COUNTY OF SAN LUIS OBISPO
Department of Public Works
John Diodati, *Director*

December 13th, 2022

Technical Memorandum

Subject: Review and Update to Preliminary FEMA Hydrologic Analysis for San Luis Obispo Creek Physical Map Revision

Certification

"Pursuant to 44 CFR Section 67.6, this memorandum demonstrates technical incorrectness due to inferior data and measurements and provides corrections to FEMA's hydrologic analysis via incorporation of more correct data and measurements. FEMA's acceptance of these modifications will result in more correct flood hazard determinations."

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Introduction & Basis of Appeal

County staff has closely reviewed FEMA's hydrologic analysis and modeling of San Luis Obispo Creek prepared by STARRII for FEMA. While staff greatly appreciates STARR II's professional approach to this effort, a misunderstanding of previous studies prepared by the County and available to STARRII has resulted in hydrologic modeling that overestimates flow and volume in the San Luis Obispo Creek Watershed.

Section 2.1.1 of the Hydraulic Analysis Report discusses STARRII's consideration of the Waterway Management Plan, the County's key study of the San Luis Obispo Creek:

> *"In 2007, the San Luis Obispo Department of Public Works developed an HEC-HMS and HEC-RAS model for the San Luis Obispo Watershed to "examine county stage and rain gage data from water years 2003-2005" and "calibrate existing watershed models with County gage data". The County calibrated the model to 2 rain gages (both located upstream of the study reach and 5 stage gages (stage gages did not record discharge and are located upstream of the study reach). The event used to calibrate the model occurred between December 27, 2004 and December 31, 2004.*

The models developed by the San Luis Obispo County Department of Public Works were acquired for this project and were used as a reference for STARRII's development of the San Luis Obispo Creek Hydrologic study, only. The received models only contained simulations for the calibrated event, and not for any storm frequencies required for this study such as the 1-percent-annual-chance, 24-hour storm. Since the model was not used to determine peak discharges frequency events and model input parameters such as curve numbers and lag times were calibrated for a 4-day storm, the model input parameters within the San Luis Obispo County's model were not leveraged in the STARRII Study."

Unfortunately, this description represents a misunderstanding of these studies. The County originally published the Waterway Management Plan (WMP) in 2003. The WMP, which includes multiple reports and hydrologic and hydraulic models, was specifically prepared for consideration of a full range of 24-hour storms (1%, 2%, 4%, 10%, 50% annual chance) through the San Luis Obispo Creek watershed. For clarity, Appendix C: Hydrology and Hydraulic Studies has been extracted from the full WMP documentation and attached in this appeal submittal. The technical approach to the WMP hydrologic and hydraulic models was very similar to STARRII's approach, with one key difference. Unlike the STARRII analysis, which was not calibrated to any historical flood events, the WMP was calibrated to historical high water mark records resulting from a severe 24-hour storm on March 9-10 1995. In order to perform this calibration, the County obtained adjusted NEXRAD meteorological data prepared by the NEXRAIN corporation to use as an input to the hydrologic model, as described on pages C-17-18 of WMP Appendix C. The calibration resulted in curve numbers across the watershed being reduced by 15%, which produced more accurate results relative to the historical high water mark records when input into the hydraulic model. The resulting hydrologic and hydraulic results were compared to effective FEMA FIS results across the watershed and were considered more accurate as well as more conservative in evaluating 1% annual chance flood risks.

Subsequently, in 2008, the County commissioned a restudy of the WMP modeling to examine its performance in representing more modest storm events. For reference, the report is attached in this appeal submittal. After finding that the previous modeling drastically overpredicted flooding in more frequent return interval events, the restudy resulted in a recalibration of the hydrologic and hydraulic parameters to improve model performance for such events. However, the originally calibrated hydrologic and hydraulic parameters remained included within the WMP model files as a separate scenario as the original analyses were considered most appropriate for use in evaluating less frequent return interval events, such as the 1% annual chance event.

It appears that this data and these facts were not recognized by STARRII upon reviewing the WMP files. The resulting deficiency in the STARRII analysis is highlighted by the fact that the most comprehensive and accurate high water mark records used to calibrate the WMP models pertain to the Physical Map Revision study reach from Avila Beach to the Ontario Road bridge. The WMP referenced the "Avila Beach Resort Flooding Investigations – Storms of January and March 1995" prepared by Church Water Consultants in 1995 for these records. The report and relevant excerpts from its figures and appendices are attached in this appeal submittal.

Taken together, the NEXRAIN meteorologic data and 1995 high water mark measurements represent the best available data for calibration of a flood risk model in the lower San Luis Obispo Creek watershed. Inclusion of these data and measurements in the FEMA hydrologic and hydraulic studies,

as well as proper consideration of the Waterway Management Plan studies, will result in more correct flood hazard determinations.

As such, County staff has prepared revisions to the STARRII HEC-HMS model to incorporate the superior data and measurements by calibration. The remainder of this memo describes the calibration performed and the subsequent results. The resulting changes to the hydrologic model are considered complementary to the hydraulic model modifications detailed in the technical memo prepared by Avila & Associates and included in this appeal submittal. All reported results include the hydraulic model modifications.

Hydrologic Calibration

Calibration of the STARRII HEC-HMS model was performed via a similar procedure to original calibration of the WMP HEC-HMS model. In summary, NEXRAIN precipitation was run through the STARRII final basin model. Resulting flows were run through a modified STARRII HEC-RAS model. Resulting water surface elevations were evaluated relative to recorded high water marks. Physical parameters from the STARRII basin model were then modified to generate flows that improve modeled water surface elevation agreement with recorded high water marks.

Calibration Setup

The NEXRAIN meteorological data contained in the WMP was prepared for use with specific subbasins delineated in the WMP hydrologic model. Thus, to use the meteorological data with the STARRII model, the STARRII subbasins needed to be reconciled with the WMP subbasins. Fortunately, there was good general correspondence with subbasins delineated by the WMP and the STARRII model. The few exceptions were primarily minor catchments that were delineated as standalone basins in the WMP model but included in larger subbasins by STARRII. For these areas, the precipitation gage utilized corresponded to the WMP subbasin that comprised the greatest area of the STARRII subbasin. A larger exception was the East Fork SLO Creek basins. STARRII subbasin SLO-5 comprised three WMP precipitation gage areas of similar size. Precipitation rates from these three gage records were evaluated and the gage representing the closest to the average of the three was applied to all of SLO-5. The following table identifies the STARRII subbasins, their corresponding WMP subbasins, and the precipitation gage data assigned to each.

STARR II Subbasin	Corresponding WMP Subbasin(s)	WMP Precipitation Gage(s)	Precipitation Gage Utilized
SLO-1	Miguelito Creek	Miguelito	Miguelito
SLO-2	Upper Prefumo	Upper Prefum	Upper_Prefum
SLO-3	Lower SLO Creek Squire Canyon Gragg Canyon	Lower_SLO_Ck Squire Gragg	Lower_SLO_Ck
SLO-4	Davenport Creek	Davenport	
SLO-5	EB 102-119	Lower_E_Fk M_Br_E_Fk E_Br_E_Fk	E_Br_E_Fk
SLO-6	Brizziolari Creek	Brizziolari	Brizziolari

SLO-7	Lower Stenner	Lower_Stenner	Lower_Stenner
SLO-8	Upper Stenner	Upper_Stenner	Upper_Stenner
SLO-9	Laguna Lake Sycamore Canyon	Laguna Sycamore	Laguna
SLO-10	Upper SLO City	Upper_SLO	Upper_SLO
SLO-11	Lower SLO City Madonna Drainage Lower Prefumo	Lower_SLO_Ci Lower_Prefum Lower_Prefum	Lower_SLO_Ci
SLO-12	Reservoir Canyon	Reservoir_Cn	Reservoir_Cn
SLO-13	Upper SLO Creek	Upper_SLO_Ck	Upper_SLO_Ck
SLO-14	EB 202-212	Tank_Farm	Tank_Farm
SLO-15	EB 301-317	W_Br_E_Fk	W_Br_E_Fk
SLO-16	Lower SLO Creek (NE Drainage) Mid SLO Creek (SW Drainage)	Lower_SLO_Ck Lower_Prefum	Lower_SLO_Ck
SLO-17	Froom Creek	Lower_Prefum	Lower_Prefum
SLO-18	Mid SLO Creek	Lower_Prefum	Lower_Prefum

The NEXRAIN 9-10 March 1995 precipitation gage data was imported into the STARRII HMS model from the WMP HMS model files. A control specification was created corresponding to the 24-hour storm period. This storm scenario was applied to the STARRII SLO_100YR_24HR basin model.

Before utilizing the STARRII RAS (hydraulic) model for these calibration purposes, it was necessary to temporarily modify the RAS model to better correspond to conditions in March 1995. At the time of the 9-10 March storm event, a notable flood event in January 1995 had created improved hydraulic conditions in the lower SLO Creek watershed by flushing vegetation and debris. Such conditions would be a stark contrast from the current-day, heavily vegetated conditions reflected in the STARRII RAS model. To limit the influence of these hydraulic parameters on the calibration, separate calibration geometry and plan files were created in the RAS model. In the geometry file, cross-section manning's roughness values from the downstream boundary to the Ontario Road bridge were generally adjusted down to roughly correspond with manning's values reflected in the WMP RAS model. Although the WMP RAS model was prepared years after these flood events, those conditions are assumed to be substantially more similar to March 1995 conditions than existing conditions.

A new steady flow file (SLO steady flow data_Calibration) was then created for use with the March 1995 calibration flows. One additional flow change location was added to ensure WSEs were not artificially overestimated above the confluence with See Canyon Creek. Junction 10 flows were placed at the location of the final flow change in the base STARRII model. Sink flows were moved to the new flow change at RS 10210.

Observed WSEs were added to the calibration flow file. High Water Marks (HWMs) were extracted from the attached Church Water Consultants report. HWMs noted as surveyed in the Church Water Consultants report were reported relative to the effective FIS datum at the time. This datum has now

been revised to NAVD88. The SLO Creek datum conversion factor of +2.9' as identified in the SLO County FIS was applied to all surveyed HWMs. These converted HWMs, shown in the table below, were added to the calibration flow file as observed WSEs. The location of the lowest observed HWM was very close to the STARRII model downstream boundary, so this HWM was set as the known downstream boundary elevation.

RS	HWM Location	Reported HWM	Modeled HWM [NAVD88]
14065	Ontario Road Bridge	32.4	32.4
11551	Sycamore Mineral Springs	29	31.9
8723	San Luis Bay Bridge US	24.8	27.7
8637	San Luis Bay Bridge DS	22.8	25.7
6474	Marre Weir US	17	19.9
3785	Golf Course Bridge #3	12.5	15.4
DS Bound	Golf Course Bridge #2	10.5	13.4

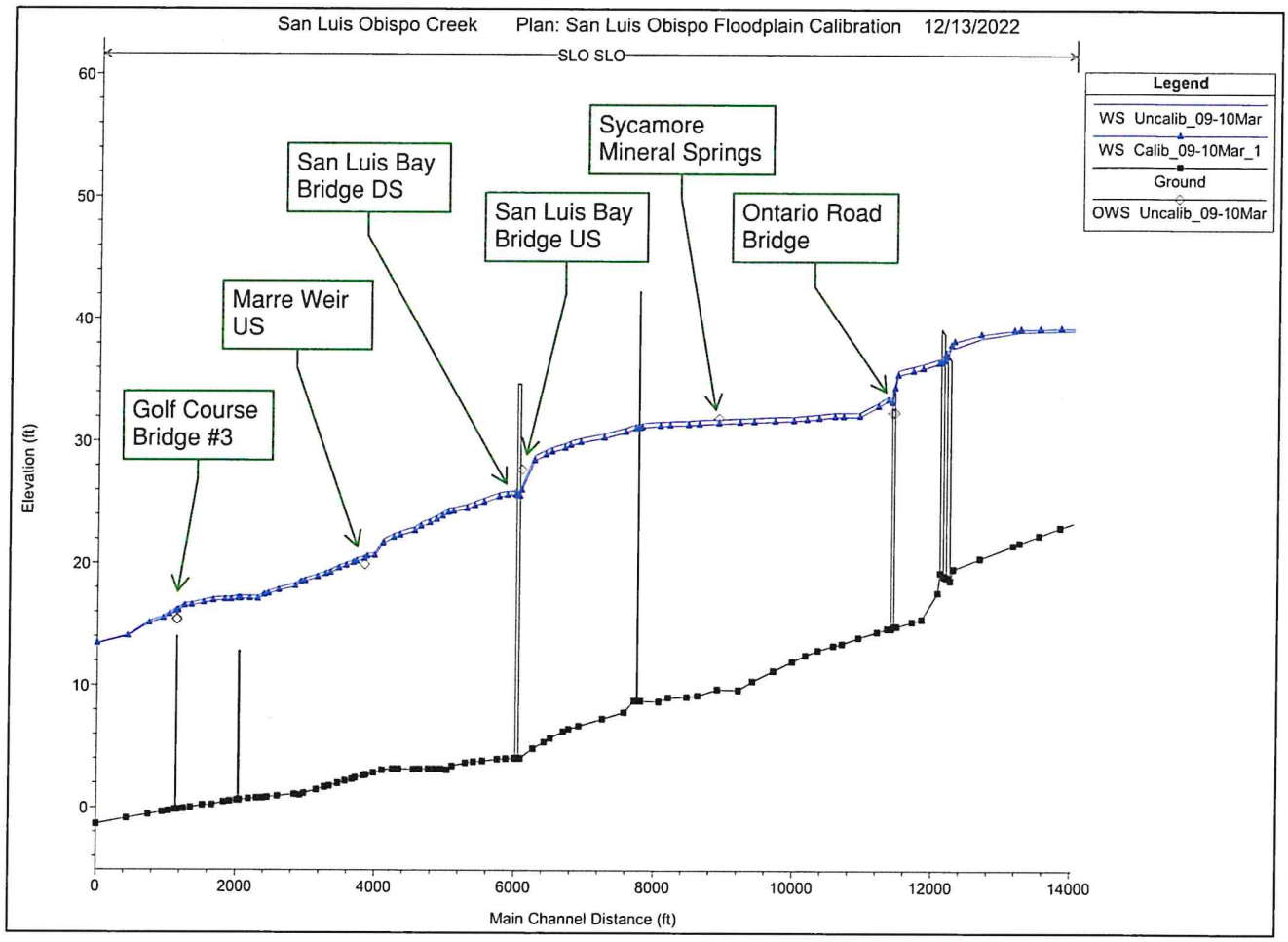
Calibration

As expected, the uncalibrated hydrologic model produced WSEs above almost all the recorded HWMs. The one exception was the Sycamore Mineral Springs HWM, which was slightly above the uncalibrated WSE at that location. This exception is assumed attributed to the approximate nature of the HWM at that location. It was reported as a relative height on a speed limit sign and not surveyed by Church Water Consultants.

As the rest of the HWMs were below uncalibrated WSEs, calibration proceeded consistent with the WMP calibration methodology by adjusting the loss parameters of the STARRII basin model to reduce generated flows. A calibrated basin model (SLO_100YR_24HR – Calibrated) was created in the STARRII HMS model. STARRII subbasin curve number loss parameters were reduced by 0-15%. Uncalibrated and calibrated curve numbers from the WMP HMS model were used as a guideline for adjustment. STARRII CNs were adjusted to be between WMP uncalibrated and calibrated CNs. The largest adjustments were made to the East Fork subbasins due to additional confidence in reduced curve numbers in this area in accordance with other County studies (see East Fork Study for discussion of additional curve number calibration and detention effects resulting in reduced discharges to SLO Creek). The following table provides all values utilized in loss parameter calibration:

STARRII Subbasin	Uncalib CN	Calibration Factor	Calib CN	WMP CN (Uncal)	WMP CN (Cal)	Corresponding WMP Subbasin(s)
SLO-1	60	1	60	71.6	60.8	Miguelito Creek
SLO-2	71	0.95	67	75.8	64.4	Upper Prefumo
SLO-3	65	1	65	76.9 76.4 73.0	65.3 65.0 62.1	Lower SLO Creek Squire Canyon Gragg Canyon
SLO-4	74	0.95	70	77.1	65.6	Davenport Creek
SLO-5	83	0.9	75	78.7-92.8	66.9-78.9	EB 102-119
SLO-6	83	0.95	79	83.7	71.2	Brizziolari Creek
SLO-7	87	0.9	78	85.6	72.7	Lower Stenner
SLO-8	78	0.95	74	80.5	68.5	Upper Stenner
SLO-9	80	0.95	76	83.4 76.1	70.9 64.7	Laguna Lake Sycamore Canyon
SLO-10	87	0.9	78	87.5	74.4	Upper SLO City
SLO-11	86	0.9	77	88.9 82.7 88.4	75.6 70.3 75.1	Lower SLO City Madonna Drainage Lower Prefumo
SLO-12	68	1	68	78.3	66.5	Reservoir Canyon
SLO-13	71	0.95	67	78.6	66.8	Upper SLO Creek
SLO-14	86	0.85	73	83.7-92.9	71.1-79.0	EB 202-212
SLO-15	87	0.85	74	83.8-92.9	71.3-78.9	EB 301-317
SLO-16	79	0.9	71	76.9 81.5	65.3 69.3	Lower SLO Creek (NE Drainage) Mid SLO Creek (SW Drainage)
SLO-17	80	0.85	68	76.1	64.7	Froom Creek
SLO-18	81	0.9	73	81.5	69.3	Mid SLO Creek

The 9-10 March 1995 storm scenario was then run through the calibrated basin model. The resulting flows were input into the RAS calibration flow file for comparison with the uncalibrated flows. Profile results from the calibrated and uncalibrated flows are shown in the figure below:



The calibration generally improved the performance of the hydraulic model in corresponding with recorded HWMs. The remaining variation can be reasonably attributed to physical changes since 1995. In particular, the San Luis Bay Drive Bridge has since been replaced, explaining the discrepancy in upstream behavior. However, the downstream calibrated elevation showed good agreement with the historical HWM. Additionally, at the time of the March 1995 flood event, the Ontario Road bridge was newly constructed and not fully complete. Notably, the bridge rail guards had not been installed. Extrapolating from the modeled downstream water surface profile leads to excellent agreement with the Ontario Road bridge HWM. No further reductions in loss parameters were deemed justified due to residual uncertainty with topographic and manning's roughness assumptions.

Results

The STARRII 100yr24hr storm scenario was then applied to the calibrated basin model to produce final calibrated flows for the 1% annual chance event. The resulting flows are tabulated below:

Element	Drainage Area (mi2)	Uncalibrated Peak Discharge (cfs)	Calibrated Peak Discharge (cfs)	Change
Reach-11	56.1	20588	17730	-14%
SLO-16	1.8	1782	1553	-13%
SLO-11	4	3514	2683	-24%
SLO-10	1.7	2214	1714	-23%
SLO-17	1.3	1079	680	-37%
SLO-6	2.7	2697	2389	-11%
SLO-18	1.1	1454	1108	-24%
SLO-13	6.6	4092	3412	-17%
Reservoir-1	11.4	6381	5811	-9%
SLO-12	4.8	3023	3023	0%
SLO-2	4.6	2611	2177	-17%
Junction-2	4.8	3023	3023	0%
Reach-7	1.3	1076	677	-37%
Junction-1	8.5	6168	5381	-13%
Reach-6	13.7	1196	1064	-11%
Junction-4	23.7	13896	12439	-10%
Junction-3	10.6	7746	6586	-15%
Reach-8	42.7	14221	12529	-12%
Reach-3	11.4	5818	5712	-2%
Junction-6	42.7	14248	12534	-12%
Reach-2	4.8	2853	2853	0%
Reach-5	23.7	12572	11080	-12%
Reach-4	10.6	7694	6531	-15%
Junction-7	1.3	1079	680	-37%
Reach-1	8.5	6020	5255	-13%
Laguna lake	13.7	1196	1065	-11%
SLO-8	5.8	3855	3340	-13%
SLO-7	2.1	2429	1877	-23%
SLO-9	9.1	4444	3881	-13%
Junction-8B	43.8	14430	12719	-12%
SLO-5	8.7	4094	3146	-23%
Reach-9	2.1	2110	1414	-33%
Junction-5	2.1	2429	1627	-33%
Junction-9	3.6	3120	2074	-34%
SLO-15	2.1	2429	1627	-33%
SLO-14	1.5	1021	671	-34%
Reach-10	3.6	3051	2022	-34%
Junction-8	56.1	20607	17746	-14%
Junction-11B	57.9	21002	18082	-14%

SLO-4	6.9	2973	2523	-15%
Junction-11	64.8	23793	20318	-15%
Reach-12	64.8	23445	19960	-15%
SLO-3	7.3	1818	1818	0%
Junction-10	72.1	25154	21563	-14%
Reach-13	72.1	24866	21194	-15%
SLO-1	9.3	1236	1236	0%
Sink-1	81.4	25868	22251	-14%

Results used at flow change locations in the STARRII RAS model are highlighted in yellow. These key flow locations show decreases from uncalibrated flows of roughly 15%. The calibrated results show notably improved agreement with the effective FIS discharge of 22,000 cfs at the mouth of SLO Creek.

The results at Junction 6, downstream of the confluence of Prefumo and SLO Creeks, were highlighted in orange because they were discussed in the Hydrologic Analysis Report. Although the calibrated peak discharge is now below the effective FIS discharge of 13,400 cfs, it had a similar margin of difference from the effective discharge as the uncalibrated value.

Hydraulic Verification

The calibrated 100-year 24-hour flows were evaluated through the hydraulic model to determine impacts on Base Flood Elevations. The corrected hydraulic model with geometry modifications prepared by Avila & Associates was used as the basis for these comparisons. The STARRII steady state flow data was copied to a new file and a profile (100YR24HR_Calibrated) was added for calibrated 100-year 24-hour flows. For this profile, the flow change locations identified by STARRII were updated with calibrated flows. The downstream boundary was set to a known WSE of 15.97' consistent with the downstream effective model. The results are tabulated below:

		Uncalibrated		Calibrated			
Reach	River Sta	Q Total (cfs)	W.S. Elev (ft)	Q Total (cfs)	W.S. Elev (ft)	WSE Change (ft)	WSE Change %
SLO	38139	14400	100.81	12700	100.36	-0.45	0%
SLO	37924	14400	99.12	12700	98.78	-0.34	0%
SLO	37625 V	14400	97.61	12700	97.22	-0.39	0%
SLO	37370	14400	96.59	12700	96.23	-0.36	0%
SLO	36962	14400	95.87	12700	95.5	-0.37	0%
SLO	36694 U	14400	95.42	12700	95.04	-0.38	0%
SLO	36384	14400	94.65	12700	94.27	-0.38	0%
SLO	36344	Bridge		Bridge			
SLO	36309	14400	94.02	12700	93.69	-0.33	0%
SLO	35941	14400	93.6	12700	93.29	-0.31	0%
SLO	35671	14400	93.29	12700	93	-0.29	0%
SLO	35424	14400	93	12700	92.72	-0.28	0%

SLO	35204	14400	92.62	12700	92.34	-0.28	0%
SLO	34978 T	14400	92	12700	91.69	-0.31	0%
SLO	34708	14400	91.36	12700	91.02	-0.34	0%
SLO	34389	14400	90.71	12700	90.29	-0.42	0%
SLO	34006	14400	90.07	12700	89.48	-0.59	-1%
SLO	33822 S	14400	89.51	12700	88.81	-0.7	-1%
SLO	33601	14400	88.56	12700	87.71	-0.85	-1%
SLO	33345	14400	87.89	12700	86.93	-0.96	-1%
SLO	33278	Bridge		Bridge			
SLO	33253	14400	87.57	12700	86.57	-1	-1%
SLO	32979	21000	85.87	18100	85.11	-0.76	-1%
SLO	32716	21000	83.92	18100	83.34	-0.58	-1%
SLO	32668	21000	83.74	18100	83.14	-0.6	-1%
SLO	32521	21000	82.93	18100	82.39	-0.54	-1%
SLO	32399	21000	82.2	18100	81.69	-0.51	-1%
SLO	32234	21000	81.38	18100	80.9	-0.48	-1%
SLO	32077	21000	80.8	18100	80.33	-0.47	-1%
SLO	31938	21000	80.1	18100	79.65	-0.45	-1%
SLO	31853	21000	79.57	18100	79.07	-0.5	-1%
SLO	31690	21000	78.92	18100	78.38	-0.54	-1%
SLO	31492	21000	78.34	18100	77.74	-0.6	-1%
SLO	31370	21000	78.11	18100	77.49	-0.62	-1%
SLO	31280	21000	77.86	18100	77.24	-0.62	-1%
SLO	31157	21000	77.65	18100	77.01	-0.64	-1%
SLO	31129 R	21000	77.57	18100	76.92	-0.65	-1%
SLO	31059	21000	77.4	18100	76.74	-0.66	-1%
SLO	30923	21000	77.27	18100	76.6	-0.67	-1%
SLO	30761	21000	77.13	18100	76.44	-0.69	-1%
SLO	30654	21000	76.91	18100	76.22	-0.69	-1%
SLO	30515	21000	76.61	18100	75.92	-0.69	-1%
SLO	30259	21000	76.26	18100	75.55	-0.71	-1%
SLO	30232	Bridge		Bridge			
SLO	30205	21000	76	18100	75.29	-0.71	-1%
SLO	30166	21000	75.92	18100	75.2	-0.72	-1%
SLO	29956	21000	75.72	18100	74.97	-0.75	-1%
SLO	29749	25900	75	22200	74.2	-0.8	-1%
SLO	29442	25900	74.04	22200	73.15	-0.89	-1%
SLO	29399	Bridge		Bridge			
SLO	29374	25900	74	22200	73.13	-0.87	-1%
SLO	28918	25900	73.51	22200	72.57	-0.94	-1%
SLO	28630	25900	73.29	22200	72.32	-0.97	-1%

SLO	28507	25900	73.16	22200	72.18	-0.98	-1%
SLO	28347	25900	73.04	22200	72.05	-0.99	-1%
SLO	28018	25900	72.71	22200	71.69	-1.02	-1%
SLO	27595	25900	72.38	22200	71.36	-1.02	-1%
SLO	27317 Q	25900	71.99	22200	70.98	-1.01	-1%
SLO	27027	25900	71.78	22200	70.75	-1.03	-1%
SLO	26872	25900	71.32	22200	70.33	-0.99	-1%
SLO	26649	25900	69.58	22200	68.65	-0.93	-1%
SLO	26420	25900	68.99	22200	68.08	-0.91	-1%
SLO	26270	25900	68.47	22200	67.6	-0.87	-1%
SLO	26119	25900	67.93	22200	67.06	-0.87	-1%
SLO	25974	25900	66.97	22200	66.16	-0.81	-1%
SLO	25912	25900	66.54	22200	65.73	-0.81	-1%
SLO	25770 P	25900	64.64	22200	63.95	-0.69	-1%
SLO	25706	25900	64.17	22200	63.52	-0.65	-1%
SLO	25562	25900	63.49	22200	62.78	-0.71	-1%
SLO	25367	25900	63.24	22200	62.5	-0.74	-1%
SLO	25252	25900	63	22200	62.26	-0.74	-1%
SLO	25043	25900	62.29	22200	61.59	-0.7	-1%
SLO	24854	25900	61.95	22200	61.24	-0.71	-1%
SLO	24647	25900	61.54	22200	60.84	-0.7	-1%
SLO	24440	25900	61	22200	60.3	-0.7	-1%
SLO	24179	25900	60.18	22200	59.52	-0.66	-1%
SLO	23986	25900	59.52	22200	58.89	-0.63	-1%
SLO	23841	25900	59.02	22200	58.41	-0.61	-1%
SLO	23594	25900	57.69	22200	57.15	-0.54	-1%
SLO	23407 O	25900	56.78	22200	56.29	-0.49	-1%
SLO	23157	25900	55.45	22200	54.96	-0.49	-1%
SLO	22876	25900	54.72	22200	54.15	-0.57	-1%
SLO	22693	25900	54.25	22200	53.67	-0.58	-1%
SLO	22650	Bridge		Bridge			
SLO	22628	25900	54.14	22200	53.57	-0.57	-1%
SLO	22383	25900	53.94	22200	53.36	-0.58	-1%
SLO	22282	25900	53.78	22200	53.19	-0.59	-1%
SLO	22158	25900	53.43	22200	52.84	-0.59	-1%
SLO	21975	25900	52.91	22200	52.31	-0.6	-1%
SLO	21485	25900	51.87	22200	51.26	-0.61	-1%
SLO	21141	25900	51	22200	50.4	-0.6	-1%
SLO	20882	25900	50.49	22200	49.88	-0.61	-1%
SLO	20699	25900	50.14	22200	49.52	-0.62	-1%
SLO	20532	25900	49.72	22200	49.1	-0.62	-1%

SLO	20242	25900	49.2	22200	48.56	-0.64	-1%
SLO	19870	25900	48.67	22200	48.04	-0.63	-1%
SLO	19488 N	25900	48.27	22200	47.65	-0.62	-1%
SLO	19234	25900	47.75	22200	47.15	-0.6	-1%
SLO	19135	Bridge		Bridge			
SLO	19094	25900	43.57	22200	43.13	-0.44	-1%
SLO	18759 M	25900	42.96	22200	42.42	-0.54	-1%
SLO	18559	25900	42.7	22200	42.13	-0.57	-1%
SLO	18288	25900	42.25	22200	41.63	-0.62	-1%
SLO	18200	25900	42.04	22200	41.38	-0.66	-2%
SLO	18012	25900	41.62	22200	40.85	-0.77	-2%
SLO	17926	25900	41.49	22200	40.68	-0.81	-2%
SLO	17735	25900	41.24	22200	40.33	-0.91	-2%
SLO	17644	25900	41.07	22200	40.09	-0.98	-2%
SLO	17368 L	25900	40.92	22200	39.87	-1.05	-3%
SLO	17192	25900	40.87	22200	39.8	-1.07	-3%
SLO	16835	25900	40.81	22200	39.73	-1.08	-3%
SLO	16748	25900	40.8	22200	39.72	-1.08	-3%
SLO	16471	25900	40.75	22200	39.67	-1.08	-3%
SLO	16173	25900	40.72	22200	39.64	-1.08	-3%
SLO	15893	25900	40.68	22200	39.6	-1.08	-3%
SLO	15799	25900	40.61	22200	39.52	-1.09	-3%
SLO	15322 K	25900	40.24	22200	39.16	-1.08	-3%
SLO	14934	25900	39.78	22200	38.62	-1.16	-3%
SLO	14848	Bridge		Bridge			
SLO	14819	25900	39.52	22200	38.41	-1.11	-3%
SLO	14808	25900	39.59	22200	38.48	-1.11	-3%
SLO	14798	Bridge		Bridge			
SLO	14713	25900	38.57	22200	37.67	-0.9	-2%
SLO	14484 J	25900	38.3	22200	37.38	-0.92	-2%
SLO	14346	25900	38.18	22200	37.25	-0.93	-2%
SLO	14125	25900	37.86	22200	36.92	-0.94	-2%
SLO	14065	Bridge		Bridge			
SLO	13991	25900	35.68	22200	34.72	-0.96	-3%
SLO	13847 I	25900	35.23	22200	34.19	-1.04	-3%
SLO	13579	25900	34.69	22200	33.56	-1.13	-3%
SLO	13344	25900	34.34	22200	33.26	-1.08	-3%
SLO	13216 H	25900	34.24	22200	33.15	-1.09	-3%

SLO	12996	25900	34.11	22200	33.02	-1.09	-3%
SLO	12814	25900	34.03	22200	32.94	-1.09	-3%
SLO	12624	25900	33.94	22200	32.85	-1.09	-3%
SLO	12357	25900	33.86	22200	32.78	-1.08	-3%
SLO	12055	25900	33.79	22200	32.71	-1.08	-3%
SLO	11853 G	25900	33.73	22200	32.65	-1.08	-3%
SLO	11551	25900	33.65	22200	32.57	-1.08	-3%
SLO	11266	25900	33.6	22200	32.52	-1.08	-3%
SLO	11110	25900	33.54	22200	32.47	-1.07	-3%
SLO	10844	25900	33.48	22200	32.4	-1.08	-3%
SLO	10704	25900	33.39	22200	32.32	-1.07	-3%
SLO	10445	25900	33.25	22200	32.19	-1.06	-3%
SLO	10394	Bridge		Bridge			
SLO	10355	25900	33.11	22200	32.07	-1.04	-3%
SLO	10210	25900	32.8	22200	31.77	-1.03	-3%
SLO	9900	25900	32.42	22200	31.35	-1.07	-3%
SLO	9563	25900	32.19	22200	31.09	-1.1	-3%
SLO	9417	25900	31.9	22200	30.79	-1.11	-3%
SLO	9339	25900	31.8	22200	30.69	-1.11	-3%
SLO	9156	25900	31.58	22200	30.46	-1.12	-4%
SLO	9068	25900	31.48	22200	30.36	-1.12	-4%
SLO	8904 F	25900	31.31	22200	30.18	-1.13	-4%
SLO	8723	25900	30.27	22200	29.14	-1.13	-4%
SLO	8677	Bridge		Bridge			
SLO	8637	25900	29.67	22200	28.62	-1.05	-4%
SLO	8520	25900	29.51	22200	28.43	-1.08	-4%
SLO	8395	25900	29.09	22200	28.03	-1.06	-4%
SLO	8183	25900	28.63	22200	27.56	-1.07	-4%
SLO	8053	25900	28.28	22200	27.22	-1.06	-4%
SLO	7936	25900	27.92	22200	26.86	-1.06	-4%
SLO	7743	25900	27.38	22200	26.31	-1.07	-4%
SLO	7670	25900	27.2	22200	26.13	-1.07	-4%
SLO	7590	25900	26.84	22200	25.78	-1.06	-4%
SLO	7505	25900	26.61	22200	25.56	-1.05	-4%
SLO	7405	25900	26.37	22200	25.3	-1.07	-4%
SLO	7281	25900	26.02	22200	24.97	-1.05	-4%
SLO	7188	25900	25.6	22200	24.59	-1.01	-4%
SLO	6982	25900	25.22	22200	24.21	-1.01	-4%
SLO	6890	25900	25.07	22200	24.05	-1.02	-4%
SLO	6739	25900	24.28	22200	23.3	-0.98	-4%
SLO	6616	25900	23.61	22200	22.71	-0.9	-4%
SLO	6512	25900	23.22	22200	22.34	-0.88	-4%

SLO	6474	25900	23.07	22200	22.19	-0.88	-4%
SLO	6355	25900	22.74	22200	21.89	-0.85	-4%
SLO	6310	25900	22.53	22200	21.73	-0.8	-4%
SLO	6208	25900	22.04	22200	21.25	-0.79	-4%
SLO	6104	25900	21.68	22200	20.91	-0.77	-4%
SLO	5984	25900	21.25	22200	20.5	-0.75	-4%
SLO	5916	25900	21.07	22200	20.33	-0.74	-4%
SLO	5798	25900	20.84	22200	20.11	-0.73	-4%
SLO	5617	25900	20.5	22200	19.78	-0.72	-4%
SLO	5562	25900	20.39	22200	19.68	-0.71	-3%
SLO	5479	25900	20.01	22200	19.33	-0.68	-3%
SLO	5240 E	25900	19.34	22200	18.69	-0.65	-3%
SLO	5090	25900	18.98	22200	18.39	-0.59	-3%
SLO	5031	25900	18.86	22200	18.27	-0.59	-3%
SLO	4943	25900	18.7	22200	18.12	-0.58	-3%
SLO	4828	25900	18.66	22200	18.09	-0.57	-3%
SLO	4693	25900	18.67	22200	18.09	-0.58	-3%
SLO	4682	Bridge		Bridge			
SLO	4658	25900	18.68	22200	18.1	-0.58	-3%
SLO	4558	25900	18.58	22200	18.01	-0.57	-3%
SLO	4470	25900	18.58	22200	18	-0.58	-3%
SLO	4302	25900	18.5	22200	17.94	-0.56	-3%
SLO	4165	25900	18.36	22200	17.82	-0.54	-3%
SLO	3993	25900	18.2	22200	17.68	-0.52	-3%
SLO	3890 D	25900	18.16	22200	17.64	-0.52	-3%
SLO	3802	25900	17.94	22200	17.45	-0.49	-3%
SLO	3785	Bridge		Bridge			
SLO	3768	25900	17.73	22200	17.3	-0.43	-2%
SLO	3677	25900	17.42	22200	17.04	-0.38	-2%
SLO	3589	25900	17.06	22200	16.77	-0.29	-2%
SLO	3386	25900	16.68	22200	16.49	-0.19	-1%
SLO	3075	25900	16.27	22200	16.19	-0.08	0%
SLO	2640 C	25900	15.97	22200	15.97	0	0%

As a result of calibration, Base Flood Elevations throughout the study area generally decrease by 0.3 to 1.1 feet. A review of the upstream and downstream bounding effective profiles from the FIS indicates that these elevations should be acceptable for tie-in.

Conclusion

Calibration of the STARRII hydrologic model of San Luis Obispo Creek to data and measurements from the March 9-10, 1995 severe flood event reduces peak discharges and resulting water surface elevations. As incorporation of these data and measurements improves upon the predictive capability of the primarily theoretical methodology utilized by STARRII, these results will result in more correct flood hazard determinations.

Attached Reports

- San Luis Obispo Creek Waterway Management Plan, Appendix C "Hydraulic and Hydrologic Report", 2003
- San Luis Obispo Creek H&H Model Calibration Study, 2008
- 1995 Flood Report: "Insurance Claim of Infinite Horizons, Inc., Avila Beach Resort Flooding Investigations, Storms of January and March 1995"