

Appendix B
Wet-Weather Hydrology
Calibration and Validation for
the Los Angeles River Watershed

May 2004

Prepared for:
USEPA Region 9
Los Angeles Regional Water Quality Control Board

Prepared by:
Tetra Tech, Inc.

Hydrology Calibration for Rio Hondo above Stuart and Gray Road (gage F45B-R, model subwatershed 32).

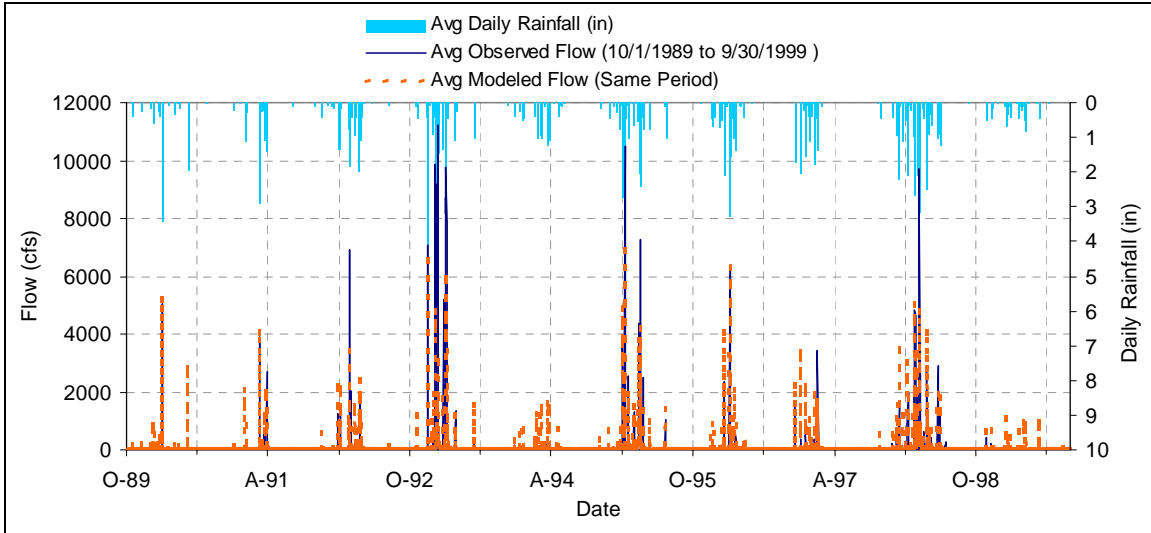


Figure B-1. Comparison of Modeled and Observed Daily Flows for Rio Hondo above Stuart and Gray Road.

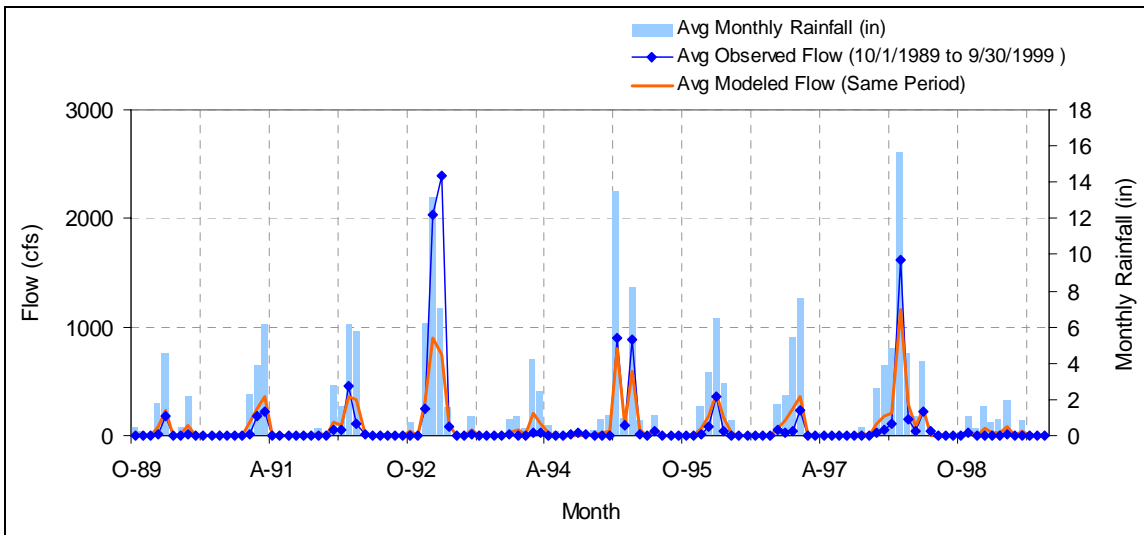


Figure B-2. Comparison of Modeled and Observed Average Monthly Flows for Rio Hondo above Stuart and Gray Road.

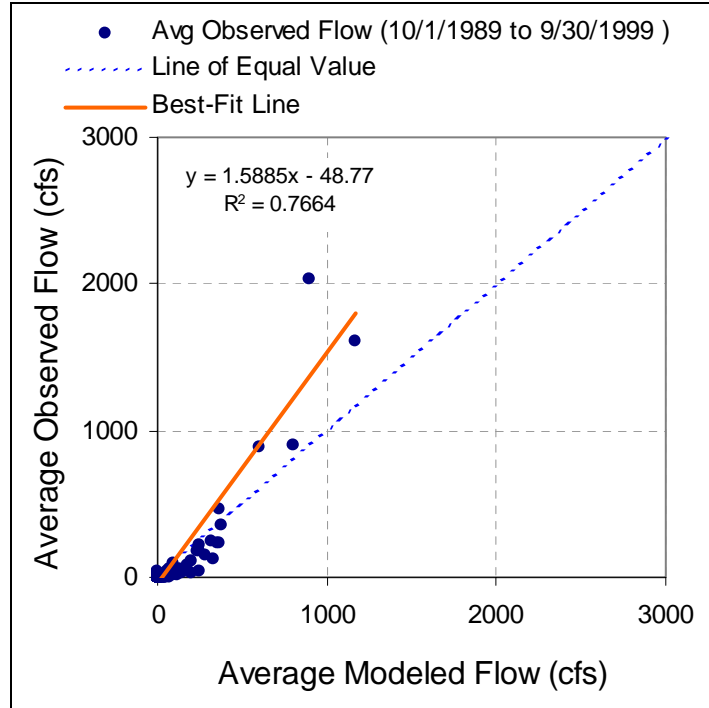


Figure B-3. Regression of Modeled and Observed Average Monthly Flows for Rio Hondo above Stuart and Gray Road.

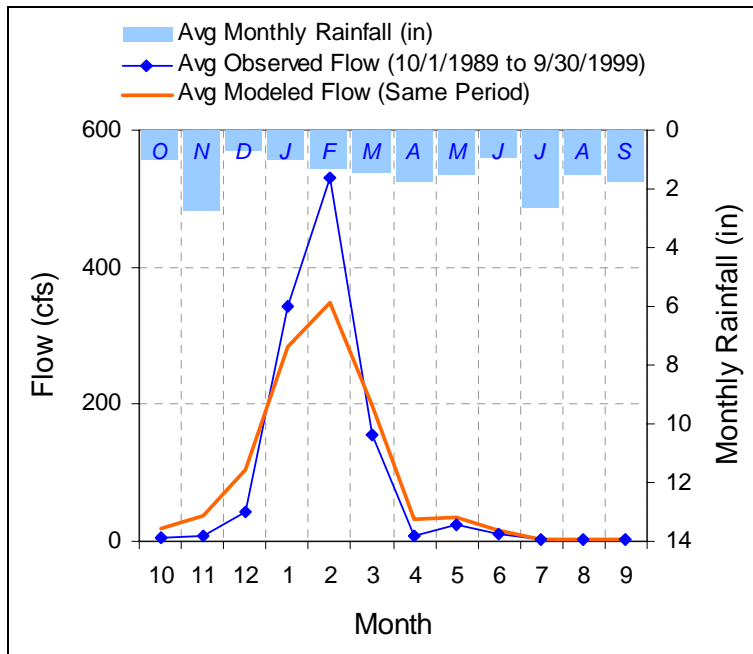


Figure B-4. Seasonal Variation of Modeled and Observed Flows for Rio Hondo above Stuart and Gray Road.

Table B-1. Volumes and Relative Error of Modeled Flows Versus Observed Flows for Rio Hondo above Stuart and Gray Road.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 32 10-Year Analysis Period: 10/1/1989 - 9/30/1999 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F45B-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	64,476	Total Observed In-stream Flow:	66,723
Total of simulated highest 10% flows:	61,802	Total of Observed highest 10% flows:	65,947
Total of Simulated lowest 50% flows:	544	Total of Observed Lowest 50% flows:	75
Simulated Summer Flow Volume (months 7-9):	458	Observed Summer Flow Volume (7-9):	422
Simulated Fall Flow Volume (months 10-12):	9,814	Observed Fall Flow Volume (10-12):	3,510
Simulated Winter Flow Volume (months 1-3):	49,101	Observed Winter Flow Volume (1-3):	60,202
Simulated Spring Flow Volume (months 4-6):	5,104	Observed Spring Flow Volume (4-6):	2,589
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	-3.48	10	
Error in 50% lowest flows:	86.23	10	
Error in 10% highest flows:	-6.71	15	
Seasonal volume error - Summer:	7.91	30	
Seasonal volume error - Fall:	64.23	30	
Seasonal volume error - Winter:	-22.61	30	
Seasonal volume error - Spring:	49.28	30	

Hydrology Calibration for the Los Angeles River at Tujunga Avenue (gage F300-R, model subwatershed 18).

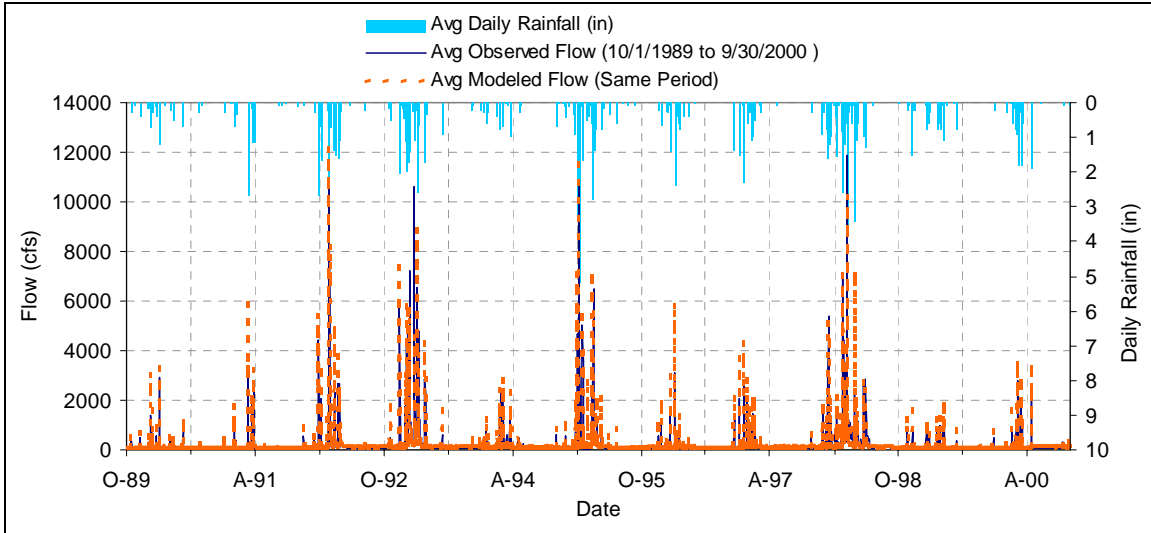


Figure B-5. Comparison of Modeled and Observed Daily Flows for the LA River at Tujunga Avenue.

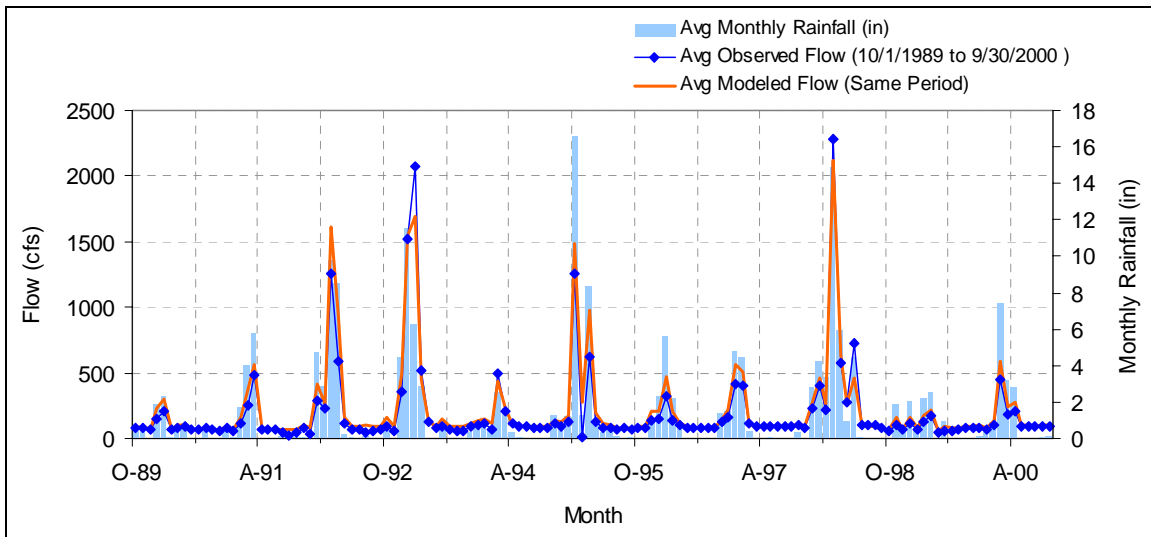


Figure B-6. Comparison of Modeled and Observed Average Monthly Flows for the LA River at Tujunga Avenue.

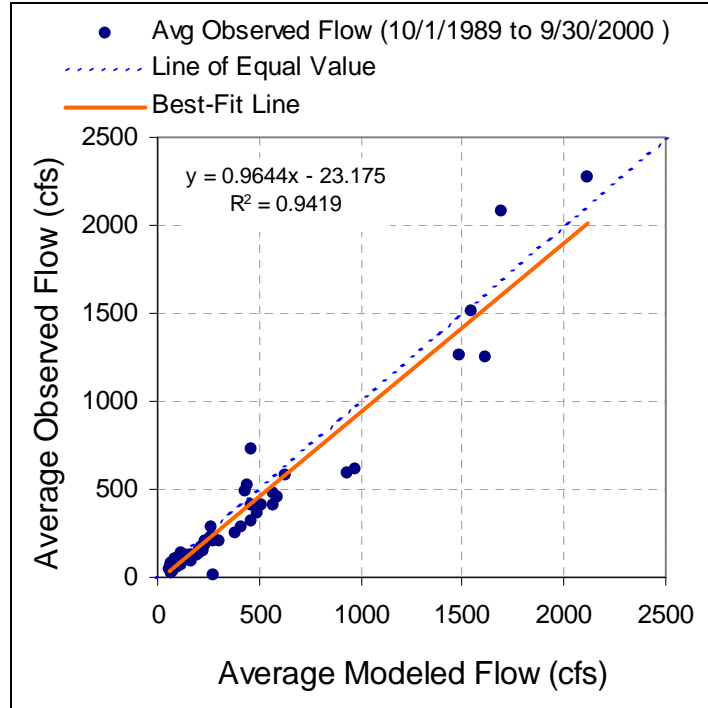


Figure B-7. Regression of Modeled and Observed Average Monthly Flows for the LA River at Tujunga Avenue.

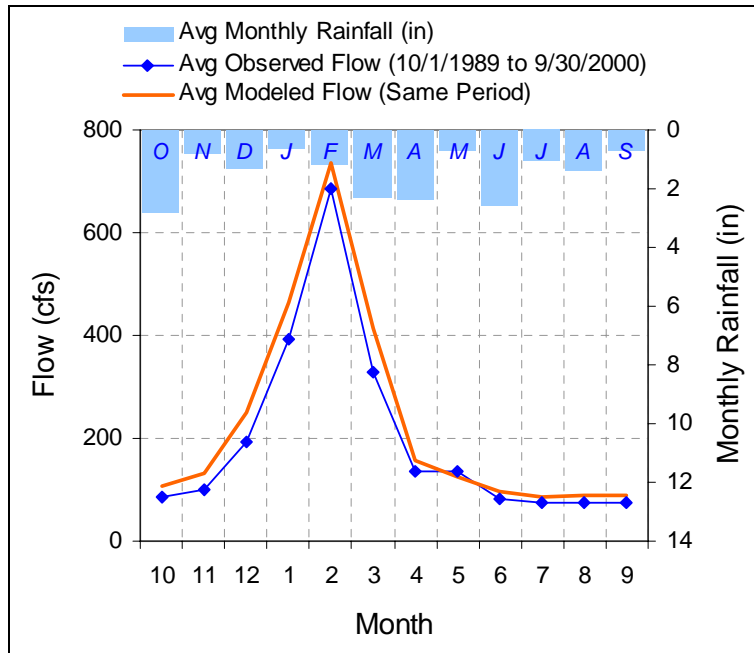


Figure B-8. Seasonal Variation of Modeled and Observed Flows for the LA River at Tujunga Avenue.

Table B-2. Volumes and Relative Error of Modeled Flows Versus Observed Flows for the LA River at Tujunga Wash.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 18 11-Year Analysis Period: 10/1/1989 - 9/30/2000 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F300-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	163,562	Total Observed In-stream Flow:	140,805
Total of simulated highest 10% flows:	105,868	Total of Observed highest 10% flows:	90,014
Total of Simulated lowest 50% flows:	27,168	Total of Observed Lowest 50% flows:	22,446
Simulated Summer Flow Volume (months 7-9):	15,812	Observed Summer Flow Volume (7-9):	13,531
Simulated Fall Flow Volume (months 10-12):	29,827	Observed Fall Flow Volume (10-12):	23,069
Simulated Winter Flow Volume (months 1-3):	95,254	Observed Winter Flow Volume (1-3):	82,831
Simulated Spring Flow Volume (months 4-6):	22,670	Observed Spring Flow Volume (4-6):	21,375
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	13.91	10	
Error in 50% lowest flows:	17.38	10	
Error in 10% highest flows:	14.97	15	
Seasonal volume error - Summer:	14.43	30	
Seasonal volume error - Fall:	22.66	30	
Seasonal volume error - Winter:	13.04	30	
Seasonal volume error - Spring:	5.71	30	

Hydrology Validation for Burbank Western Storm Drain at Riverside Drive (gage F285-R, model subwatershed 19).

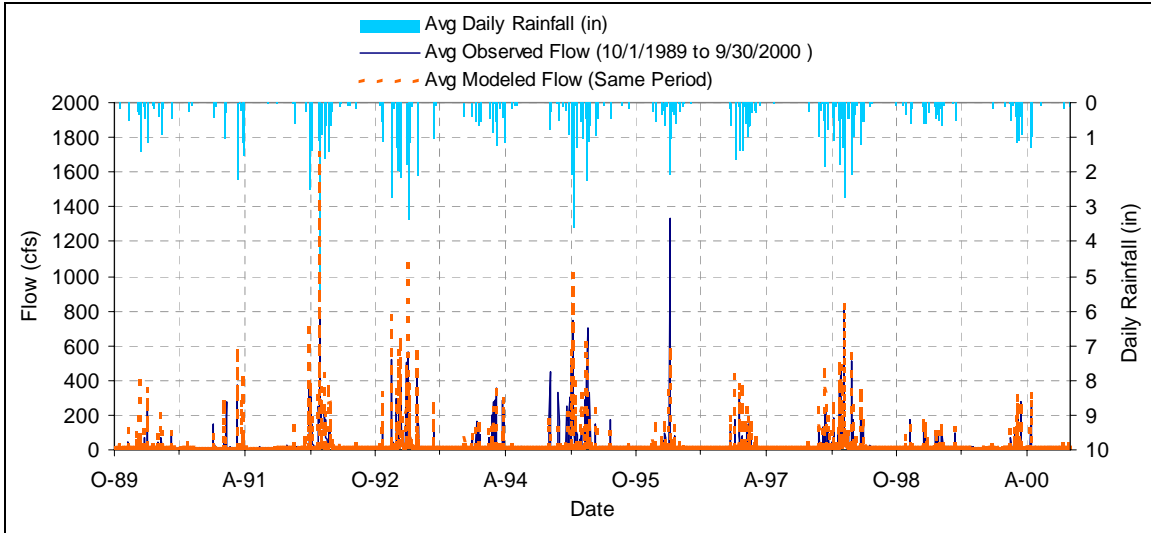


Figure B-9. Comparison of Modeled and Observed Daily Flows for Burbank Western Storm Drain at Riverside Drive.

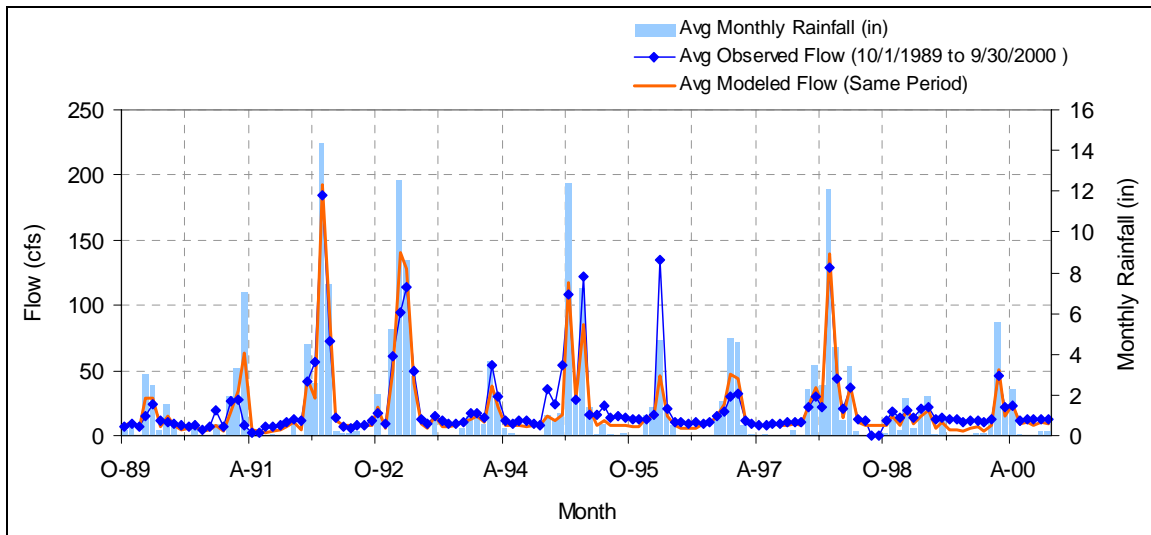


Figure B-10. Comparison of Modeled and Observed Average Monthly Flows for Burbank Western Storm Drain at Riverside Drive.

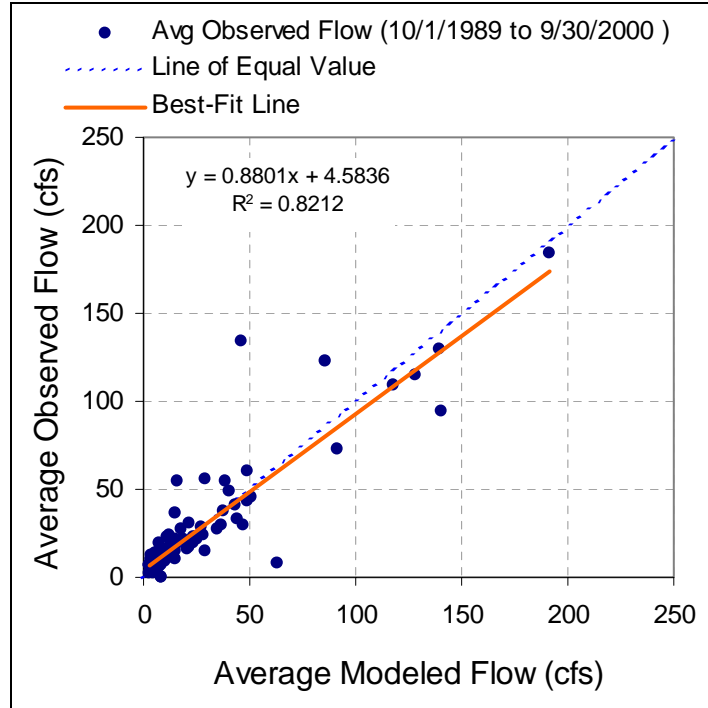


Figure B-11. Regression of Modeled and Observed Average Monthly Flows for Burbank Western Storm Drain at Riverside Drive.

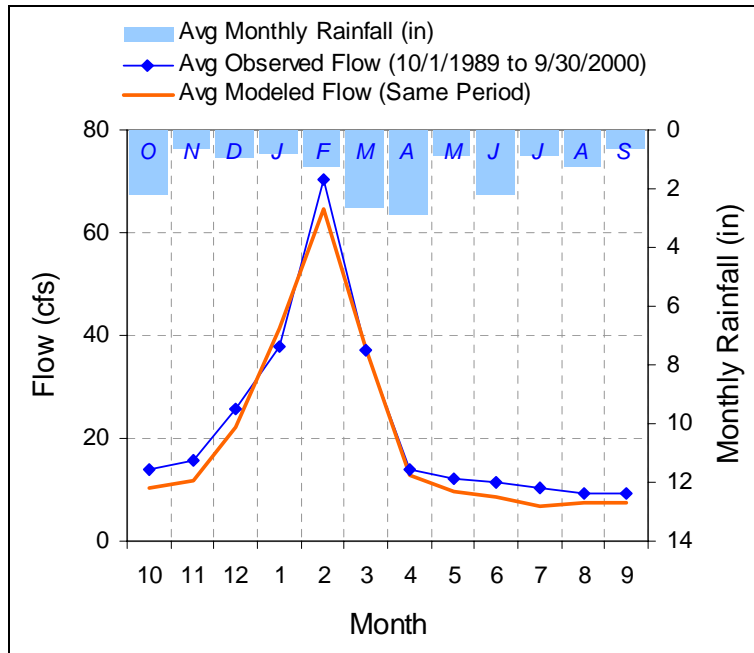


Figure B-12. Seasonal Variation of Modeled and Observed Flows for Burbank Western Storm Drain at Riverside Drive.

Table B-3. Volumes and Relative Error of Modeled Flows Versus Observed Flows for Burbank Western Storm Drain at Riverside Drive.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 19 11-Year Analysis Period: 10/1/1989 - 9/30/2000 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F285-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	14,372	Total Observed In-stream Flow:	15,945
Total of simulated highest 10% flows:	9,812	Total of Observed highest 10% flows:	9,232
Total of Simulated lowest 50% flows:	2,037	Total of Observed Lowest 50% flows:	2,870
Simulated Summer Flow Volume (months 7-9):	1,315	Observed Summer Flow Volume (7-9):	1,748
Simulated Fall Flow Volume (months 10-12):	2,690	Observed Fall Flow Volume (10-12):	3,381
Simulated Winter Flow Volume (months 1-3):	8,491	Observed Winter Flow Volume (1-3):	8,559
Simulated Spring Flow Volume (months 4-6):	1,877	Observed Spring Flow Volume (4-6):	2,256
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	-10.94	10	
Error in 50% lowest flows:	-40.94	10	
Error in 10% highest flows:	5.91	15	
Seasonal volume error - Summer:	-32.95	30	
Seasonal volume error - Fall:	-25.69	30	
Seasonal volume error - Winter:	-0.81	30	
Seasonal volume error - Spring:	-20.20	30	

Hydrology Validation for Compton Creek near Greenleaf Drive (gage F37B-R, model subwatershed 33).

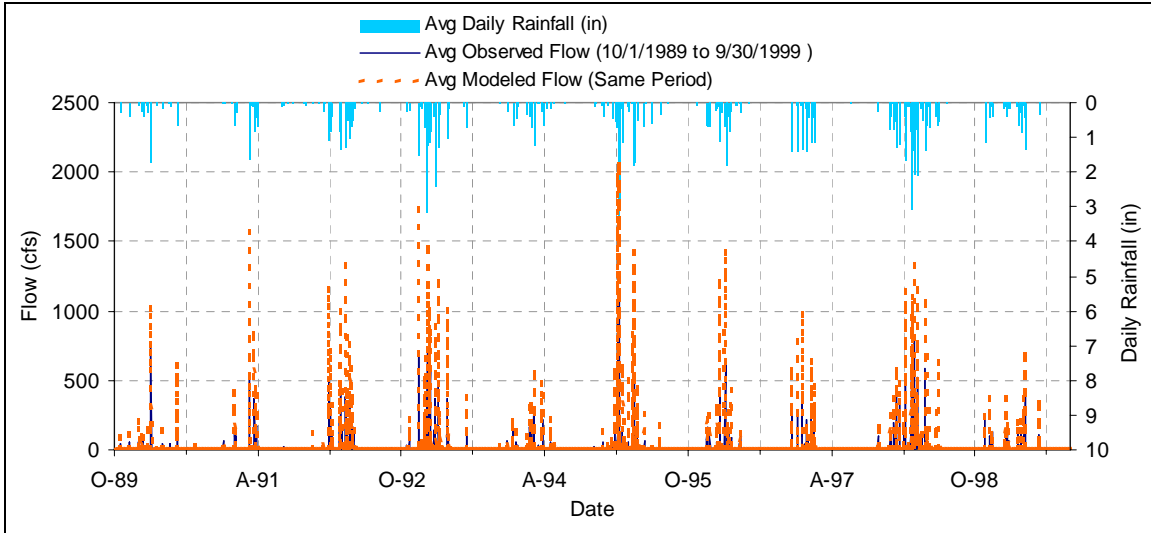


Figure B-13. Comparison of Modeled and Observed Daily Flows for Compton Creek near Greenleaf Drive.

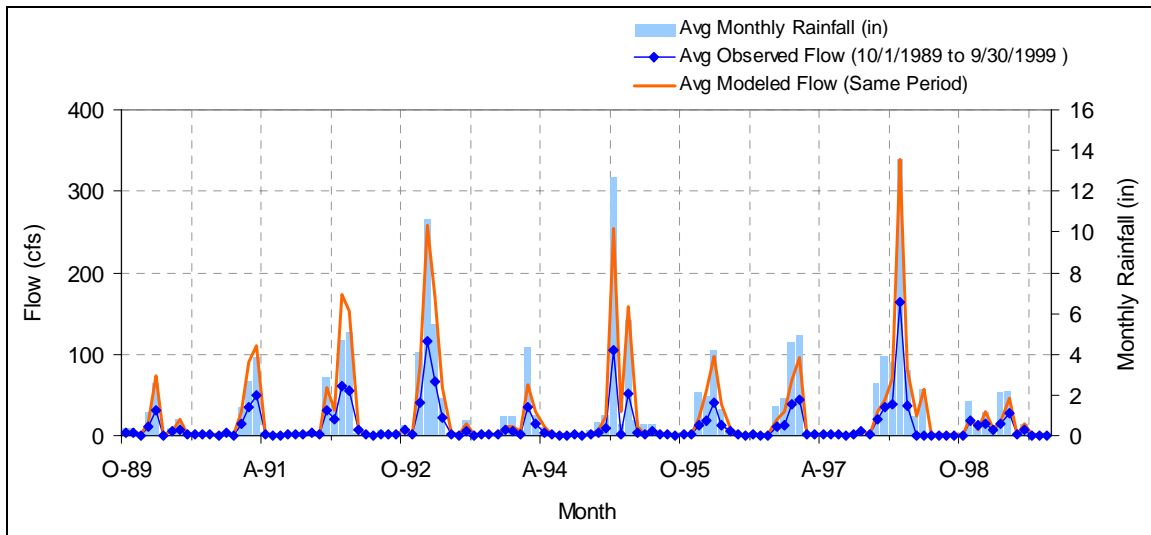


Figure B-14. Comparison of Modeled and Observed Average Monthly Flows for Compton Creek near Greenleaf Drive.

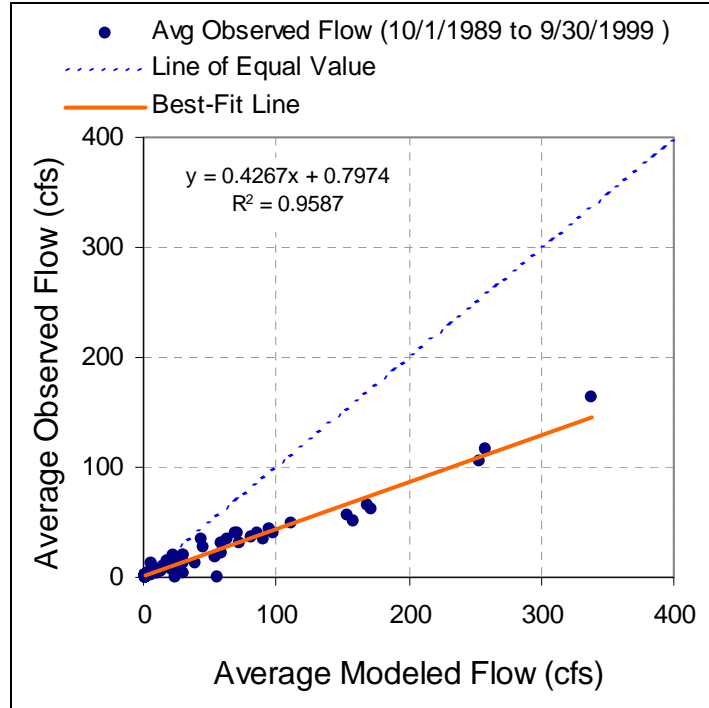


Figure B-15. Regression of Modeled and Observed Average Monthly Flows for Compton Creek near Greenleaf Drive.

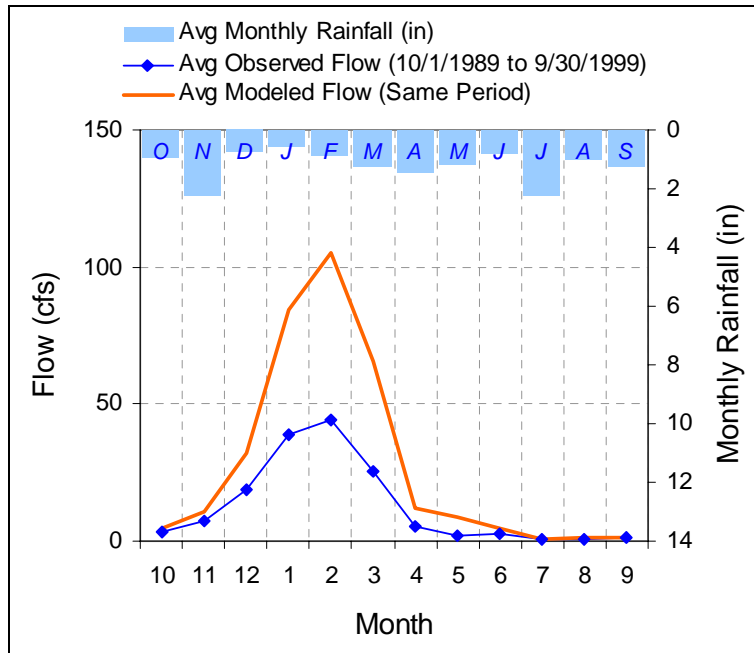


Figure B-16. Seasonal Variation of Modeled and Observed Flows for Compton Creek near Greenleaf Drive.

Table B-4. Volumes and Relative Error of Modeled Flows Versus Observed Flows for Compton Creek near Greenleaf Drive.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 33 10-Year Analysis Period: 10/1/1989 - 9/30/1999 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F37B-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	19,741	Total Observed In-stream Flow:	9,002
Total of simulated highest 10% flows:	18,842	Total of Observed highest 10% flows:	7,998
Total of Simulated lowest 50% flows:	362	Total of Observed Lowest 50% flows:	263
Simulated Summer Flow Volume (months 7-9):	224	Observed Summer Flow Volume (7-9):	206
Simulated Fall Flow Volume (months 10-12):	2,923	Observed Fall Flow Volume (10-12):	1,779
Simulated Winter Flow Volume (months 1-3):	15,072	Observed Winter Flow Volume (1-3):	6,434
Simulated Spring Flow Volume (months 4-6):	1,522	Observed Spring Flow Volume (4-6):	582
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	54.40	10	
Error in 50% lowest flows:	27.44	10	
Error in 10% highest flows:	57.55	15	
Seasonal volume error - Summer:	8.04	30	
Seasonal volume error - Fall:	39.12	30	
Seasonal volume error - Winter:	57.31	30	
Seasonal volume error - Spring:	61.74	30	

Hydrology Validation for Verdugo Wash at Estelle Avenue (gage F252-R, model subwatershed 21).

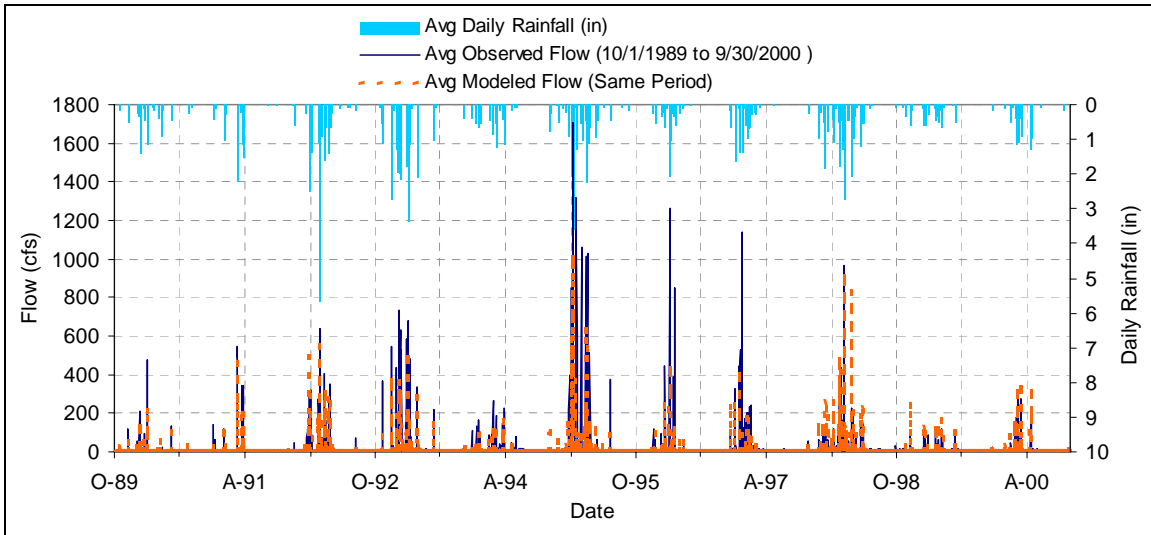


Figure B-17. Comparison of Modeled and Observed Daily Flows for Verdugo Wash at Estelle Avenue.

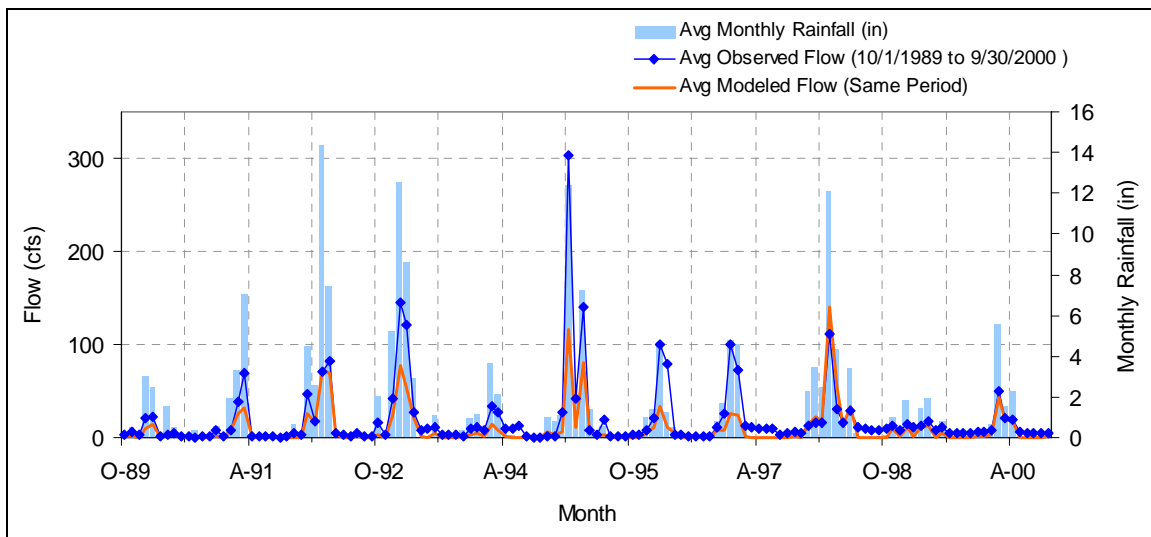


Figure B-18. Comparison of Modeled and Observed Average Monthly Flows for Verdugo Wash at Estelle Avenue.

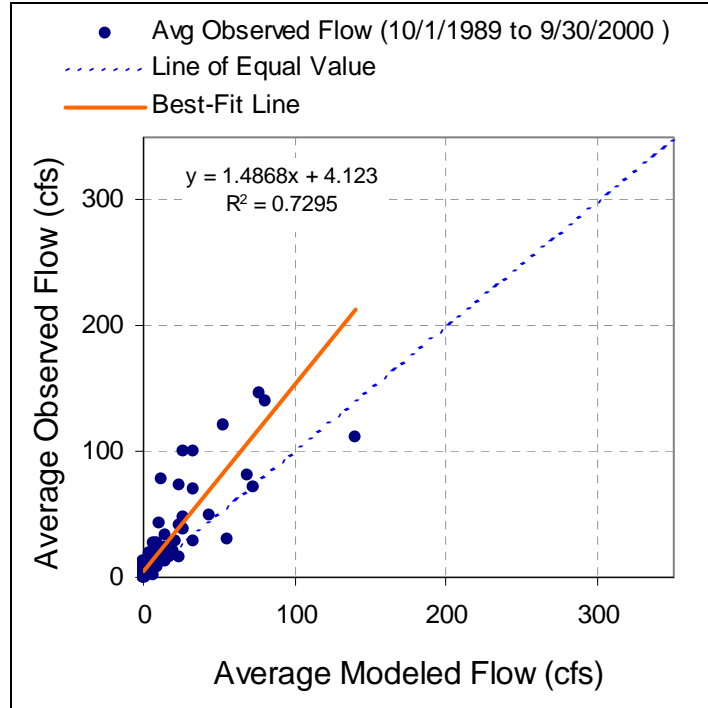


Figure B-19. Regression of Modeled and Observed Average Monthly Flows for Verdugo Wash at Estelle Avenue.

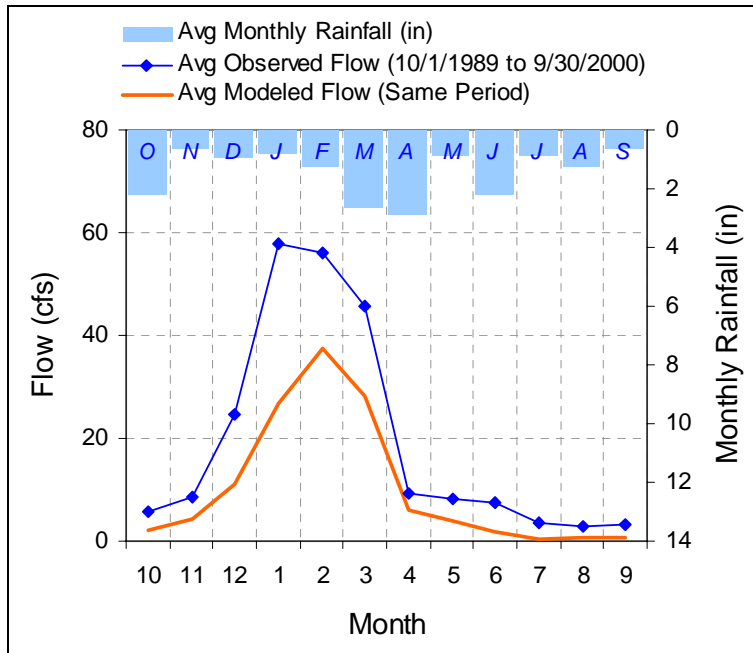


Figure B-20. Seasonal Variation of Modeled and Observed Flows for Verdugo Wash at Estelle Avenue.

Table B-5. Volumes and Relative Error of Modeled Flows Versus Observed Flows for Verdugo Wash at Estelle Avenue.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 21 11-Year Analysis Period: 10/1/1989 - 9/30/2000 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F252-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	7,372	Total Observed In-stream Flow:	13,981
Total of simulated highest 10% flows:	6,906	Total of Observed highest 10% flows:	10,971
Total of Simulated lowest 50% flows:	181	Total of Observed Lowest 50% flows:	705
Simulated Summer Flow Volume (months 7-9):	109	Observed Summer Flow Volume (7-9):	593
Simulated Fall Flow Volume (months 10-12):	1,069	Observed Fall Flow Volume (10-12):	2,373
Simulated Winter Flow Volume (months 1-3):	5,489	Observed Winter Flow Volume (1-3):	9,518
Simulated Spring Flow Volume (months 4-6):	706	Observed Spring Flow Volume (4-6):	1,498
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	-89.65	10	
Error in 50% lowest flows:	-289.24	10	
Error in 10% highest flows:	-58.85	15	
Seasonal volume error - Summer:	-444.11	30	
Seasonal volume error - Fall:	-122.01	30	
Seasonal volume error - Winter:	-73.40	30	
Seasonal volume error - Spring:	-112.27	30	

Hydrology Validation for the Los Angeles River above Arroyo Seco (gage F57C-R, model subwatershed 24).

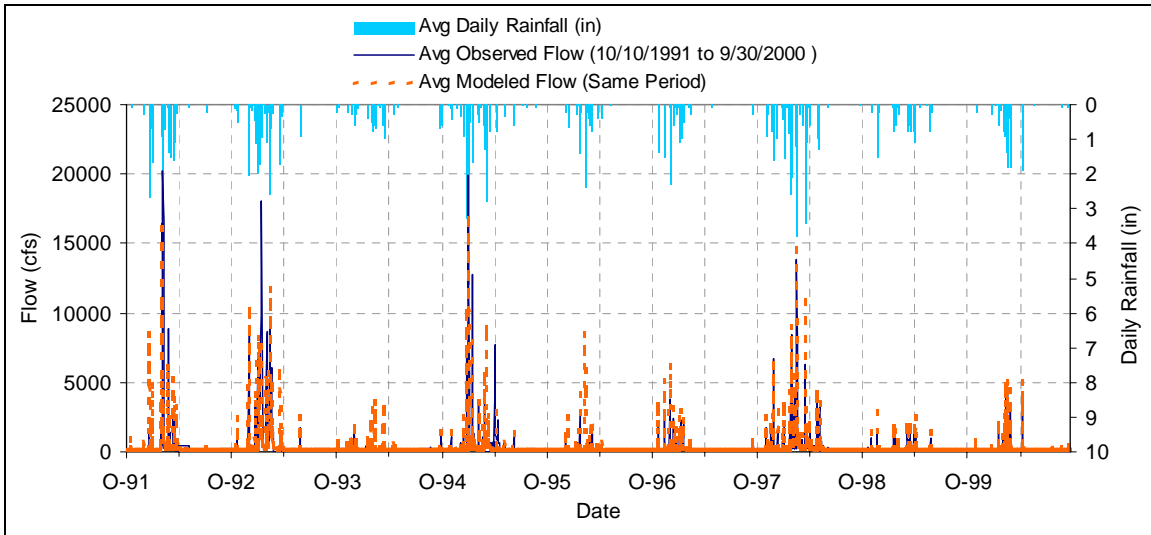


Figure B-21. Comparison of Modeled and Observed Daily Flows for the LA River above Arroyo Seco.

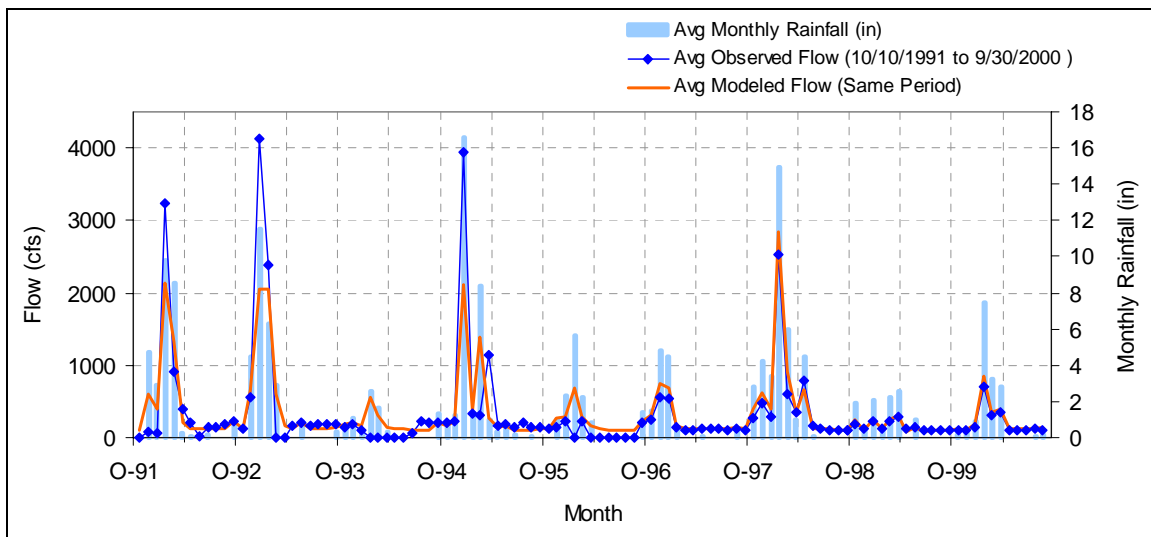


Figure B-22. Comparison of Modeled and Observed Average Monthly Flows for the LA River above Arroyo Seco.

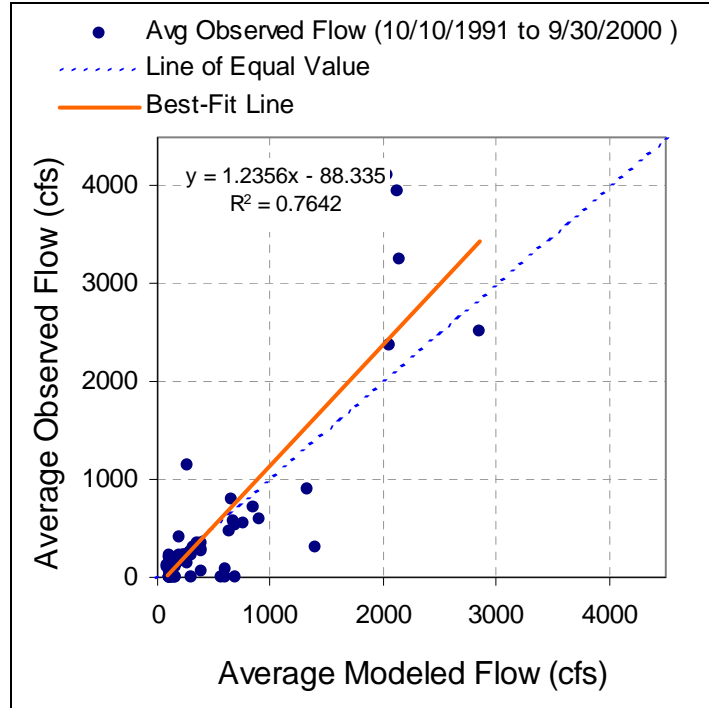


Figure B-23. Regression of Modeled and Observed Average Monthly Flows for the LA River above Arroyo Seco.

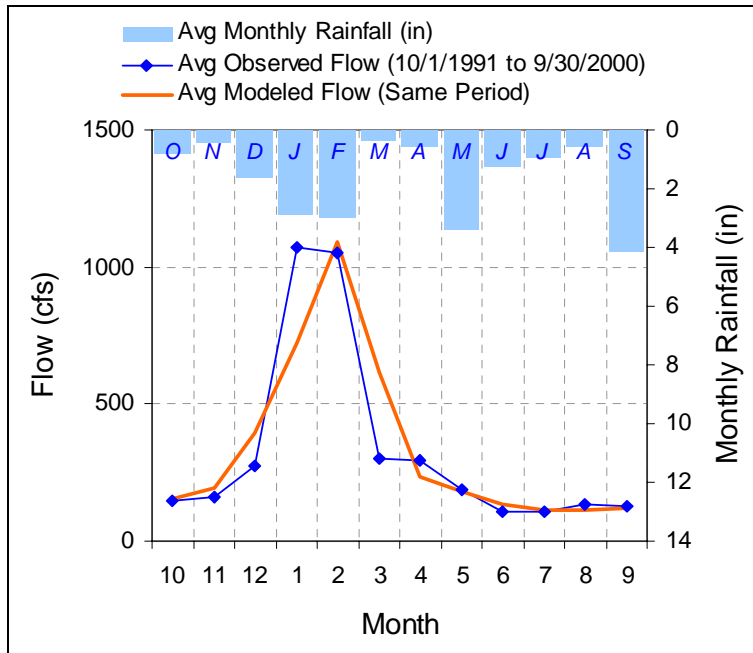


Figure B-24. Seasonal Variation of Modeled and Observed Flows for the LA River above Arroyo Seco.

Table B-6. Volumes and Relative Error of Modeled Flows Versus Observed Flows for the LA River above Arroyo Seco.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 24 8.98-Year Analysis Period: 10/1/1991 - 9/30/2000 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F57C-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	244,224	Total Observed In-stream Flow:	237,715
Total of simulated highest 10% flows:	162,094	Total of Observed highest 10% flows:	165,321
Total of Simulated lowest 50% flows:	39,253	Total of Observed Lowest 50% flows:	23,418
Simulated Summer Flow Volume (months 7-9):	21,405	Observed Summer Flow Volume (7-9):	22,681
Simulated Fall Flow Volume (months 10-12):	45,527	Observed Fall Flow Volume (10-12):	35,238
Simulated Winter Flow Volume (months 1-3):	144,081	Observed Winter Flow Volume (1-3):	144,062
Simulated Spring Flow Volume (months 4-6):	33,210	Observed Spring Flow Volume (4-6):	35,734
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	2.67	10	
Error in 50% lowest flows:	40.34	10	
Error in 10% highest flows:	-1.99	15	
Seasonal volume error - Summer:	-5.96	30	
Seasonal volume error - Fall:	22.60	30	
Seasonal volume error - Winter:	0.01	30	
Seasonal volume error - Spring:	-7.60	30	

Hydrology Validation for the Los Angeles River below Firestone Boulevard (gage F34D-R, model subwatershed 25).

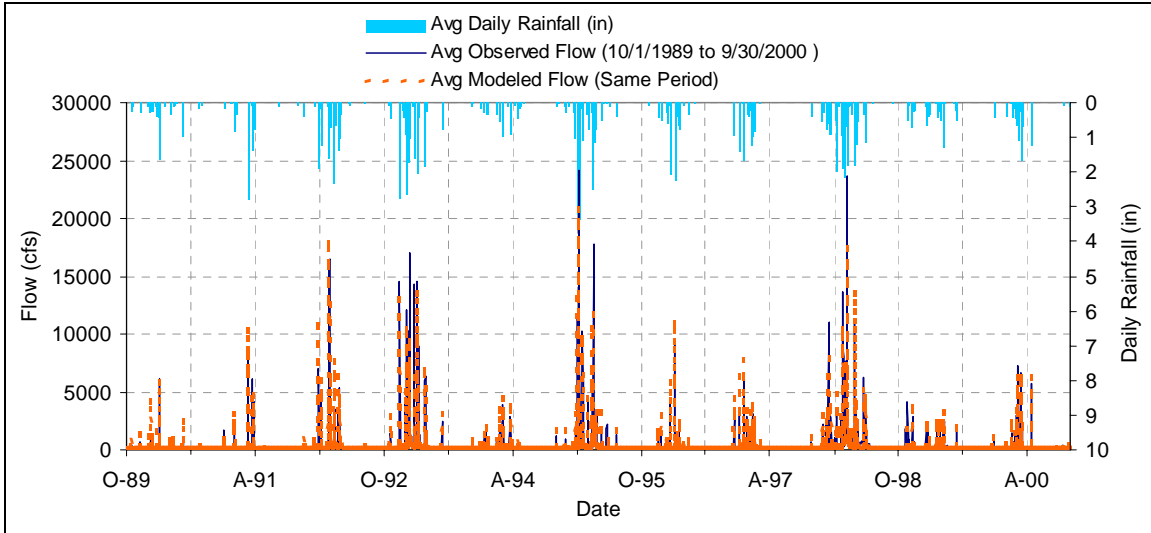


Figure B-25. Comparison of Modeled and Observed Daily Flows for the LA River below Firestone Boulevard.

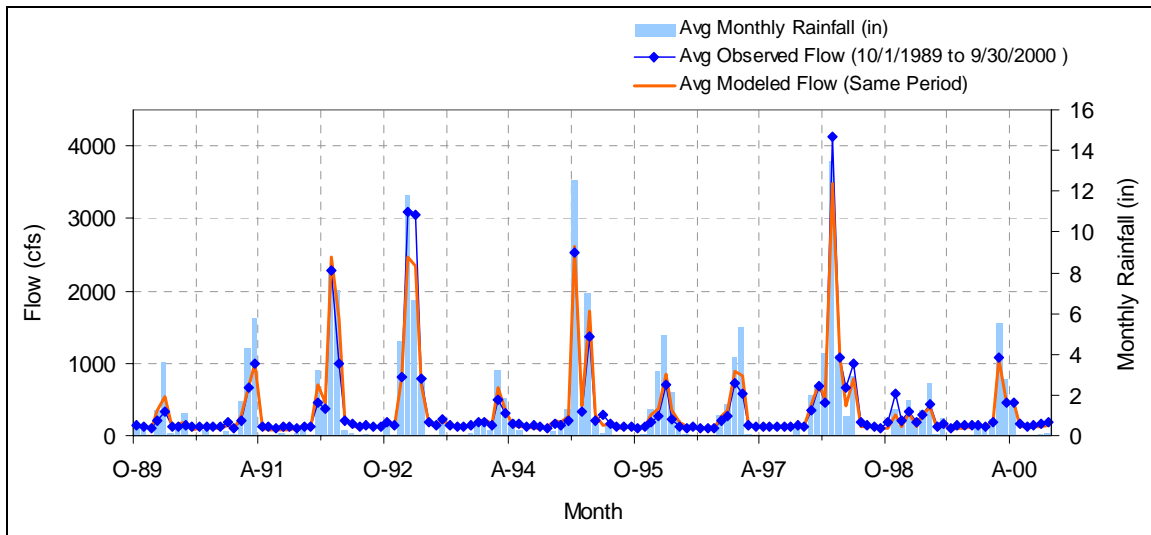


Figure B-26. Comparison of Modeled and Observed Average Monthly Flows for the LA River below Firestone Boulevard.

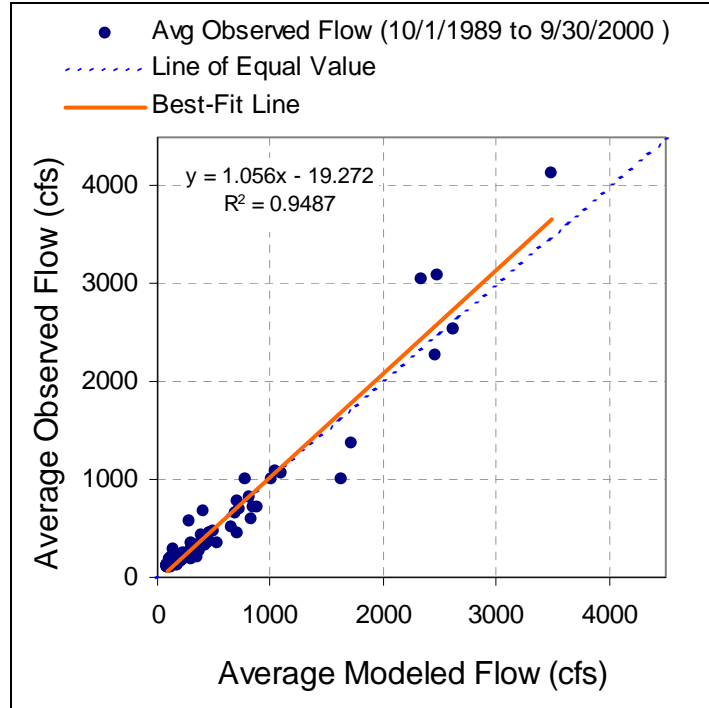


Figure B-27. Regression of Modeled and Observed Average Monthly Flows for the LA River below Firestone Boulevard.

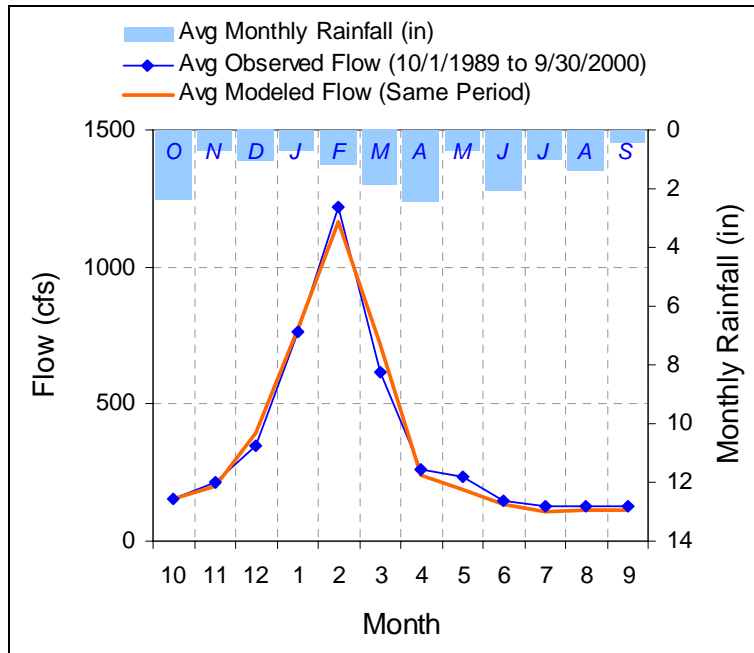


Figure B-28. Seasonal Variation of Modeled and Observed Flows for the LA River below Firestone Boulevard.

Table B-7. Volumes and Relative Error of Modeled Flows Versus Observed Flows for the LA River below Firestone Boulevard.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 25 11-Year Analysis Period: 10/1/1989 - 9/30/2000 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F34D-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	257,666	Total Observed In-stream Flow:	257,817
Total of simulated highest 10% flows:	179,186	Total of Observed highest 10% flows:	170,343
Total of Simulated lowest 50% flows:	37,341	Total of Observed Lowest 50% flows:	40,980
Simulated Summer Flow Volume (months 7-9):	20,791	Observed Summer Flow Volume (7-9):	22,834
Simulated Fall Flow Volume (months 10-12):	45,916	Observed Fall Flow Volume (10-12):	43,477
Simulated Winter Flow Volume (months 1-3):	157,209	Observed Winter Flow Volume (1-3):	153,070
Simulated Spring Flow Volume (months 4-6):	33,751	Observed Spring Flow Volume (4-6):	38,436
<i>Errors (Simulated-Observed)</i>	<i>Current Run (n)</i>	<i>Recommended Criteria</i>	
Error in total volume:	-0.06	10	
Error in 50% lowest flows:	-9.75	10	
Error in 10% highest flows:	4.93	15	
Seasonal volume error - Summer:	-9.82	30	
Seasonal volume error - Fall:	5.31	30	
Seasonal volume error - Winter:	2.63	30	
Seasonal volume error - Spring:	-13.88	30	

Hydrology Validation for the Los Angeles River below Wardlow River Road (gage F319-R, model subwatershed 35).

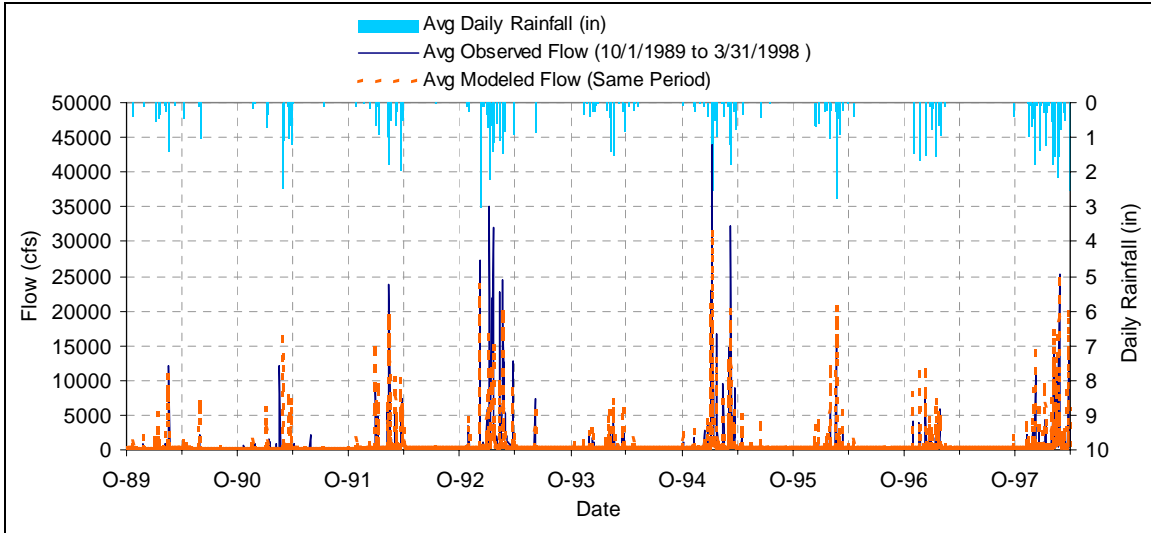


Figure B-29. Comparison of Modeled and Observed Daily Flows for the LA River below Wardlow River Road.

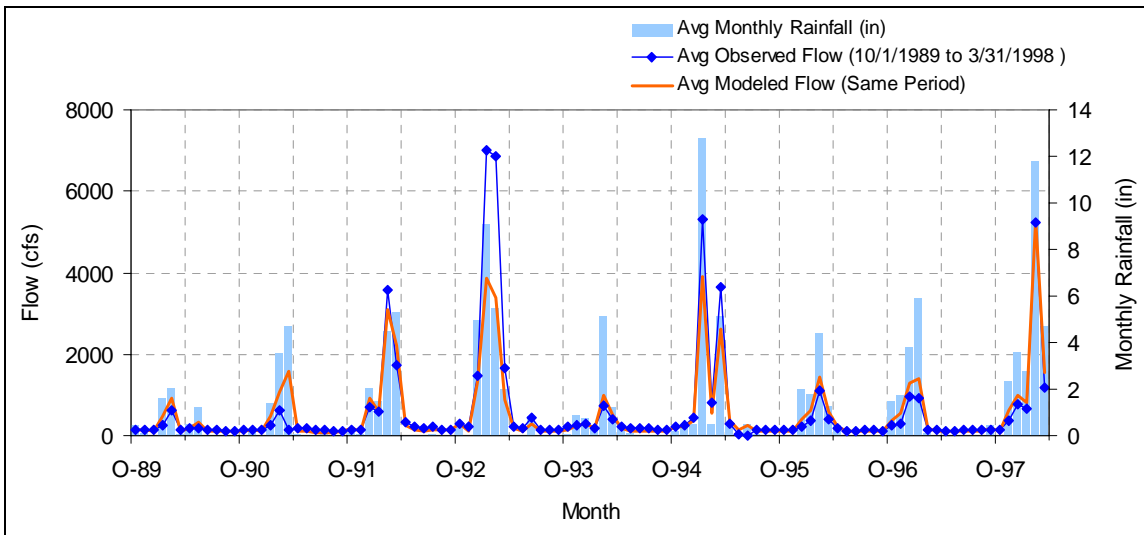


Figure B-30. Comparison of Modeled and Observed Average Monthly Flows for the LA River below Wardlow River Road.

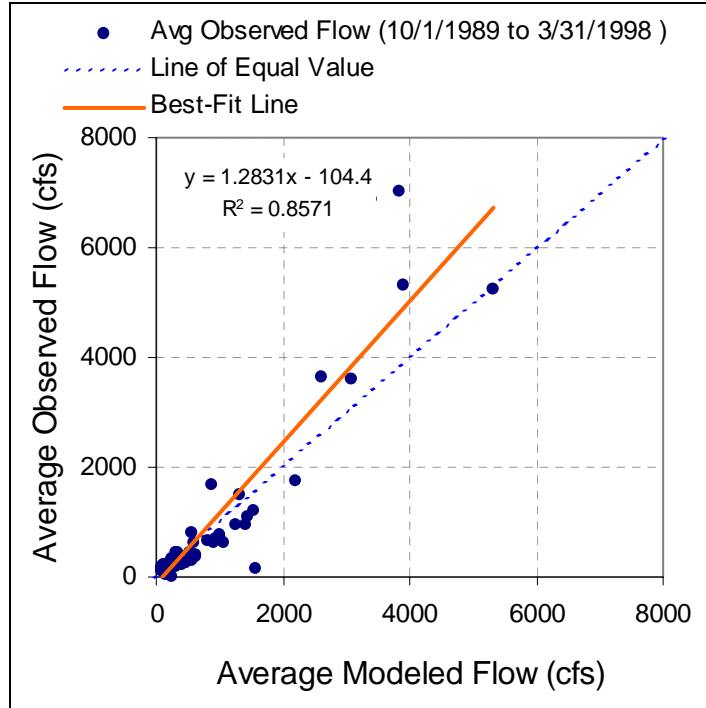


Figure B-31. Regression of Modeled and Observed Average Monthly Flows for the LA River below Wardlow River Road.

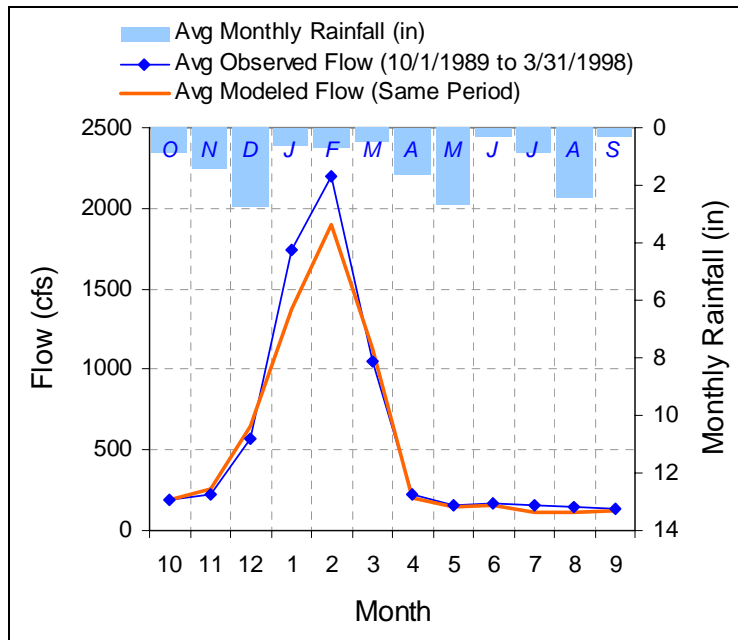


Figure B-32. Seasonal Variation of Modeled and Observed Flows for the LA River below Wardlow River Road.

Table B-8. Volumes and Relative Error of Modeled Flows Versus Observed Flows for the LA River below Wardlow River Road.

LSPC Simulated Flow		Observed Flow Gage	
REACH OUTFLOW FROM SUBBASIN 35 8.5-Year Analysis Period: 10/1/1989 - 3/31/1998 Flow volumes are (inches/year) for upstream drainage area		Flow Gage F319-R Los Angeles, CA	
	Volume (acre-ft)		Volume (acre-ft)
Total Simulated In-stream Flow:	394,911	Total Observed In-stream Flow:	431,200
Total of simulated highest 10% flows:	307,787	Total of Observed highest 10% flows:	320,578
Total of Simulated lowest 50% flows:	39,309	Total of Observed Lowest 50% flows:	46,158
Simulated Summer Flow Volume (months 7-9):	20,205	Observed Summer Flow Volume (7-9):	24,797
Simulated Fall Flow Volume (months 10-12):	70,661	Observed Fall Flow Volume (10-12):	63,764
Simulated Winter Flow Volume (months 1-3):	275,206	Observed Winter Flow Volume (1-3):	311,727
Simulated Spring Flow Volume (months 4-6):	28,840	Observed Spring Flow Volume (4-6):	30,912
<i>Errors (Simulated-Observed)</i>	<i>Error (%)</i>	<i>Recommended Criteria</i>	
Error in total volume:	-9.19	10	
Error in 50% lowest flows:	-17.42	10	
Error in 10% highest flows:	-4.16	15	
Seasonal volume error - Summer:	-22.73	30	
Seasonal volume error - Fall:	9.76	30	
Seasonal volume error - Winter:	-13.27	30	
Seasonal volume error - Spring:	-7.19	30	

Table B-9. Hydrology Model Parameters Used for Modeling the LA River Watershed.

Pervious Parameters	Parameter Code	Units	Land Use*					
			AGR	FOR	RES	COM	IND	OTH
Soil Group C								
Fraction of Remaining E-T from Active Groundwater	AGWETP	none	0.05	0.04	0.04	0.04	0.04	0.04
Daily Base Groundwater Recession	AGWRC	none	0.97	0.98	0.965	0.965	0.965	0.965
Fraction of Remaining E-T from Baseflow	BASETP	none	0.05	0.05	0.05	0.05	0.05	0.05
Interception Storage Capacity	CEPSC	inches	0.23	0.27	0.17	0.17	0.17	0.17
Fraction of Groundwater to Deep Aquifer	DEEPFR	none	0.45	0.75	0.4	0.4	0.4	0.4
Infiltration Equation Exponent	INFEXP	none	2	2	2	2	2	2
Ratio Between Maximum and Mean Infiltration Capacities	INFILD	none	2	2	2	2	2	2
Infiltration Capacity of the Soil	INFILT	inches/hr	0.17	0.17	0.17	0.17	0.17	0.17
Interflow Inflow Parameter	INTFW	none	2	2	2	2	2	2
Interflow Recession Parameter (oer day)	IRC	none	0.7	0.7	0.6	0.6	0.6	0.6
Groundwater Recession	KVARY	1/inches	3	3	3	3	3	3
Length of Overland Flow Plane	LSUR	feet	300	300	300	300	300	300
Lower Zone E-T Parameter	LZETP	none	0.7	0.78	0.5	0.5	0.5	0.5
Lower Zone Nominal Storage	LZSN	inches	11	13.4	9	9	9	9
Manning's n for Overland Flow Plane	NSUR	none	0.25	0.35	0.2	0.2	0.2	0.2
Temperature Below which E-T is Reduced	PETMAX	deg F	35	35	35	35	35	35
Temperature Below which E-T is Zero	PETMIN	deg F	30	30	30	30	30	30
Slope of Overland Flow Plane	SLSUR	none	0.05	0.05	0.05	0.05	0.05	0.05
Upper Zone Nominal Storage	UZSN	inches	0.7	0.82	0.6	0.6	0.6	0.6
Soil Group D								
Fraction of Remaining E-T from Active Groundwater	AGWETP	none	0.05	0.04	0.04	0.04	0.04	0.04
Daily Base Groundwater Recession	AGWRC	none	0.97	0.98	0.965	0.965	0.965	0.965
Fraction of Remaining E-T from Baseflow	BASETP	none	0.05	0.05	0.05	0.05	0.05	0.05
Interception Storage Capacity	CEPSC	inches	0.23	0.27	0.17	0.17	0.17	0.17
Fraction of Groundwater to Deep Aquifer	DEEPFR	none	0.43	0.79	0.38	0.38	0.38	0.38
Infiltration Equation Exponent	INFEXP	none	2	2	2	2	2	2
Ratio Between Maximum and Mean Infiltration Capacities	INFILD	none	2	2	2	2	2	2
Infiltration Capacity of the Soil	INFILT	inches/hr	0.15	0.15	0.15	0.15	0.15	0.15
Interflow Inflow Parameter	INTFW	none	2	2	2	2	2	2
Interflow Recession Parameter (oer day)	IRC	none	0.7	0.7	0.6	0.6	0.6	0.6
Groundwater Recession	KVARY	1/inches	3	3	3	3	3	3
Length of Overland Flow Plane	LSUR	feet	300	300	300	300	300	300
Lower Zone E-T Parameter	LZETP	none	0.7	0.78	0.5	0.5	0.5	0.5
Lower Zone Nominal Storage	LZSN	inches	11	13.4	9	9	9	9
Manning's n for Overland Flow Plane	NSUR	none	0.25	0.35	0.2	0.2	0.2	0.2
Temperature Below which E-T is Reduced	PETMAX	deg F	35	35	35	35	35	35
Temperature Below which E-T is Zero	PETMIN	deg F	30	30	30	30	30	30
Slope of Overland Flow Plane	SLSUR	none	0.05	0.05	0.05	0.05	0.05	0.05
Upper Zone Nominal Storage	UZSN	inches	0.7	0.835	0.6	0.6	0.6	0.6
Impervious Parameters								
Impervious Parameters	Parameter Code	Units	Land Use					
			AGR	FOR	RES	COM	IND	OTH
Soil Group C								
Length of Overland Flow Plane	LSUR	feet	300	300	300	300	300	300
Manning's n for Overland Flow Plane	NSUR	None	0.06	0.06	0.06	0.06	0.06	0.06
Temperature Below which E-T is Reduced	PETMAX	deg F	35	35	35	35	35	35
Temperature Below which E-T is Zero	PETMIN	deg F	30	30	30	30	30	30
Retention Storage Capacity of the Surface	RETSC	inches	0.1	0.1	0.1	0.1	0.1	0.1
Slope of Overland Flow Plane	SLSUR	None	0.05	0.05	0.05	0.05	0.05	0.05
Soil Group D								
Length of Overland Flow Plane	LSUR	feet	300	300	300	300	300	300
Manning's n for Overland Flow Plane	NSUR	none	0.06	0.06	0.06	0.06	0.06	0.06
Temperature Below which E-T is Reduced	PETMAX	deg F	35	35	35	35	35	35
Temperature Below which E-T is Zero	PETMIN	deg F	30	30	30	30	30	30
Retention Storage Capacity of the Surface	RETSC	inches	0.1	0.1	0.1	0.1	0.1	0.1
Slope of Overland Flow Plane	SLSUR	none	0.05	0.05	0.05	0.05	0.05	0.05

* Land Use Codes: AGR = Agriculture; FOR = Forest / Open; RES = Residential; COM = Commercial; IND = Industrial; OTH = Other