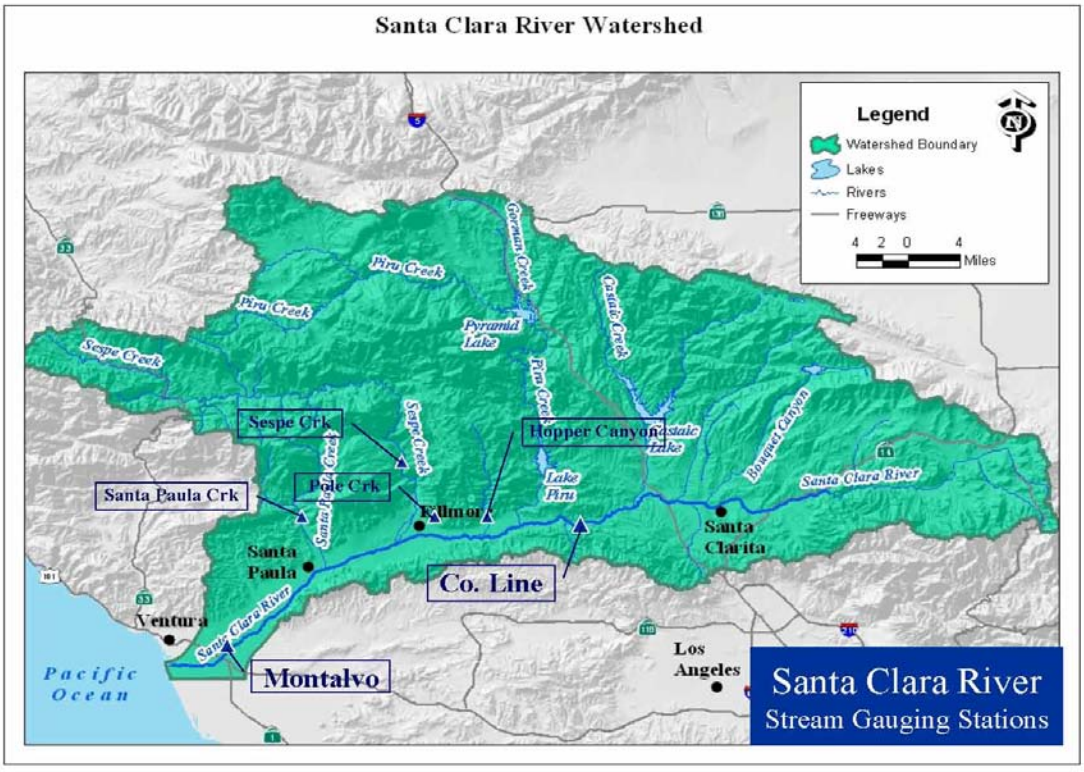
ADDENDUM

Report Appendix L Addendum: Hydrologic Modeling of the Santa Clara River with U.S. EPA Hydrologic Simulation Program – FORTRAN (HSPF) December, 2009

Santa Clara River

Feasibility Study

February, 2011



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Ac.	Acres
cfs	Cubic feet per second
Corps	US Army Corps of Engineers
District	Ventura County Watershed Protection District, formerly Flood Control District (VCFCD)
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
Fps	Feet per second
Ft	Feet
HSPF	Hydrologic Simulation Program - FORTRAN
In.	Inches
LACDPW	Los Angeles County Department of Public Works
Mi.	Miles
Q100	100-yr peak discharge
PMP	Project Management Plan
Sq. Mi.	Square miles
VCWPD	Ventura County Watershed Protection District
Yr	Year

SECTION 1 INTRODUCTION

The Santa Clara River Feasibility Study is a joint project undertaken by Federal and Local Agencies to evaluate the watershed and identify opportunities for projects to resolve any problems. The activities in the Feasibility study are outlined in the Project Management Plan (PMP) and include creation of hydrologic, hydraulic, and sediment transport models of the watershed to evaluate natural, existing, and future conditions. The study partners are the Ventura County Watershed Protection District (VCWPD), the Los Angeles County Department of Public Works (LACDPW), and the Los Angeles District of the U. S. Army Corps of Engineers (Corps).

A hydrology model of the watershed was the first product specified in the PMP to be completed. A hydrology report describing the creation and use of the Hydrologic Simulation Program – FORTRAN (HSPF) model finalized in December, 2009 was prepared by AQUA TERRA Consultants (AQUA TERRA) hired by VCWPD. This continuous model simulates surface water runoff in the streams included in the model for the period from October, 1959 to September, 2005 for natural (pre-European) and existing (2005) baseline land use conditions. The continuous model was also used to provide design storm 100-yr peaks (Q100) for the study tributaries to be included in the hydraulic modeling effort of the PMP as described in Appendices L and M of the 2009 AQUA TERRA Report. The peak discharges for the other design storm levels to be evaluated using the hydraulic model were provided through the use of design storm ratios developed with stream gage flow frequency analysis data.

In May, 2010, a Ventura County engineering firm, Jensen Design and Survey, Inc. (Jensen), prepared a detailed study of the Orcutt Creek watershed just to the east of Santa Paula Creek. The work included detailed field investigations that showed that the HSPF model watershed boundary used for Orcutt Creek needed to be revised. Jensen used the District's VCRat model to provide peak flows at various locations in the watershed. Their peak flow at the watershed outlet compared well with the most recent HSPF peak provided to FEMA.

1.1 PURPOSE AND SCOPE

As a result of the Jensen study, it is necessary to revise the HSPF model boundary for Orcutt Creek in the HSPF design storm model. The revisions to subarea 821 representing Orcutt in the HSPF model also affected subarea 822 (Timber Canyon), subarea 835 (lower Santa Paula Creek), and subarea 830 (mainstem of the Santa Clara River) as shown in Figure 1-1. The revised land uses based on the new boundaries were calculated following the same steps and using the same files as in the Aqua Terra (2009) report and the .uci file controlling the HSPF simulation was revised accordingly. The model was then run and the rainfall factor for subarea 821 was adjusted to match the VCRat result so that the two models would provide consistent results.

As Orcutt Creek is being studied by FEMA as part of the ongoing Flood Insurance Study (FIS), this addendum will be provided to FEMA for their use in the FIS.

1.2 HSPF Model Boundary Revisions

The numerous subareas used by Jensen in their modified rational method model of the watershed were merged into one watershed boundary. This new boundary was used to revise the boundaries of the HSPF model as shown in Figure 1-1.

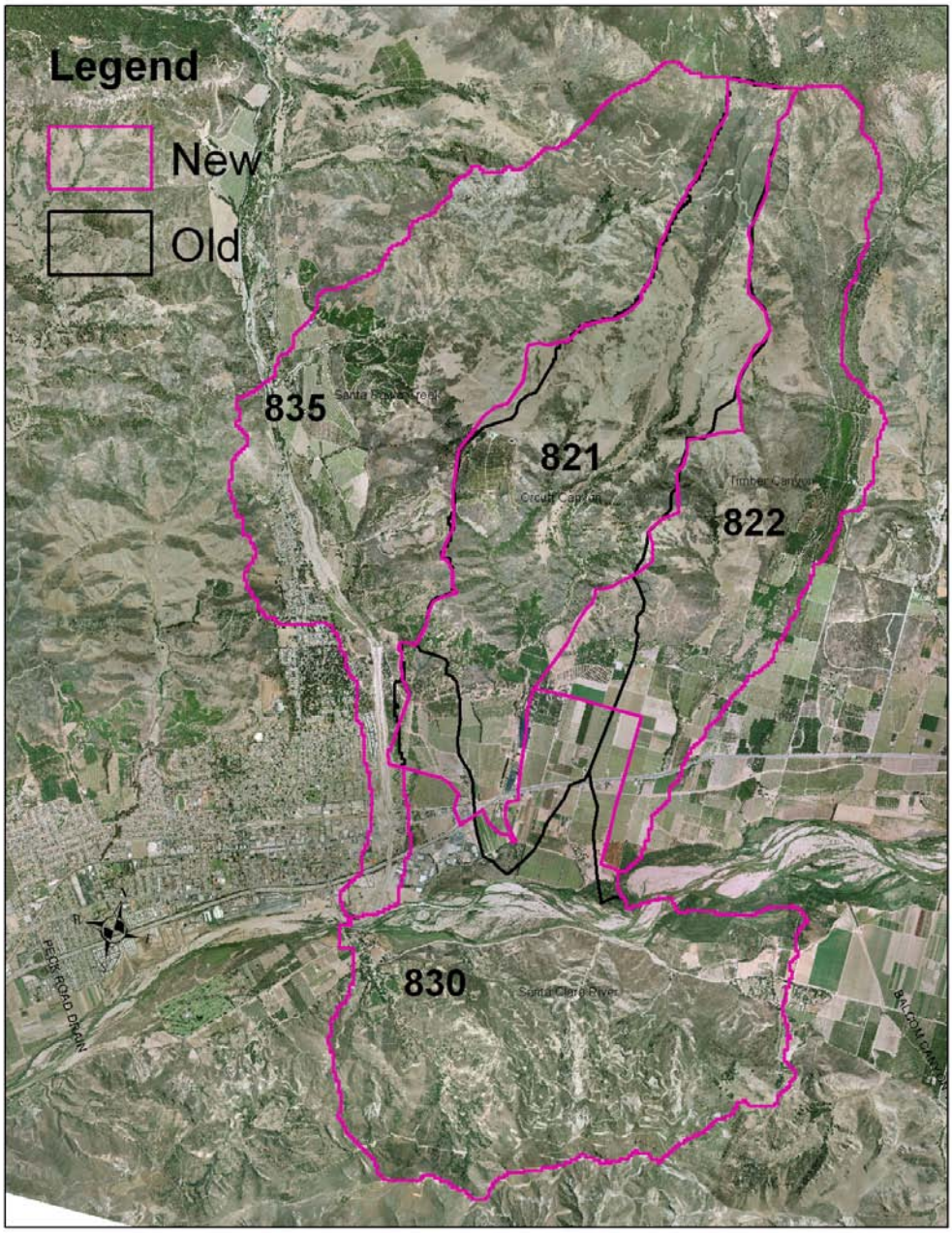

Figure1-1- Old and Revised HSPF Model Boundaries

1.3 LAND USE REVISIONS

The changes in land use acreages based on the new boundaries were calculated following the same steps and using the same files as the Aqua Terra (2009) report. The revised land use acreages were then inserted in the .uci file that controls how the HSPF simulation is done and writes the results to an output file. In the Santa Clara model, there can be as many as 9 land use categories for pervious areas and one impervious land use category assigned to a subarea. Table 1-1 shows a comparison of the changes in land uses for the old and new boundaries for the four affected subareas.

Table 1-1 Land Use Comparison

Original Model				Update		Original Model			Update	
Land Type	Use Code	Area Ac	Reach	Area. Ac	Diff.	Use Code	Area Ac	Reach	Area. Ac	Diff.
ORCUTT CYN						**SANTA PAULA CK**				
Pervious	931	617.2	821	607.4	9.9	831	539.4	835	650.5	-111.1
Pervious	932	1986.8	821	1620.0	366.8	832	1674.2	835	1627.2	47.0
Pervious	933	94.3	821	28.9	65.4	833	256.2	835	105.0	151.2
Pervious	934	301.7	821	569.8	-268.1	834	770.8	835	777.2	-6.4
Pervious	935	43.7	821	19.1	24.6	835	84.3	835	73.0	11.3
Pervious	936	1.7	821	0.0	1.7	836	28.4	835	0.6	27.8
Pervious	937	10.9	821	0.4	10.5	837	80.4	835	85.0	-4.6
Pervious	938	18.3	821	33.2	-14.9	838	160.3	835	174.9	-14.6
Pervious	939	0.0	821	0.2	-0.2	839	0.0	835	54.5	-54.5
Imperv.	931	13.1	821	18.0	-4.9	831	111.9	835	112.4	-0.5
SUBTOT.		3087.7		2897.0	190.7		3705.9		3660.2	45.7
TIMBER CYN						**SANTA CLARA R.**				
Pervious	841	471.9	822	603.9	-132.0	841	624.8	830	864.7	-239.9
Pervious	842	1097.3	822	1132.0	-34.7	842	1119.3	830	1210.5	-91.2
Pervious	843	135.9	822	49.2	86.7	843	280.9	830	134.6	146.3
Pervious	844	795.9	822	780.0	15.9	844	744.0	830	649.7	94.3
Pervious	845	26.3	822	22.7	3.6	845	119.3	830	125.9	-6.6
Pervious	846	0.9	822	0.0	0.9	846	21.6	830	0.0	21.6
Pervious	847	5.1	822	0.0	5.1	847	47.2	830	2.4	44.8
Pervious	848	14.9	822	25.6	-10.7	848	633.0	830	797.0	-164.0
Pervious	849	0.0	822	0.0	0.0	849	0.0	830	0.7	-0.7
Imperv.	841	12.5	822	12.7	-0.2	841	108.3	830	111.5	-3.2
SUBTOT.		2560.7		2626.0	-65.3		3698.4		3896.9	-198.5

1.4 VCRAT Results and HSPF Calibration

The Jensen (2010) study provided a 100-yr peak of 4,849 cfs at the downstream end of the model with a watershed of about 2,890 ac. The previous HSPF model with a watershed area of about 3,090 ac provided a 100-yr peak of about 5,300 cfs. These two results compare well on a cfs/ac ratio basis, and therefore it was considered reasonable to revise the HSPF model and adjust the rainfall factor in the HSPF model so that the two models would agree to within less than 1%.

SECTION 2 HSPF MODEL RESULTS

The resulting 100-yr discharge for Orcutt Creek in the revised HSPF model is 4,850 cfs. As was done in the original Appendix L, this discharge is converted to other frequencies based on the results of an analysis of stream gage frequency data. For Timber Canyon, a floodplain mapping study done for the District by a consultant required intermediate discharge data at various points along the tributary. As described in a previous Addendum to the HSPF Report (VCWPD, 2010), the USGS method of adjusting model or gage results at a downstream location was used to provide intermediate discharges. As the watershed area for Timber Canyon was adjusted in this study; therefore, the downstream and intermediate discharges have changed slightly. Table 2-1 shows the revised model results for the three tributary areas affected by the Orcutt Creek boundary revisions. The mainstem flow of subarea 830 was not affected by the minor changes in the tributary flows presented here.

Because the Orcut Creek VCRat model provides results at each individual subarea in the model, it can be used to provide intermediate discharges at locations required for floodplain mapping efforts.

Table 2-3 HSPF Model and Design Storm Ratio Results

Name	GIS Sub-Area	Study	Area (ac.)	Cum. Area (sq. mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Multiplier
Orcutt Canyon	821	FEMA	3,087	4.8	229	763	1,389	2,565	3,768	5,300	7,129	10,346	Undeveloped
Orcutt Creek Rev.	821	FEMA	2,890	4.5	210	698	1,271	2,347	3,448	4,850	6,523	9,467	Undeveloped
Timber Upstream	3822	CDM	723	-	76	254	461	852	1,252	1,761	2,368	3,437	Undeveloped
Timber Intermediate 1	2822	CDM	1,070	-	106	351	639	1,180	1,733	2,438	3,279	4,758	Undeveloped
Timber Intermediate 2	1822	CDM	1,398	-	132	438	797	1,473	2,164	3,043	4,093	5,941	Undeveloped
Timber Cyn	822	CDM	2,561	4.0	218	724	1,318	2,435	3,576	5,030	6,765	9,819	Undeveloped
Timber Upstream Rev	3822	CDM	722	-	77	257	468	864	1,269	1,785	2,400	3,484	Undeveloped
Timber Intermed. 1 Rev	2822	CDM	1,068	-	107	356	647	1,195	1,756	2,470	3,322	4,821	Undeveloped
Timber Intermed. 2 Rev	1822	CDM	1,400	-	134	445	810	1,497	2,198	3,092	4,159	6,036	Undeveloped
Timber Cyn Rev.	822	CDM	2,619	4.1	225	749	1,362	2,517	3,697	5,200	6,994	10,150	Undeveloped
Santa Paula Creek	835	CDM	3,779	45.8	1,706	5,674	10,323	19,070	28,013	39,400	52,993	76,909	Undeveloped
Santa Paula Ck Rev.	835	CDM	3,651	45.6	1,697	5,645	10,270	18,973	27,871	39,200	52,724	76,518	Undeveloped

Note (1): Calculated 100-yr Discharges for Intermediate Reaches Have Names in Red Font and 4 digit Subarea Numbers.

SECTION 3 REFERENCES

AQUA TERRA, 2009. Hydrologic Modeling of the Santa Clara River Watershed with the U.S. EPA Hydrologic Simulation Program – FORTRAN (HSPF). Revised Final Draft, December 2009.

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