

# **Hydrologic Model Calibration / Validation Results**

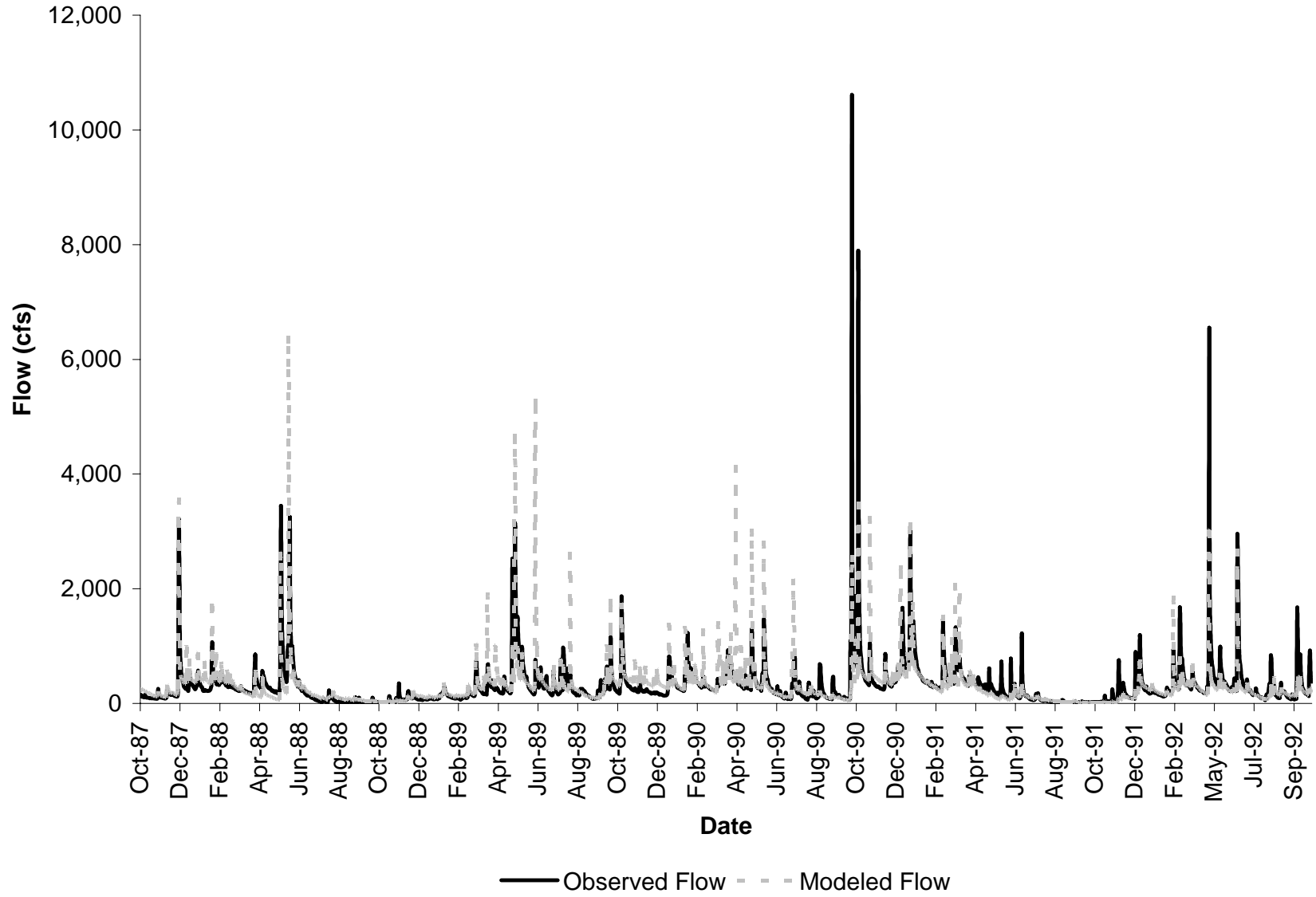


Figure 1. Observed and modeled flows for the calibration period 10/1/87 to 9/30/92 in Hazel River watershed.

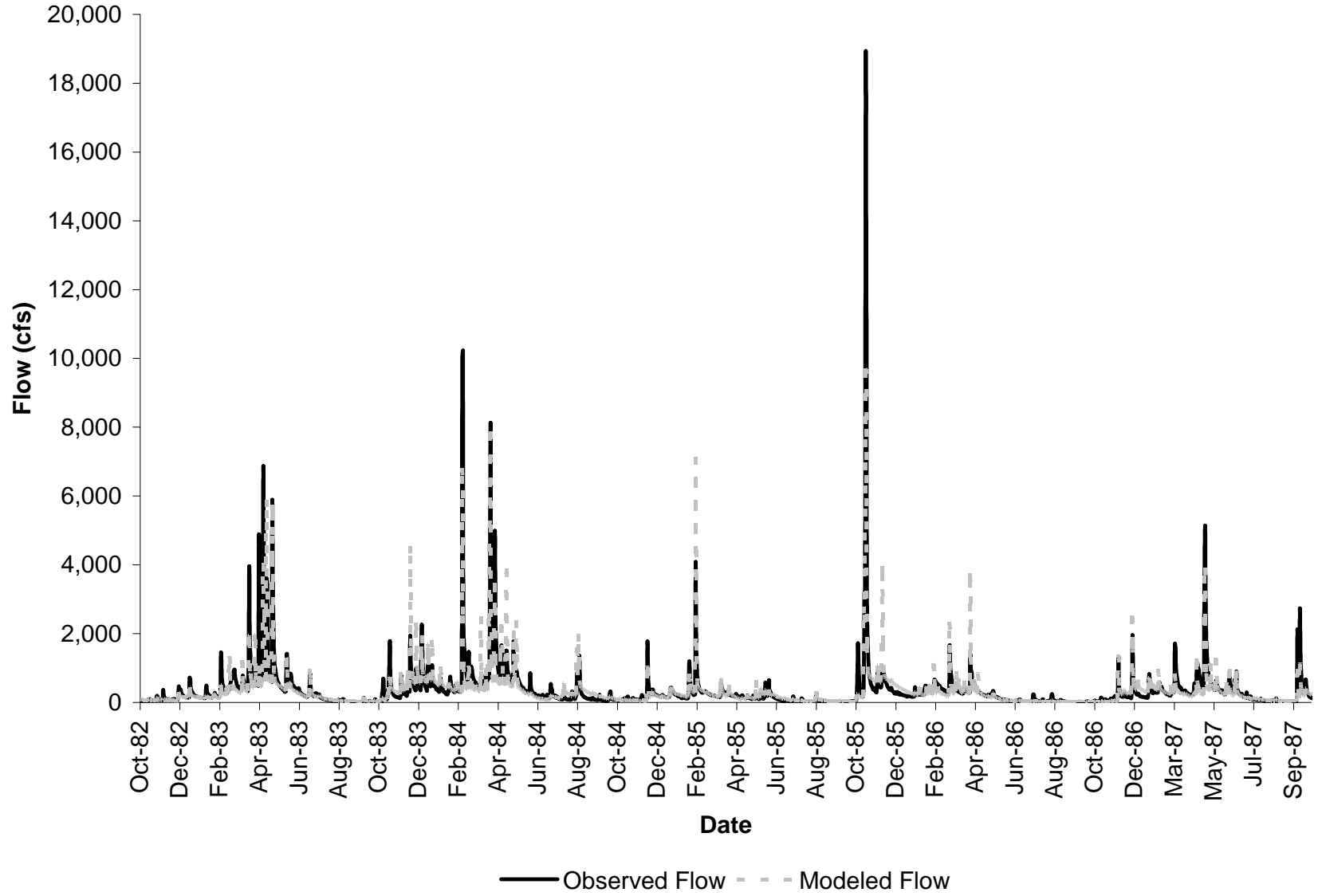
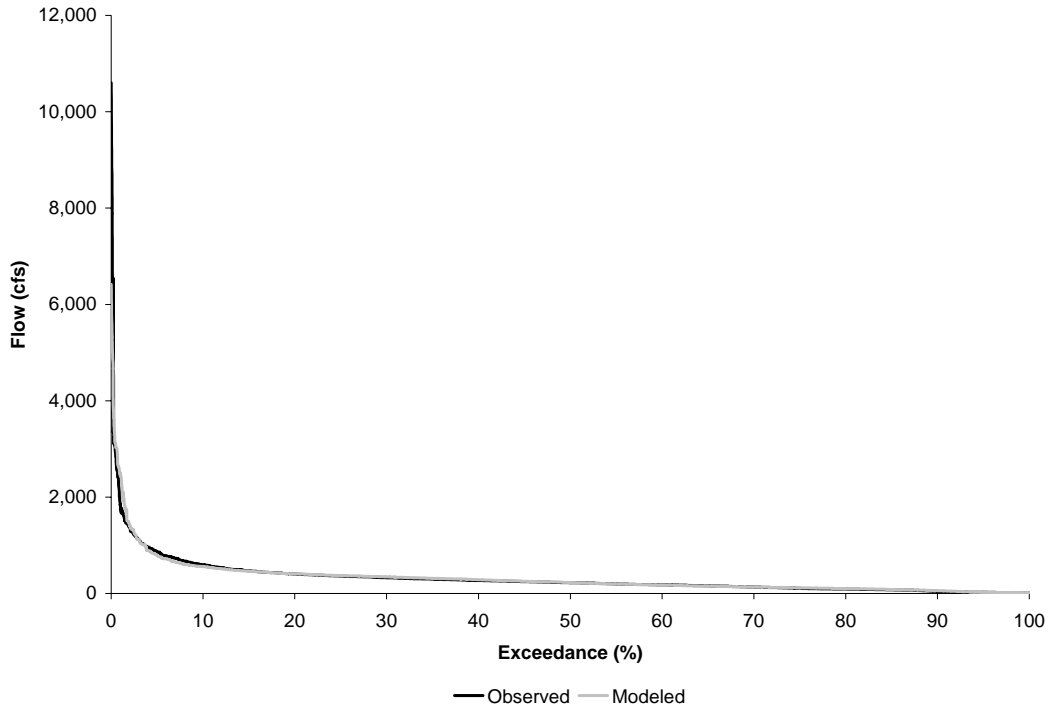
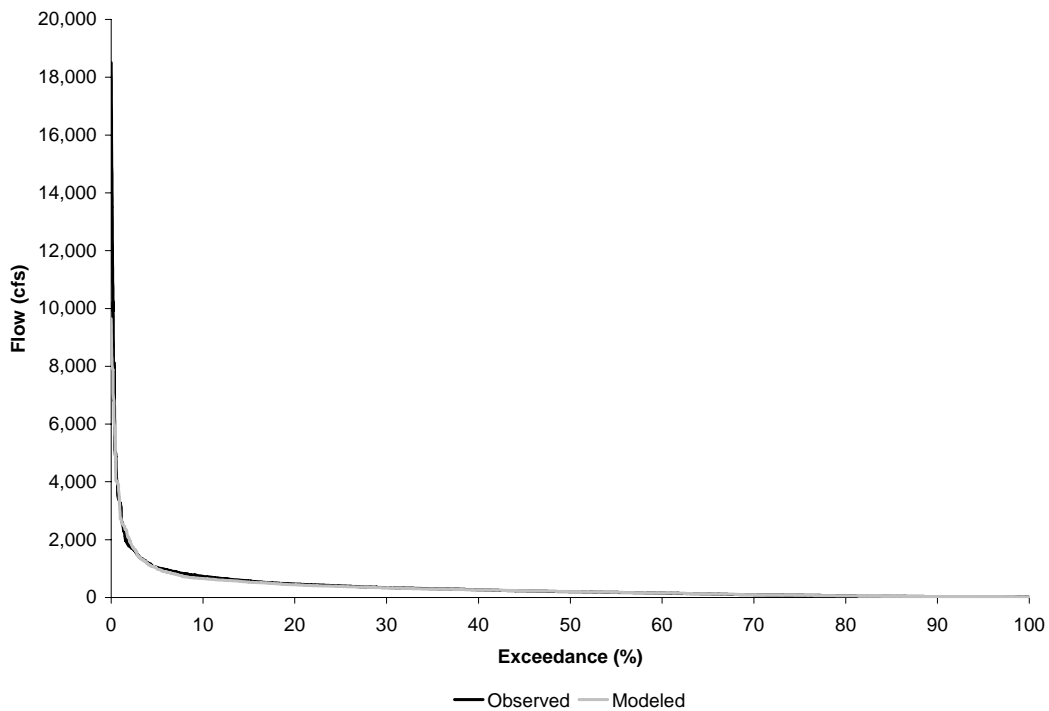


Figure 2. Observed and modeled flows for the validation period 10/1/82 to 9/30/87 in Hazel River watershed.



**Figure 3. Cumulative frequency curves for the calibration period 10/1/82 to 9/30/92 in Hazel River watershed.**



**Figure 4. Cumulative frequency curves for the validation period 10/1/82 to 9/30/87 in Hazel River watershed.**

**Table 1. Flow partitioning for the calibration and validation periods in Hazel River watershed.**

Average Annual Flow	Calibration	Validation
Total Runoff (in)	63.2	72.8
Surface Runoff (in)	9.9 (15.7%)	13.4 (18.4%)
Interflow (in)	12.8 (20.3%)	15.4 (21.2%)
Baseflow (in)	40.5 (64.0%)	44.0 (60.5%)

**Table 2. Summary statistics for the calibration period (10/1/87 to 9/30/92) in Hazel River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Runoff (in)	10	74.1	74.7	0.8
Total of Highest 10% Flows (in)	15	28.1	27.5	-2.2
Total of Lowest 50% Flows (in)	10	13.3	13.7	2.9
Total Winter Runoff (in)	20	21.4	23.2	7.8
Total Summer Runoff (in)	20	9.7	9.8	1.0
Total Storm Runoff (in)	20	70.3	71.1	1.1
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.73			

**Table 3. Summary statistics for the validation period (10/1/82 to 9/30/87) in Hazel River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Volume (in)	20	86.5	82.0	-5.5
Total of Highest 10% Flows (in)	25	40.4	37.0	-9.2
Total of Lowest 50% Flows (in)	20	10.2	10.6	3.8
Total Winter Flow (in)	30	29.4	27.3	-7.7
Total Summer Flow Volume (in)	30	6.1	7.0	12.9
Total Storm Volume (in)	30	83.7	78.6	-6.5
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.79			

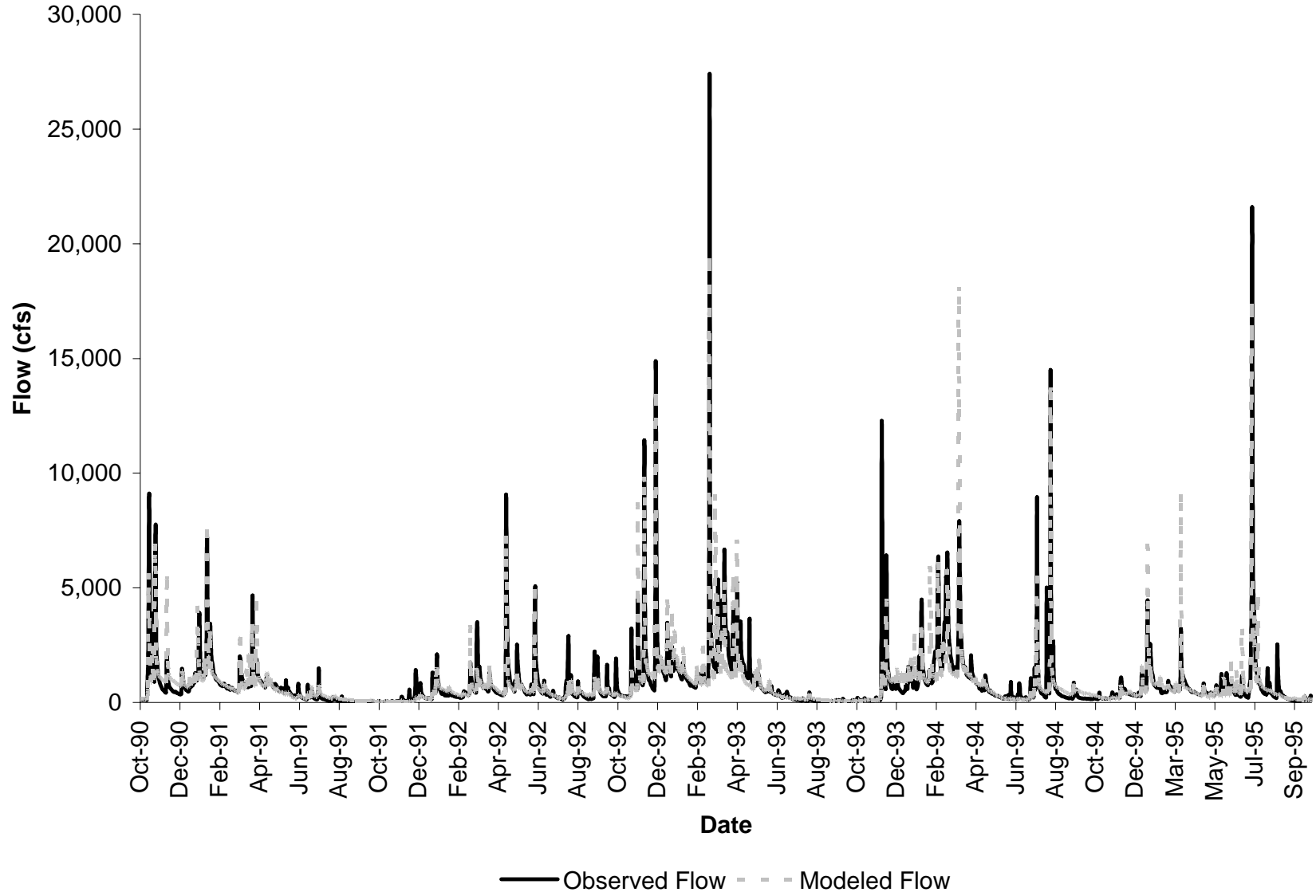


Figure 5. Observed and modeled flows for the calibration period 10/1/90 to 9/30/95 in Rappahannock River watershed.

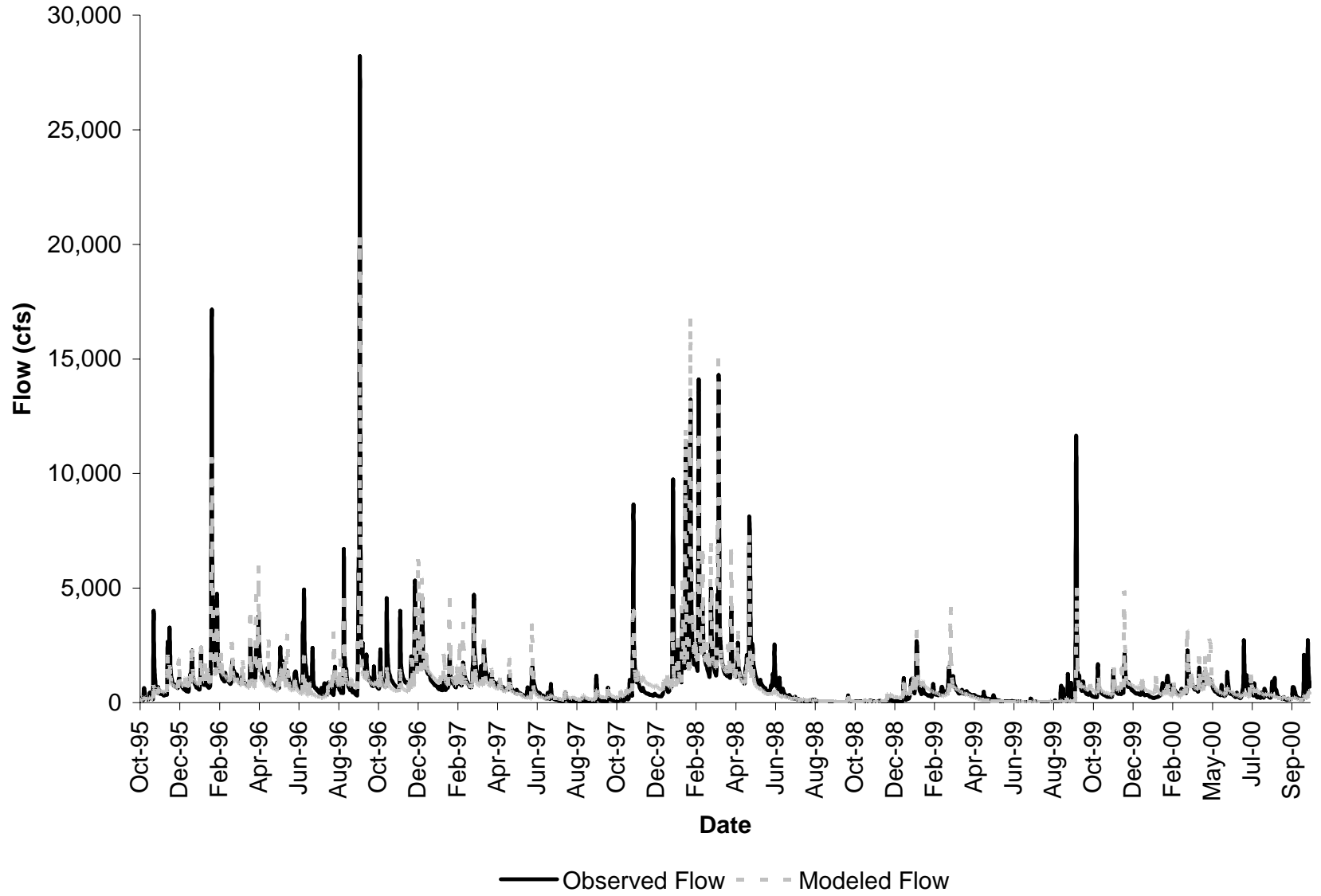
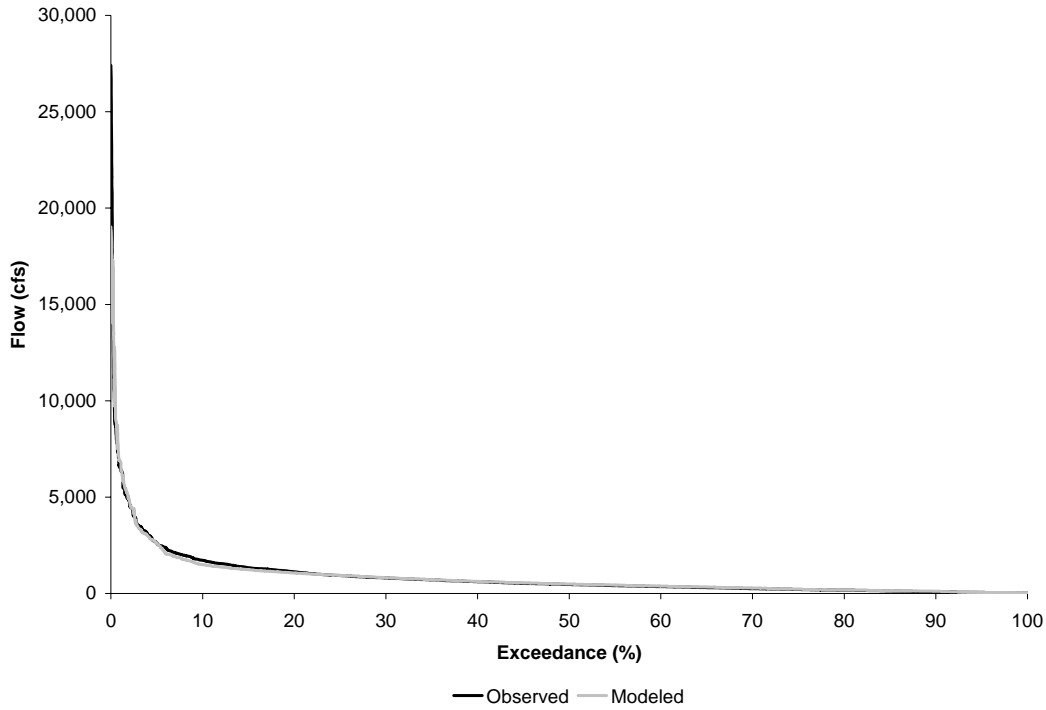
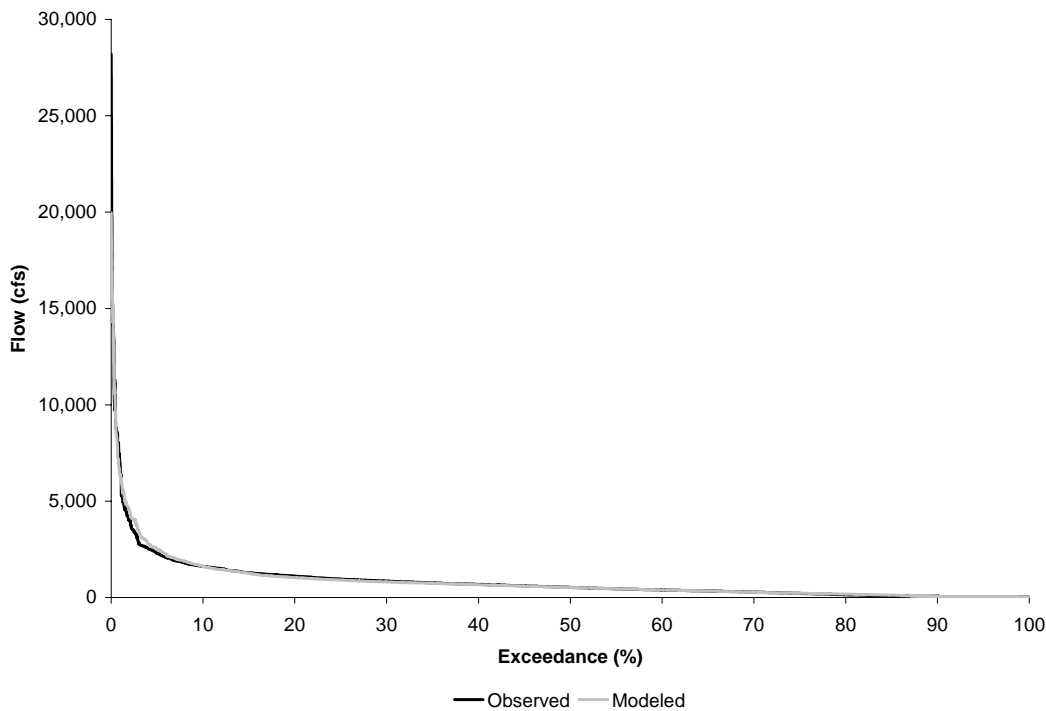


Figure 6. Observed and modeled flows for the validation period 10/1/95 to 9/30/00 in Rappahannock River watershed.



**Figure 7. Cumulative frequency curves for the calibration period 10/1/90 to 9/30/95 in Rappahannock River watershed.**



**Figure 8. Cumulative frequency curves for the validation period 10/1/95 to 9/30/00 in Rappahannock River watershed.**



**Table 4. Flow partitioning for the calibration and validation periods in Rappahannock River watershed.**

Average Annual Flow	Calibration	Validation
Total Runoff (in)	77.7	76.6
Surface Runoff (in)	17.2 (22.2%)	14.7 (19.1%)
Interflow (in)	14.8 (19.1%)	16.6 (21.7%)
Baseflow (in)	45.6 (58.7%)	45.3 (59.1%)

**Table 5. Summary statistics for the calibration period (10/1/90 to 9/30/95) in Rappahannock River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Runoff (in)	10	90.7	90.1	-0.7
Total of Highest 10% Flows (in)	15	40.3	39.4	-2.3
Total of Lowest 50% Flows (in)	10	11.9	13.0	8.5
Total Winter Runoff (in)	20	36.3	38.1	4.7
Total Summer Runoff (in)	20	11.1	11.4	2.6
Total Storm Runoff (in)	20	87.7	86.1	-1.9
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.83			

**Table 6. Summary statistics for the validation period (10/1/95 to 9/30/00) in Rappahannock River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Volume (in)	20	88.8	89.2	0.4
Total of Highest 10% Flows (in)	25	36.6	38.4	4.7
Total of Lowest 50% Flows (in)	20	12.2	12.6	3.2
Total Winter Flow (in)	30	35.7	39.5	9.6
Total Summer Flow Volume (in)	30	12.9	11.0	-17.3
Total Storm Volume (in)	30	86.8	86.7	-0.1
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.80			

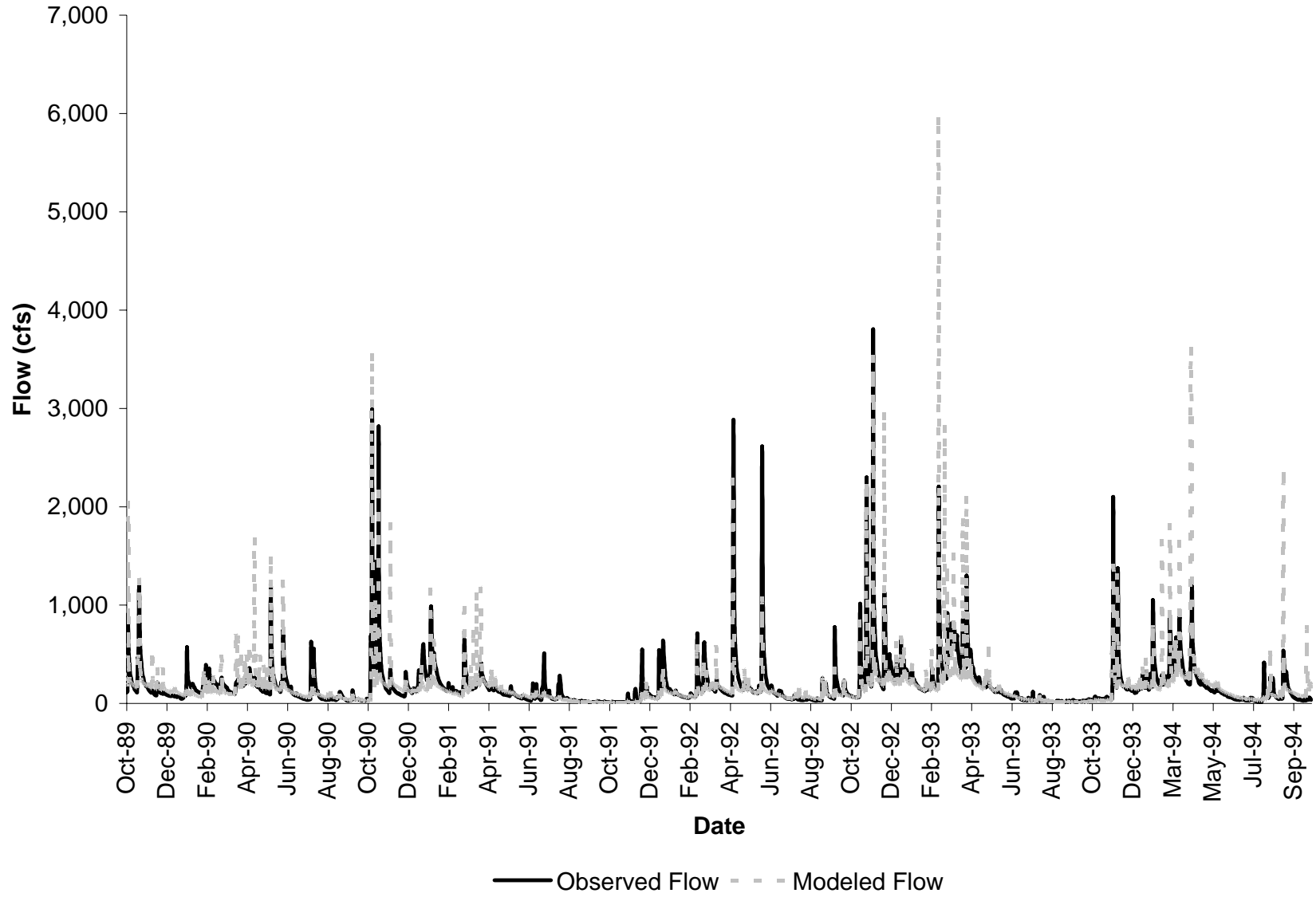


Figure 9. Observed and modeled flows for the calibration period 10/1/89 to 9/30/94 in Upper Rapidan River watershed.

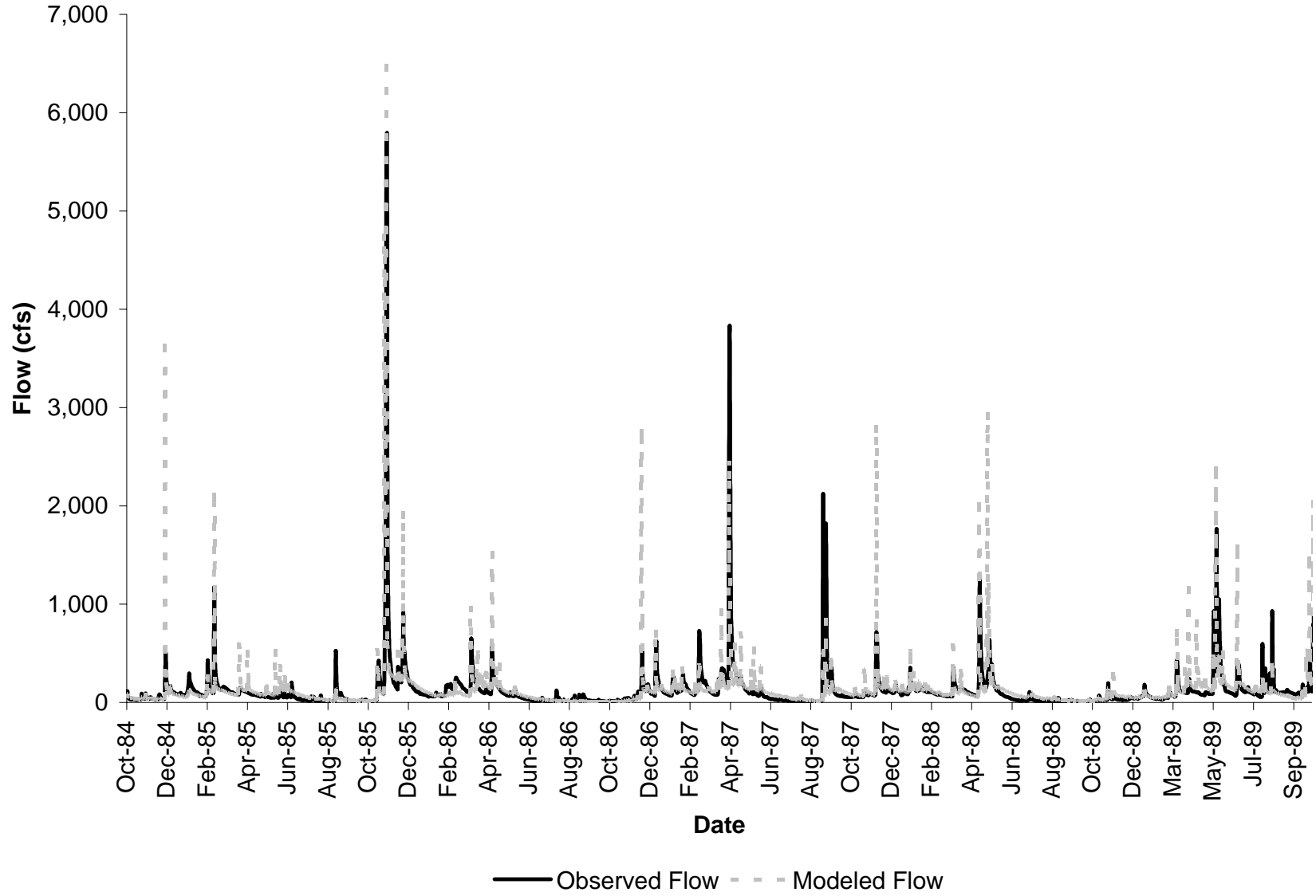
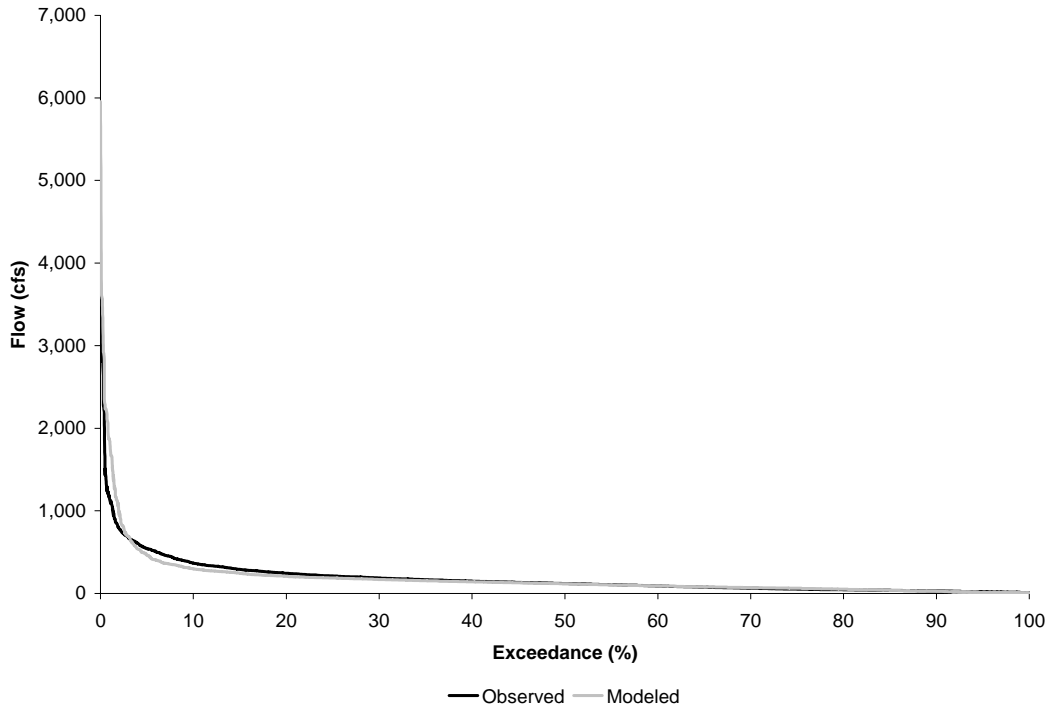
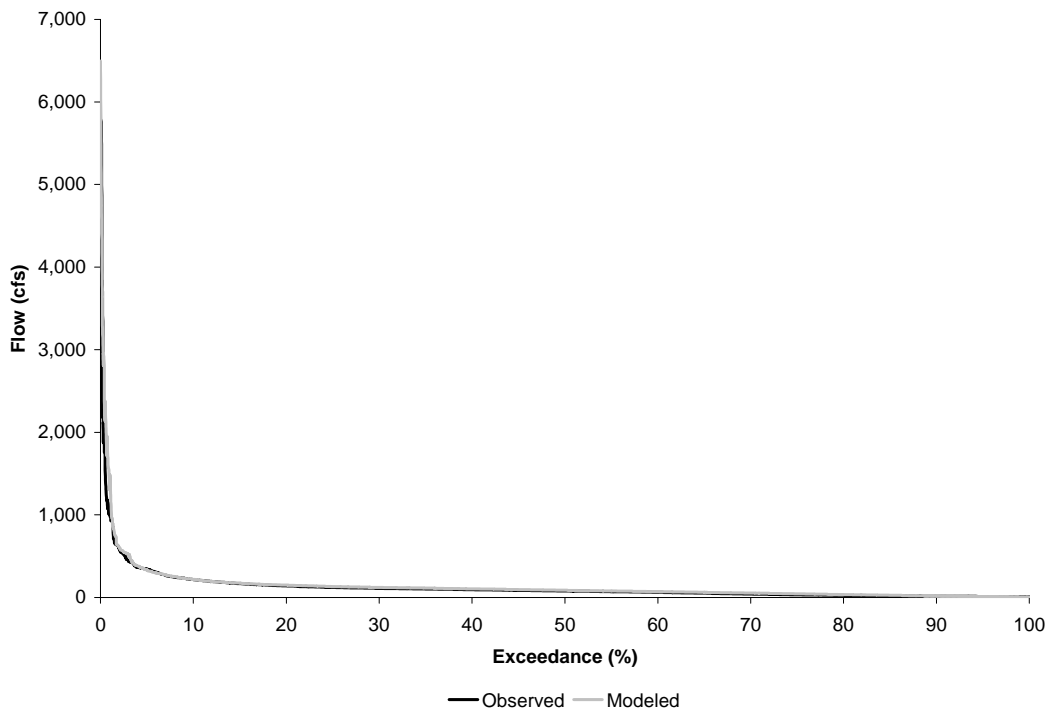


Figure 10. Observed and modeled flows for the validation period 10/1/94 to 9/30/99 in Upper Rapidan River watershed.



**Figure 11. Cumulative frequency curves for the calibration period 10/1/89 to 9/30/94 in Upper Rapidan River watershed.**



**Figure 12. Cumulative frequency curves for the validation period 10/1/94 to 9/30/99 in Upper Rapidan River watershed.**

**Table 7. Flow partitioning for the calibration and validation periods in Upper Rapidan River watershed.**

Average Annual Flow	Calibration	Validation
Total Runoff (in)	66.5	50.2
Surface Runoff (in)	11.2 (16.9%)	9.9 (19.7%)
Interflow (in)	10.0 (15.1%)	6.8 (13.5%)
Baseflow (in)	45.3 (68.1%)	33.6 (66.8%)

**Table 8. Summary statistics for the calibration period (10/1/89 to 9/30/94) in Upper Rapidan River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Runoff (in)	10	106.4	105.6	-0.8
Total of Highest 10% Flows (in)	15	41.6	45.7	9.0
Total of Lowest 50% Flows (in)	10	17.2	17.5	1.7
Total Winter Runoff (in)	20	37.9	38.4	1.3
Total Summer Runoff (in)	20	10.2	10.1	-1.0
Total Storm Runoff (in)	20	98.1	100.8	2.7
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.77			

**Table 9. Summary statistics for the validation period (10/1/94 to 9/30/99) in Upper Rapidan River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Volume (in)	20	71.2	79.8	10.8
Total of Highest 10% Flows (in)	25	32.0	36.2	11.6
Total of Lowest 50% Flows (in)	20	11.2	13.0	13.8
Total Winter Flow (in)	30	18.7	18.8	0.5
Total Summer Flow Volume (in)	30	10.4	8.8	-18.2
Total Storm Volume (in)	30	65.5	76.3	14.2
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.66			

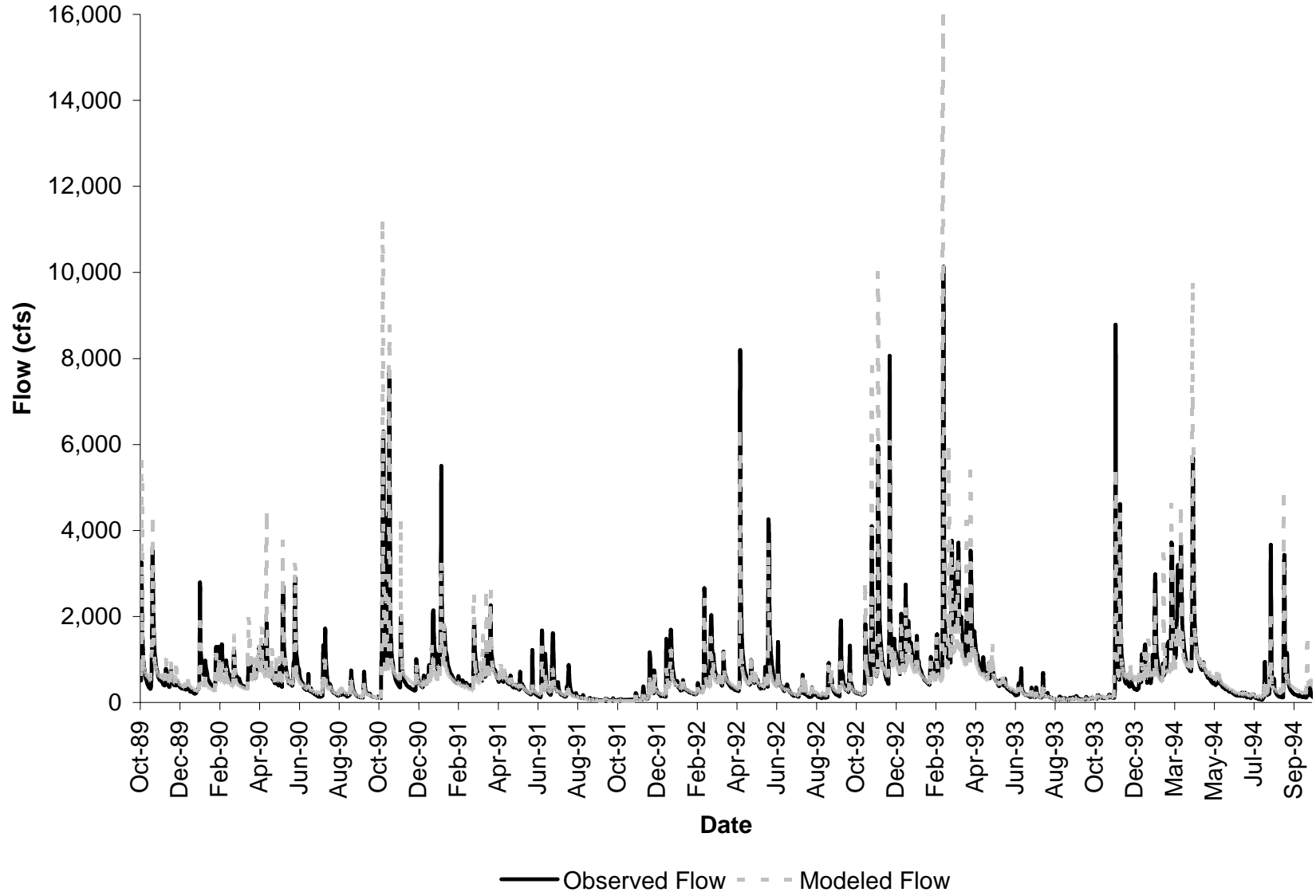


Figure 13. Observed and modeled flows for the calibration period 10/1/89 to 9/30/94 in Lower Rapidan River watershed.

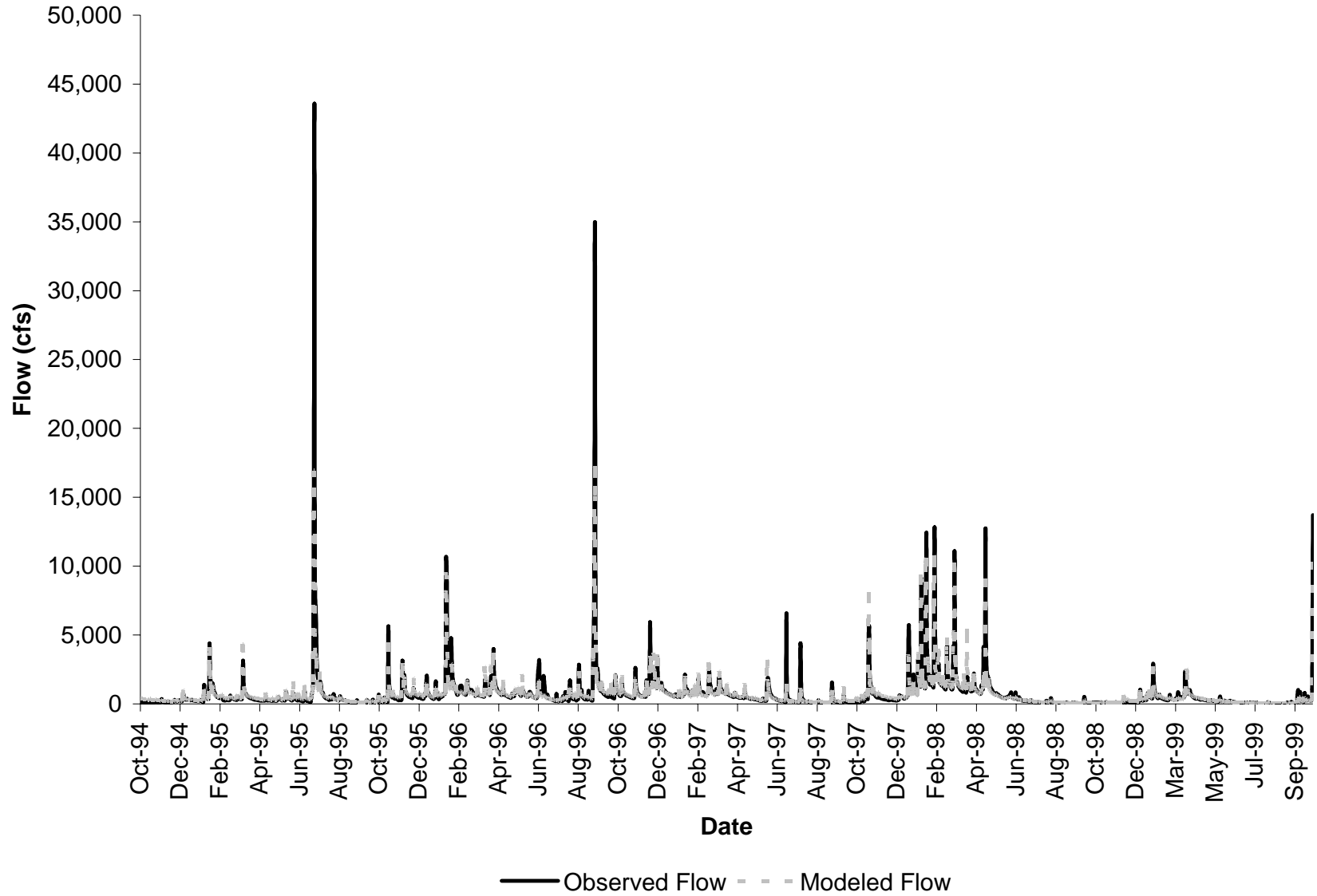
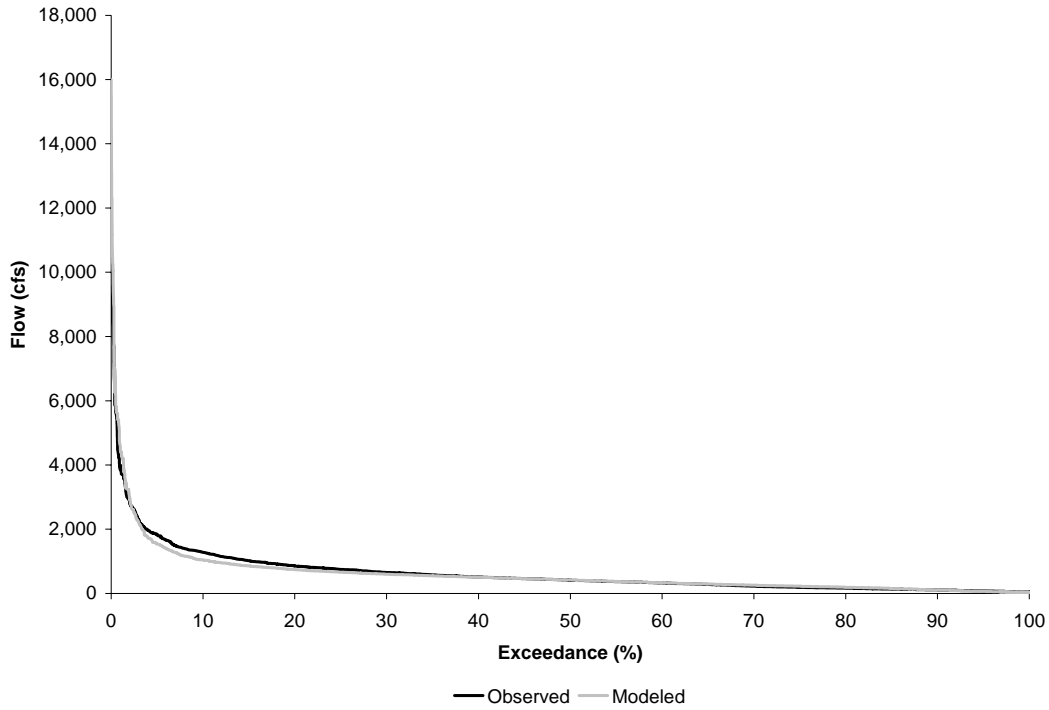
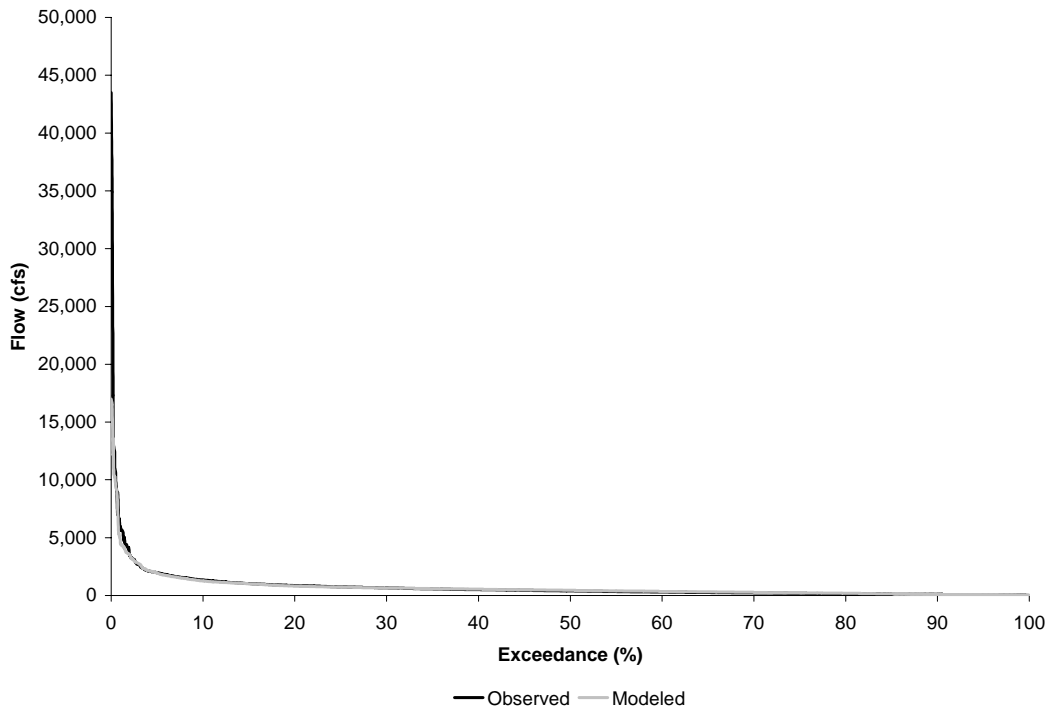


Figure 14. Observed and modeled flows for the validation period 10/1/94 to 9/30/99 in Lower Rapidan River watershed.



**Figure 15. Cumulative frequency curves for the calibration period 10/1/89 to 9/30/94 in Lower Rapidan River watershed.**



**Figure 16. Cumulative frequency curves for the validation period 10/1/94 to 9/30/99 in Lower Rapidan River watershed.**



**Table 10. Flow partitioning for the calibration and validation periods in Lower Rapidan River watershed.**

Average Annual Flow	Calibration	Validation
Total Runoff (in)	65.8	64.0
Surface Runoff (in)	17.8 (27.1%)	18.0 (28.1%)
Interflow (in)	13.5 (20.5%)	13.7 (21.4%)
Baseflow (in)	34.5 (52.4%)	32.3 (50.5%)

**Table 11. Summary statistics for the calibration period (10/1/89 to 9/30/94) in Lower Rapidan River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Runoff (in)	10	154.1	148.3	-3.9
Total of Highest 10% Flows (in)	15	57.9	57.7	-0.3
Total of Lowest 50% Flows (in)	10	25.9	27.5	5.8
Total Winter Runoff (in)	20	59.2	53.5	-10.7
Total Summer Runoff (in)	20	16.0	15.7	-1.9
Total Storm Runoff (in)	20	139.2	137.9	-0.9
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.88			

**Table 12. Summary statistics for the validation period (10/1/94 to 9/30/99) in Lower Rapidan River watershed.**

	Criterion (%)	Observed	Modeled	Error (%)
Total Volume (in)	20	177.4	168.9	-5.0
Total of Highest 10% Flows (in)	25	83.7	71.0	-17.9
Total of Lowest 50% Flows (in)	20	23.3	27.9	16.5
Total Winter Flow (in)	30	68.3	67.4	-1.3
Total Summer Flow Volume (in)	30	30.7	24.6	-24.8
Total Storm Volume (in)	30	168.6	160.6	-5.0
Groundwater Recession Coefficient	1	0.97	0.98	1.0
Coefficient of Determination, $r^2$	0.91			