

Figure 6 – Proposed Project + Local Projects Topography Modifications

Figure 7 – Existing Conditions Roughness

Figure 8 – Proposed Project Roughness

Figure 9 – Proposed Project + Local Projects Roughness

Figure 10 – Proposed Project Impacts (Water Level)

Figure 11 – Proposed Project Impacts (Velocity)

Figure 12 – Proposed Project + Local Projects Impacts (Water Level)

Figure 13 – Proposed Project + Local Projects Impacts (Velocity)

Figure 14 – Stockpile Fill Sensitivity



























