APPENDIX F-2

Chelsea Wetland Restoration Project Hydraulic Analysis Technical Memorandum (Questa, 2015)

Technical Memorandum

Date: August 11, 2014; updated August 13, 2015

To: Ducks Unlimited

From: Questa Engineering Corporation

Subject: Chelsea Wetland Restoration Project Hydraulic Analysis

Proposed Chelsea Wetland Restoration Project

The proposed Chelsea Wetland Restoration Project is a tidal marsh restoration project located in Pinole, Contra Costa County, California. The project is immediately adjacent to Pinole Creek approximately 1,800 feet upstream of its confluence with San Francisco Bay. Pinole Creek is part of the federally authorized Pinole Creek Local Flood Protection Project. The proposed project includes excavation and grading of approximately 12 acres of land adjacent to Pinole Creek, construction of tidal channels connecting the project site to Pinole Creek through a new concrete bottomless arch culvert, and the construction of small upland islands. The project will also entail the installation of a vinyl-sheet pile wall..

The project is not proposing significant changes to the Pinole Creek channel geometry or hydraulic function. The new culvert will allow daily tidal influence into the site but will have little effect during large magnitude or design flows. During these events, flow overtops the existing northern (right) bank when rates exceed of the 25-year event and flood the site. These flows are generally nearly still and the project area represents flood plain storage and not conveyance.

On behalf of Ducks Unlimited, Questa conducted a hydraulic impact analysis to determine the impacts of the proposed project on the authorized Federal project. The Pinole Creek Local Flood Protection Project was authorized for a 2,600 cfs discharge.

METHODOLOGY

The methodology used to determine the hydraulic impacts associated with the proposed project were to compare the water surface elevation associated with the with-project condition to the water surface elevation of the existing condition using the design flow of 2,600 cfs. Velocities are low in the project area and the site is considered to be non-effective flow and floodplain storage.

Downstream Boundary Condition - Tidal Water Surface Elevation

The beginning tidal elevations used as the downstream boundary condition for the HEC-RAS models are summarized in **Table 1**.

Table 1. Tidal Elevations

Design Value	NAVD88
Mean Higher High Water Beginning water surface elevation : **design conditions**	**5.76 feet**

Upstream Boundary Condition and Flow Regime

The HEC-RAS models were run with the mixed flow regime and the upstream boundary conditions were set as normal depth with a slope of 0.003 ft/ft.

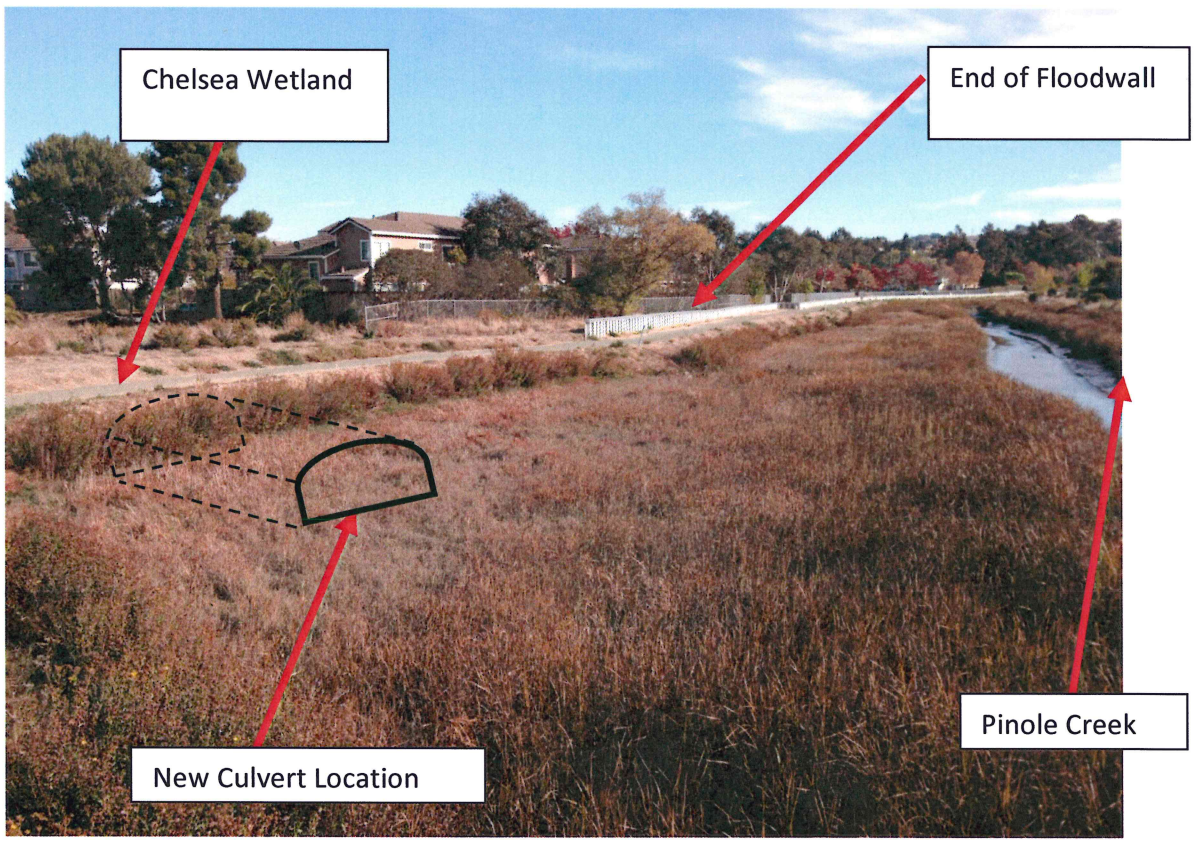
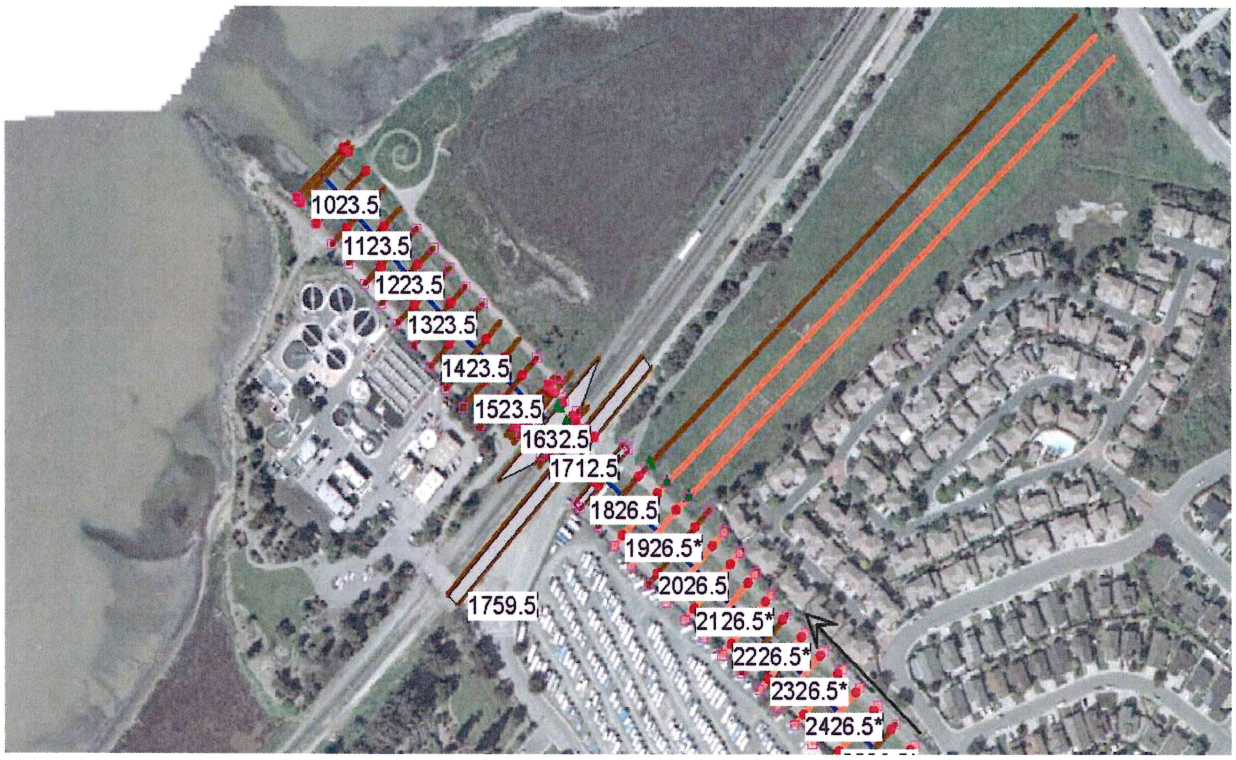


Photo 1. Floodwall along the northern bank of Pinole Creek ending at Chelsea Wetland; photo taken from new pedestrian bridge looking upstream to the east.

Existing Pinole Creek Cross Sections

Channel cross sections taken from a 2012 field survey were compared to the cross sections simulating the Chelsea Wetlands Restoration project. The existing condition and proposed project are modeled in applicable HEC-RAS models. The five cross sections located at Stations 1876.5, 1926.5, 1976.5, 2026.5, and 2076.5 as shown on **Figure 1,** were updated based on existing topography from the 2012 survey. Cross sections 1876.5, 1926.5, and 1976 were extended into the Chelsea wetland site.

Figure 1. Plan View of HEC-RAS Cross Section Location



Results

Figure 2 below shows the existing condition profile for the design flow of 2,600 cfs. As can be seen by the profile below the bridges immediately downstream of the project site create significant back water at the site and control the water surface elevations on Chelsea site. Figure 3 show the cross section through the Chelsea site. For both the pre and post project models the channel bank was lowered on the right bank and flow was allowed to spill into the Chelsea site. The three cross sections in the post project model were revised to represent the general grading of the Chelsea site. The site will be lowered in elevation from 9 to 10 NAVD to 6 NAVD. The culvert installed in the right bank to allow for tidal inundation is overtopped easily and therefore is not included in these models. The Chelsea site was modeled as ineffective flow in both the pre and post project scenarios. The grading has no effect other than increasing the amount of floodplain storage on the site.

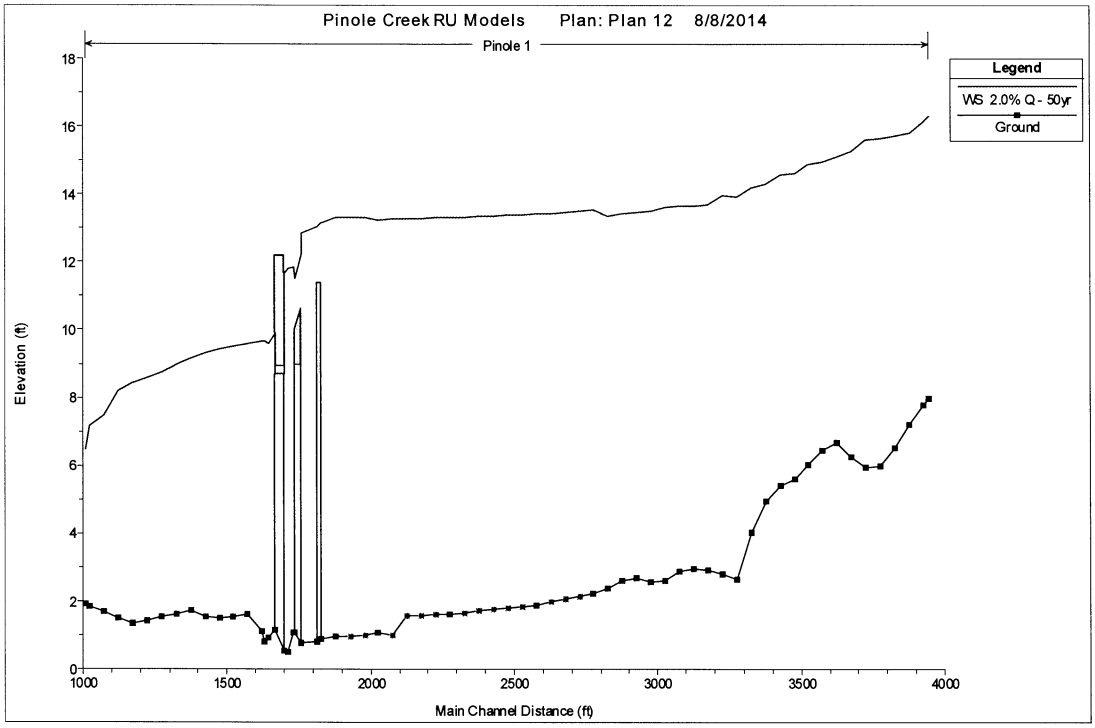


Figure 2. Existing condition Water Surface Profile, 2,600 cfs (50-year design flow)

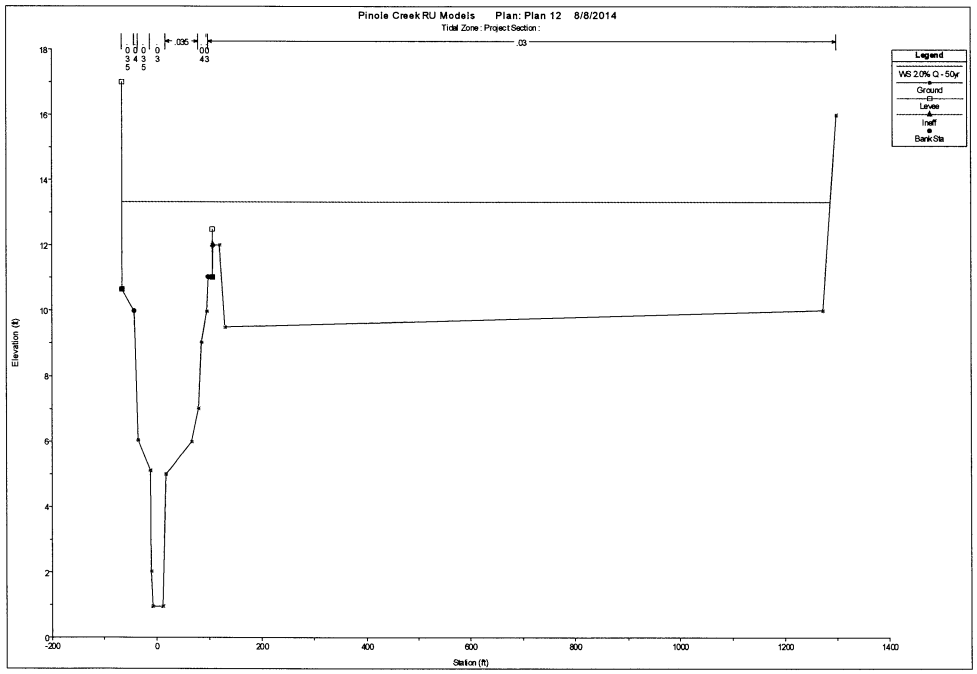


Figure 3. Existing condition, Cross section – 2013 survey

Table 2. Comparison between Existing and Proposed conditions at the Chelsea Wetlands Project

River Sta	Q Total (cfs)	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)	Existing Vel Chnl (ft/s)	Proposed Vel Chnl (ft/s)	Change in W.S. Elev (ft)	Change in Vel Chnl (ft/s)
2176.5	2600	13.3	13.28	2.89	2.9	-0.02	0.01
2126.5	2600	13.29	13.28	2.75	2.76	-0.01	0.01
2076.5	2600	13.26	13.27	2.87	2.61	0.01	-0.26
2026.5	2600	13.25	13.27	2.87	2.47	0.02	-0.4
1976.5	2600	13.33	13.33	0.68	0.25	0	-0.43
1926.5	2600	13.33	13.33	0.64	0.25	0	-0.39
1876.5	2600	13.33	13.33	0.63	0.25	0	-0.38
1826.5	2600	13.17	13.17	3.64	3.64	0	0
1820	Bridge						
1814.5	2600	13.03	13.03	3.67	3.67	0	0
1759.5	2600	12.87	12.87	4.29	4.29	0	0
1746.5	Bridge						
1733.5	2600	11.86	11.86	4.9	4.9	0	0
1712.5	2600	11.84	11.84	4.86	4.86	0	0
1700.5	2600	11.68	11.68	5.66	5.66	0	0
1684.5	Bridge						
1668.5	2600	9.91	9.91	5.99	5.99	0	0
1644.5	2600	9.61	9.61	6.97	6.97	0	0
1632.5	2600	9.66	9.66	6.45	6.45	0	0

August 2015 Update

Channel Capacity

After meeting with the USACE on July 28, 2015 additional hydraulic modeling and analysis was completed to demonstrate the proposed Chelsea project would not cause adverse effects to the authorized project. USACE specifically requested the "ultimate channel capacity" (i.e. maximum flow rate) under the 1962 as-built condition and the existing condition be determined. The ultimate channel capacity provides no freeboard.

Questa obtained a previously compiled as-built HEC-RAS geometry file from Contra Cost County Flood Control. This geometry file was spot checked with the as-built plans. To find the ultimate channel capacity of the as-built channel, a series of discharges were run through the as-built model. This analysis determined that approximately 3,100 cfs was the ultimate channel capacity of the channel under the as-built condition. It should be noted that the as-built model used a channel Manning's n value of 0.03, or the equivalent of a grassed lined channel. A similar analysis was completed using the existing condition model (2013 survey info) that includes the flood walls.

The model was amended to include the Chelsea site as basic floodplain storage. In this scenario, the proposed Chelsea project site was indicated as ineffective flow and basically functions as simply flood plain storage. The reason for this is an appropriate modeling technique is that the area really functions as flood storage and there is no lateral structure influencing the flood plain in the existing conditions. For future conditions the new culvert is large enough so to allow the water surface in Chelsea project area to raise and lower with the water surface elevations in the main channel. Because the waters

surface are commensurate there is no need to model a lateral structure in the proposed condition model. The existing condition model used a Manning's n-value of 0.03. The existing condition analysis determined that the ultimate channel capacity is approximately 3,000 cfs as presented in Table 3.

Finally, an existing condition model with the proposed grading at the Chelsea site was used to determine ultimate capacity under the proposed condition. Again, the proposed Chelsea project site was indicated as ineffective flow. The proposed condition analysis determined that the ultimate channel capacity is nearly identical to the existing condition, approximately 3,000 cfs, as presented in Table 3.

Table 3. Ultimate Channel Capacity – Existing and Proposed Conditions

Cross Section	Existing Condition		Proposed Condition		Top of Wall Height (ft)
	Q Capacity (cfs)	WSE (ft)	Q Capacity (cfs)	WSE (ft)	
2126.5	3,100	14.03	3,100	14.05	14.08
2076.5	3,100	14.00	3,050	13.97	14.02
2026.5	3,050	13.91	3,050	13.95	13.96
1976.5	3,000	13.84	3,000	13.85	13.96
1926.5	3,000	13.85	3,000	13.84	13.84
1876.5	2,950	13.77	2,950	13.77	13.78

In summary, ultimate channel capacity under the as-built conditions is nearly the same as the existing condition, and proposed condition, with no meaningful difference.

Design Discharge Channel Performance

In addition to the previous analysis (see result in Table 2 above) using the existing conditions model, Questa also analyzed the channel performance at the design discharge of 2,600 cfs under the as-built condition, the existing condition (i.e. revised roughness, no Chelsea project), and proposed condition using the as-built model. Table 4 presents the water surface elevations at the design discharge predicted in the as-built model.

Table 4. 1962 As-built Condition Design Water Surface Elevations

River Station	Discharge (cfs)	WSE (ft)
2266	2,600	11.51
2200	2,600	11.59
2061.75	2,600	11.37
1888	2,600	11.14
1800	2,600	11.04

Table 5 presents the water surface elevations of the design discharge of 2,600 cfs under existing and proposed conditions.

Table 5. Existing and Proposed Conditions Water Surface Elevations at Design Discharge

Cross Section	Discharge (cfs)	Existing Condition	Proposed Condition	Top of Wall Height (ft)
		WSE (ft)	WSE (ft)	
2126.5	2,600	13.30	13.31	14.08
2076.5	2,600	13.27	13.31	14.02
2026.5	2,600	13.26	13.3	13.96
1976.5	2,600	13.26	13.3	13.96
1926.5	2,600	13.27	13.29	13.84
1876.5	2,600	13.26	13.26	13.78

The water surface elevations predicted by the as-built model with and without the Chelsea wetland grading were identical, showing that the grading of the wetland only provides added floodplain storage and does not impact channel capacity.

As was the case with ultimate channel capacity, there is no meaningful change in water surface elevation as a result of the proposed Chelsea project. The analysis does show that the water surface elevation of the design discharge has risen over two-feet since its construction. However, unrelated to this project, a non-Federal sheetpile wall was installed to mitigate this rise in 2010.

CONCLUSION

The analyses discussed above demonstrate that the proposed project will not result in significant changes to the performance of the Pinole Creek Local Flood Protection Project. The maximum water surface elevation impact is 0.04 feet or 0.48 inches and is likely within the error of the modeling effort.

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