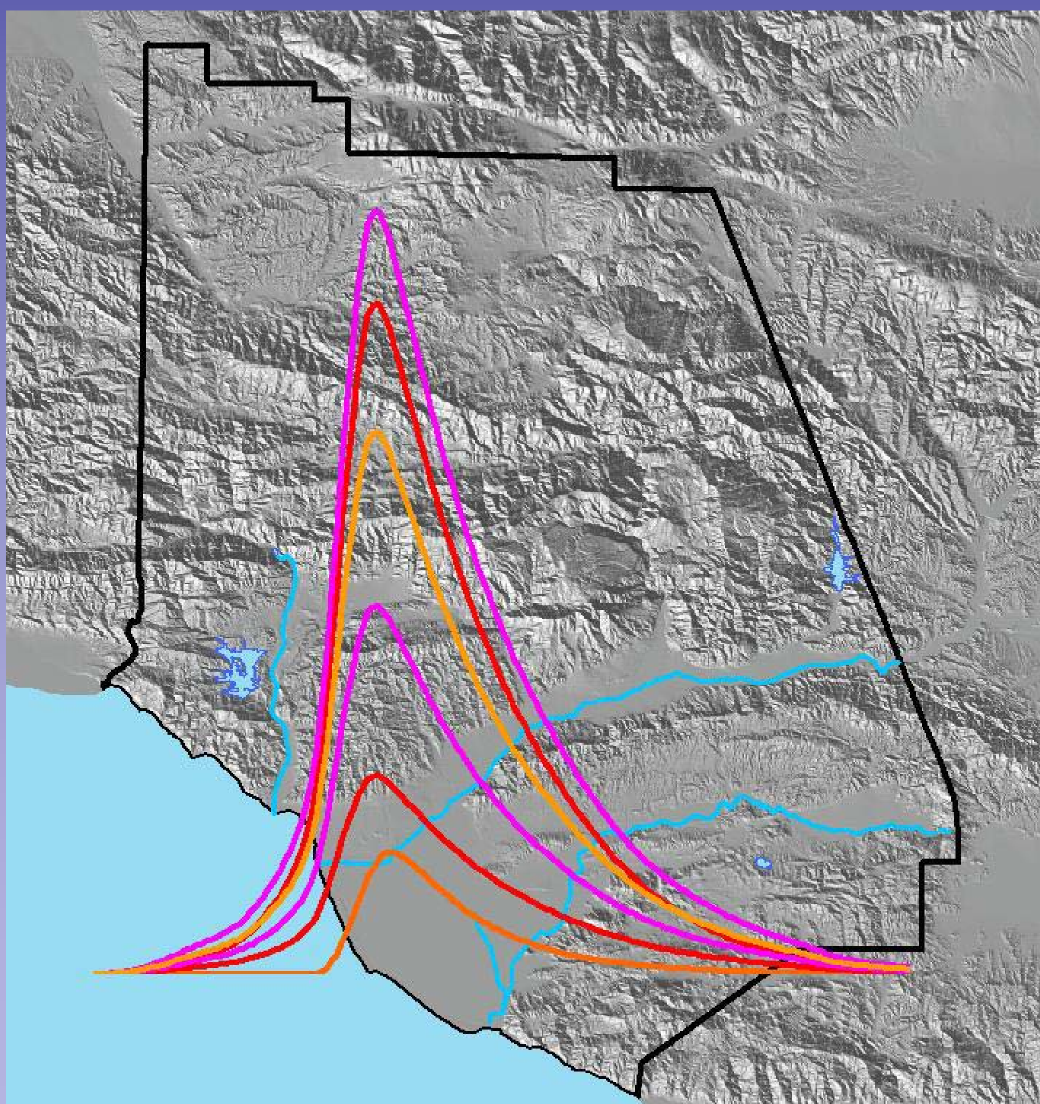
VENTURA RIVER WATERSHED DESIGN STORM MODELING

ADDENDUM II



May, 2011

Hydrology Section
Watershed Resources and Technology Division
Ventura County Watershed Protection District

Ventura County

Watershed Protection District

Hydrology Section

Project 11033

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EXECUTIVE SUMMARY

This report documents the work done by the Ventura County Watershed Protection District (District) using the calibrated Ventura River HSPF Model (Tetra Tech 2009 Draft). The model was previously used to provide the design storm peaks for hydraulic modeling and floodplain mapping of the river and its tributaries for the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS). The report prepared by the District (February, 2010) served as the basis for the hydrology evaluation performed by FEMA's contractor for the study. The approach involved identifying a storm that caused saturated conditions in the model and then applying 100-yr design storm balanced hyetographs for each rain gage used in the HSPF Model. Flood Frequency Analysis (FFA) results of stream data from gaged tributaries were used to calibrate the model in the modeling. Ungaged tributary HSPF results were verified by comparing the HSPF results to previous modeling study results.

The first report Addendum I described work done to update the HSPF model based on site-specific studies done since February, 2010. The addendum contained information about adjustments to the model due to a redelineation of the Canada De San Joaquin (CSJ) watershed based on consultant feedback and field visits to the watershed. The current Addendum II describes the work to produce and evaluate the hydrographs from the CSJ and East Ojai portion of the HSPF model for use in two-dimensional flow models (FLO-2D). The major East Ojai watersheds of interest include the McNell, Thacher, and Senior-Gridley watersheds. The hydrographs from the 100-yr design storm model were transformed into the 10- 25-, 50- and 500-yr hydrographs using frequency analysis design storm peak flow ratios and the resultant hydrograph yields were checked against the Natural Resources Conservation Service (NRCS) Curve Number yields.

As shown in Table ES-1, the resultant 100-yr hydrograph yields for the East Ojai watersheds range from 785 af to about 6,300 af. Senior-Gridley has a higher volume than Thacher even though they are about the same size due to higher average rainfall. Based on the results presented in the summary table, the method used for hydrograph generation in this report provides reasonable results for the 10-, 25- and 100-yr hydrographs. For the 50-yr hydrograph, the NRCS yields are consistently higher than the hydrograph yields by as much as almost an inch. The 500-yr hydrograph yield is 20% higher than the NRCS yield for 2 of the cases but is about 29% higher than the NRCS yield for the Senior-Gridley watershed. It appears that the most important factor in obtaining a reasonable result for the 500-yr hydrograph volume is to calibrate the 100-yr hydrograph volume using the rainfall factor in the model.

Table ES-1 Design Storm Hydrograph Yield Comparison

Senior-Gridley Area 6,181 ac					
Category	**100-yr**	**10-yr**	**25-yr**	**50-yr**	**500-yr**
Stream Gage 100-yr Ratios	1.000	0.262	0.484	0.711	1.952
Hydrograph Volume af	6,308	1,653	3,053	4,485	12,314
Hydrograph Yield Depth in	12.25	3.21	5.93	8.71	23.91
Applied Rain for Gage 264 in	15.27	10.01	12.18	13.75	18.61
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq. Analysis	1.00	0.66	0.80	0.90	1.22
24-hr Rain at Centroid Using Ratios	16.00	10.49	12.77	14.41	19.50
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	65.06	44.74	54.90	65.06	81.24
NRCS Yield Depth in	10.98	3.16	6.40	9.50	16.98
Percent Difference, Model to NRCS Yield	10%	2%	-8%	-9%	29%
Thacher Area 6,735 ac	.				
Stream Gage 100-yr Ratios	1.000	0.262	0.484	0.711	1.952
Adjusted Hydro Volume af	4,414	1,157	2,137	3,139	8,617
Hydrograph Yield Depth in	7.87	2.06	3.81	5.59	15.35
Applied Rain for Gage 64 in	10.14	6.64	8.09	9.13	12.35
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq. Analysis	1.00	0.66	0.80	0.90	1.22
24-hr Rain at Centroid Using Ratios	12.00	7.866	9.573	10.805	14.622
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	66.08	45.86	55.97	66.08	81.92
NRCS Yield Depth in	7.48	1.75	4.03	6.41	12.27
Percent Difference, Model to NRCS Yield	5%	15%	-6%	-15%	20%
McNell Area 1,419 ac.					
Stream Gage 100-yr Ratios	1.000	0.262	0.484	0.711	1.952
Adjusted Hydro Volume AF	785	206	380	558	1,532
Hydrograph Yield Depth in	6.64	1.74	3.21	4.72	12.96
Applied Rain for Gage 165 in	11.09	7.24	8.85	9.98	13.52
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq. Analysis	1.00	0.65	0.80	0.90	1.22
24-hr Rain at Centroid Using Ratios	10.50	6.86	8.38	9.45	12.80
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	66.05	45.83	55.94	66.05	81.90
NRCS Yield Depth in	6.14	1.24	3.16	5.23	10.48
Percent Difference, Model to NRCS Yield	7%	29%	2%	-11%	19%

Canada De San Joaquin Area 841 ac	**100-yr**	**10-yr**	**25-yr**	**50-yr**	**500-yr**
Stream Gage 100-yr Ratios	1.000	0.262	0.484	0.711	1.952
Adjusted Hydro Volume AF	329	86	159	234	642
Hydrograph Yield Depth in	4.69	1.23	2.27	3.34	9.16
Applied Rain for Gage 167 in	8.13	5.32	6.49	7.32	9.91
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq. Analysis	1.000	0.655	0.798	0.900	1.219
24-hr Rain at Centroid Using Ratios	8.6	5.633	6.863	7.744	10.482
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	70.9	51.4	61.2	70.9	85.0
NRCS Yield Depth in	5.09	1.06	2.62	4.35	8.63
Percent Difference, Model to NRCS Yield	-9%	13%	-15%	-30%	6%

TABLE OF CONTENTS

1. INTRODUCTION

This report provides hydrographs for some of the design peak flows used for floodplain mapping of the Ventura River Watershed by the Federal Emergency Management Agency (FEMA). The floodplain mapping project by FEMA's consultant will update the floodplain shown on current Flood Insurance Rate Maps (FIRMs). The work done previously to provide model results for the Flood Insurance Study (FIS) was documented in the District's February 2010 report. In that report, the calibrated Ventura River HSPF Model (Tetra Tech 2009) was used as the basis for generating the tributary design storm peaks for use in hydraulic modeling of the river and its tributaries in this study. The design storm flows for the Ventura River mainstem were provided by the USBR as a result of their work on the Matilija project. (USBR, 2004). The tributaries in the study included most of the creeks downstream of the Matilija Dam.

Since that report was published, other projects evaluating the hydrology in the watershed have been finished and have provided better information related to the hydrology of various watersheds. Addendum I (August 2010) contained information about adjustments to the model due to a refinement of the Canada De San Joaquin (CSJ) watershed. The current report, Addendum II, provides a summary of the work done to generate hydrographs from the HSPF model for use in studies of the CSJ area and the East Ojai floodplain mapping study for FEMA. The East Ojai study watershed is the upper San Antonio Creek upstream from the point where the East Ojai Drain confluences with the channel. The main subwatersheds in this area used in the yield evaluation include the Senior-Gridley Creeks, McNell Creek, and Thacher Creek as shown in Figure 1. Figure 2 shows the individual HSPF subarea boundaries and numbering used in the model, including the smaller Dron and Crooked Canyons included in the East Ojai Area..

2. PEAK FLOW RESULTS

2.1 Design Storm Rainfall

The East Ojai Watersheds include a variety of topography such as steep mountainous areas and their associated downstream alluvial fans. The CSJ watershed is a smaller foothill watershed near the mouth of the Ventura River. The HSPF model used four different rain gages for the East Ojai subareas as shown in Table 1. Only one rain gage was used for the CSJ watershed. The design storm model requires the results of rain frequency analyses from at least 20 years of record from a rain gage to generate the input design storm hyetograph to the model. Therefore, the rain gages with less than 20 years of data used in the continuous model were replaced by nearby gages with longer records for the design storm run as shown in Table 1. Where the design storm gage was at a higher elevation than the continuous model gage, the rainfall factor (MFACT) in the HSPF model applied to the subareas was increased by the ratio of the 100-yr rainfall contours at the respective gage locations. This led to an increase in the design storm rainfall of 1.11 to 1.168 for three of the gages. Figure 1 also shows a map of the rain gages used in the continuous and design storm modeling work for the East Ojai Area. (The rain gage locations used for the CSJ watershed are shown in Figure 7.)

2.2 Design Storm Peak Flows

The 100-yr peak flows for the East Ojai Area and CSJ watersheds are obtained from the HSPF model of the San Antonio Watershed. Details about the design storm modeling are provided in VCWPD's February 2010 report. For this effort, the two dimensional flow model requires the unsteady flow hydrographs at the upstream boundaries of the model, and the individual hydrographs from any HSPF subareas included in the model domain. Table 2 presents a summary of the peak flows provided for this report. Peaks from local flow generated by individual subareas are identified as "local" in the flow type column.

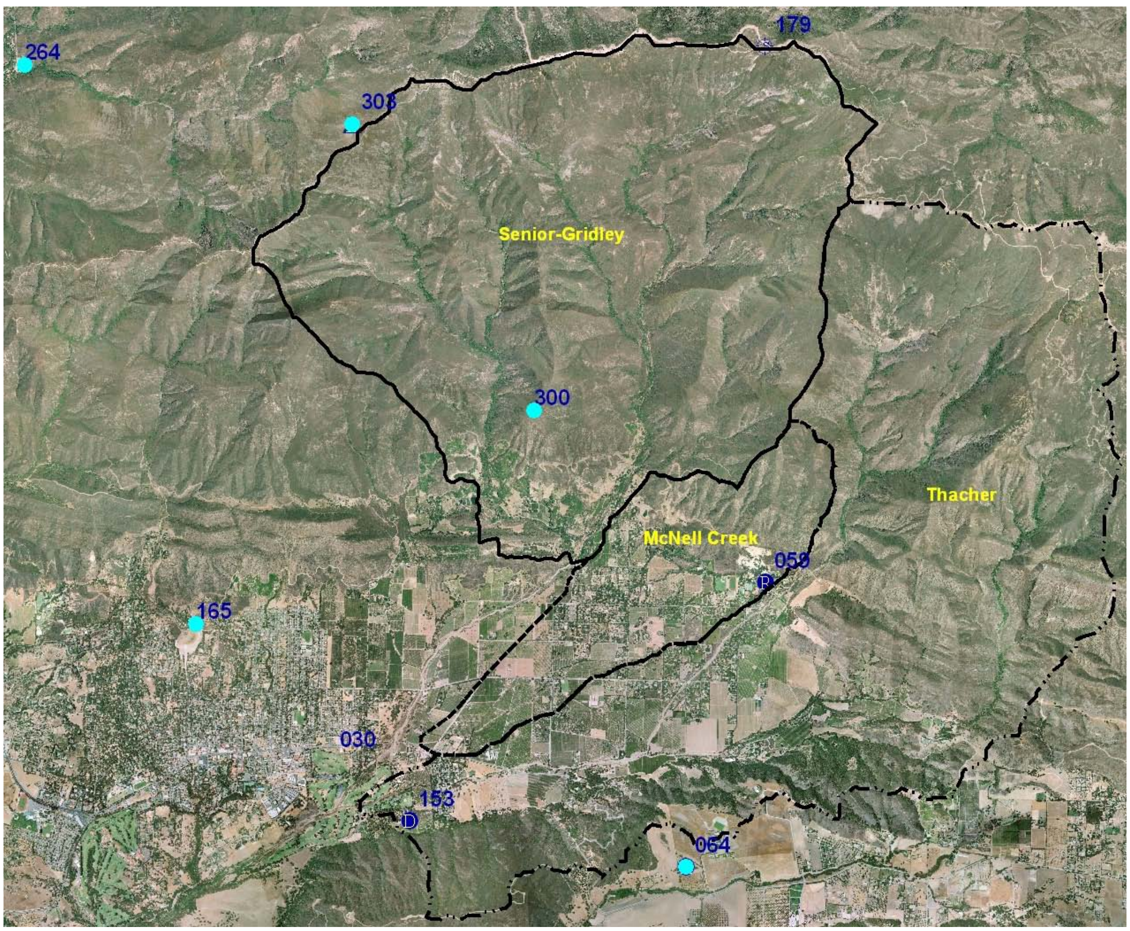

Figure 1 – East Ojai Watersheds and Rain Gages

Table 1. HSPF Rain Gages

Watershed	Cont. Model Rain Gage	HSPF DSN	Design Storm Gage	MFACT Factor
Senior-Gridley	A614 (303)	17	264	1.110
McNell Creek	A71 (300)	16	165	1.168
Thacher Ck	64	9	64	1.000
East Ojai Drain	165	10	165	1.000
Canada De San Joaquin	66	1	167	1.140

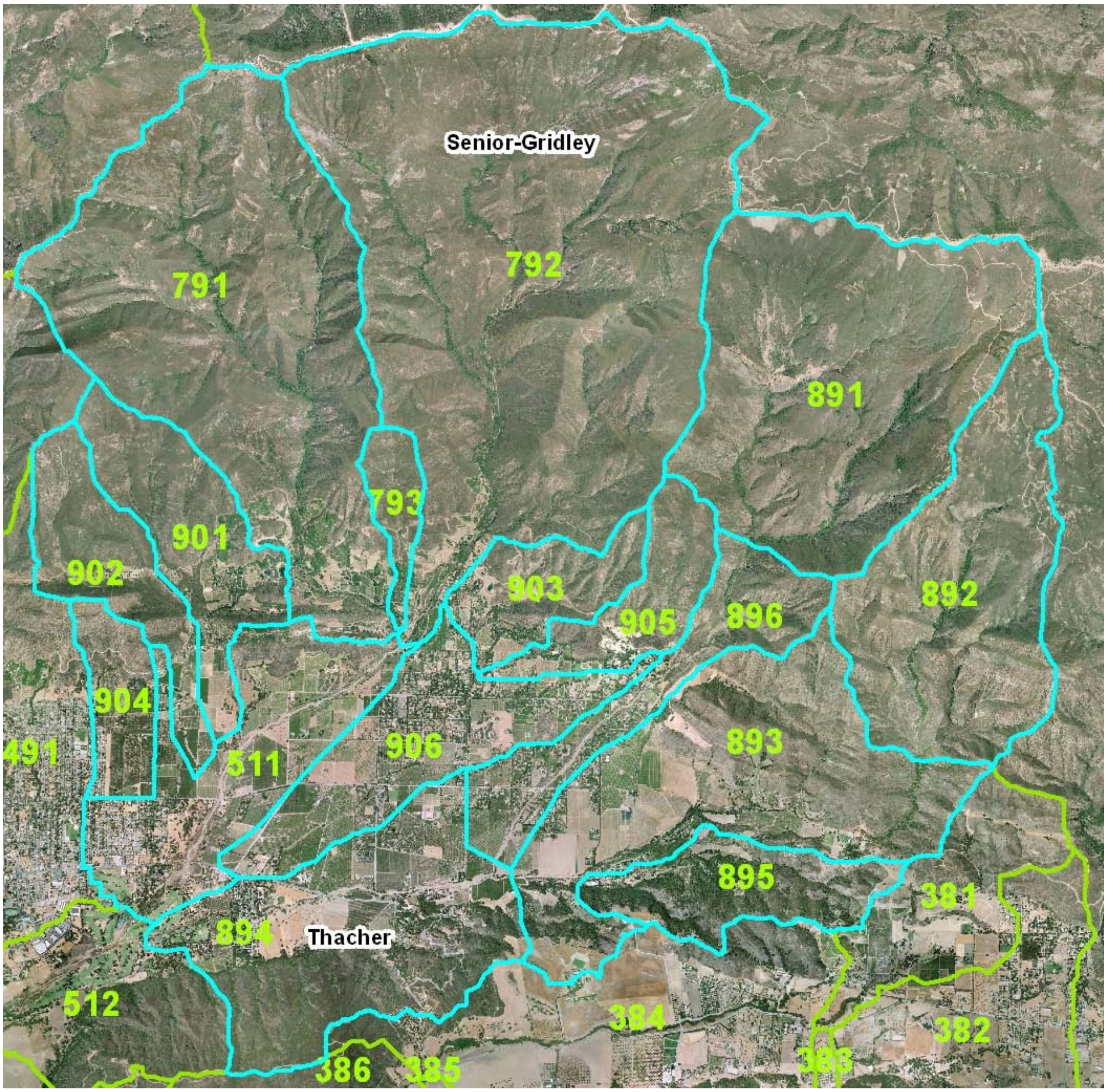

Figure 2 – East Ojai HSPF Model Subareas

Table 2 – East Ojai and CSJ HSPF Subarea Peak Flows

Location	HSPF File ID	Reach #	Flow Type	Peak cfs	Area ac	Peak/Area cfs/ac
San Antonio Ck blw Thacher	5511	511L	Local	1,350	852	1.58
Thacher Abv San Antonio	5894	894	Local	2,490	1,200	2.08
Reeves Abv McAndrews	5046	893	Routed	5,290	2,681	1.97
Upper Reeves	6010	892	Routed	3,350	1,228	2.73
Middle Reeves Local Inflow	5893	893	Local	4,110	1,453	2.83
McAndrews abv Reeves	6011	895	Routed	1,020	441	2.31
Thacher Abv Reeves	5047	896	Routed	6,590	2,415	2.73
Upper Thacher	6009	891	Routed	6,060	1,873	3.24
Thacher abv Reeves Local	5896	896	Local	1,120	542	2.07
McNell Abv SA Ck	5052	906	Routed	2,170	1,419	1.53
McNell Upper North	6007	903	Routed	1,040	339	3.07
McNell Upper South	6008	905	Routed	833	351	2.37
Lower McNell Local	5906	906	Local	1,140	729	1.56
Crooked Ck	5049	902	Routed	831	458	1.81
Dron Ck	5048	901	Routed	1,620	583	2.78
Ladera Ck	6006	793	Routed	432	144	3.00
Gridley Cyn	6005	791	Routed	6,730	2,336	2.88
Senior Cyn	5033	792	Routed	10,900	3,701	2.95
East Ojai Drn @ SA Ck	5062	904	Routed	369	249	1.48
Upper CSJ	5040	874	Routed	1,870	841	2.22
CSJ-South	5878	878	Routed	331	91	3.64
CSJ Lower	5879	879	Routed	979	1,054	0.93
CSJ Lower	6879	879	Local	468	1,054	0.44
Dent Drain	5043	877	Routed	527	248	2.13

3. HYDROGRAPH GENERATION AND YIELD

3.1 Design Storm and Baseflow 100-Yr Hydrographs

Because the design storm rainfall is applied to the model on the simulation date of January 10, 2005, there is a considerable amount of baseflow in the model from the historical rainfall that occurred starting January 7, 2005. In order to get a more accurate assessment of the yield due to the applied design storm rainfall, an HSPF model run was done with the design storm rainfall set to 0. The baseflow hydrograph was obtained through this manner, and subtracted from the design storm hydrograph for the yield calculations. Figure 3 shows an example of design storm and baseflow hydrographs for the Senior-Gridley watershed.

In general, the HSPF model was prepared with output hydrographs provided at the outlets of key subareas where data was required for hydraulic modeling efforts. The conceptual model of HSPF is that runoff from an individual subarea combines with any upstream flow at the upstream end of the subarea and is routed through the subarea channel. Therefore, any local runoff peaks from a subarea are also subjected to routing effects in the channel. For the unsteady flow analyses requiring the incremental flow hydrographs from individual subareas, the model was revised to provide the runoff hydrograph before any routing is done. Without the channel routing attenuation, local runoff hydrographs can have high peaks relative to routed flow.

Another aspect of the HSPF model noticed during this effort was that at several locations, hydrographs from adjacent subareas were summed internally in the model and then sent to an output file. The individual output from each subarea were also sent to files and summed in a spreadsheet. It was noticed that the hydrograph summed in HSPF had a lower peak than the spreadsheet sum of the two individual hydrographs. The internal hydrograph had a peak that was very close to what would be obtained if peak datum was averaged with an adjacent datapoint before summing.

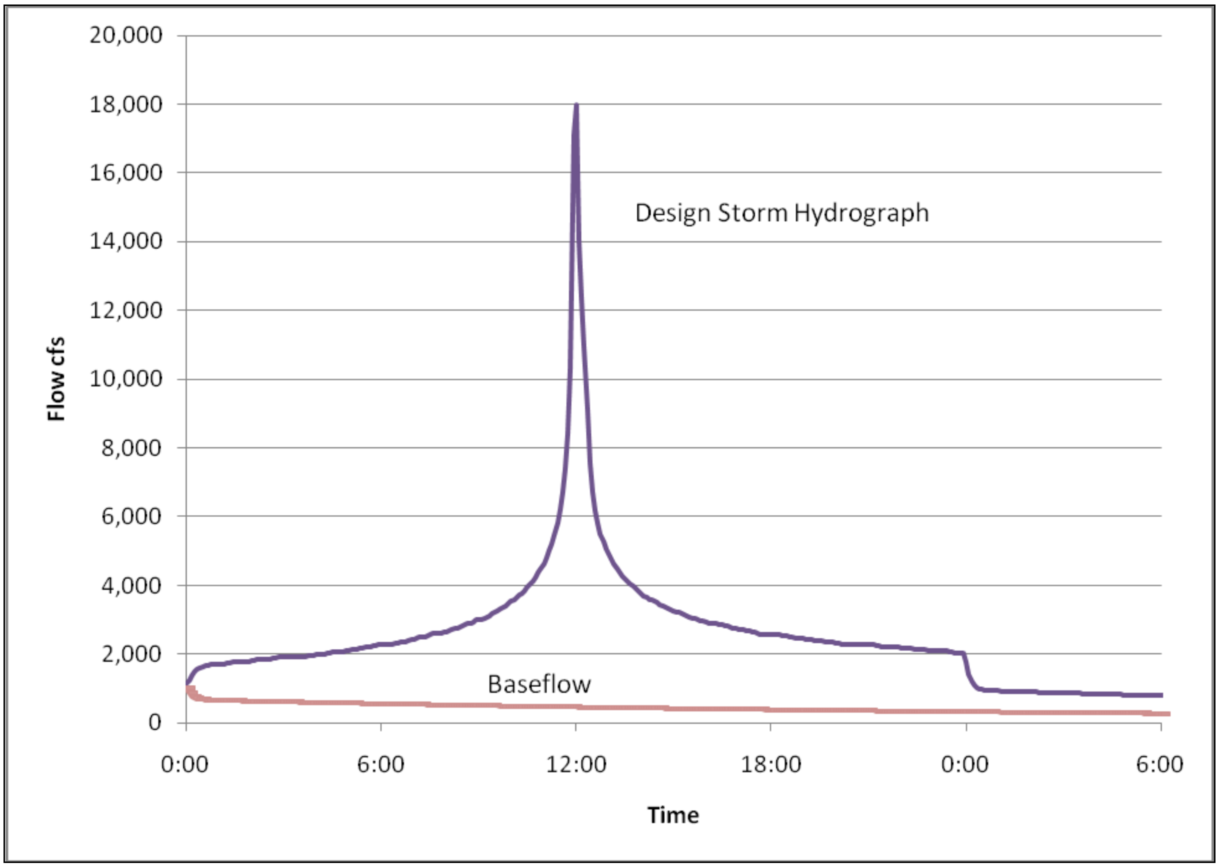

Figure 3. Senior-Gridley Watershed 100-Yr Hydrographs

3.2 Hydrographs and Yield Evaluation Method

For FLO-2D modeling of the East Ojai Watershed, the 10-, 25-, 50-, and 500-yr hydrographs are required. It is difficult to use the HSPF model to produce these hydrographs for the following reasons:

1. The extensive work required to prepare design storm rainfall for each of those conditions.
2. The uncertainty in establishing the antecedent moisture conditions leading to the n-year runoff in the model.
3. The extensive work to obtain the stage-storage-discharge data that should be used to characterize the overbank flow and peak attenuation in the channel routing portion of the model for the 500-yr storm. The channel conditions are likely to be very different due to scour and deposition during the 500-year event than the existing channel routing data as defined by HEC-RAS models.

Due to these reasons, the assumption was made that the ratios used to provide n-yr peaks from the 100-yr results could also provide n-yr hydrographs with reasonable yields. The reasonableness of this assumption was checked by also calculating the watershed yield using weighted average NRCS Curve Numbers calculated for the soil and land use combinations found in each watershed. The methodology used in the analysis is as follows:

1. Calculate the net watershed yield by subtracting the baseflow hydrograph from the 100-yr design storm hydrograph for each watershed for the four watersheds included in the yield analysis.
2. Multiply each 100-yr hydrograph by the n-yr/100-yr ratio for peaks as presented in the February 2010 report and calculate the yield in inches of runoff over the watershed area.
3. Create a map of the watershed showing the 100-yr 24-hr rain contours and find the weighted average rainfall for the watershed.
4. Convert that rainfall to other n-yr values using the n-yr/100-yr 24-hr rain data from the Pearson III rain frequency analysis data for long term gages.
5. Based on previous calibration work, 100-yr yields using the NRCS Curve Number approach show relatively good agreement with hydrograph yields if AMC II conditions are assumed. For the 50-yr storm, the same AMC II condition is assumed. For the 25-yr storm, Ponce (1989) suggests that the AMC 1.5 condition is applicable. For the 10-yr storm, AMC I conditions are assumed. For the 500-yr storm, AMC III conditions are assumed.
6. GIS is used to calculate the soil and land use combinations present in each watershed. The District’s Hydrology Manual is used to provide CNs for each combination, and a weighted average CN is calculated for the watershed.
7. The NRCS yield is calculated using the weighted average CN.
8. The yields from the hydrographs and the NRCS approach are compared.

The rainfall contour maps for the four watersheds subjected to a yield analysis are provided in Figures 4 through 7 below.

The initial 100-yr hydrograph yield evaluation for CSJ showed the HSPF yield to be much lower than the NRCS yield. This was concluded to be due to the assignment of rain gage 66 at the Ventura City Hall as the source of the continuous rainfall in the HSPF model. The 100-yr rainfall 24-hr rain depth at that gage is about 7.0 inches, whereas the 100-yr 24-yr rainfall contours for the main CSJ watershed shows a depth of about 8.6 inches at the centroid. In order to obtain a better match to the NRCS yield, the rainfall factor in the design storm model was increase from 1.0 to about 1.14. This brought the hydrograph yield to within about 10% of the NRCS yield, consistent with the other watersheds being evaluated.

3.3 Model Results and Yield Evaluation

The results of the hydrograph yield calculations for each watershed are presented in Tables 3 through 6. The results show that the 100-yr hydrograph yields agree with the NRCS AMC II CN yields to within about 10%. The 10-yr hydrograph yields agree with the NRCS AMC I CN yields to within 3% for the Senior-Gridley, but the NRCS yield is about 0.3 to 0.5 inches lower than the hydrograph yield for the Thacher, McNell and CSJ watersheds. The 25-yr hydrograph yields are within 10% of the NRCS yields, except the CSJ watershed, which is within 15% of the NRCS yield.

The 50-yr hydrograph yields are lower than the NRCS CN AMC II condition yields for all watersheds by as much as an inch. The 500-yr hydrograph yields are within 20% of the NRCS yields except for Senior-Gridley. Senior-Gridley has a relatively high 500-yr design storm hydrograph yield as it is based on the 100-yr hydrograph that is about 10% higher than the NRCS 100-yr yield. Because of this, the 500-yr hydrograph shows a yield that is much higher than the NRCS 500-yr calculated yield assuming AMC III conditions. Appendix A provides a spreadsheet file with the hydrographs that are to be provided for the East Ojai Area and CSJ watersheds.

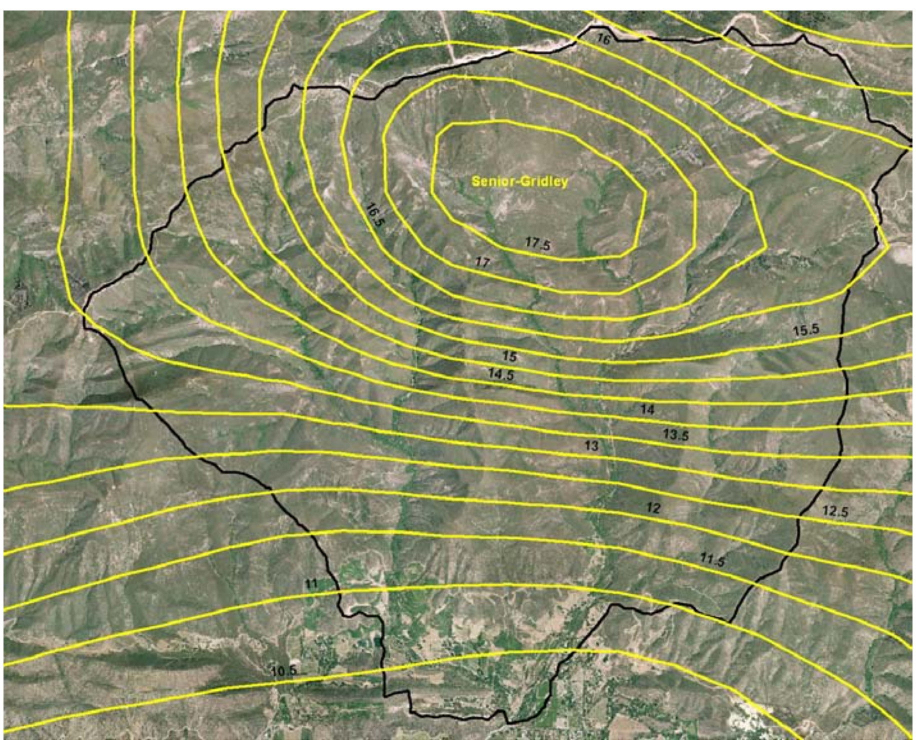

Figure 4 – Senior-Gridley 100-yr Rain

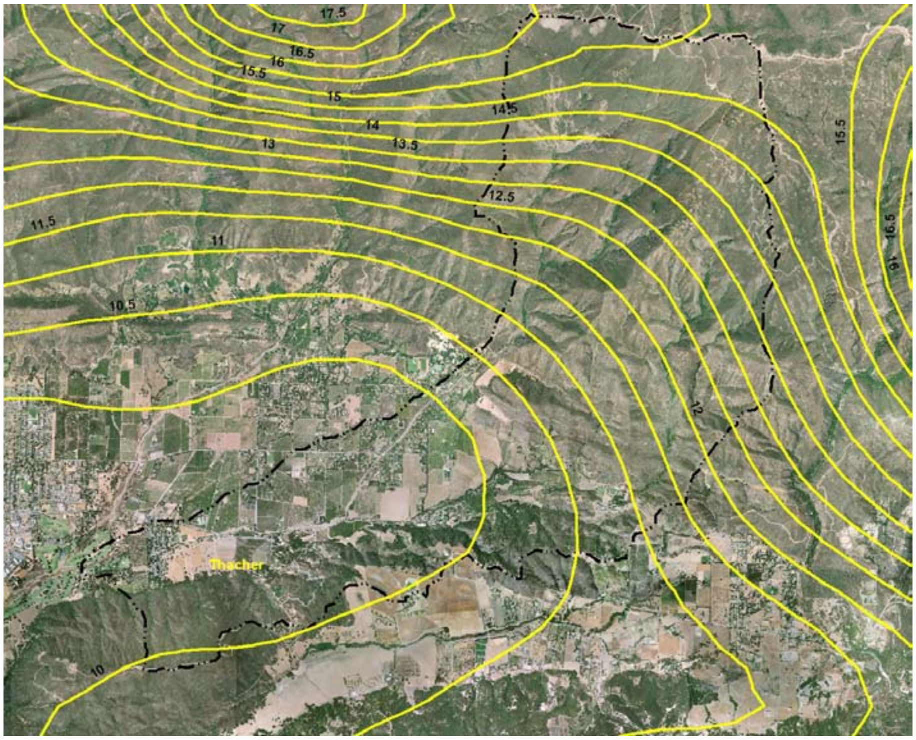

Figure 5 – Thacher 100-yr Rain

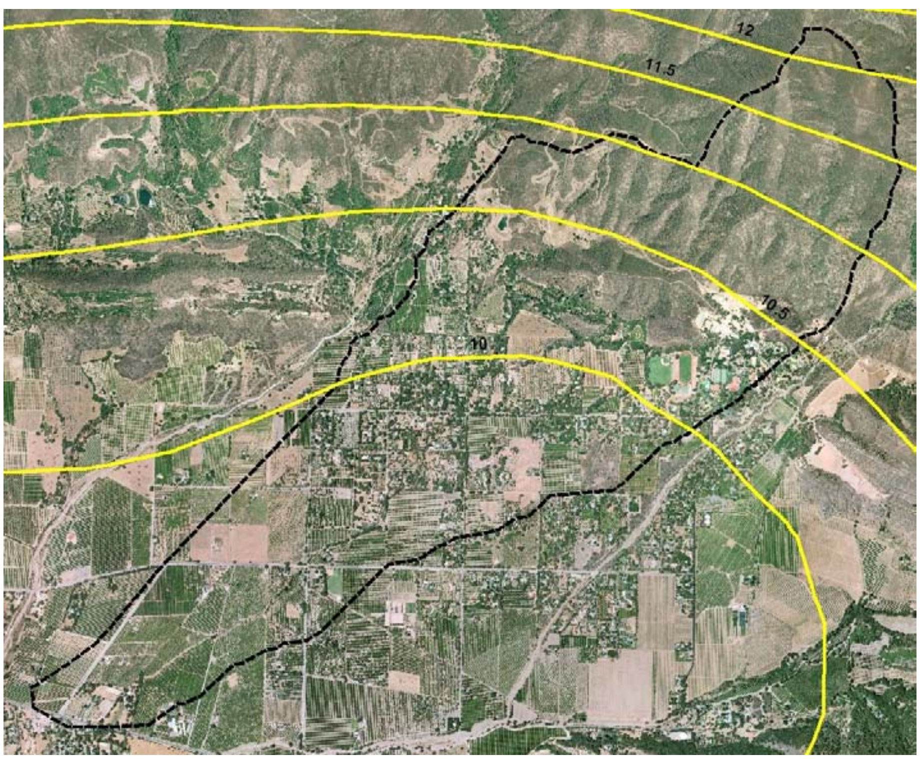

Figure 6 – McNell 100-yr Rain

Figure 7 – Canada De San Joaquin- 100-yr Rain and Rain Gages

Table 3. Senior-Gridley Yield Analysis Results

Category	100-yr	10-yr	25-yr	50-yr	500-yr
Stream Gage 100-yr Ratio	1.000	0.262	0.484	0.711	1.952
Net Hydrograph Volume af	5,903	1,547	2,857	4,197	11,524
Hydrograph Yield Depth in	11.46	3.00	5.55	8.15	22.37
Rain Gage 24-hr Depth in	13.36	8.76	10.66	12.03	16.28
Applied Rain for Gage 64 in	15.27	10.01	12.18	13.75	18.61
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq Analysis					
24-hr Rain at Centroid Using Ratio in	1.000	0.656	0.798	0.900	1.219
Antecedent Moisture Condition	15.500	10.163	12.368	13.957	18.888
Weighted CN	II	I	I.5	II	III
NRCS Yield in	65.1	44.7	54.9	65.1	81.2
Yield Difference %	10.51	2.95	6.07	9.09	16.37
Stream Gage 100-yr Ratio	8%	2%	-9%	-12%	27%

Note: Area=6,181 ac, Rain Gage 264 used with MFACT = 1.143

Table 4 Thacher Yield Analysis Results

Category	100-yr	10-yr	25-yr	50-yr	500-yr
Stream Gage 100-yr Ratio	1.000	0.262	0.484	0.711	1.952
Net Hydrograph Volume af	4,414	1,157	2,137	3,139	8,617
Hydrograph Yield Depth in	7.87	2.06	3.81	5.59	15.35
Rain Gage 24-hr Depth in	9.84	6.45	7.85	8.86	11.99
Applied Rain for Gage 64 in	10.14	6.64	8.09	9.13	12.35
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq Analysis	1.000	0.655	0.798	0.900	1.218
24-hr Rain at Centroid Using Ratio in	12.000	7.866	9.573	10.805	14.622
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	66.1	45.9	56.0	66.1	81.9
NRCS Yield in	7.48	1.75	4.03	6.41	12.27
Yield Difference %	5%	15%	-6%	-15%	20%

Note: Area=6,735 ac, Rain Gage 64 used with MFACT = 1.03

Table 5. McNell Yield Analysis Results

Category	100-yr	10-yr	25-yr	50-yr	500-yr
Stream Gage 100-yr Ratio	1.000	0.262	0.484	0.711	1.952
Net Hydrograph Volume af	785	206	380	558	1,532
Hydrograph Yield Depth in	6.64	1.74	3.21	4.72	12.96
Rain Gage 24-hr Depth in	9.22	6.02	7.36	8.3	11.24
Applied Rain for Gage 64 in	11.09	7.24	8.85	9.98	13.52
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq Analysis	1.000	0.653	0.798	0.900	1.219
24-hr Rain at Centroid Using Ratio in	10.500	6.856	8.382	9.452	12.800
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	66.1	45.8	55.9	66.1	81.9
NRCS Yield in	6.14	1.24	3.16	5.23	10.48
Yield Difference %	7%	29%	2%	-11%	19%

Note: Area=1,419 ac, Rain Gage 165 used with MFACT = 1.203

Table 6. Canada De San Joaquin Yield Analysis Results

Category	100-yr	10-yr	25-yr	50-yr	500-yr
Stream Gage 100-yr Ratio	1.000	0.262	0.484	0.711	1.952
Net Hydrograph Volume af	329	86	159	234	642
Hydrograph Yield Depth in	4.69	1.23	2.27	3.34	9.16
Rain Gage 24-hr Depth in	7.13	4.67	5.69	6.42	8.69
Applied Rain for Gage 64 in	8.13	5.32	6.49	7.32	9.91
NRCS Analysis					
Rain Ratio to 100-yr - Rain Freq Analysis	1.00	0.655	0.798	0.900	1.219
24-hr Rain at Centroid Using Ratio in	8.6	5.633	6.863	7.744	10.482
Antecedent Moisture Condition	II	I	I.5	II	III
Weighted CN	70.9	51.4	61.2	70.9	85.0
NRCS Yield in	5.09	1.06	2.62	4.35	8.63
Yield Difference %	-9%	13%	-15%	-30%	6%

Note: Area=841 ac, Rain Gage 167 used with MFACT = 1.140

3.4 Discussion

Based on the results presented in the summary tables, the method used for hydrograph generation in this report provides reasonable results for the 10-, 25- and 100-yr hydrographs for the four watershed included in the analysis. For the 50-yr hydrograph, the NRCS yields are consistently higher than the hydrograph yields by up to an inch.

It appears that the most important factor in obtaining a reasonable result for the 500-yr hydrograph volume is to calibrate the 100-yr hydrograph volume using the rainfall factor in the model. The CSJ model hydrograph yield is within 6% of the 500-yr NRCS yield because the 100-yr hydrograph yield is about 10% lower than the NRCS yield. The Ventura Model is more difficult to calibrate in this way due to the Hydrologic Response Unit (HRU) approach used in generating the pervious land runoff in the model. Rather than assigning a rain gage for each subarea and adjusting the rainfall factor to account for differences in elevation between the rain gage and the subarea centroid as is done in the Santa Clara and Calleguas HSPF models, the Ventura HSPF model assigns a rain gage to a number of nearby subareas and uses only one rain gage factor for those subareas. Because of this, if the subareas vary in elevation significantly, there is a chance that the runoff volumes will be different for frequencies other than the 100-yr hydrograph.

3.5 Model File Summary

K:\WRT\hydrology\Watersheds\Ventura\WPP-Prop50\HSPF\DesignStorm\Design Storm Model\Updated6-09\EastOjai4-11
Contains spreadsheet with summary of model results (EastOjaiHydrographs4-11.xlsx), HSPF Model files, hydrograph text files, and yield analysis spreadsheet.

K:\WRT\hydrology\Watersheds\Ventura\WPP-Prop50\HSPF\DesignStorm\Design Storm Model\Updated6-09\EastOjai4-11
Contains the Canada de San Joaquin files model for providing the hydrographs.

K:\WRT\hydrology\Watersheds\Ventura\WPP-Prop50\HSPF\DesignStorm\Design Storm Model\Updated6-09\CSJ2011
Contains the spreadsheets with the output hydrographs and yield calculations

K:\WRT\hydrology\Watersheds\Ventura\WPP-Prop50\HSPF\GIS
Contains GIS files and .jpg maps used for yield analyses and in this report.

K:\WRT\hydrology\Watersheds\Ventura\WPP-Prop50\HSPF\DesignStorm\FinalRept2-2010\2010Addendum
This report.

4. REFERENCES

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APPENDIX A- HSPF HYDROGRAPH FILES