Appendix C:
Hydrology Calibration and Validation Results

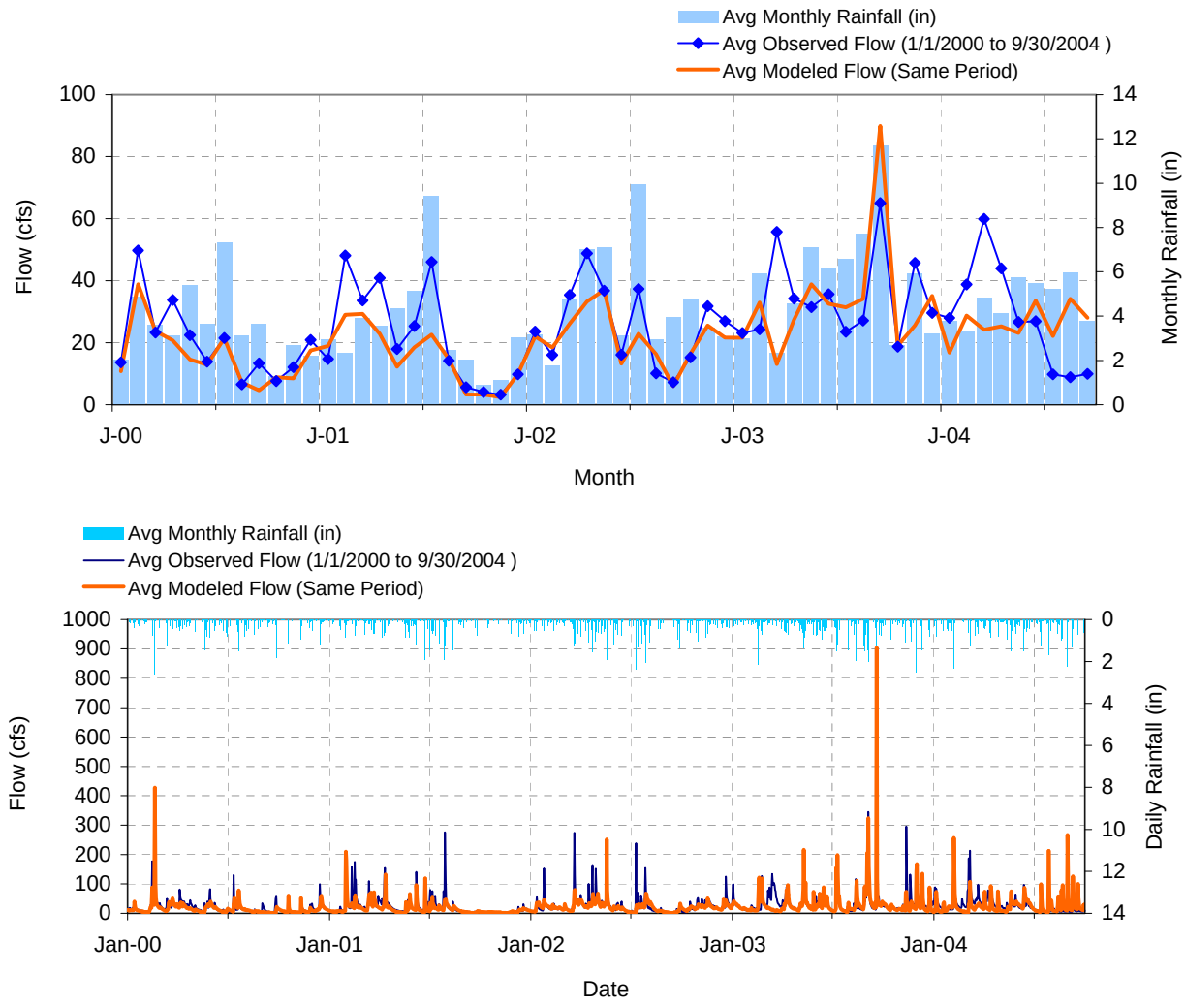

Figure C-1. Daily validation plot for USGS 01594930

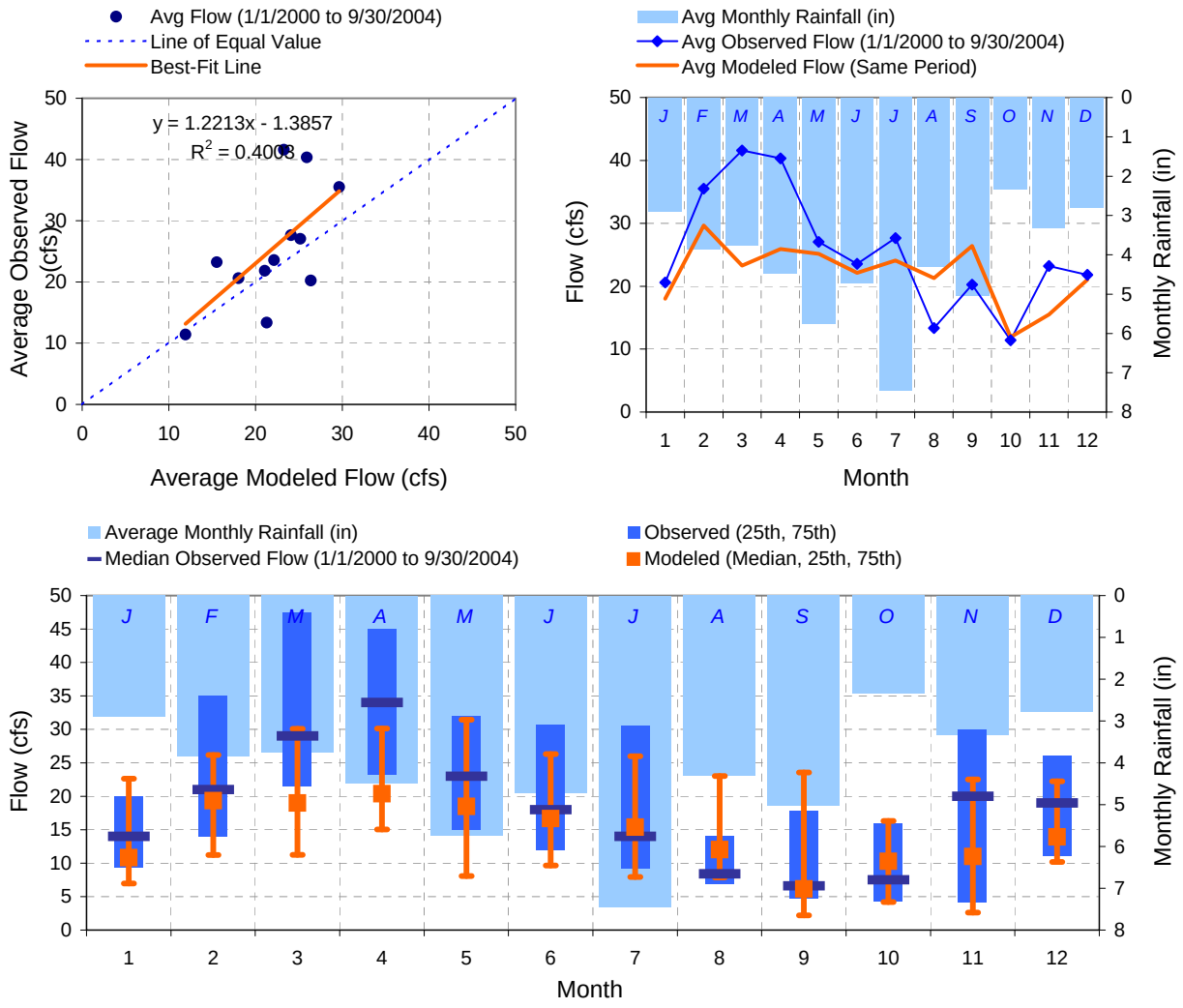

Figure C-2. Validation plot for USGS 01594930

Table C-1. Validation summary for USGS 01594930

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 302 4.75-Year Analysis Period: 1/1/2000 - 9/30/2004 Flow volumes are (inches/year) for upstream drainage area		USGS 01594930 LAUREL RUN AT DOBBIN RD NEAR WILSON, MD Hydrologic Unit Code: 2070002 Latitude: 39.2436111 Longitude: -79.4283056 Drainage Area (sq-mi): 8.23		
Total Simulated In-stream Flow:	**36.78**	Total Observed In-stream Flow:		**42.57**
Total of simulated highest 10% flows:	**14.14**	Total of Observed highest 10% flows:		**15.55**
Total of Simulated lowest 50% flows:	**6.64**	Total of Observed Lowest 50% flows:		**7.93**
Simulated Summer Flow Volume (months 7-9):	**10.46**	Observed Summer Flow Volume (7-9):		**8.93**
Simulated Fall Flow Volume (months 10-12):	**5.66**	Observed Fall Flow Volume (10-12):		**6.57**
Simulated Winter Flow Volume (months 1-3):	**10.10**	Observed Winter Flow Volume (1-3):		**13.96**
Simulated Spring Flow Volume (months 4-6):	**10.57**	Observed Spring Flow Volume (4-6):		**13.11**
Total Simulated Storm Volume:	**7.55**	Total Observed Storm Volume:		**8.20**
Simulated Summer Storm Volume (7-9):	**2.98**	Observed Summer Storm Volume (7-9):		**2.54**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	-13.61	10	-8.61	17.58
Error in 50% lowest flows:	-16.35	10	-7.31	10.77
Error in 10% highest flows:	-9.10	15	-4.55	9.05
Seasonal volume error - Summer:	17.06	30	-5.88	9.36
Seasonal volume error - Fall:	-13.82	30	-9.93	21.13
Seasonal volume error - Winter:	-27.70	30	-15.40	23.02
Seasonal volume error - Spring:	-19.38	30	-4.83	16.53
Error in storm volumes:	-7.86	20	-5.79	8.52
Error in summer storm volumes:	17.00	50	4.43	38.58

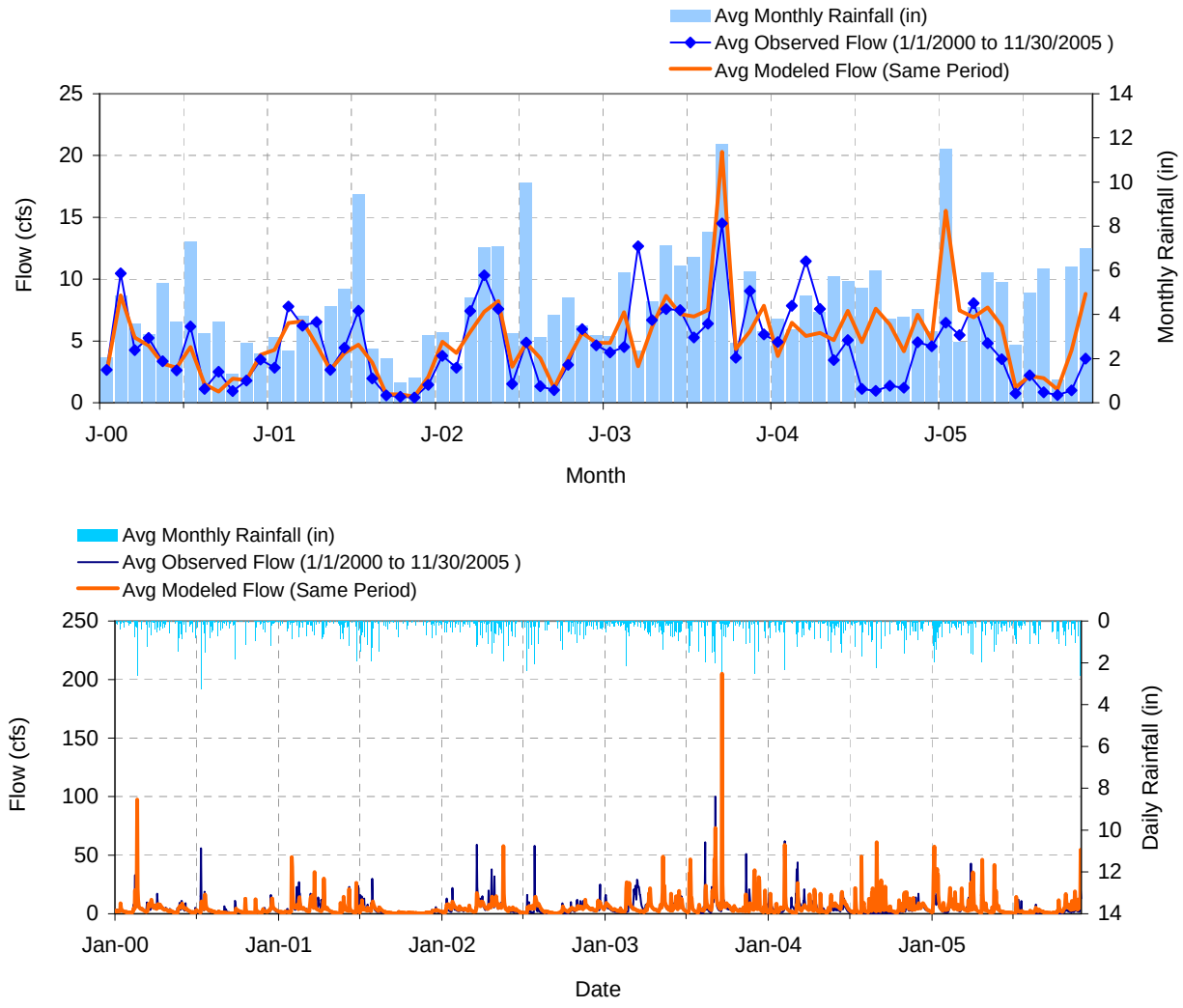

Figure C-3. Daily calibration plot for USGS 01594936

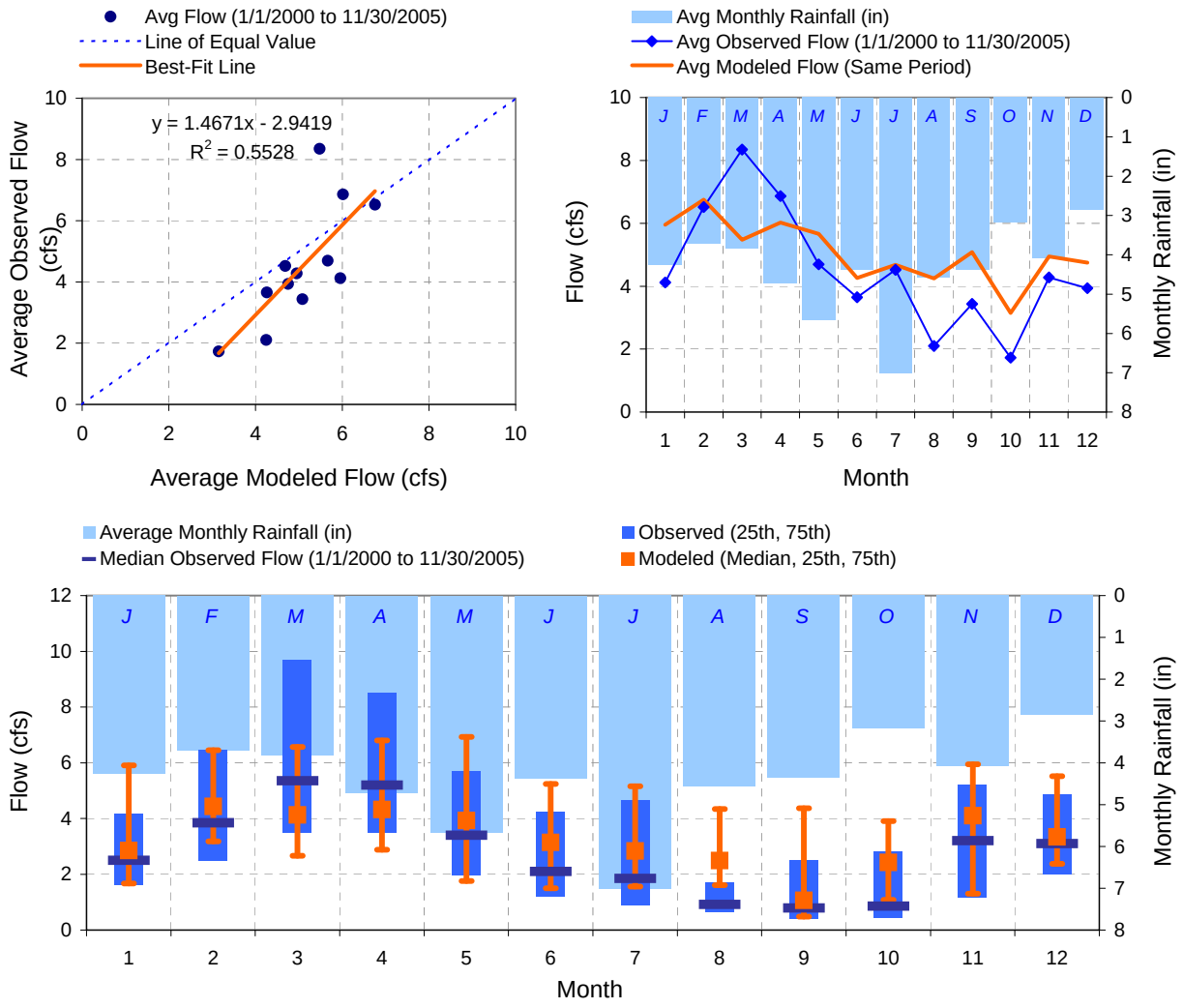

Figure C-4. Calibration plot for USGS 01594936

Table C-2. Calibration summary for USGS 01594936

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 310 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 01594936 NORTH FORK SAND RUN NEAR WILSON, MD Hydrologic Unit Code: 2070002 Latitude: 39.26030556 Longitude: -79.4097778 Drainage Area (sq-mi): 1.91		
Total Simulated In-stream Flow:	**36.10**	Total Observed In-stream Flow:		**32.07**
Total of simulated highest 10% flows:	**14.42**	Total of Observed highest 10% flows:		**13.32**
Total of Simulated lowest 50% flows:	**6.21**	Total of Observed Lowest 50% flows:		**4.54**
Simulated Summer Flow Volume (months 7-9):	**8.48**	Observed Summer Flow Volume (7-9):		**6.09**
Simulated Fall Flow Volume (months 10-12):	**7.28**	Observed Fall Flow Volume (10-12):		**5.60**
Simulated Winter Flow Volume (months 1-3):	**10.78**	Observed Winter Flow Volume (1-3):		**11.28**
Simulated Spring Flow Volume (months 4-6):	**9.56**	Observed Spring Flow Volume (4-6):		**9.10**
Total Simulated Storm Volume:	**7.69**	Total Observed Storm Volume:		**7.21**
Simulated Summer Storm Volume (7-9):	**2.38**	Observed Summer Storm Volume (7-9):		**2.23**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	12.56	10	-8.61	17.58
Error in 50% lowest flows:	36.84	10	-7.31	10.77
Error in 10% highest flows:	8.28	15	-4.55	9.05
Seasonal volume error - Summer:	39.26	30	-5.88	9.36
Seasonal volume error - Fall:	30.00	30	-9.93	21.13
Seasonal volume error - Winter:	-4.43	30	-15.40	23.02
Seasonal volume error - Spring:	5.03	30	-4.83	16.53
Error in storm volumes:	6.58	20	-5.79	8.52
Error in summer storm volumes:	6.49	50	4.43	38.58

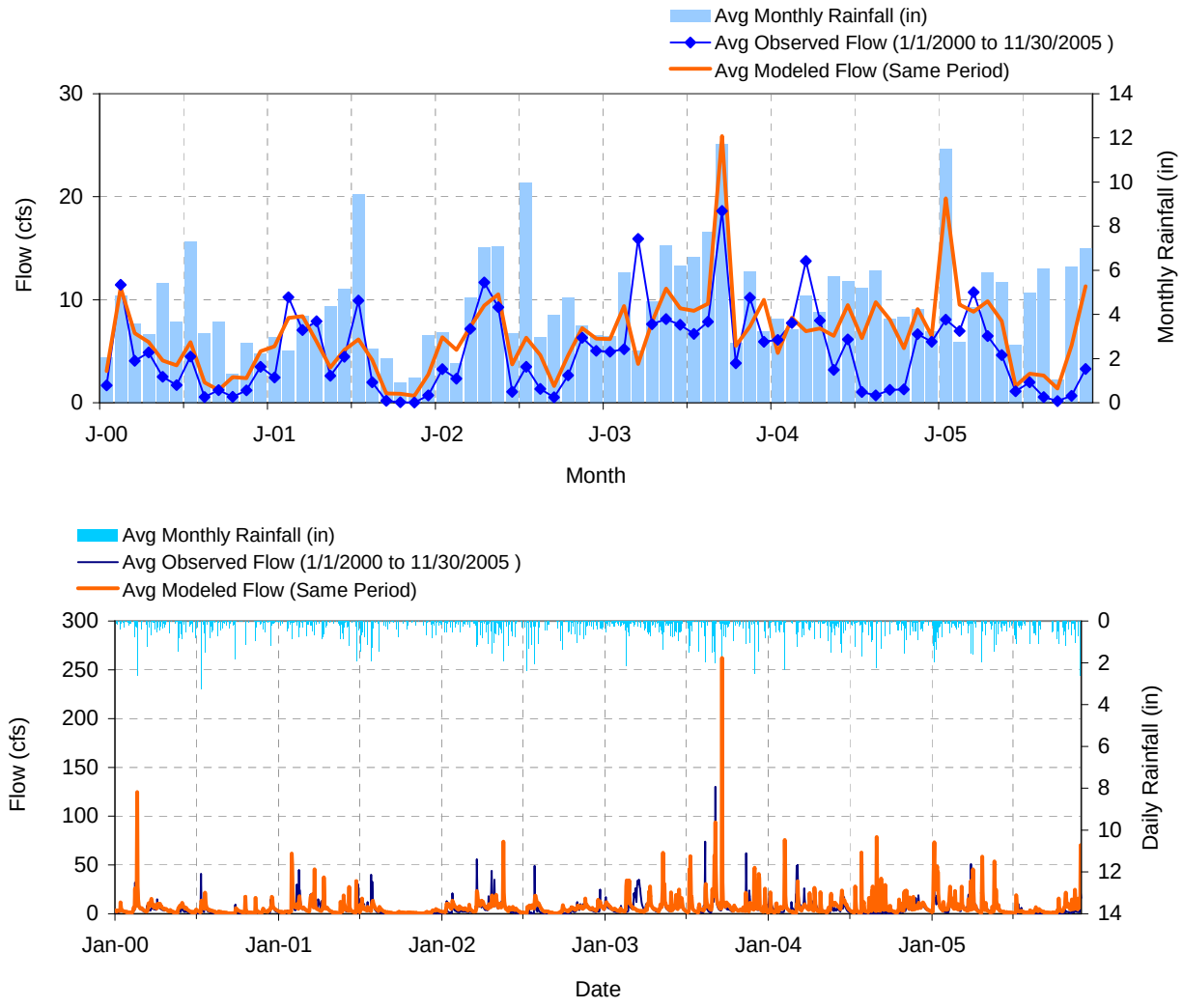

Figure C-5. Daily validation plot for USGS 01594950

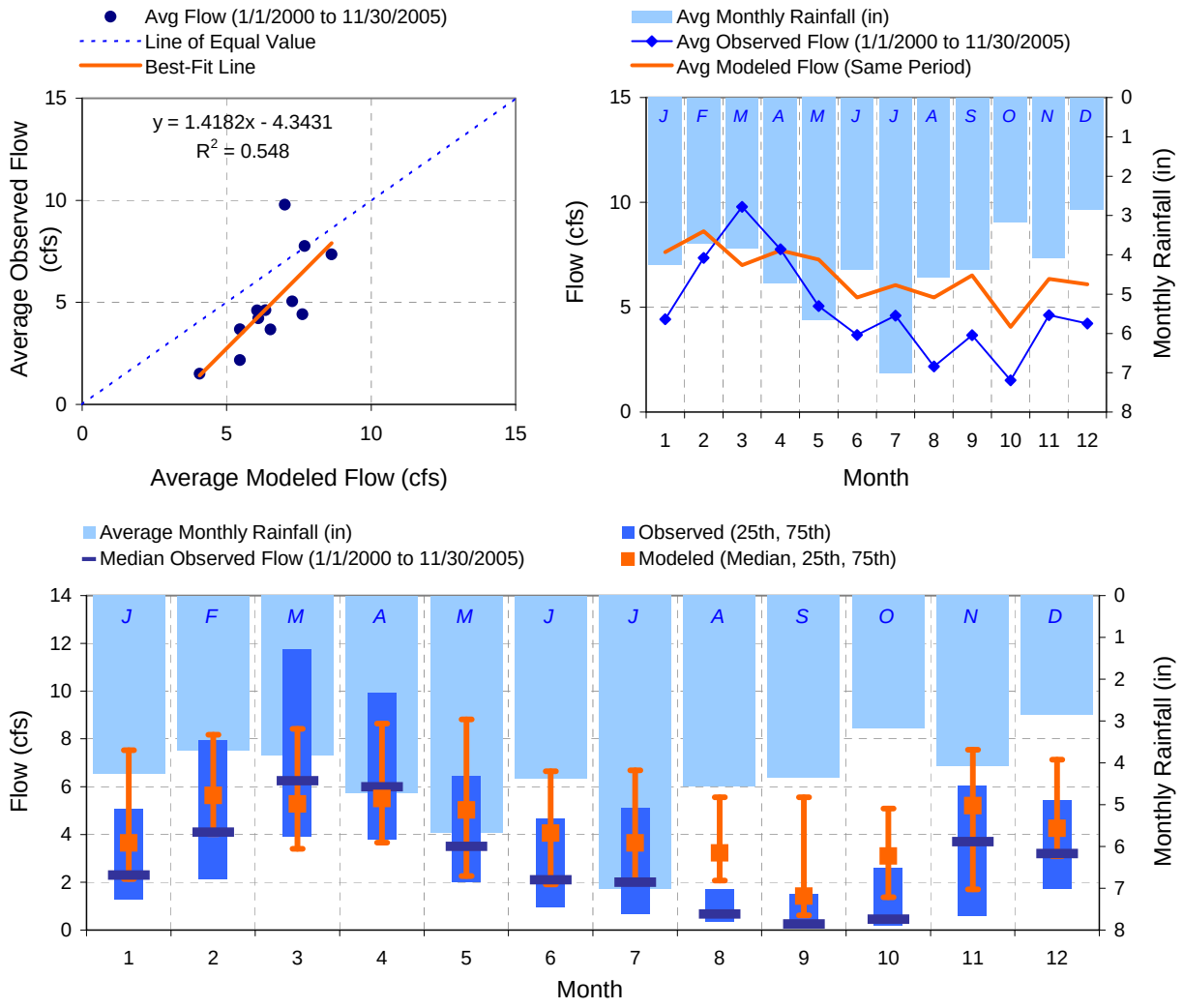

Figure C-6. Validation plot for USGS 01594950

Table C-3. Validation summary for USGS 01594950

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 312 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 01594950 MCMILLAN F NEAR FORT PENDELTON, MD Hydrologic Unit Code: 2070002 Latitude: 39.26030556 Longitude: -79.4097778 Drainage Area (sq-mi): 1.91		
Total Simulated In-stream Flow:	**46.30**	Total Observed In-stream Flow:		**34.80**
Total of simulated highest 10% flows:	**18.48**	Total of Observed highest 10% flows:		**15.30**
Total of Simulated lowest 50% flows:	**8.00**	Total of Observed Lowest 50% flows:		**3.65**
Simulated Summer Flow Volume (months 7-9):	**10.91**	Observed Summer Flow Volume (7-9):		**6.32**
Simulated Fall Flow Volume (months 10-12):	**9.35**	Observed Fall Flow Volume (10-12):		**5.81**
Simulated Winter Flow Volume (months 1-3):	**13.79**	Observed Winter Flow Volume (1-3):		**12.81**
Simulated Spring Flow Volume (months 4-6):	**12.24**	Observed Spring Flow Volume (4-6):		**9.87**
Total Simulated Storm Volume:	**9.89**	Total Observed Storm Volume:		**7.20**
Simulated Summer Storm Volume (7-9):	**3.07**	Observed Summer Storm Volume (7-9):		**2.23**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	33.02	10	-8.61	17.58
Error in 50% lowest flows:	119.18	10	-7.31	10.77
Error in 10% highest flows:	20.76	15	-4.55	9.05
Seasonal volume error - Summer:	72.71	30	-5.88	9.36
Seasonal volume error - Fall:	60.95	30	-9.93	21.13
Seasonal volume error - Winter:	7.65	30	-15.40	23.02
Seasonal volume error - Spring:	24.08	30	-4.83	16.53
Error in storm volumes:	37.44	20	-5.79	8.52
Error in summer storm volumes:	37.40	50	4.43	38.58

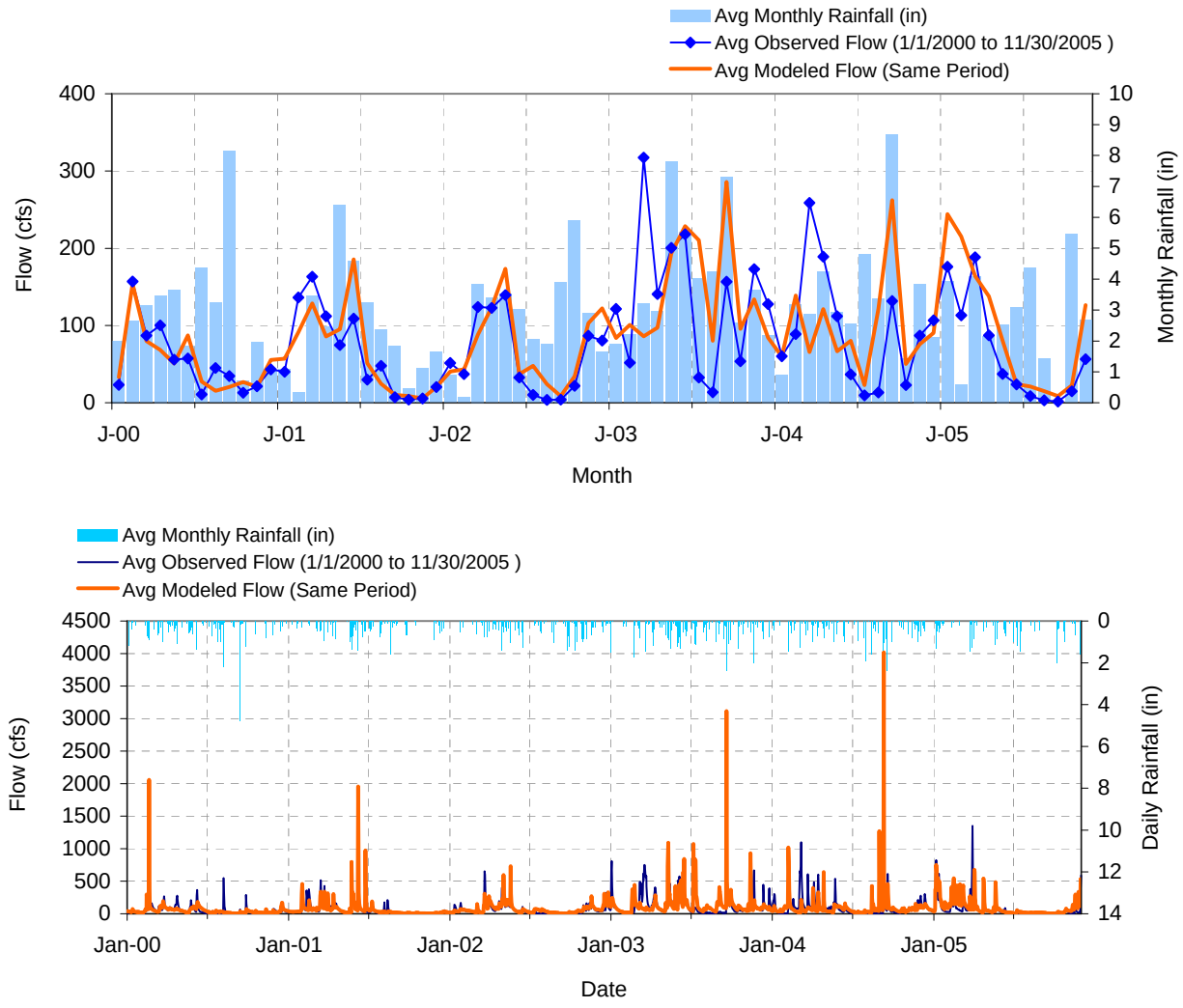

Figure C-7. Daily calibration plot for USGS 01596500

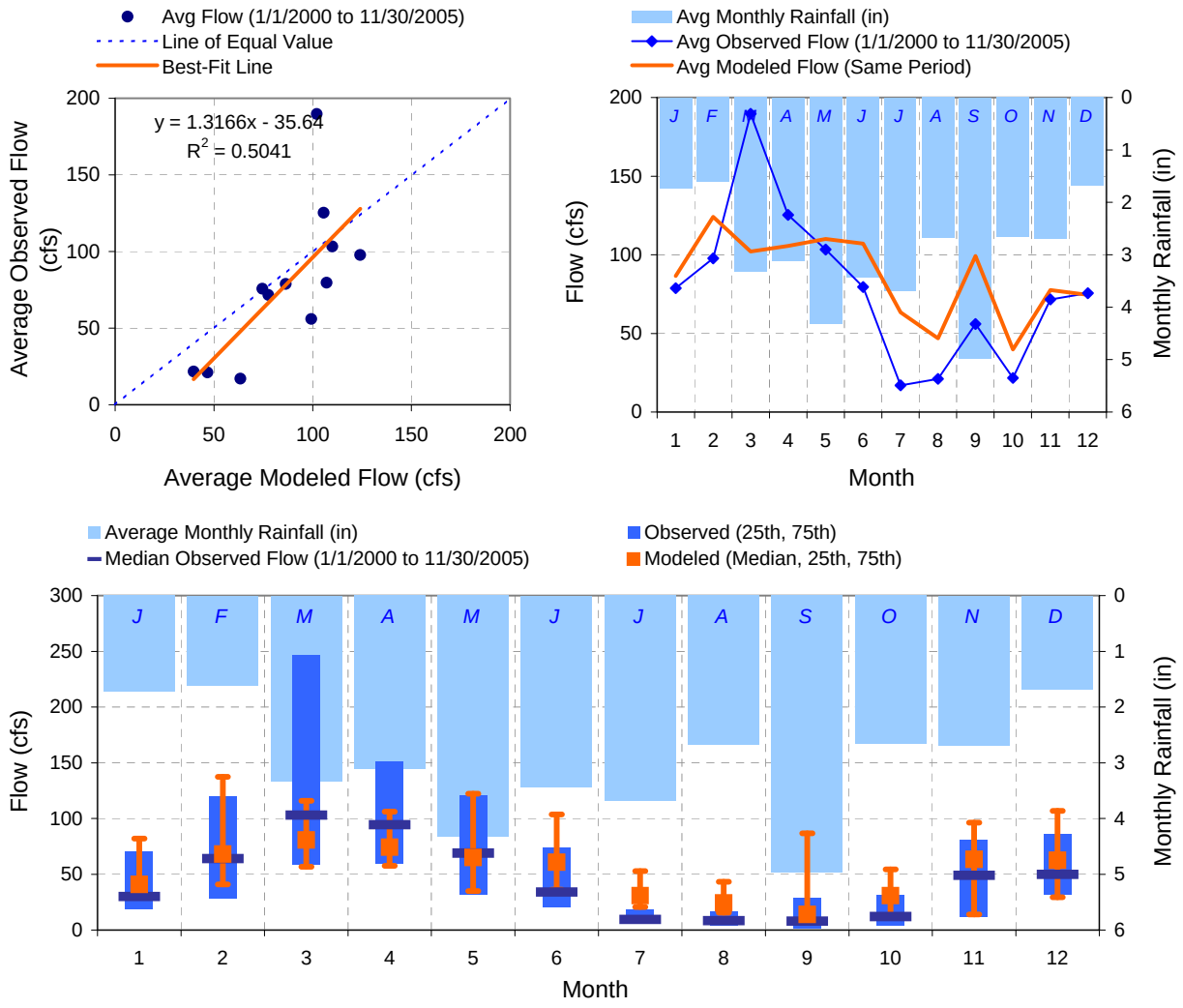

Figure C-8. Calibration plot for USGS 01596500

Table C-4. Calibration summary for USGS 01596500

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 227 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 01596500 SAVAGE RIVER NEAR BARTON, MD Hydrologic Unit Code: 2070002 Latitude: 39.57005556 Longitude: -79.1019444 Drainage Area (sq-mi): 49.1		
Total Simulated In-stream Flow:	**23.84**	Total Observed In-stream Flow:		**21.56**
Total of simulated highest 10% flows:	**10.40**	Total of Observed highest 10% flows:		**10.42**
Total of Simulated lowest 50% flows:	**3.58**	Total of Observed Lowest 50% flows:		**1.97**
Simulated Summer Flow Volume (months 7-9):	**4.91**	Observed Summer Flow Volume (7-9):		**2.20**
Simulated Fall Flow Volume (months 10-12):	**4.21**	Observed Fall Flow Volume (10-12):		**3.67**
Simulated Winter Flow Volume (months 1-3):	**7.19**	Observed Winter Flow Volume (1-3):		**8.52**
Simulated Spring Flow Volume (months 4-6):	**7.52**	Observed Spring Flow Volume (4-6):		**7.18**
Total Simulated Storm Volume:	**8.70**	Total Observed Storm Volume:		**8.17**
Simulated Summer Storm Volume (7-9):	**2.30**	Observed Summer Storm Volume (7-9):		**1.21**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	10.54	10	-8.61	17.58
Error in 50% lowest flows:	81.54	10	-7.31	10.77
Error in 10% highest flows:	-0.16	15	-4.55	9.05
Seasonal volume error - Summer:	123.72	30	-5.88	9.36
Seasonal volume error - Fall:	14.79	30	-9.93	21.13
Seasonal volume error - Winter:	-15.59	30	-15.40	23.02
Seasonal volume error - Spring:	4.76	30	-4.83	16.53
Error in storm volumes:	6.39	20	-5.79	8.52
Error in summer storm volumes:	90.54	50	4.43	38.58

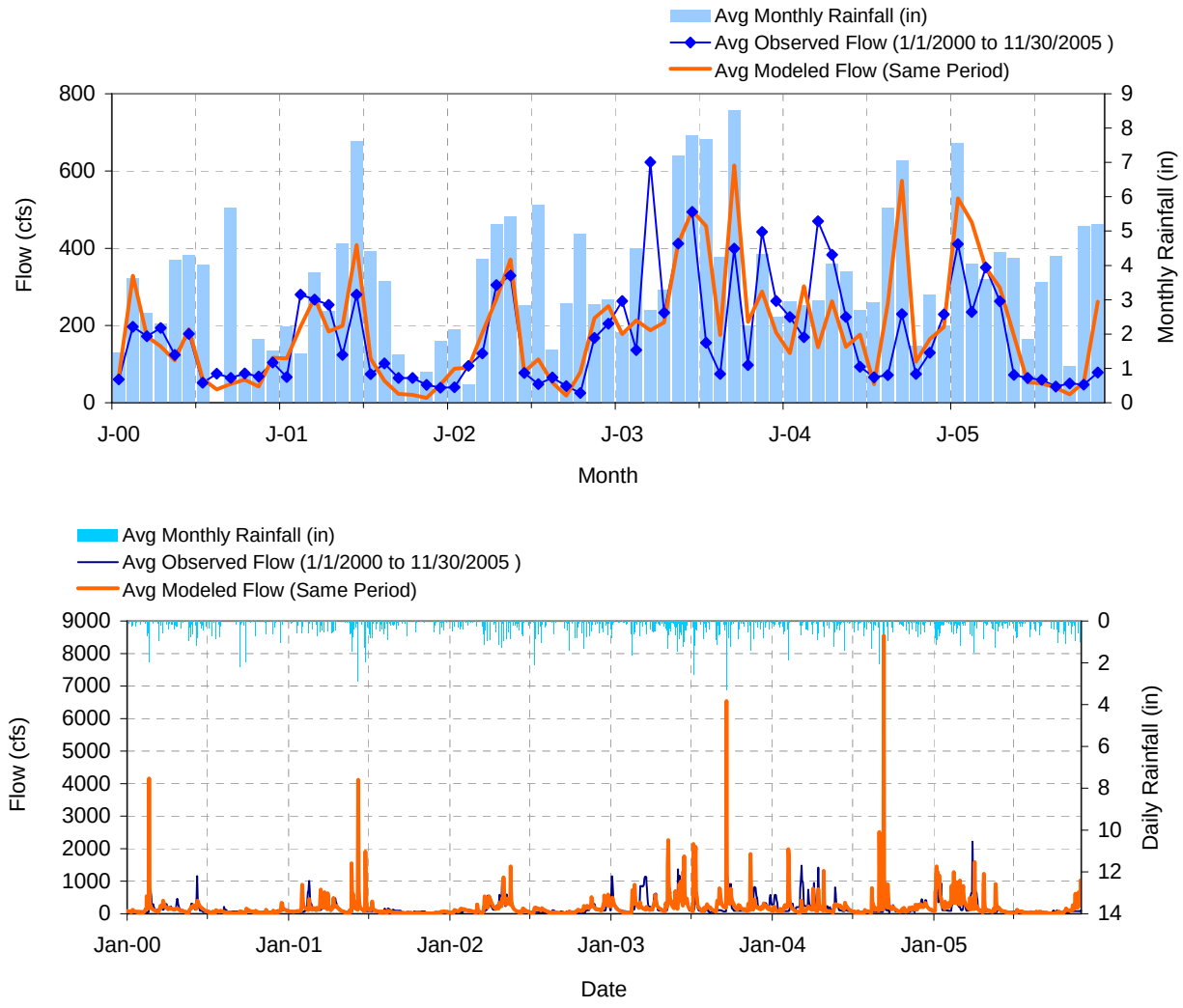

Figure C-9. Daily validation plot for USGS 01597500

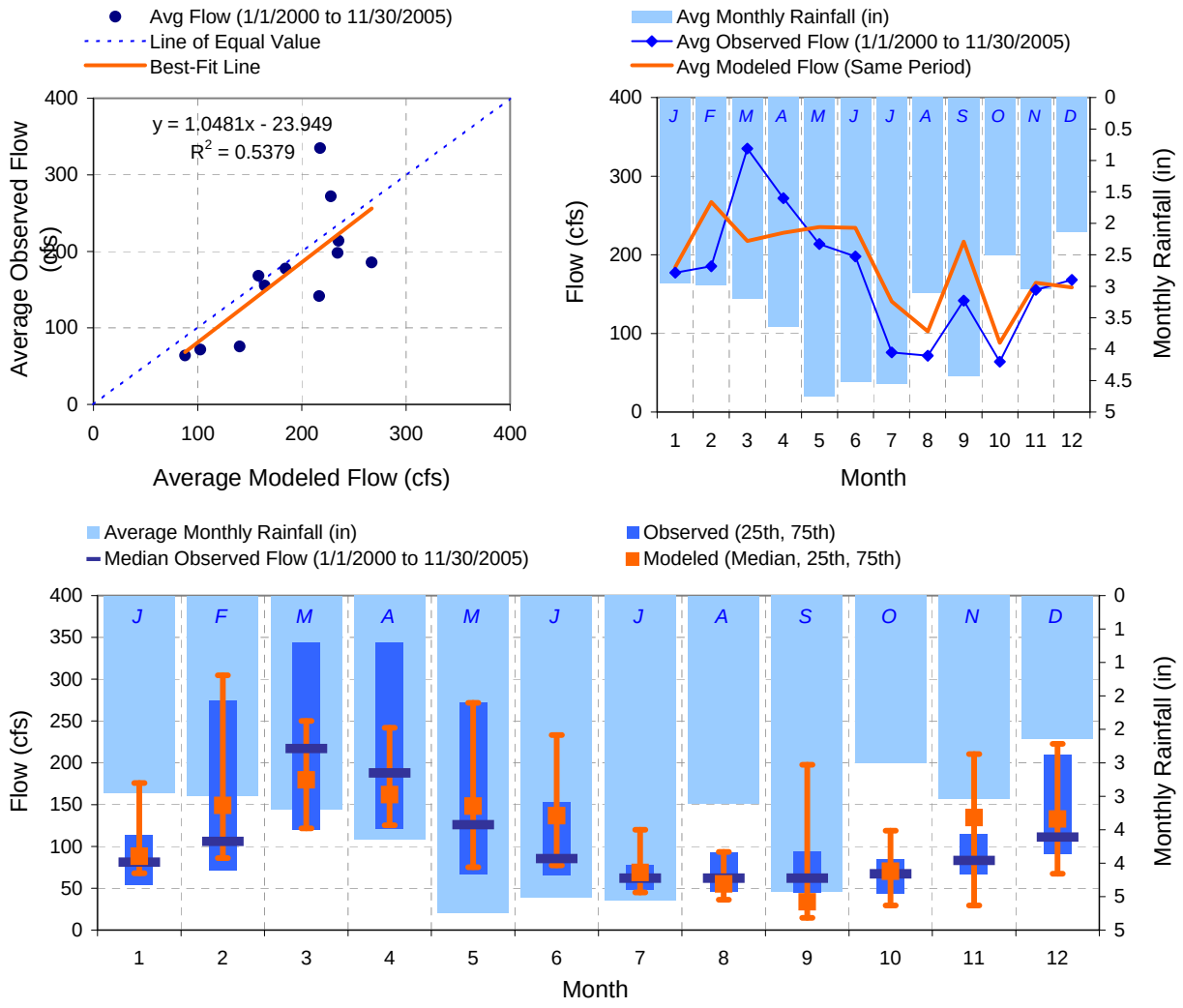

Figure C-10. Validation plot for USGS 01597500

Table C-5. Validation summary for USGS 01597500

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 203 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 01597500 SAVAGE RIV BL SAVAGE RIV DAM NEAR BLOOMINGTON, MD Hydrologic Unit Code: 2070002 Latitude: 39.50275 Longitude: -79.1239722 Drainage Area (sq-mi): 106		
Total Simulated In-stream Flow:	**23.83**	Total Observed In-stream Flow:		**21.94**
Total of simulated highest 10% flows:	**10.16**	Total of Observed highest 10% flows:		**9.29**
Total of Simulated lowest 50% flows:	**3.63**	Total of Observed Lowest 50% flows:		**3.78**
Simulated Summer Flow Volume (months 7-9):	**5.00**	Observed Summer Flow Volume (7-9):		**3.14**
Simulated Fall Flow Volume (months 10-12):	**4.18**	Observed Fall Flow Volume (10-12):		**3.91**
Simulated Winter Flow Volume (months 1-3):	**7.13**	Observed Winter Flow Volume (1-3):		**7.52**
Simulated Spring Flow Volume (months 4-6):	**7.53**	Observed Spring Flow Volume (4-6):		**7.37**
Total Simulated Storm Volume:	**8.34**	Total Observed Storm Volume:		**5.24**
Simulated Summer Storm Volume (7-9):	**2.26**	Observed Summer Storm Volume (7-9):		**0.72**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	8.64	10	-8.61	17.58
Error in 50% lowest flows:	-3.93	10	-7.31	10.77
Error in 10% highest flows:	9.33	15	-4.55	9.05
Seasonal volume error - Summer:	59.18	30	-5.88	9.36
Seasonal volume error - Fall:	6.98	30	-9.93	21.13
Seasonal volume error - Winter:	-5.24	30	-15.40	23.02
Seasonal volume error - Spring:	2.16	30	-4.83	16.53
Error in storm volumes:	58.99	20	-5.79	8.52
Error in summer storm volumes:	213.87	50	4.43	38.58

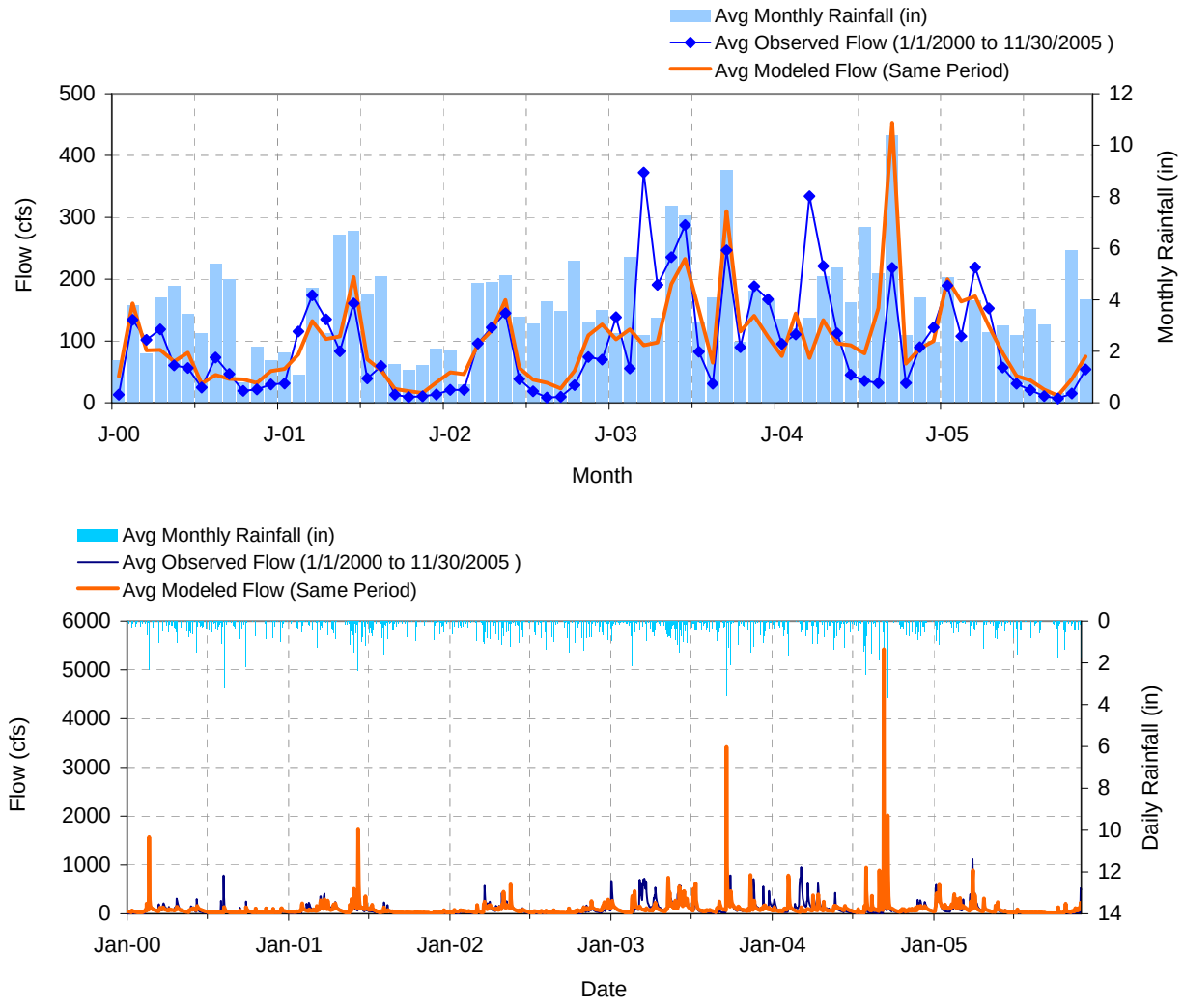

Figure C-11. Daily calibration plot for USGS 01599000

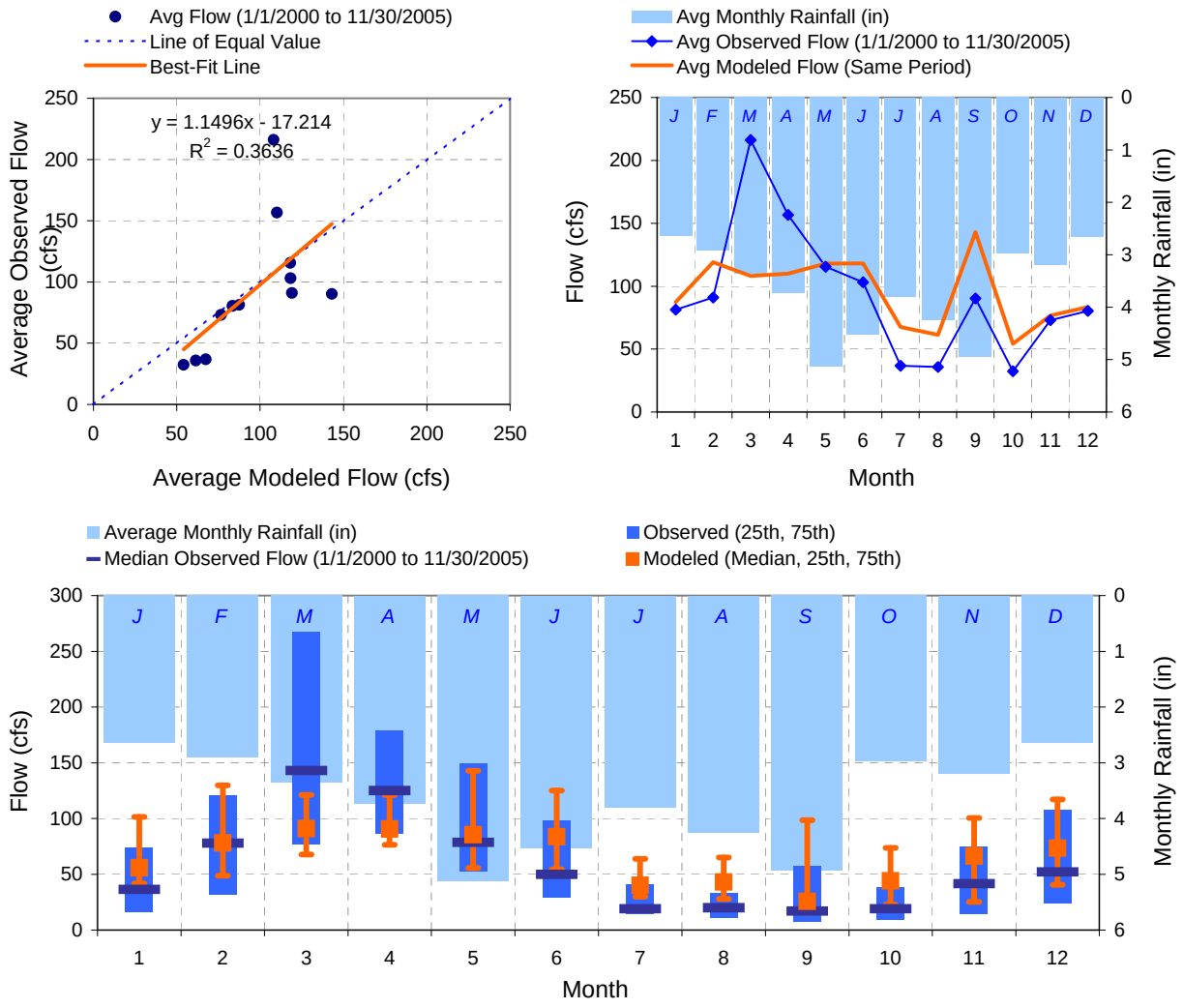

Figure C-12. Calibration plot for USGS 01599000

Table C-6. Calibration summary for USGS 01599000

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 401 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 01599000 GEORGES CREEK AT FRANKLIN, MD Hydrologic Unit Code: 2070002 Latitude: 39.49391667 Longitude: -79.0446944 Drainage Area (sq-mi): 72.4		
Total Simulated In-stream Flow:	**17.91**	Total Observed In-stream Flow:		**17.40**
Total of simulated highest 10% flows:	**6.64**	Total of Observed highest 10% flows:		**7.69**
Total of Simulated lowest 50% flows:	**3.63**	Total of Observed Lowest 50% flows:		**1.96**
Simulated Summer Flow Volume (months 7-9):	**4.32**	Observed Summer Flow Volume (7-9):		**2.58**
Simulated Fall Flow Volume (months 10-12):	**3.20**	Observed Fall Flow Volume (10-12):		**2.75**
Simulated Winter Flow Volume (months 1-3):	**4.92**	Observed Winter Flow Volume (1-3):		**6.15**
Simulated Spring Flow Volume (months 4-6):	**5.47**	Observed Spring Flow Volume (4-6):		**5.93**
Total Simulated Storm Volume:	**5.50**	Total Observed Storm Volume:		**5.40**
Simulated Summer Storm Volume (7-9):	**2.04**	Observed Summer Storm Volume (7-9):		**1.25**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	2.89	10	-8.61	17.58
Error in 50% lowest flows:	84.60	10	-7.31	10.77
Error in 10% highest flows:	-13.68	15	-4.55	9.05
Seasonal volume error - Summer:	67.25	30	-5.88	9.36
Seasonal volume error - Fall:	16.39	30	-9.93	21.13
Seasonal volume error - Winter:	-20.02	30	-15.40	23.02
Seasonal volume error - Spring:	-7.63	30	-4.83	16.53
Error in storm volumes:	1.90	20	-5.79	8.52
Error in summer storm volumes:	62.89	50	4.43	38.58

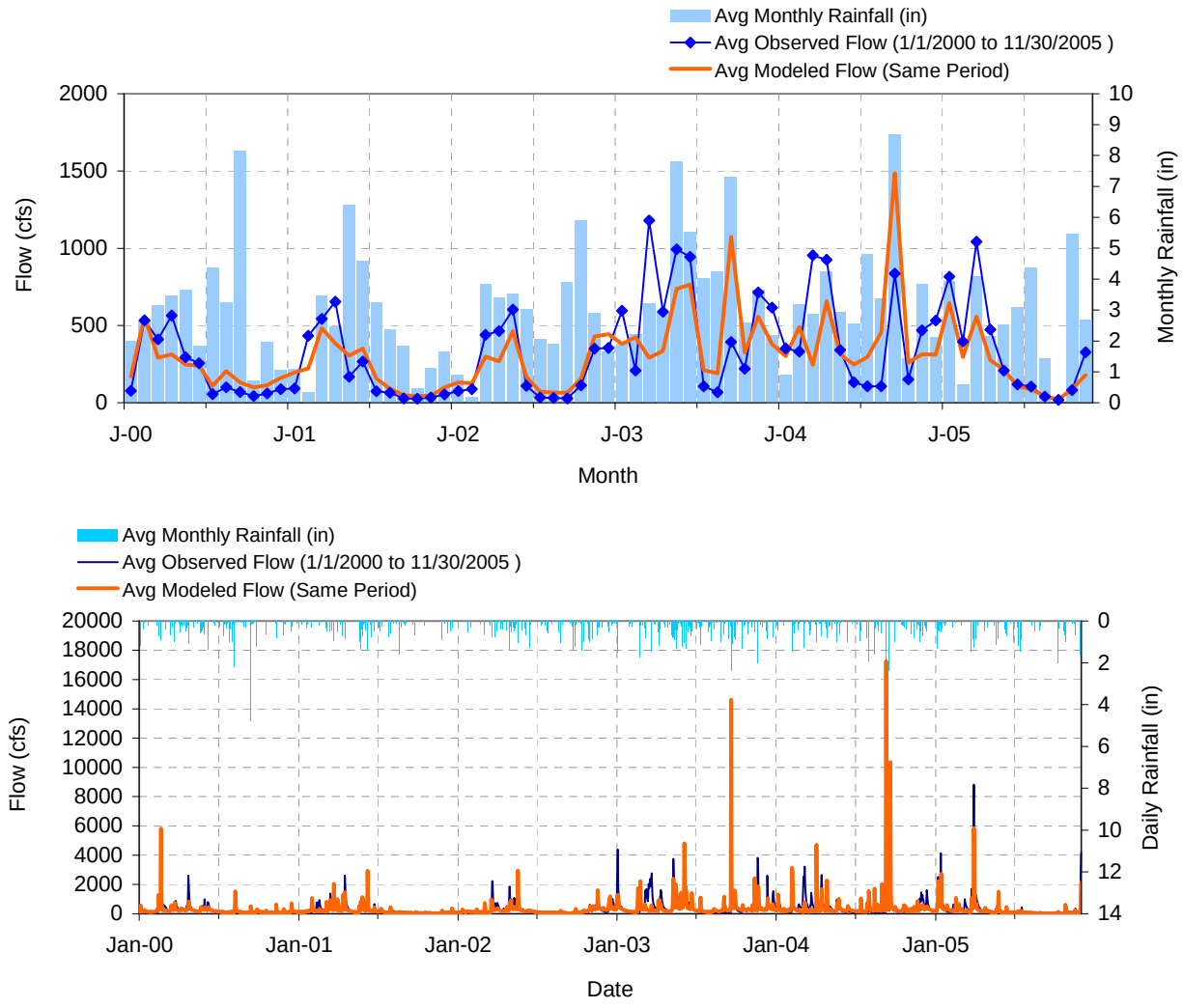

Figure C-13. Daily calibration plot for USGS 01601500

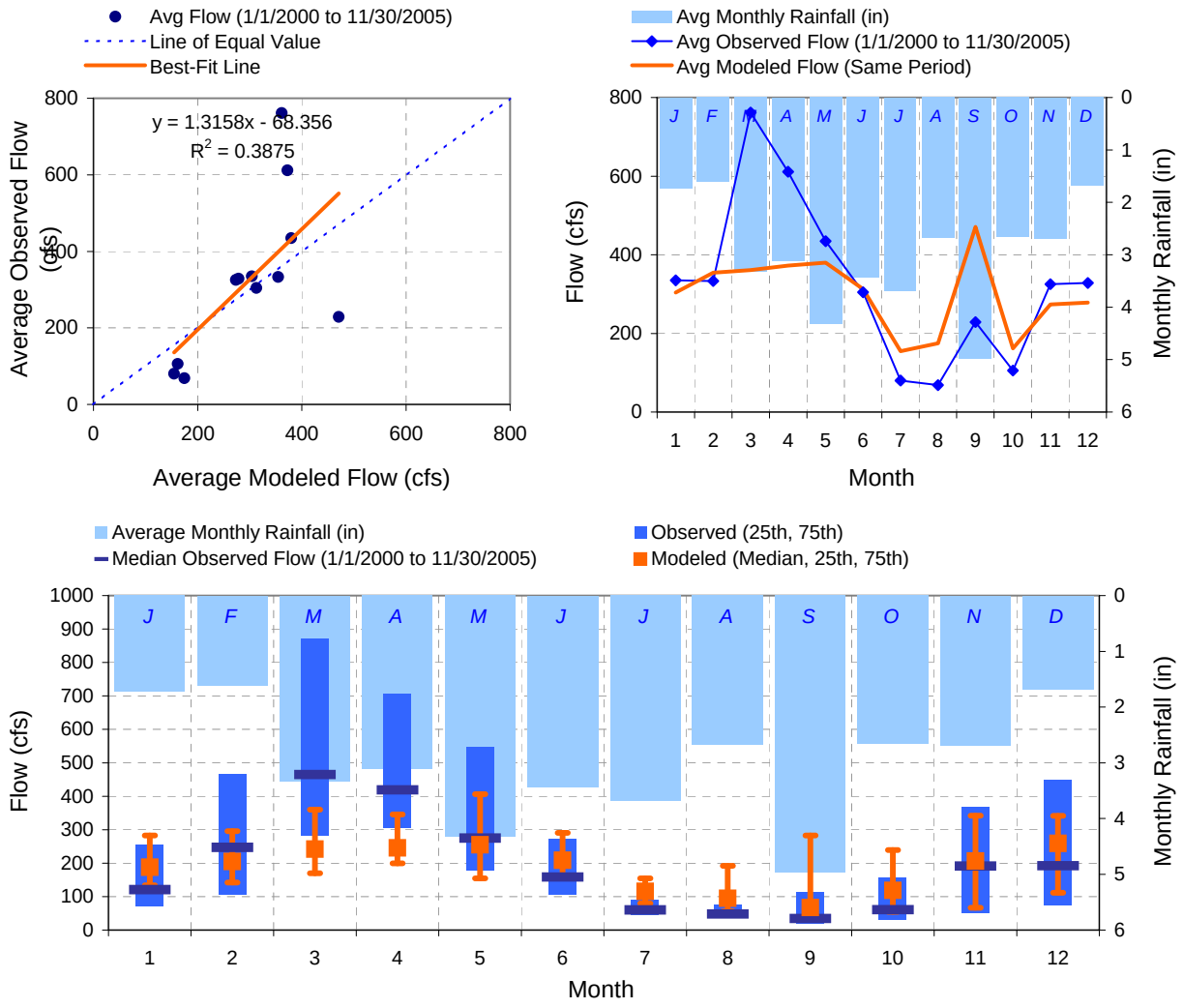

Figure C-14. Calibration plot for USGS 01601500

Table C-7. Calibration summary for USGS 01601500

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 506 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 01601500 WILLS CREEK NEAR CUMBERLAND, MD Hydrologic Unit Code: 2070002 Latitude: 39.6696111 Longitude: -78.7880278 Drainage Area (sq-mi): 247		
Total Simulated In-stream Flow:	**16.46**	Total Observed In-stream Flow:		**17.92**
Total of simulated highest 10% flows:	**7.19**	Total of Observed highest 10% flows:		**8.39**
Total of Simulated lowest 50% flows:	**2.89**	Total of Observed Lowest 50% flows:		**1.83**
Simulated Summer Flow Volume (months 7-9):	**3.72**	Observed Summer Flow Volume (7-9):		**1.75**
Simulated Fall Flow Volume (months 10-12):	**3.12**	Observed Fall Flow Volume (10-12):		**3.29**
Simulated Winter Flow Volume (months 1-3):	**4.68**	Observed Winter Flow Volume (1-3):		**6.63**
Simulated Spring Flow Volume (months 4-6):	**4.94**	Observed Spring Flow Volume (4-6):		**6.25**
Total Simulated Storm Volume:	**7.35**	Total Observed Storm Volume:		**7.51**
Simulated Summer Storm Volume (7-9):	**2.17**	Observed Summer Storm Volume (7-9):		**0.95**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	-8.16	10	-8.61	17.58
Error in 50% lowest flows:	57.78	10	-7.31	10.77
Error in 10% highest flows:	-14.38	15	-4.55	9.05
Seasonal volume error - Summer:	112.45	30	-5.88	9.36
Seasonal volume error - Fall:	-5.15	30	-9.93	21.13
Seasonal volume error - Winter:	-29.36	30	-15.40	23.02
Seasonal volume error - Spring:	-21.03	30	-4.83	16.53
Error in storm volumes:	-2.09	20	-5.79	8.52
Error in summer storm volumes:	129.12	50	4.43	38.58

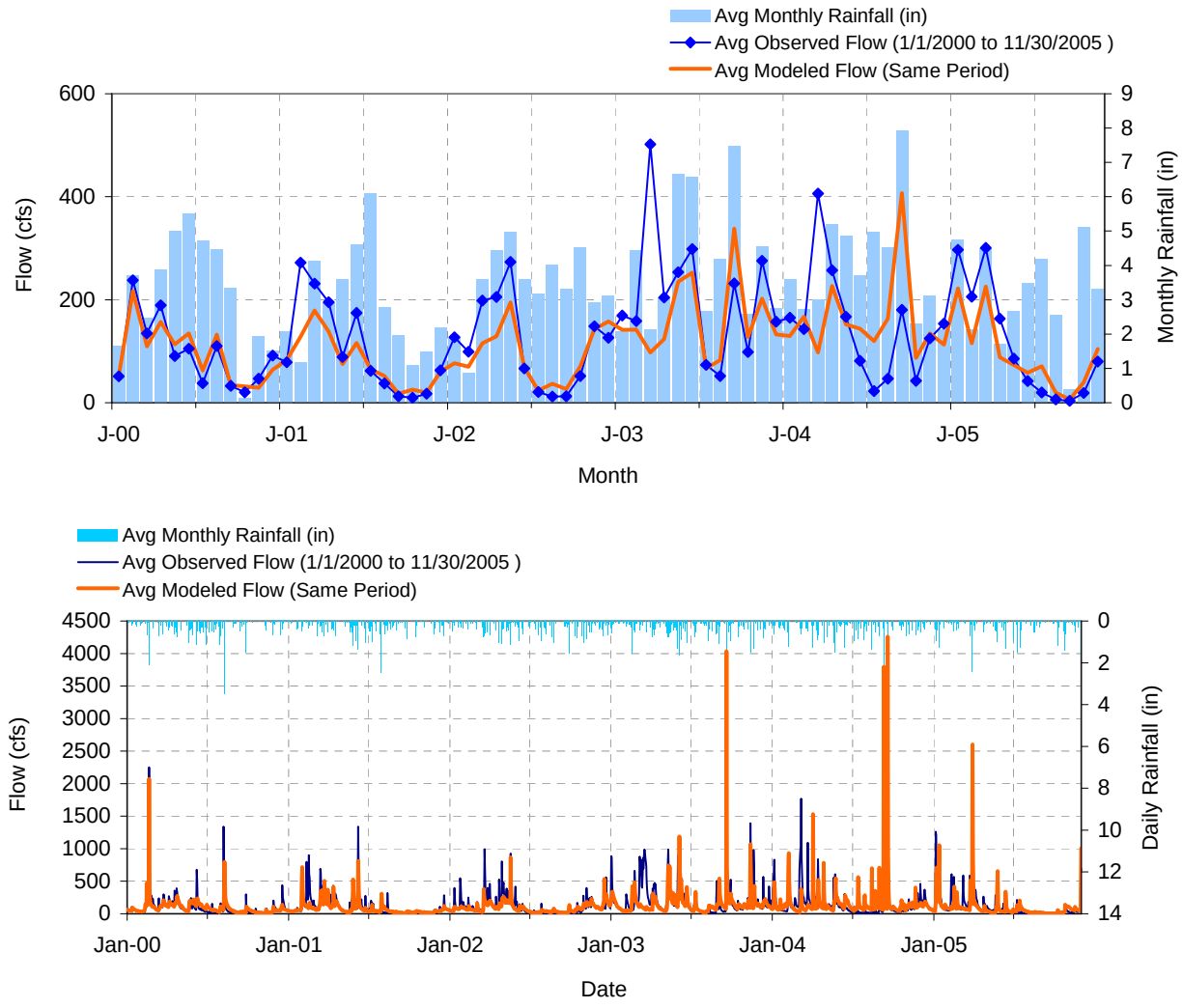

Figure C-15. Daily calibration plot for USGS 03078000

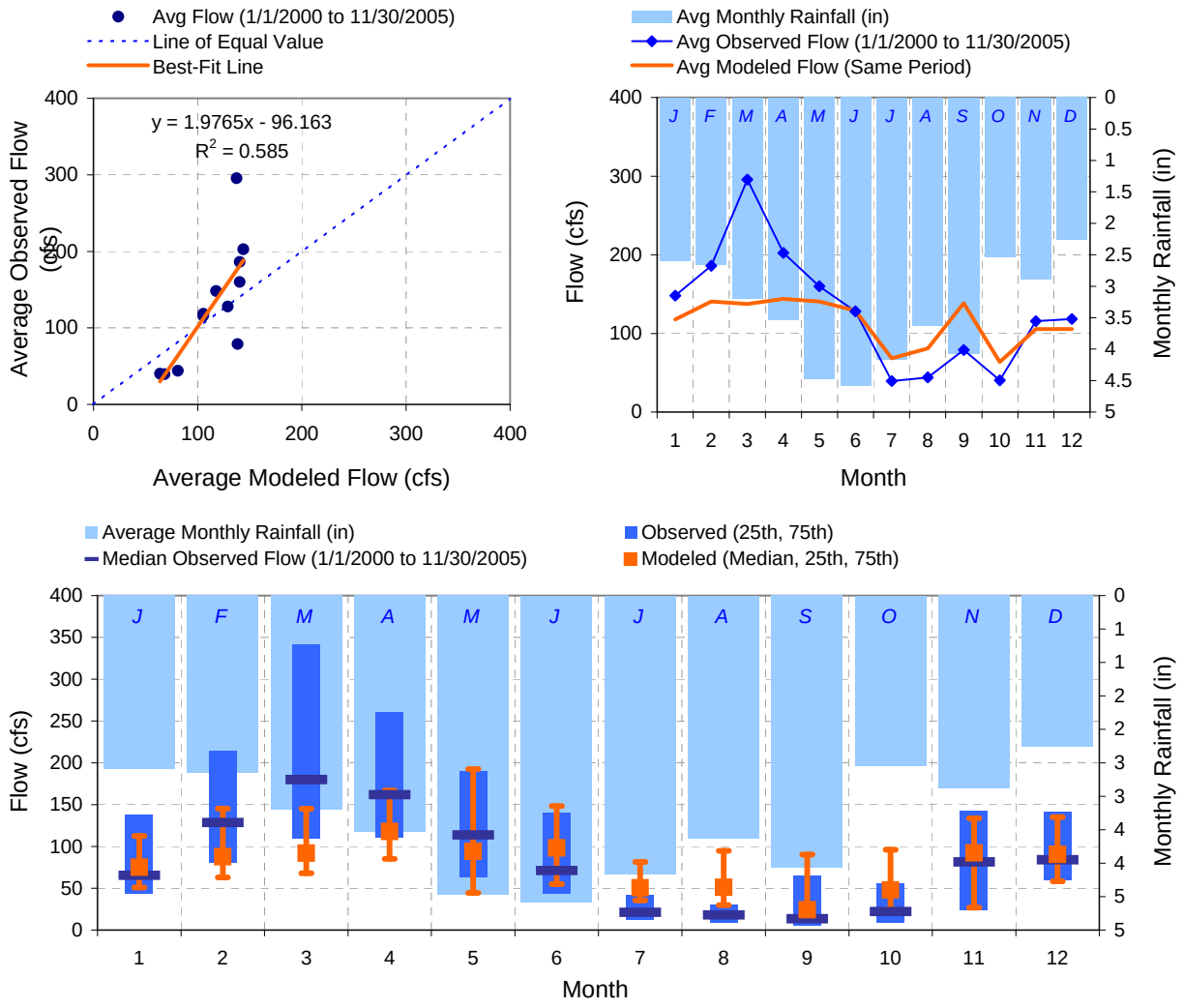

Figure C-16. Calibration plot for USGS 03078000

Table C-8. Calibration summary for USGS 03078000

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 104 5.92-Year Analysis Period: 1/1/2000 - 11/30/2005 Flow volumes are (inches/year) for upstream drainage area		USGS 03078000 CASSELMAN RIVER AT GRANTSVILLE, MD Hydrologic Unit Code: 5020006 Latitude: 39.70219444 Longitude: -79.13638889 Drainage Area (sq-mi): 62.5		
Total Simulated In-stream Flow:	**24.79**	Total Observed In-stream Flow:		**28.14**
Total of simulated highest 10% flows:	**9.49**	Total of Observed highest 10% flows:		**12.17**
Total of Simulated lowest 50% flows:	**4.62**	Total of Observed Lowest 50% flows:		**3.32**
Simulated Summer Flow Volume (months 7-9):	**5.30**	Observed Summer Flow Volume (7-9):		**2.99**
Simulated Fall Flow Volume (months 10-12):	**4.75**	Observed Fall Flow Volume (10-12):		**4.69**
Simulated Winter Flow Volume (months 1-3):	**7.18**	Observed Winter Flow Volume (1-3):		**11.48**
Simulated Spring Flow Volume (months 4-6):	**7.57**	Observed Spring Flow Volume (4-6):		**8.97**
Total Simulated Storm Volume:	**8.31**	Total Observed Storm Volume:		**10.39**
Simulated Summer Storm Volume (7-9):	**2.52**	Observed Summer Storm Volume (7-9):		**1.61**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1998*	*1999-2002*
Error in total volume:	-11.90	10	-8.61	17.58
Error in 50% lowest flows:	39.33	10	-7.31	10.77
Error in 10% highest flows:	-22.03	15	-4.55	9.05
Seasonal volume error - Summer:	76.93	30	-5.88	9.36
Seasonal volume error - Fall:	1.24	30	-9.93	21.13
Seasonal volume error - Winter:	-37.50	30	-15.40	23.02
Seasonal volume error - Spring:	-15.65	30	-4.83	16.53
Error in storm volumes:	-20.09	20	-5.79	8.52
Error in summer storm volumes:	56.59	50	4.43	38.58