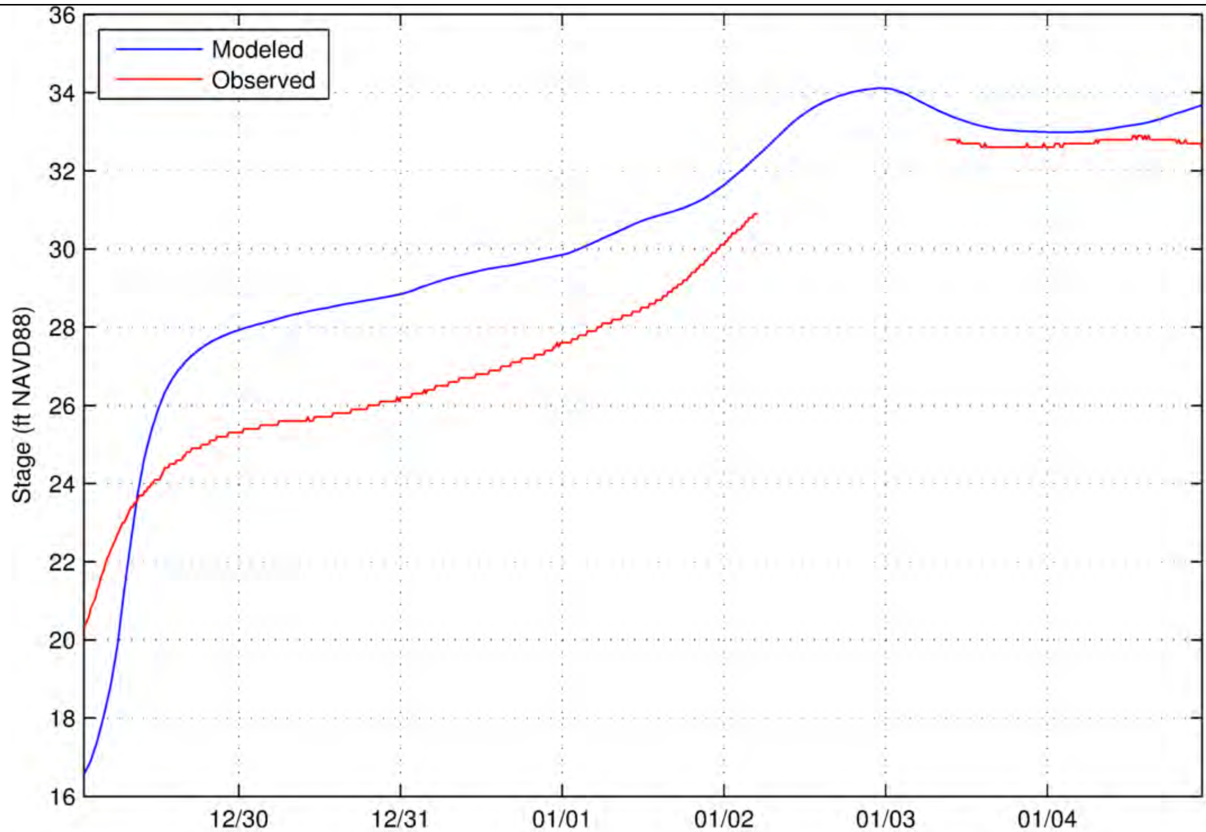
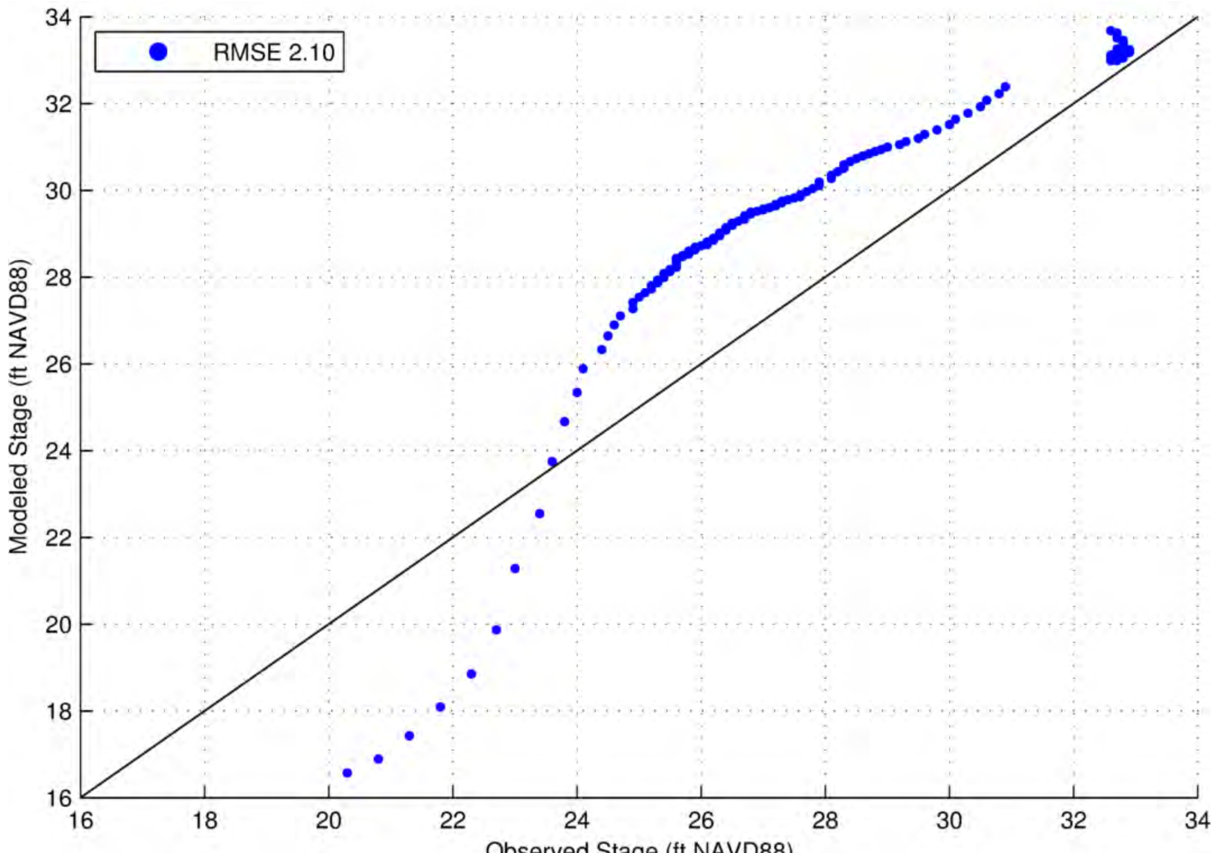
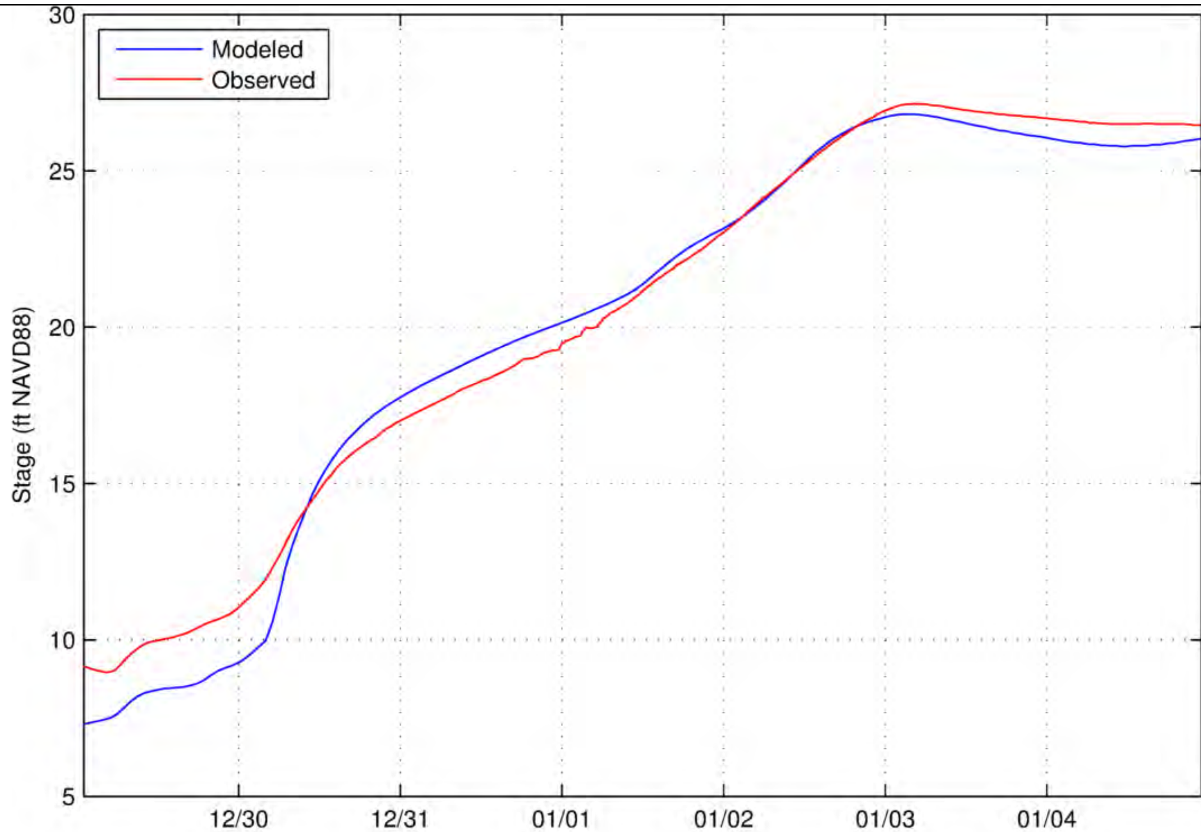
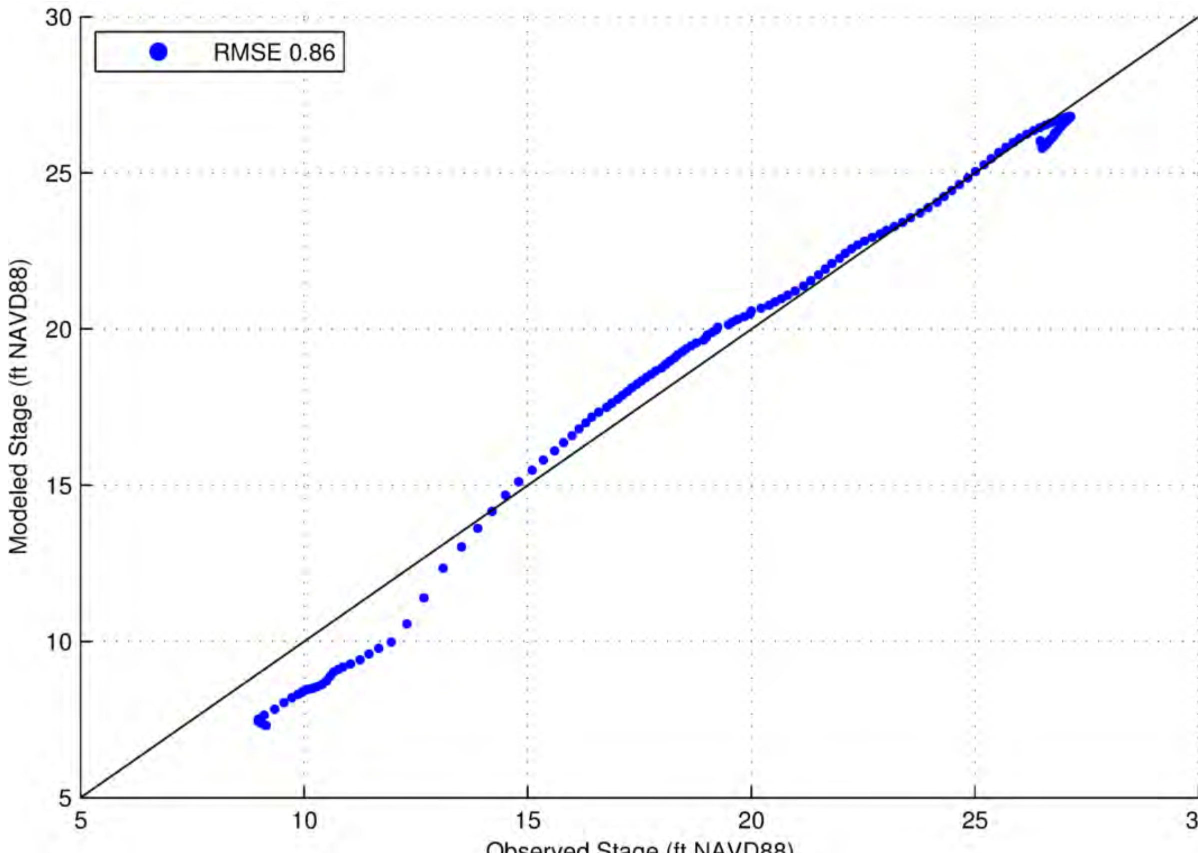




Notes:		*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **1997 Calibration Near Woodland Stage**		
		Prepared for DWR	Created By: RDJ	**Figure 5-16**



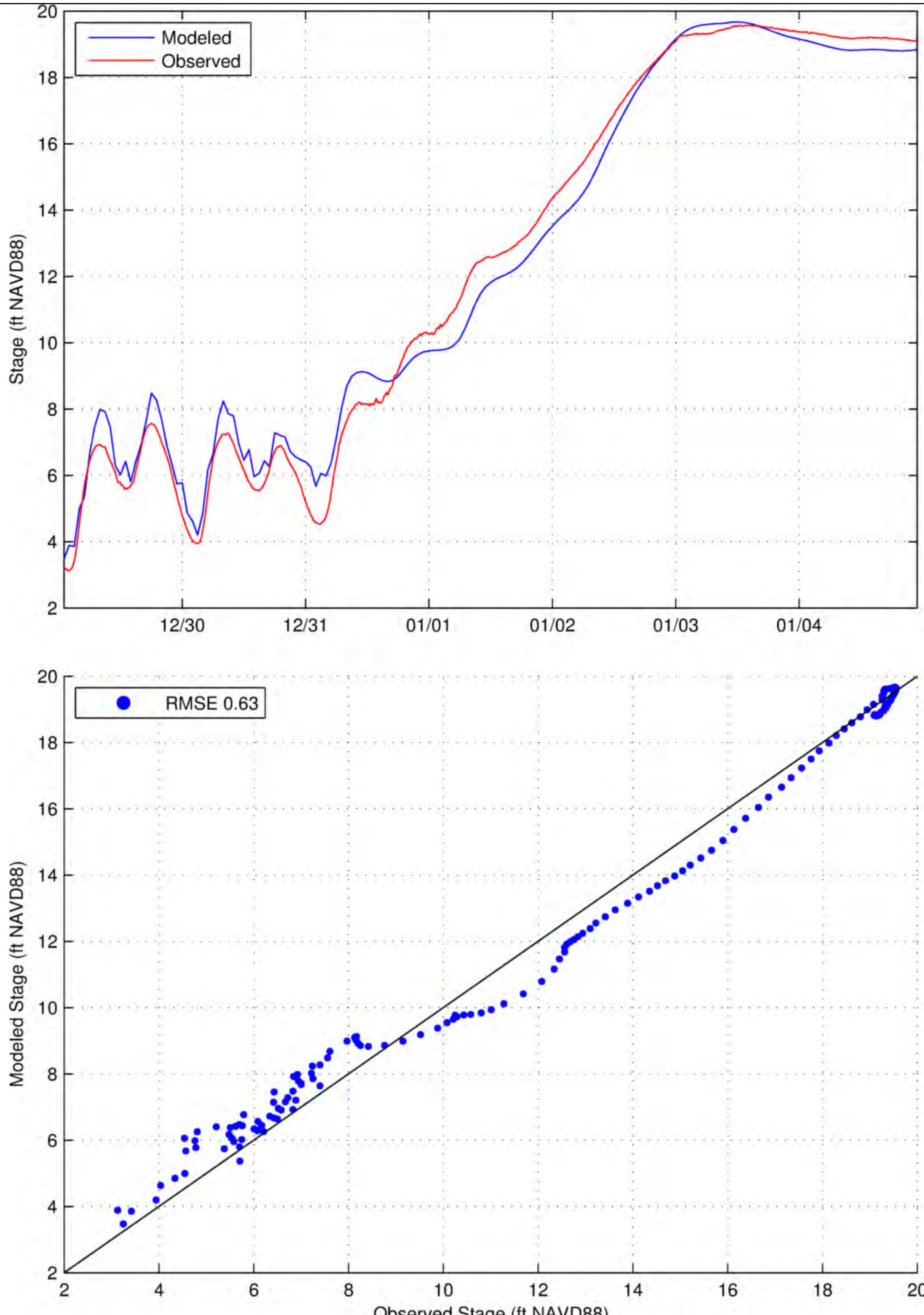


Notes:

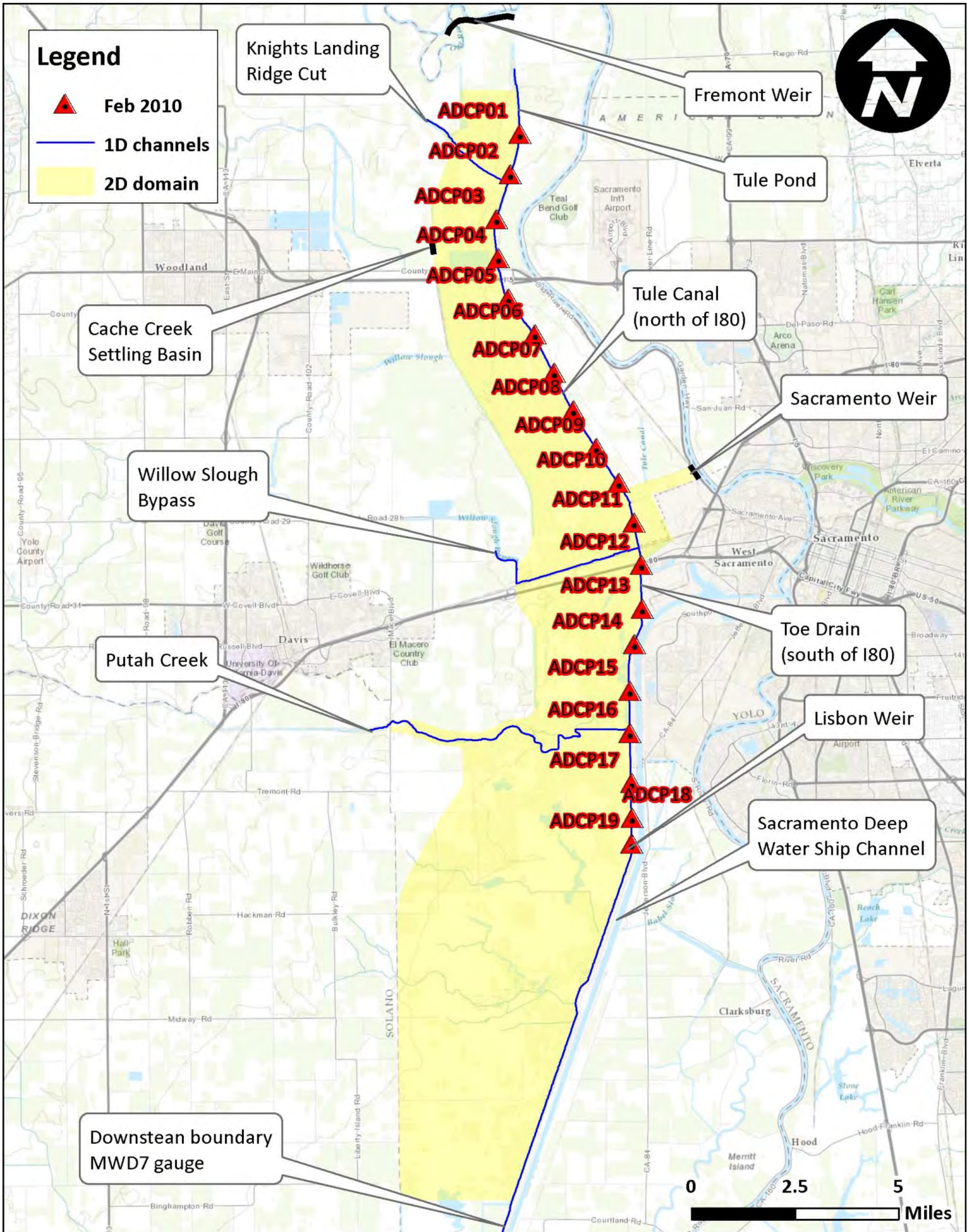
Yolo Bypass Salmonid Habitat Restoration and Fish Passage

1997 Calibration Lisbon Weir Stage

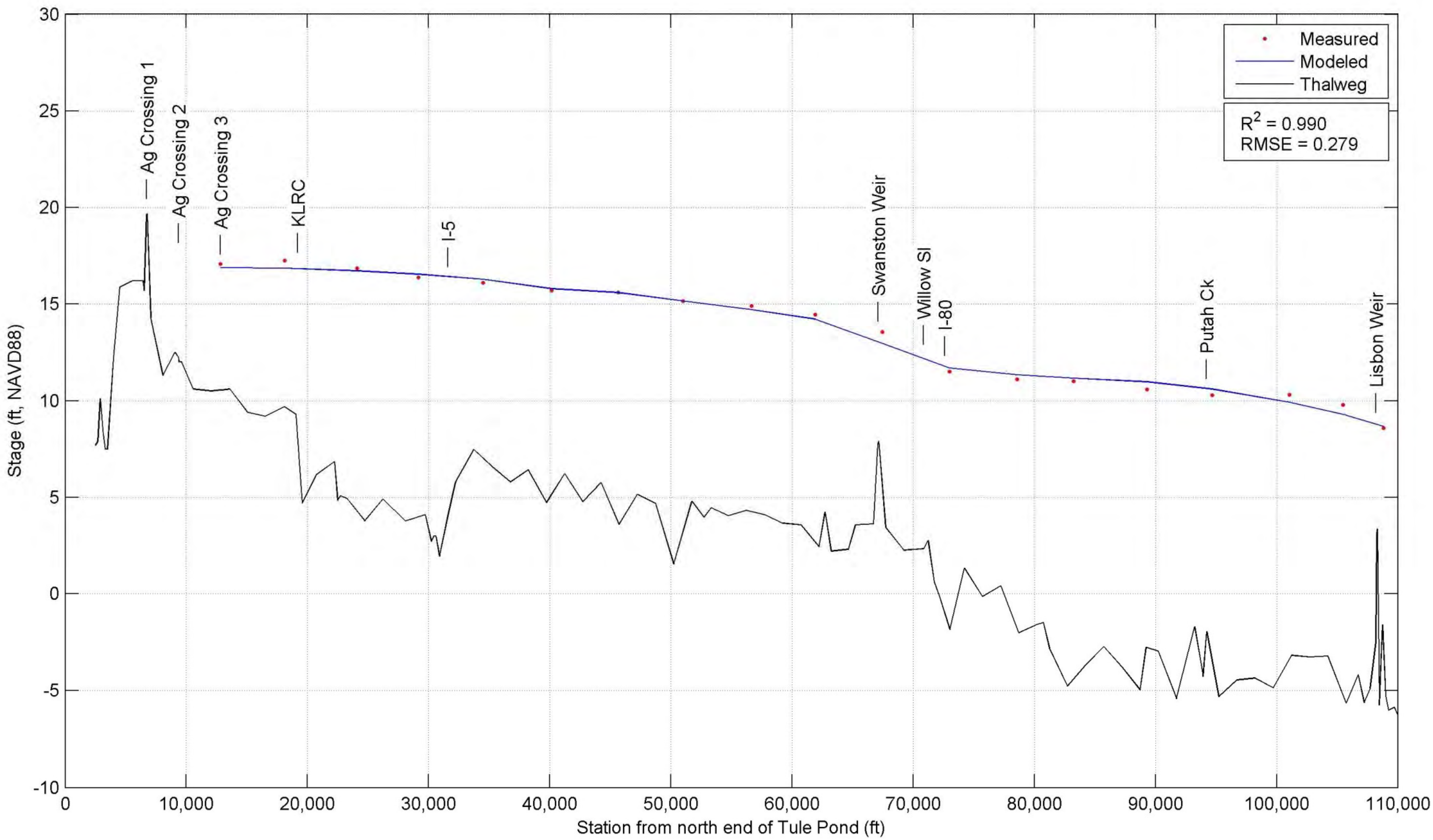
Prepared for DWR	Created By: RDJ	**Figure 5-17**



Notes: Upstream of Weir		*Yolo Bypass Salmonid Habitat Restoration and Fish Passage*		
		1997 Calibration Liberty Island Stage		
		Prepared for DWR	Created By: RDJ	**Figure 5-18**



Notes:		*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **2010 Low Flow Calibration Data**		
		Prepared for DWR	Created By: SP	**Figure 5-19**

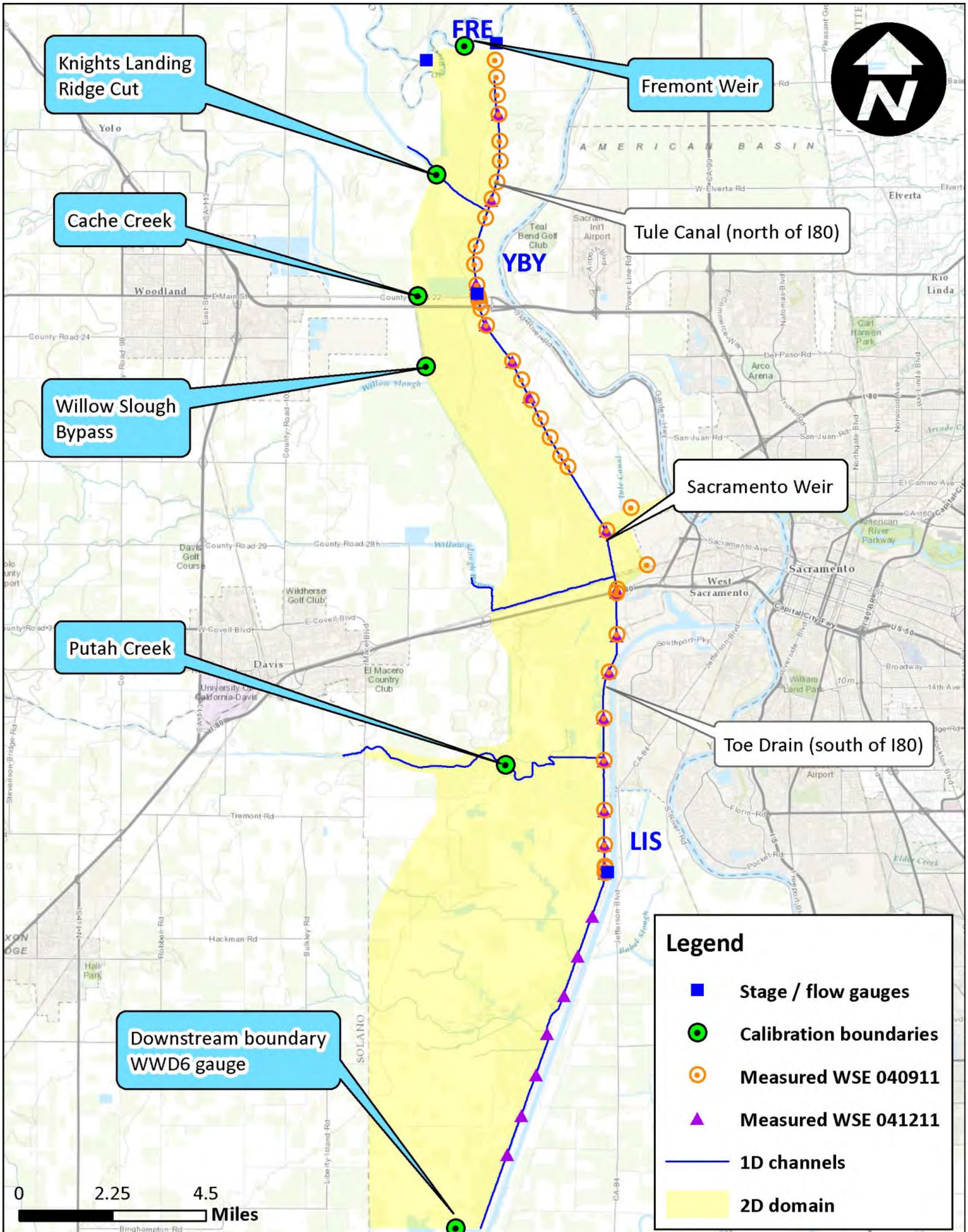


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

2010 Low Flow Calibration-Comparison of WSEs

Prepared for DWR	Created By: SJB	**Figure 5-20**

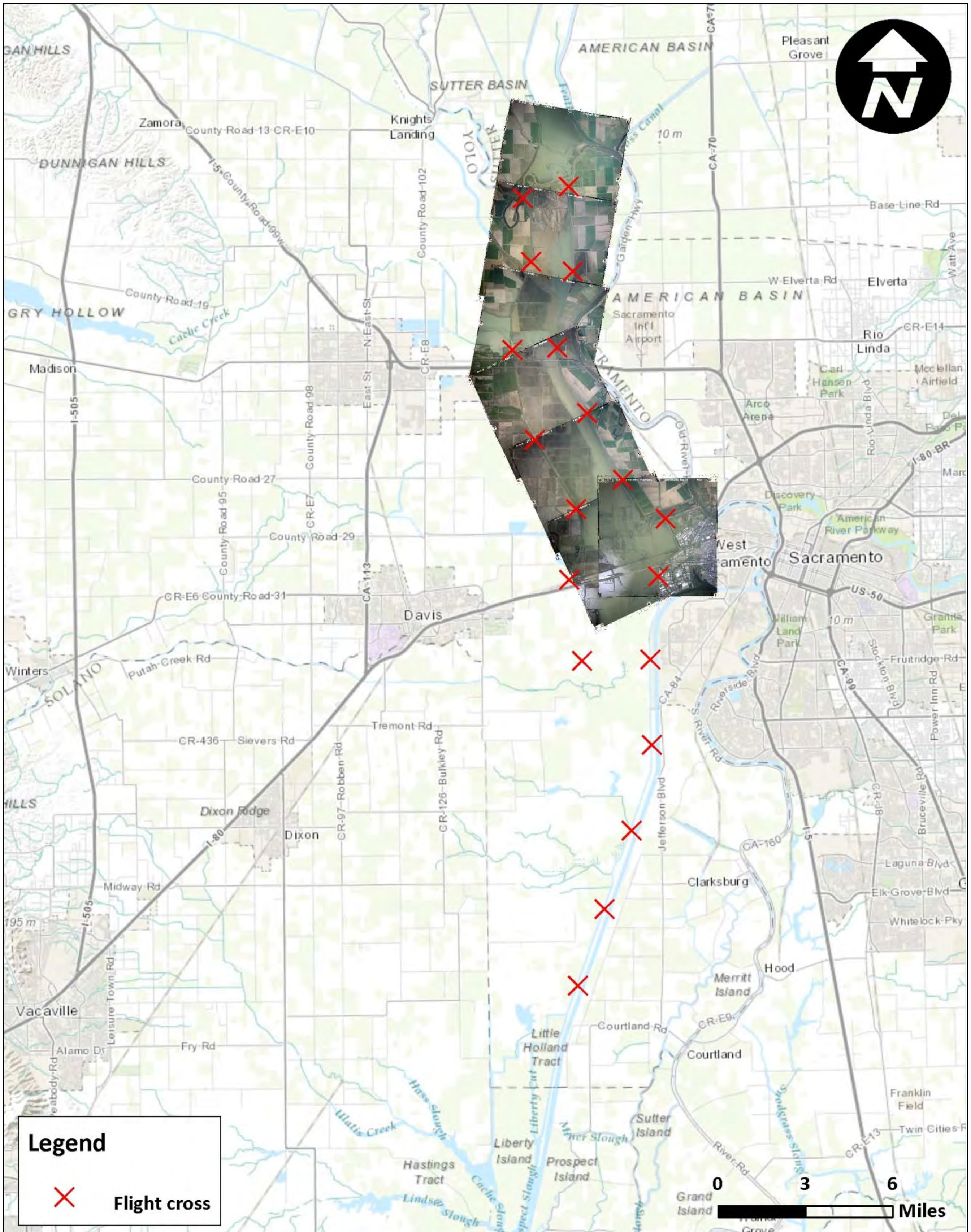


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

2011 Flood Calibration Data

Prepared for DWR	Created By: SP	**Figure 5-21**



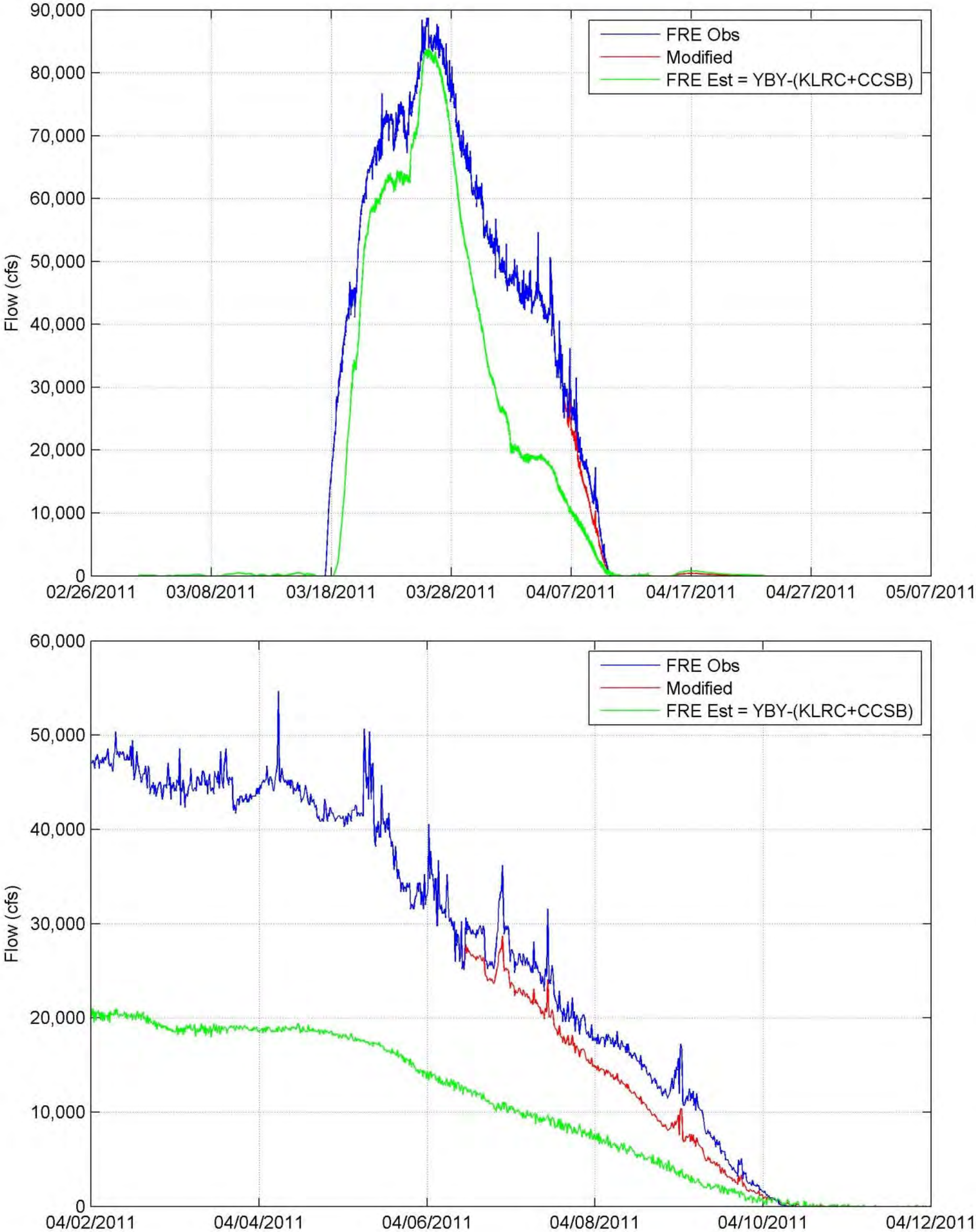
Notes:	HDR cbec eco engineering	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Aerial Photos of Yolo Bypass-April 9, 2011**		
		Prepared for DWR	Created By: SP	**Figure 5-22**

Notes:

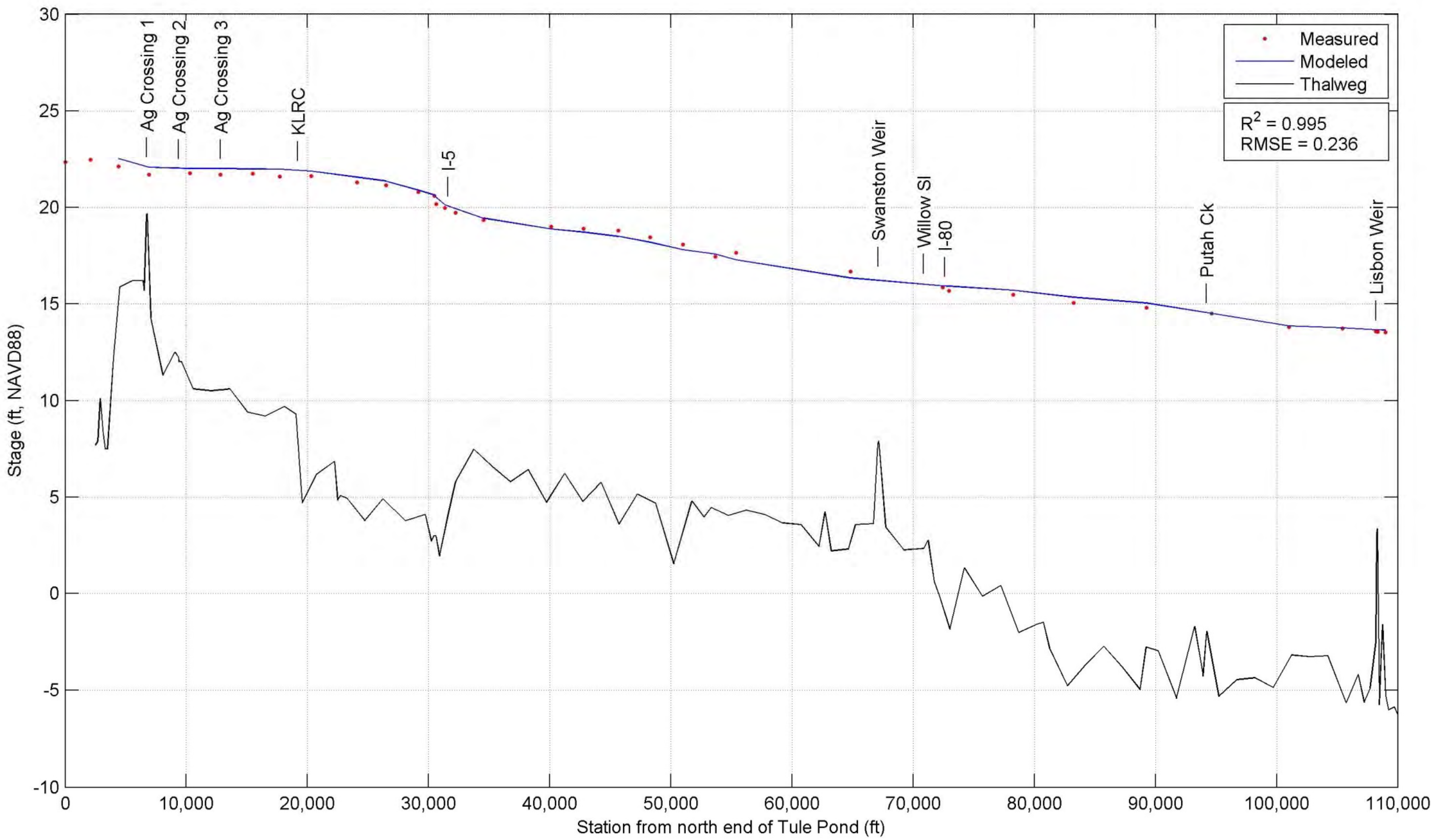
Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Aerial Photos of Yolo Bypass-April 12, 2011

Prepared for DWR	Created By: SP	**Figure 5-23**



Notes:		*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **2011 Flood Calib-Mods to Fremont Inflows**		
		Prepared for DWR	Created By: CMB	**Figure 5-24**

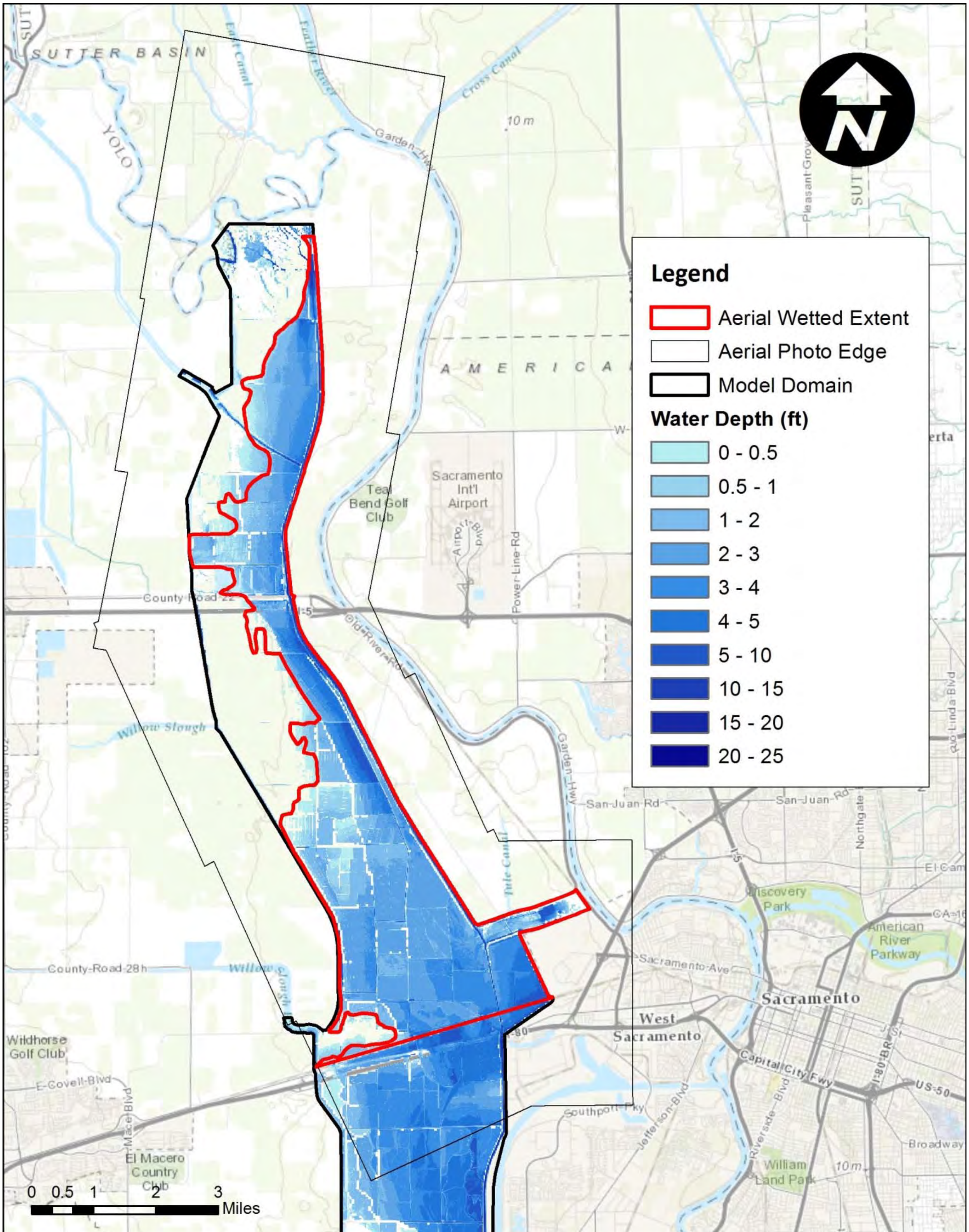


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

2011 Flood Calib-Comparison of April 9 - WSEs

Prepared for DWR	Created By: SJB	**Figure 5-25**

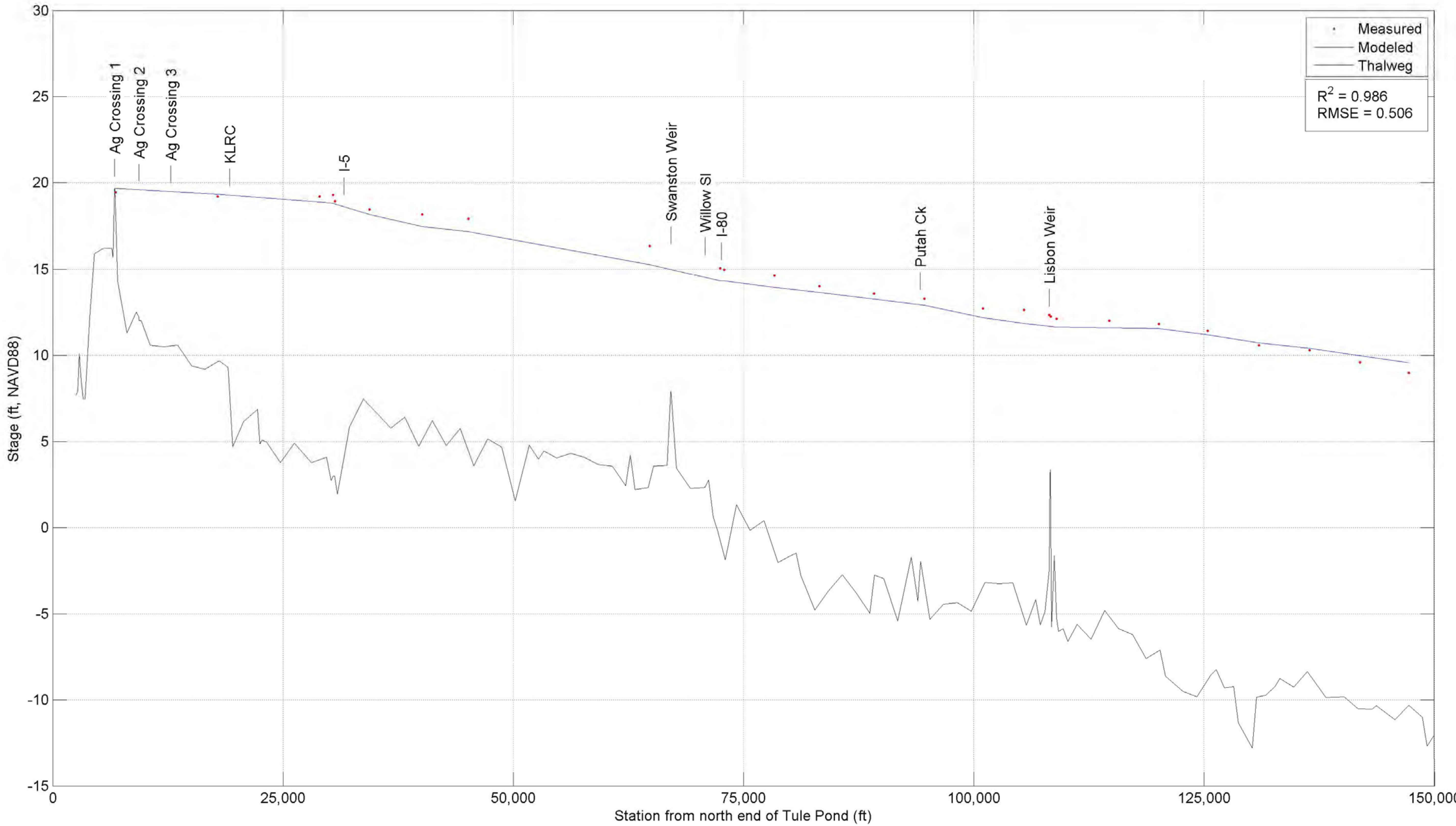


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

2011 Flood Calibration – April 9, 2011

Prepared for DWR	Created By: CMB	**Figure 5-26**

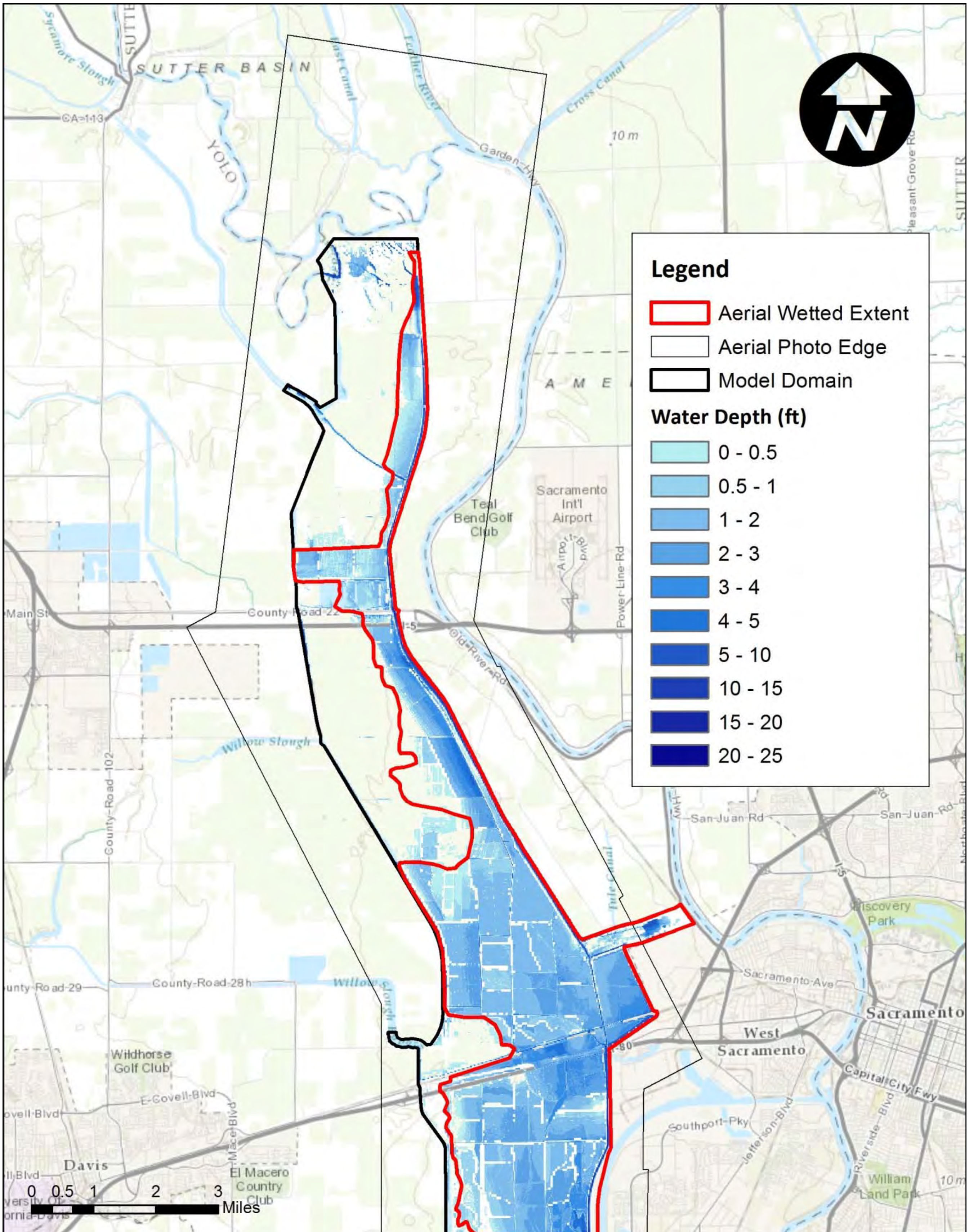


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

2011 Flood Calibration- Comparison of April 12- WSEs

Prepared for DWR	Created By: SJB	**Figure 5-27**

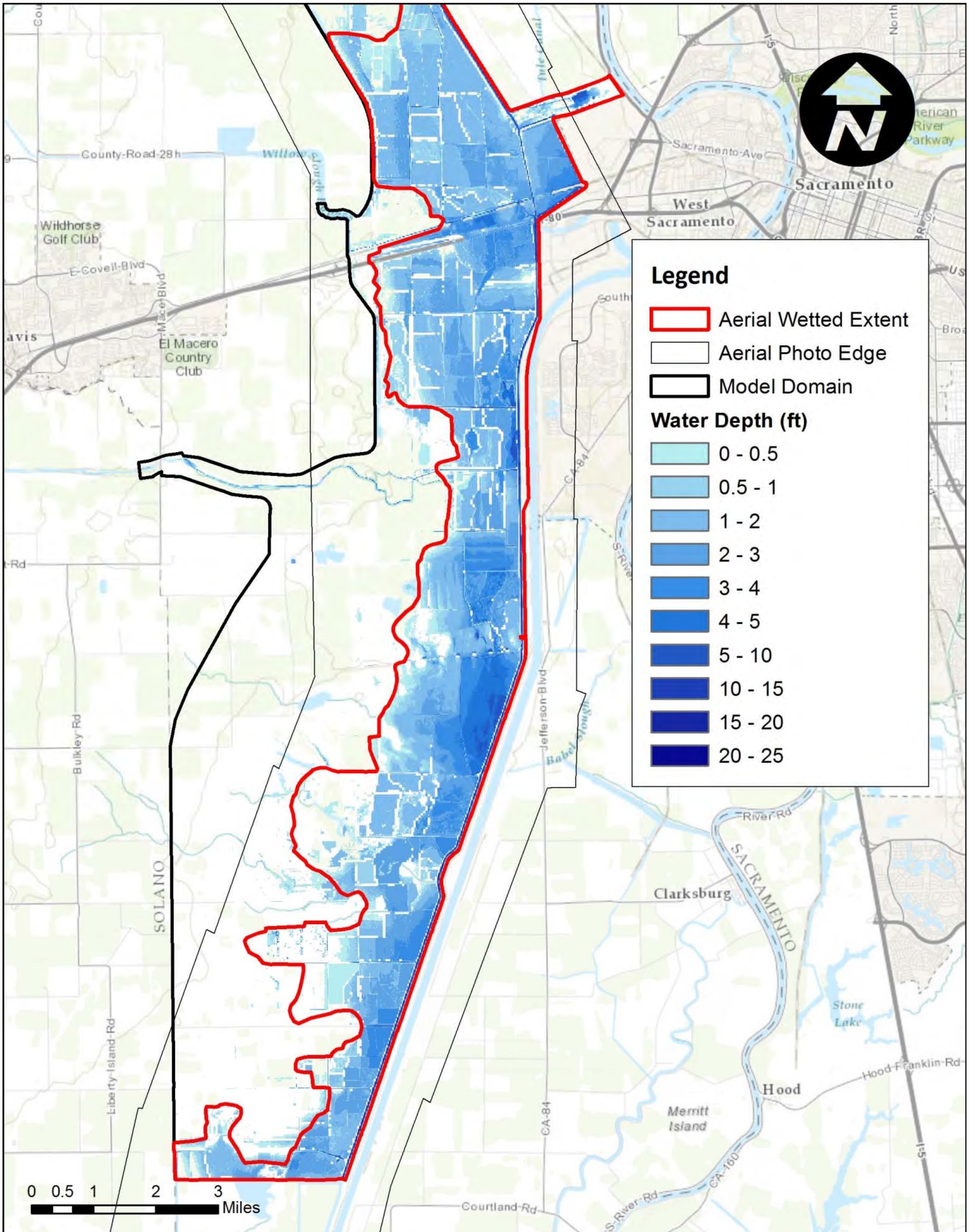


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

2011 Flood Calibration – April 12, 2011

Prepared for DWR	Created By: CMB	**Figure 5-28**



Notes:		*Yolo Bypass Salmonid Habitat Restoration and Fish Passage*		
	HDR cbec eco engineering	**2011 Flood Calibration – April 12, 2011**		
		Prepared for DWR	Created By: CMB	**Figure 5-29**

6.0 Existing Conditions Analysis

6.1 Overview of Results

The existing conditions model was run for the 16-year period from water year 1997 through water year 2012. All model runs start on October 2. Most runs end on May 31, but the wetter years were extended at least through June 31 to capture late season inundations and/or provide results for extended fish habitat periods (1997, 1998, 1999, 2000, 2003, 2005, 2006, and 2011).

The results for the existing conditions model include daily WSEs, depths, and velocities for the entire model domain extracted from the Model at the 24th hour of each day. Discharge values through time were output at 1D channels and across predefined polylines within the 2D domain. Spatial time-varying results are in the mesh/dataset format used by the Surface-Water Modeling System (SMS) and in Environmental Systems Research Institute (ESRI) binary raster format (FLT).

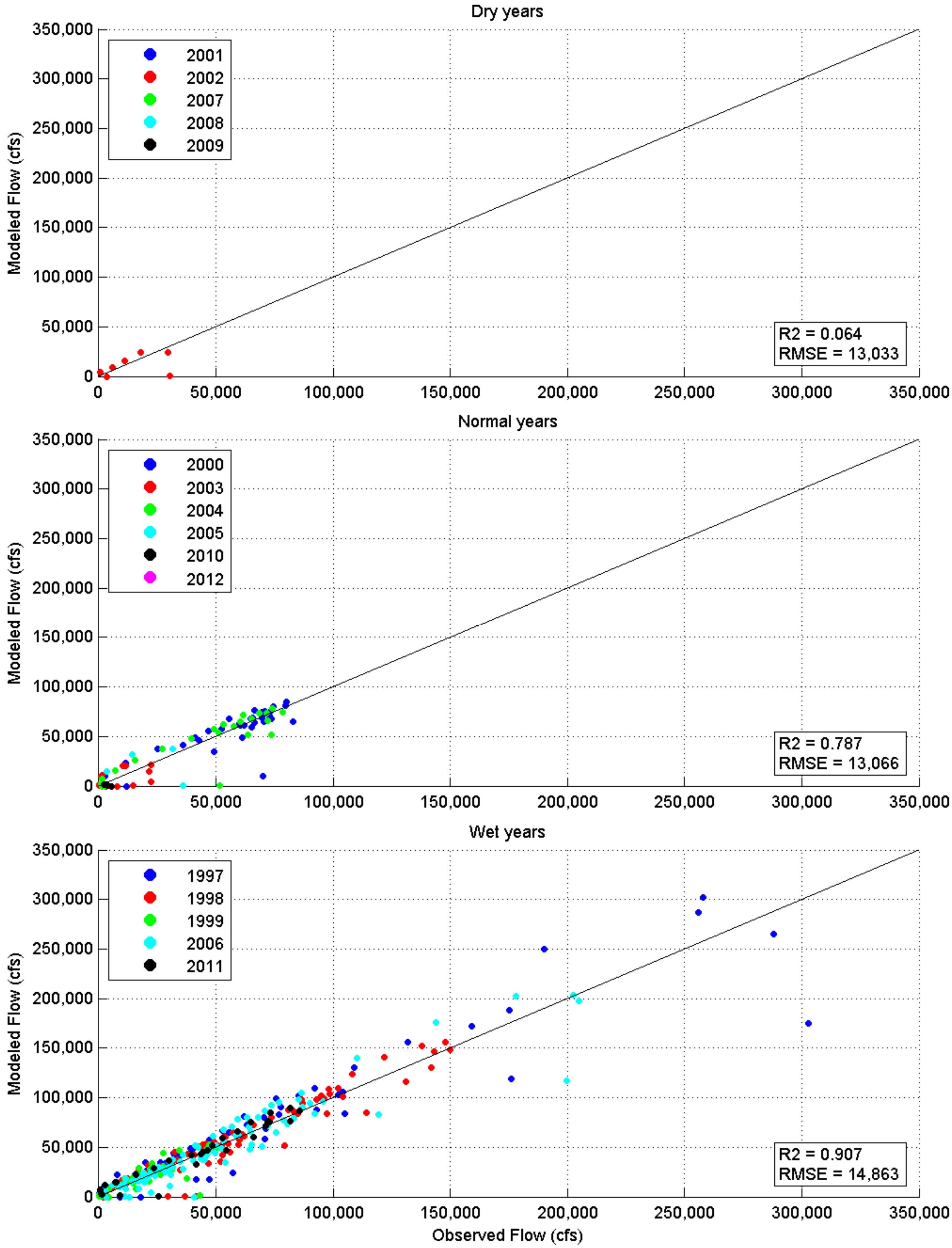
6.2 Comparisons to Observed Data

To verify that the model and underlying assumptions could reasonably simulate existing conditions over the long term, a suite of modeled versus observed scatter plots were prepared. Figure 6-1 shows that the flow over Fremont Weir has a RMSE of 13,000 to 15,000 cfs over the full range of conditions, which compares favorably with the RMSE from the 1997 calibration. Figure 6-2 shows that the Sacramento River stage in front of Fremont Weir has a RMSE of 0.9 to 1.3 feet, which is more than twice as large as the RMSE for the 1997 calibration. Figure 6-3 shows that the Sacramento River flow at Verona has a RMSE of 1,300 to 3,200 cfs over the full range of conditions, which is better than the RMSE 8900 cfs for the week-long 1997 calibration. Figure 6-4 shows that the stage at Yolo Bypass at Woodland has a RMSE of 2.4 to 3.0 feet, which is similar to that observed during the 1997 calibration. The most significant errors occur below an elevation of 17 feet, which is lower than the February 2010 calibration conditions. Flows are largely confined to the Tule Canal below elevation 17 feet and are below the adjacent floodplain, but modeled stages are sometimes more than 5 feet higher than recorded by the USGS. This discrepancy is not considered to impact the results of this study in the larger scale because the larger errors occur when the flows are largely confined to the Tule Canal and such times are not of interest for the current analysis.

In preparing these figures, it was discovered that the datum conversion from USED to NAVD88 was inadvertently not applied for water years 2005 and prior. This resulted in the tidal boundary at Rio Vista being 0.6 feet too high. This error presents itself in Figure 6-5 and Figure 6-6, hence the reason for computing RMSE twice. Figure 6-5 shows that for water years 2005 and prior, the stage at Lisbon Weir has a RMSE of 0.9 to 1.0 feet, whereas later years have a RMSE of 0.7 to 0.8 feet. Figure 6-6 shows that for water years 2005 and prior, the stage at Liberty Island has a RMSE of 0.7 to 1.0 feet, whereas later years have a RMSE of 0.3 to 0.5 feet.

To understand if this datum correction error has an influence on the inundation results in the Yolo Bypass, Figure 6-7 and Figure 6-8 were prepared to test the sensitivity of wetted acres and LDW, respectively, during water year 2002 with a datum correction applied at Rio Vista. Water year 2002 was classified as a dry year and experienced a small spill event over Fremont Weir. Figure 6-7 shows that there is an insignificant difference in wetted area through time. This is corroborated by Figure 6-8 which shows that a dozen fields between Lisbon Weir and the Stair Step are drier one day sooner with the corrected (or lowered) stage boundary at Rio Vista. As such, inundation and drainage within the Bypass are not significantly affected by the datum error.

Given that model impact outcomes in the Bypass are insensitive to the relatively small datum error, the Lead Agencies with the guidance from the modelers determined not to re-run the model, and to use the original results. Based on the original model results, Figure 6-9 shows the wetted acres time series for existing conditions by water year and water year type. These time series will serve as the basis for making relative comparisons amongst the alternatives.

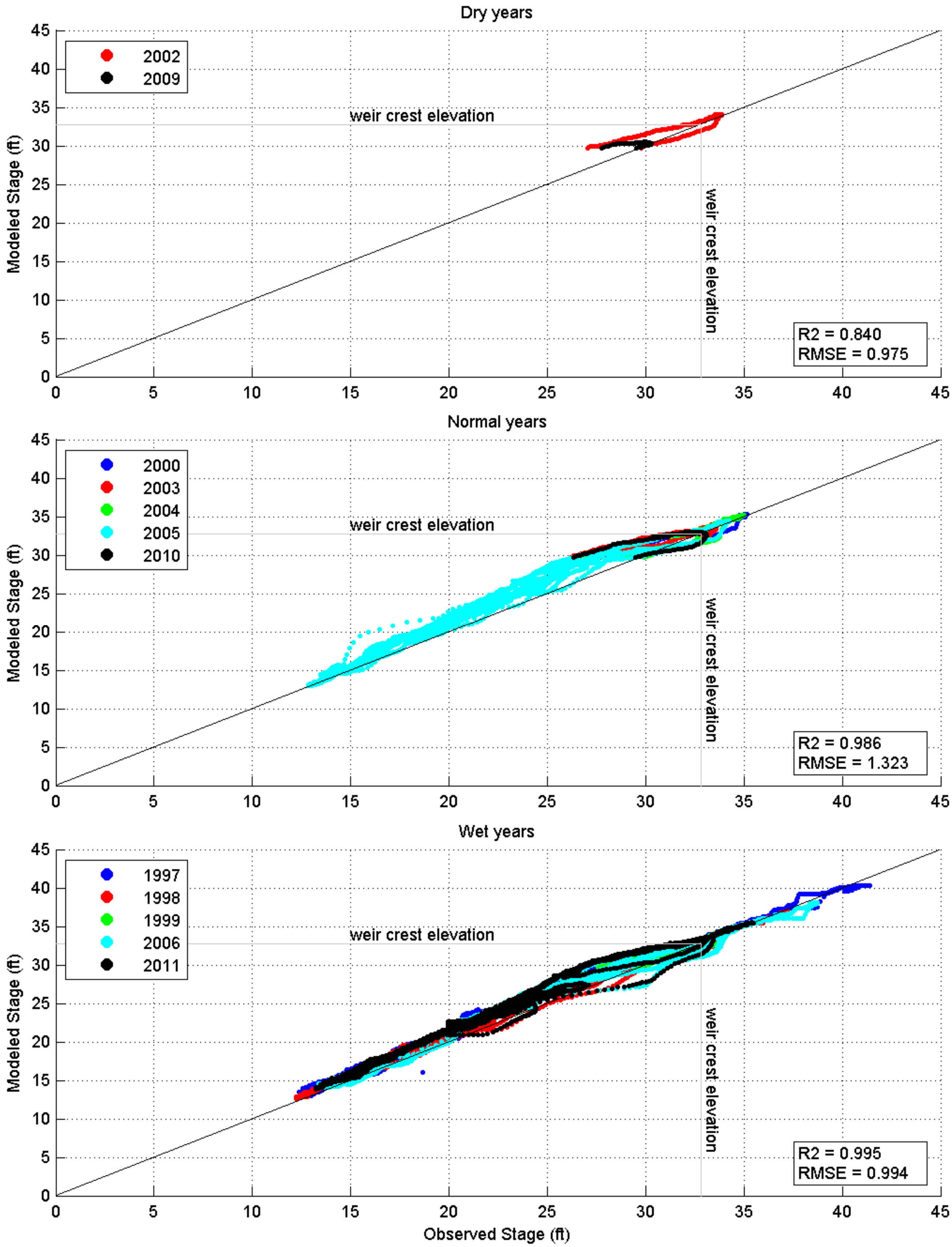


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Existing Fremont Weir Flow Comparison

Prepared for DWR	Created By: SJB	**Figure 6-1**



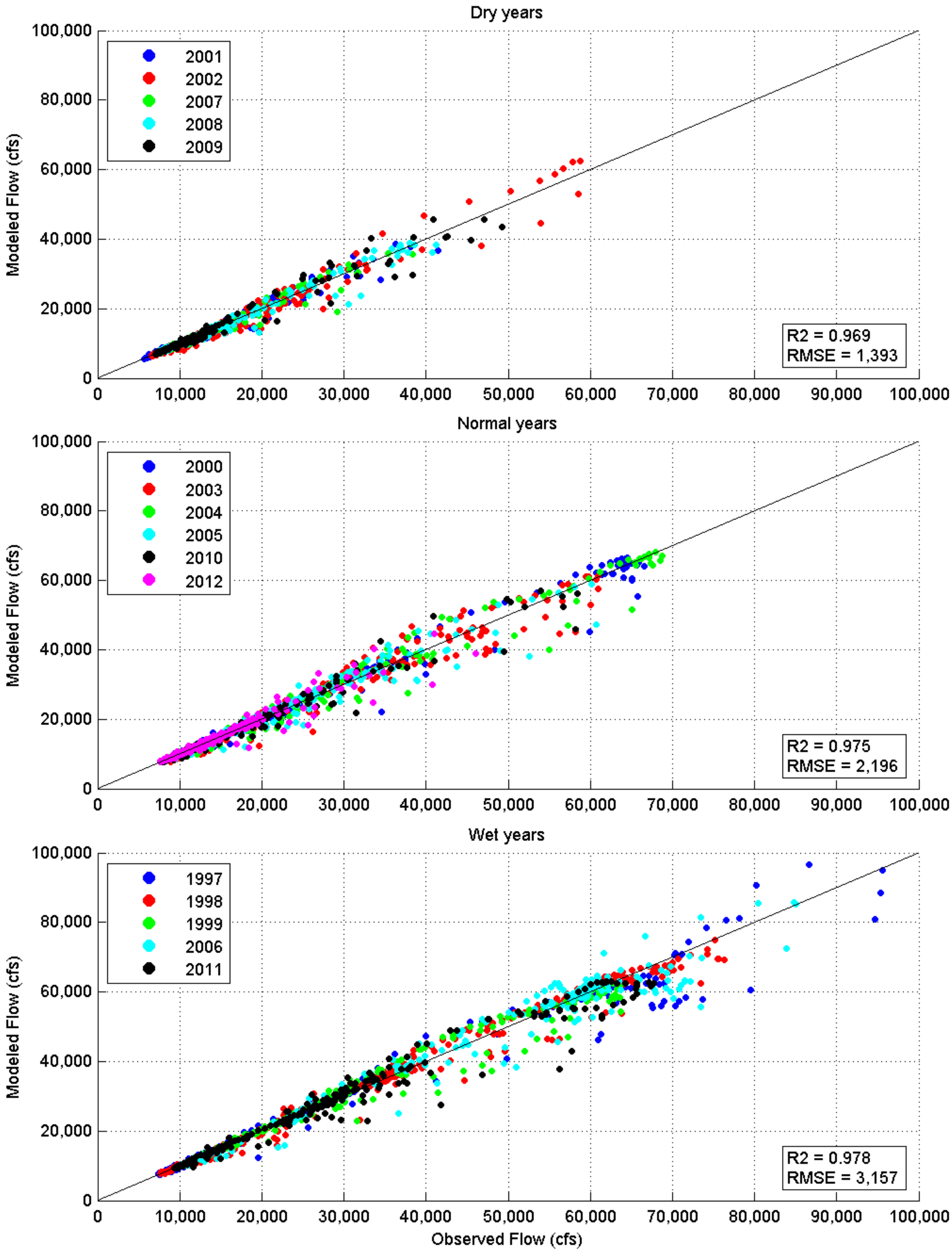
Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Existing Fremont Weir Stage Comparison

Prepared for DWR | Created By: SJB

Figure 6-2

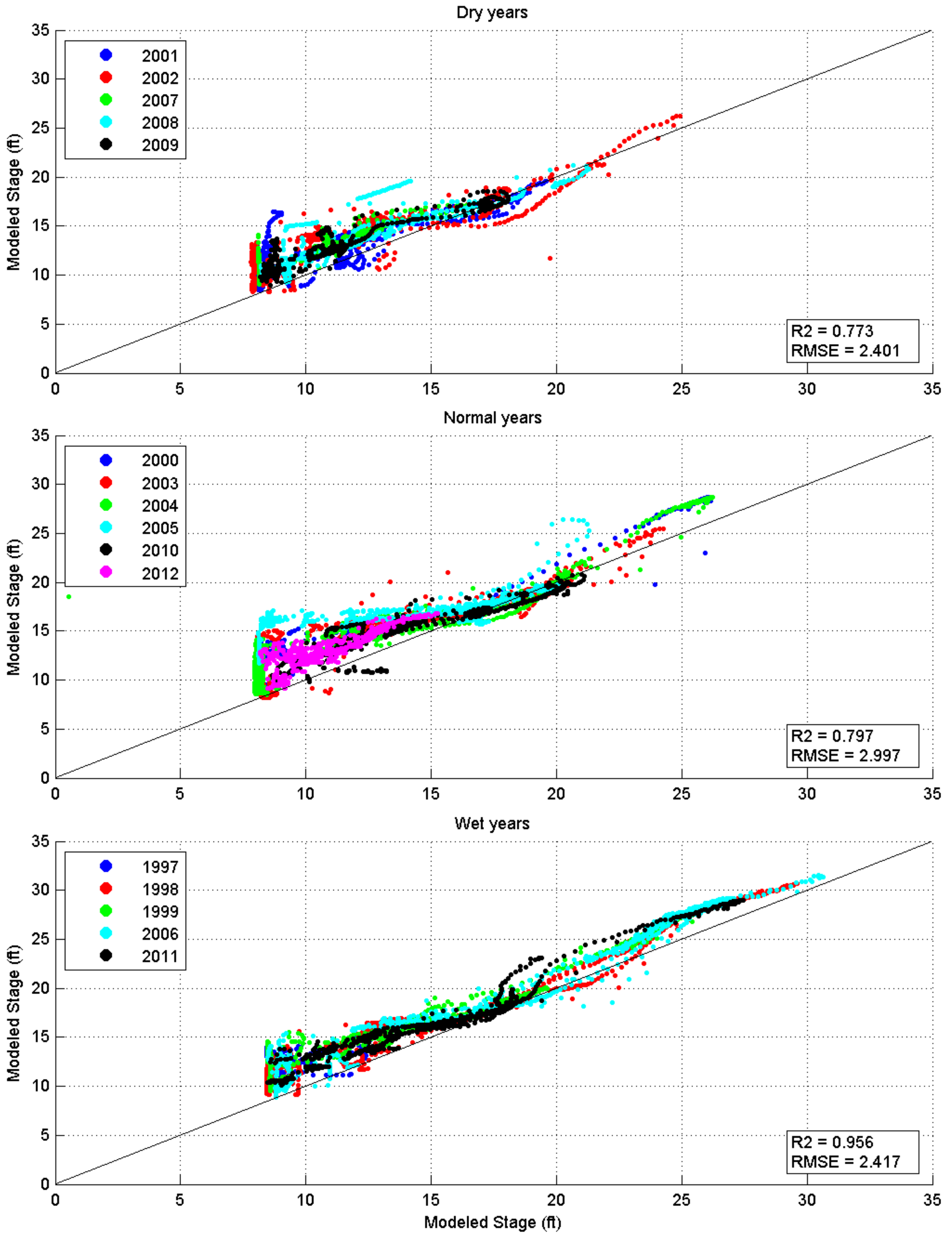


Notes:

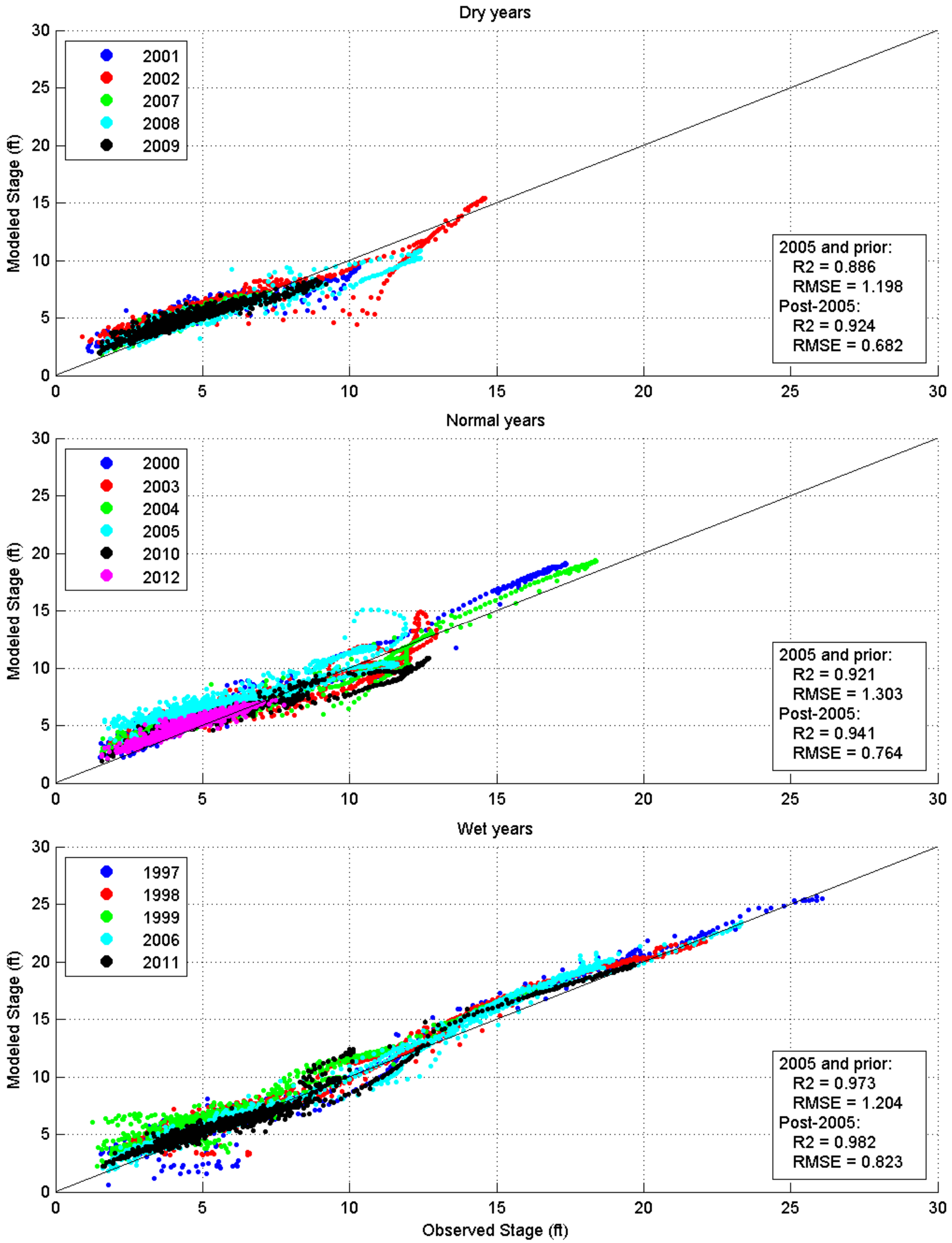
Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Existing Sac R at Verona Flow Comparison

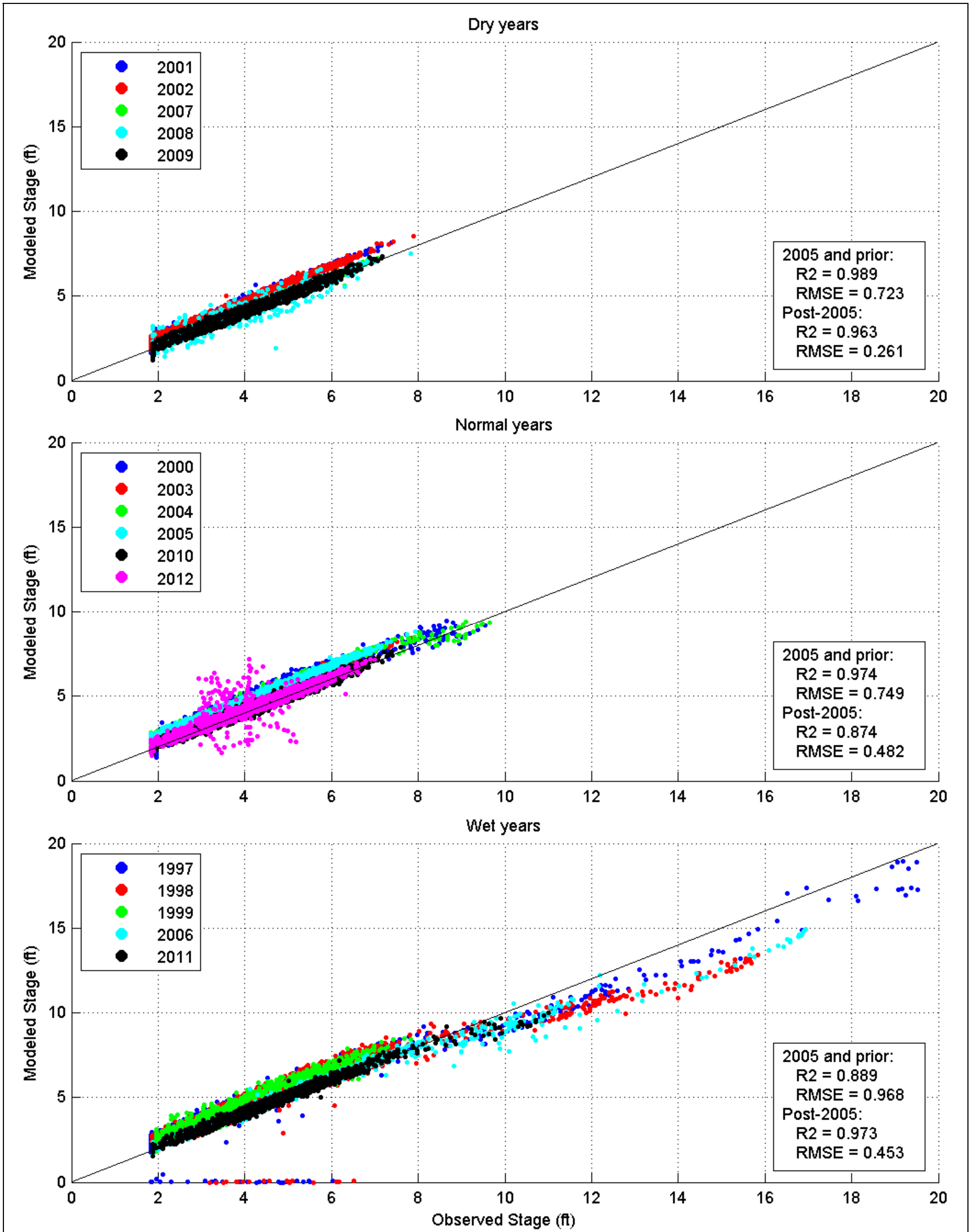
Prepared for DWR	Created By: SJB	**Figure 6-3**



Notes:	HDR cbec	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Existing YB at Woodland Stage Comparison**		
		Prepared for DWR	Created By: SJB	**Figure 6-4**



Notes:	HDR cbec	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Existing Lisbon Weir Stage Comparison**
		Prepared for DWR | Created By: SJB | **Figure 6-5**

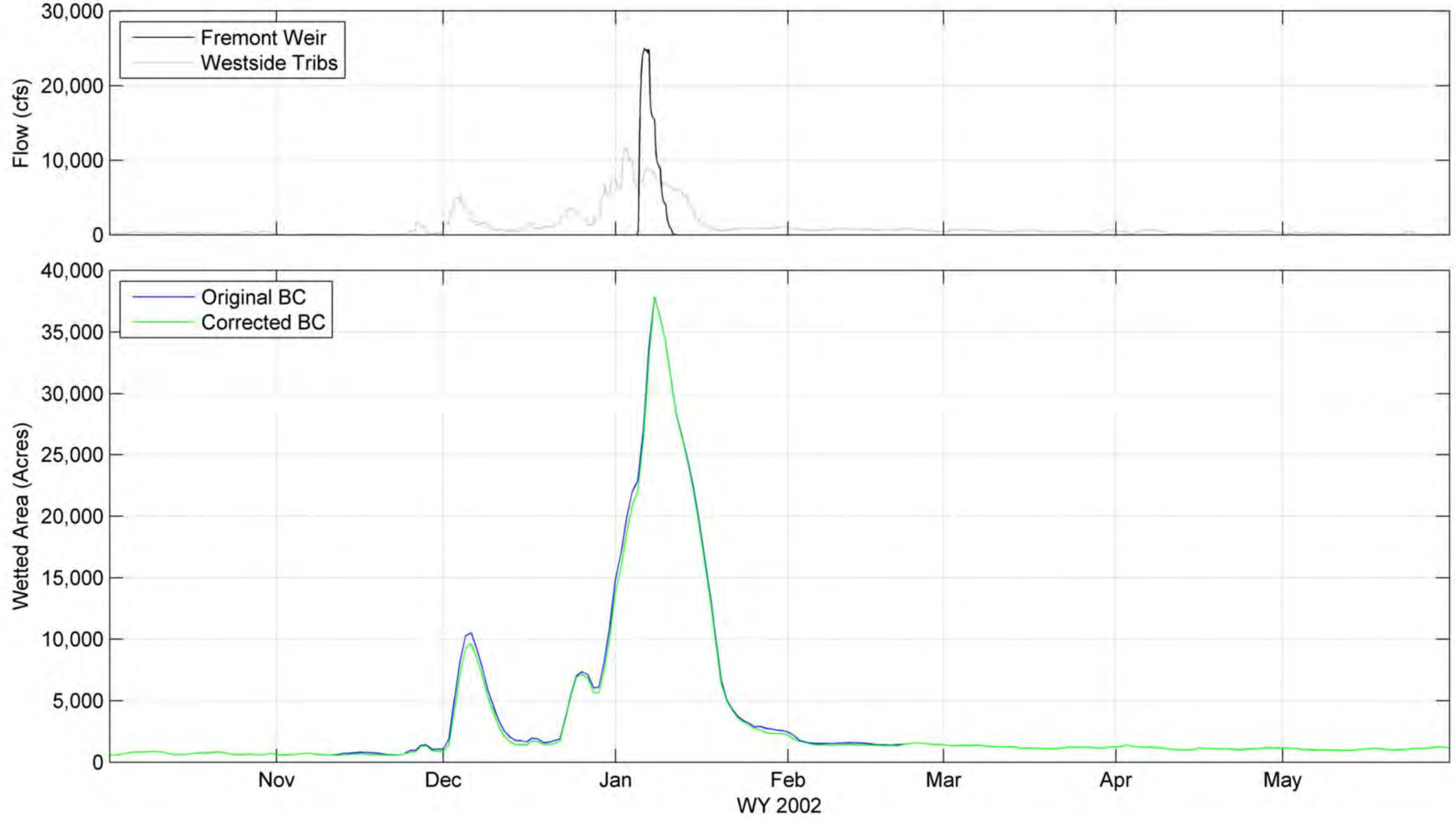


Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Existing YB at Liberty Is Stage Comparison

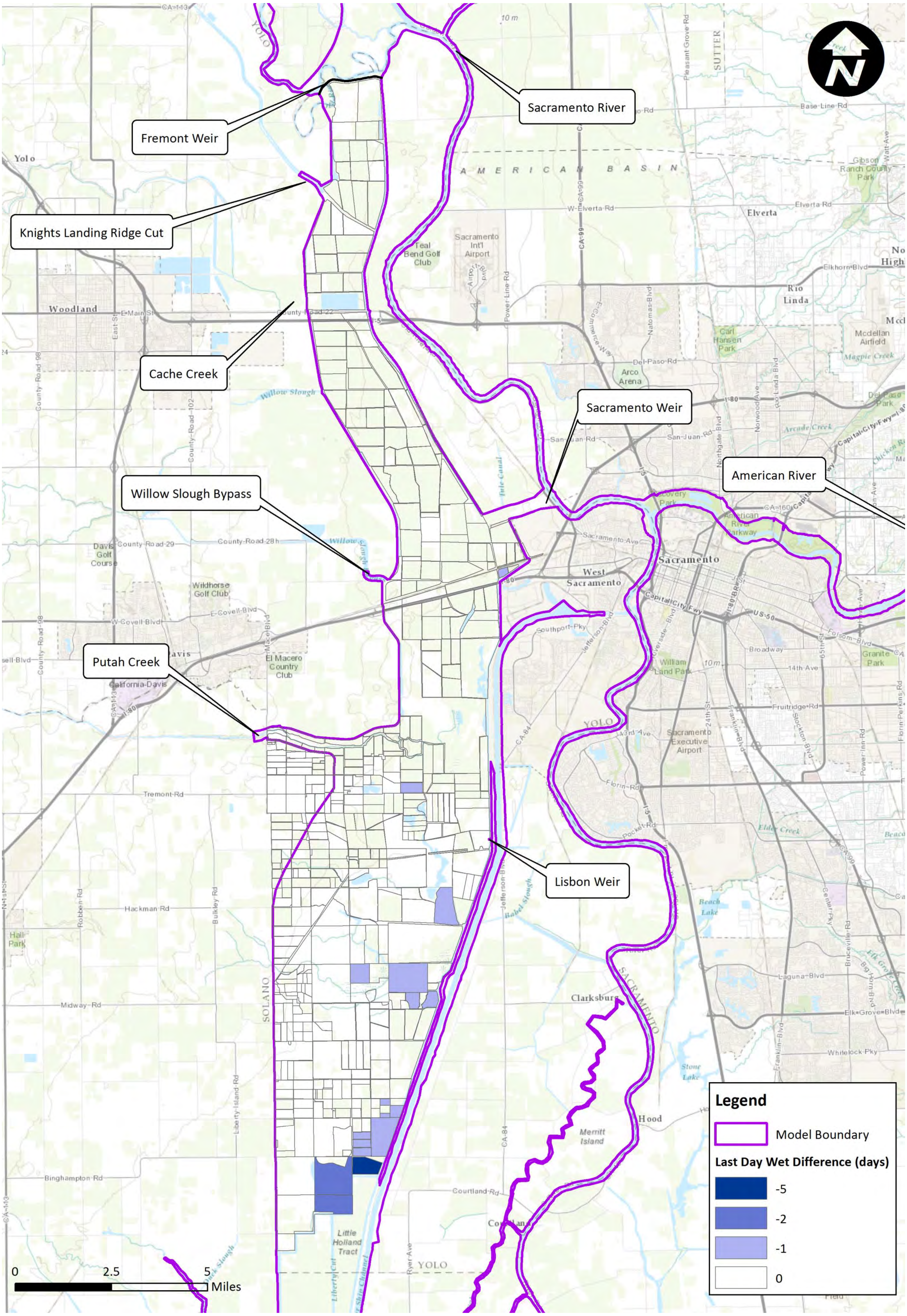
Prepared for DWR	Created By: SJB	**Figure 6-6**



Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Downstream BC Sensitivity – Wet Area 2002

Prepared for DWR	Created By: RDJ	**Figure 6-7**



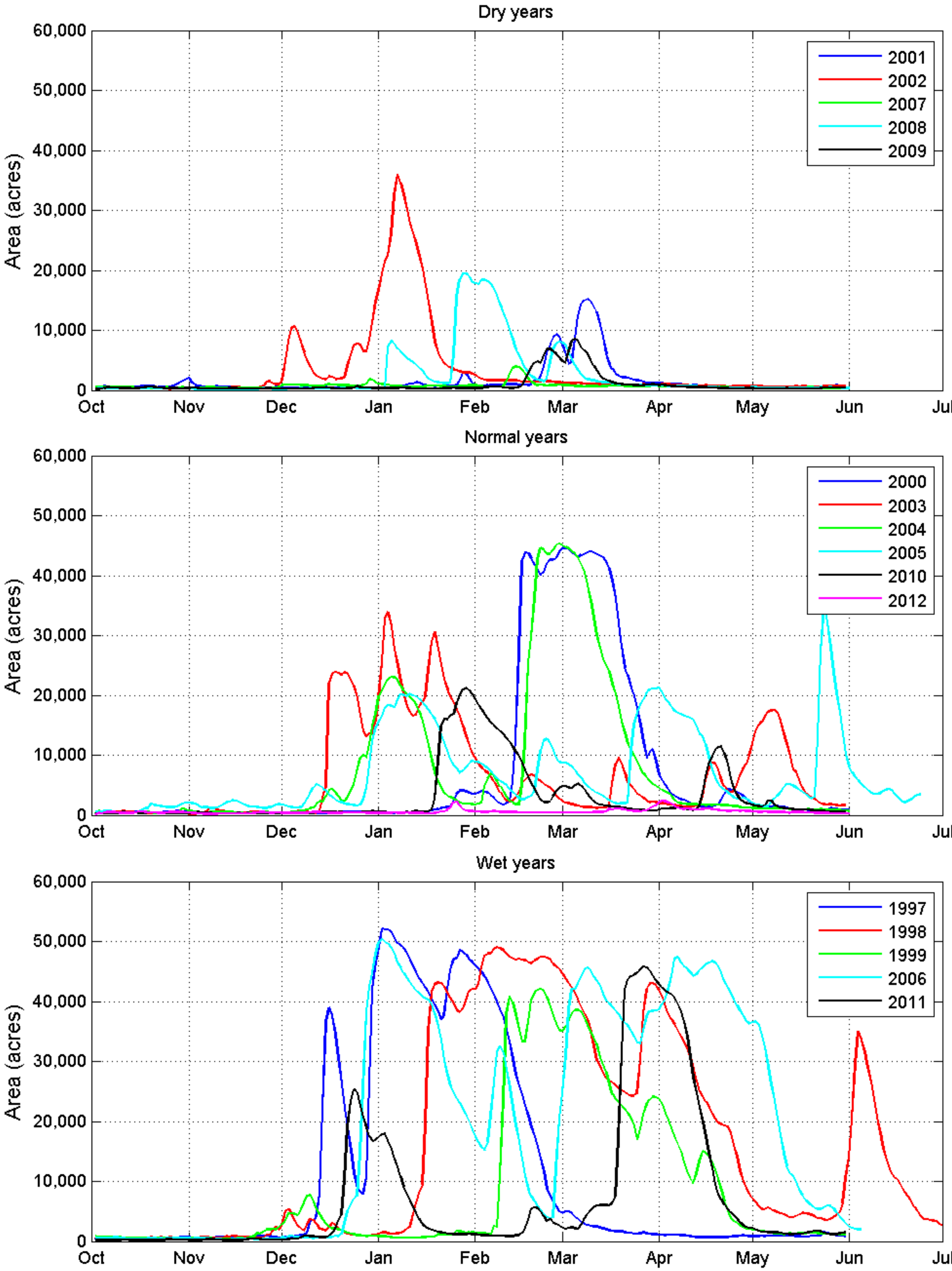
Notes:

Yolo Bypass Salmonid Habitat Restoration and Fish Passage

Exg Downstream BC Sensitivity – LDW 2002

Prepared for DWR | Created By: RDJ

Figure 6-8



Notes:	HDR cbec	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Existing Wetted Acres by WY Type**
		Prepared for DWR | Created By: SJB | **Figure 6-9**

7.0 Alternatives Analysis

Each of the project alternatives was modeled for the 16 year period including simulations to model different project end dates when all of the gates are closed. The different gate closure dates that were modeled were February 15, March 1, March 15, April 1, and April 30. Each of the simulations for the April 30 gate closure date covered the period from October 2 to May 31. Simulations for the other gate closure dates used the April 30 solution as a "hotstart," that is, starting just before the gate closure date and ending 30 days afterwards. Once the gates have been closed for at least 30 days the alternative results and existing conditions results are nearly equivalent. Output data in the same formats as generated for the existing condition runs were generated for the alternatives.

7.1 Model Implementation

The channel profiles and preliminary gate configurations for the Fremont Weir and Sacramento Weir Gated Channel Alternatives were initially screened in HEC-RAS (see Appendix C) to 1) understand the backwater effects on the gates from Yolo Bypass inundation given that proposed upstream inverts at the river are below the baseline water levels in the Tule Canal; and 2) optimize the notched gate openings ability to divert 6,000 cfs from the Sacramento River to the Bypass during non weir overtopping periods with the objective to maximize fish entrainment while minimizing head losses across the gate. Gate optimization was performed in HEC-RAS because such a function was not yet available in TUFLOW and gate logic was a relatively new feature in TUFLOW.

For the HEC-RAS analysis, the Tule Canal was assumed to have baseline flow contributions of 500 cfs, 350 cfs, 50 cfs, and 300 cfs from KLRC, Cache Creek Settling Basin, Willow Slough, and Putah Creek, respectively, for existing conditions and all four alternatives. Rule operations in the HEC-RAS unsteady flow editor were used to optimize gate operations for the gated channel alternatives to maximize gate flows up to 6,000 cfs based on the Sacramento River WSEs and gate characteristics.

Following gate optimization in HEC-RAS, the Fremont Weir and Sacramento Weir Gated Channel Alternatives were implemented in TUFLOW. The Fremont Weir alternatives were modeled by adding a 1D channel connecting the Sacramento River through Tule Pond to the northern end of Tule Canal. The 1D channel included the proposed gate configurations at Fremont Weir (see Section 7.1.1), which vary in size, number, and gate closure operations by alternative. The Sacramento Weir alternative includes modifications to the 2D grid to represent the proposed channel within the Sacramento Bypass. A 1D channel at the Sacramento River connects the river to the Sacramento Bypass, which includes the proposed gate configuration at Sacramento Weir (see Section 7.1.2). For each alternative, the Sacramento River stage-dependent rule curves were implemented in the TUFLOW for all but one of the multiple bays representing each gate configuration. The remaining bays for each alternative used gate logic in

TUFLOW to regulate flows in the proposed channels downstream of the gates so channel flows would not exceed 6,000 cfs.

7.1.1 Fremont Weir Gated Channel Alternatives Setup (1D channels, gates, Ag crossings)

For the Fremont Weir Gated Channel Alternatives, each alternative included a proposed channel excavated at the east end of Fremont Weir and parallel to the flood levee, connecting the Sacramento River with the Tule Canal (see Figure 7-1). The channel dimensions of the three Fremont Weir alternatives are provided in Table 7-1. For the reach of the proposed channels between the Sacramento River and Fremont Weir, a length of approximately 800 feet, the channel was graded from Fremont Weir to the Sacramento River at a slope of 0.0025 with a bottom width of 225 feet and 3:1 side slopes. This was done to reduce head losses within the channel upstream of the gate and minimize the change in the WSE between the river and the weir.

Table 7-1. Fremont Weir alternatives channel dimensions

Channel Size	Invert at Fremont Weir(ft, NAVD88)	Bottom Width (ft)	Slope	Side Slopes
Small	14.0	20	0.00016	3:1
Medium	17.5	225	0.00035	3:1
Large	14.0	225	0.00016	3:1

Downstream of the gated channel, there are three agricultural crossings (Ag crossings) on the Tule Canal between Tule Pond and the confluence with KLRC (see Section 4.5). Ag Crossing #1 is an earthen berm 1.7 miles south of Fremont Weir at the bottom of Tule Pond that impounds irrigation water for RD 1600 so it can be conveyed through the levee to the Elkhorn Basin. This berm can become degraded during Fremont Weir overtopping events. Ag Crossing#2 is 0.5 miles further south and is an earthen berm with one 32-inch culvert. Ag Crossing #3 is 0.6 miles further south and is an earthen berm with three 24-inch culverts.

The Small and Large channels tie into the Tule Canal just downstream of Ag Crossing #2. The Medium channel ties into the Tule Canal just upstream of Ag Crossing #2. As a result, all three channel alternatives require the partial removal and modification of the earthen berm forming Ag Crossing #1, but only the Small and Large channels require the additional modification to Ag Crossing #2. For the purposes of this analysis, and as demonstrated by the backwater effects on the future gate location at the river during low flows due to the limited capacity of the Tule Canal downstream of KLRC and the agricultural crossings upstream of KLRC (see Appendix C), it was assumed that all three agricultural crossings were replaced with railcar bridges as part of the alternatives to maximize the frequency of inundation from the Sacramento River. The railcar bridges were assumed to be 90 feet long, 3 feet in vertical depth, and situated on 2-foot-wide abutments with wing walls. Under gate operations, all future agricultural crossings were assumed to be fully open.

A series of radial gates (final gate types and design will be determined later) at the channel connection with the Sacramento River was used to maximize the flow into the Yolo Bypass for non-overtopping flow events up to 6,000 cfs. In general, gate widths were limited to 30 feet in width with 3 feet pillars between them. Some of the gates were limited in height to prevent them from extending above the existing weir crest (32.8 feet NAVD88) during an overtopping event. Combinations of gate heights were used to optimize gate openings to achieve the 6.000 cfs discharge cap. After Fremont Weir overtops, the gates remain in their last configuration within the model (either fully open, partially open, or closed). If additional analysis indicates that this modeling assumption increases flood impacts, it is assumed that gate operations will be changed or design modifications will be made to mitigate impacts. For the Small channel, the bottom width of the channel was widened to accommodate three gates to minimize the head loss across the gate structure. The resulting gate configurations are shown in Table 7-2 and Figure 7-2, Figure 7-3, and Figure 7-4 for the Small, Medium, and Large channels, respectively.

Table 7-2. Fremont Weir gate configurations

Channel Size	Invert at River (ft, 88)	Bottom Width at Gate (ft)	Gate Invert (ft)	Gate Height (ft)	Gate Width (ft)	Number of Gates
Small	14	115	14	8, 14	30	3
Medium	17.5	225	17.5	6, 12	30	6
Large	14	225	14	7.5, 10	30	6

7.1.2 Sacramento Weir Gated Channel Alternative Setup (1D channels, gates)

The Sacramento Weir Gated Channel Alternative was assumed to be constructed just north of the southern Sacramento Bypass levee, connecting the Sacramento River with the Tule Canal (see Figure 7-5). The proposed channel has an invert elevation of 7 feet NAVD88 with a 225-foot bottom width and 3:1 side slopes.

WSEs in the Sacramento Bypass are controlled by the low flow conveyance capacity within Tule Canal and an agricultural crossing 2,300 feet downstream of the Sacramento Bypass as operated by Swanston Ranch. The minimum WSE in Tule Canal at the confluence with the Sacramento Bypass during baseline flows (i.e., 850 cfs as contributed by KLRC and Cache Creek) was 10.65 feet NAVD88. At stages below 11 feet NAVD88, flow through the Sacramento Bypass gated channel is limited due to backwater from Tule Canal.

A series of six new radial or sluice gates (final gate types and design will be determined later) at the Sacramento Weir were used to regulate flows into the Sacramento Bypass up to 6,000 cfs. It was assumed that the new gates were installed directly below the existing bays of the Sacramento Weir on the southern end of the weir (see Figure 7-6). The new gate dimensions are provided in Table 7-3, and generally consist of 30-foot-wide gates with inverts at 7 feet NAVD88 and 12 foot pillars between them. The pillars are wider than the Fremont Weir alternatives because the 30 foot new gates are situated directly beneath individual bays of the

Sacramento Weir which are generally 40 feet wide. Gate operations were optimized to maximize discharges into the Sacramento Bypass up to 6,000 cfs for river stages in front of the Sacramento Weir up to elevations corresponding to the I Street WSE trigger of 30.04 feet NAVD88. After the I Street elevation trigger is met, the Sacramento Weir is opened and the new gates will remain open to their last configuration within the model. If additional analysis indicates that this modeling assumption increases flood impacts, it is assumed that gate operations will change or design modification will be made to mitigate flood impacts. Gates 1 and 2 were limited in height to prevent the top of the gate from extending above the existing weir sill (24 feet NAVD88) during a flood event when the Sacramento Weir is open and the two gates are partially open to convey up to 6,000 cfs. The resulting gate configuration is shown in Table 7-3 and depicted in Figure 7-6.

Table 7-3. Sacramento Weir gate configuration

Gate #	Gate Invert (NAVD88 ft)	Gate Height (ft)	Gate Width (ft)
Gate 1	7	7	30
Gate 2	7	11	30
Gate 3 to Gate 6	7	14	30

7.2 Alternatives Results and Analysis of Results

7.2.1 Yolo Bypass Inundation

Modeled inundation area of the Yolo Bypass, relative to existing conditions, has been determined to include the Tule Canal/Toe Drain, as defined north to south between Fremont Weir and the north bank of the Stair Step, and east to west between the project levees. Figures 7-7 through Figure 7-11 show wetted acres and gate flows for all alternatives for WY 2003 for the five gate closure dates. A complete set of graphics for all water years and all gate closure dates can be found in Appendix D. These figures clearly show the increased frequency and duration of inundation and generally demonstrate that the increases in inundation acreage are greatest with the large channel at Fremont (FreLg), followed by medium channel at Fremont (FreMed), small channel at Fremont (FreSm), and Sacramento Weir option (SacW).

To augment these figures, a series of animation snapshots (see Figures 7-12 through Figure 7-15 and Appendix E) were prepared that spatially depict the potential differences in wetted area for each alternative for the April 30 gate closure relative to existing conditions. These figures also show wetted-area times-series comparisons for all gate closure dates within a specific water year for each gate closure date.

To understand and quantify the increased inundation provided by each alternative, expected annual inundation was computed directly from the wetted-area time-series following the recently published methods by Matella & Jagt (2013). To streamline the analysis, the wetted-area time-series outputs for the 16 water years were used directly in the analysis. The wetted-area time-series were imported into HEC-EFM and statistical queries were generated for the period of November 1 to May 30 to populate area-duration-frequency (ADF) curves for durations of 2, 3, 7, 14, 21, 28, and 60 days. The wetted-area time-series considers all wet areas within the previously defined Yolo Bypass extents, and were not further screened for suitable depths or velocities for a specific fish species nor refined for shorter periods of time corresponding to specific fish life history needs; otherwise this may have been stated as expected annual habitat, but this determination is outside the scope of this modeling effort.

The ADF curves were then used in two ways. First, the curves were used to identify inundation acreages at flow frequencies of 1 in 3 years (33 percent exceedance), 1 in 2 years (50 percent exceedance), and 2 in 3 years (67 percent exceedance). Table 7-4, Table 7-5, and Table 7-6 presents the inundation acreages for 33 percent, 50 percent, and 67 percent exceedances, respectively. These tables generally demonstrate that: 1) longer duration events (i.e., > 4 weeks) are inundated longer in 1 out of 3 years; 2) medium duration events (i.e., 2 to 4 weeks) are inundated longer in 1 out of 2 years; and 3) shorter duration events (i.e., < 3 weeks) are inundated longer in 2 out of 3 years. The FreLg alternative provides the greatest inundation increase ranging from 7,700 acres in 2 out of 3 years to 8,800 acres in 1 out of 2 years. The other Fremont Weir alternatives are not too far behind in terms of acres inundated, but the Sacramento Weir alternative typically provides half of the inundation increase as the Fremont Weir alternatives.

Second, the area under the ADF curves were integrated to compute expected annual inundation based on the 16 years of model outputs. Table 7-7 and Figure 7-16 show similar trends amongst the alternatives. Expected annual inundation relative to existing conditions predicted to be 3,650±550 acres for FreLg, 3,350±500 acres for FreMed, 2,800±350 acres for FreSm, and 1,400±350 acres for SacW.

It is noted that the ADF curves and expected annual inundation results are based on an annual maxima approach per Matella & Jagt (2013) for a relatively short 16-year period. Given that there can be multiple discrete inundation events in the Bypass, a partial duration series approach could be considered.

Table 7-4. Inundated area in 33% of years between November 1 and May 30

Duration (days)	Inundated Area (acres)					Inundation Increase (acres)			
	Existing	FreLg	FreMed	FreSm	SacW	FreLg	FreMed	FreSm	SacW
2	47,806	47,832	47,852	47,824	48,112	26	46	18	307
3	47,690	47,718	47,735	47,705	48,001	28	46	16	312
7	46,461	46,501	46,513	46,484	46,817	41	52	23	356
14	45,085	45,154	45,165	45,148	45,458	68	80	63	373
21	36,267	36,378	36,375	36,432	37,068	111	108	165	801
28	30,330	32,630	32,505	32,481	32,024	2,300	2,176	2,152	1,695
60	2,152	14,650	13,137	10,526	5,432	12,498	10,985	8,374	3,281

Table 7-5. Inundated area in 50% of years between November 1 and May 30

Duration (days)	Inundated Area (acres)					Inundation Increase (acres)			
	Existing	FreLg	FreMed	FreSm	SacW	FreLg	FreMed	FreSm	SacW
2	36,180	36,588	36,571	36,622	37,256	408	391	442	1,076
3	34,140	36,214	36,271	36,169	36,769	2,074	2,131	2,029	2,629
7	27,068	31,430	31,433	31,472	30,246	4,362	4,365	4,404	3,178
14	19,704	26,771	26,507	26,082	22,102	7,067	6,803	6,378	2,398
21	15,823	24,695	24,551	23,135	18,949	8,872	8,728	7,312	3,126
28	15,823	24,695	24,032	22,775	18,733	8,872	8,209	6,952	2,910
60	1,667	5,683	4,953	4,081	2,293	4,016	3,286	2,414	626

Table 7-6. Inundated area in 67% of years between November 1 and May 30

Duration (days)	Inundated Area (acres)					Inundation Increase (acres)			
	Existing	FreLg	FreMed	FreSm	SacW	FreLg	FreMed	FreSm	SacW
2	24,850	30,818	30,842	30,919	29,675	5,968	5,992	6,069	4,824
3	24,320	30,026	30,040	30,131	28,797	5,706	5,720	5,811	4,477
7	19,982	26,854	26,572	25,812	23,797	6,872	6,590	5,830	3,815
14	16,391	23,456	22,820	21,592	19,129	7,065	6,429	5,201	2,738
21	9,976	17,670	16,919	15,530	10,545	7,694	6,943	5,554	569
28	6,231	9,709	9,556	9,222	6,690	3,478	3,324	2,991	459
60	1,402	2,189	1,717	1,684	1,469	787	315	282	67

Table 7-7. Expected annual inundation

Duration (days)	Expected Annual Inundation (acres)					Expected Annual Increase (acres)			
	Existing	FreLg	FreMed	FreSm	SacW	FreLg	FreMed	FreSm	SacW
2	34,534	38,413	38,204	37,614	36,318	3,879	3,670	3,080	1,784
3	34,063	37,903	37,699	37,079	35,745	3,840	3,636	3,016	1,682
7	30,787	34,965	34,695	34,019	32,363	4,178	3,908	3,232	1,576
14	27,803	31,495	31,172	30,605	28,912	3,692	3,369	2,802	1,109
21	23,499	26,605	26,313	25,758	24,319	3,106	2,814	2,259	820
28	19,255	21,990	21,729	21,440	20,385	2,735	2,475	2,186	1,131
60	7,029	11,152	10,531	9,955	8,693	4,122	3,502	2,926	1,663

7.3 Post-processed Data

The TUFLOW model results will inform other analyses including agriculture economic impacts, fisheries benefits model, and CALSIM modeling. The model results required post-processing to prepare the output data into the appropriate format for each type of analysis.

7.3.1 Last Day Wet Determination

The most extensive post-processing involved the determination of the last day wet (LDW) for individual field units within the Bypass. Yolo County performed landowner outreach to gather additional information to use in the Yolo Bypass Agricultural Impact Analysis for this project. During those discussions with landowners it was learned that that farmers are likely to begin planting their fields when at least 70 percent of their fields were dry (or conversely, the last day when more than 30% of the area is wet). Based on this information and discussions with the lead modeler of the Yolo Bypass Agricultural Impact Analysis, it was agreed upon to use this assumption as the ratio for last day wet (LDW) calculations. The field units were provided by the Agriculture Economics team which will be utilizing the LDW to inform their analysis regarding the potential impacts the proposed channels may have on agriculture within the Bypass.

It should be noted that the LDW data is produced by post-processing the Model results and the ratio used for determining LDW can be changed without altering the Model. The LDW is determined by analyzing the raster solutions for each day of the simulation (specific water year, alternative, and gate closure date) by subtracting the 25-foot base DEM from the TUFLOW water surface elevation outputs to create 25-foot depth rasters. LDW results for water year 2001 for each configuration are shown in Figures 7-17 through Figure 7-21. Additional LDW results are included in Appendix F. The number of output raster cells that are dry for each field unit are counted and compared with the number of raster cells within the field unit. The last day in the simulation where less than 70 percent of the raster cells are dry is assigned to the LDW attribute.

7.3.2 Post-processing for Fisheries Team

Minor post-processing was required to fulfill the fisheries benefits models hydrodynamic data input needs. The fisheries team requested depth and velocity magnitude raster datasets covering the Bypass in ESRI ASCII format and daily average discharge values for the Fremont Weir (including channel flows), the Sacramento at Verona, and the Sacramento River at Freeport. The raster results from TUFLOW were converted from ESRI binary float format to ESRI ASCII format. The discharge values from the 1D and 2D time-series output were averaged on a daily basis and provided in csv format as requested.

7.3.3 Rating Curve Derivation for CALSIM Modeling

The CALSIM modeling group requested flow versus flow rating curves at the Fremont Weir. Because flows from the Sutter Bypass, the Feather River, and the Sacramento River intermix, the rating curves are based upon comparing flows at Verona with the sum of the flows over the Fremont Weir and through the proposed gate channels. A rating curve was developed for existing conditions based upon the TUFLOW model results and matches well to rating curves previously used in the CALSIM model confirming the approach used.

The rating curves were developed as scatterplots containing a point for each output value where the Fremont Weir overtopped or the gate channels were open and active. The resulting rating curves are shown in Figure 7-22. The lower discharge portion of the rating curves are shown in Figure 7-23.

7.4 Preliminary Flood Impact Analysis

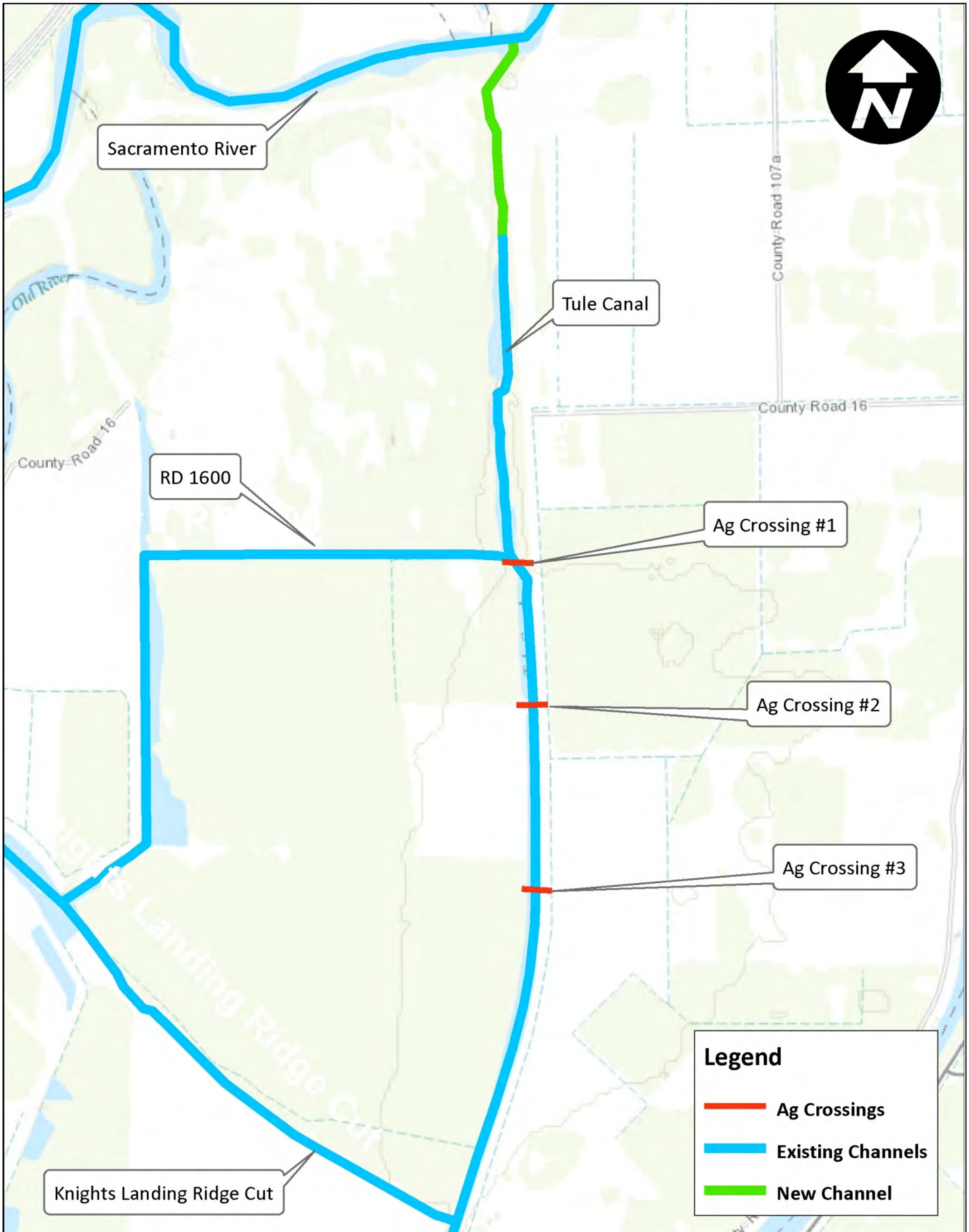
While a complete analysis of flood impacts for permitting purposes is beyond the scope of this report, the results for the water years with the largest floods were compared to predict potential flood impacts. The peak WSE for the existing conditions and the large channel alternative configurations for the 1997, 1998, and 2006 water years were compared to evaluate the potential project impacts on flooding. The analysis is based upon the previously analyzed configuration and operations. The gates were regulated to prevent more than 6,000 cfs through the channel until the Fremont Weir overtops. Once Fremont Weir overtops, the gate openings are held steady (not changed from opened or closed position) until the overtopping has ceased or the project end date (gates closed) has been reached.

Differences in maximum WSEs for the existing conditions and large channel configuration are shown in Figures 7-24 through Figure 7-26.Because the large channel configuration allows higher discharges into the Yolo Bypass than under existing conditions, the maximum WSEs are higher within the Bypass for this alternative. However, this decreases the discharge down the Sacramento River past Verona and lowers the maximum WSEs compared to existing conditions.

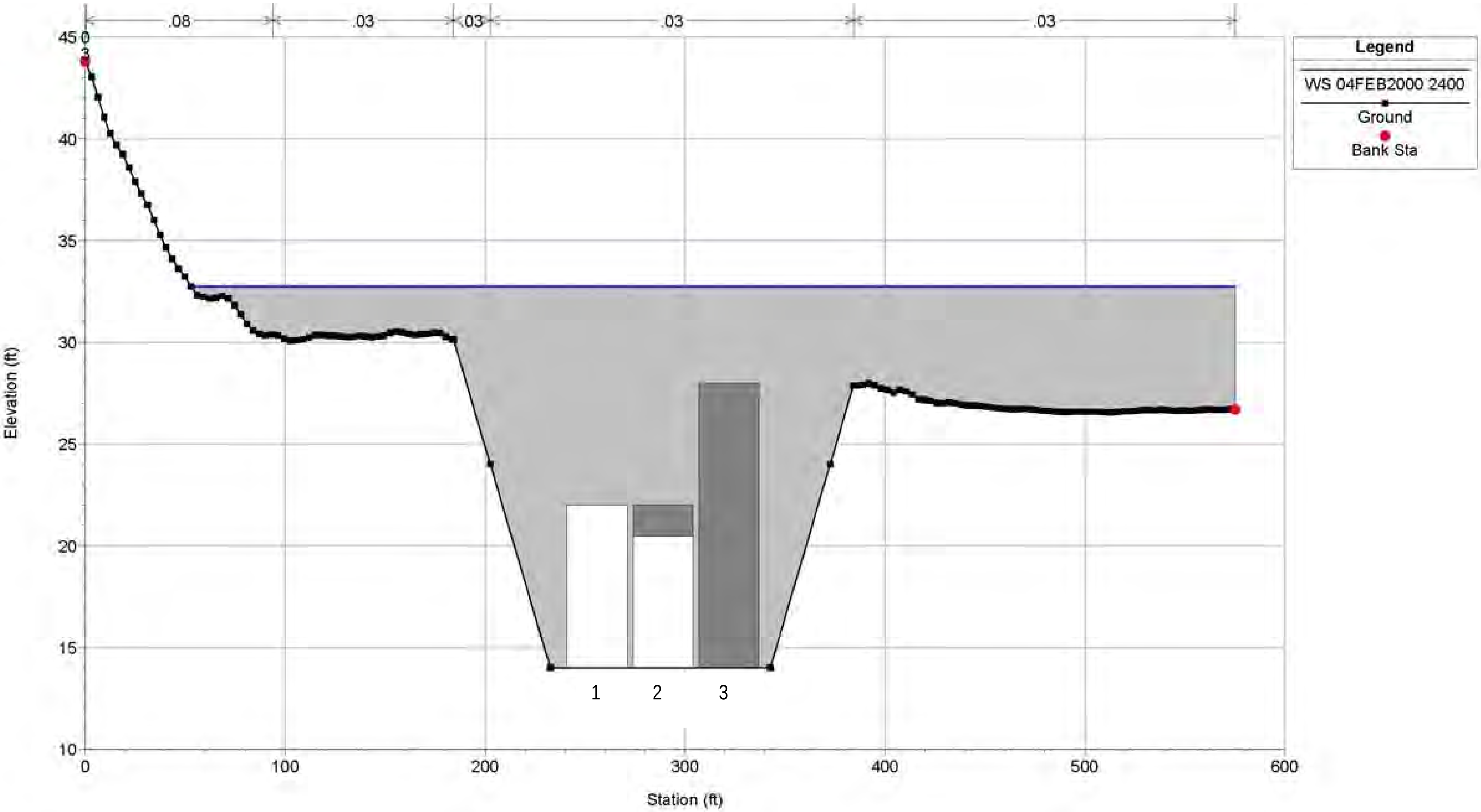
The increases in maximum WSEs within the Yolo Bypass are small for the large channel alternative. Near the proposed channels there are local increases and decreases in WSE because of the geometry changes in these areas. The increase in maximum WSE for most of the Bypass is less than 0.02 feet for all three water years analyzed. The largest flood occurred in 1997 and some portions of the Bypass experienced increases in maximum WSE between 0.02 and 0.05 feet.

Because the Sacramento River downstream of Verona is more constricted than the Bypass, the diversion of additional flows has a larger effect upon the maximum WSEs than was experienced within the Bypass. The decreases in maximum WSE extend upstream of the Yolo Bypass but the effect diminishes moving upstream.

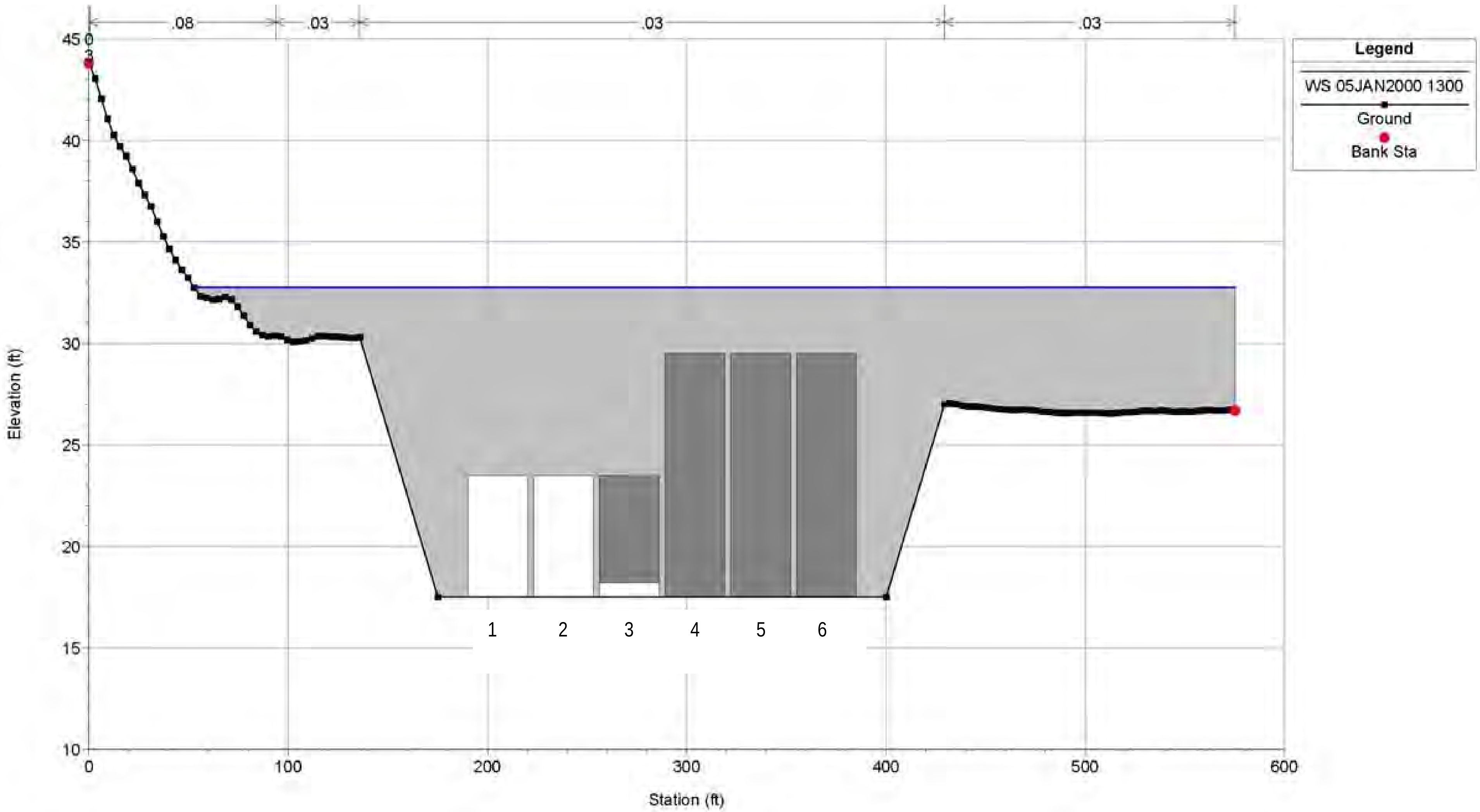
This analysis suggests that the project impacts to flooding will be minor based upon preliminary channel/gate designs and operations. Design changes to the project configuration or operations may alter flood impacts. Further analysis will be required after designs and operations have been finalized and to meet Federal Emergency Management Agency (FEMA) and other agency requirements. The required analysis to meet FEMA floodplain regulations is summarized in Appendix G.



Notes:	HDR cbec eco engineering	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Fremont Weir Alternatives Location Map**
		Prepared for DWR / Created By: CRC / **Figure 7-1**



Notes: Gate closure shown represents 6000 cfs at maximum Sacramento River Stage before Fremont Weir begins to overtop for gates operated individually. (white = gate opening, grey = partial gate closure)	HDR cbec eco engineering	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Fremont Weir Small Gate Configuration**
		Prepared for DWR / Created By: CRC / **Figure 7-2**



Notes: Gate closure shown represents 6000 cfs at maximum Sacramento River Stage before Fremont Weir begins to overtop for gates operated individually. (white = gate opening, grey = partial gate closure)	HDR cbec eco engineering	*Yolo Bypass Salmonid Habitat Restoration and Fish Passage* **Fremont Weir Medium Gate Configuration**		
		Prepared for DWR	Created By: CRC	**Figure 7-3**