APPENDIX C: WATERSHED MODEL CALIBRATION RESULTS

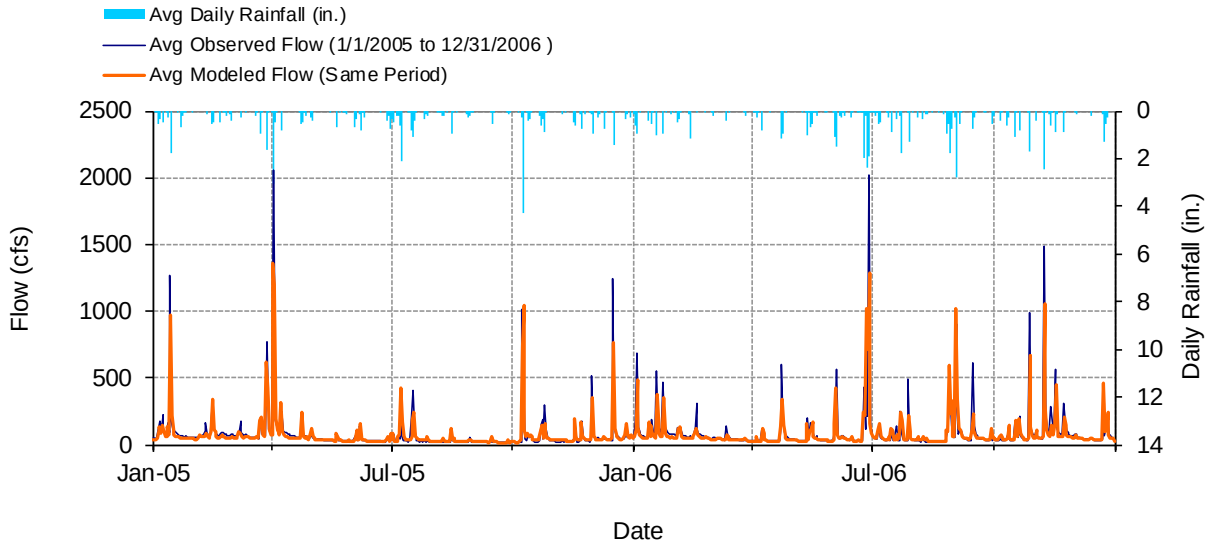

Figure F-1. Mean daily flow: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

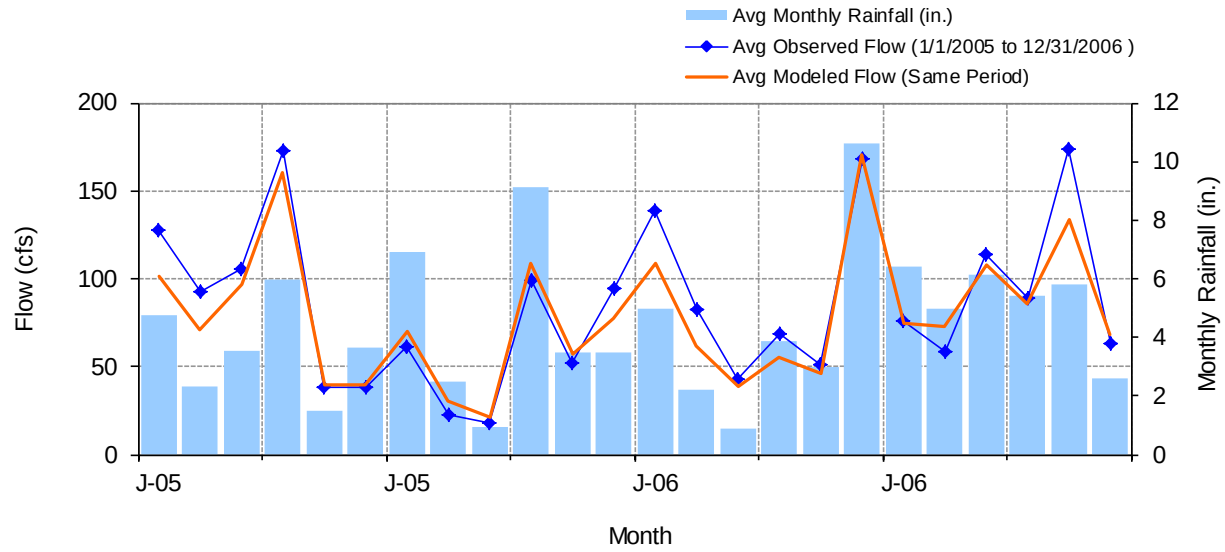

Figure H-2. Mean monthly flow: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

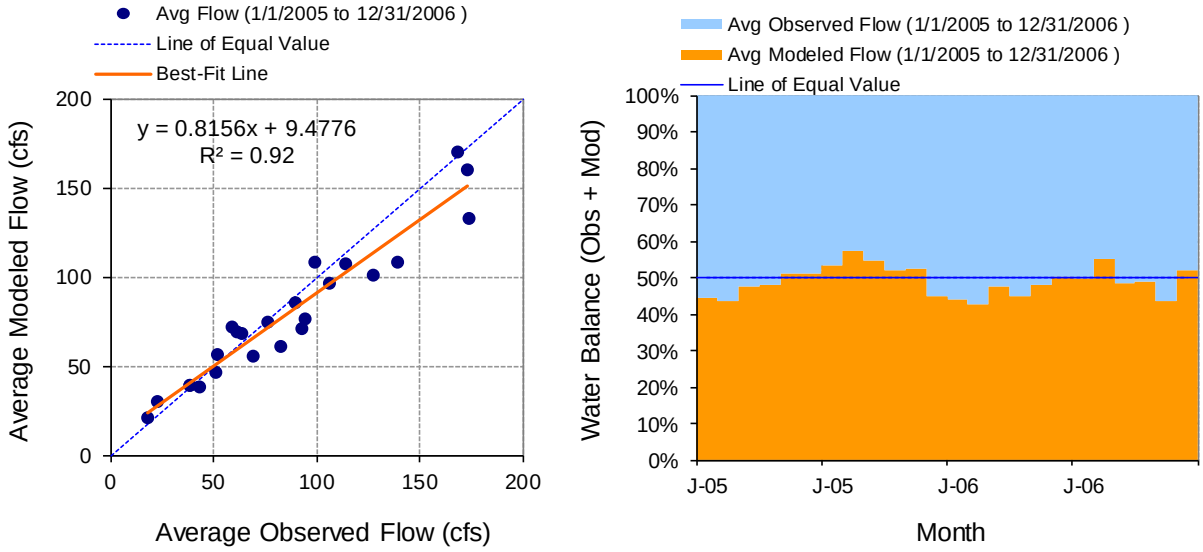

Figure F-3. Monthly flow regression and temporal variation: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

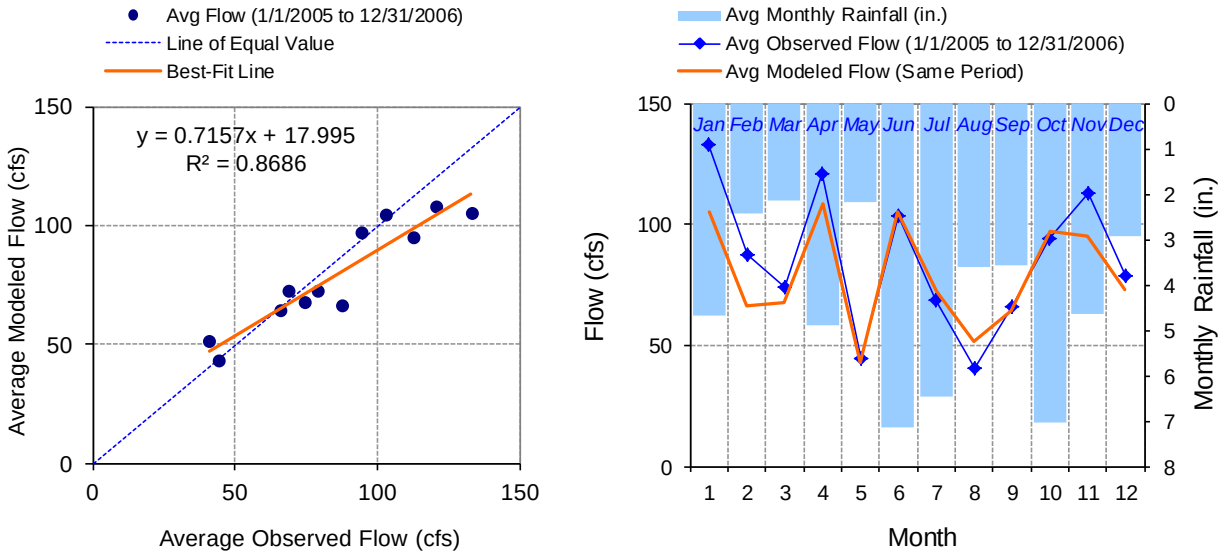

Figure F-4. Seasonal regression and temporal aggregate: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

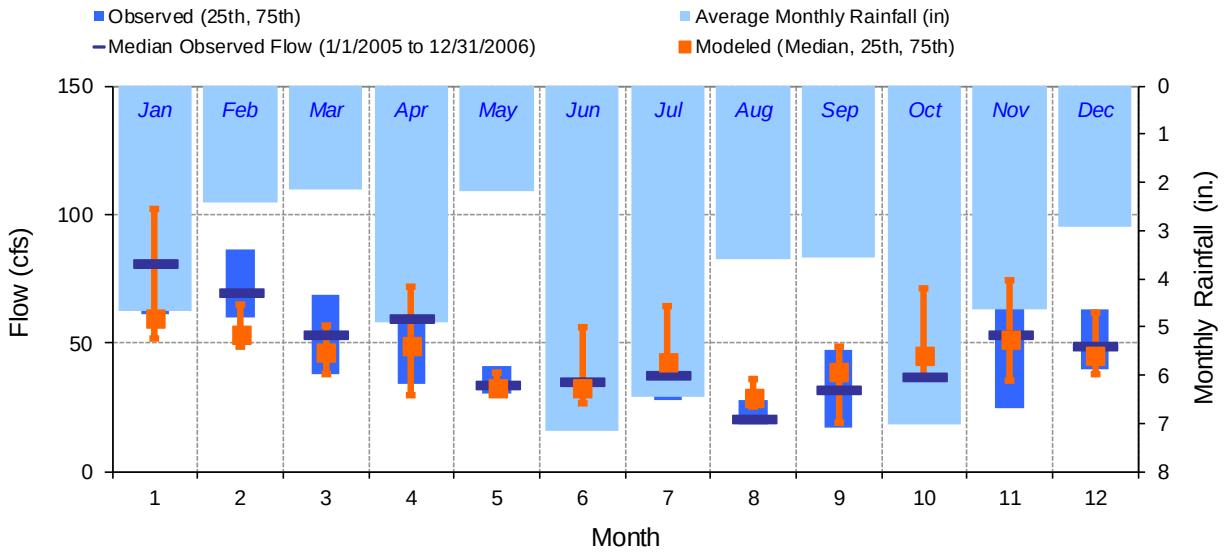

Figure F-5. Seasonal medians and ranges: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

Table F-1. Seasonal summary: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Jan	133.10	80.50	61.00	115.25	105.04	59.29	51.54	102.08
Feb	87.59	69.00	59.75	86.50	66.48	53.14	48.25	65.09
Mar	74.32	52.50	38.00	68.75	67.67	46.24	37.62	56.81
Apr	120.90	59.00	34.00	88.75	108.17	48.94	29.70	72.15
May	44.31	33.00	30.00	40.75	43.02	32.56	30.00	38.45
Jun	103.13	34.50	28.00	58.25	104.93	32.48	26.77	56.11
Jul	68.58	37.00	28.00	61.25	72.47	42.81	37.29	64.40
Aug	40.82	20.00	18.00	27.50	51.57	28.40	25.18	36.06
Sep	65.63	31.00	17.00	47.50	64.35	38.53	18.88	48.65
Oct	94.18	36.50	29.00	67.75	97.13	45.29	36.83	71.14
Nov	112.60	52.50	24.75	100.25	95.16	51.24	35.57	74.42
Dec	78.85	48.00	40.00	62.75	72.89	45.02	37.99	61.57

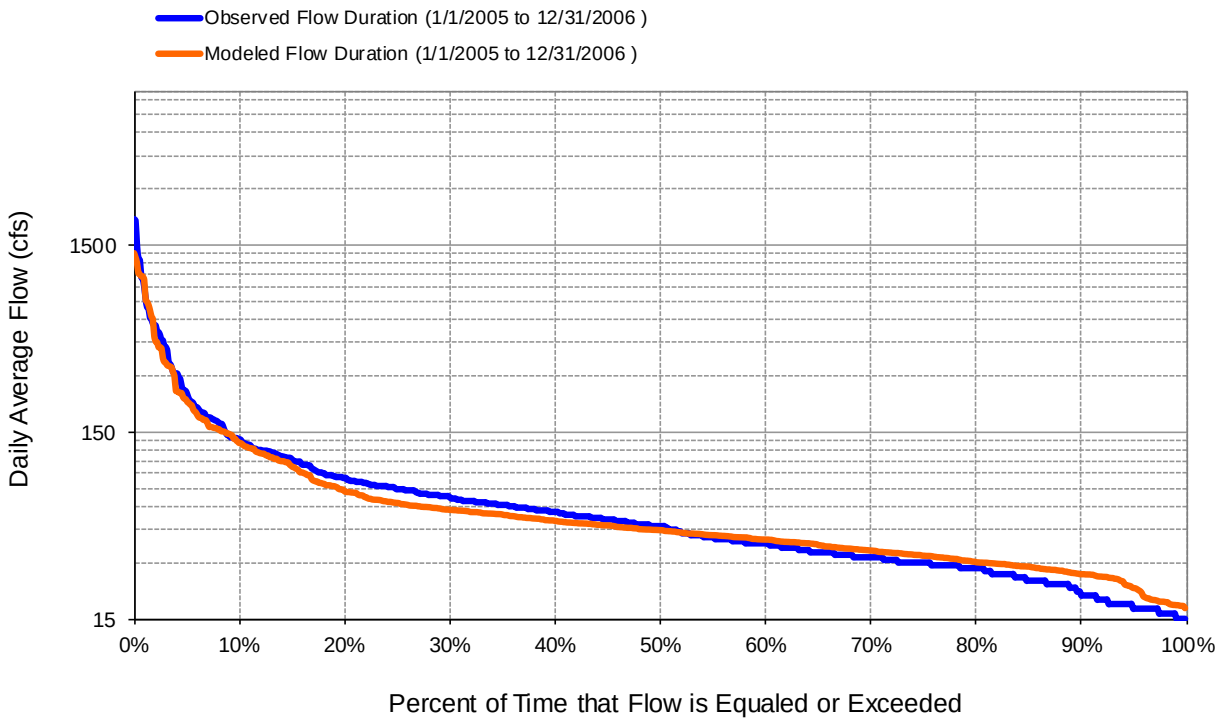

Figure F-6. Flow exceedence: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

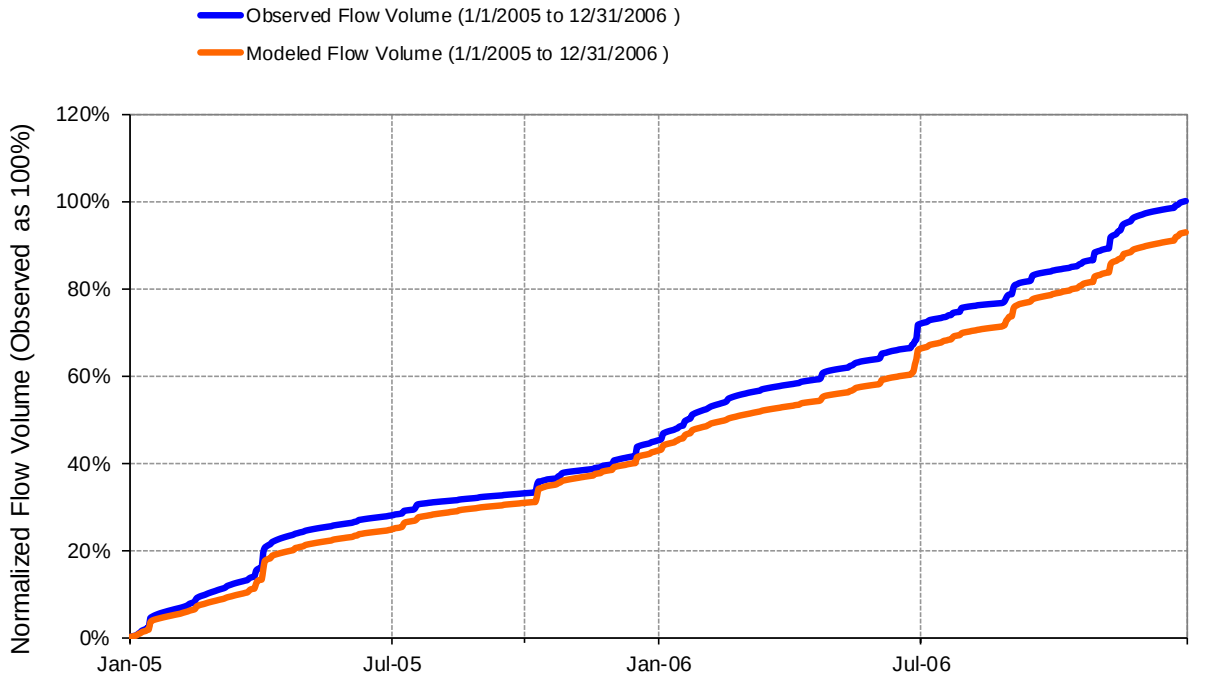

Figure F-7. Flow accumulation: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

Table F-2. Summary statistics: Model Outlet 39 vs. USGS 01473900 Wissahickon Creek at Fort Washington, PA

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 39 2-Year Analysis Period: 1/1/2005 - 12/31/2006 Flow volumes are (inches/year) for upstream drainage area		USGS 01473900 Wissahickon Creek at Fort Washington, PA Hydrologic Unit Code: 2040203 Latitude: 40.1239987 Longitude: -75.2198992 Drainage Area (sq-mi): 40.8		
Total Simulated In-stream Flow:	**26.31**	Total Observed In-stream Flow:		**28.35**
Total of simulated highest 10% flows:	**12.21**	Total of Observed highest 10% flows:		**13.72**
Total of Simulated lowest 50% flows:	**5.42**	Total of Observed Lowest 50% flows:		**4.94**
Simulated Summer Flow Volume (months 7-9):	**5.27**	Observed Summer Flow Volume (7-9):		**4.89**
Simulated Fall Flow Volume (months 10-12):	**7.41**	Observed Fall Flow Volume (10-12):		**7.97**
Simulated Winter Flow Volume (months 1-3):	**6.58**	Observed Winter Flow Volume (1-3):		**8.10**
Simulated Spring Flow Volume (months 4-6):	**7.05**	Observed Spring Flow Volume (4-6):		**7.38**
Total Simulated Storm Volume:	**12.75**	Total Observed Storm Volume:		**14.14**
Simulated Summer Storm Volume (7-9):	**2.43**	Observed Summer Storm Volume (7-9):		**2.56**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1999*	*2000-2004*
Error in total volume:	-7.20	10	-1.43	7.35
Error in 50% lowest flows:	9.79	10	-1.60	-3.91
Error in 10% highest flows:	-11.01	15	2.26	1.75
Seasonal volume error - Summer:	7.75	30	13.27	-2.52
Seasonal volume error - Fall:	-7.05	30	4.49	12.42
Seasonal volume error - Winter:	-18.77	30	-18.21	13.31
Seasonal volume error - Spring:	-4.55	30	1.90	6.11
Error in storm volumes:	-9.82	20	1.13	12.07
Error in summer storm volumes:	-5.18	50	3.16	15.42
Nash-Sutcliffe Coefficient of Efficiency, E:	0.799	Model accuracy increases	0.688	0.814
Baseline adjusted coefficient (Garrick), E':	0.628	as E or E' approaches 1.0	0.517	0.549

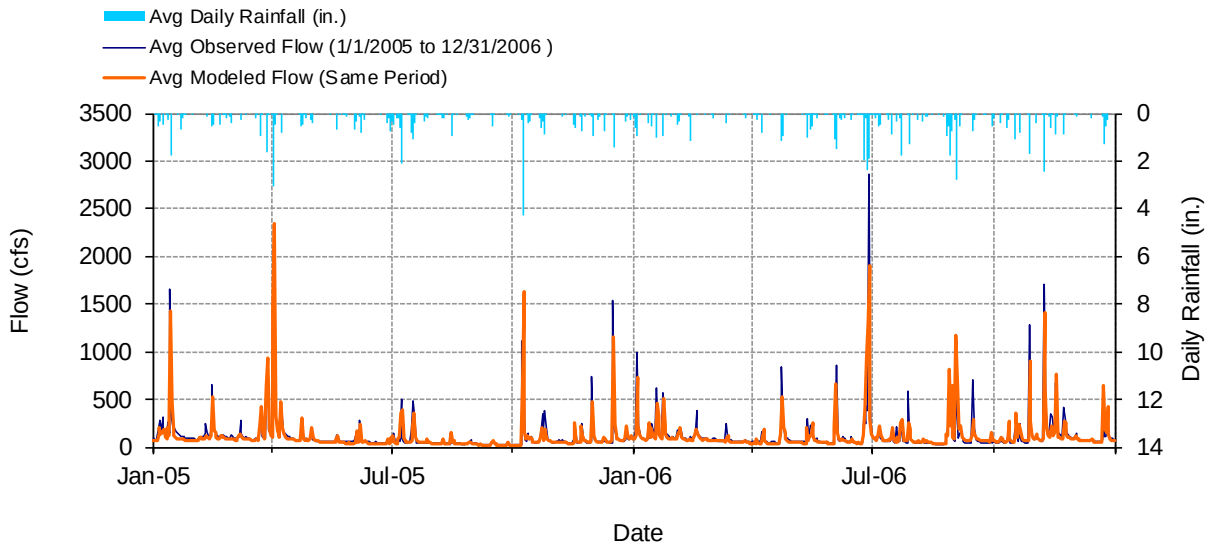

Figure F-8. Mean daily flow: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

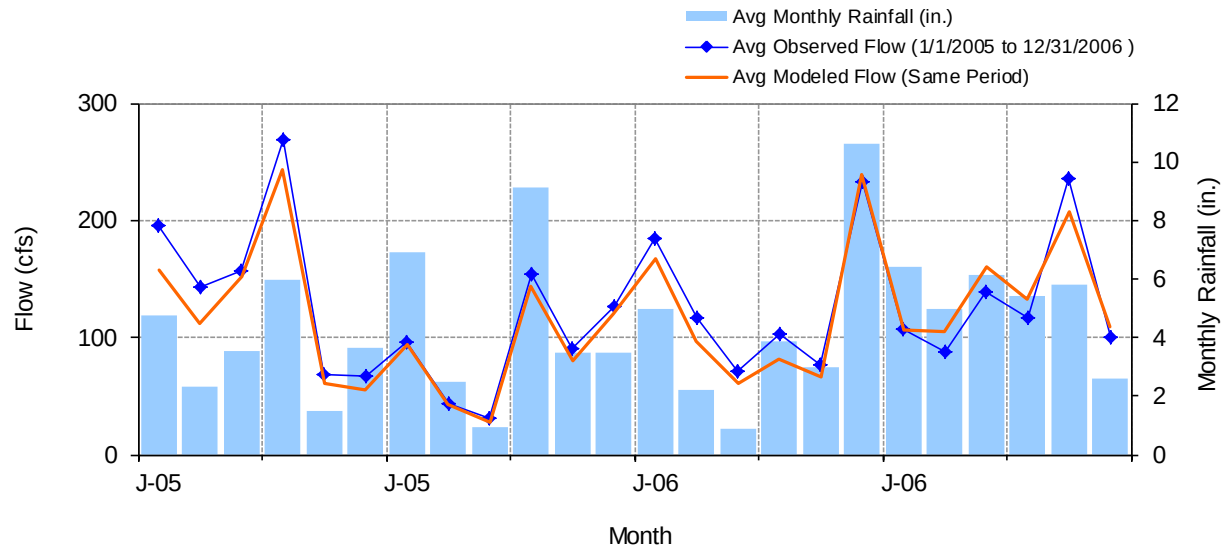

Figure F-9. Mean monthly flow: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

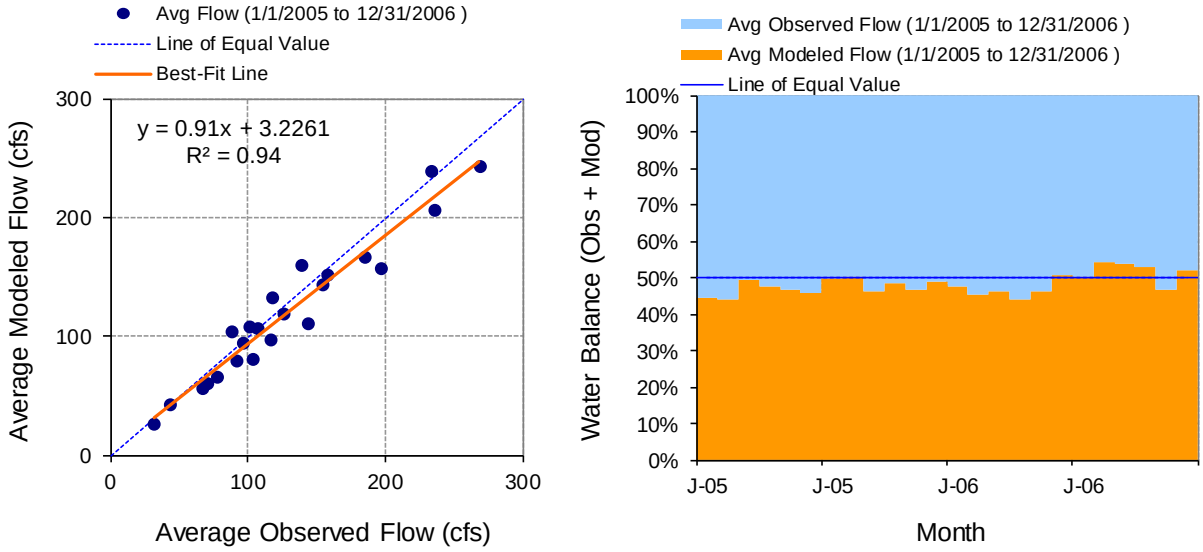

Figure F-10. Monthly flow regression and temporal variation: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

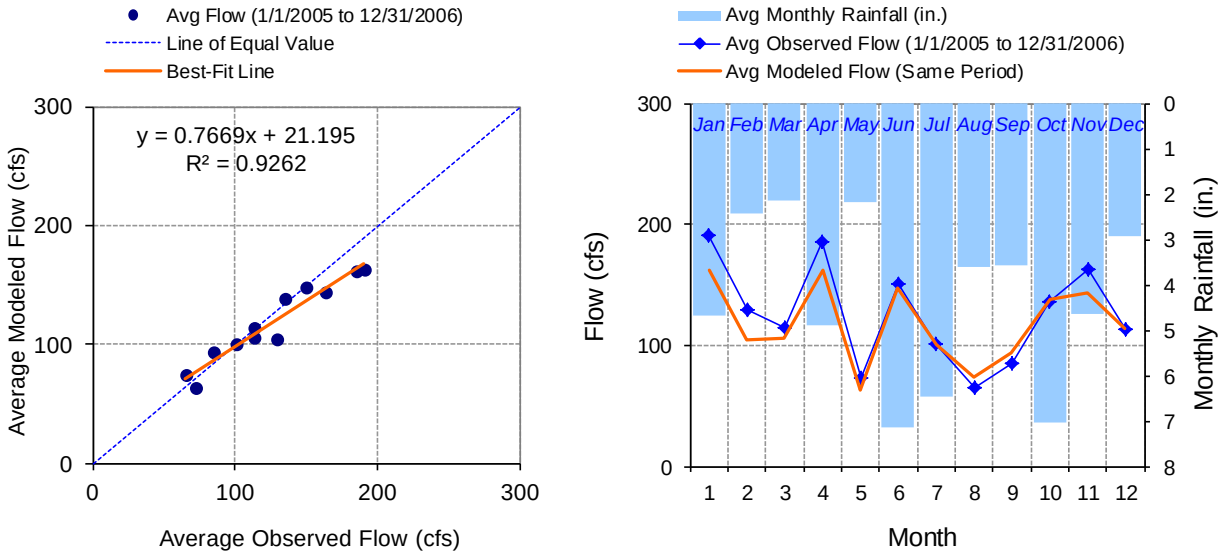

Figure F-11. Seasonal regression and temporal aggregate: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

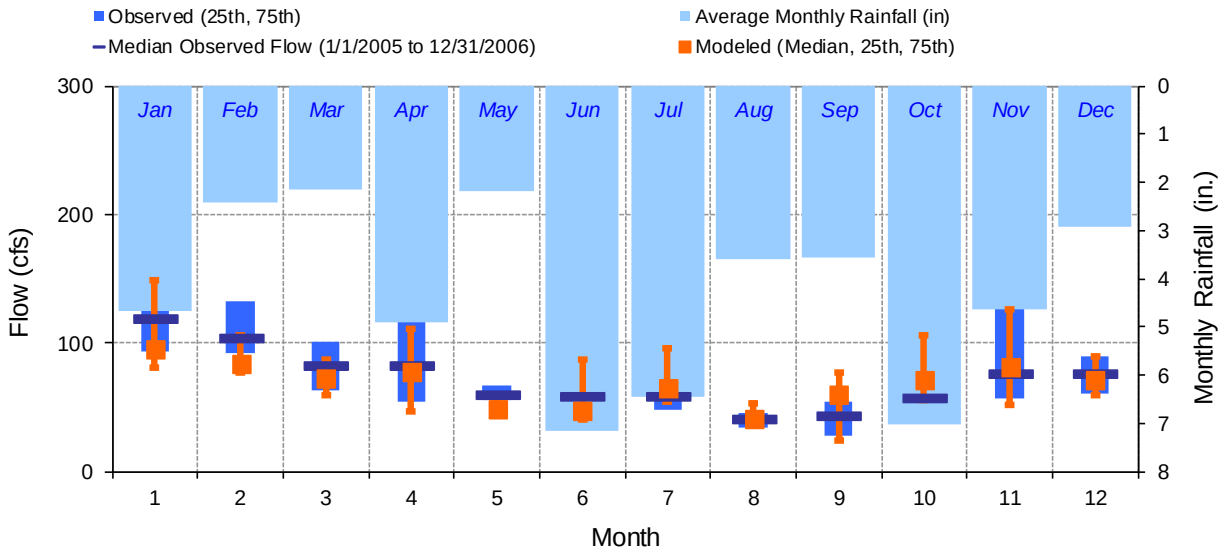

Figure F-12. Seasonal medians and ranges: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

Table F-3. Seasonal summary: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

MONTH	OBSERVED FLOW (CFS)				MODELED FLOW (CFS)			
	MEAN	MEDIAN	25TH	75TH	MEAN	MEDIAN	25TH	75TH
Jan	190.53	118.00	93.25	178.25	162.70	94.87	80.91	149.19
Feb	129.77	102.50	91.75	131.75	104.41	84.33	77.49	105.89
Mar	113.87	81.50	63.00	100.50	106.14	72.17	58.99	87.57
Apr	185.90	81.50	54.00	138.00	161.94	77.34	46.28	110.36
May	72.95	59.00	55.00	66.75	63.44	48.43	44.13	59.42
Jun	150.07	57.50	49.00	90.25	147.69	47.04	39.88	87.26
Jul	101.35	57.50	48.00	91.75	100.60	65.31	54.24	95.49
Aug	65.32	40.00	34.25	46.00	74.02	40.45	36.05	53.09
Sep	85.10	42.50	28.00	54.50	93.54	59.57	24.30	76.34
Oct	135.58	55.50	45.00	104.00	138.04	71.79	56.08	105.87
Nov	163.30	75.00	56.75	146.75	143.44	80.93	52.14	126.18
Dec	113.26	74.50	60.50	89.75	114.12	71.78	59.47	89.55

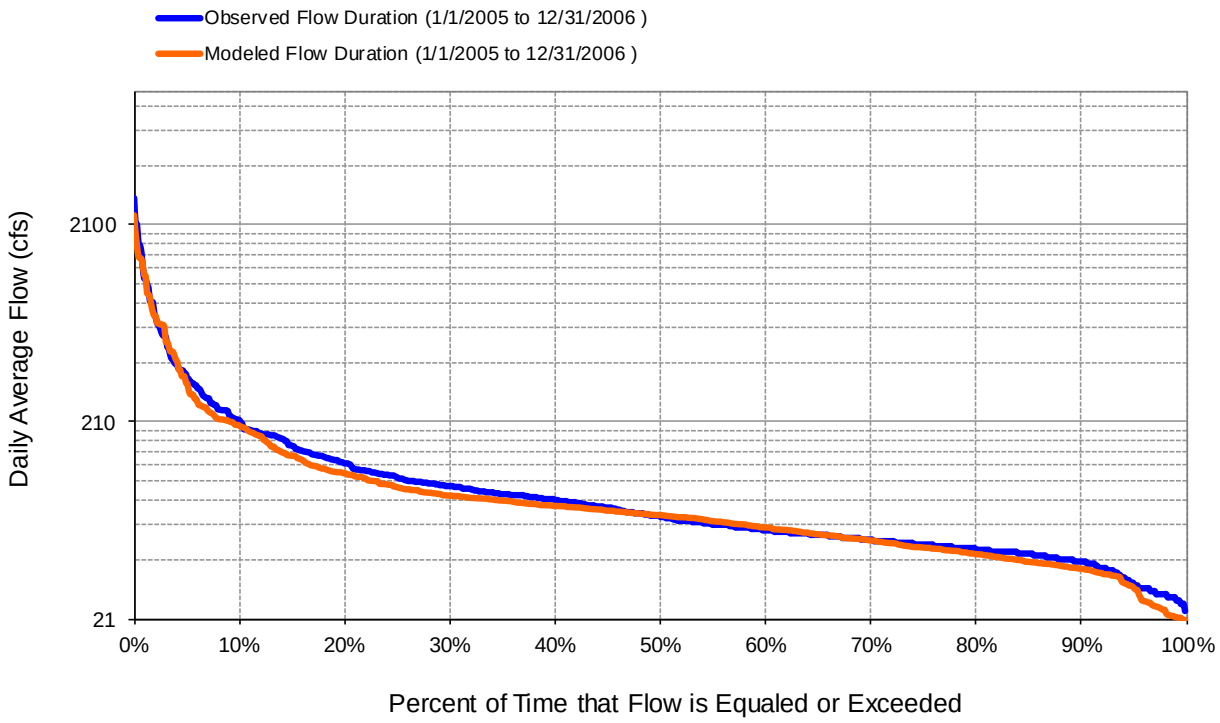

Figure F-13. Flow exceedence: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

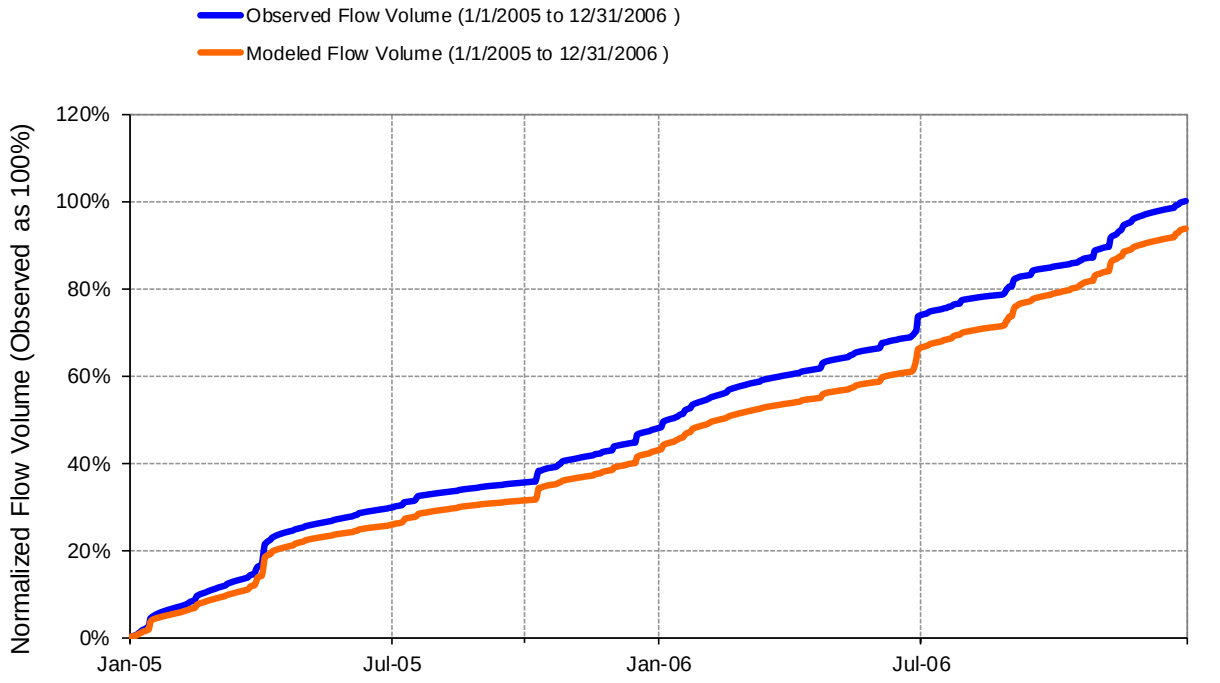

Figure F-14. Flow accumulation: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

Table F-4. Summary statistics: Model Outlet 1 vs. USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA

LSPC Simulated Flow		Observed Flow Gage		
REACH OUTFLOW FROM SUBBASIN 1 2-Year Analysis Period: 1/1/2005 - 12/31/2006 Flow volumes are (inches/year) for upstream drainage area		USGS 01474000 Wissahickon Creek at Mouth, Philadelphia, PA Hydrologic Unit Code: 2040203 Latitude: 40.01539 Longitude: -75.2068459 Drainage Area (sq-mi): 64		
Total Simulated In-stream Flow:	**24.92**	Total Observed In-stream Flow:		**26.60**
Total of simulated highest 10% flows:	**11.26**	Total of Observed highest 10% flows:		**12.07**
Total of Simulated lowest 50% flows:	**5.15**	Total of Observed Lowest 50% flows:		**5.26**
Simulated Summer Flow Volume (months 7-9):	**4.78**	Observed Summer Flow Volume (7-9):		**4.49**
Simulated Fall Flow Volume (months 10-12):	**7.05**	Observed Fall Flow Volume (10-12):		**7.33**
Simulated Winter Flow Volume (months 1-3):	**6.55**	Observed Winter Flow Volume (1-3):		**7.60**
Simulated Spring Flow Volume (months 4-6):	**6.55**	Observed Spring Flow Volume (4-6):		**7.18**
Total Simulated Storm Volume:	**11.66**	Total Observed Storm Volume:		**12.34**
Simulated Summer Storm Volume (7-9):	**2.08**	Observed Summer Storm Volume (7-9):		**2.13**
Errors (Simulated-Observed)	*Error Statistics*	*Recommended Criteria*	*1995-1999*	*2000-2004*
Error in total volume:	-6.32	10	-1.43	7.35
Error in 50% lowest flows:	-2.12	10	-1.60	-3.91
Error in 10% highest flows:	-6.69	15	2.26	1.75
Seasonal volume error - Summer:	6.46	30	13.27	-2.52
Seasonal volume error - Fall:	-3.91	30	4.49	12.42
Seasonal volume error - Winter:	-13.87	30	-18.21	13.31
Seasonal volume error - Spring:	-8.79	30	1.90	6.11
Error in storm volumes:	-5.49	20	1.13	12.07
Error in summer storm volumes:	-2.35	50	3.16	15.42
Nash-Sutcliffe Coefficient of Efficiency, E:	0.839	Model accuracy increases	0.688	0.814
Baseline adjusted coefficient (Garrick), E':	0.643	as E or E' approaches 1.0	0.517	0.549

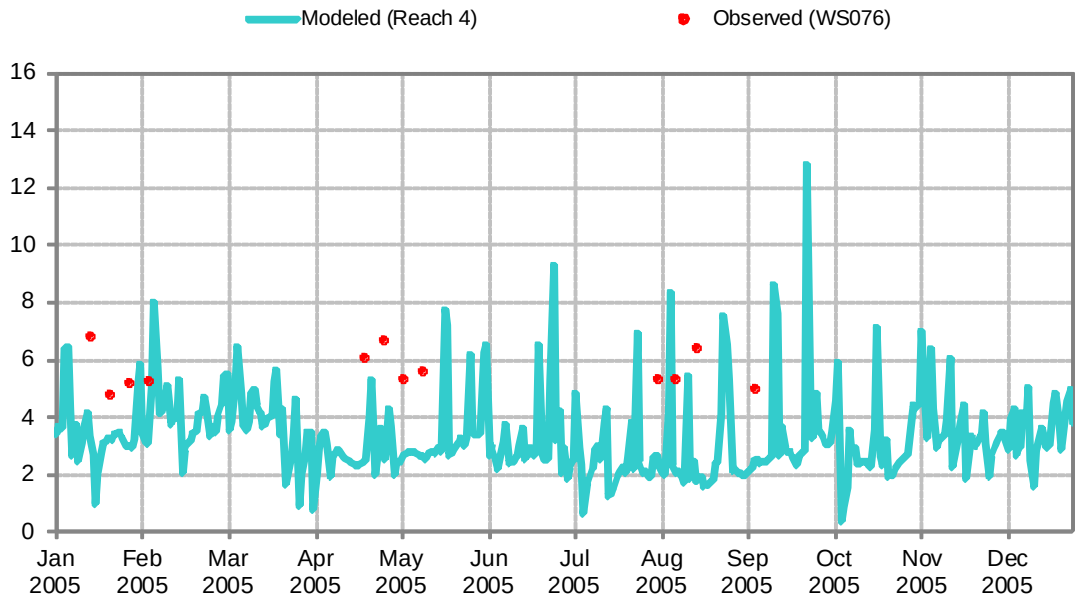

Figure F-15. Modeled vs. Observed BOD30 (mg/L) at WS076

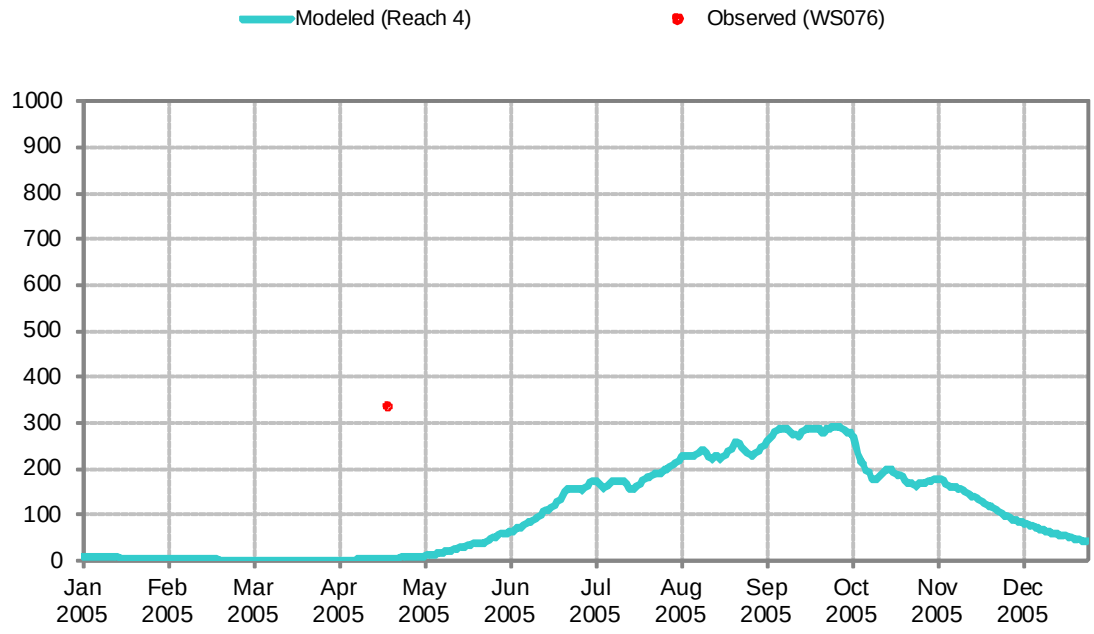

Figure F-16. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS076

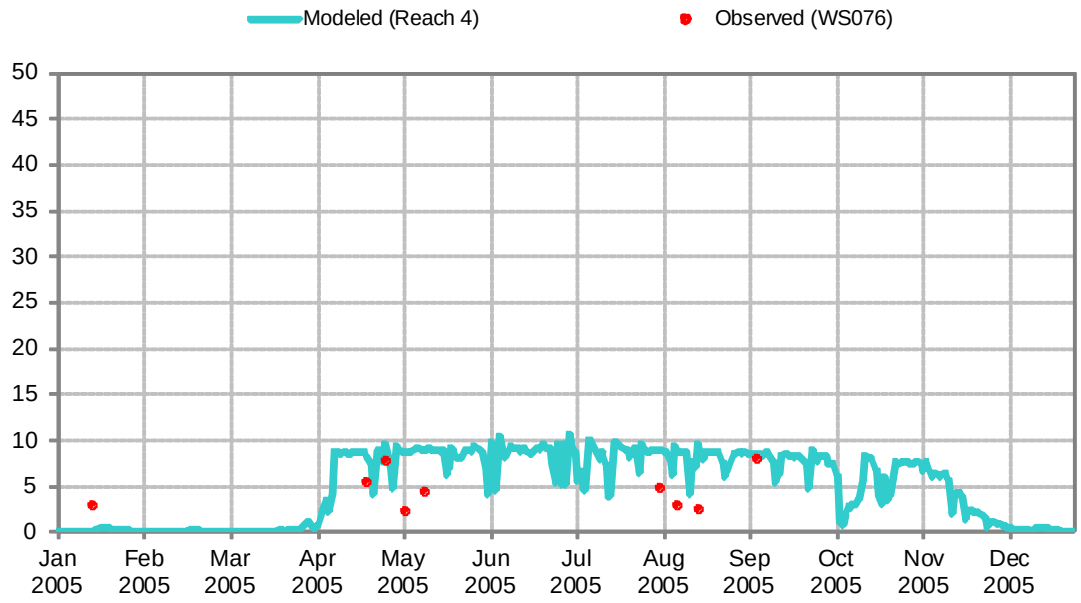

Figure F-17. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS076

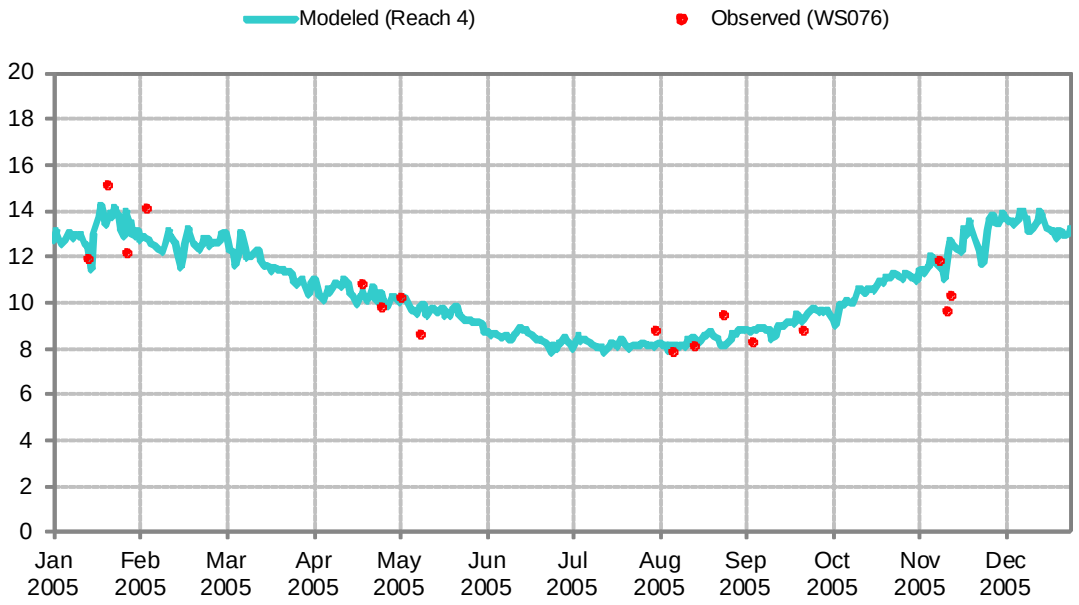

Figure F-18. Modeled vs. Observed DO (mg/L) at WS076

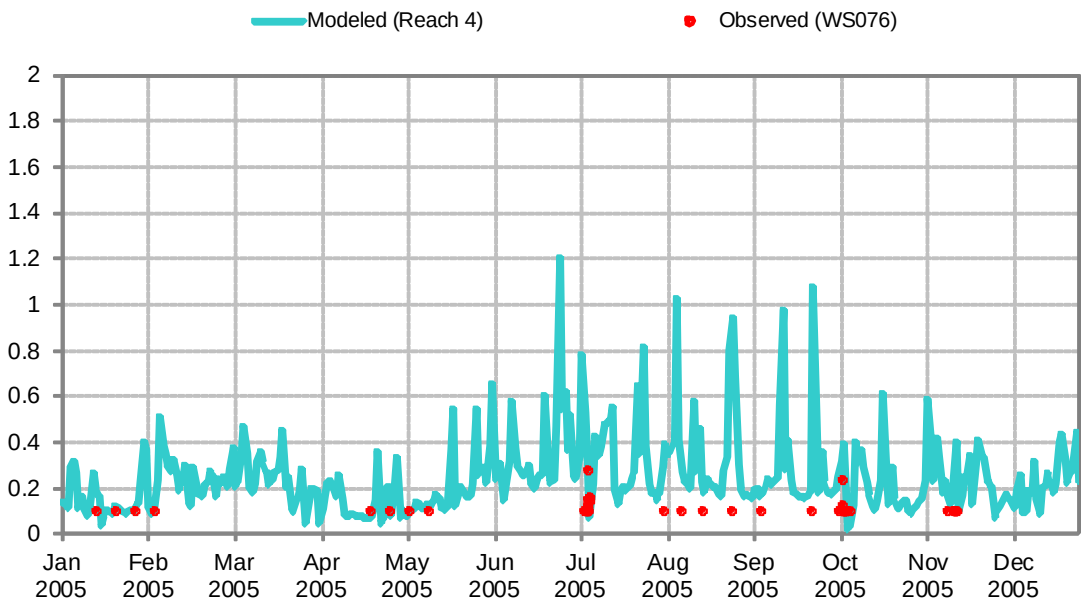

Figure F-19. Modeled vs. Observed NH3T (mg/L as N) at WS076

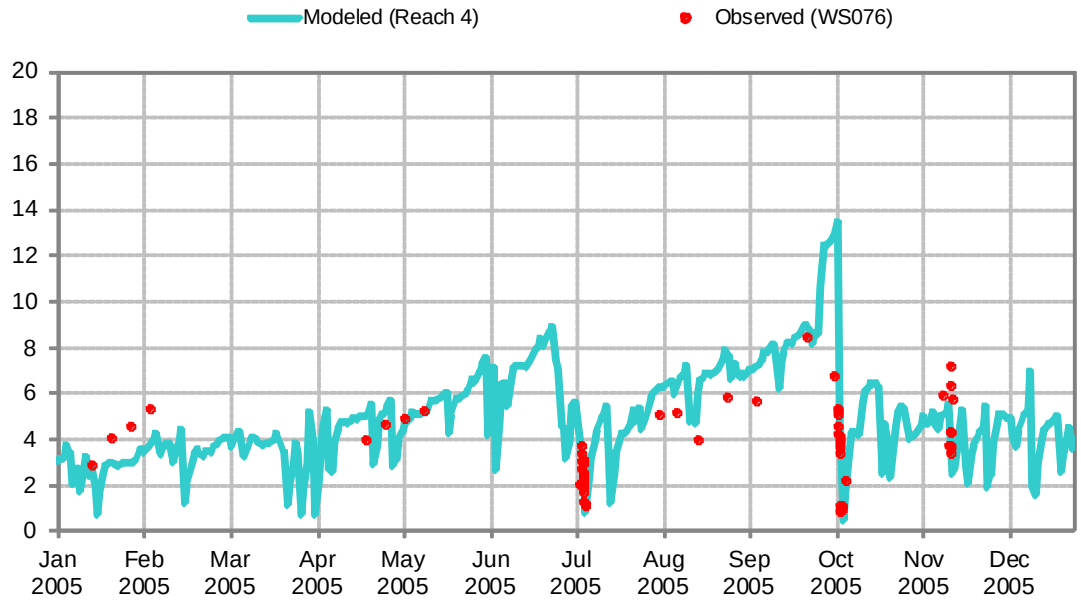

Figure F-20. Modeled vs. Observed NO3 (mg/L) at WS076

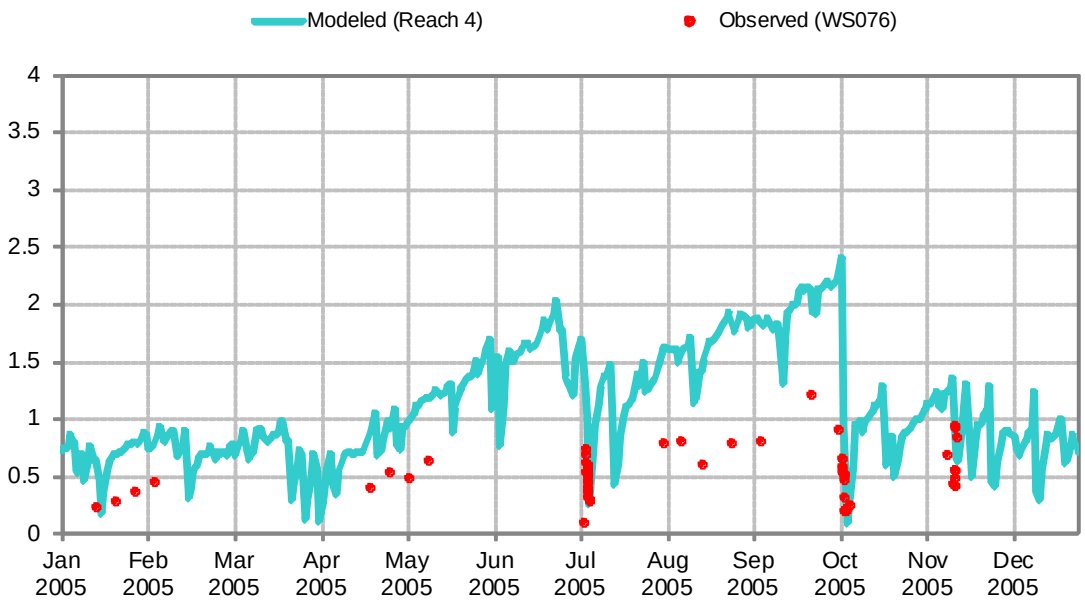

Figure F-21. Modeled vs. Observed PO4 (mg/L) at WS076

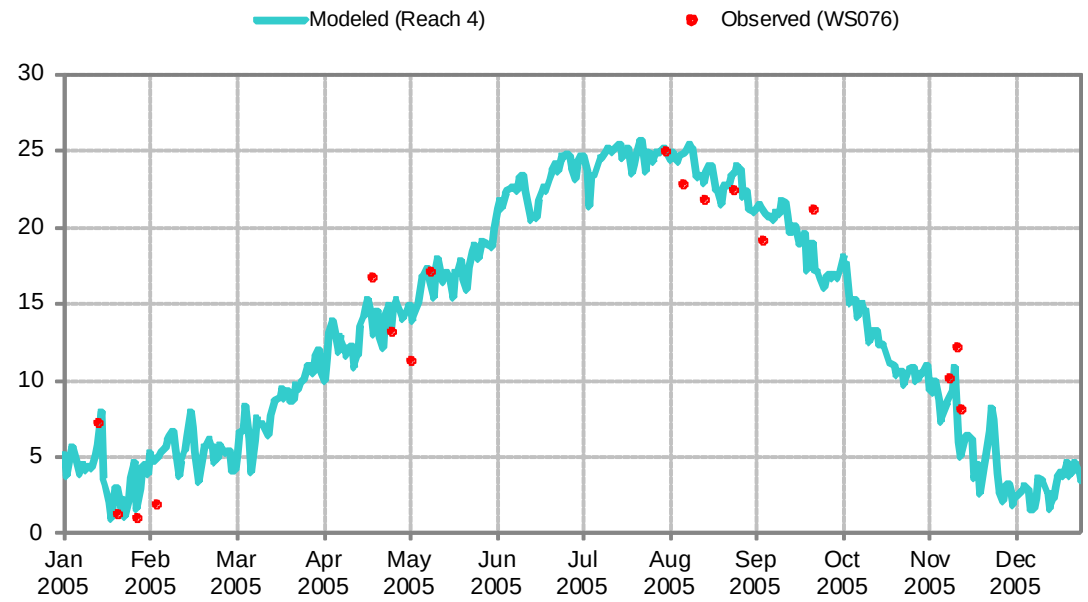

Figure F-22. Modeled vs. Observed Temperature (°C) at WS076

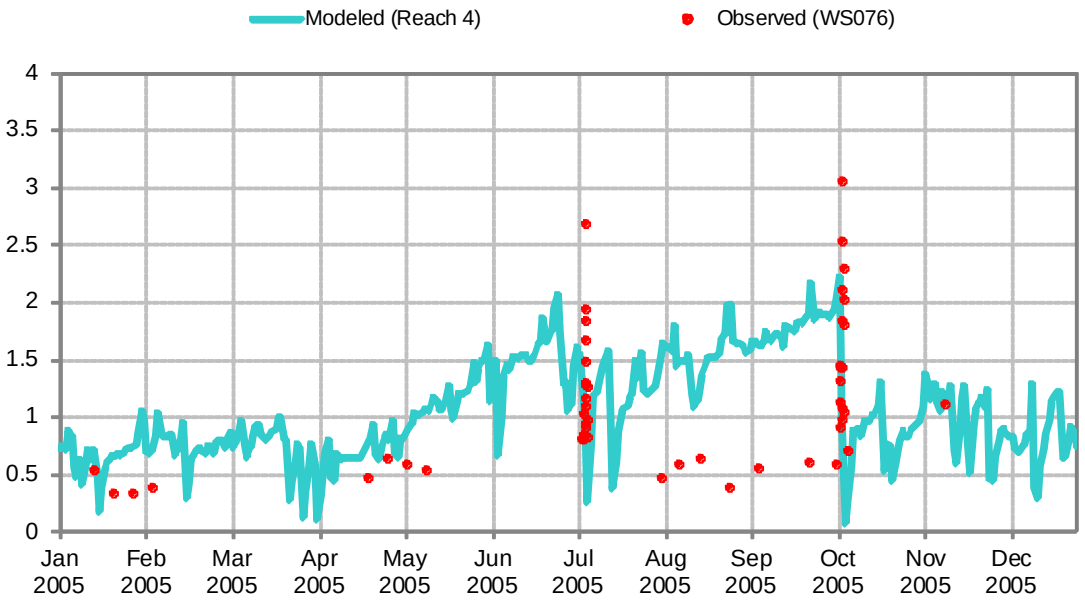

Figure F-23. Modeled vs. Observed TKN (mg/L) at WS076

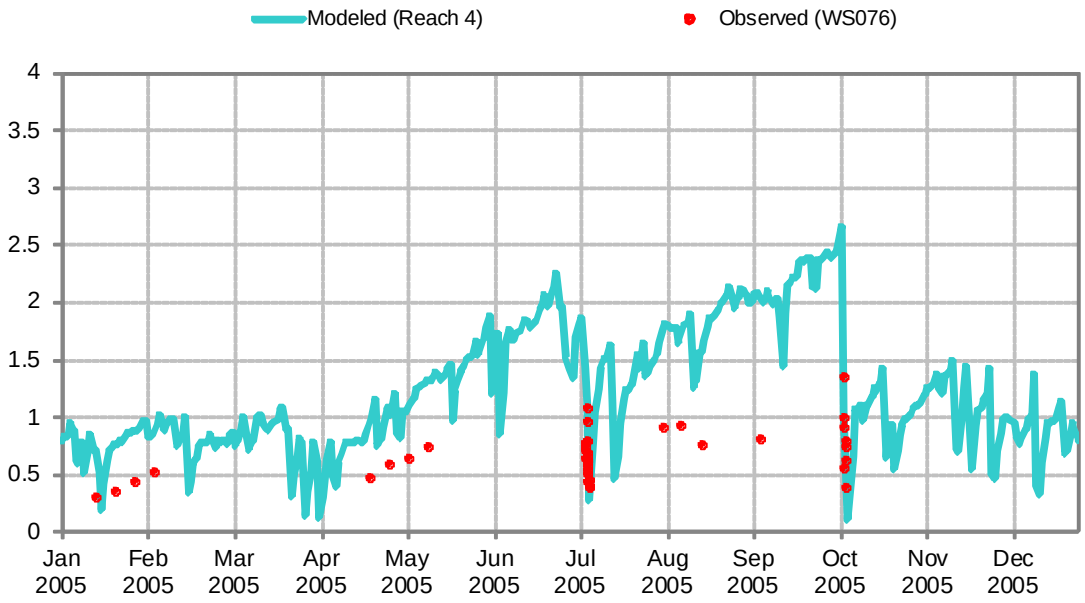

Figure F-24. Modeled vs. Observed TP (mg/L) at WS076

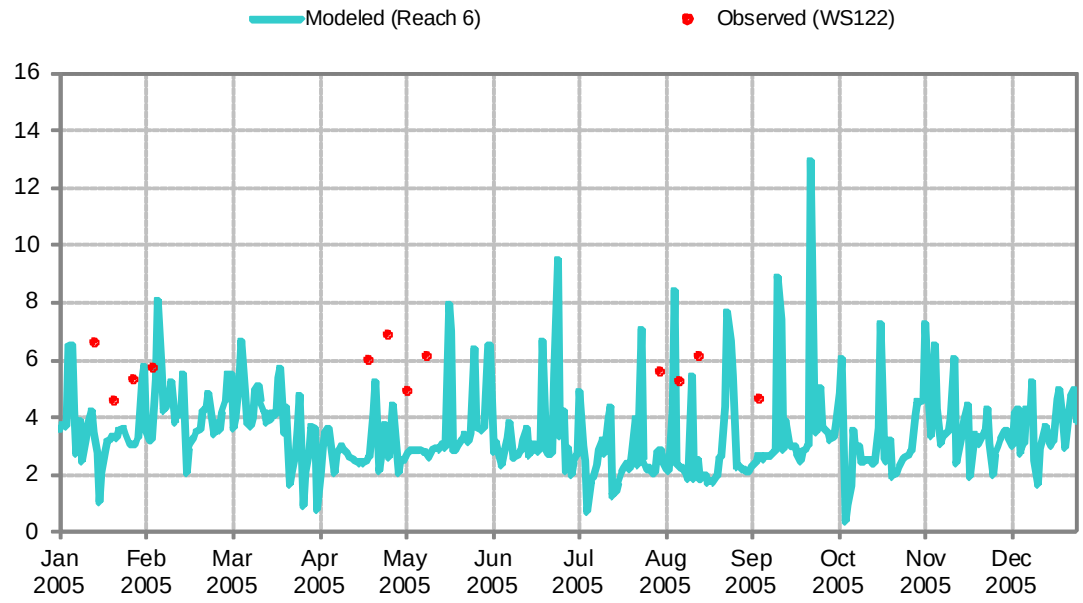

Figure F-25. Modeled vs. Observed BOD30 (mg/L) at WS122

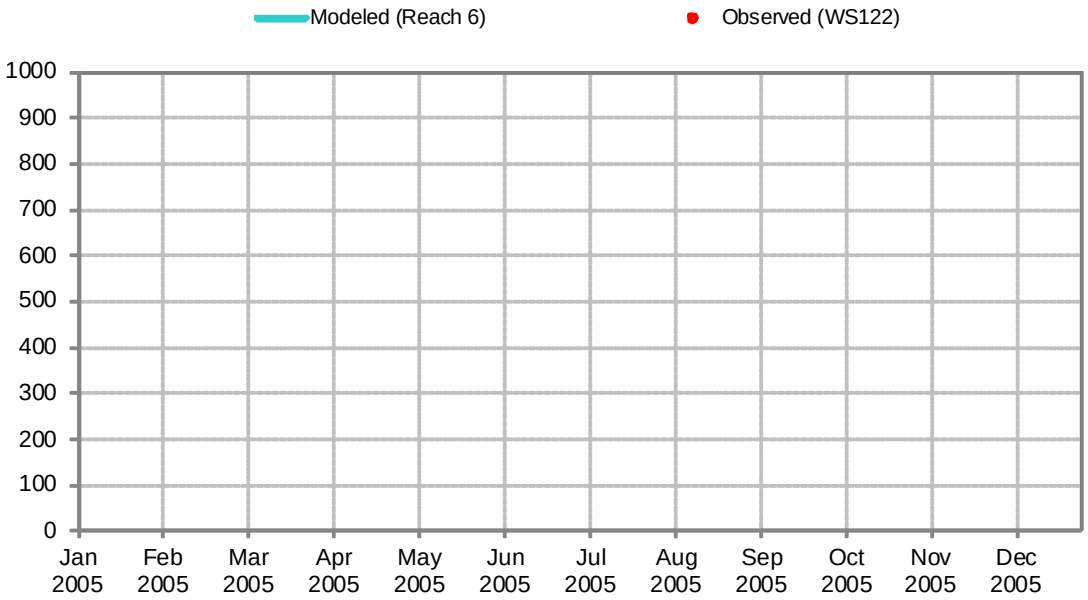

Figure F-26. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS122

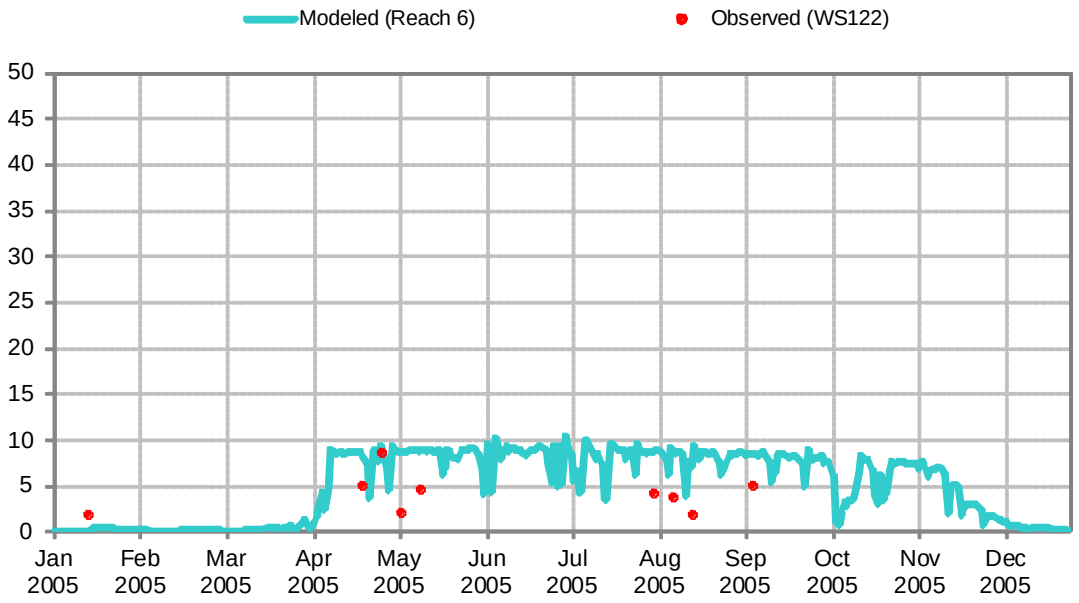

Figure F-27. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS122

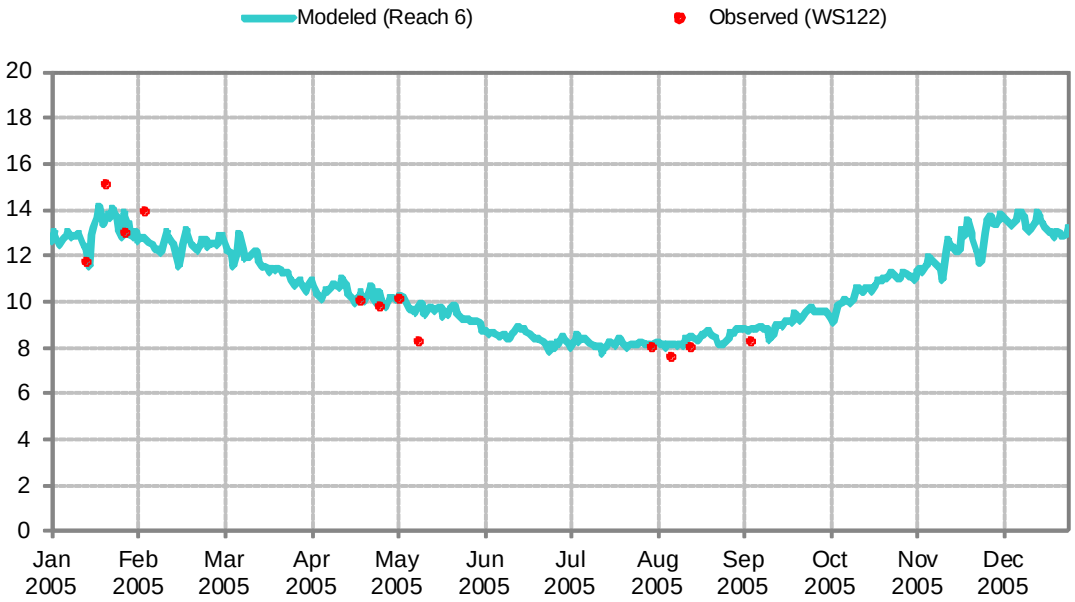

Figure F-28. Modeled vs. Observed DO (mg/L) at WS122

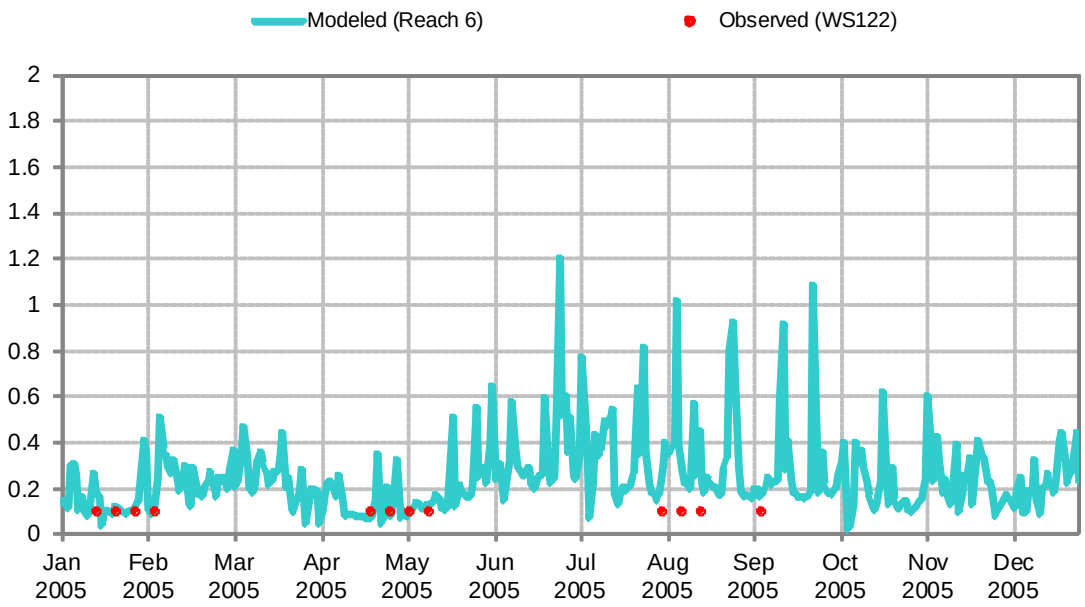

Figure F-29. Modeled vs. Observed NH3T (mg/L as N) at WS122

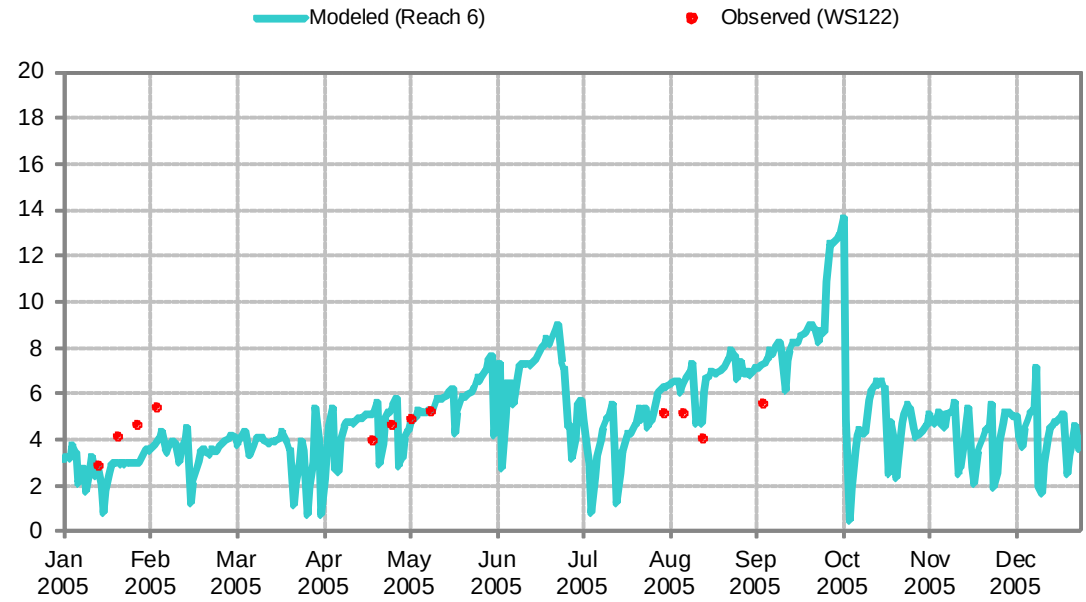

Figure F-30. Modeled vs. Observed NO3 (mg/L) at WS122

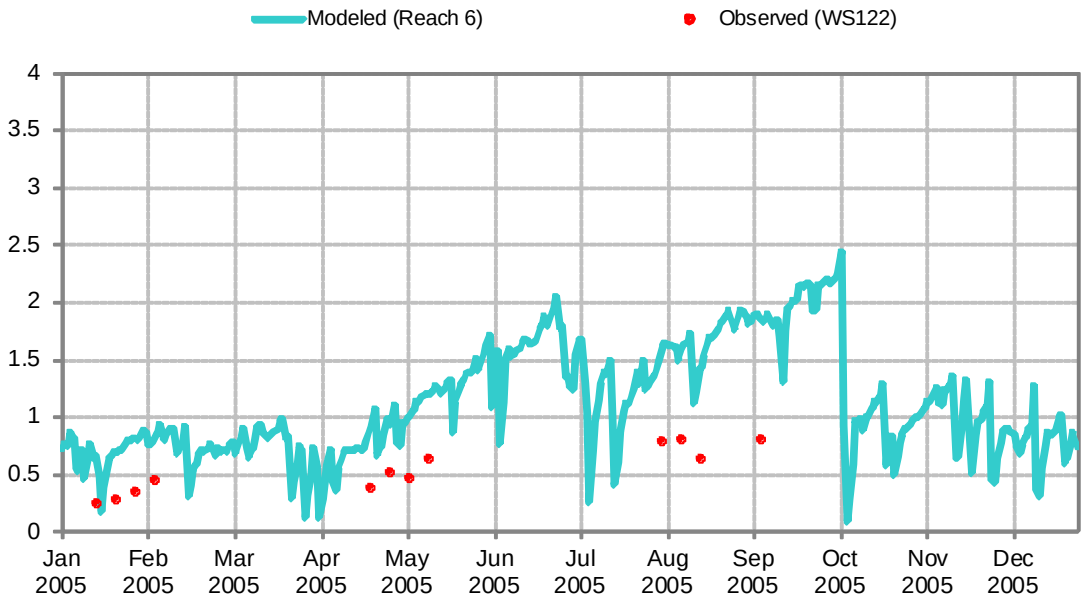

Figure F-31. Modeled vs. Observed PO4 (mg/L) at WS122

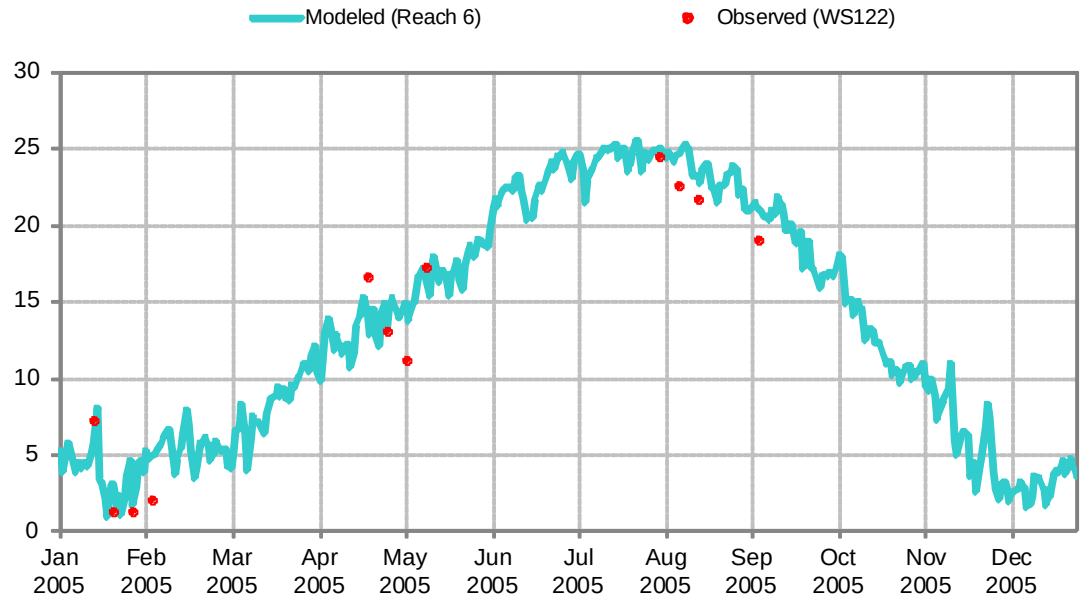

Figure F-32. Modeled vs. Observed Temperature (°C) at WS122

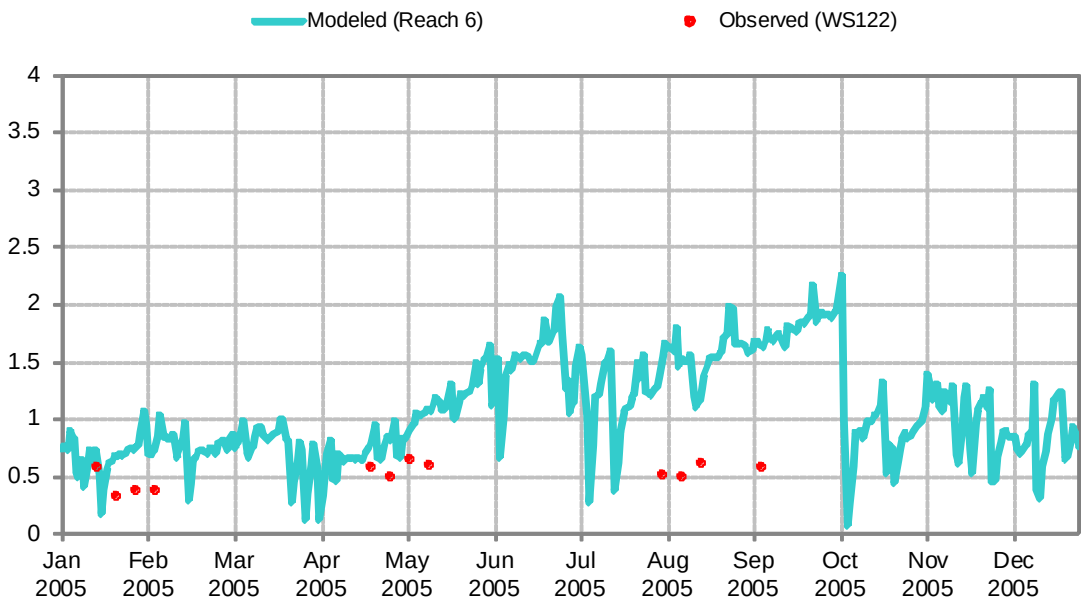

Figure F-33. Modeled vs. Observed TKN (mg/L) at WS122

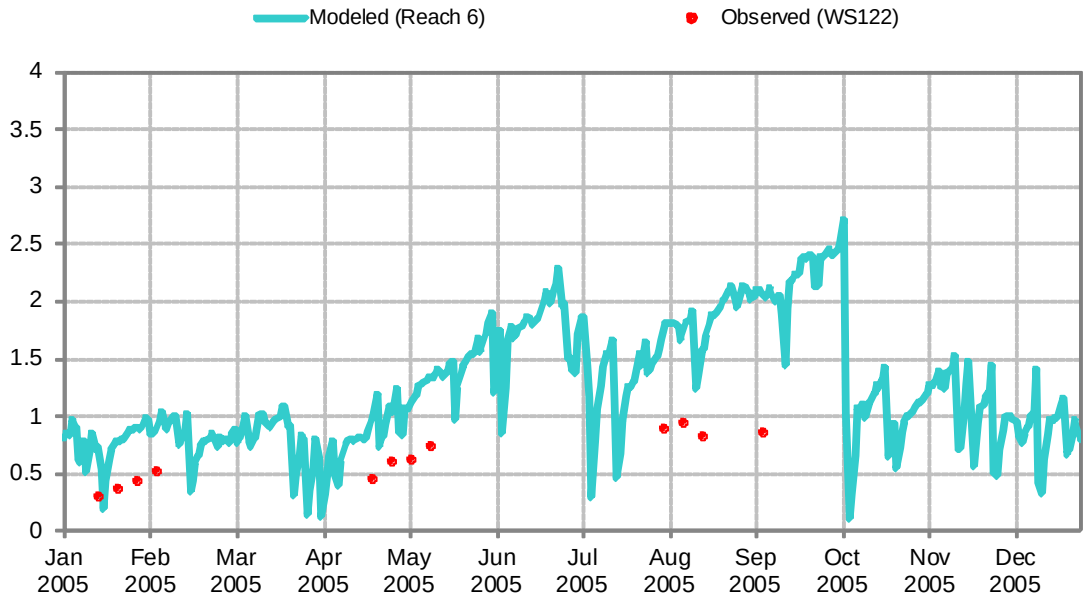

Figure F-34. Modeled vs. Observed TP (mg/L) at WS122

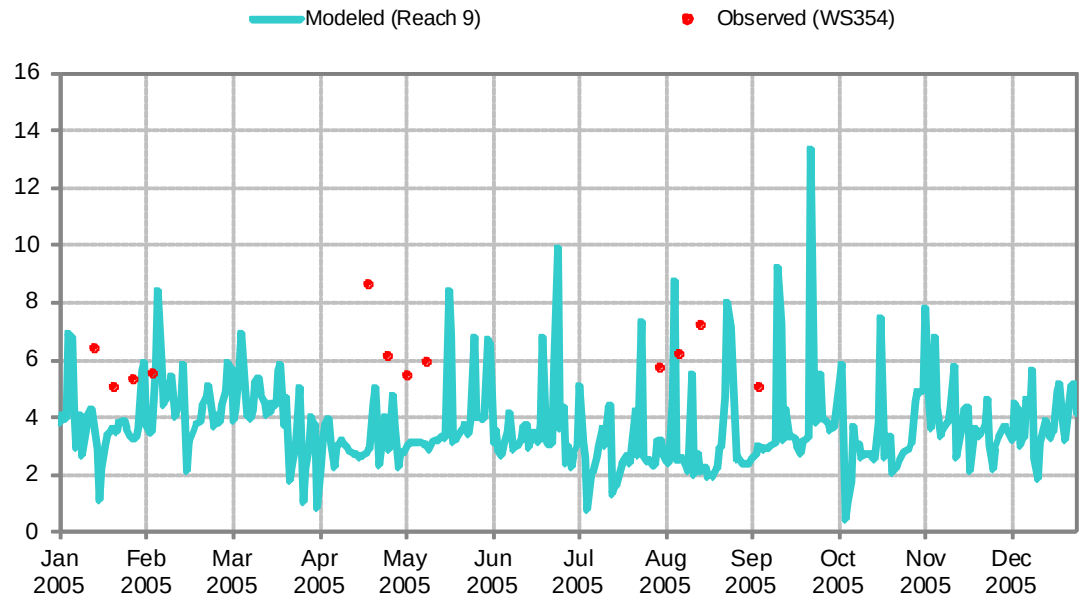

Figure F-35. Modeled vs. Observed BOD30 (mg/L) at WS354

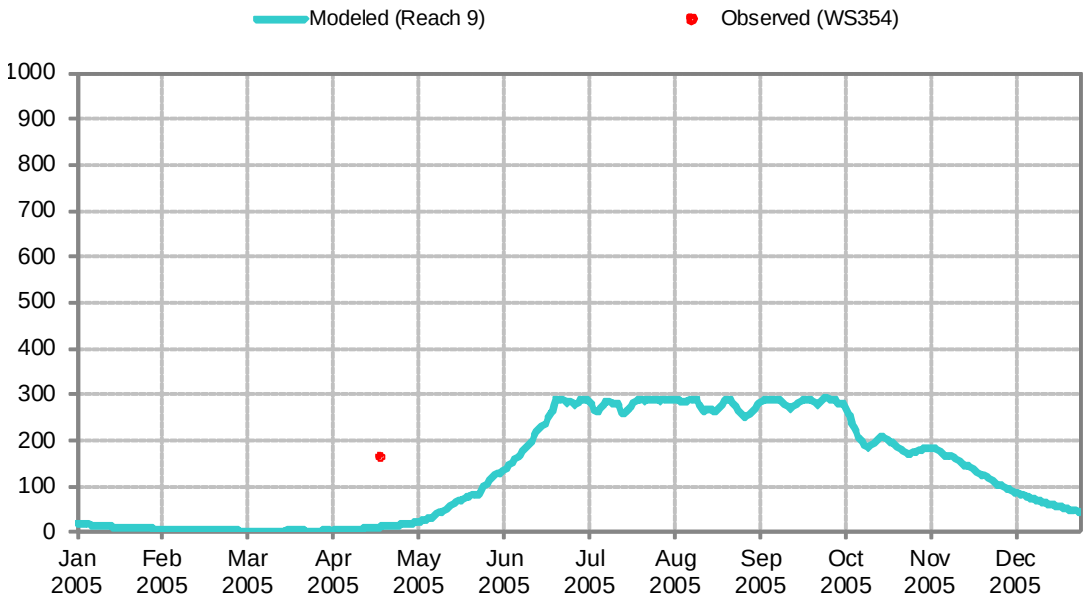

Figure F-36. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS354

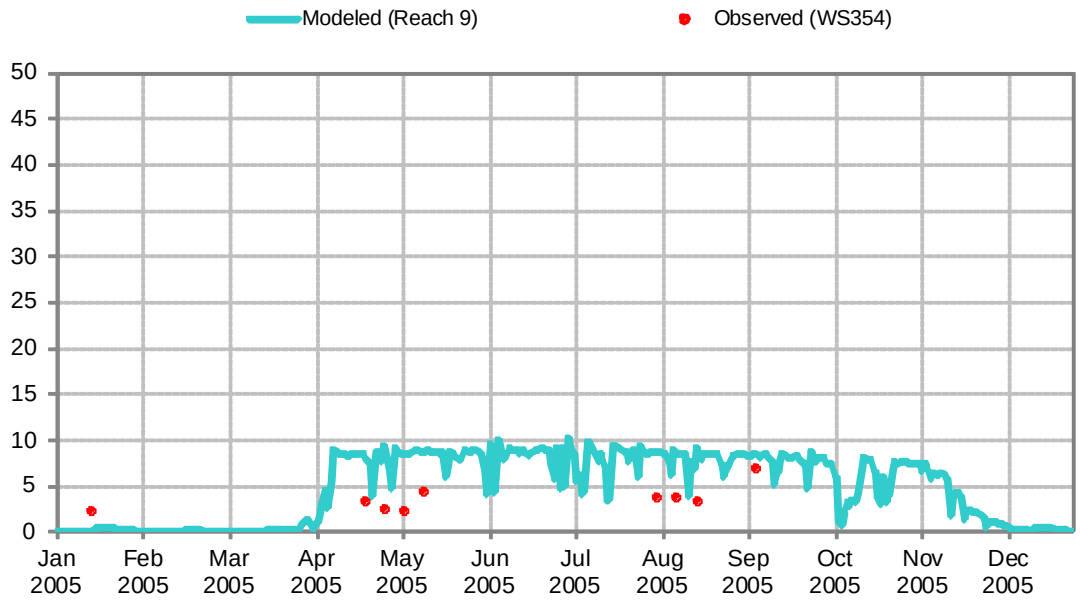

Figure F-37. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS354

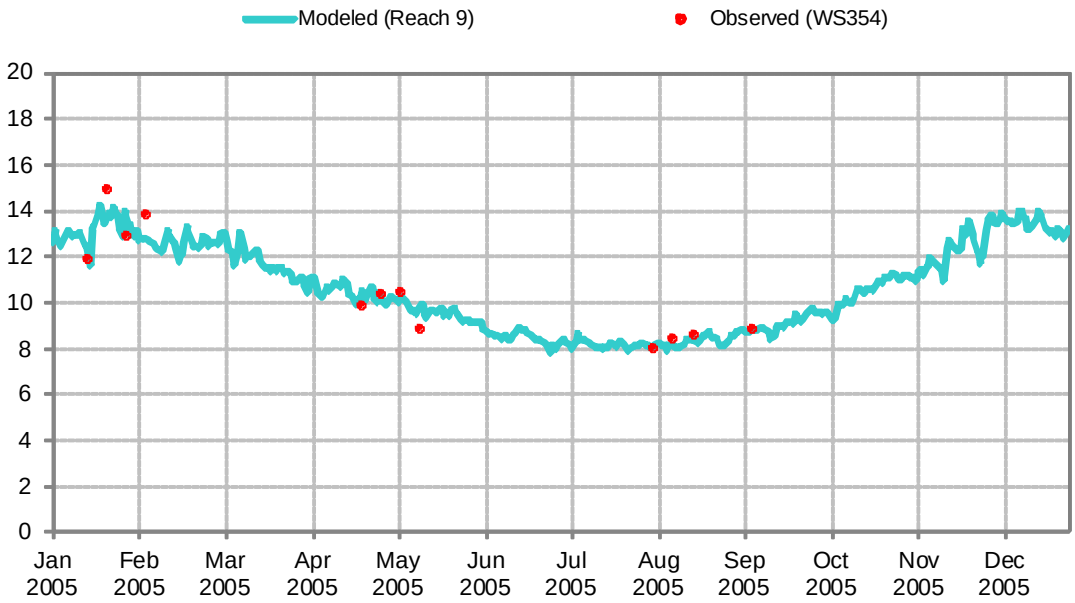

Figure F-38. Modeled vs. Observed DO (mg/L) at WS354

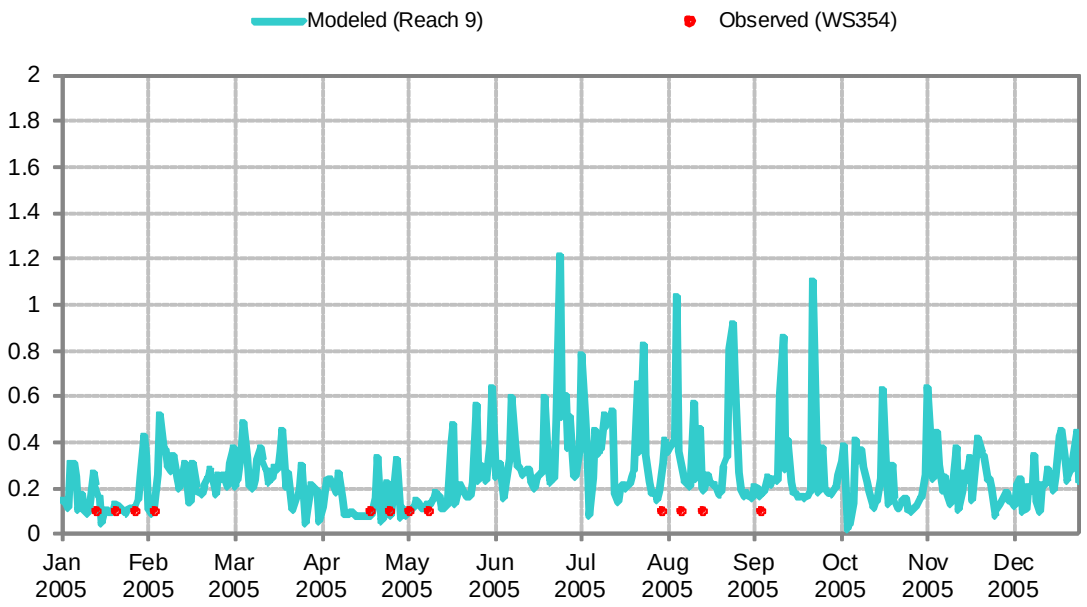

Figure F-39. Modeled vs. Observed NH3T (mg/L as N) at WS354

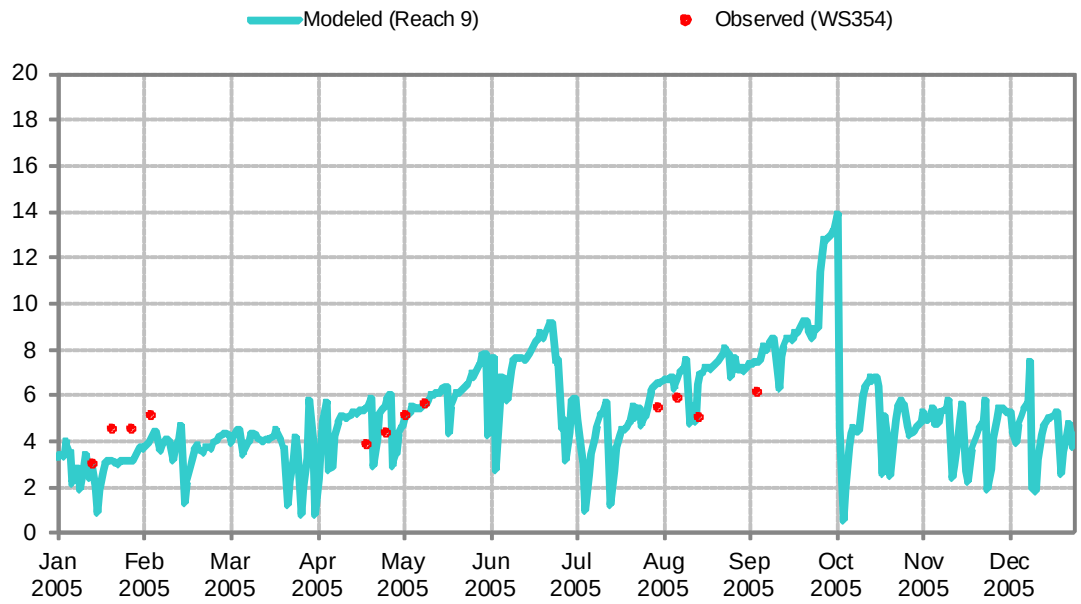

Figure F-40. Modeled vs. Observed NO3 (mg/L) at WS354

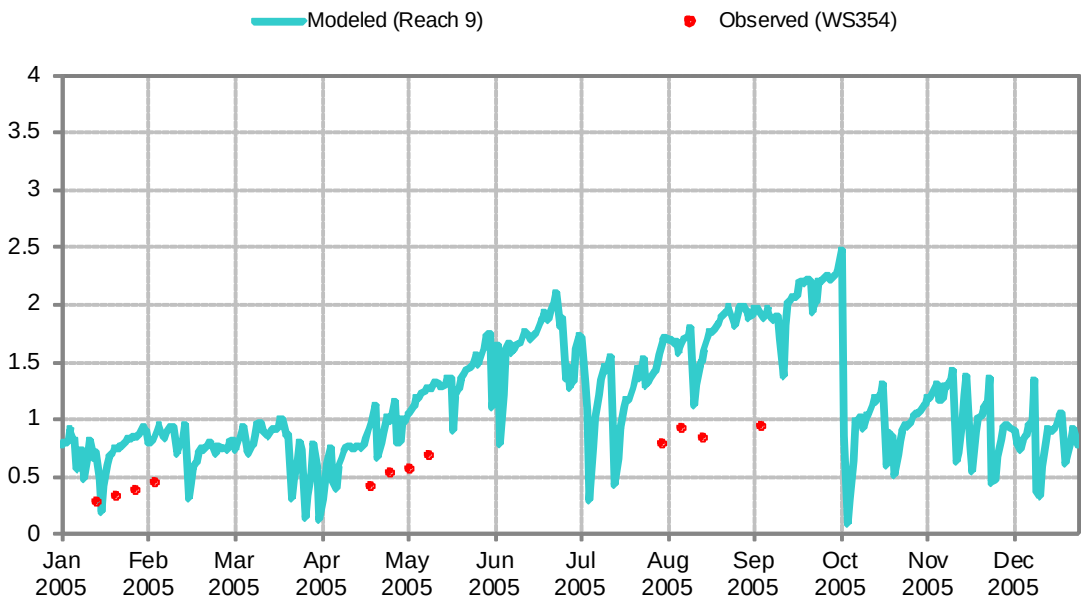

Figure F-41. Modeled vs. Observed PO4 (mg/L) at WS354

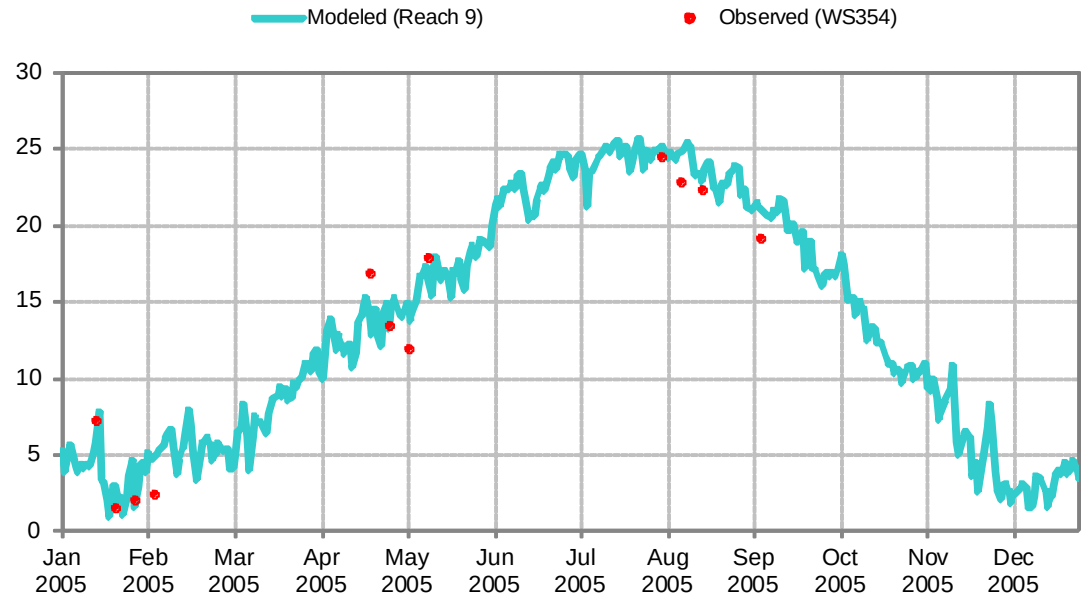

Figure F-42. Modeled vs. Observed Temperature (°C) at WS354

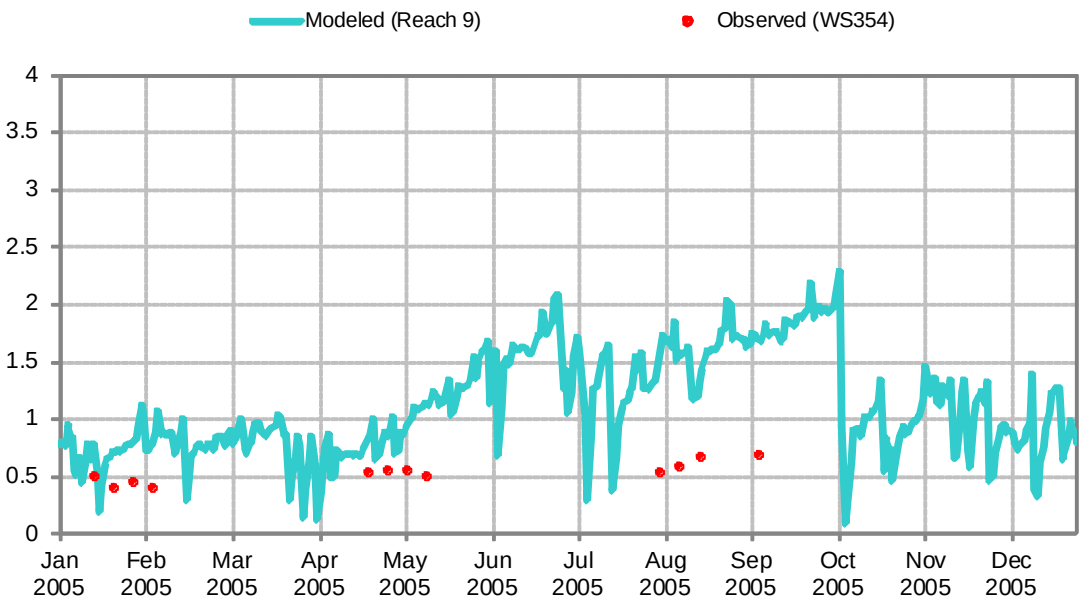

Figure F-43. Modeled vs. Observed TKN (mg/L) at WS354

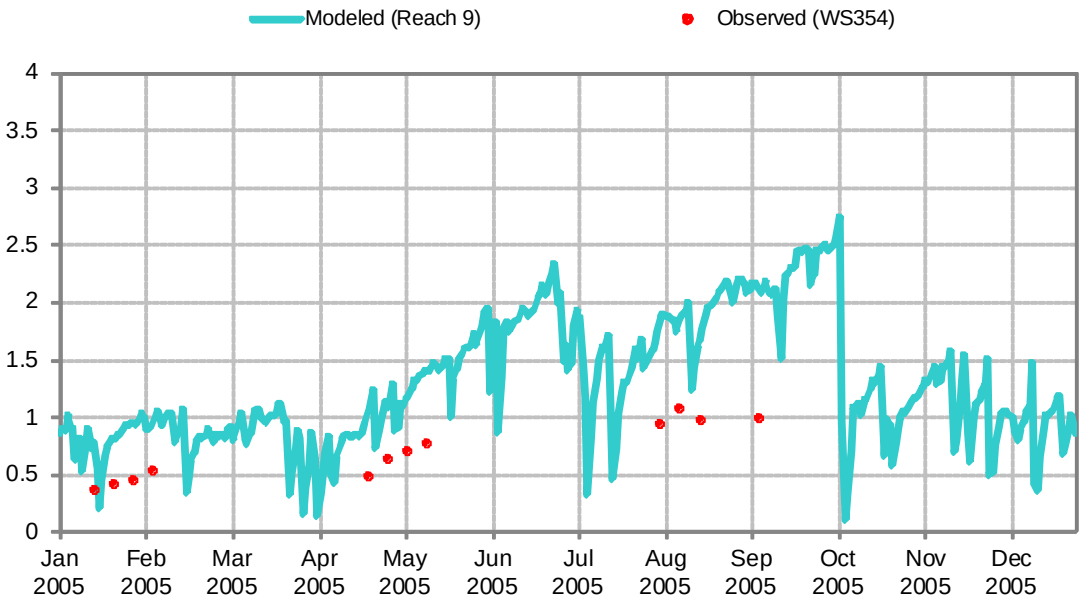

Figure F-44. Modeled vs. Observed TP (mg/L) at WS354

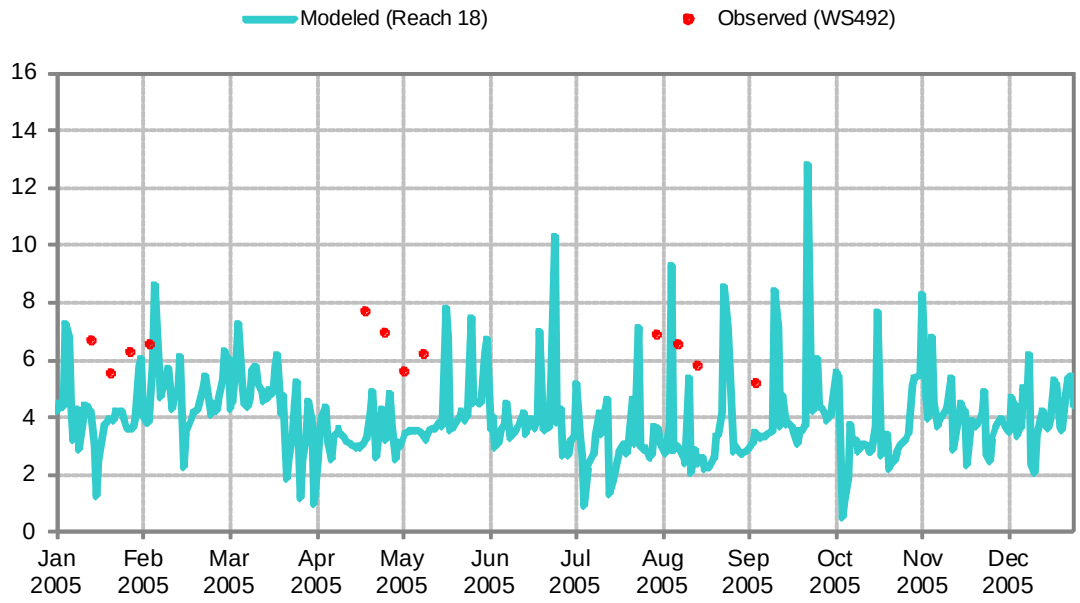

Figure F-45. Modeled vs. Observed BOD30 (mg/L) at WS492

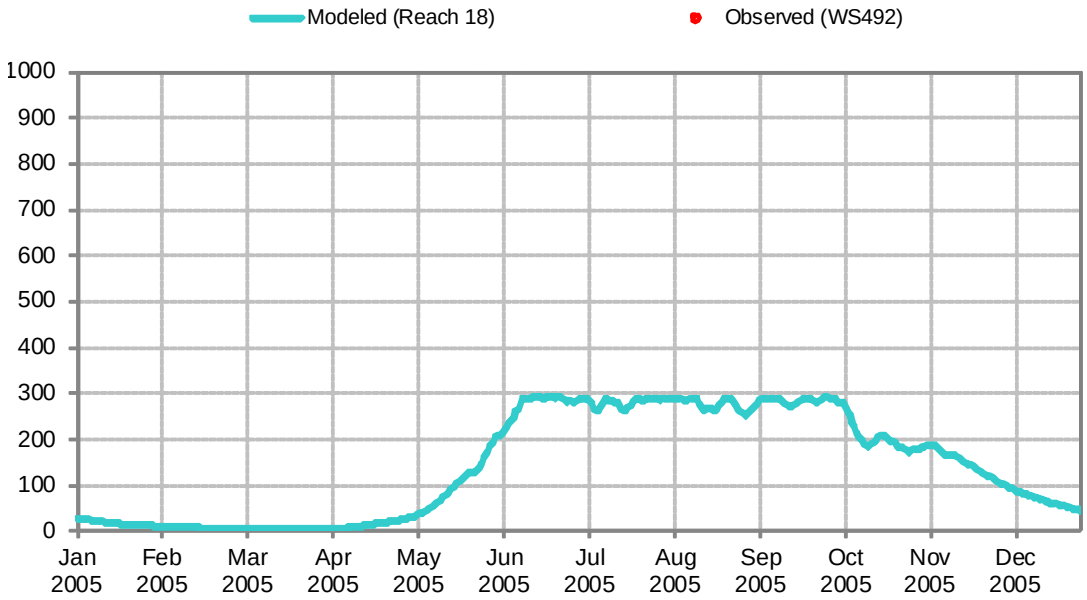

Figure F-46. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS492

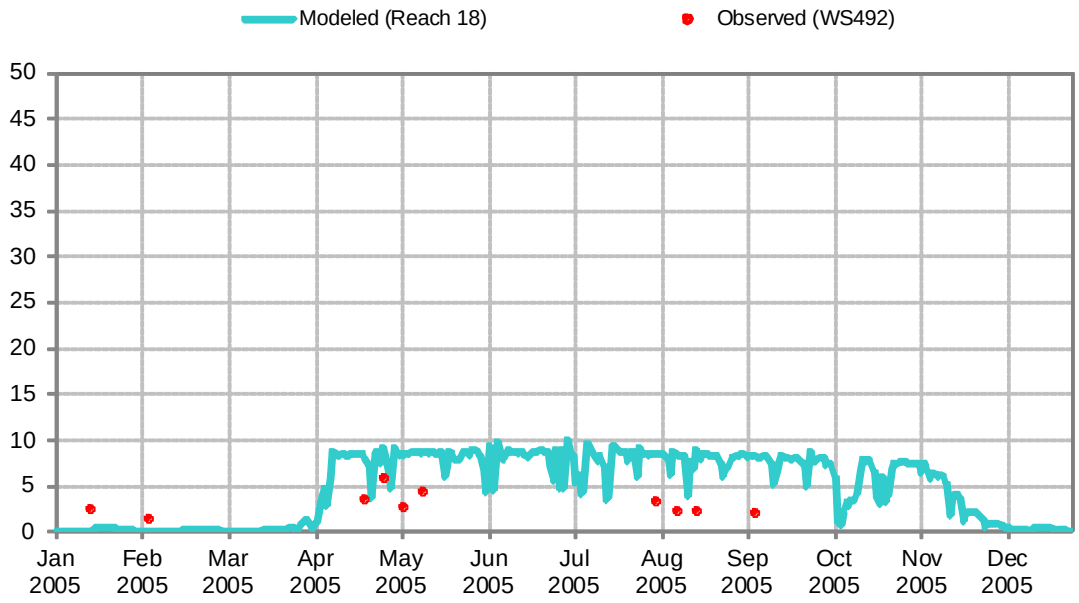

Figure F-47. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS492

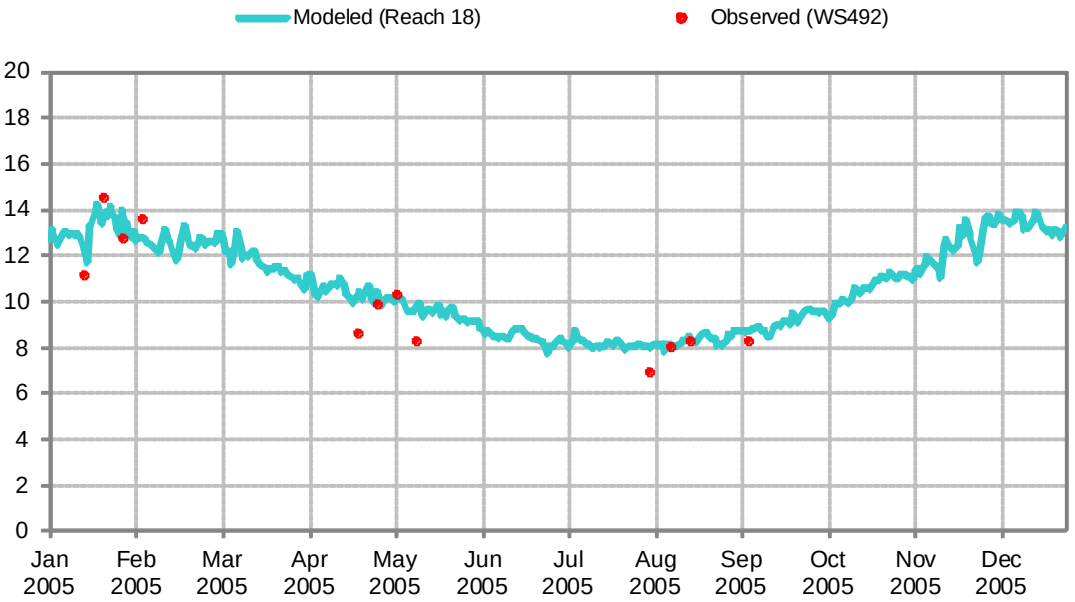

Figure F-48. Modeled vs. Observed DO (mg/L) at WS492

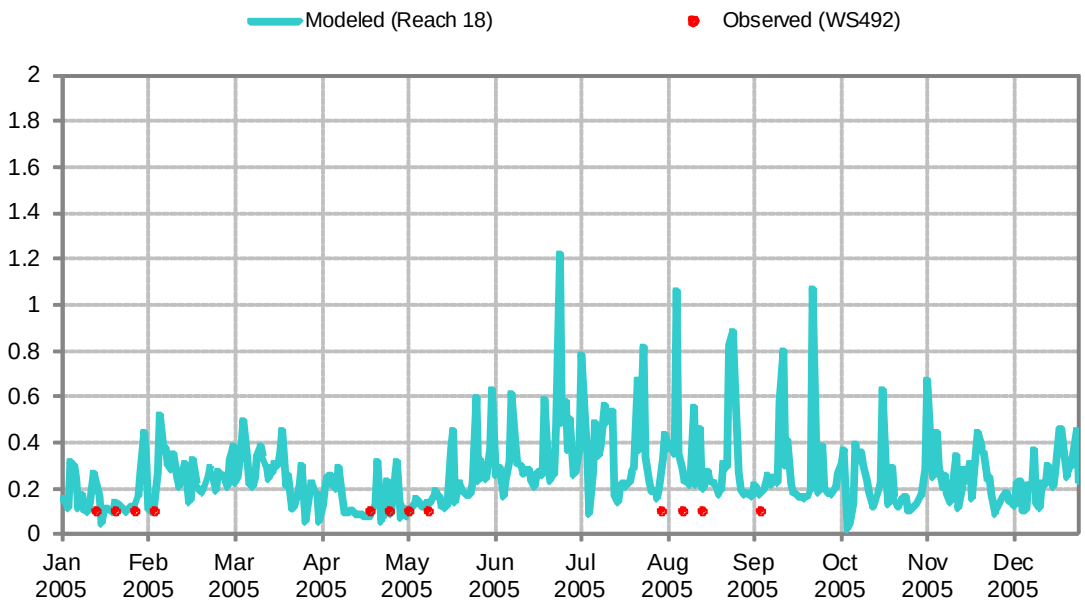

Figure F-49. Modeled vs. Observed NH3T (mg/L as N) at WS492

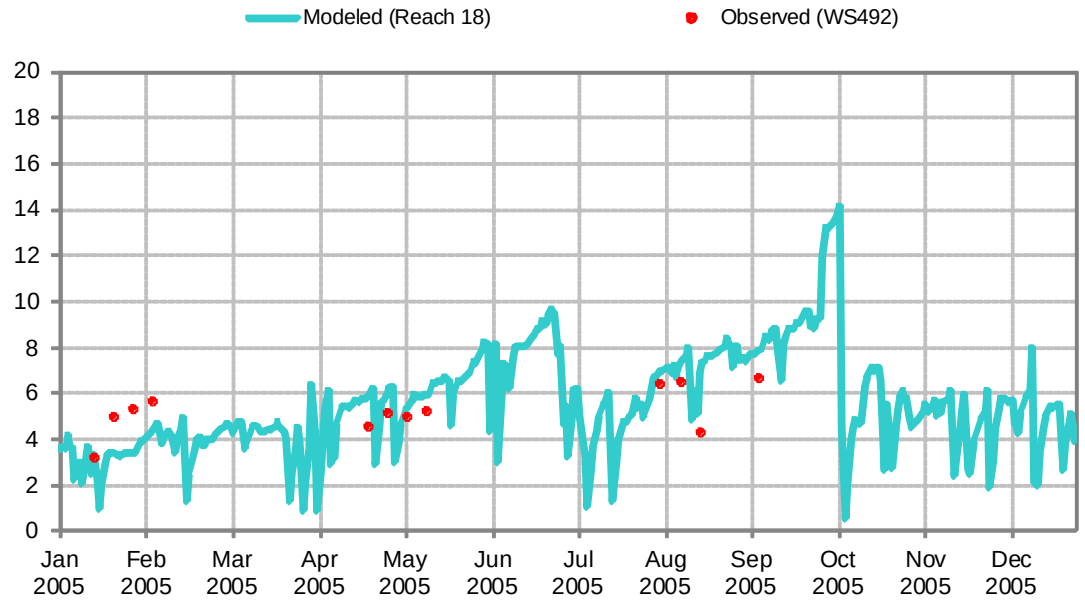

Figure F-50. Modeled vs. Observed NO3 (mg/L) at WS492

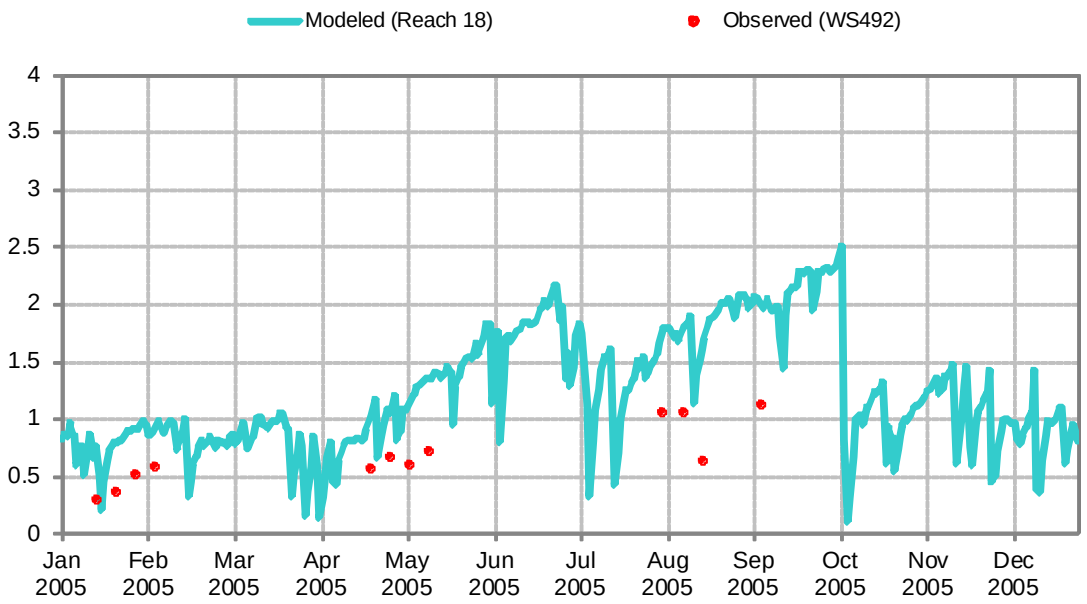

Figure F-51. Modeled vs. Observed PO4 (mg/L) at WS492

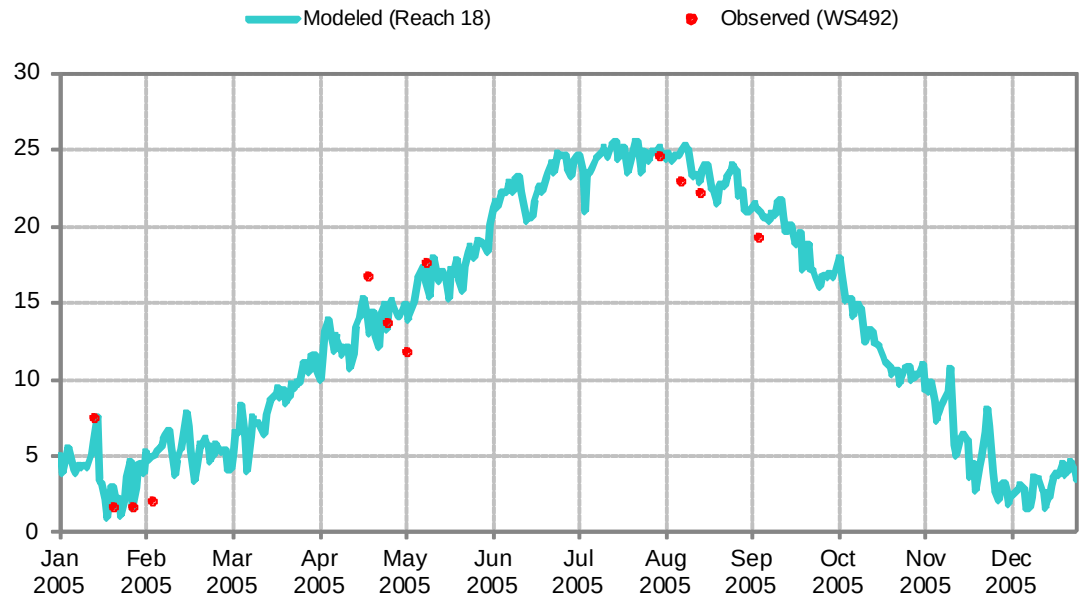

Figure F-52. Modeled vs. Observed Temperature (°C) at WS492

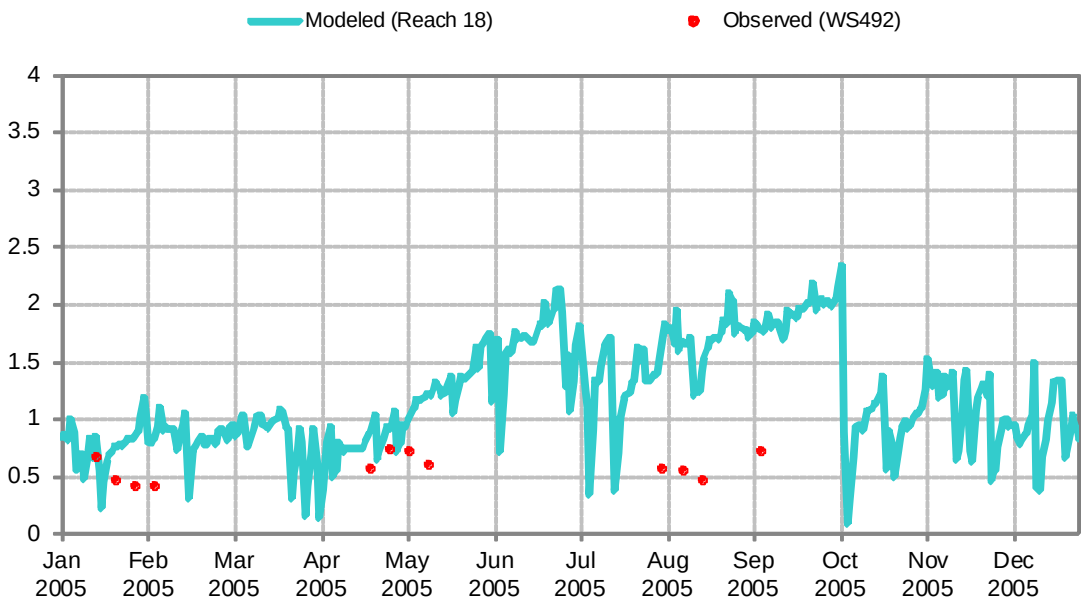

Figure F-53. Modeled vs. Observed TKN (mg/L) at WS492

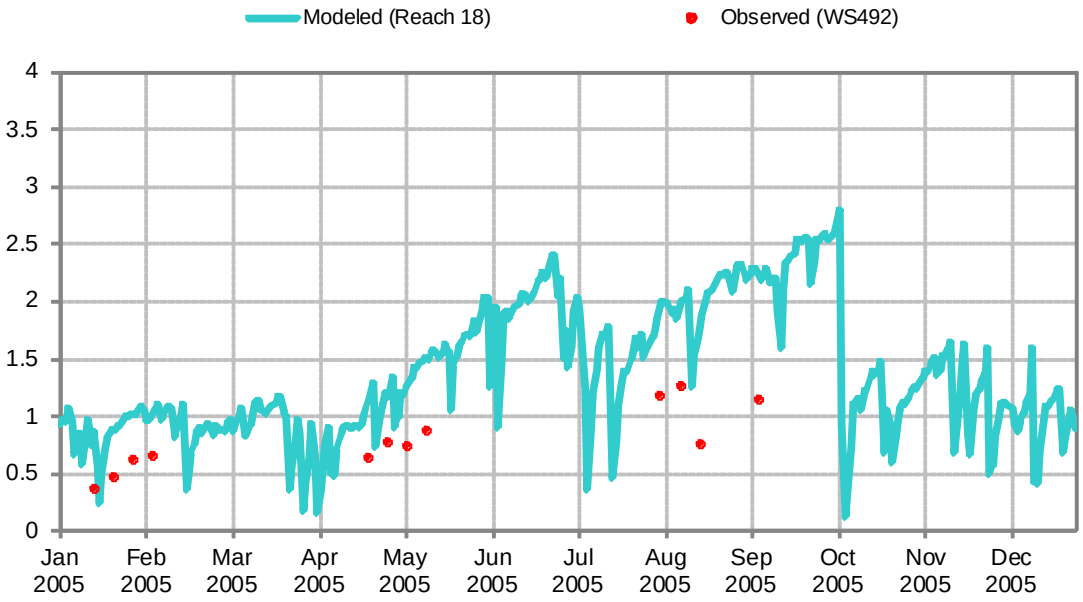

Figure F-54. Modeled vs. Observed TP (mg/L) at WS492

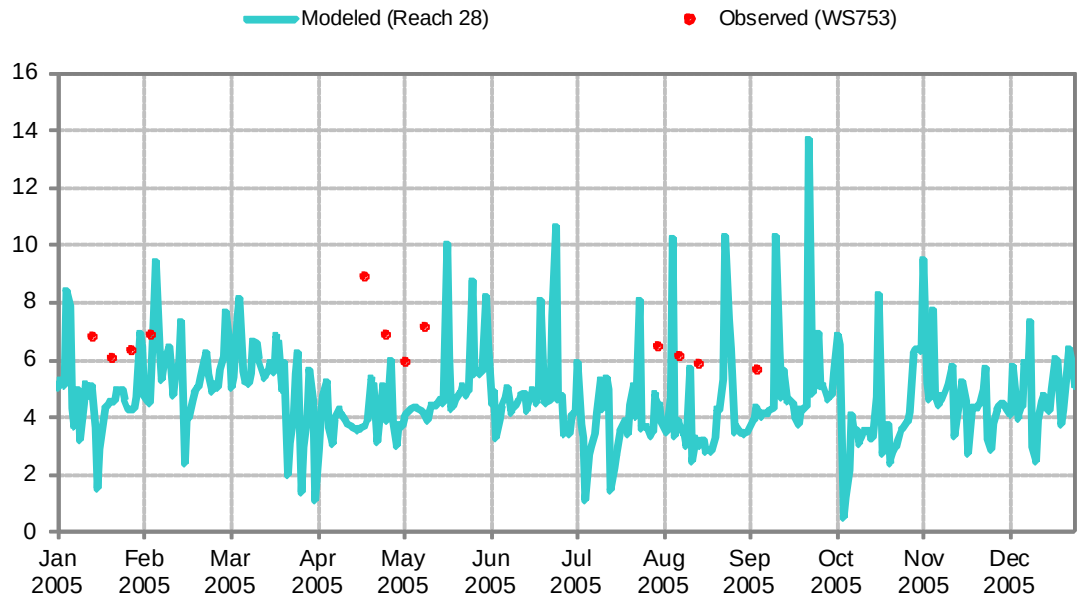

Figure F-55. Modeled vs. Observed BOD30 (mg/L) at WS753

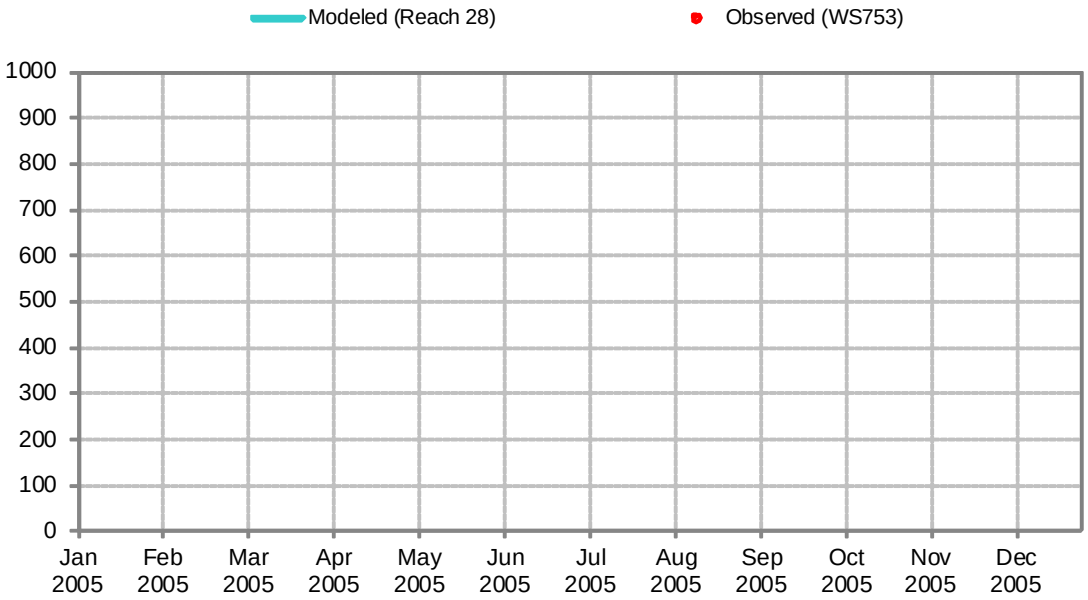

Figure F-56. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS753

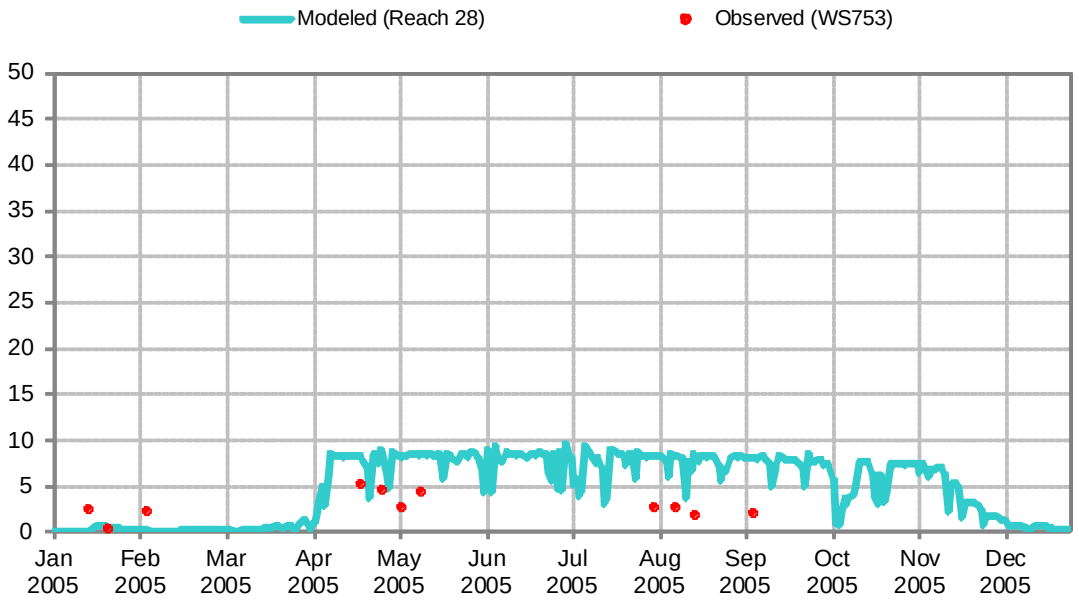

Figure F-57. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS753

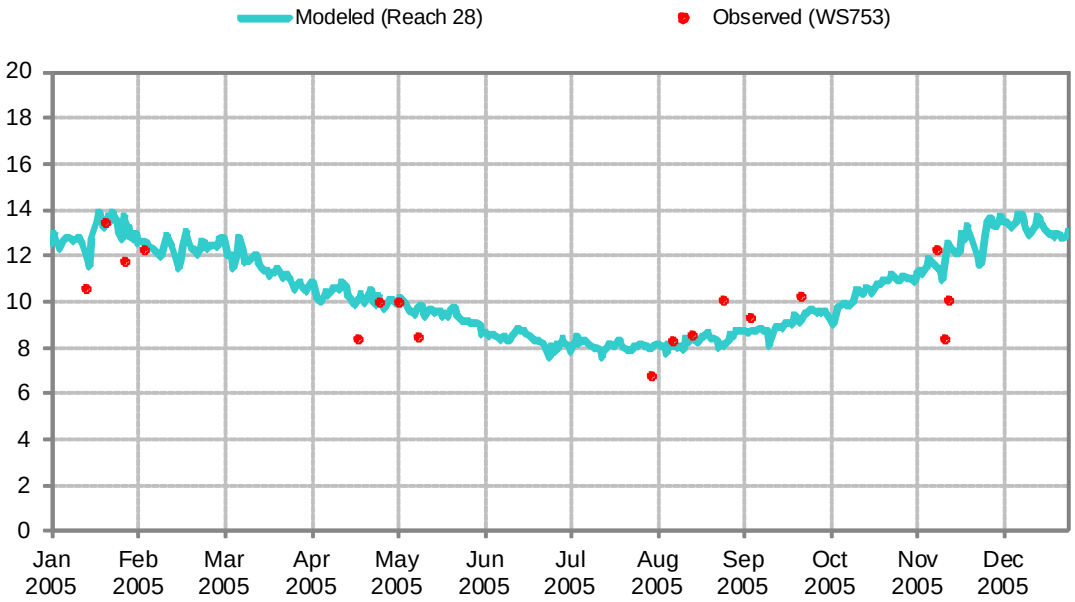

Figure F-58. Modeled vs. Observed DO (mg/L) at WS753

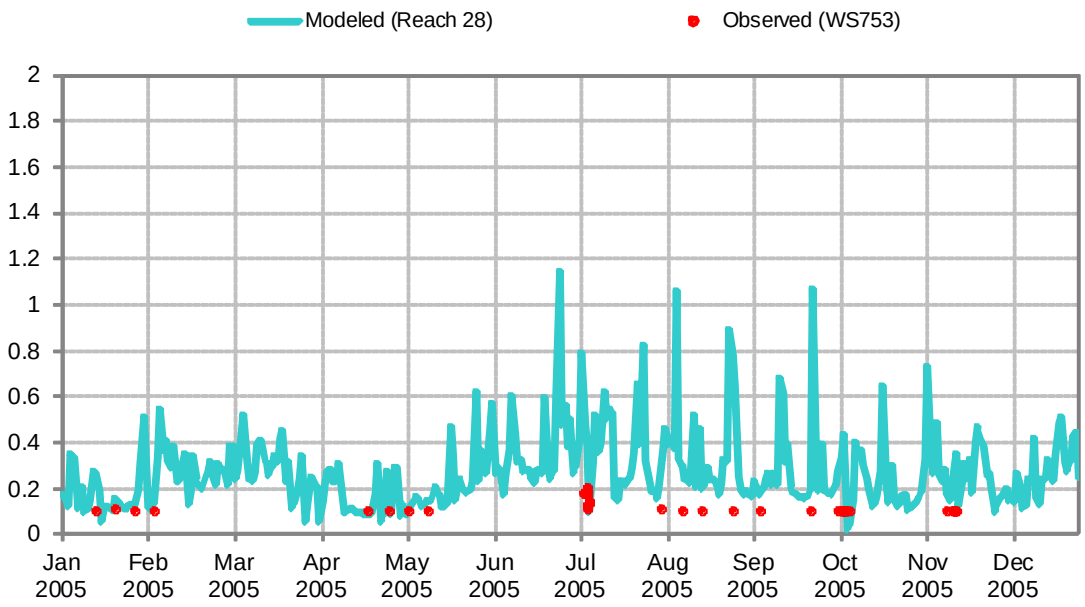

Figure F-59. Modeled vs. Observed NH3T (mg/L as N) at WS753

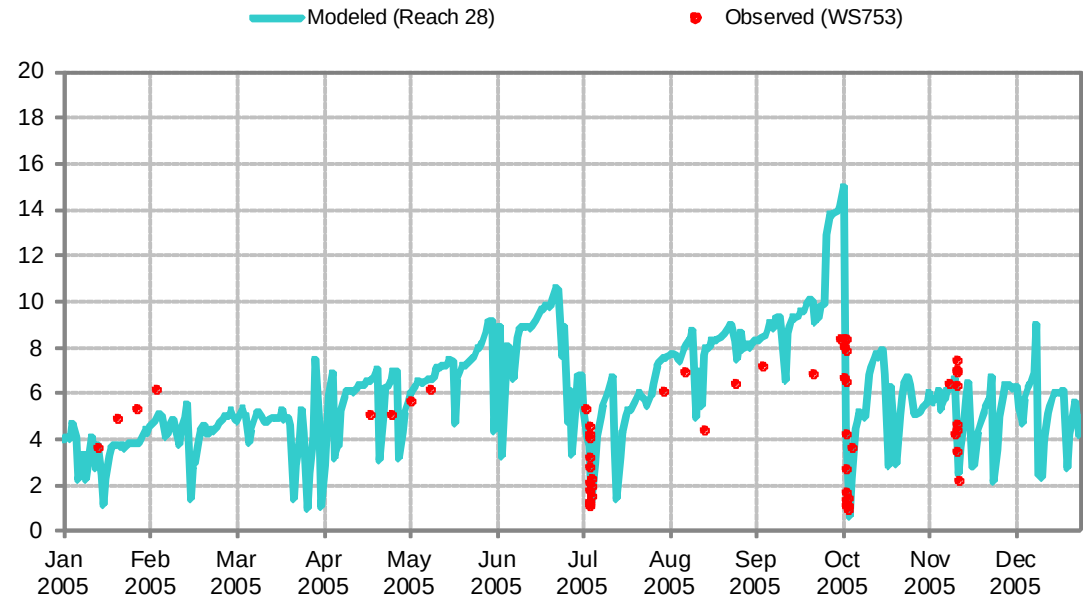

Figure F-60. Modeled vs. Observed NO3 (mg/L) at WS753

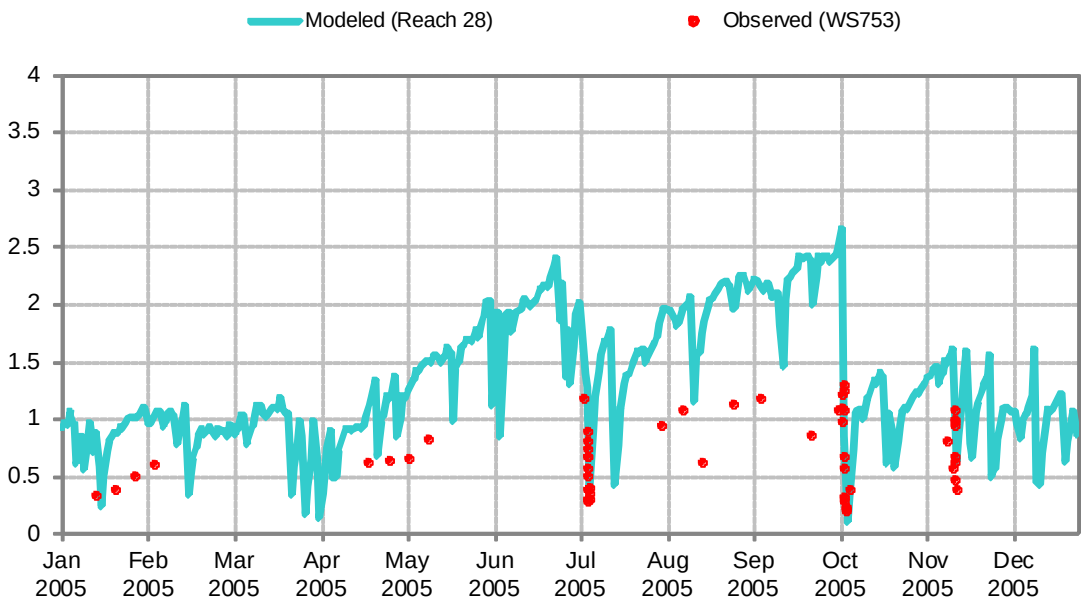

Figure F-61. Modeled vs. Observed PO4 (mg/L) at WS753

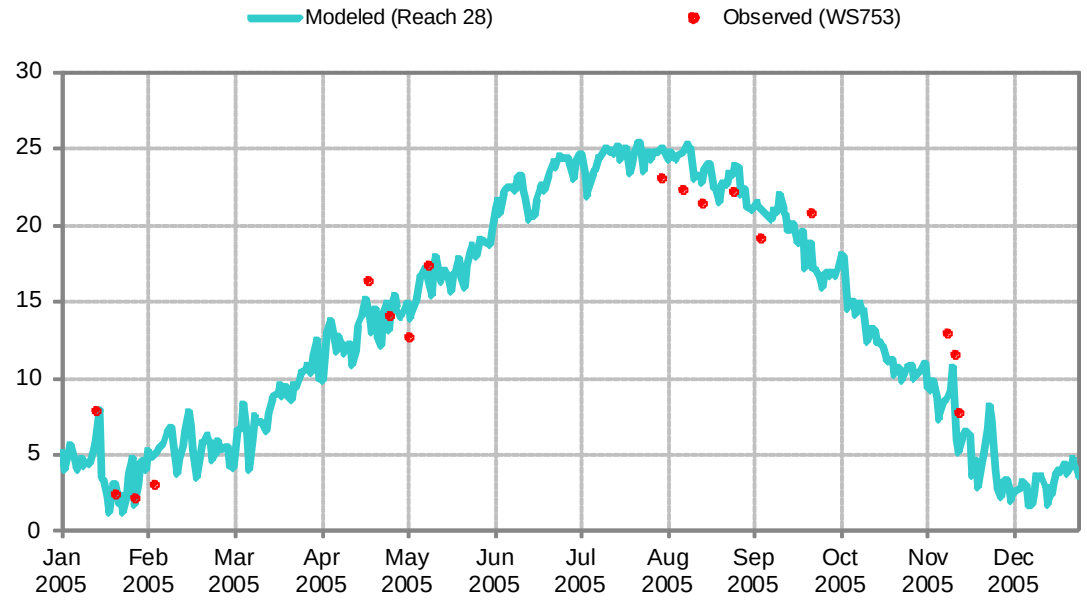

Figure F-62. Modeled vs. Observed Temperature (°C) at WS753

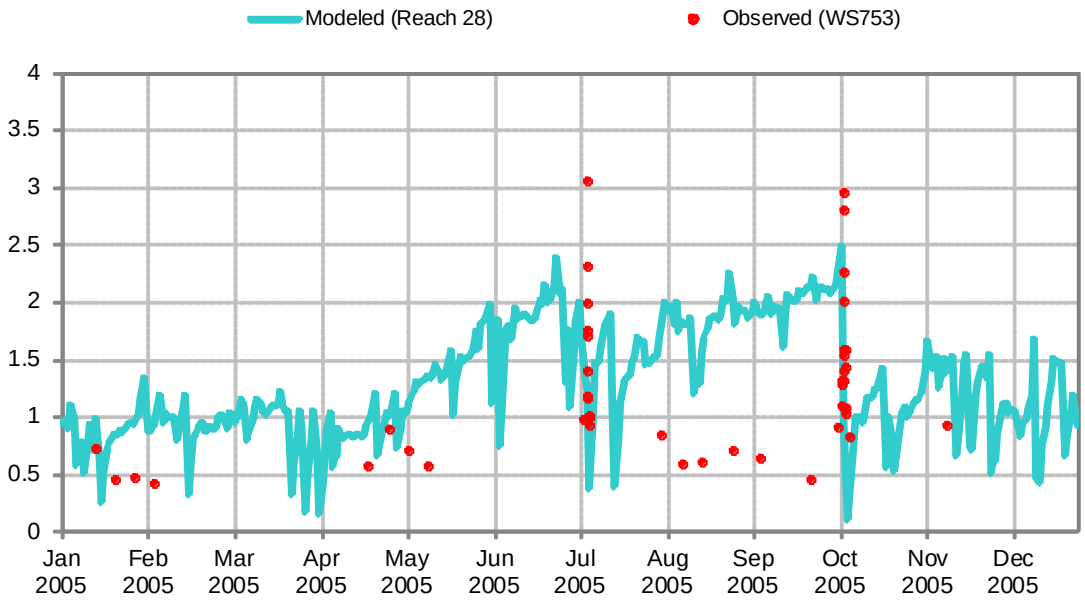

Figure F-63. Modeled vs. Observed TKN (mg/L) at WS753

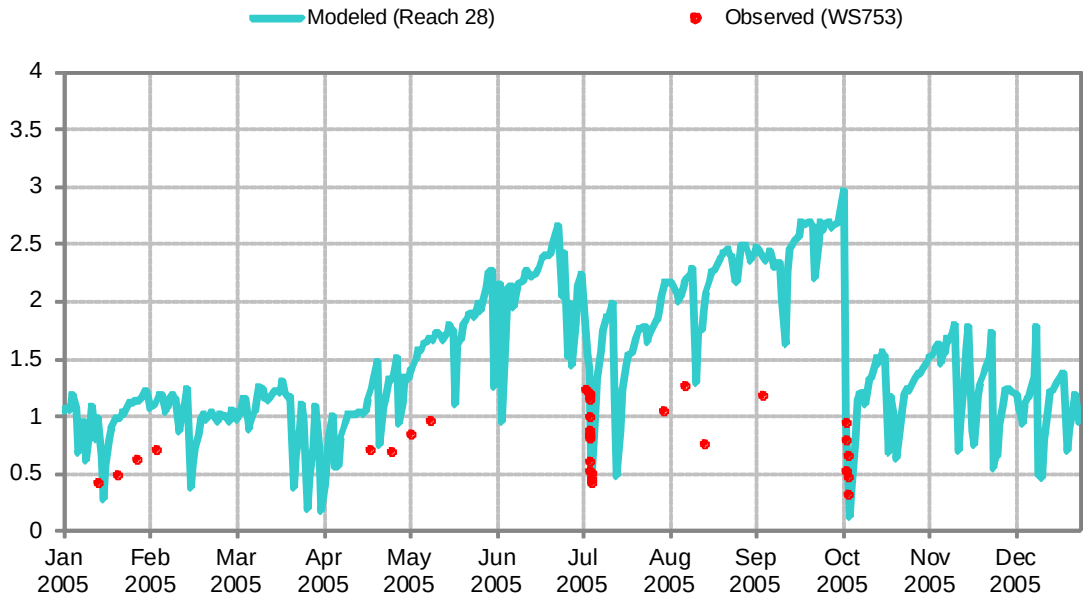

Figure F-64. Modeled vs. Observed TP (mg/L) at WS753

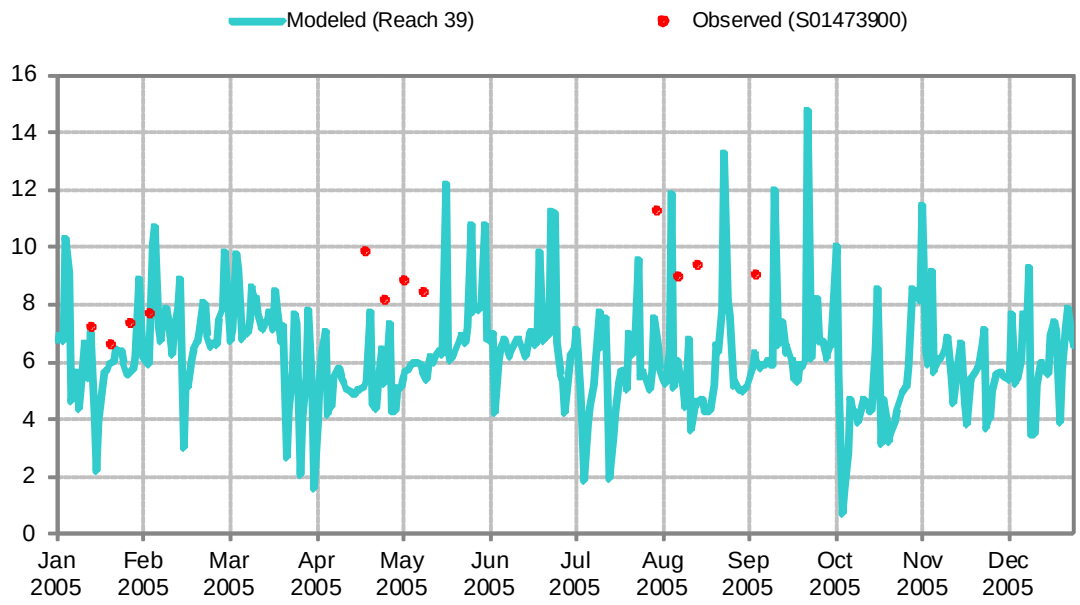

Figure F-65. Modeled vs. Observed BOD30 (mg/L) at S01473900

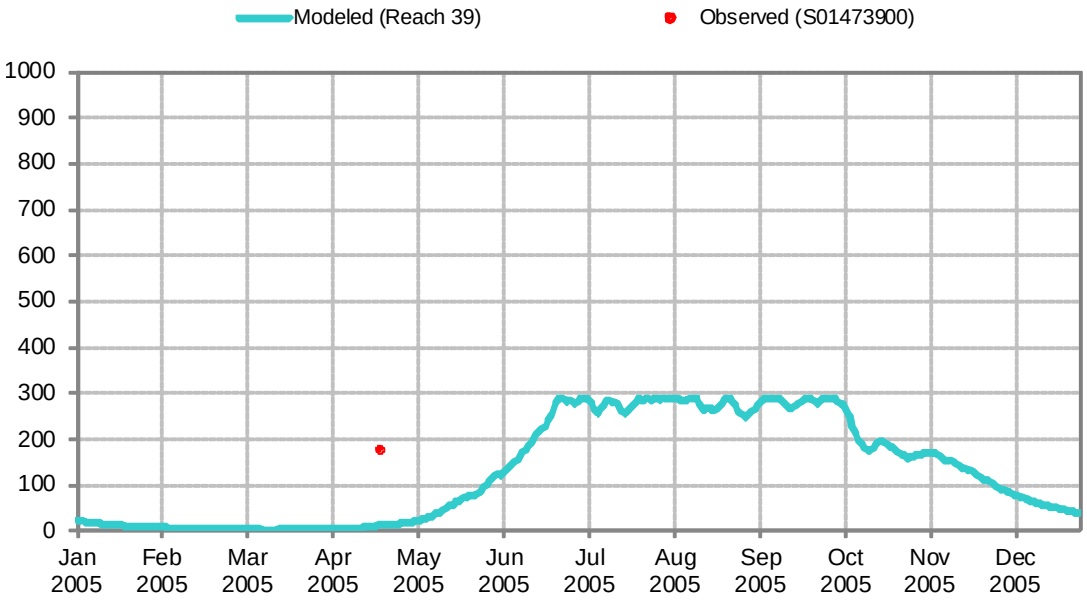

Figure F-66. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at S01473900

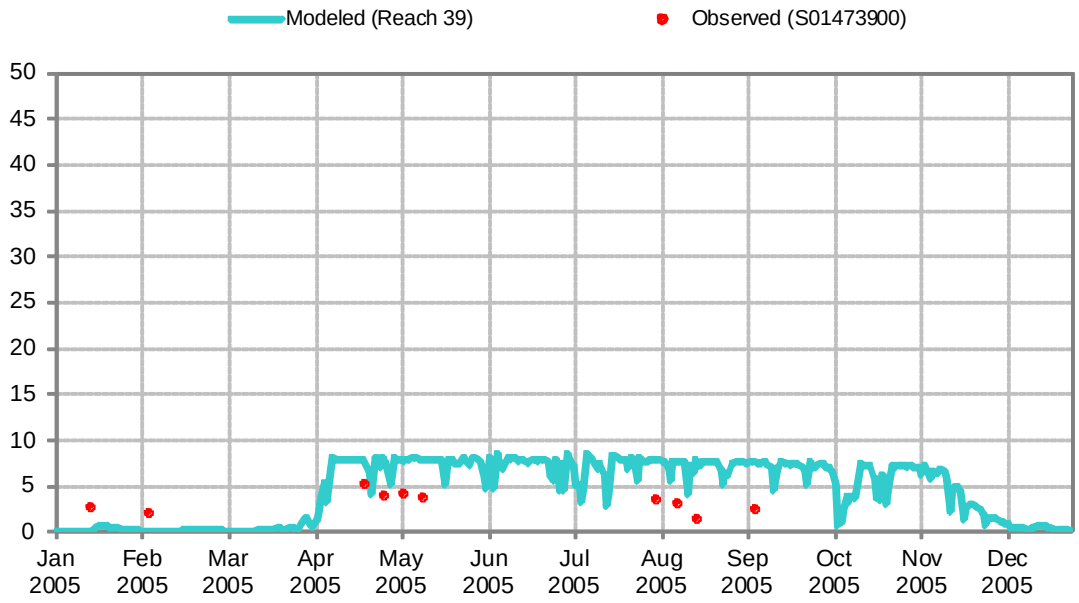

Figure F-67. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at S01473900

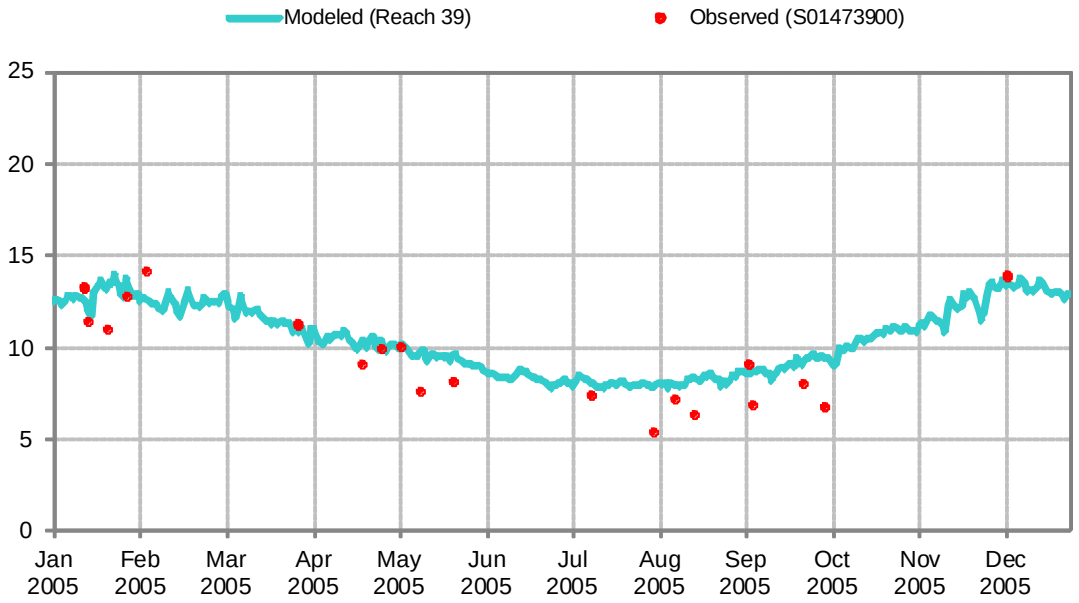

Figure F-68. Modeled vs. Observed DO (mg/L) at S01473900

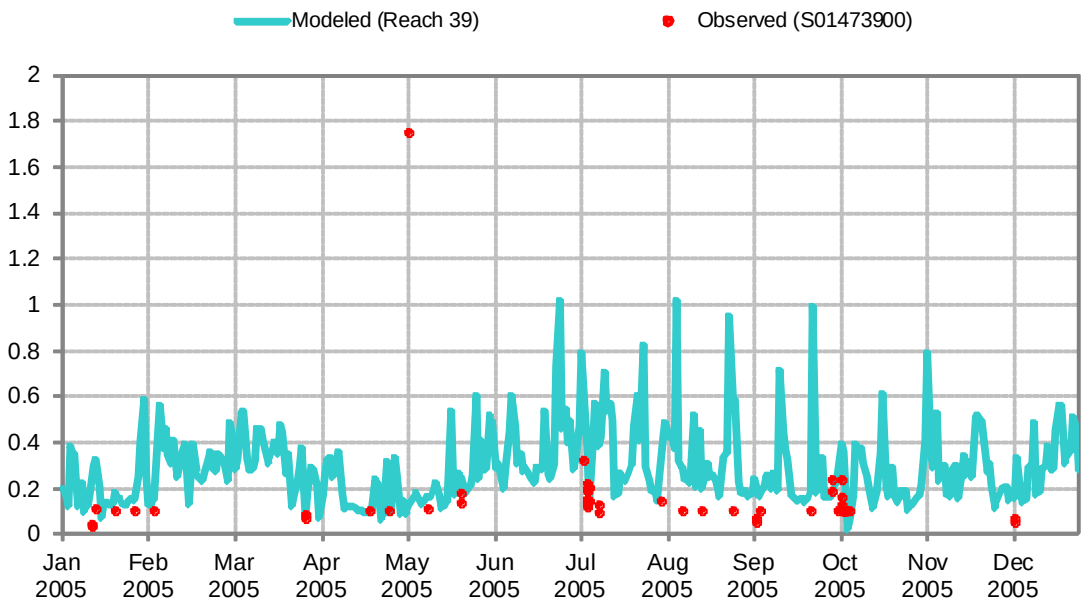

Figure F-69. Modeled vs. Observed NH3T (mg/L as N) at S01473900

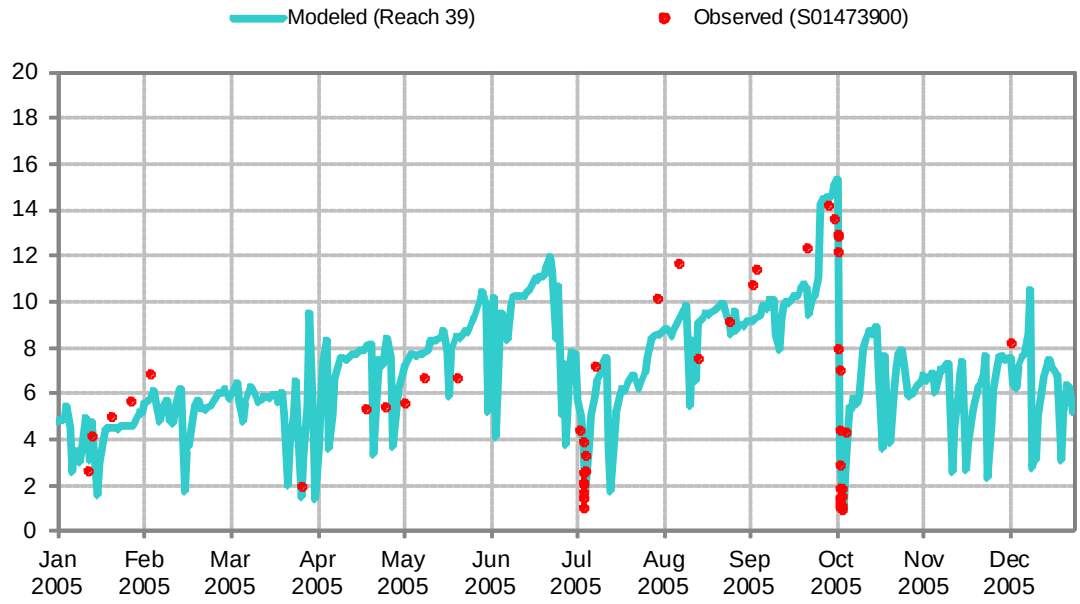

Figure F-70. Modeled vs. Observed NO3 (mg/L) at S01473900

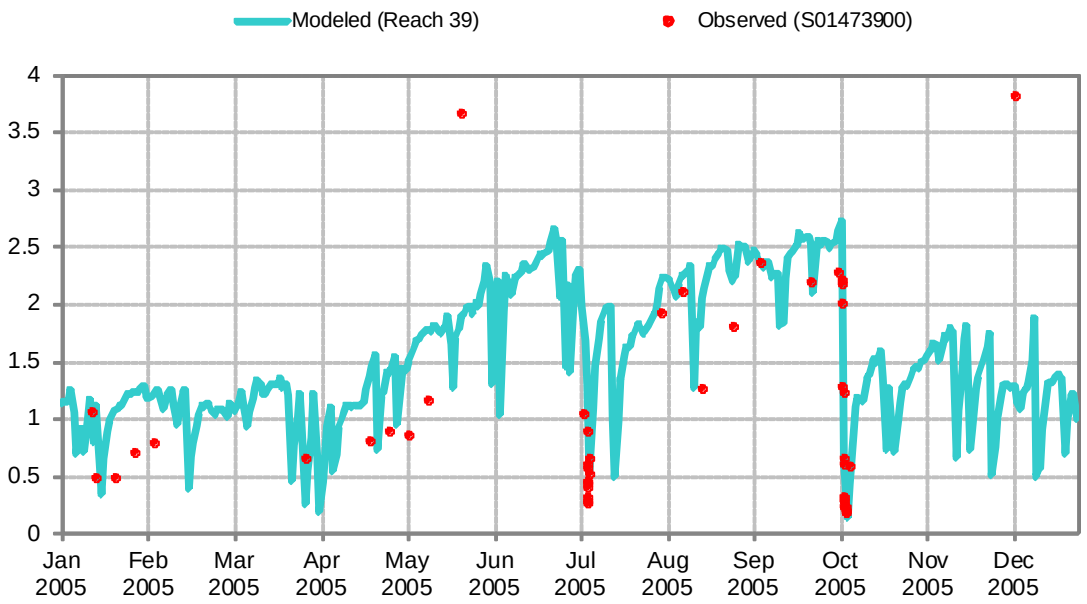

Figure F-71. Modeled vs. Observed PO4 (mg/L) at S01473900

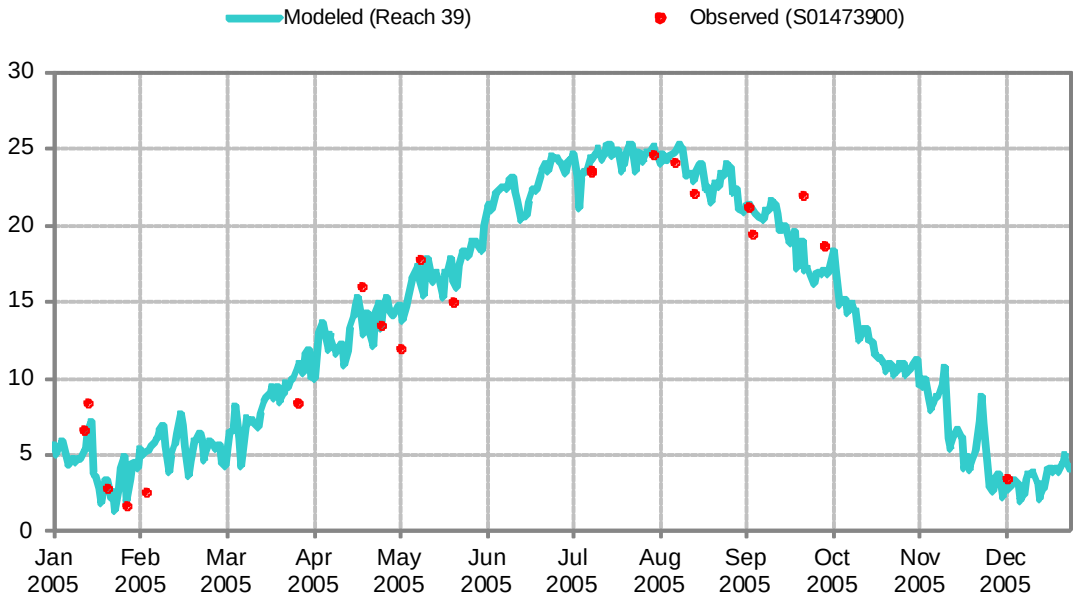

Figure F-72. Modeled vs. Observed Temperature (°C) at S01473900

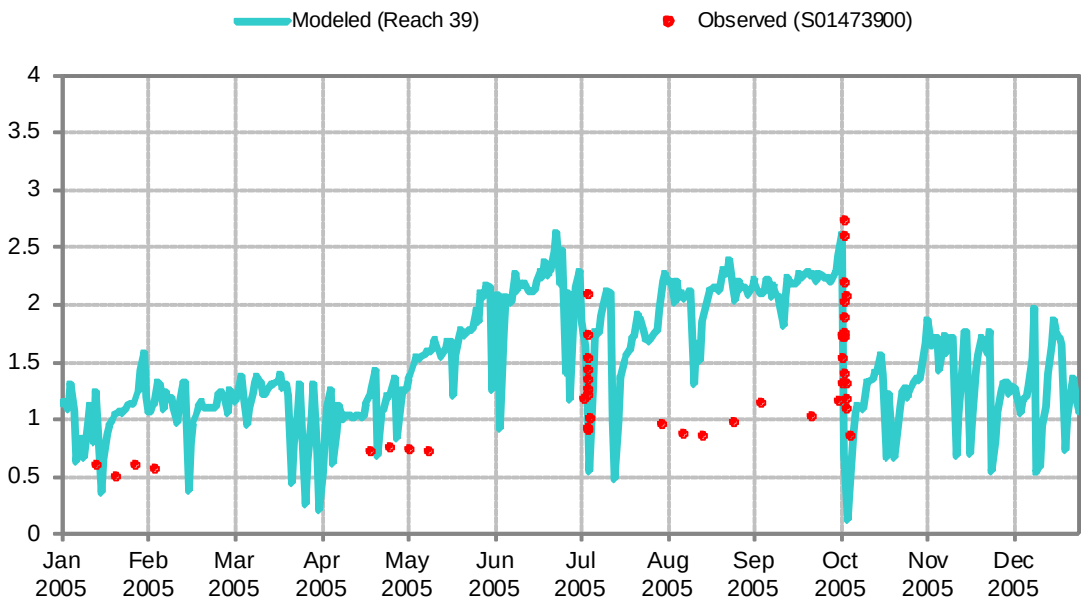

Figure F-73. Modeled vs. Observed TKN (mg/L) at S01473900

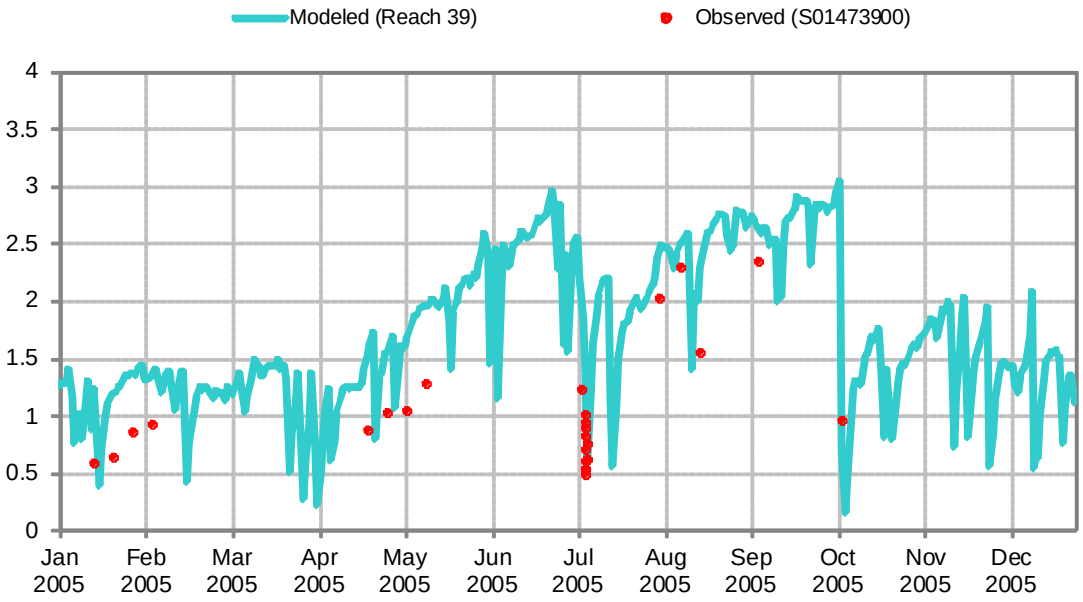

Figure F-74. Modeled vs. Observed TP (mg/L) at S01473900

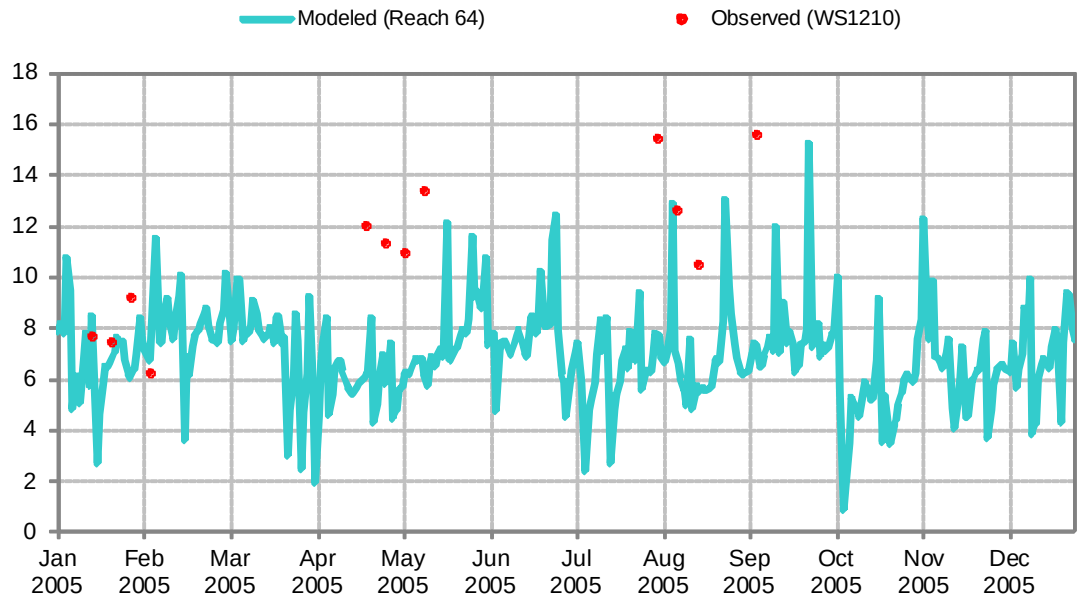

Figure F-75. Modeled vs. Observed BOD30 (mg/L) at WS1210

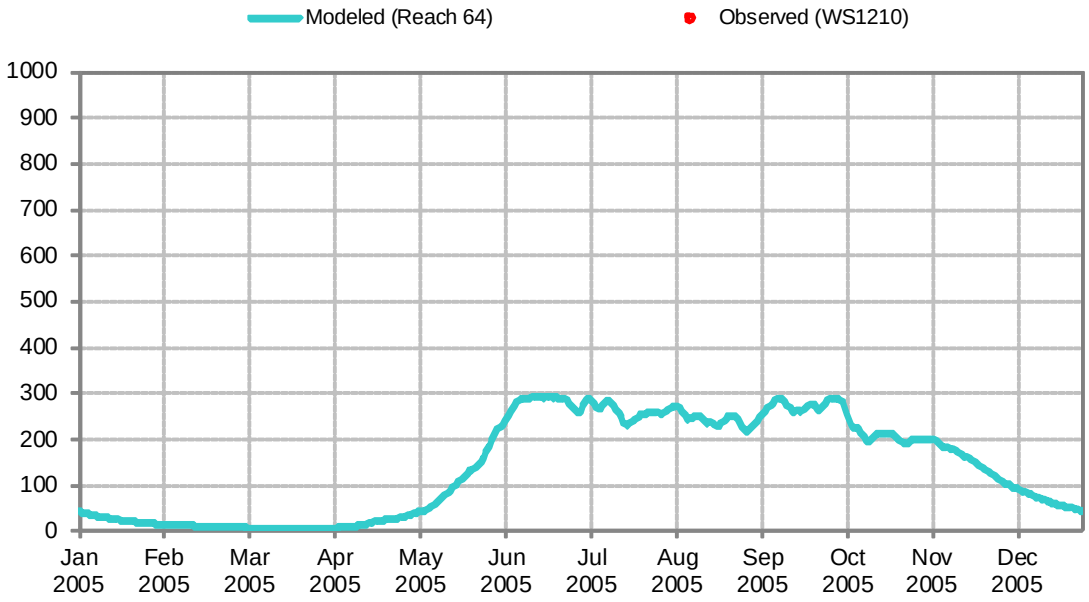

Figure F-76. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS1210

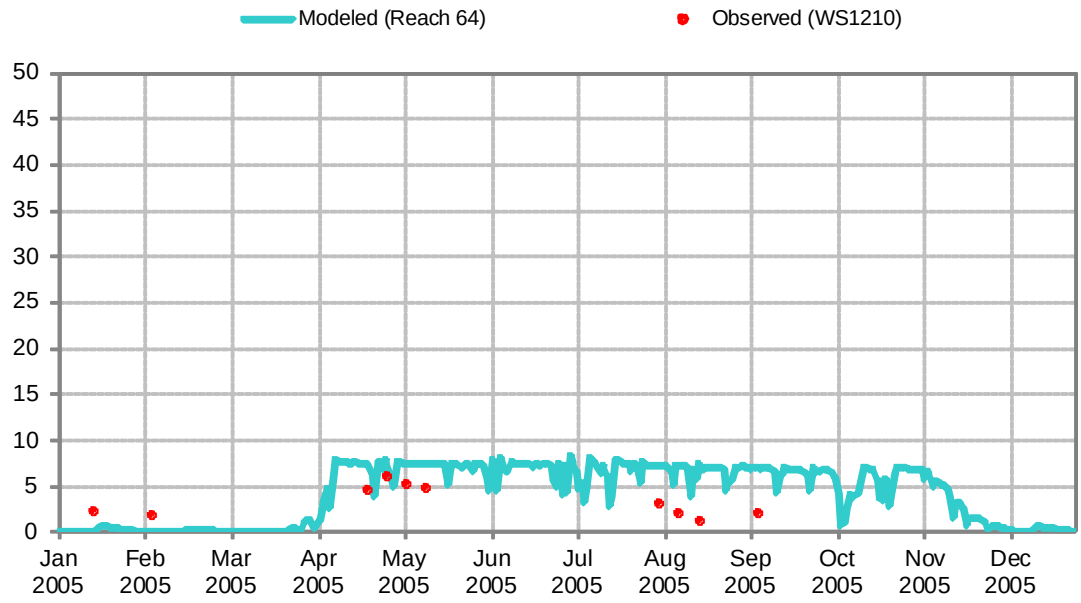

Figure F-77. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS1210

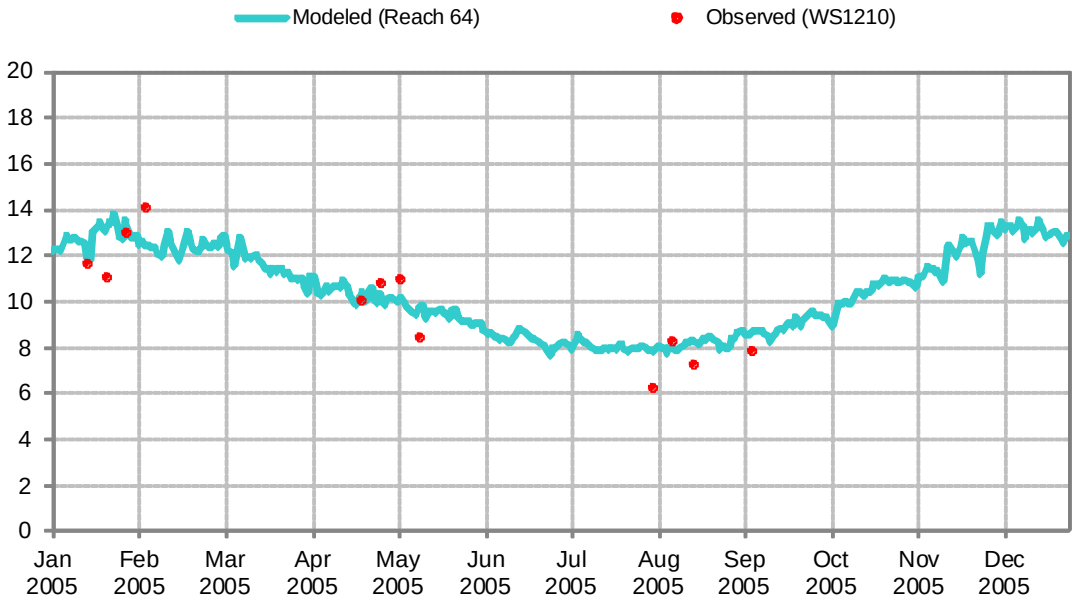

Figure F-78. Modeled vs. Observed DO (mg/L) at WS1210

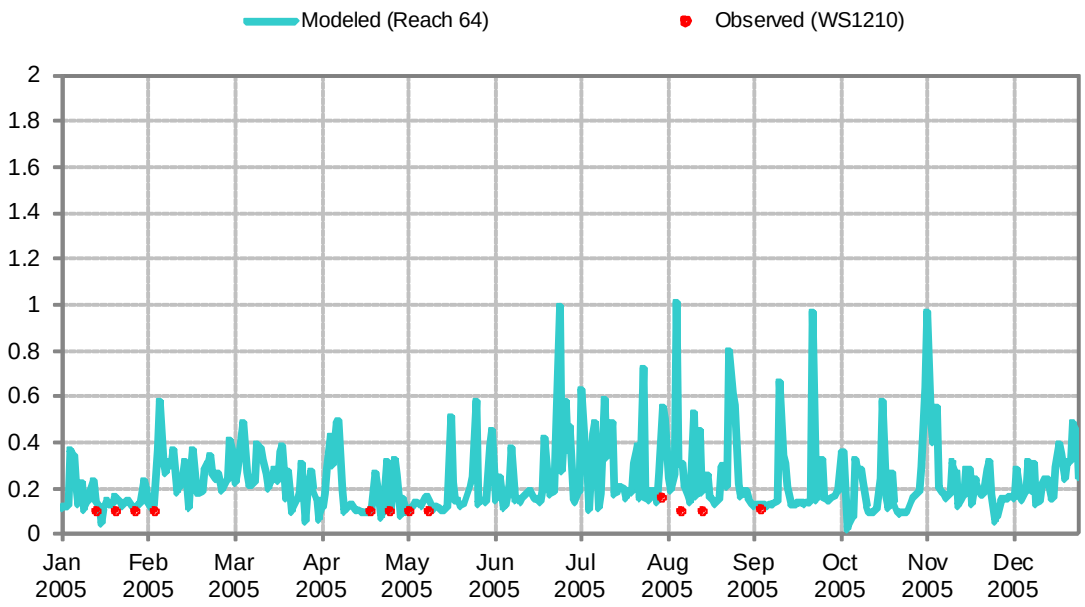

Figure F-79. Modeled vs. Observed NH3T (mg/L as N) at WS1210

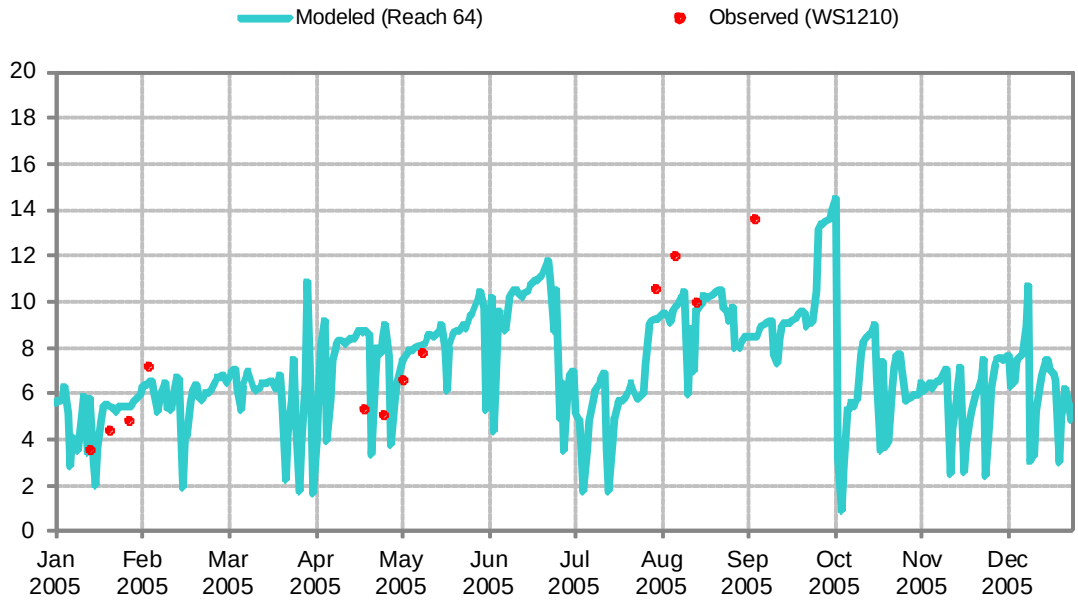

Figure F-80. Modeled vs. Observed NO3 (mg/L) at WS1210

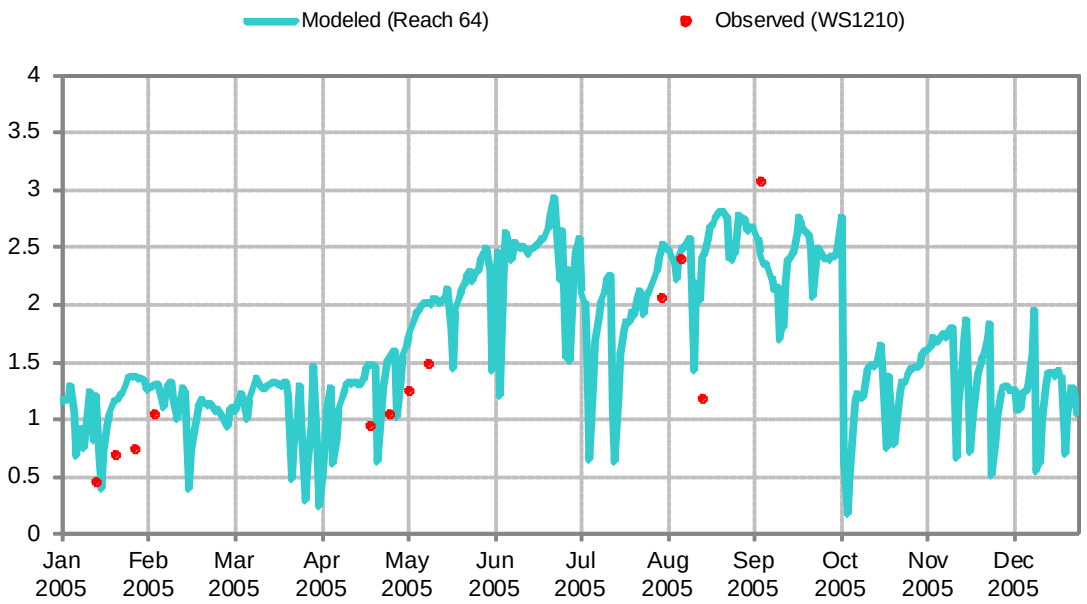

Figure F-81. Modeled vs. Observed PO4 (mg/L) at WS1210

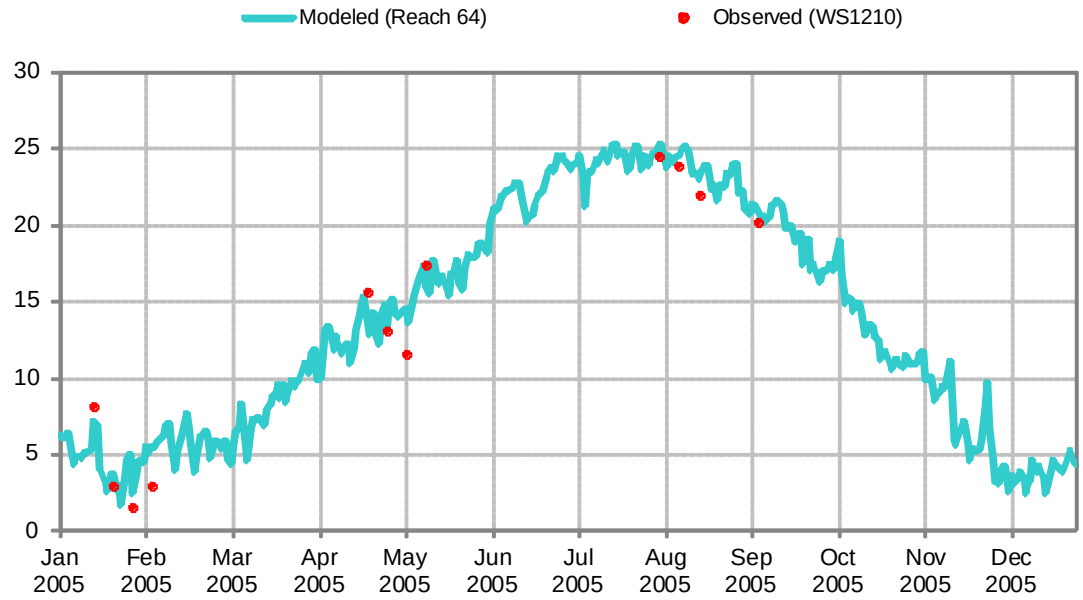

Figure F-82. Modeled vs. Observed Temperature (°C) at WS1210

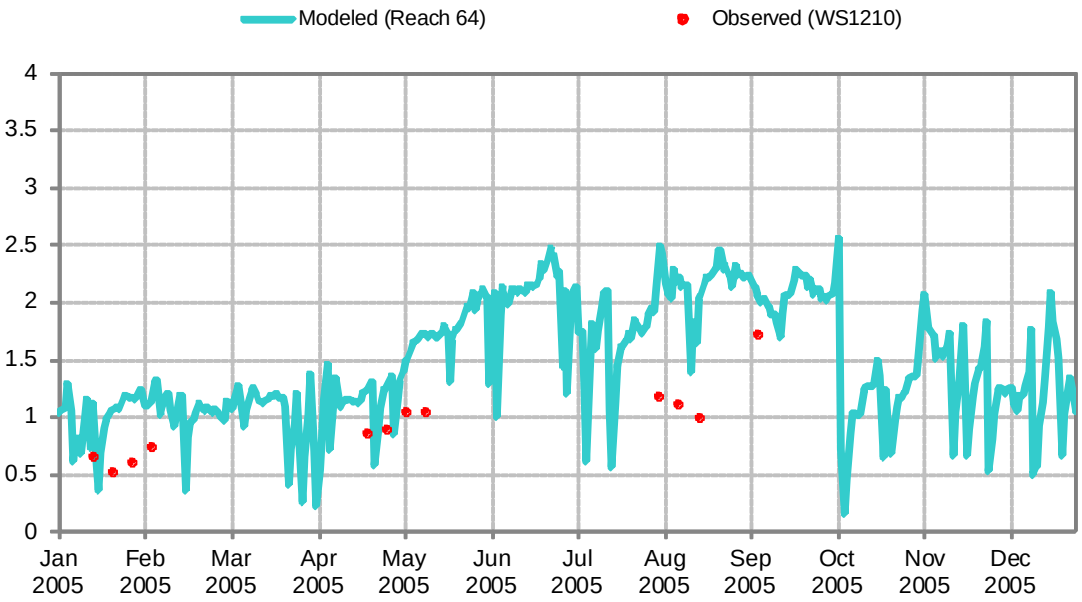

Figure F-83. Modeled vs. Observed TKN (mg/L) at WS1210

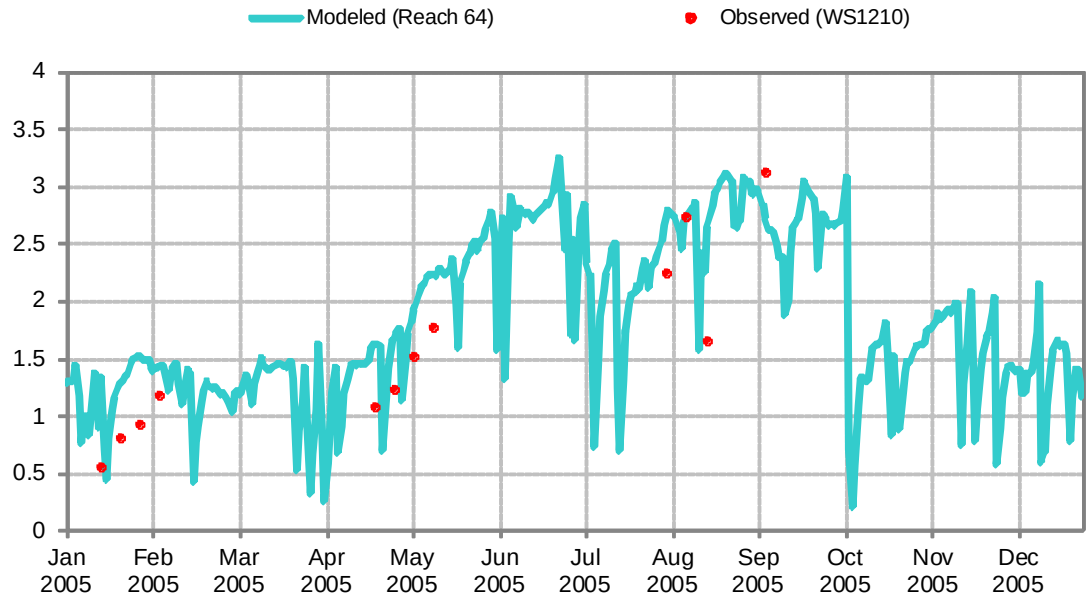

Figure F-84. Modeled vs. Observed TP (mg/L) at WS1210

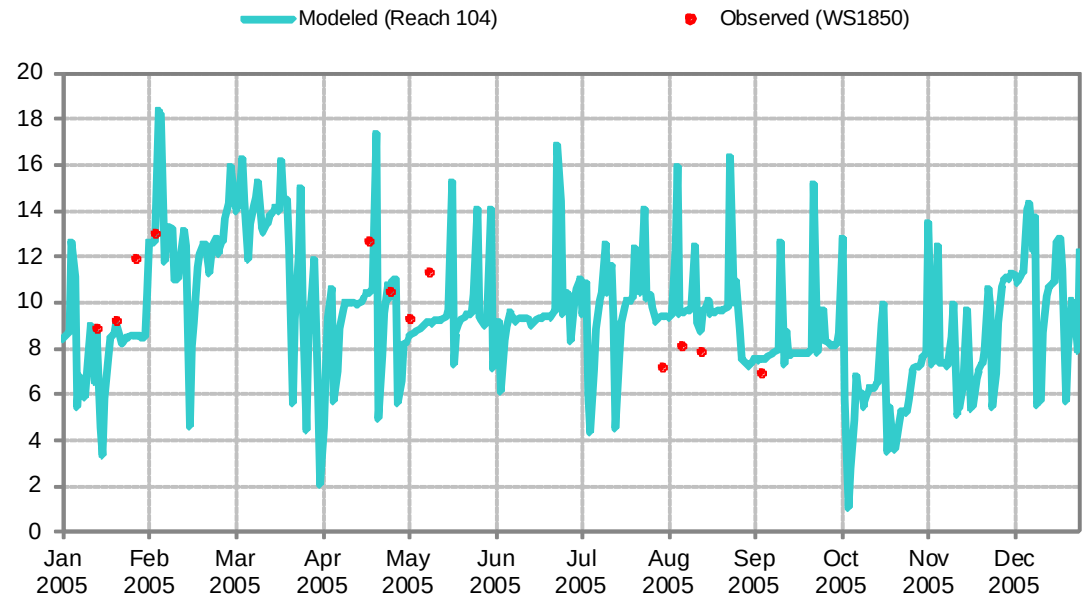

Figure F-85. Modeled vs. Observed BOD30 (mg/L) at WS1850

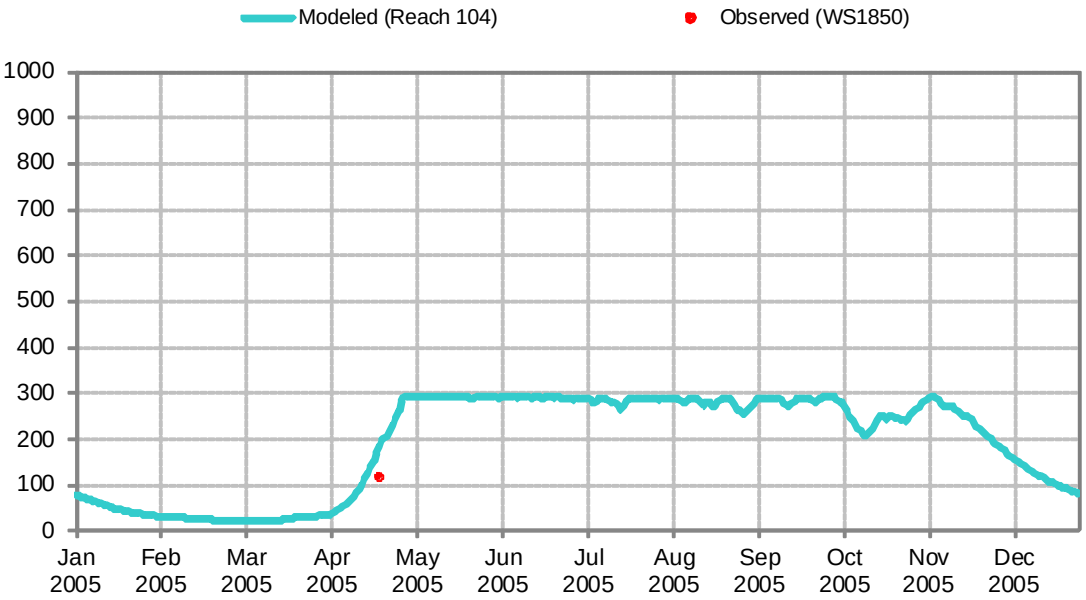

Figure F-86. Modeled vs. Observed Benthic Algae Chlorophyll *a* (mg/m^2) at WS1850

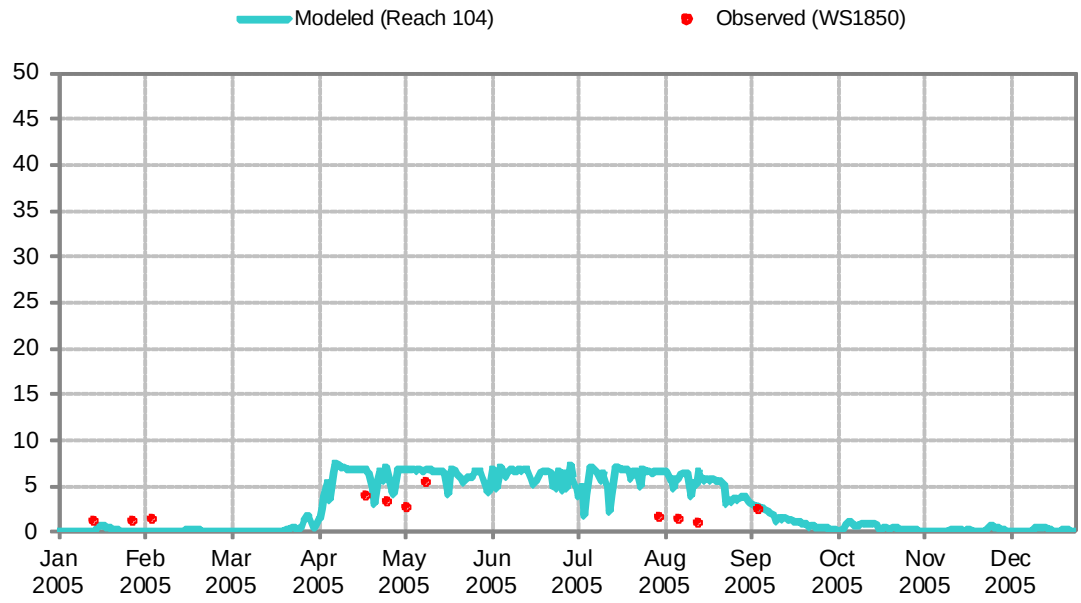

Figure F-87. Modeled vs. Observed Phytoplankton Chlorophyll *a* (µg/L) at WS1850

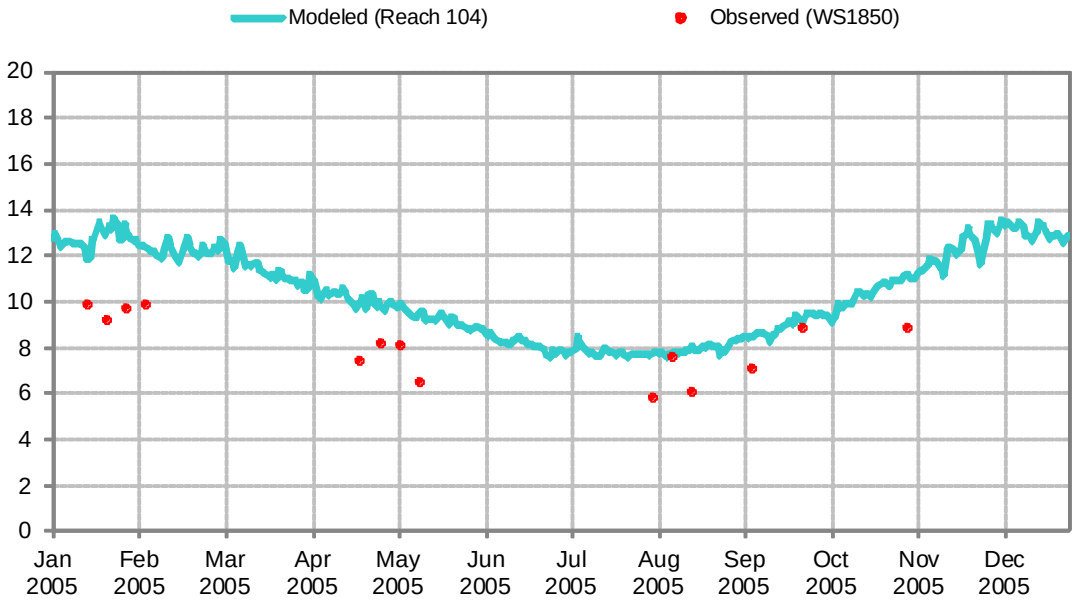

Figure F-88. Modeled vs. Observed DO (mg/L) at WS1850

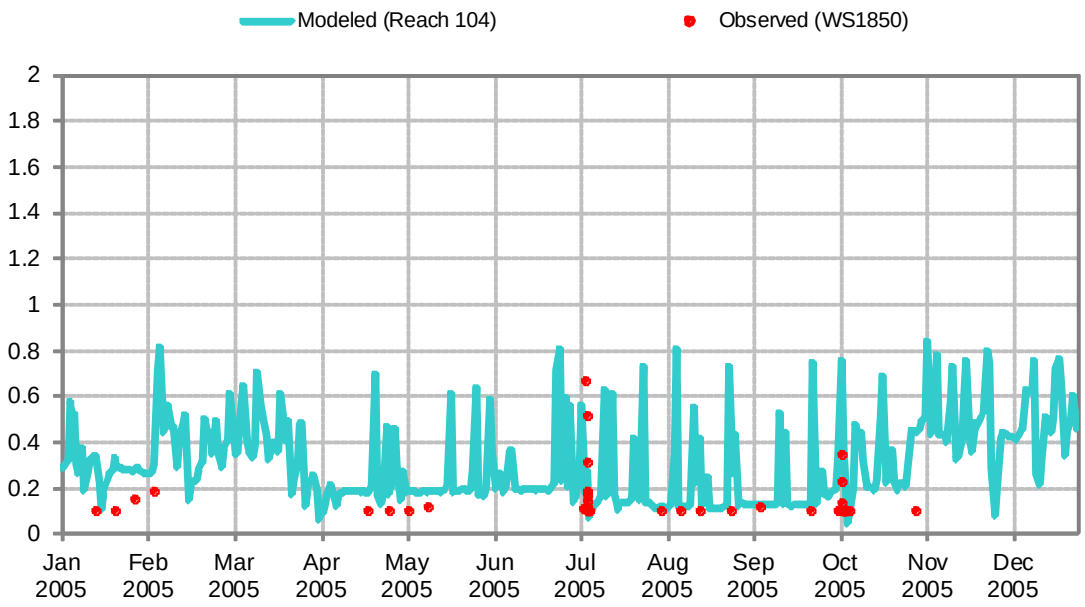

Figure F-89. Modeled vs. Observed NH3T (mg/L as N) at WS1850

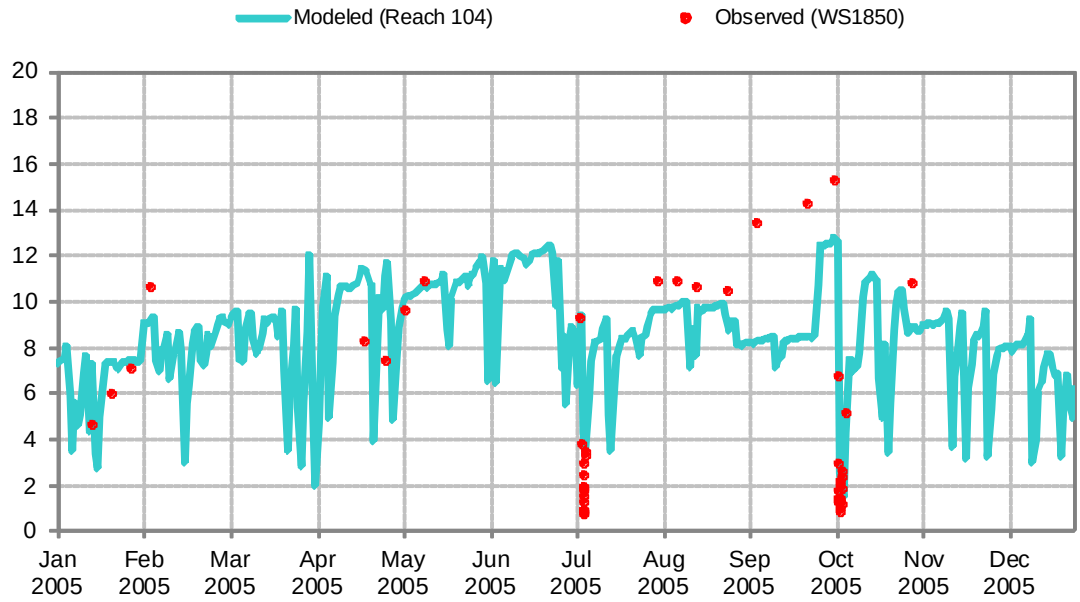

Figure F-90. Modeled vs. Observed NO3 (mg/L) at WS1850

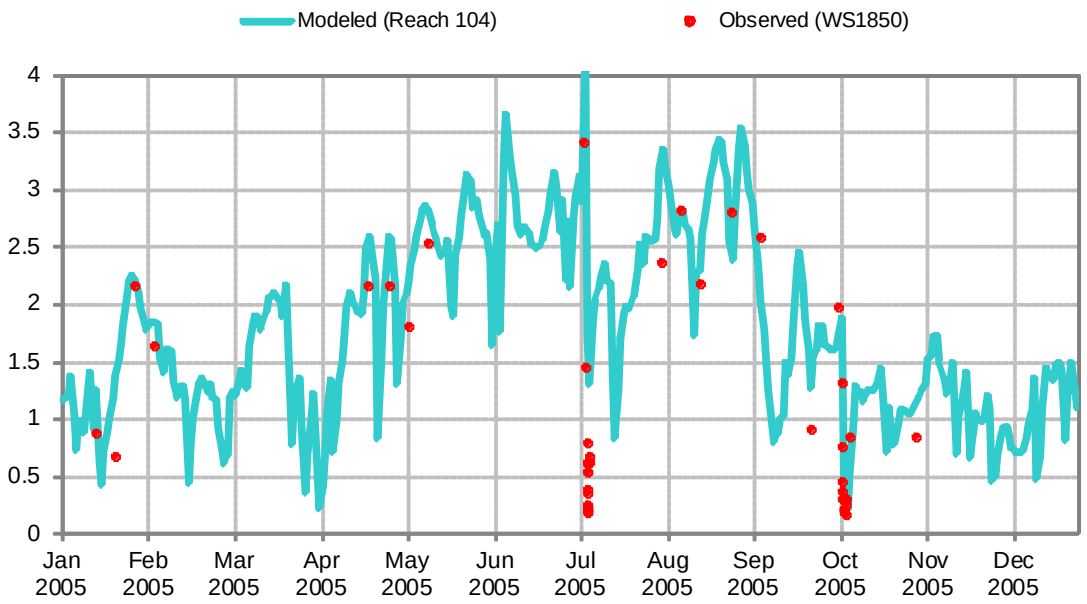

Figure F-91. Modeled vs. Observed PO4 (mg/L) at WS1850

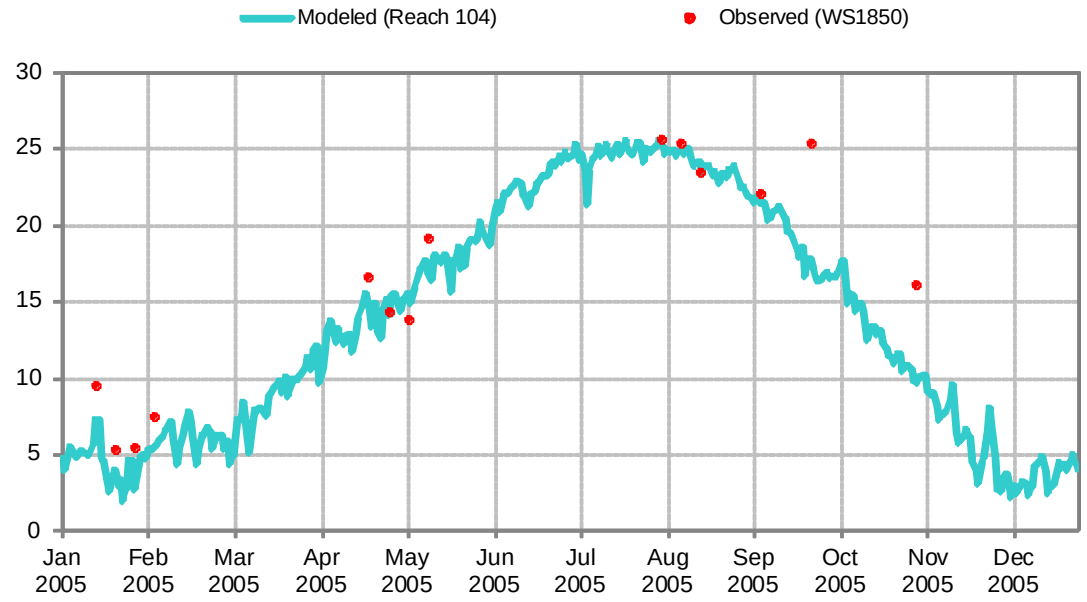

Figure F-92. Modeled vs. Observed Temperature (°C) at WS1850

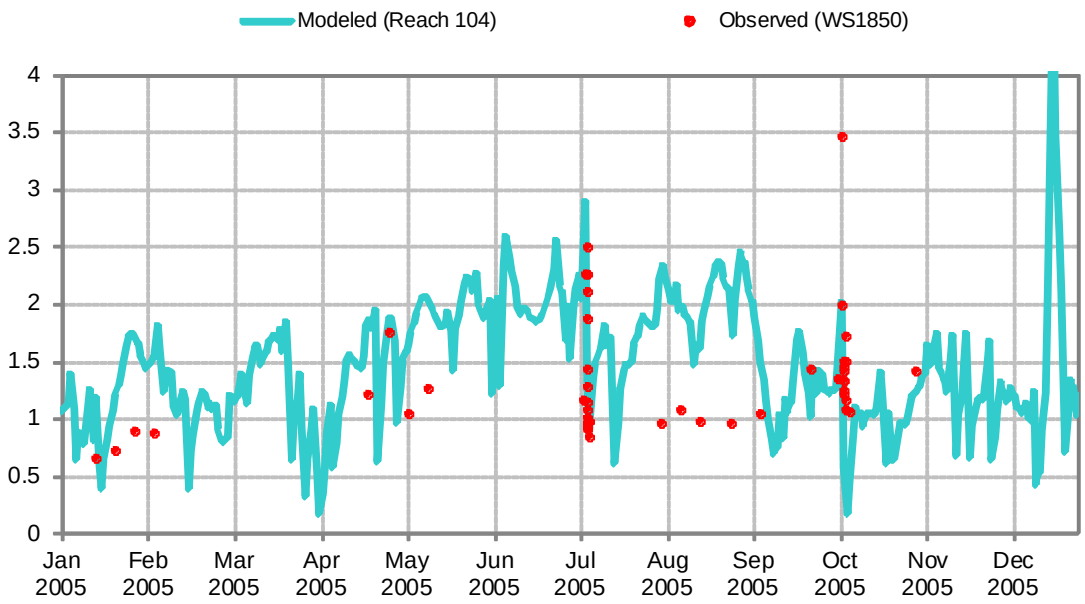

Figure F-93. Modeled vs. Observed TKN (mg/L) at WS1850

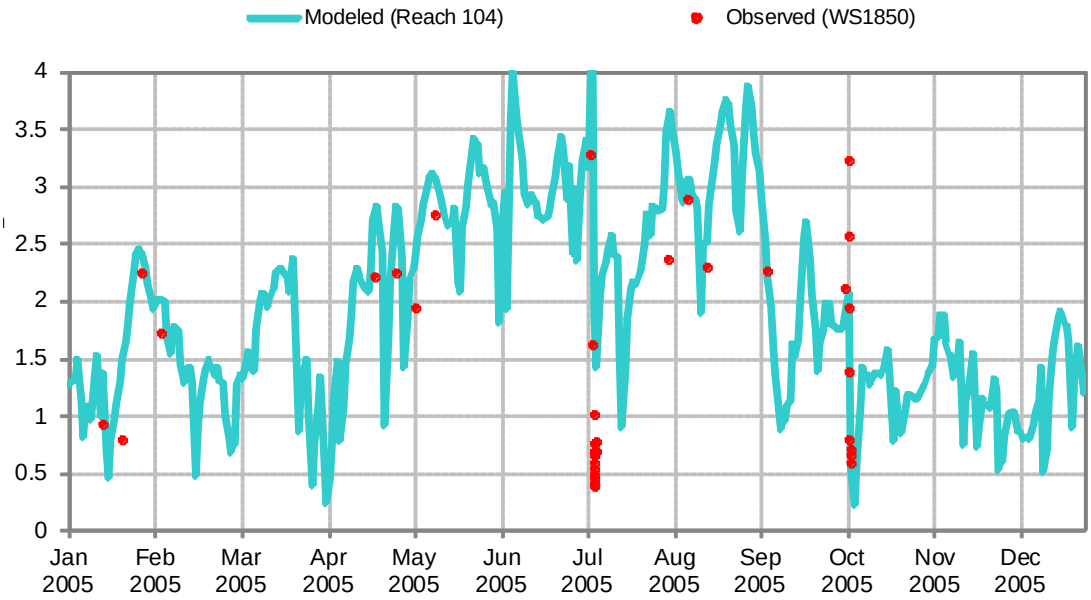

Figure F-94. Modeled vs. Observed TP (mg/L) at WS1850