Appendix B-1

MIKE URBAN CALIBRATION TEST PROJECT MEMORANDUM, NOVEMBER 2008

TECHNICAL MEMORANDUM

Project Name:	Barton, Murray, North Beach, South Magnolia CSO Facilities	**Date:**	11/05/2008
Client:	King County DNRP, Wastewater Treatment Division	**Project Number:**	7562A10
Prepared By:	Jason Nikaido, Ed Wicklein, Shawn Dent		
Reviewed By:	Brian Matson, Allen de Steiger, Karl Hadler		
Subject:	MIKE URBAN Calibration Test		
Distribution:	Bob Swarner, King County Bruce Crawford, King County Kevin Schock, King County Shahrzad Namini, King County		

Purpose

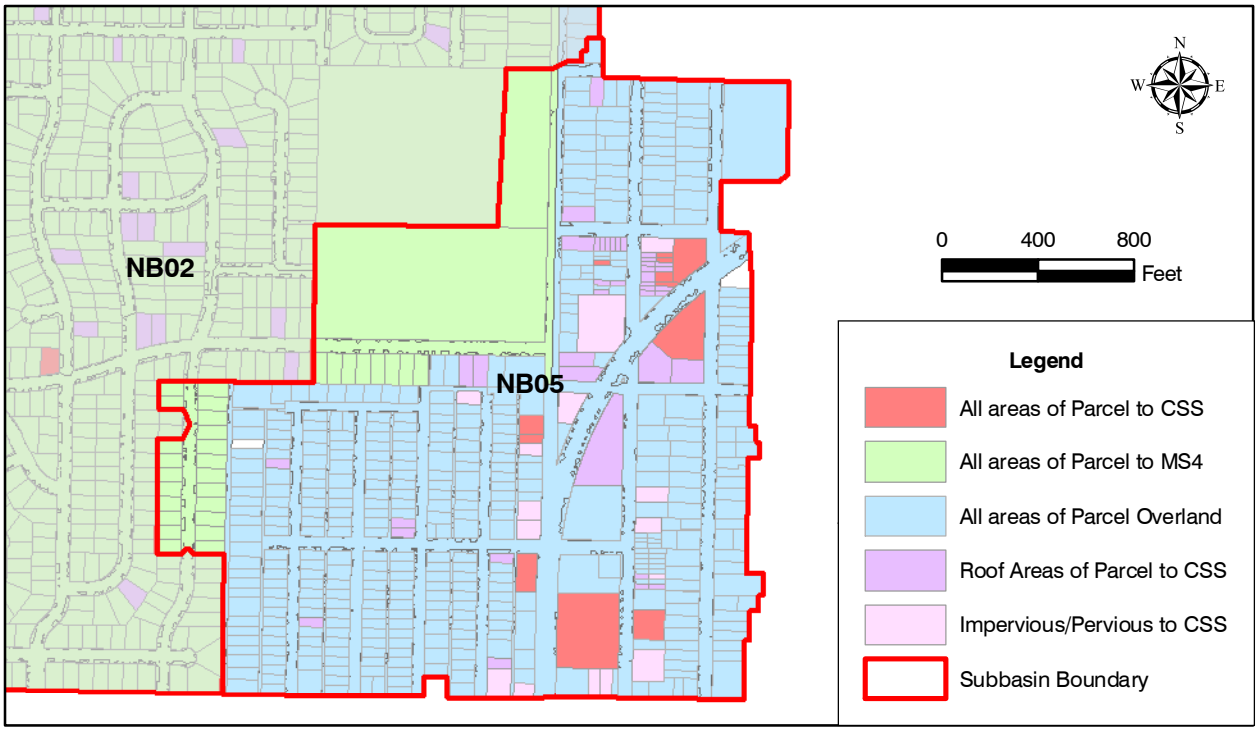
The purpose of this Technical Memorandum (TM) is describe the results of a calibration test using MIKE URBAN software to model the hydrology of subbasin NB05 in the North Beach basin. The purpose of this model calibration effort is to demonstrate how the model was calibrated, what parameters were used, and summarize the results obtained. Statistical tools available in MIKE URBAN are used to report on the accuracy and precision of the calibration. This TM provides a structured protocol for calibrating the models and a basis for judging the efficacy of MIKE URBAN to model the hydrology of the subbasins in the North Beach, South Magnolia, Barton and Murray basins. The TM, *MIKE URBAN Modeling Approach, Carollo Engineers, October 17, 2008*, should be reference for further detail on the overall modeling approach.

Subbasin NB05 Description

The North Beach basin consists of five subbasins designated by five metering locations. Subbasin NB05, the most upstream subbasin, was chosen for the test calibration. This subbasin was chosen because it is the most upstream subbasin in the North Beach basin (no upstream flow influence). The subbasin is primarily overland flow but also contains a mix of Combined Sewer System (CSS), Sanitary Sewer System (SSS) and Municipal Separate Storm Sewer System (MS4). The average slope of this subbasin is 0.014 feet/feet. The average length of this subbasin is 328 feet (length is a surrogate parameter used for time of concentration).

Table 1 summarizes the characteristics of this subbasin. Figure 1 illustrates the features of this subbasin.

Scenario A



Scenario B

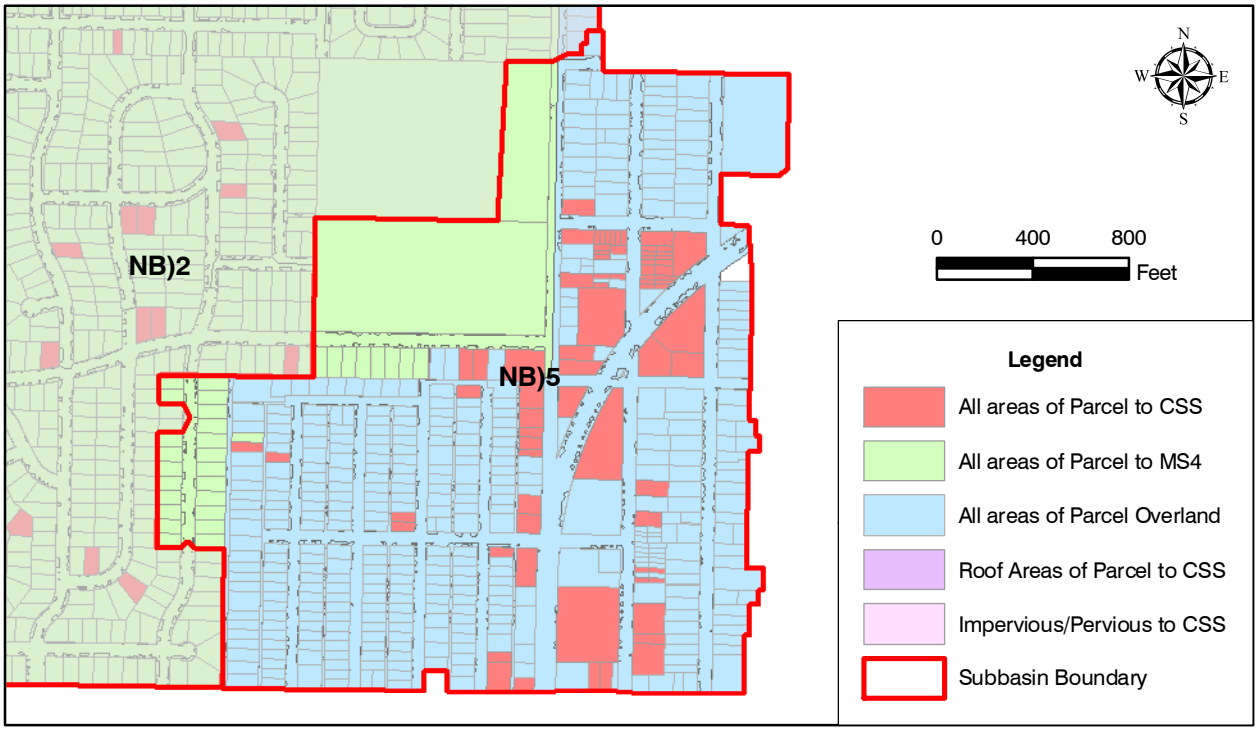


Figure 1
SUBBASIN NB05 FEATURES
BARTON, MURRAY, NORTH BEACH,
SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP,
WASTEWATER TREATMENT DIVISION

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Table 1	Subbasin NB05 Characteristics Barton, Murray, North Beach, and South Magnolia CSO Basins King County DNRP, Wastewater Treatment Division												
		Acreage						Percentage					
	Feature	Scenario A			Scenario B			Scenario A			Scenario B		
Feature	Class	CSS	MS4	O[(1)]	CSS	MS4	O	CSS	MS4	O	CSS	MS4	O
ROW	Impervious	0.0	2.9	21.9	0.0	2.9	21.9	0.0	2.6	19.9	0.0	2.6	19.9
	Pervious	0.0	0.3	2.8	0.0	0.3	2.8	0.0	0.3	2.6	0.0	0.3	2.6
Parcels	Roof	4.6	1.8	17.1	5.3	1.9	16.3	4.1	1.7	15.6	4.8	1.7	14.8
	Impervious	5.9	5.6	24.1	7.5	5.5	22.5	5.4	5.0	21.9	6.8	5.0	20.4
	Pervious	0.8	8.1	14.2	1.0	8.1	14.1	0.7	7.4	12.9	0.9	7.4	12.8
Total Area	---	11.3	18.7	80.3	13.7	18.7	77.7	10.2	17.0	72.8	12.5	16.9	70.5

Notes:
(1) O = Overland flow

Monitored data

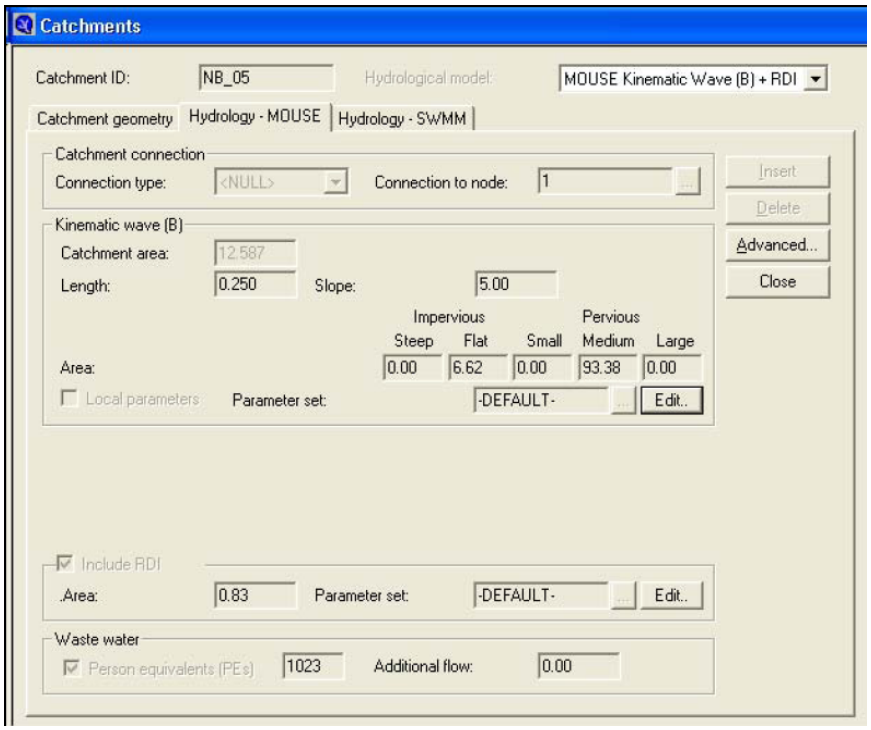
The monitoring effort completed by ADS provides the rainfall, flow, depth and velocity measurements that will be used for this study. It was the initial intent of this monitoring effort to record data at 5-minute intervals. However, due to various issues, not all the flow/depth/velocity data could be provided at this interval. Some of the data was provided at a 15-minute interval. When measured flows in a basin consist of both 5-minute and 15-minute data, the best accuracy for the overall basin defaults to 15-minute data. However, the rainfall data was provided at 5-minute intervals for each basin and will be used in the calibration effort. Therefore, 5-minute rain data will be used to run the models, but modeled flows will be aggregated to 15-minute intervals, and reported at this interval, for calibration of the subbasin flows.

Calibration Parameters

The subbasin model was calibrated to both Dry Weather Flow (DWF) and Infiltration and Inflow (I/I). DWF was calibrated by applying a unit diurnal pattern and an Average Dry Weather Flow (ADWF). The unit diurnal pattern for each subbasin was approximated from the flows that are least affected by rainfall, which included weekend and weekday flows from May 4 - 11, 2008. No rainfall was observed during this period with minimal preceding it. The ADWF was estimated as person equivalents (PE) based on unit flow factors applied to population estimates and parcel level land use data in the GIS for residential, commercial and industrial contributions. The unit flow factors were adjusted to best match the measured ADWF's. Based on the period from May 4 - 11, 2008, a dry weather flow of 0.1023 mgd was estimated. Using an average of 100 gallons per capita per day, a PE of 1,023 was used.

The MOUSE Kinematic Wave - B (MOUSE-B) and RDI were chosen to model inflow and infiltration respectively. I/I was calibrated by inputting measured parameters from the GIS (e.g. area, slope, length, and percent imperviousness) and adjusting other parameters that cannot be directly measured. Although length (analogous to time of concentration) can be measured, this parameter is usually considered a "calibration parameter" that can be adjusted to best represent measured data. Other calibration parameters are usually a subset of unmeasured parameters that have the most dramatic affect in adjusting modeled flow to match measured flow. Table 2 summarizes the calibration parameter set and the values used to calibrate the subbasins response. Figure 2 presents the Kinematic Wave and RDI parameters.

Kinematic Wave Parameters



RDI Parameters

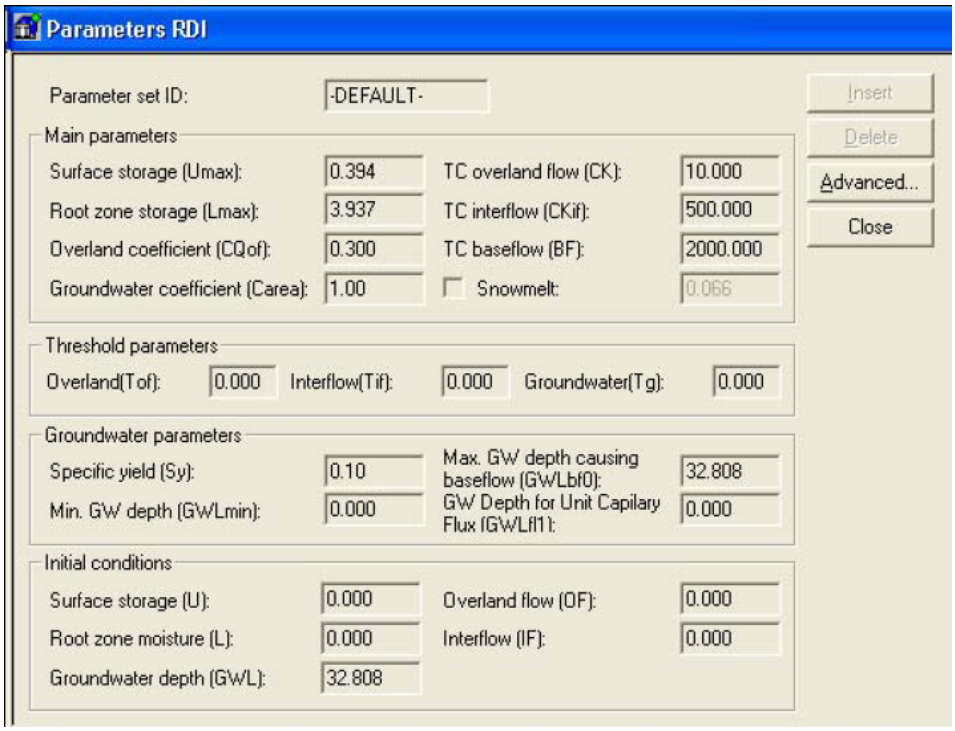


Figure 2
KINEMATIC WAVE AND RDI PARAMETERS
BARTON, MURRAY, NORTH BEACH,
SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP,
WASTEWATER TREATMENT DIVISION

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Table 2	Subbasin NB05 Hydrologic Calibration Parameters Barton, Murray, North Beach, and South Magnolia CSO Basins King County DNRP, Wastewater Treatment Division		
Parameter (units)	**Typical Range**	**Value Used**	**Comments**
Area (acres)	Varies	11.3	Physical measurement - total area tributary to CSS
Length (feet)	Varies	0.25	Physical measurement - adjusted during calibration
Slope (ft/ft)	Varies	5.00	Physical Measurement - adjusted during calibration
Steep Impervious (%)	Varies	0.00	Physical Measurement
Flat Impervious (%)	Varies	7.08	Physical Measurement - total impervious area
Small Pervious (%)	Varies	0.00	Physical Measurement
Medium Pervious (%)	Varies	92.92	Physical Measurement - total pervious area
Large Pervious (%)	Varies	0.00	Physical Measurement
RDI Area (acres)	Varies	0.83	Physical Measurement - pervious area tributary to CSS
Kinematic Wave	Varies	See Fig 2	Default
RDI	Varies	See Fig 2	Default

Results

Proper calibration requires an assessment of the precision and accuracy of modeled variables compared to measured variables. In this case, flows are the primary variable used for calibration. The goal of calibration depends on the specific use of the model. This model will need to be accurately calibrated to flow volume, peaks, and hydrograph shape because both conveyance as well as equalization facilities will be analyzed. MIKE URBAN provides several calibration tools that will be used and reported (e.g. scatter graphs, residuals, statistics, etc.). King County and Carollo will mutually decide upon what constitutes an adequate calibration by discussing the quality of the monitoring data and the results of the calibration effort.

Figures 3-9 present hydrographs of the calibration for each month. In general, the response to rainfall is good. Peak flows, hydrograph shape, and dry weather flows for the measured and modeled data match well. In addition, wet weather flows return to dry weather flows as expected.

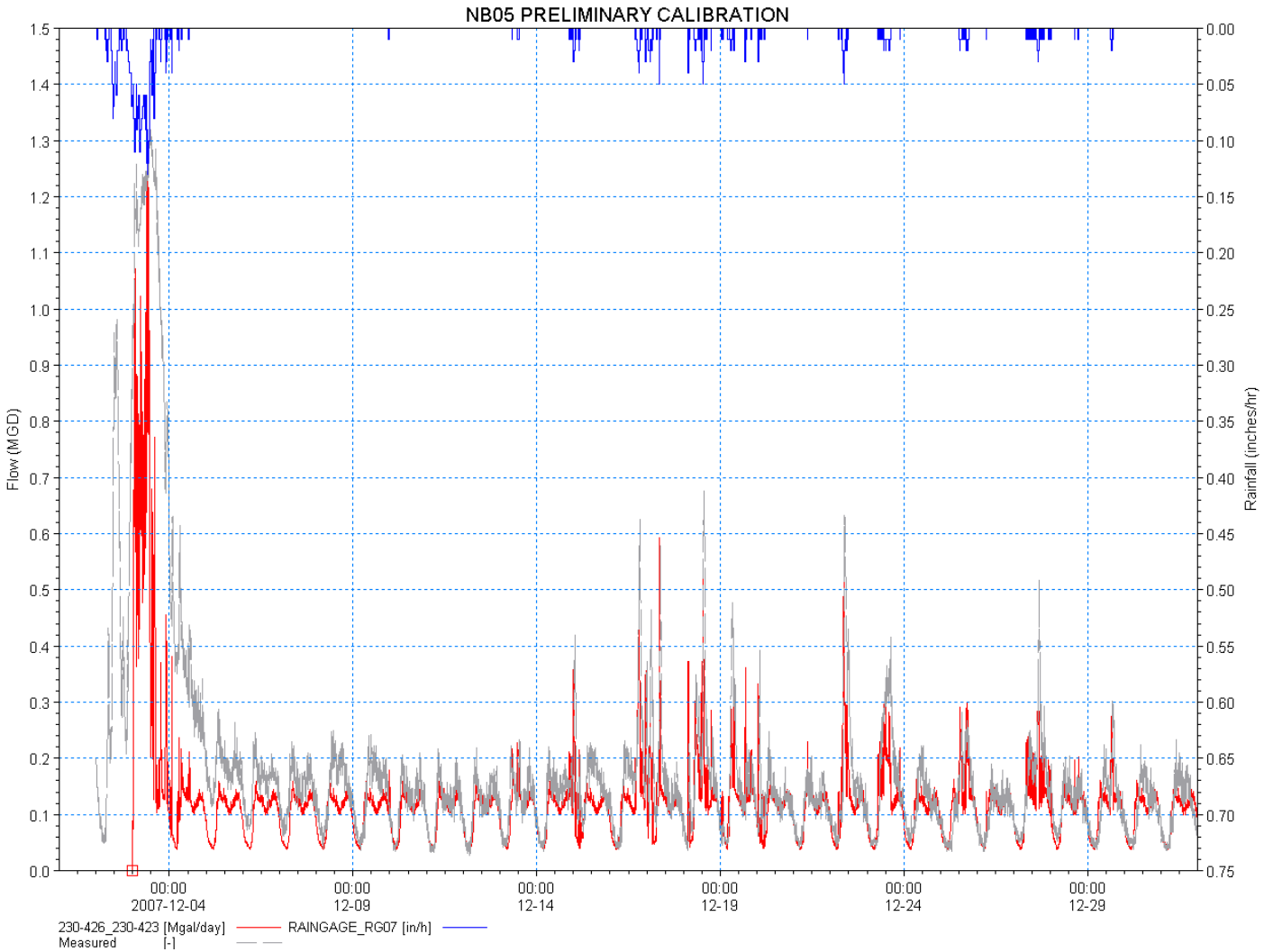

Figure 3
SUBBASIN NB05 TEST CALIBRATION - DECEMBER 2007
BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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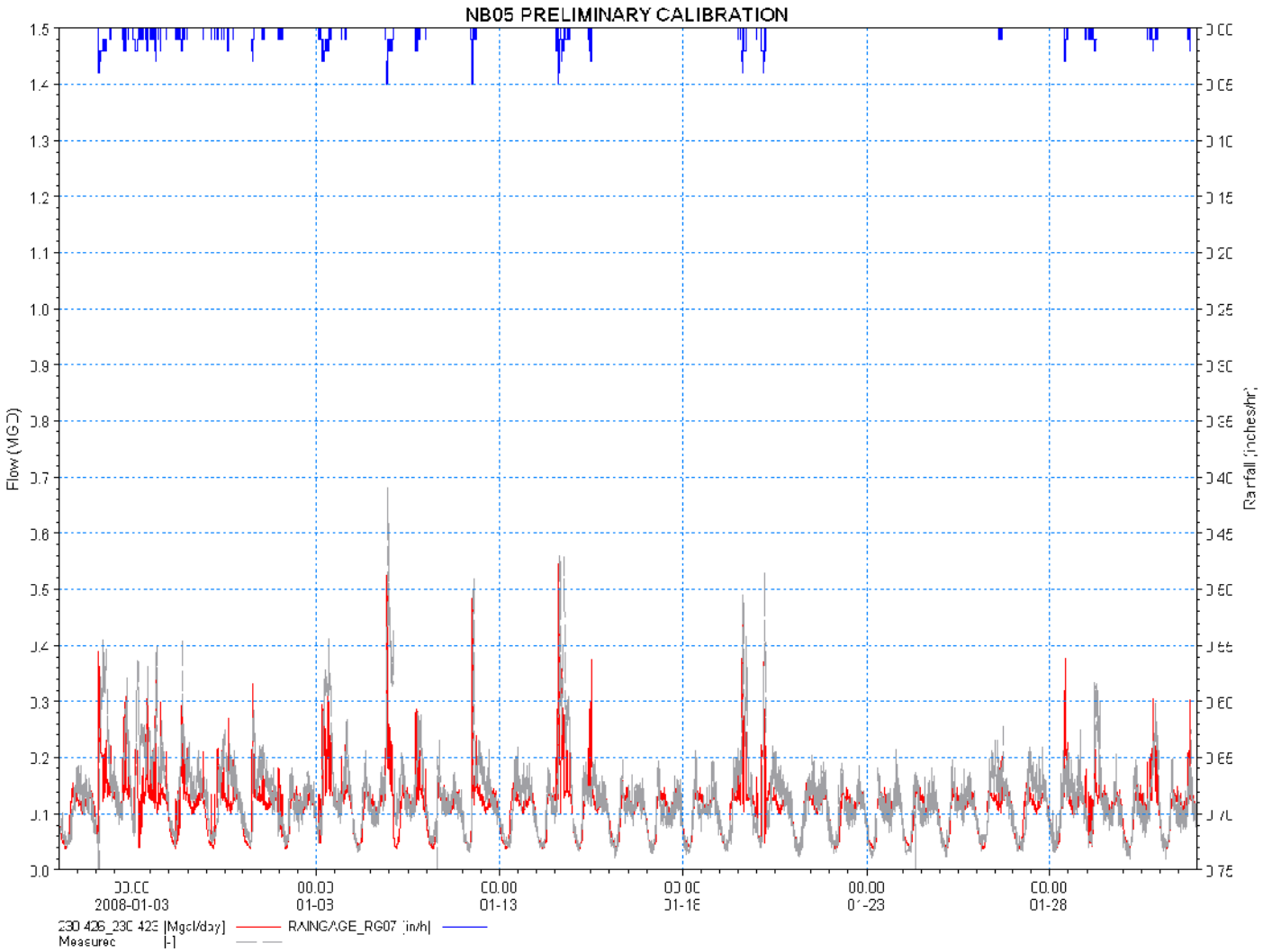

Figure 4
SUBBASIN NB05 TEST CALIBRATION - JANUARY 2008
BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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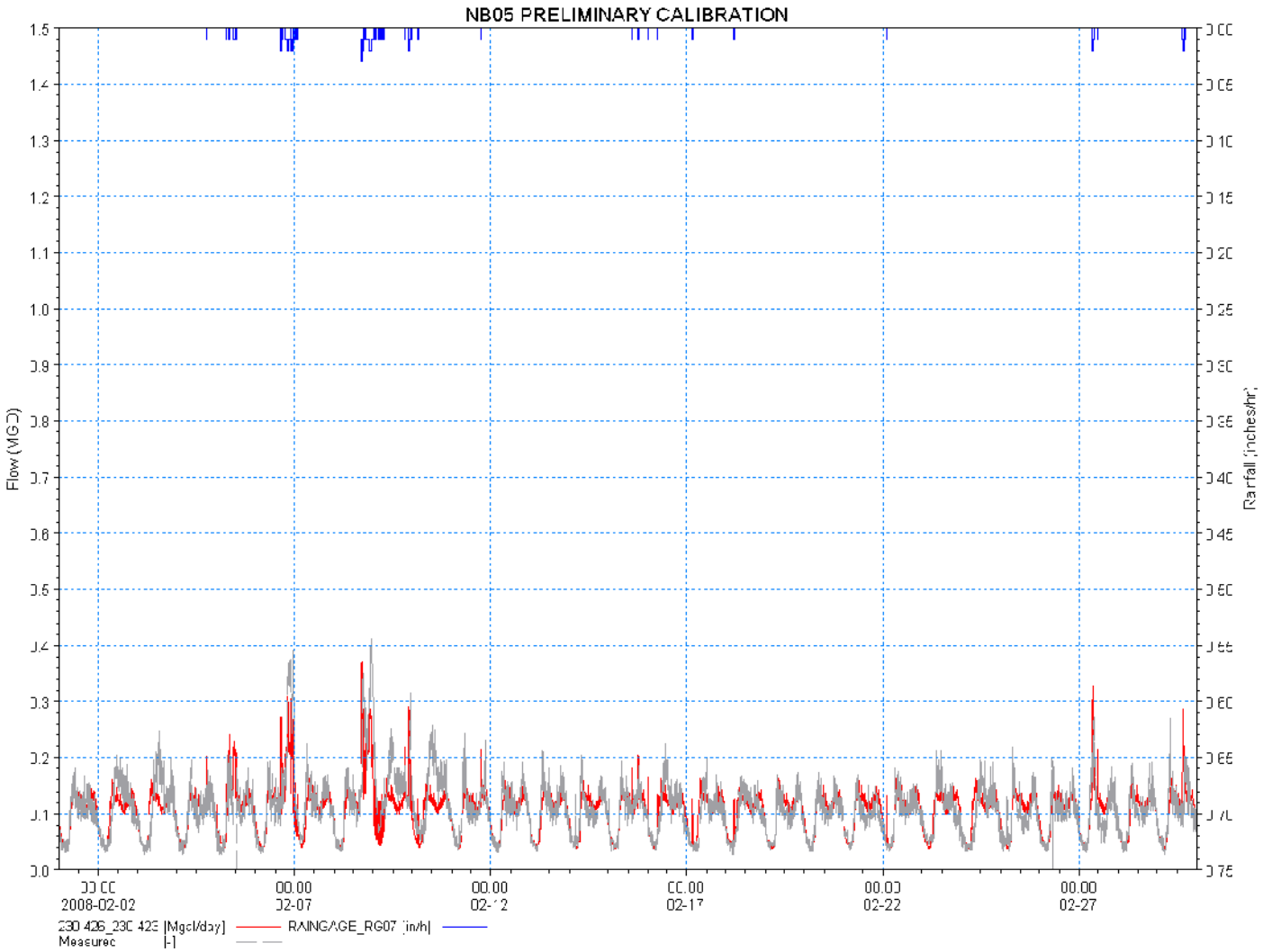

Figure 5

SUBBASIN NB05 TEST CALIBRATION - FEBRUARY 2008

BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES

KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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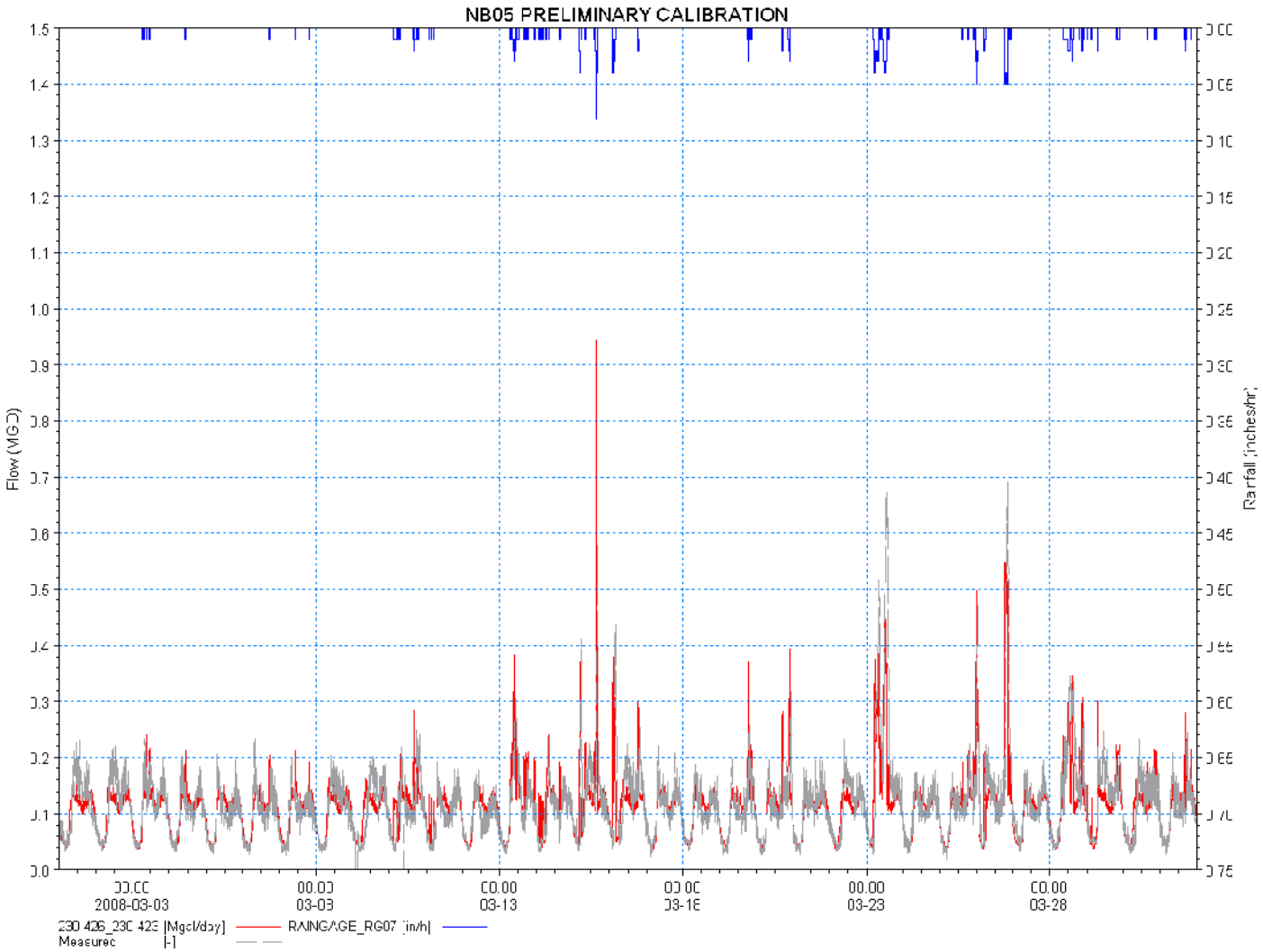

Figure 6
SUBBASIN NB05 TEST CALIBRATION - MARCH 2008
BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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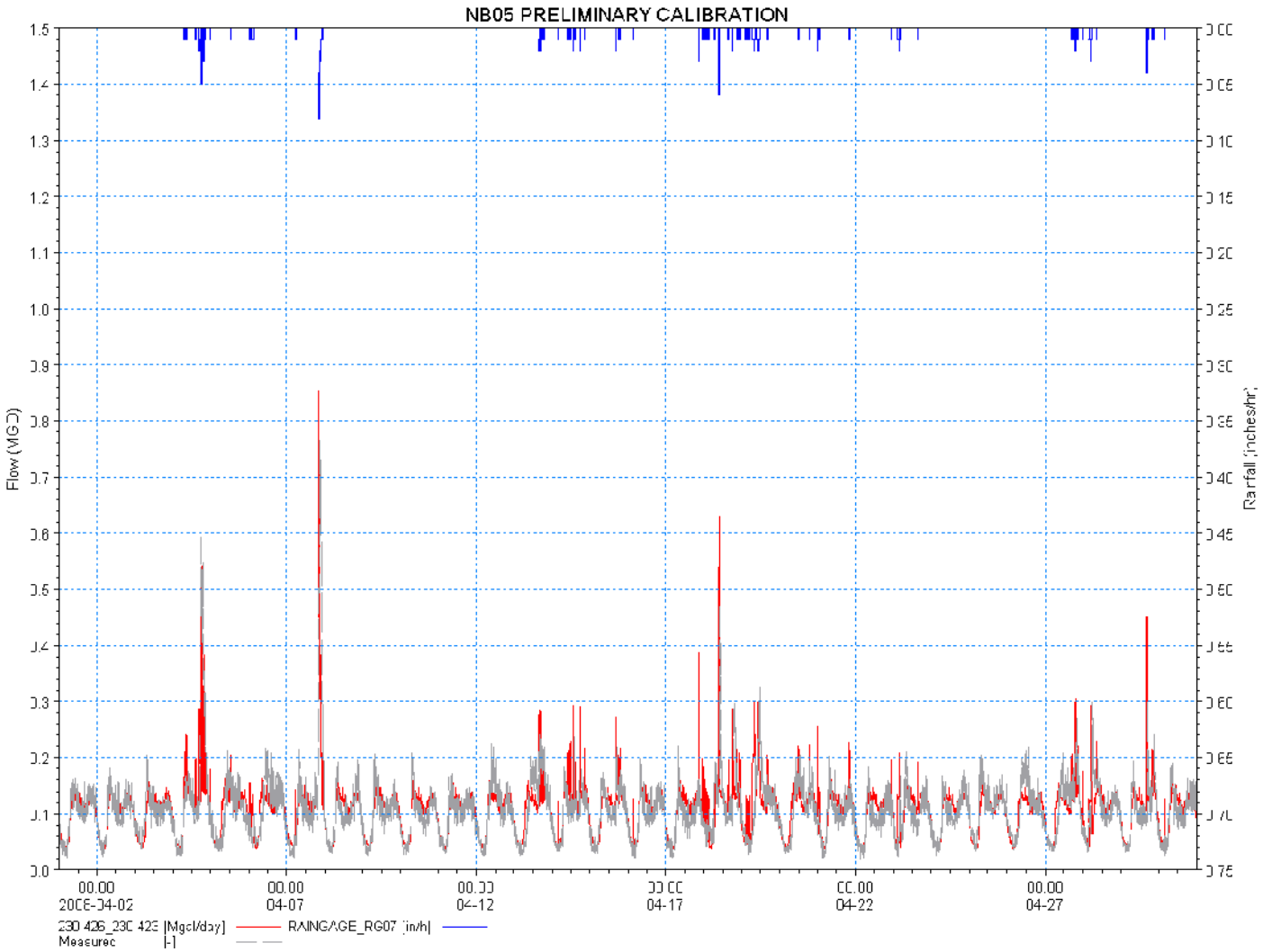

Figure 7
SUBBASIN NB05 TEST CALIBRATION - APRIL 2008
BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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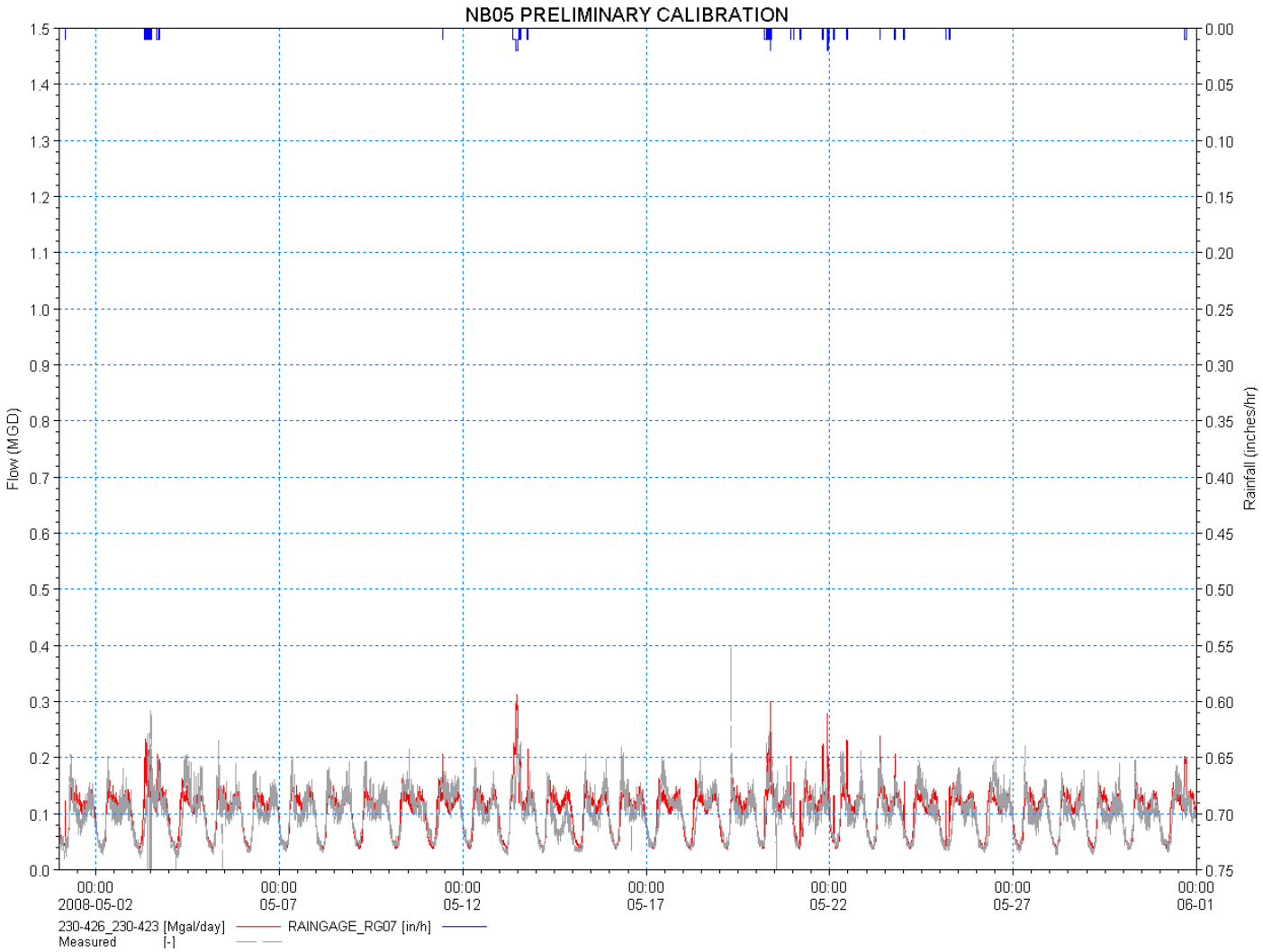

Figure 8
SUBBASIN NB05 TEST CALIBRATION - MAY 2008
BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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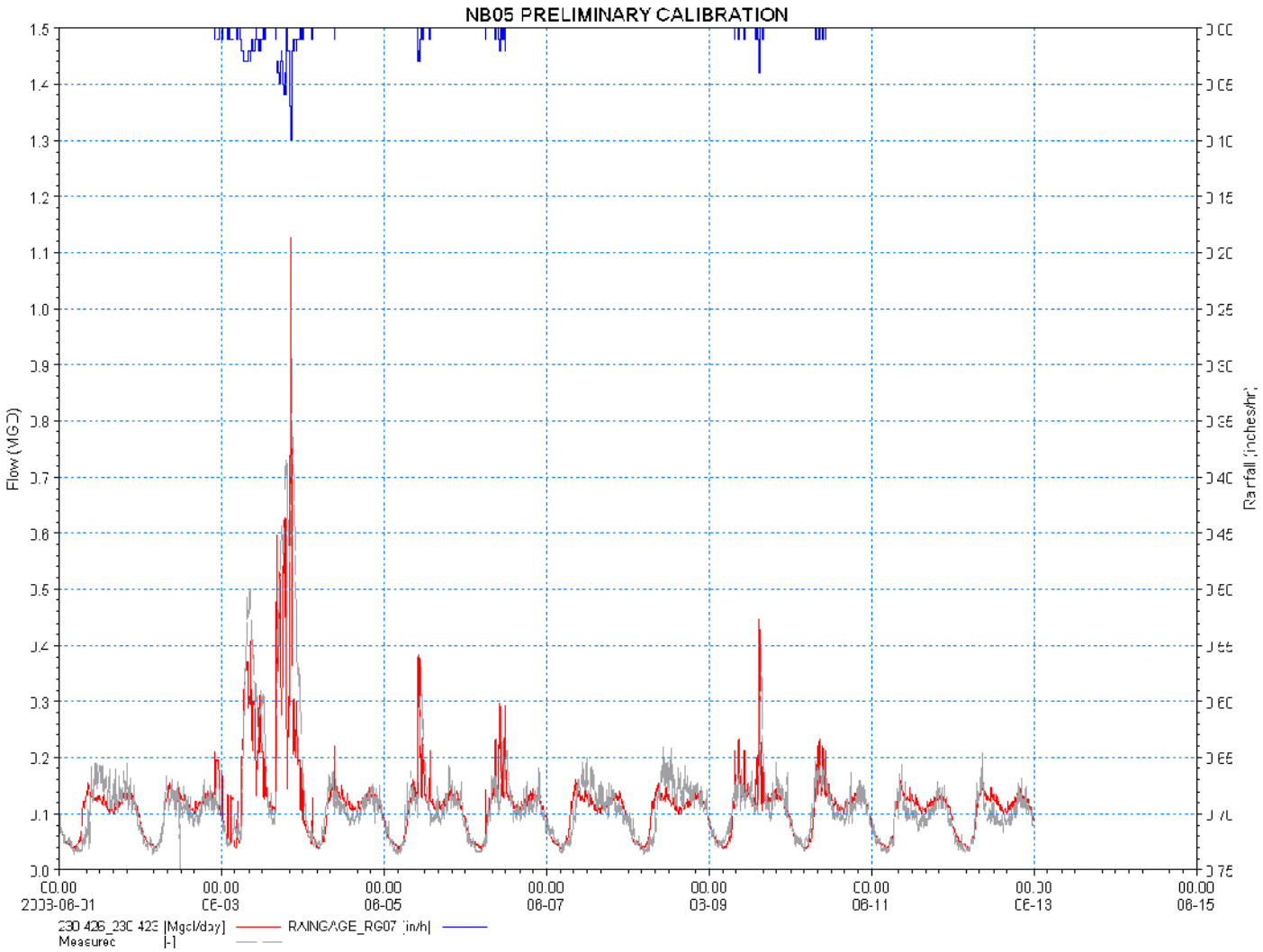

Figure 9
SUBBASIN NB05 TEST CALIBRATION - JUNE 2008
BARTON, MURRAY, NORTH BEACH, SOUTH MAGNOLIA CSO FACILITIES
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Appendix B-2

CALIBRATION ROUND 2 PROJECT MEMORANDUM, MARCH 2009

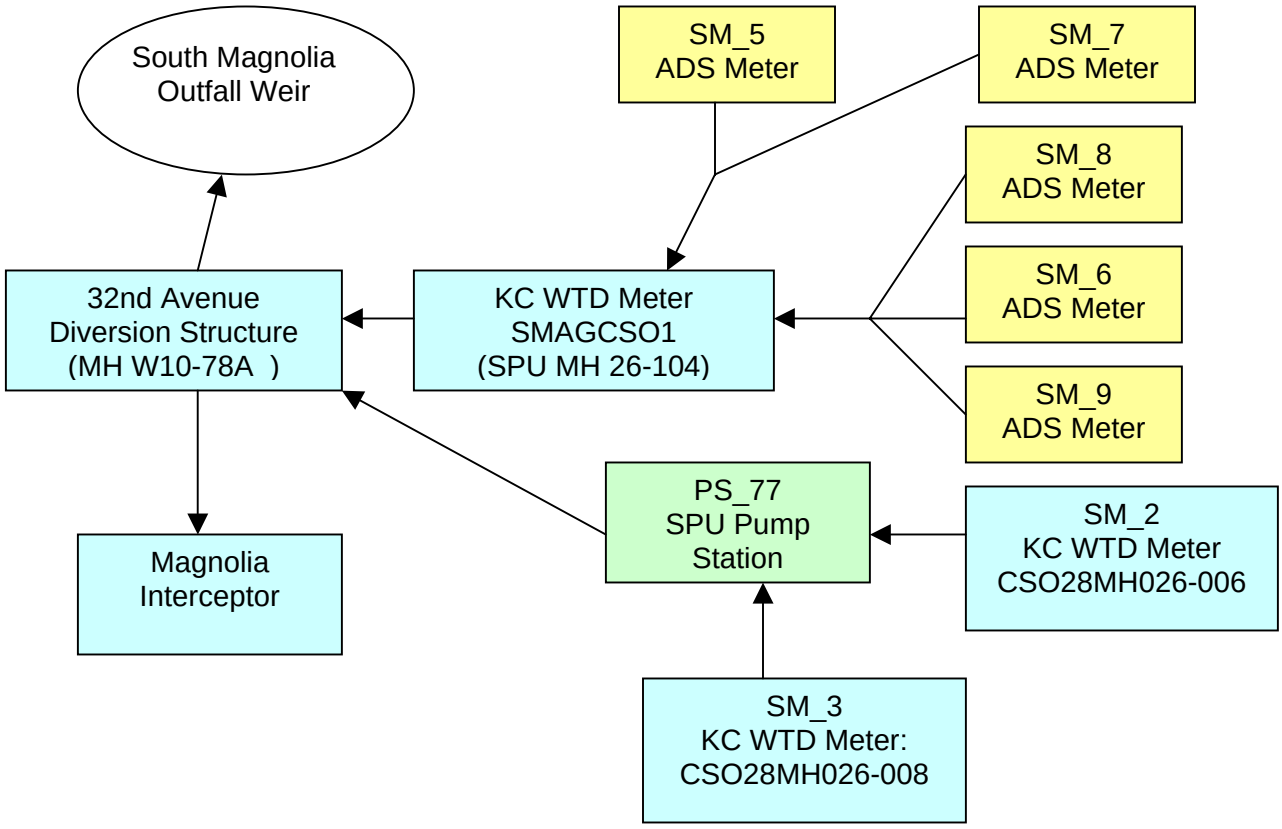
PROJECT MEMORANDUM

Project Name:	CSO Planning/Predesign Services	**Date:**	03/13/2009
Client:	King County DNRP, Wastewater Treatment Division	**Project Number:**	7562A.10
Prepared By:	Ed Wicklein		
Reviewed By:	Jason Nikaido, Allen DeSteiguer, Shawn Dent		
Subject:	South Magnolia Calibration, Round 2		
Distribution:	King County, Carollo Project Team		

The South Magnolia model was further calibrated from the previous round, primarily using the ADS data, but also looking at the MAGCSO data. The complete rainfall record was used, with hydrologic calculations beginning on September 1, 2007. The hydraulic calculations began on December 1, 2007.

The largest storms for the monitored period occurred in December and June. The storm in December lasted 56 hours and 7.2 inches of rain fell. The June storm lasted 36 hours and a total of 1.12 inches of rain fell. Calibration focused on matching a storm event in June 2008, while also looking at the larger record. Data was also not available from all meters for the December event. The December event produced a much larger recorded volume in the collection system relative to the volume of rain, as compared with the June event for the meters that had data. Matching the peak for the December event leads to the model generally over-predicting the collection flows for longer term and June storm. The peak ADS flows are already greater that the flows recorded at the MAGCSO meter.

The attached figures and tables show the results. The peak flows appear to be dominated by inflow at the storm peaks. The system seems to rapidly return to the DWF conditions within a few days of the peak storm. The model under predicts the December storm, but generally models a slightly higher volume than that recorded for the rest of the period.


South Magnolia
Outfall Weir
SM_5
ADS Meter
SM_7
ADS Meter
SM_8
ADS Meter
SM_6
ADS Meter
SM_9
ADS Meter
32nd Avenue
Diversion Structure
(MH W10-78A)
KC WTD Meter
SMAGCSO1
(SPU MH 26-104)
PS_77
SPU Pump
Station
SM_2
KC WTD Meter
CSO28MH026-006
Magnolia
Interceptor
SM_3
KC WTD Meter:
CSO28MH026-008

South Magnolia 02

December Event		
Correlation coeficient R2	0.912	
Max. positive difference	0.09	cfs
Max. negative difference	-0.788	cfs
Volume observed	96442.165	CF
Volume modelled	70882.949	CF
Volume error	-26.502	%
Peak observed value	1.406	cfs
Peak modelled value	0.711	cfs
Peak error	-49.48	%

March 2008		
Correlation coeficient R2	0.537	
Max. positive difference	0.064	cfs
Max. negative difference	-0.241	cfs
Volume observed	181772.14	CF
Volume modelled	183378.35	CF
Volume error	0.884	%
Peak observed value	0.345	cfs
Peak modelled value	0.217	cfs
Peak error	-37.023	%

June Event		
Correlation coeficient R2	0.714	
Max. positive difference	0.126	cfs
Max. negative difference	-0.161	cfs
Volume observed	26587.809	CF
Volume modelled	30616.295	CF
Volume error	15.152	%
Peak observed value	0.398	cfs
Peak modelled value	0.464	cfs
Peak error	16.684	%

South Magnolia 03

December Event		
Correlation coeficient R2	0.908	
Max. positive difference	0.339	cfs
Max. negative difference	-6.398	cfs
Volume observed	411656.741	CF
Volume modelled	272301.271	CF
Volume error	-33.852	%
Peak observed value	9.282	cfs
Peak modelled value	3.332	cfs
Peak error	-64.098	%

March		
Correlation coeficient R2	0.712	
Max. positive difference	0.349	cfs
Max. negative difference	-0.441	cfs
Volume observed	366511.003	CF
Volume modelled	454488.06	CF
Volume error	24.004	%
Peak observed value	0.947	cfs
Peak modelled value	0.887	cfs
Peak error	-6.274	%

June Event		
Correlation coeficient R2	0.911	
Max. positive difference	0.428	cfs
Max. negative difference	-0.244	cfs
Volume observed	82569.327	CF
Volume modelled	91093.418	CF
Volume error	10.324	%
Peak observed value	1.997	cfs
Peak modelled value	2.044	cfs
Peak error	2.341	%

South Magnolia 05

December		
Correlation coeficient R2	0.876	
Max. positive difference	0.327	cfs
Max. negative difference	-0.299	cfs
Volume observed	57364.972	CF
Volume modelled	53367.886	CF
Volume error	-6.968	%
Peak observed value	0.761	cfs
Peak modelled value	0.751	cfs
Peak error	-1.408	%

March		
Correlation coeficient R2	0.607	
Max. positive difference	0.183	cfs
Max. negative difference	-0.215	cfs
Volume observed	91230.017	CF
Volume modelled	75479.825	CF
Volume error	-17.264	%
Peak observed value	0.303	cfs
Peak modelled value	0.248	cfs
Peak error	-18.072	%

June		
Correlation coeficient R2	0.54	
Max. positive difference	0.291	cfs
Max. negative difference	-0.84	cfs
Volume observed	17455.756	CF
Volume modelled	18164.098	CF
Volume error	4.058	%
Peak observed value	0.893	cfs
Peak modelled value	0.617	cfs
Peak error	-30.918	%

South Magnolia 06

December - No meter data

March		
Correlation coeficient R2	0.741	
Max. positive difference	0.957	cfs
Max. negative difference	-1.724	cfs
Volume observed	1081830	CF
Volume modelled	904489.2	CF
Volume error	-16.393	%
Peak observed value	3.896	cfs
Peak modelled value	2.995	cfs
Peak error	-23.119	%

June Event		
Correlation coeficient R2	0.817	
Max. positive difference	2.18	cfs
Max. negative difference	-8.034	cfs
Volume observed	218682.8	CF
Volume modelled	230042	CF
Volume error	5.194	%
Peak observed value	16.014	cfs
Peak modelled value	7.98	cfs
Peak error	-50.169	%

South Magnolia 07

December - No meter data

March		
Correlation coeficient R2	0.614	
Max. positive difference	0.625	cfs
Max. negative difference	-1.608	cfs
Volume observed	1242144.2	CF
Volume modelled	957162.61	CF
Volume error	-22.943	%
Peak observed value	3.32	cfs
Peak modelled value	2.349	cfs
Peak error	-29.251	%

June		
Correlation coeficient R2	0.725	
Max. positive difference	3.616	cfs
Max. negative difference	-2.007	cfs
Volume observed	184665.76	CF
Volume modelled	218138.08	CF
Volume error	18.126	%
Peak observed value	7.738	cfs
Peak modelled value	6.26	cfs
Peak error	-19.092	%

South Magnolia 08

December		
Correlation coeficient R2	0.824	
Max. positive difference	2.832	cfs
Max. negative difference	-1.072	cfs
Volume observed	309573.3	CF
Volume modelled	367680.5	CF
Volume error	18.77	%
Peak observed value	3.577	cfs
Peak modelled value	4.21	cfs
Peak error	17.691	%

March		
Correlation coeficient R2	0.615	
Max. positive difference	0.481	cfs
Max. negative difference	-1.368	cfs
Volume observed	725208.4	CF
Volume modelled	888835.9	CF
Volume error	22.563	%
Peak observed value	2.107	cfs
Peak modelled value	1.283	cfs
Peak error	-39.101	%

June		
Correlation coeficient R2	0.77	
Max. positive difference	1.854	cfs
Max. negative difference	-0.603	cfs
Volume observed	103325.1	CF
Volume modelled	162233.1	CF
Volume error	57.012	%
Peak observed value	3.26	cfs
Peak modelled value	3.214	cfs
Peak error	-1.426	%

South Magnolia 09

December		
Correlation coeficient R2	0.893	
Max. positive difference	0.992	cfs
Max. negative difference	-1.105	cfs
Volume observed	210978.552	CF
Volume modelled	181466.197	CF
Volume error	-13.988	%
Peak observed value	3	cfs
Peak modelled value	2.397	cfs
Peak error	-20.09	%

March		
Correlation coeficient R2	0.112	
Max. positive difference	0.684	cfs
Max. negative difference	-0.708	cfs
Volume observed	97319.444	CF
Volume modelled	308160.254	CF
Volume error	216.648	%
Peak observed value	0.928	cfs
Peak modelled value	0.684	cfs
Peak error	-26.283	%

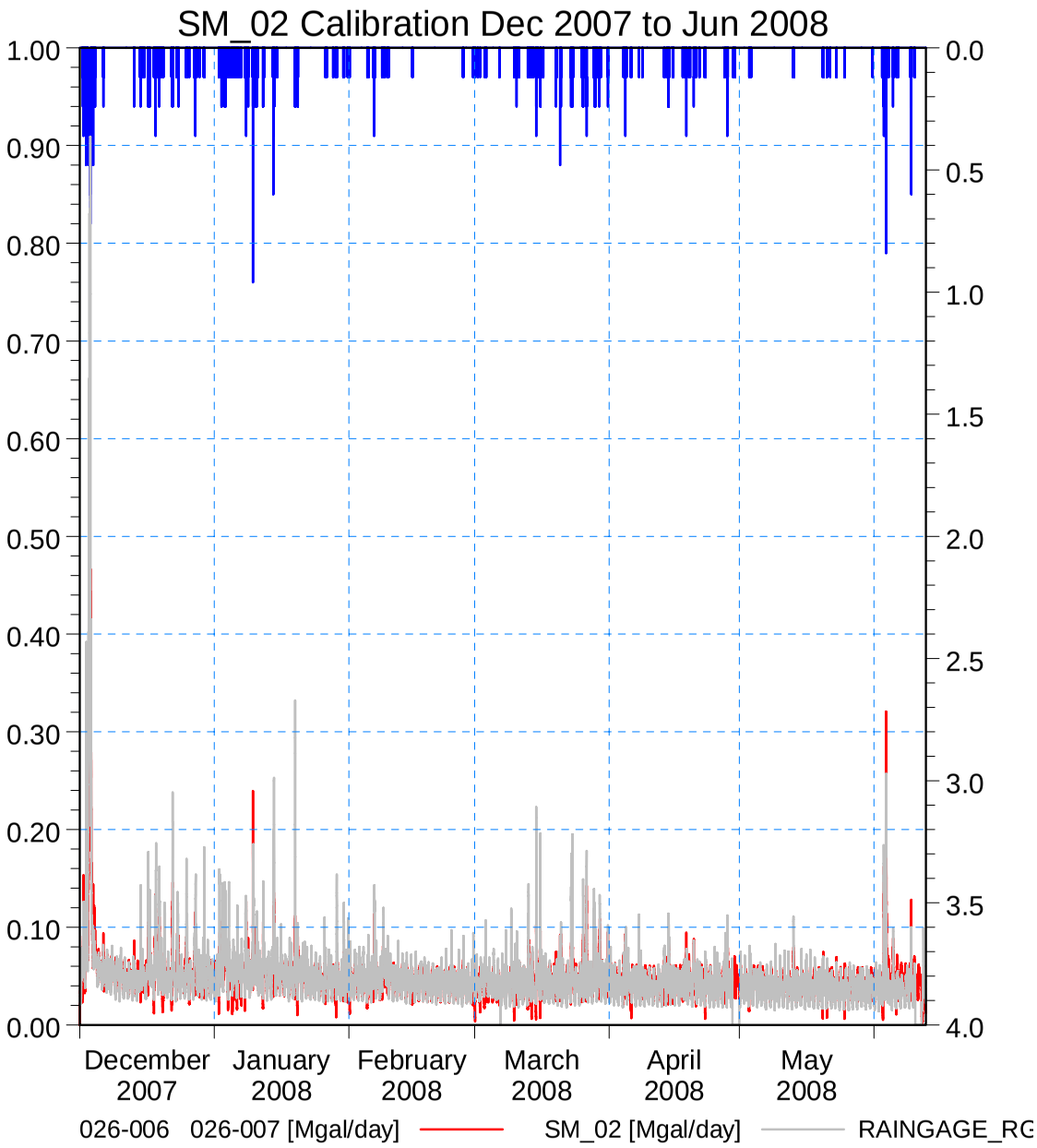
June		
Correlation coeficient R2	0.772	
Max. positive difference	0.904	cfs
Max. negative difference	-0.711	cfs
Volume observed	57250.09	CF
Volume modelled	67398.684	CF
Volume error	17.727	%
Peak observed value	2.222	cfs
Peak modelled value	1.797	cfs
Peak error	-19.107	%

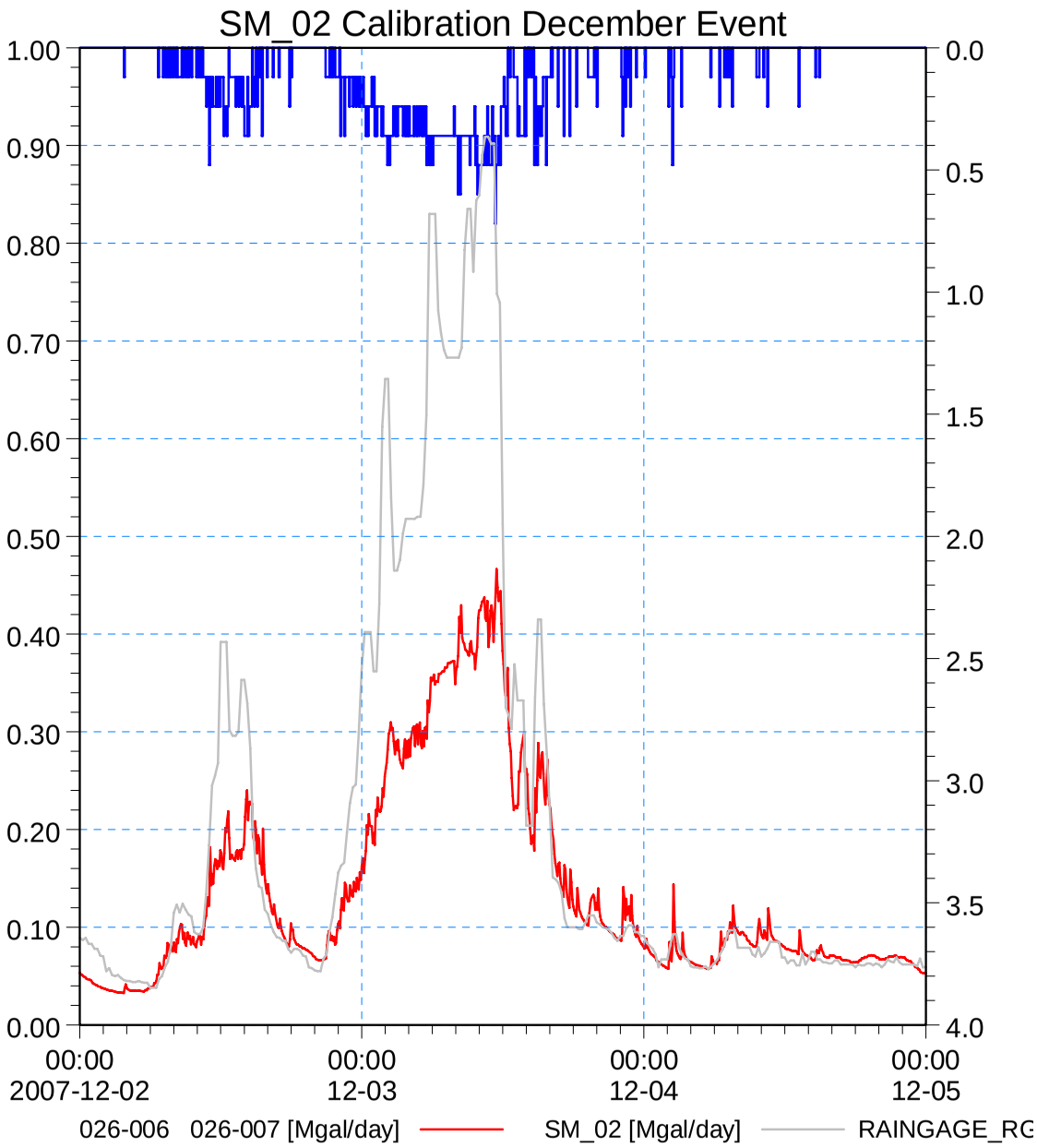
South Magnolia MAGCSO

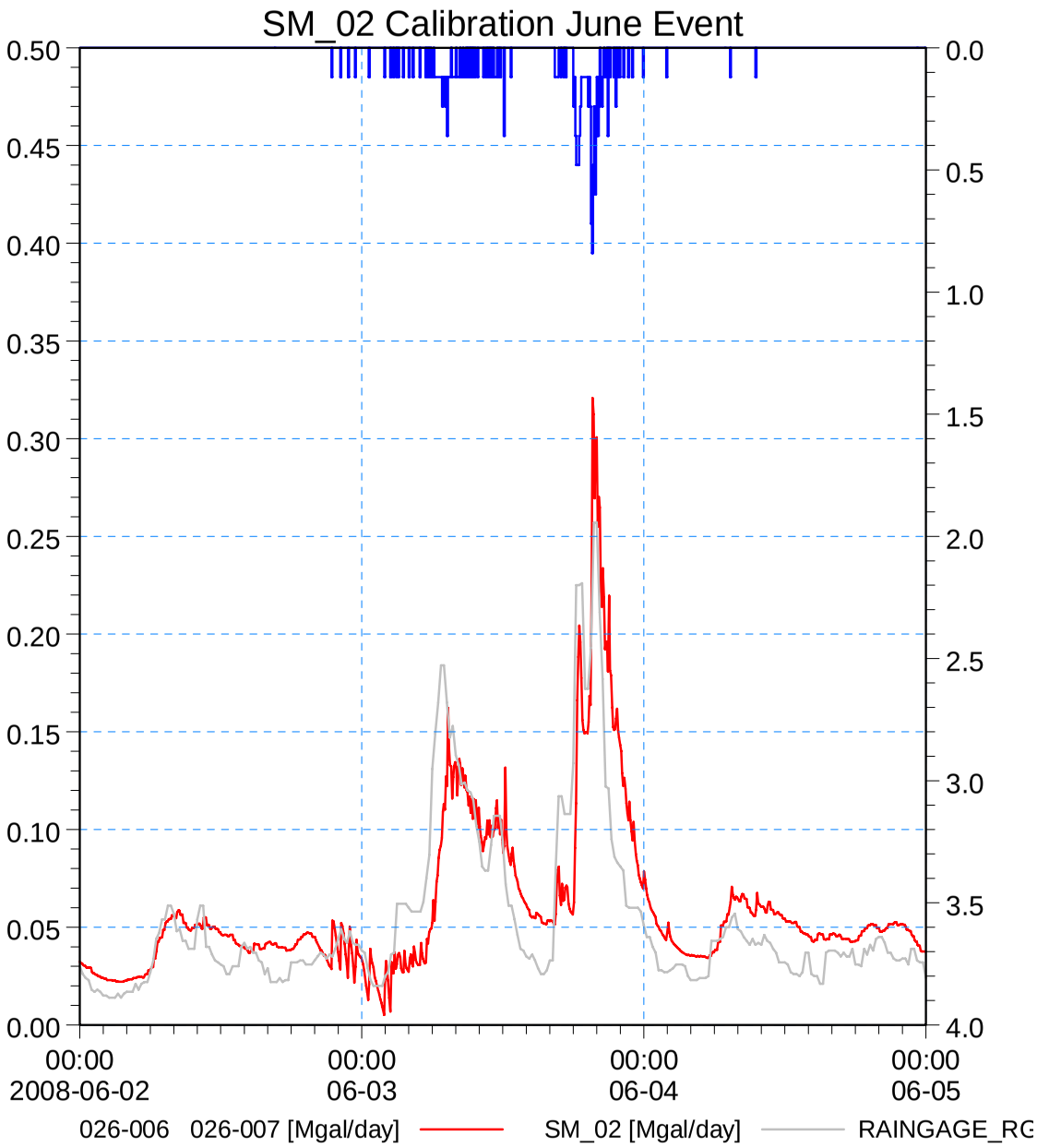
December		
Correlation coeficient R2	0.982	
Max. positive difference	1.958	cfs
Max. negative difference	-10.43	cfs
Volume observed	2506948.2	CF
Volume modelled	2181802.2	CF
Volume error	-12.97	%
Peak observed value	34.732	cfs
Peak modelled value	28.098	cfs
Peak error	-19.099	%

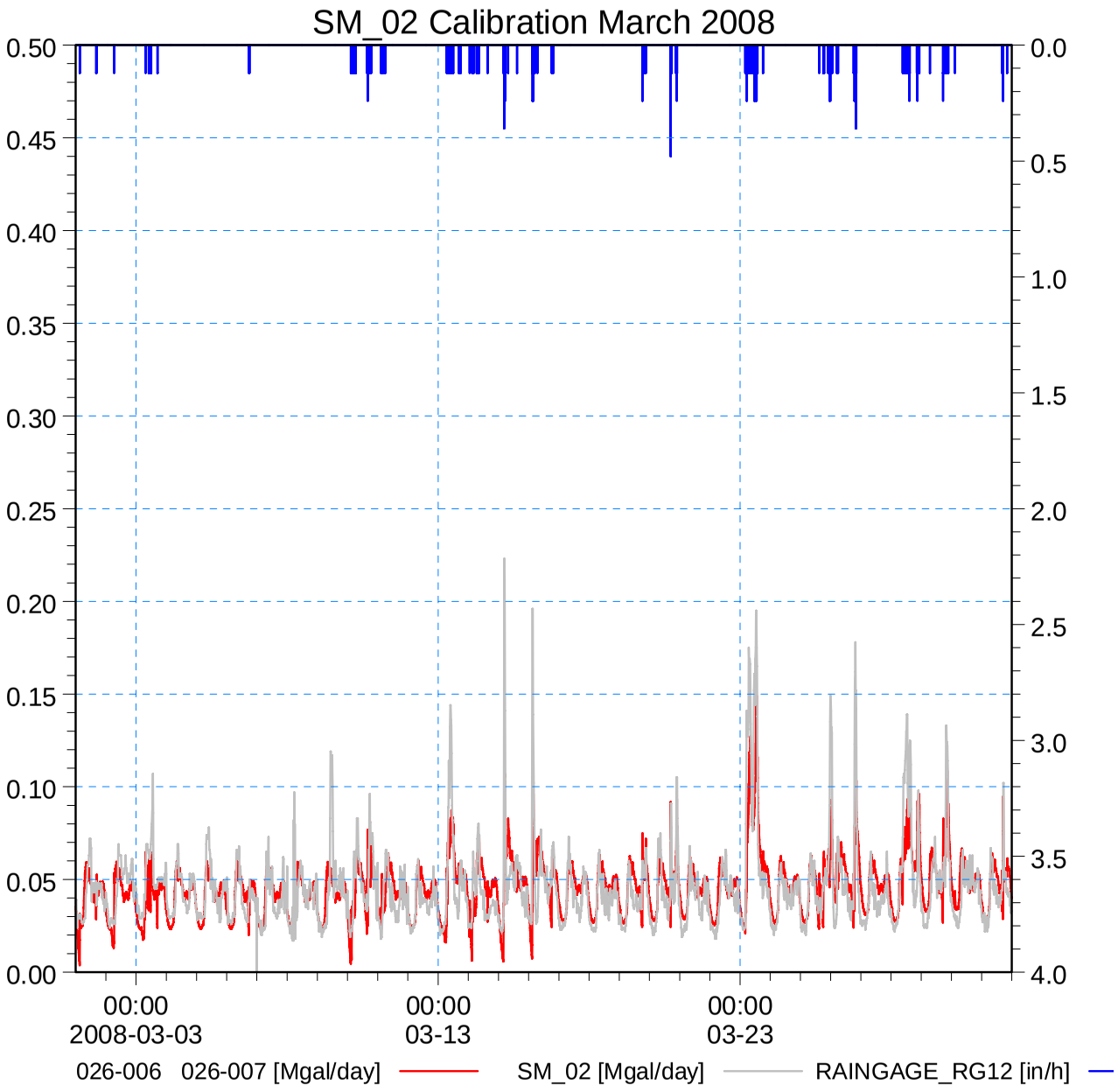
March		
Correlation coeficient R2	0.818	
Max. positive difference	2.234	cfs
Max. negative difference	-3.415	cfs
Volume observed	2606481.7	CF
Volume modelled	3433347	CF
Volume error	31.723	%
Peak observed value	9.711	cfs
Peak modelled value	7.871	cfs
Peak error	-18.94	%

June		
Correlation coeficient R2	0.896	
Max. positive difference	5.973	cfs
Max. negative difference	-3.96	cfs
Volume observed	533737.51	CF
Volume modelled	759909	CF
Volume error	42.375	%
Peak observed value	20.024	cfs
Peak modelled value	21.411	cfs
Peak error	6.925	%

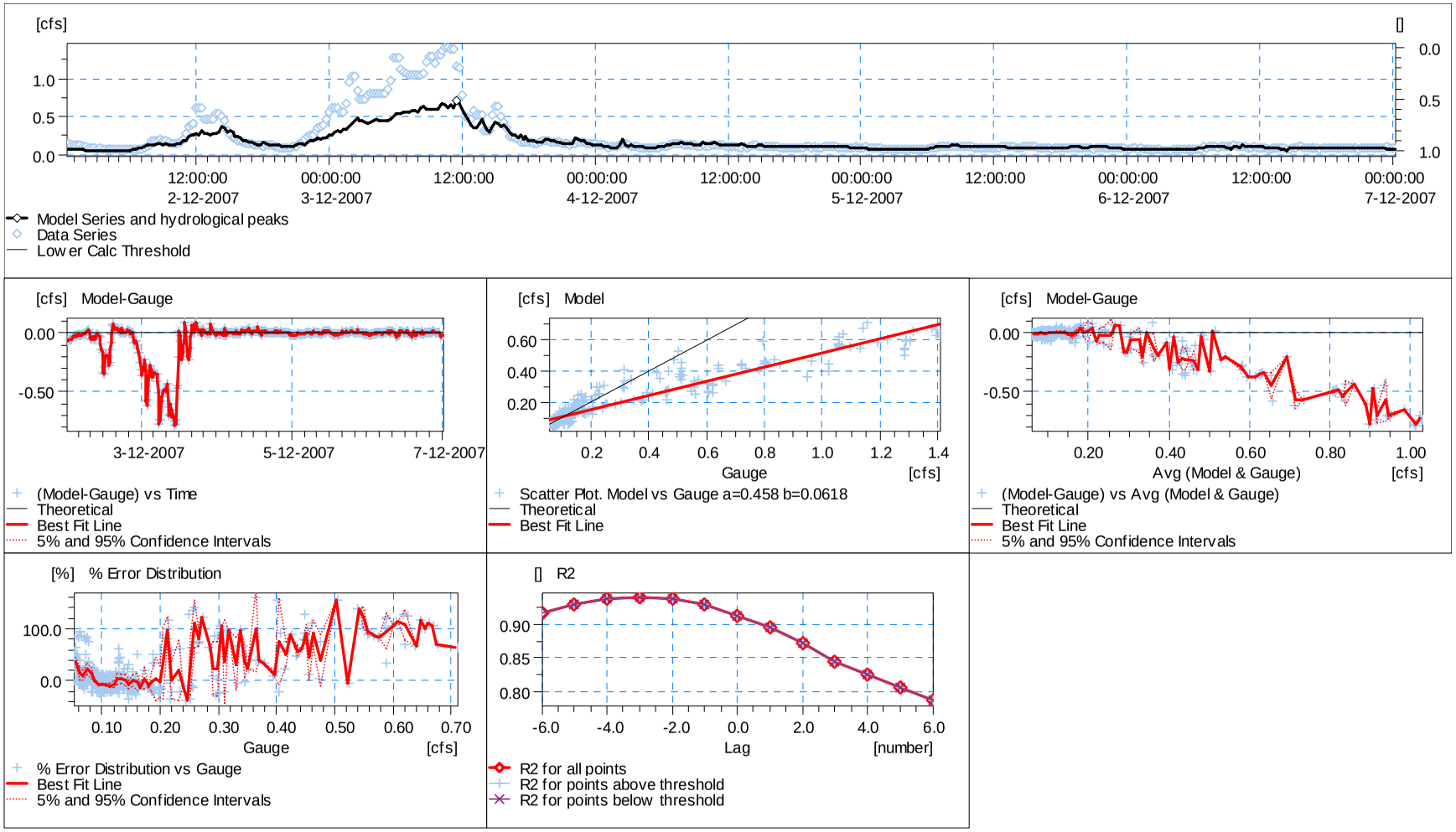

SM_02 Calibration Dec 2007 to Jun 2008
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
December 2007
January 2008
February 2008
March 2008
April 2008
May 2008
026-006
026-007 [Mgal/day]
SM_02 [Mgal/day]
RAINGAGE_RG


SM_02 Calibration December Event
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2007-12-02
00:00
12-03
00:00
12-04
00:00
12-05
026-006 026-007 [Mgal/day]
SM_02 [Mgal/day]
RAINGAGE_RG


SM_02 Calibration June Event
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-06-02
00:00
06-03
00:00
06-04
00:00
06-05
026-006 026-007 [Mgal/day]
SM_02 [Mgal/day]
RAINGAGE_RG


SM_02 Calibration March 2008
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-03-03
00:00
03-13
00:00
03-23
026-006 026-007 [Mgal/day]
SM_02 [Mgal/day]
RAINGAGE_RG12 [in/h]

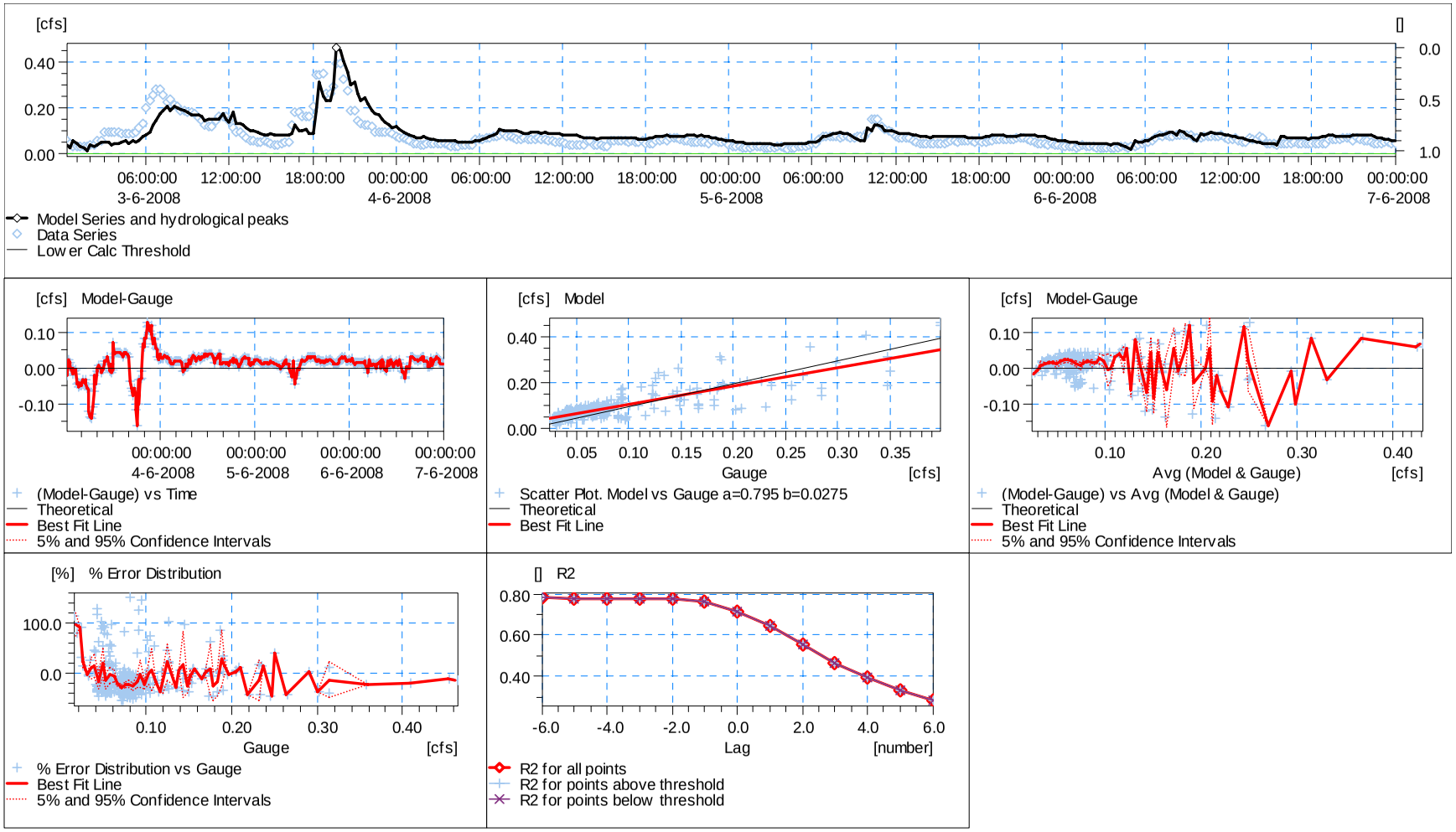
026-006 026-007 (026-006 -> 026-007) 128.46



R2 = 0.912

SM 02 Statistics

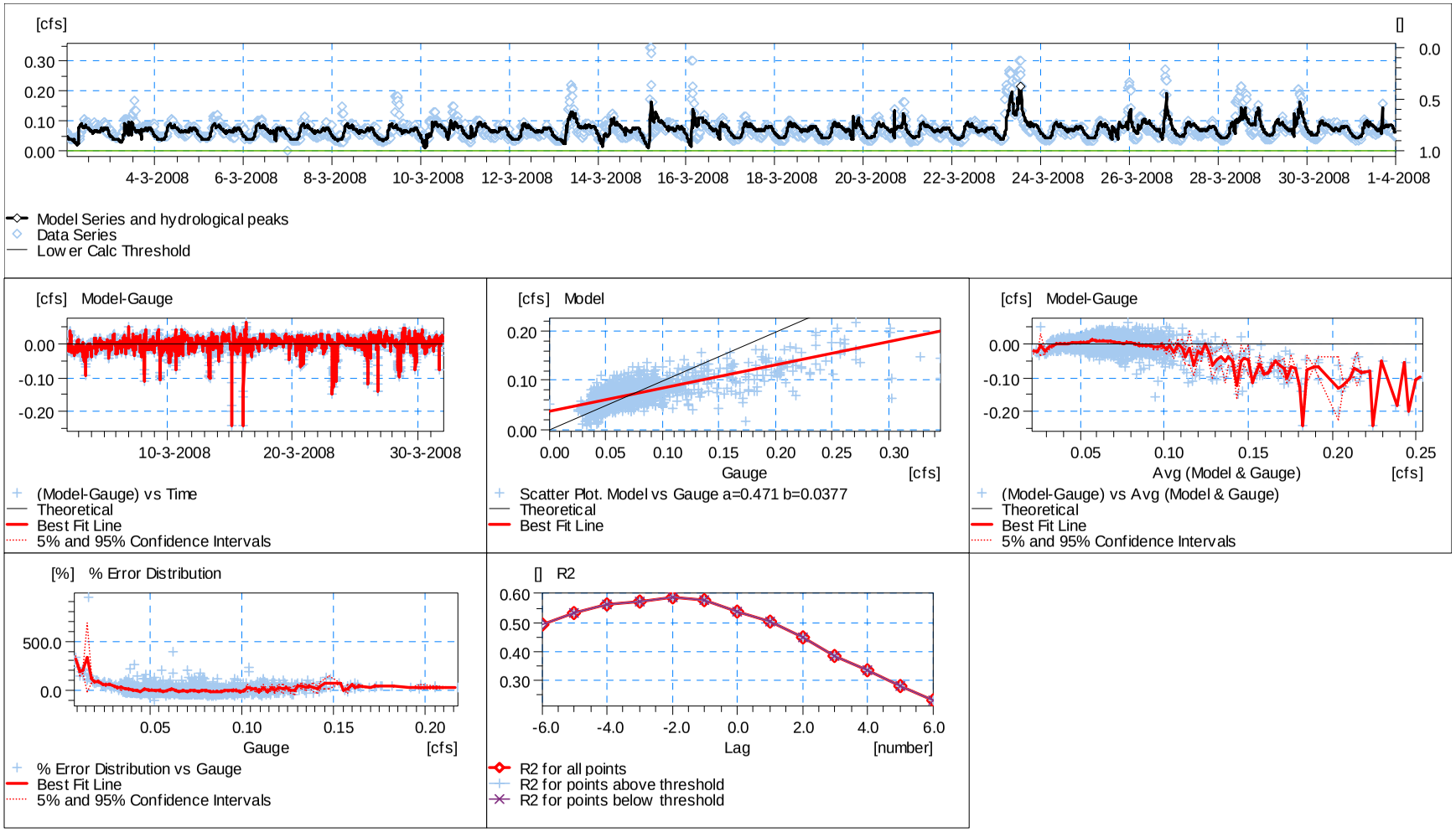
026-006 026-007 (026-006 -> 026-007) 128.46



R2 = 0.714

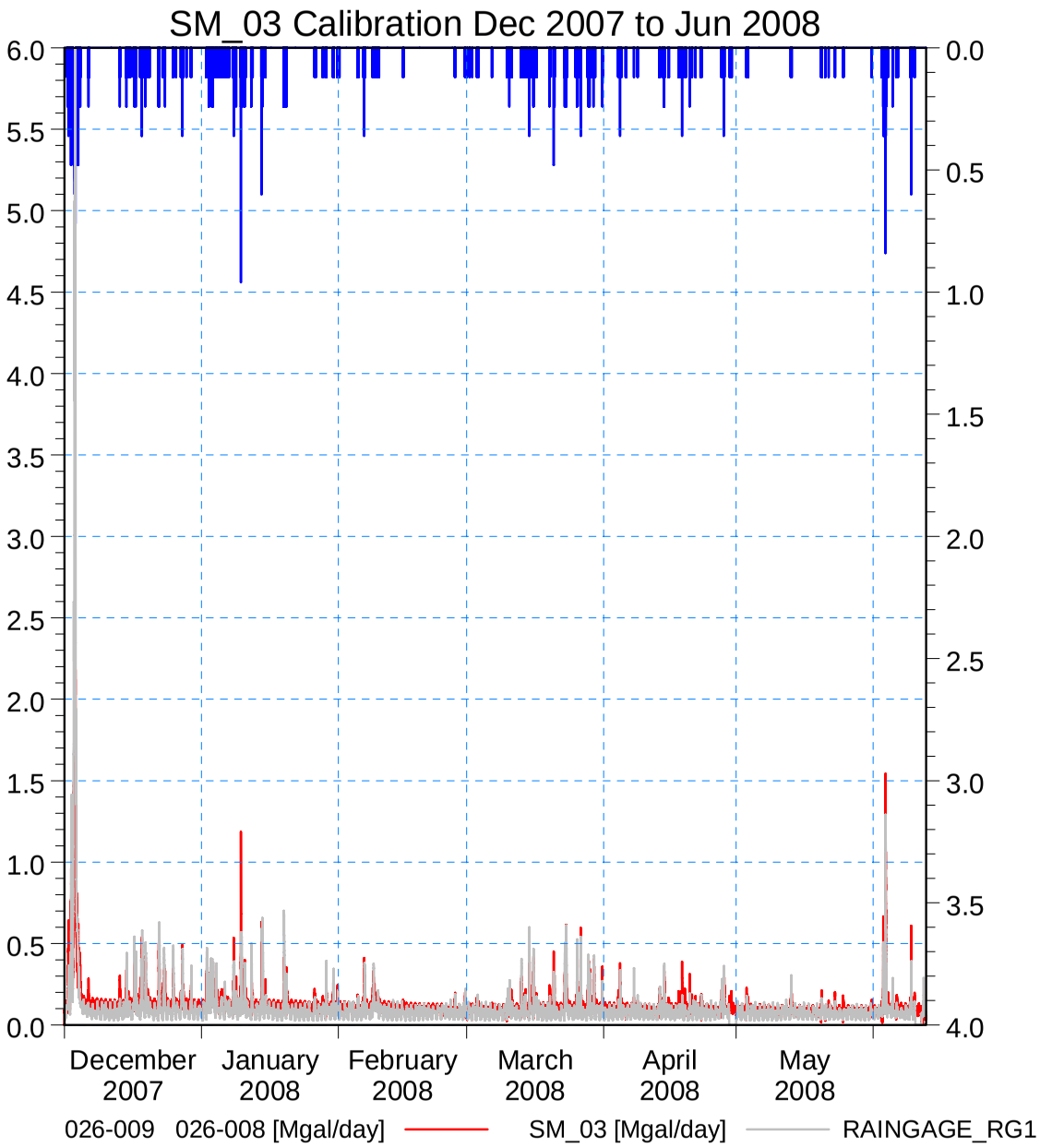
SM 02 Statistics

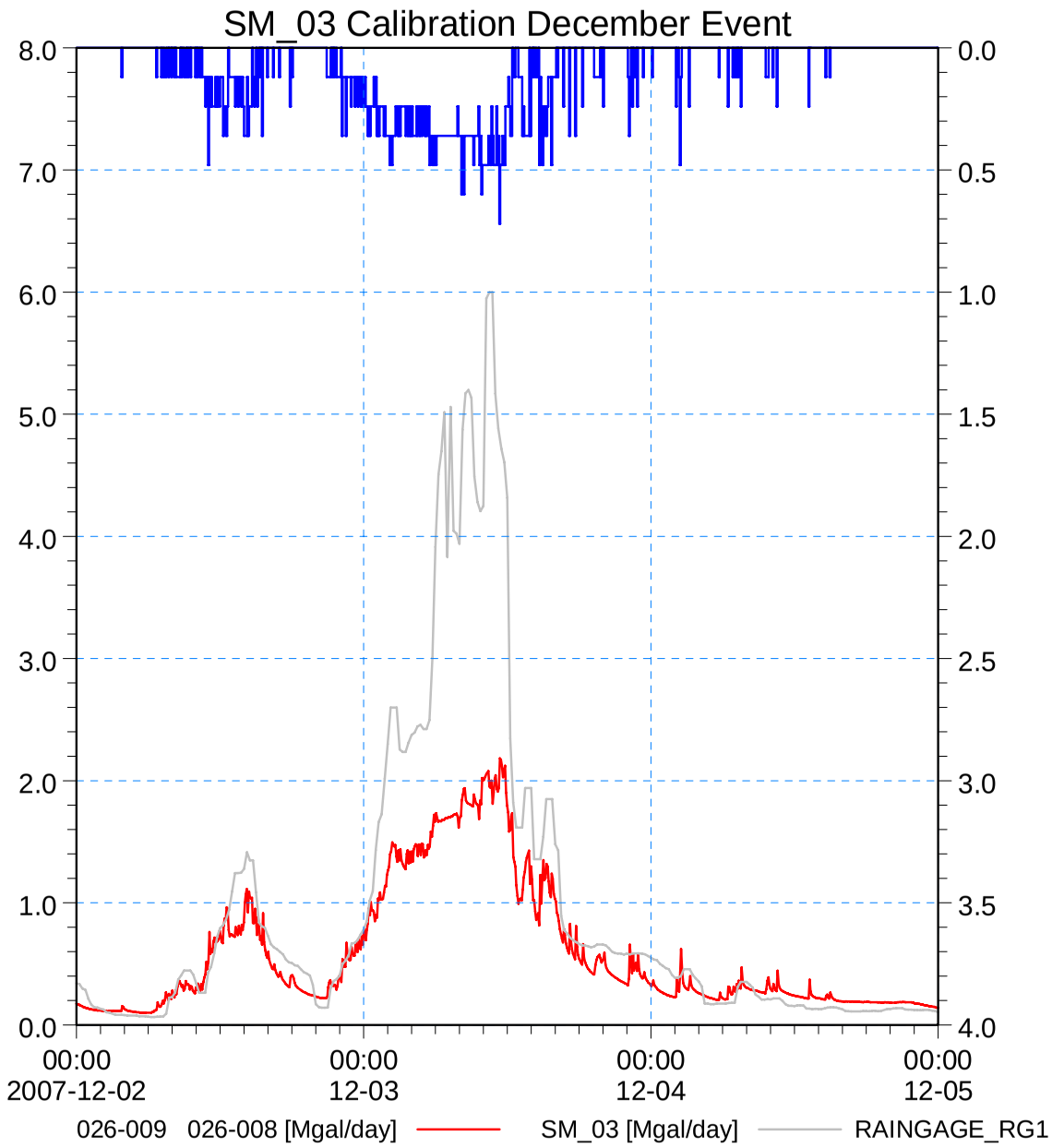
026-006 026-007 (026-006 -> 026-007) 128.46

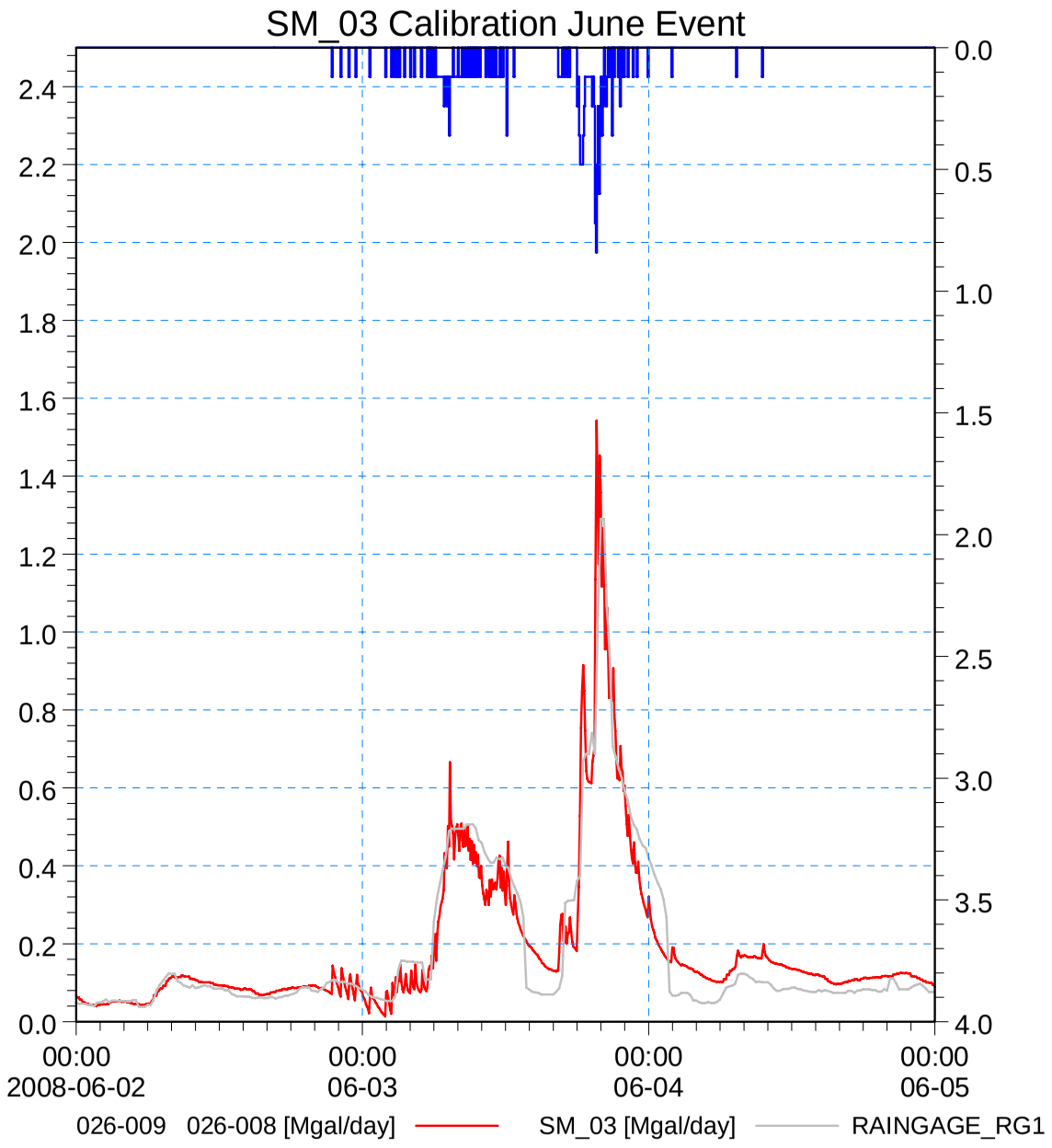


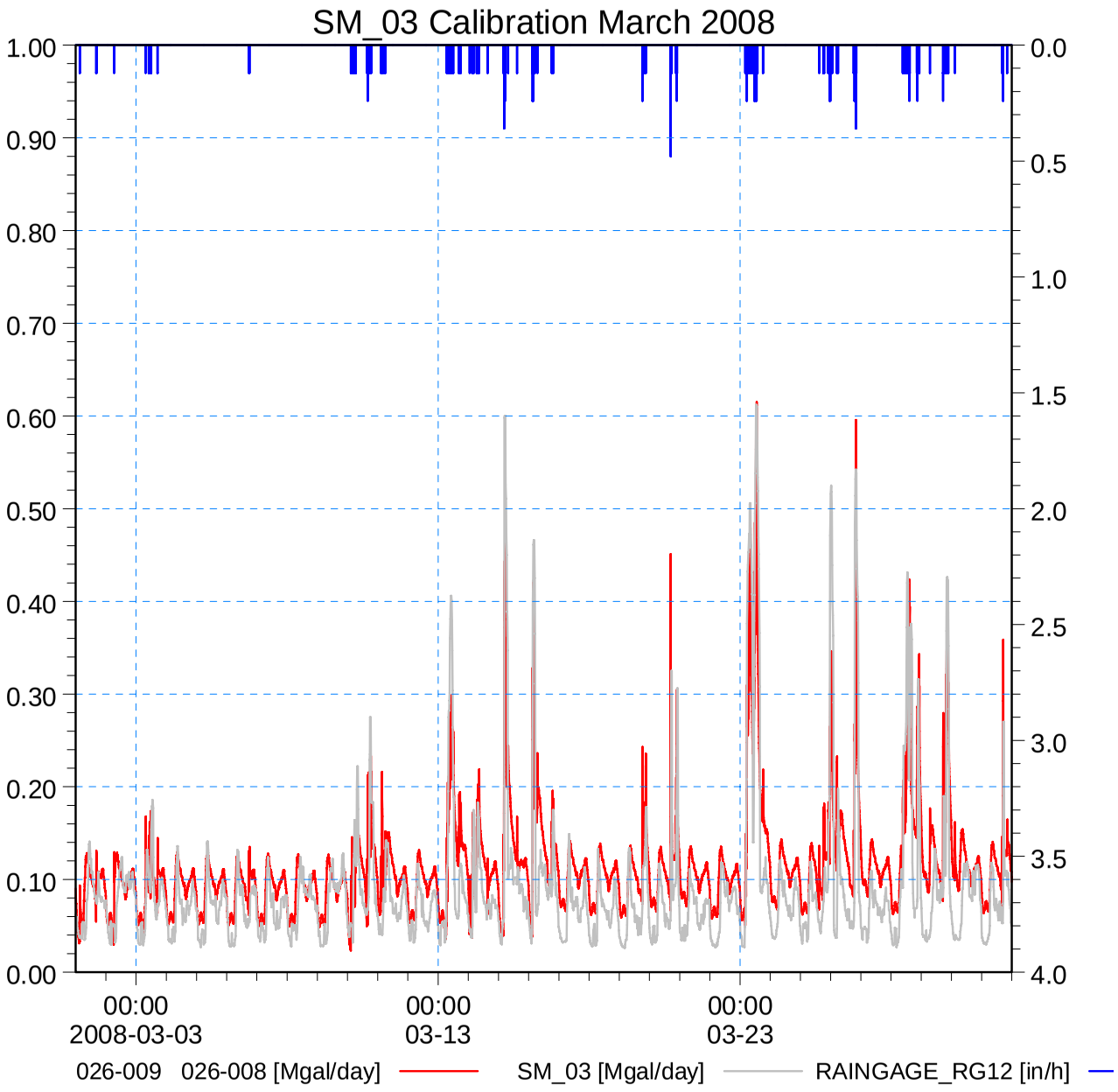
R2 = 0.537

SM 02 Statistics

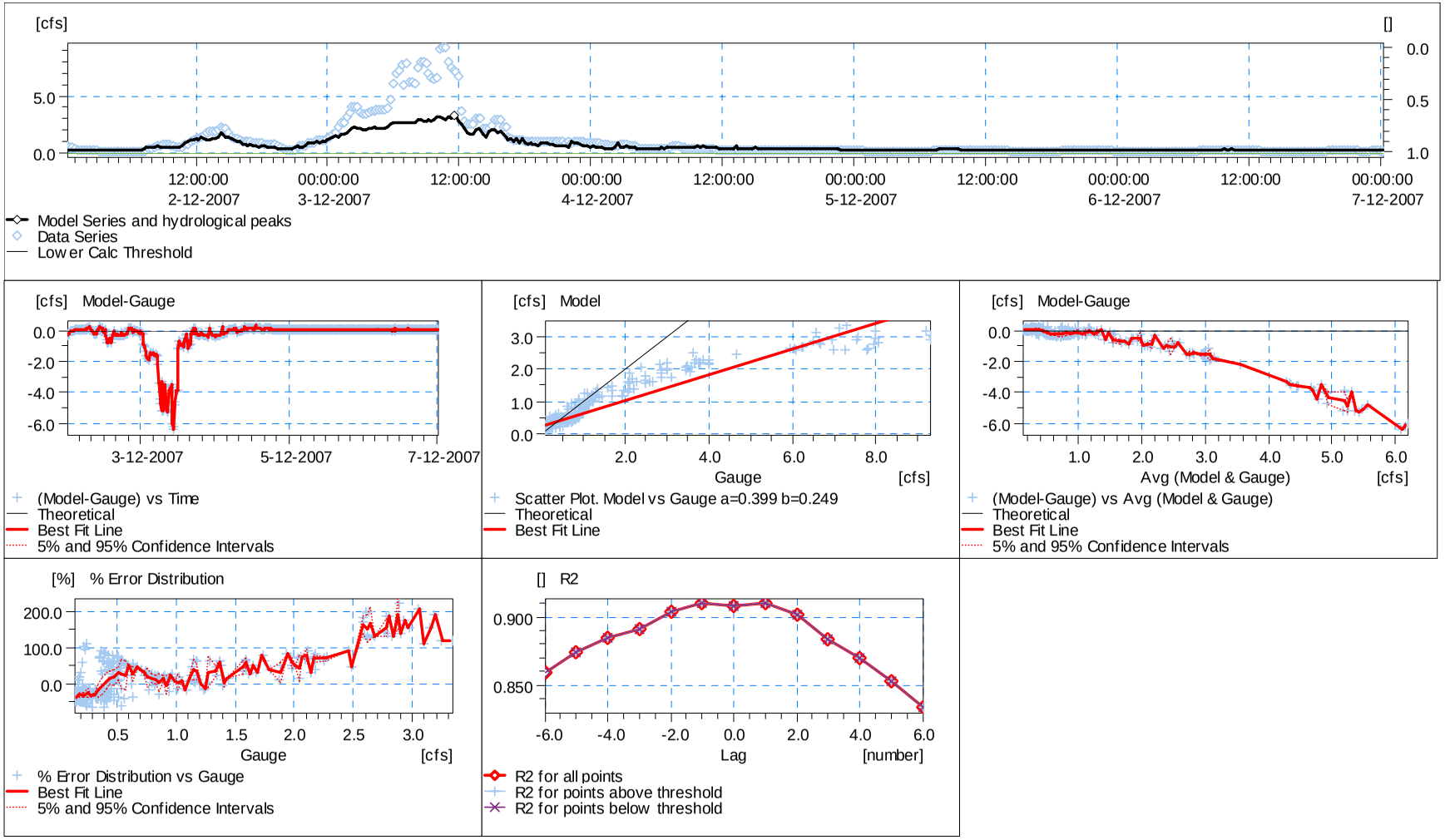

SM_03 Calibration Dec 2007 to Jun 2008
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
December 2007
January 2008
February 2008
March 2008
April 2008
May 2008
026-009 026-008 [Mgal/day]
SM_03 [Mgal/day]
RAINGAGE_RG1


SM_03 Calibration December Event
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2007-12-02
00:00
12-03
00:00
12-04
00:00
12-05
026-009 026-008 [Mgal/day]
SM_03 [Mgal/day]
RAINGAGE_RG1


SM_03 Calibration June Event
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-06-02
00:00
06-03
00:00
06-04
00:00
06-05
026-009 026-008 [Mgal/day]
SM_03 [Mgal/day]
RAINGAGE_RG1


SM_03 Calibration March 2008
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-03-03
00:00
03-13
00:00
03-23
026-009 026-008 [Mgal/day]
SM_03 [Mgal/day]
RAINGAGE_RG12 [in/h]

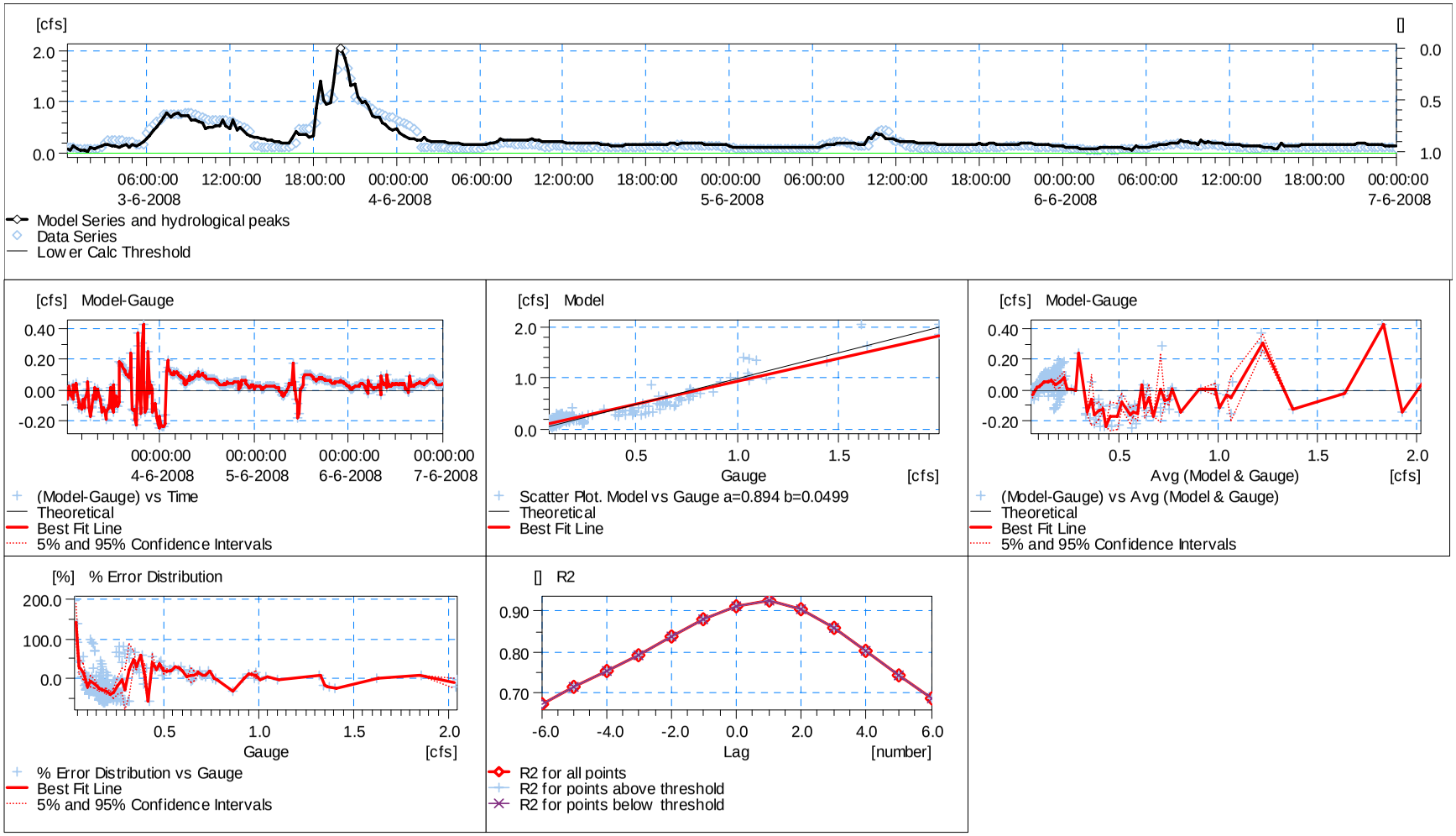
026-009 026-008 (026-009 -> 026-008) 36.91



R2 = 0.908

SM 03 Statistics

026-009 026-008 (026-009 -> 026-008) 36.91

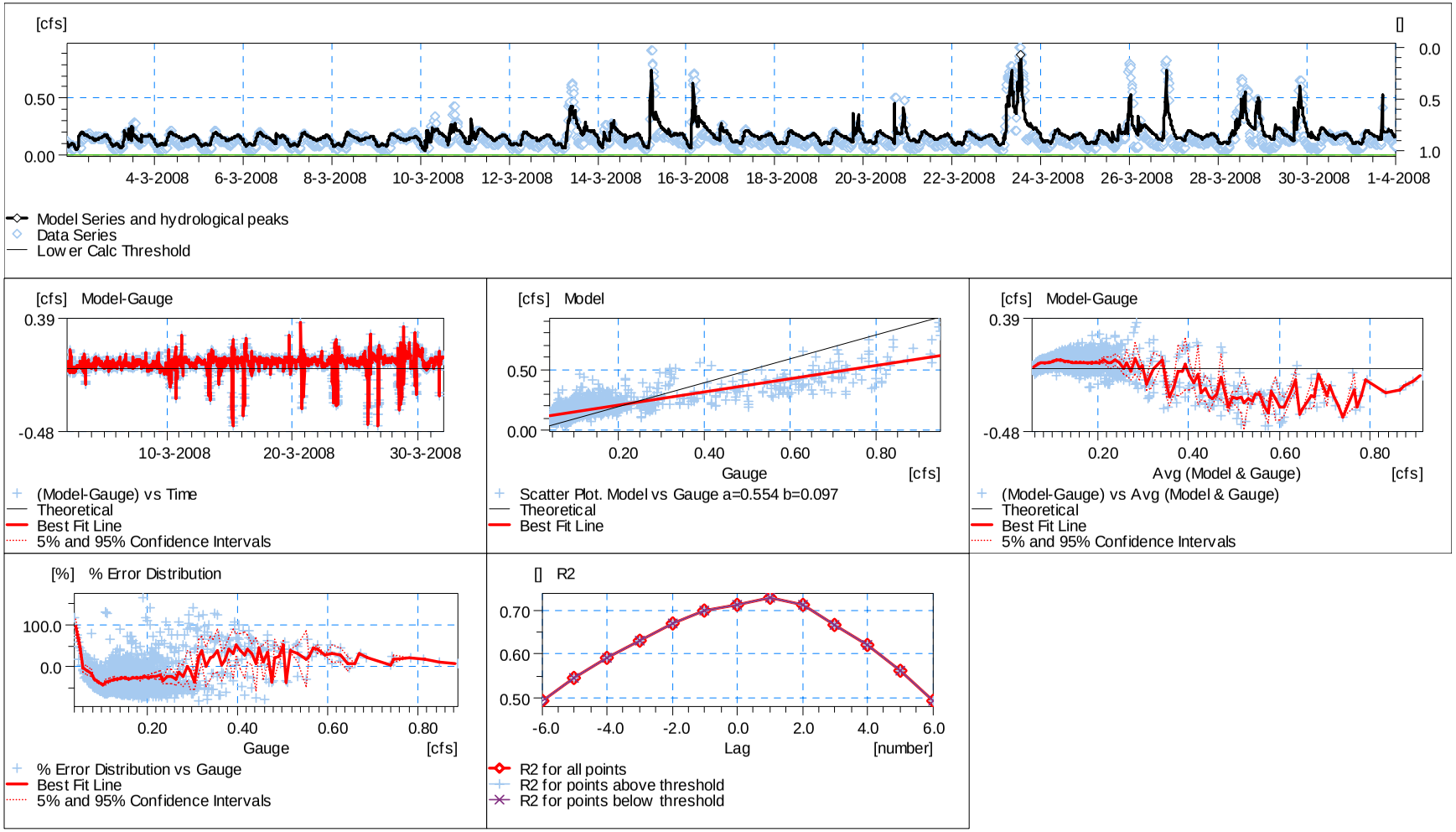


R2 = 0.911

SM 03 Statistics

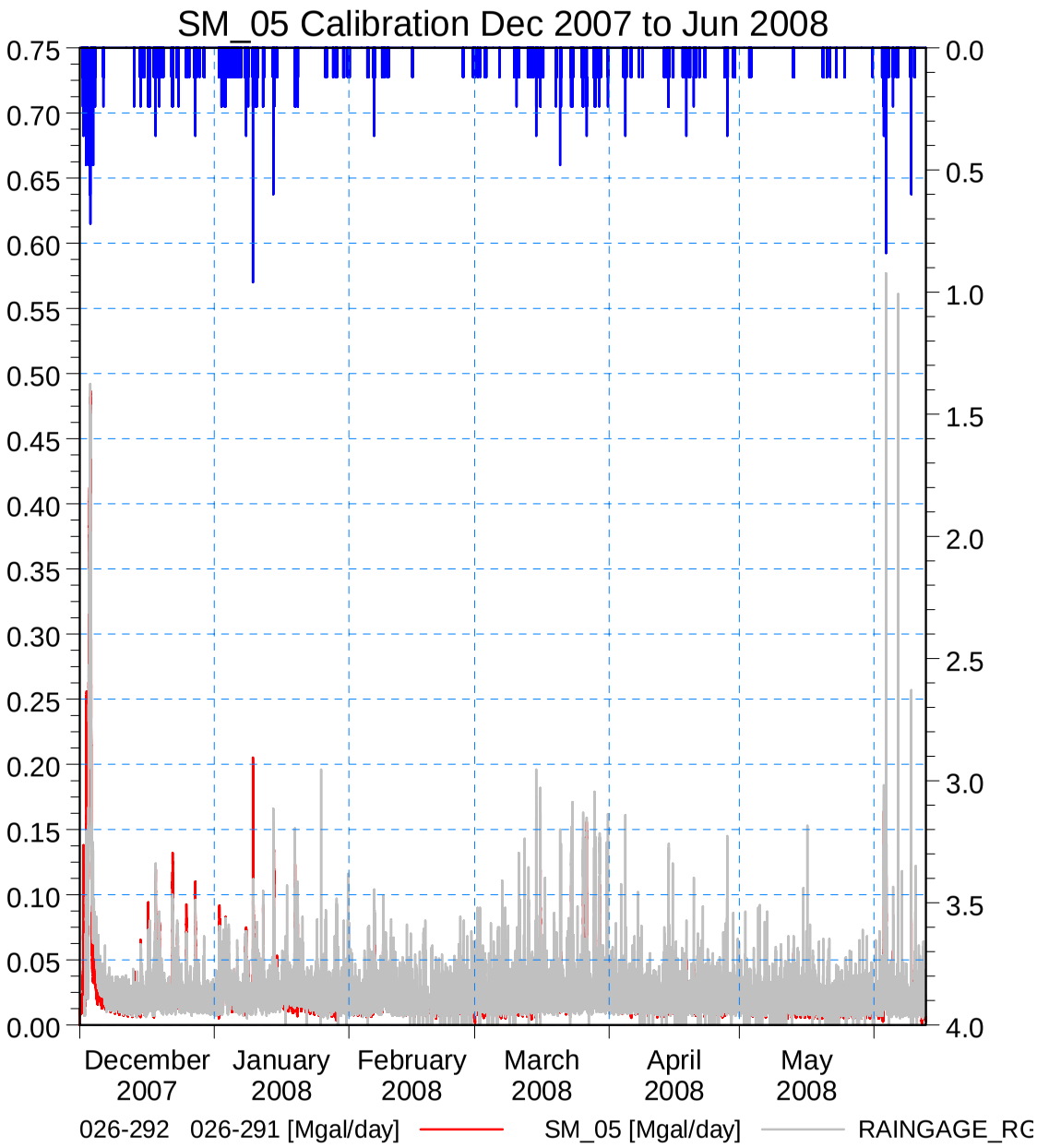
SM 03 Statistics

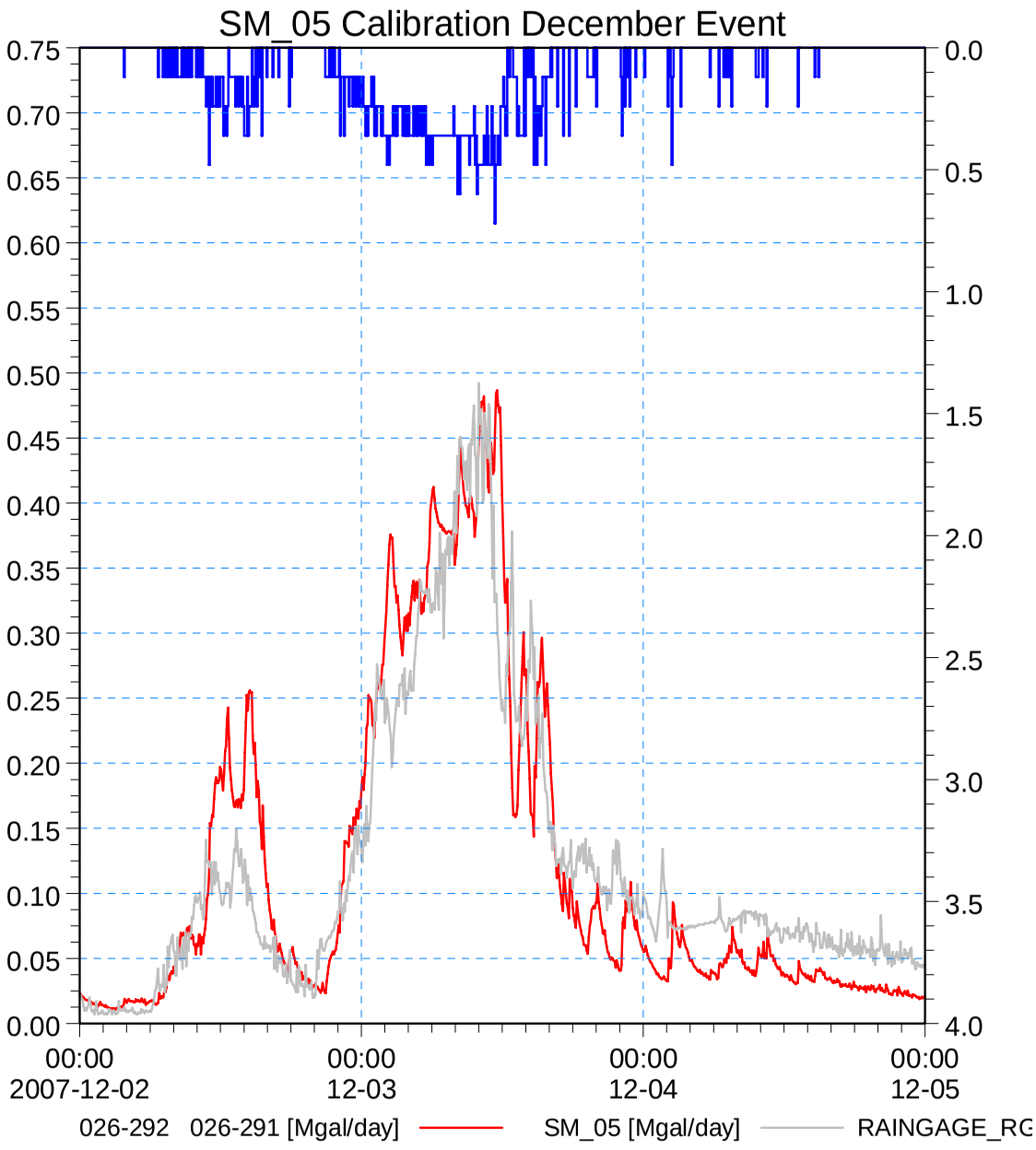
026-009 026-008 (026-009 -> 026-008) 36.91

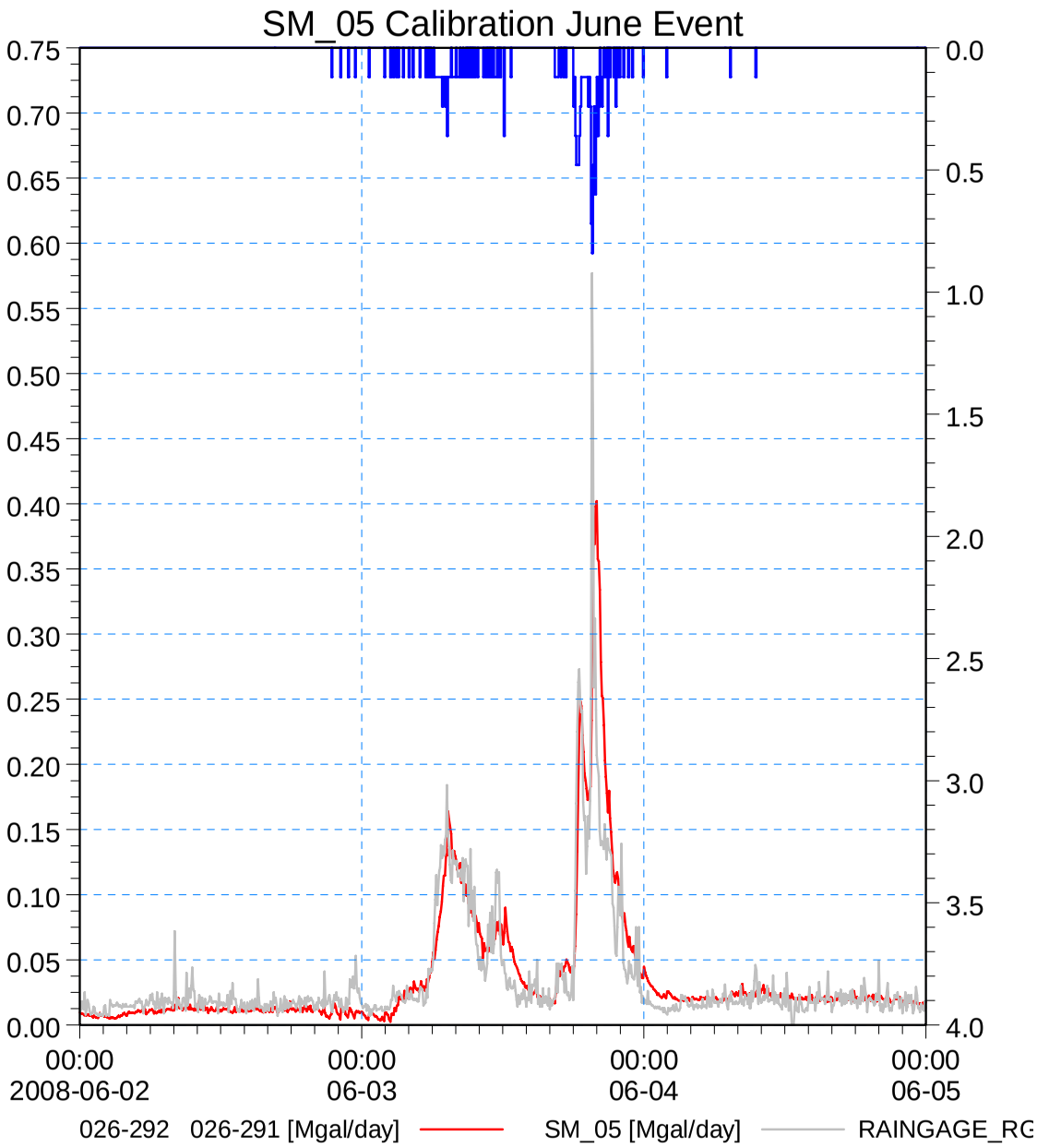


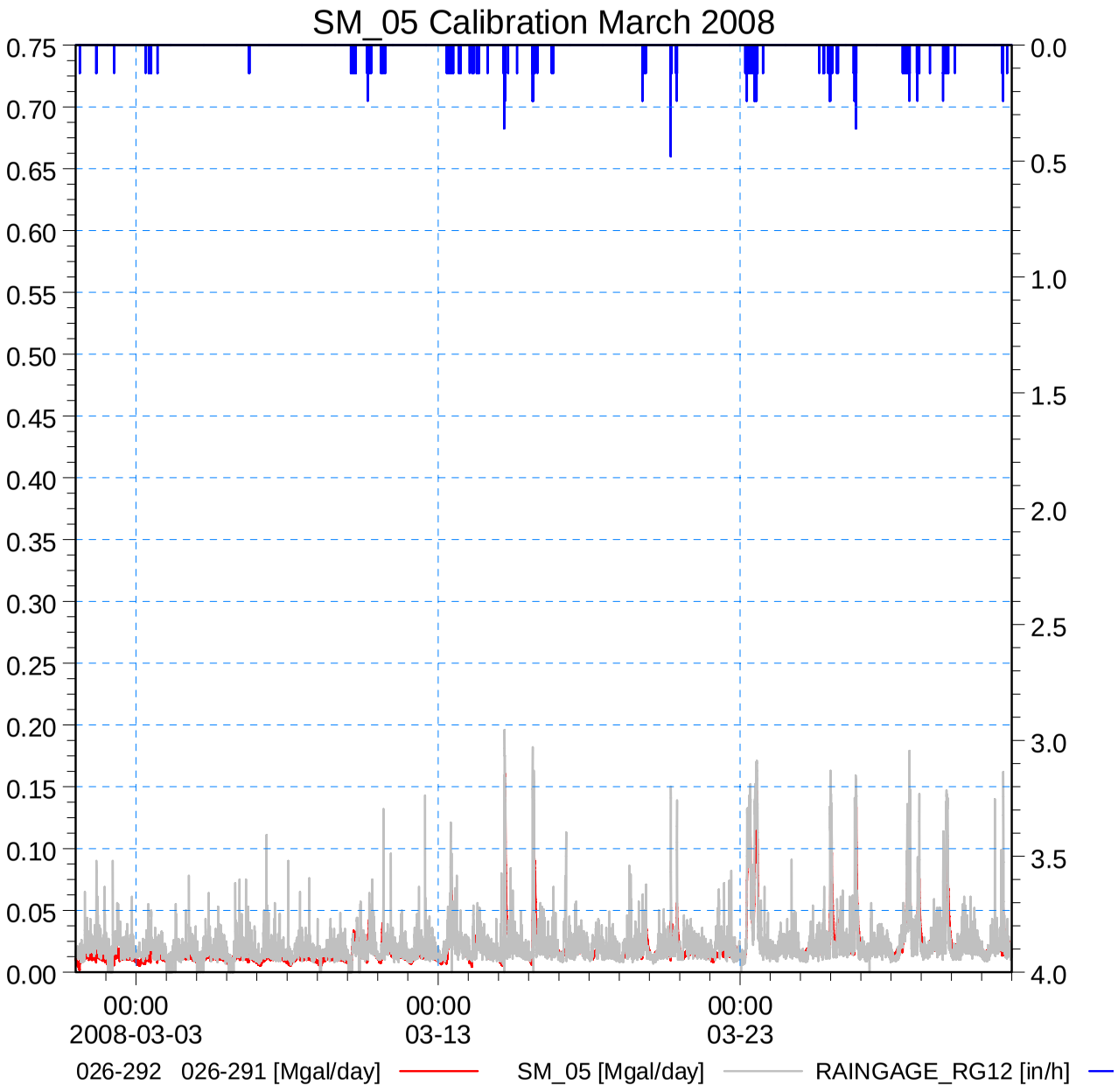
R2 = 0.712

SM 03 Statistics

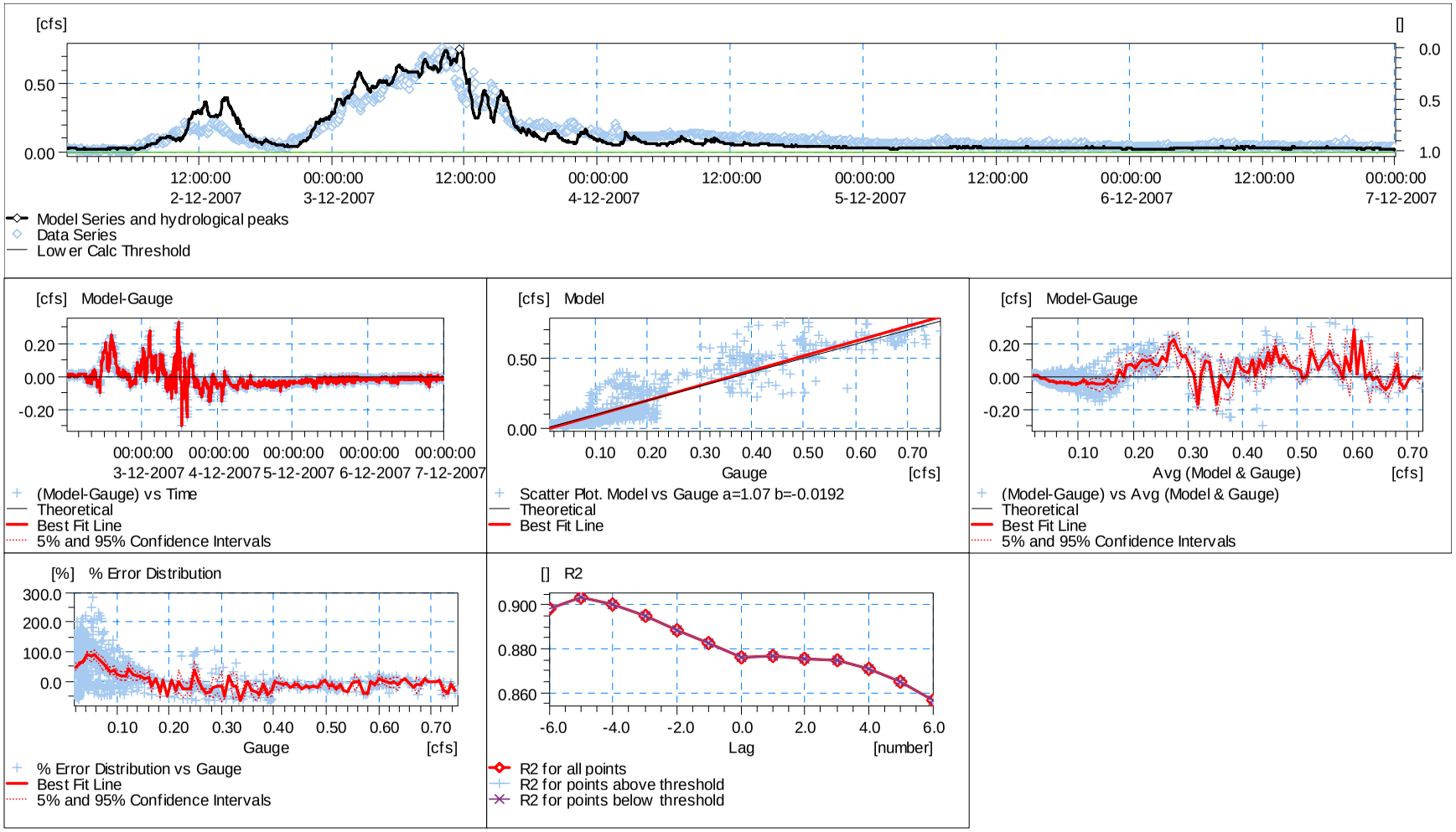

SM_05 Calibration Dec 2007 to Jun 2008
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
December 2007
January 2008
February 2008
March 2008
April 2008
May 2008
026-292
026-291 [Mgal/day]
SM_05 [Mgal/day]
RAINGAGE_RG


SM_05 Calibration December Event
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2007-12-02
00:00
12-03
00:00
12-04
00:00
12-05
026-292 026-291 [Mgal/day]
SM_05 [Mgal/day]
RAINGAGE_RG


SM_05 Calibration June Event
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-06-02
00:00
06-03
00:00
06-04
00:00
06-05
026-292 026-291 [Mgal/day]
SM_05 [Mgal/day]
RAINGAGE_RG


SM_05 Calibration March 2008
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-03-03
00:00
03-13
00:00
03-23
026-292 026-291 [Mgal/day]
SM_05 [Mgal/day]
RAINGAGE_RG12 [in/h]

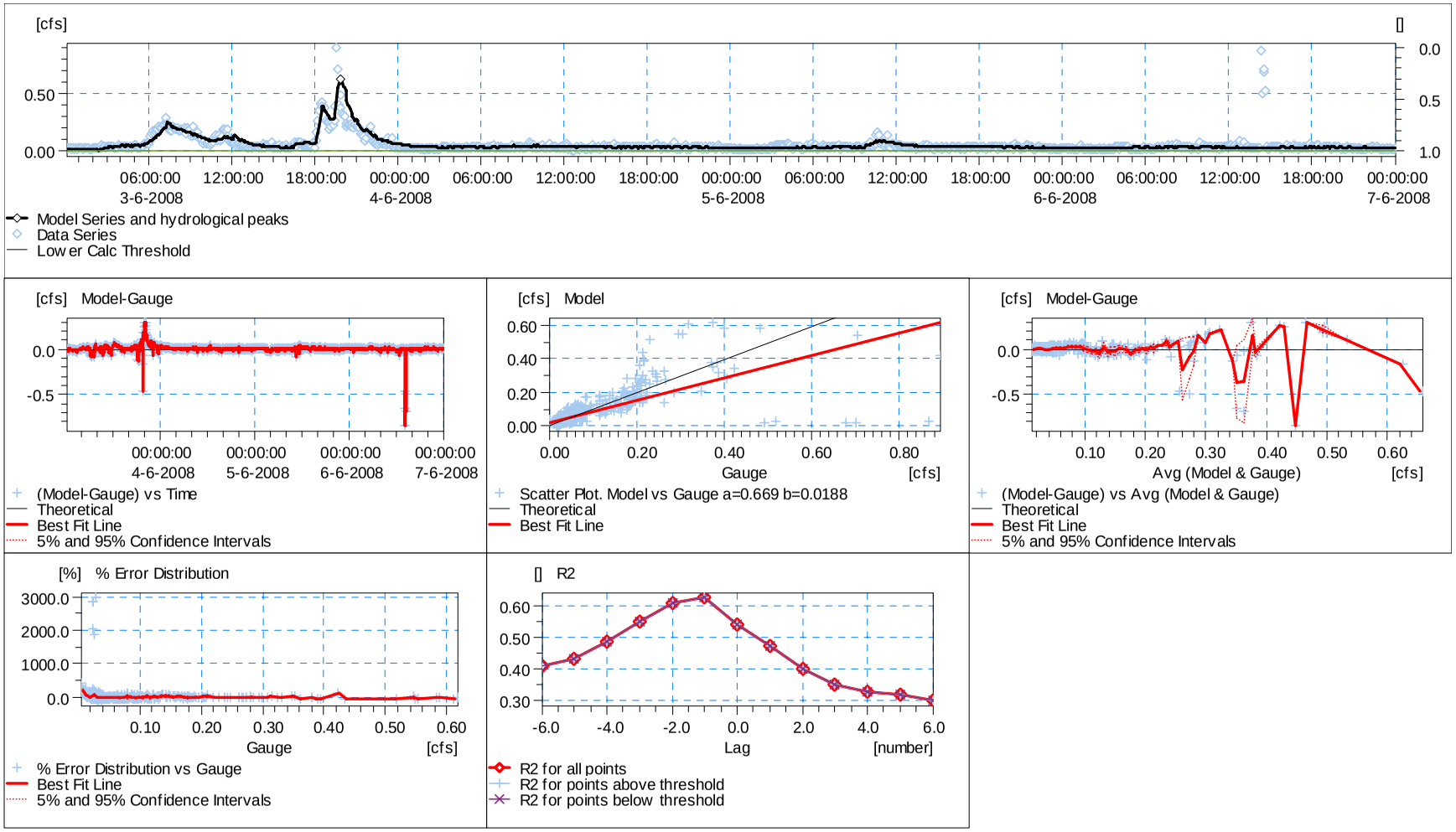
026-292 026-291 (026-292 -> 026-291) 34.87



R2 = 0.876

SM 05 Statistics

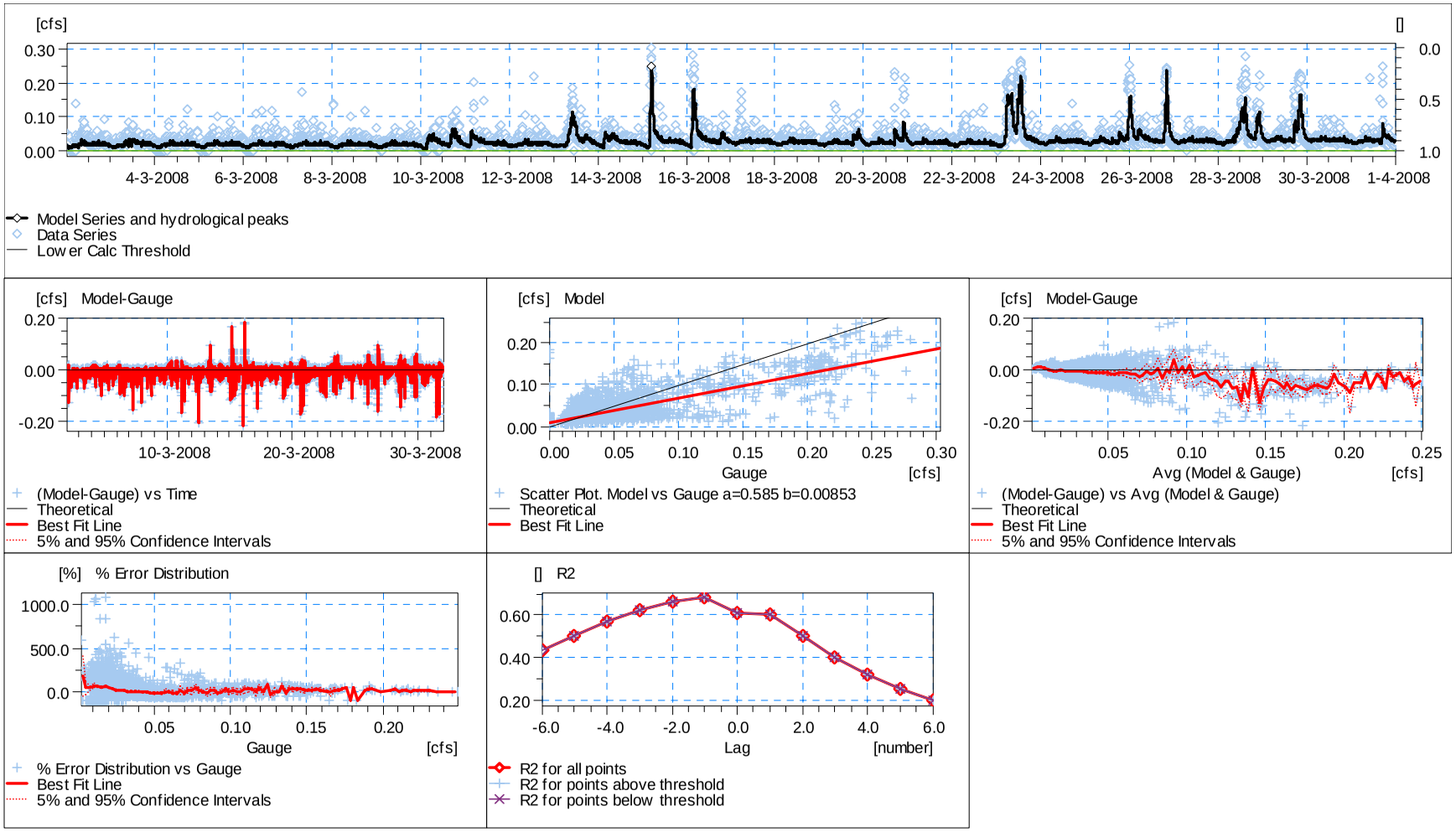
026-292 026-291 (026-292 -> 026-291) 34.87



R2 = 0.540

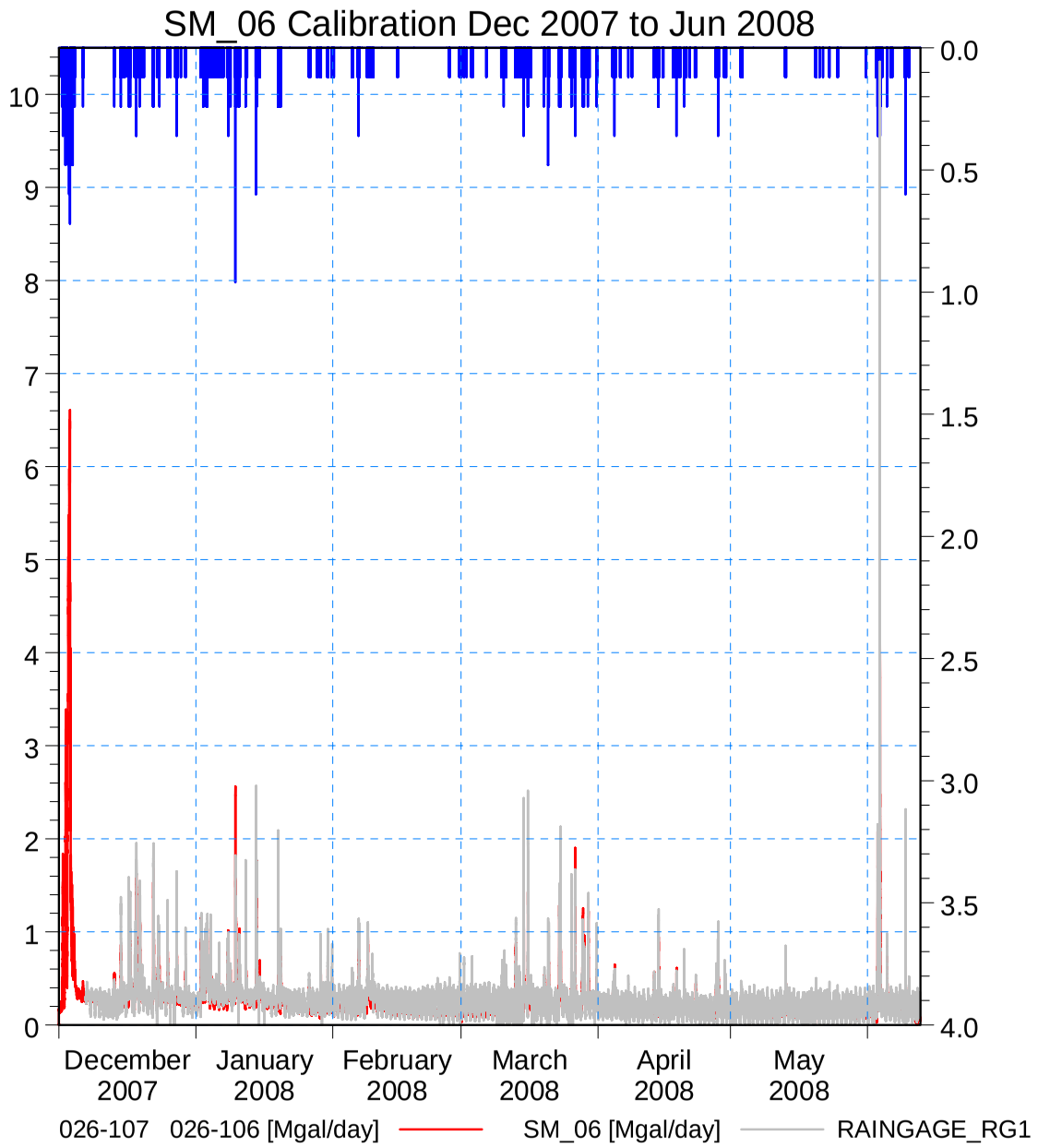
SM 05 Statistics

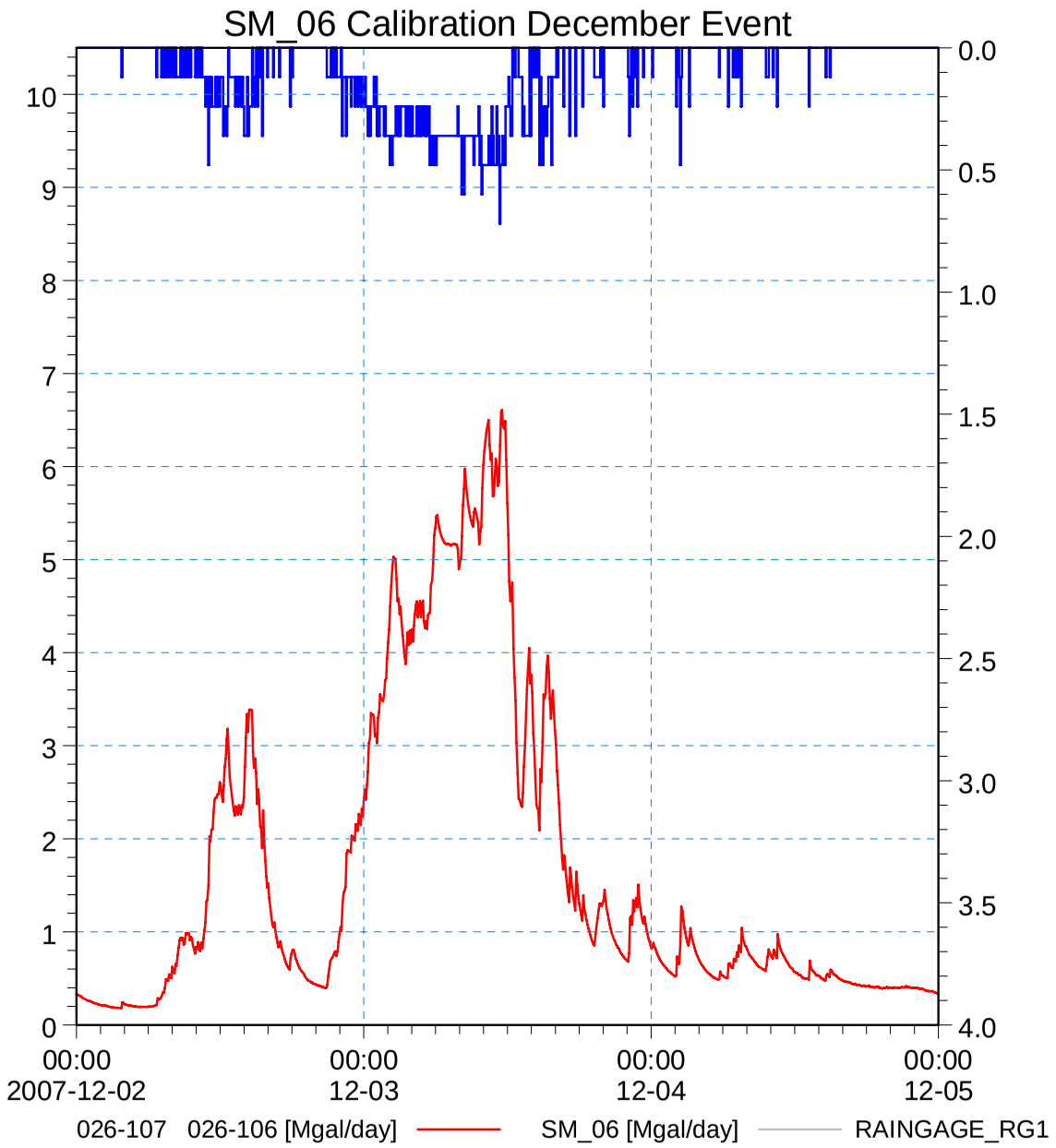
026-292 026-291 (026-292 -> 026-291) 34.87

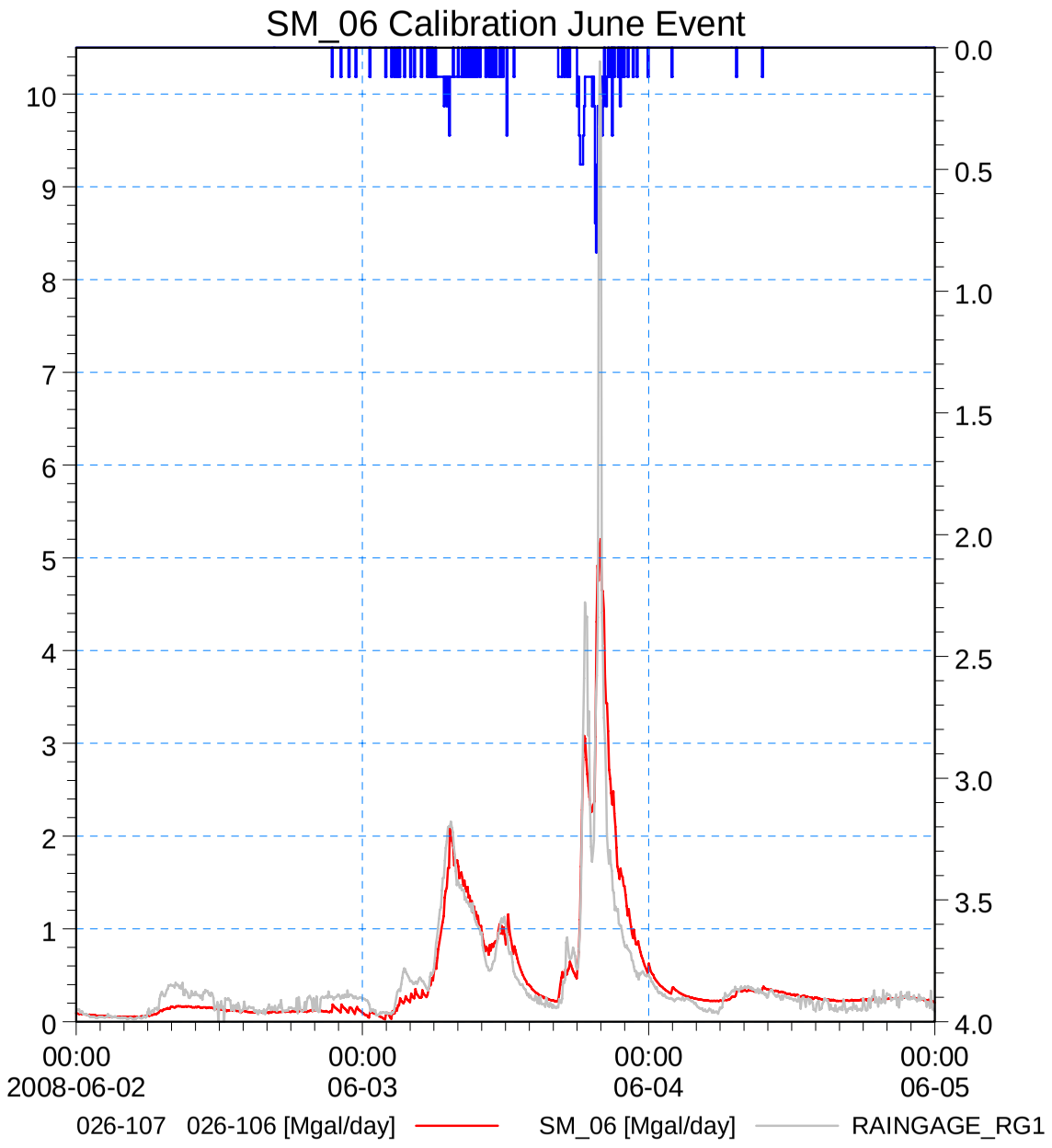


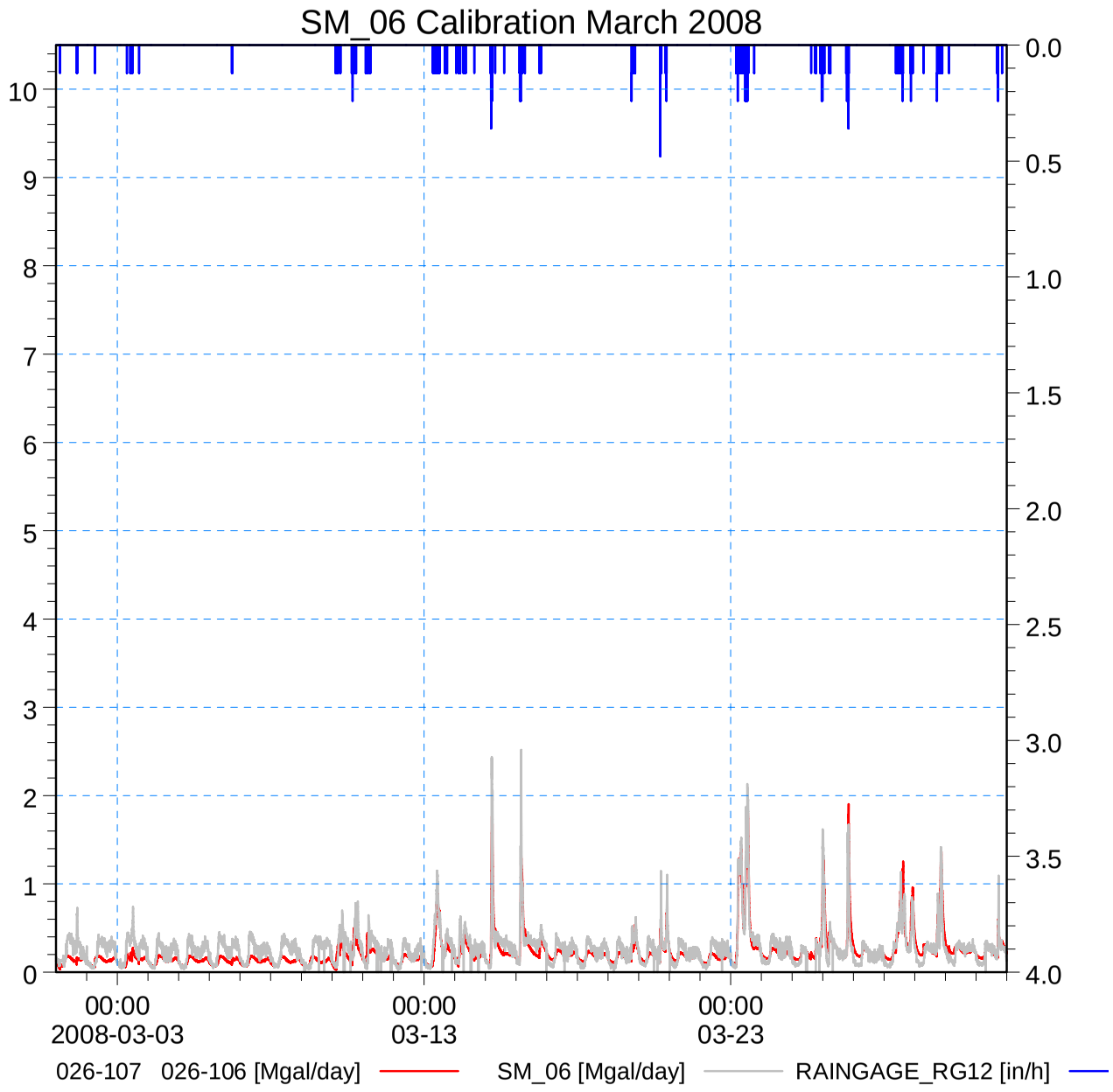
R2 = 0.607

SM 05 Statistics

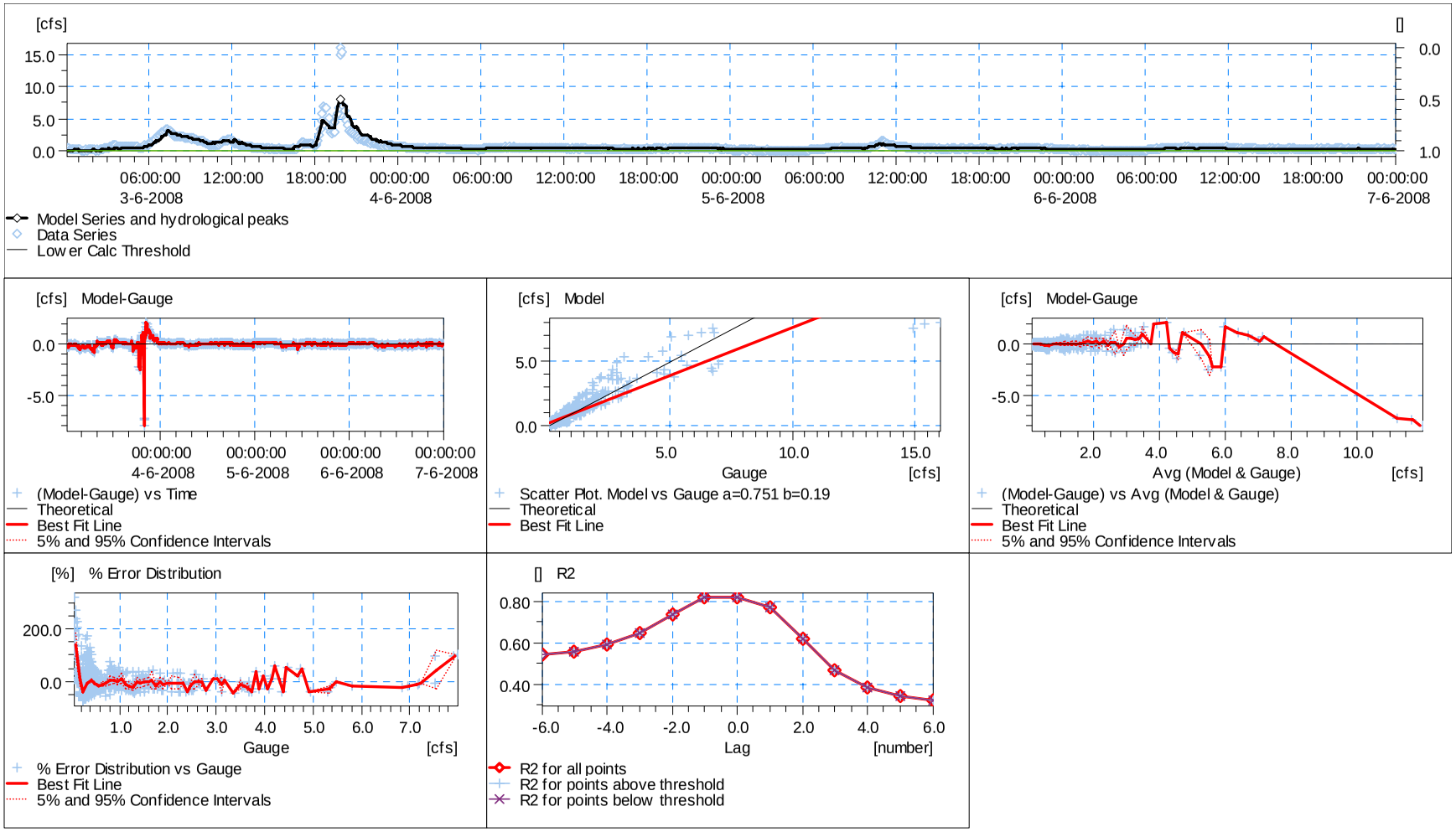

SM_06 Calibration Dec 2007 to Jun 2008
10
9
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
December 2007
January 2008
February 2008
March 2008
April 2008
May 2008
026-107
026-106 [Mgal/day]
SM_06 [Mgal/day]
RAINGAGE_RG1


SM_06 Calibration December Event
10
9
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2007-12-02
00:00
12-03
00:00
12-04
00:00
12-05
026-107 026-106 [Mgal/day]
SM_06 [Mgal/day]
RAINGAGE_RG1


SM_06 Calibration June Event
10
9
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-06-02
00:00
06-03
00:00
06-04
00:00
06-05
026-107 026-106 [Mgal/day]
SM_06 [Mgal/day]
RAINGAGE_RG1


SM_06 Calibration March 2008
10
9
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-03-03
00:00
03-13
00:00
03-23
026-107 026-106 [Mgal/day]
SM_06 [Mgal/day]
RAINGAGE_RG12 [in/h]

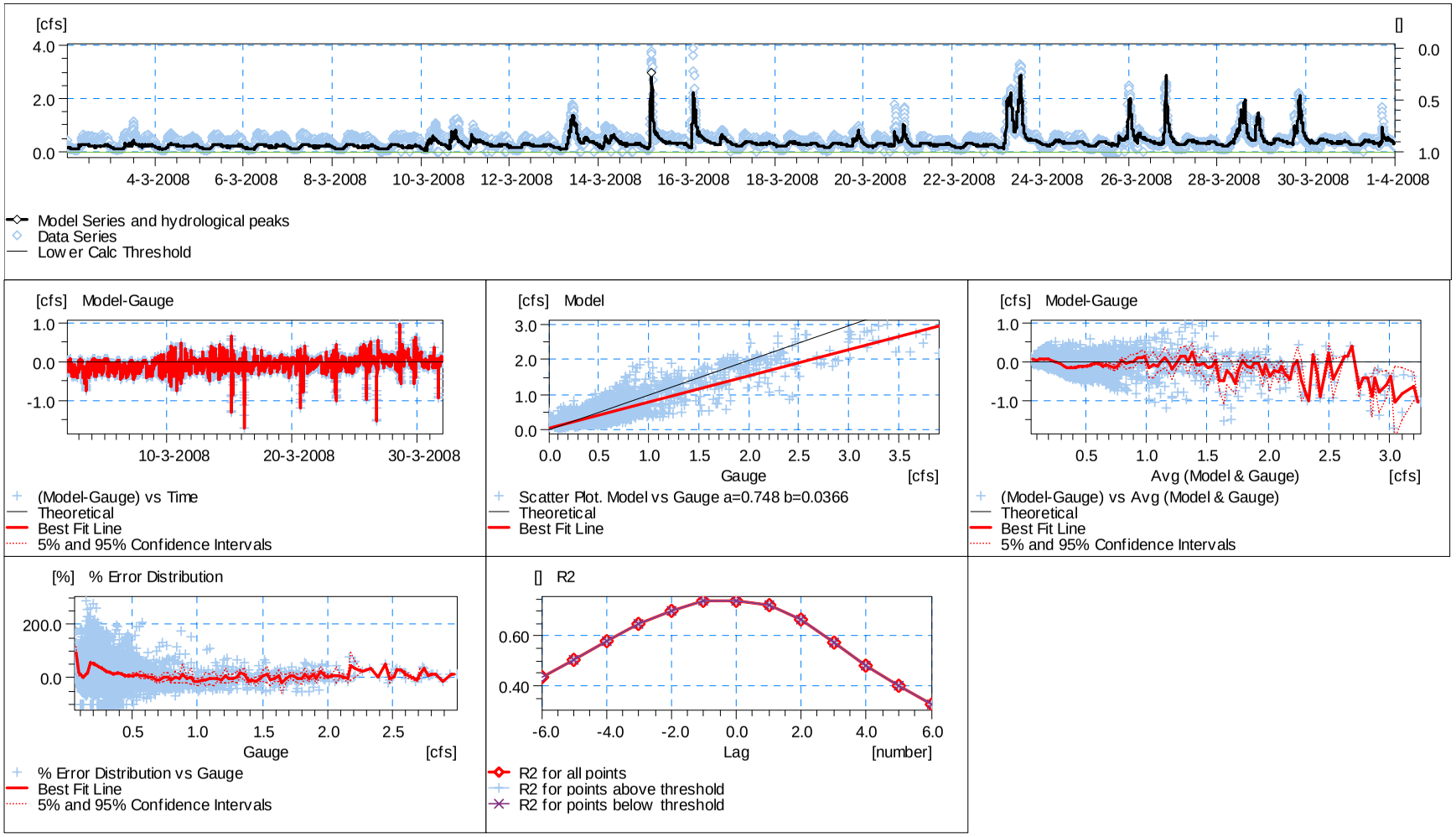
026-107 026-106 (026-107 -> 026-106) 41.90



R2 = 0.817

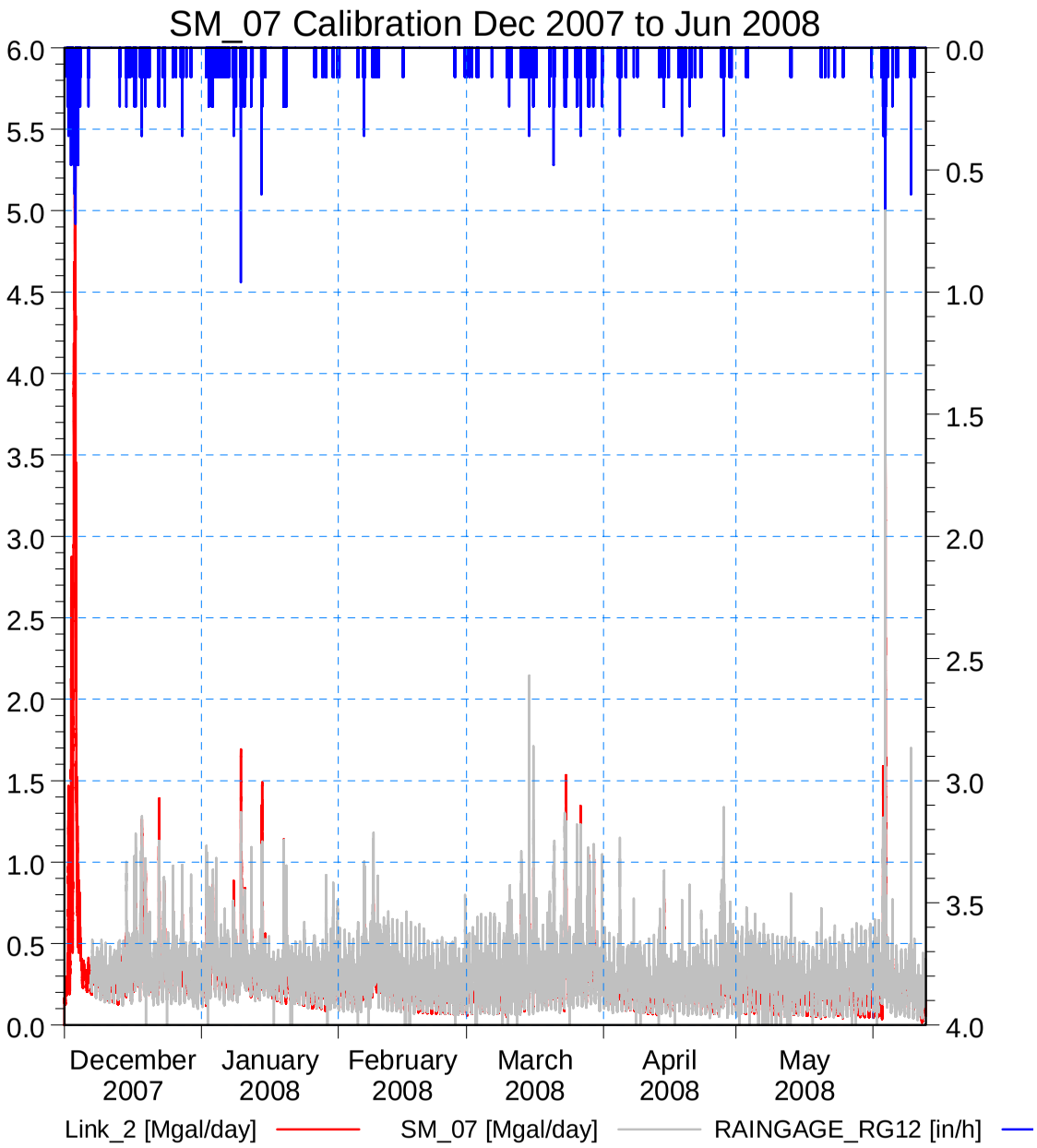
SM 06 Statistics

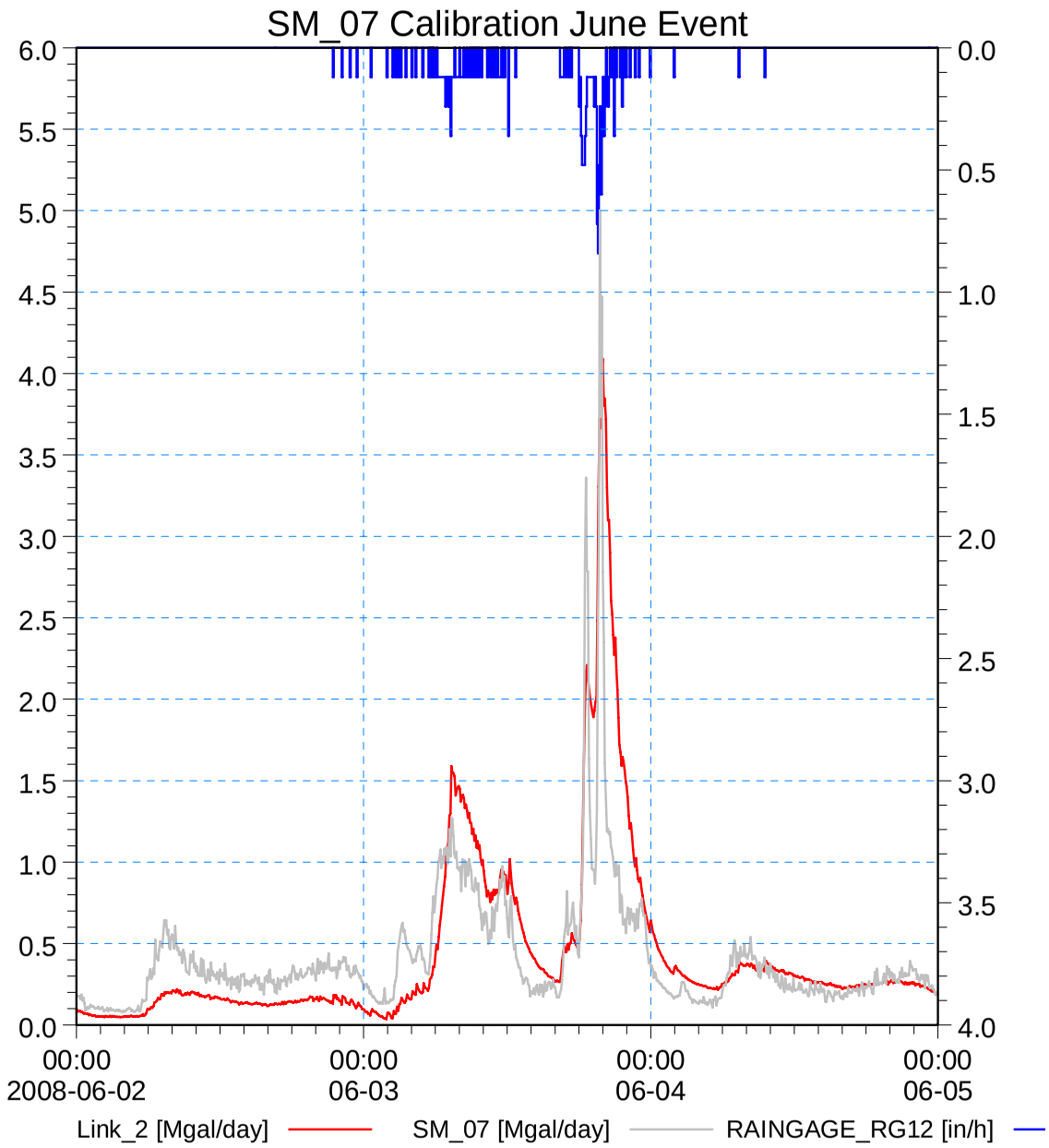
026-107 026-106 (026-107 -> 026-106) 41.90

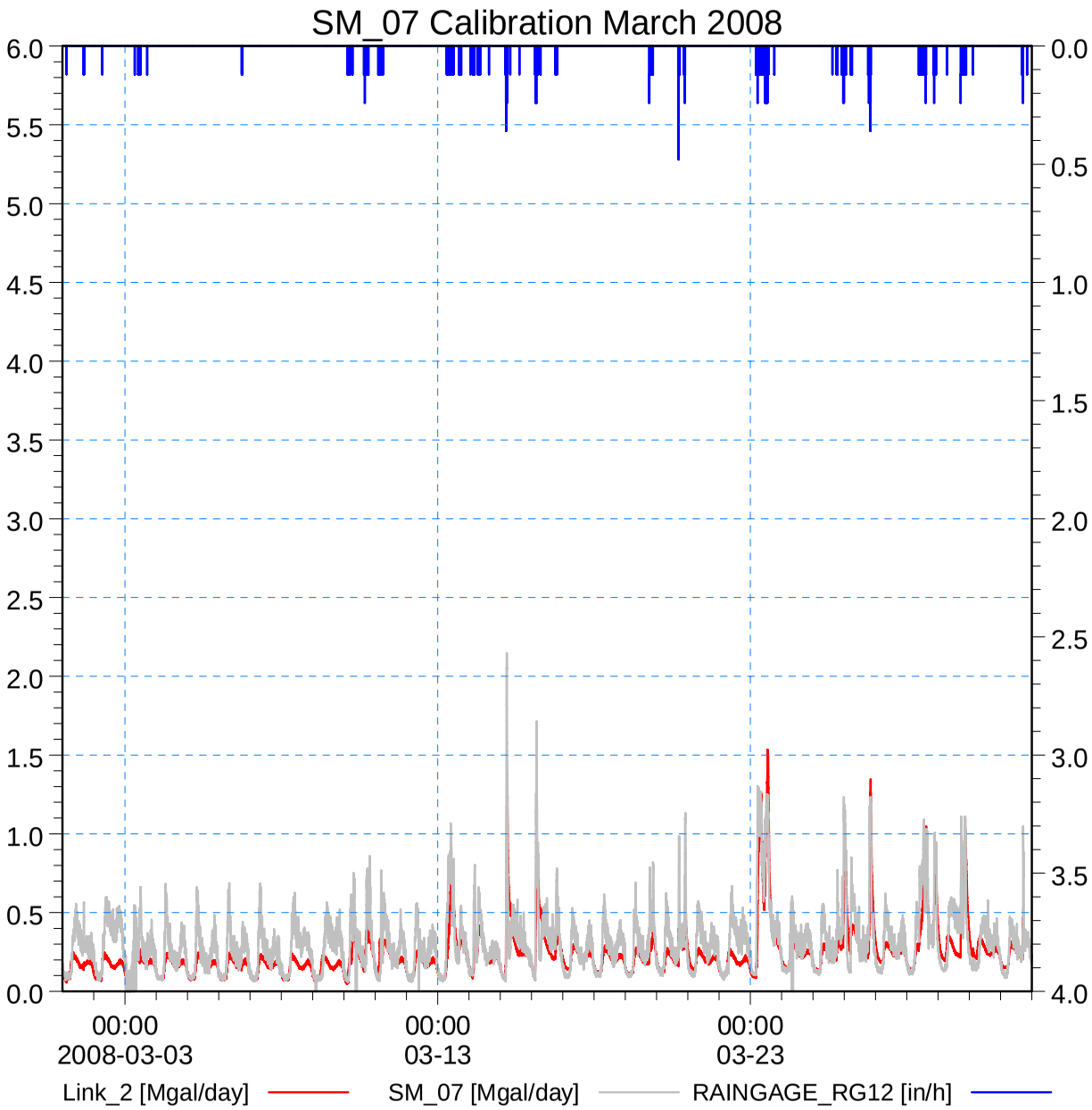


R2 = 0.741

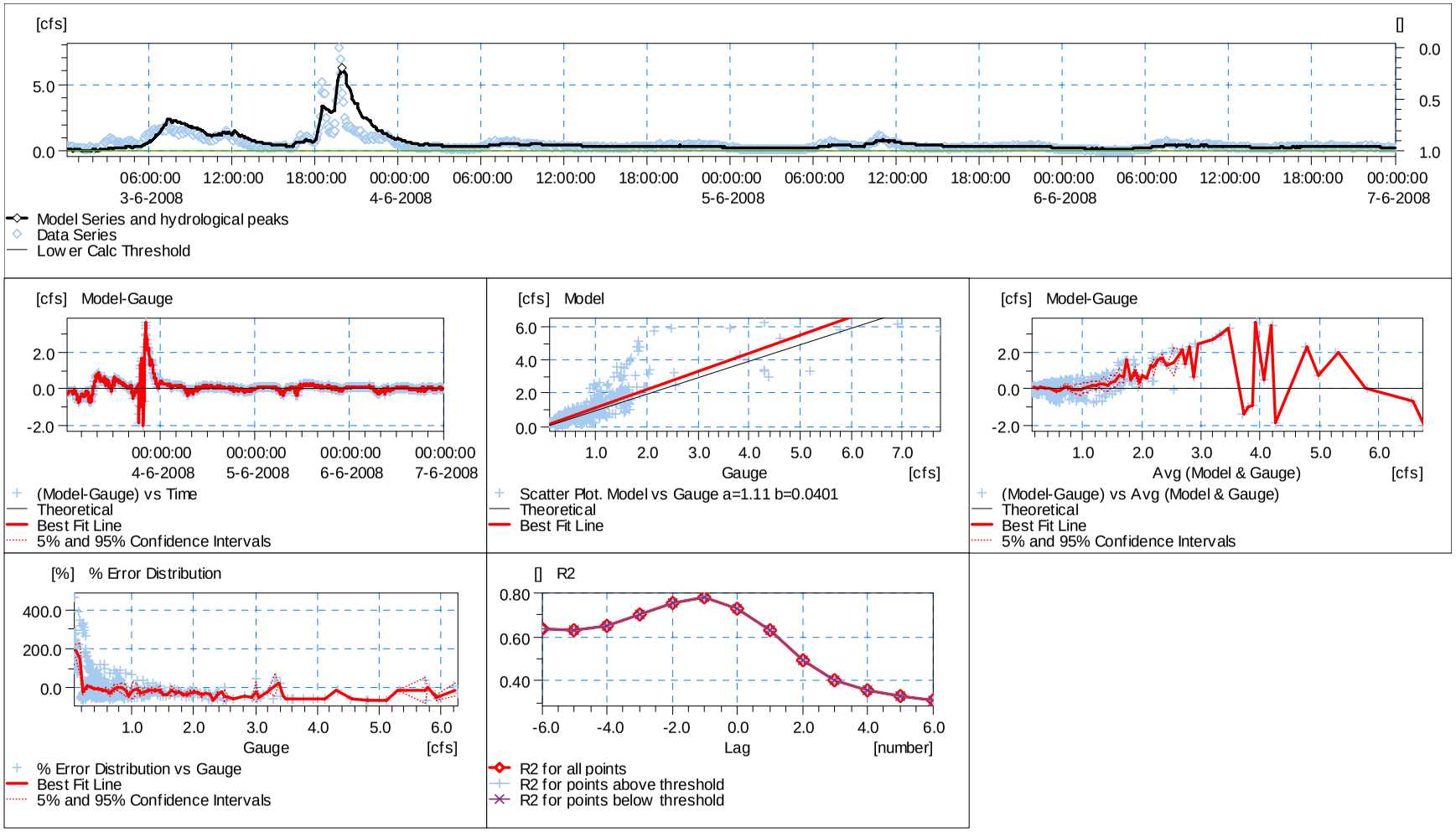
SM 06 Statistics


SM_07 Calibration Dec 2007 to Jun 2008
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
December 2007
January 2008
February 2008
March 2008
April 2008
May 2008
Link_2 [Mgal/day]
SM_07 [Mgal/day]
RAINGAGE_RG12 [in/h]


SM_07 Calibration June Event
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-06-02
00:00
06-03
00:00
06-04
00:00
06-05
Link_2 [Mgal/day]
SM_07 [Mgal/day]
RAINGAGE_RG12 [in/h]


SM_07 Calibration March 2008
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
00:00
2008-03-03
00:00
03-13
00:00
03-23
Link_2 [Mgal/day]
SM_07 [Mgal/day]
RAINGAGE_RG12 [in/h]

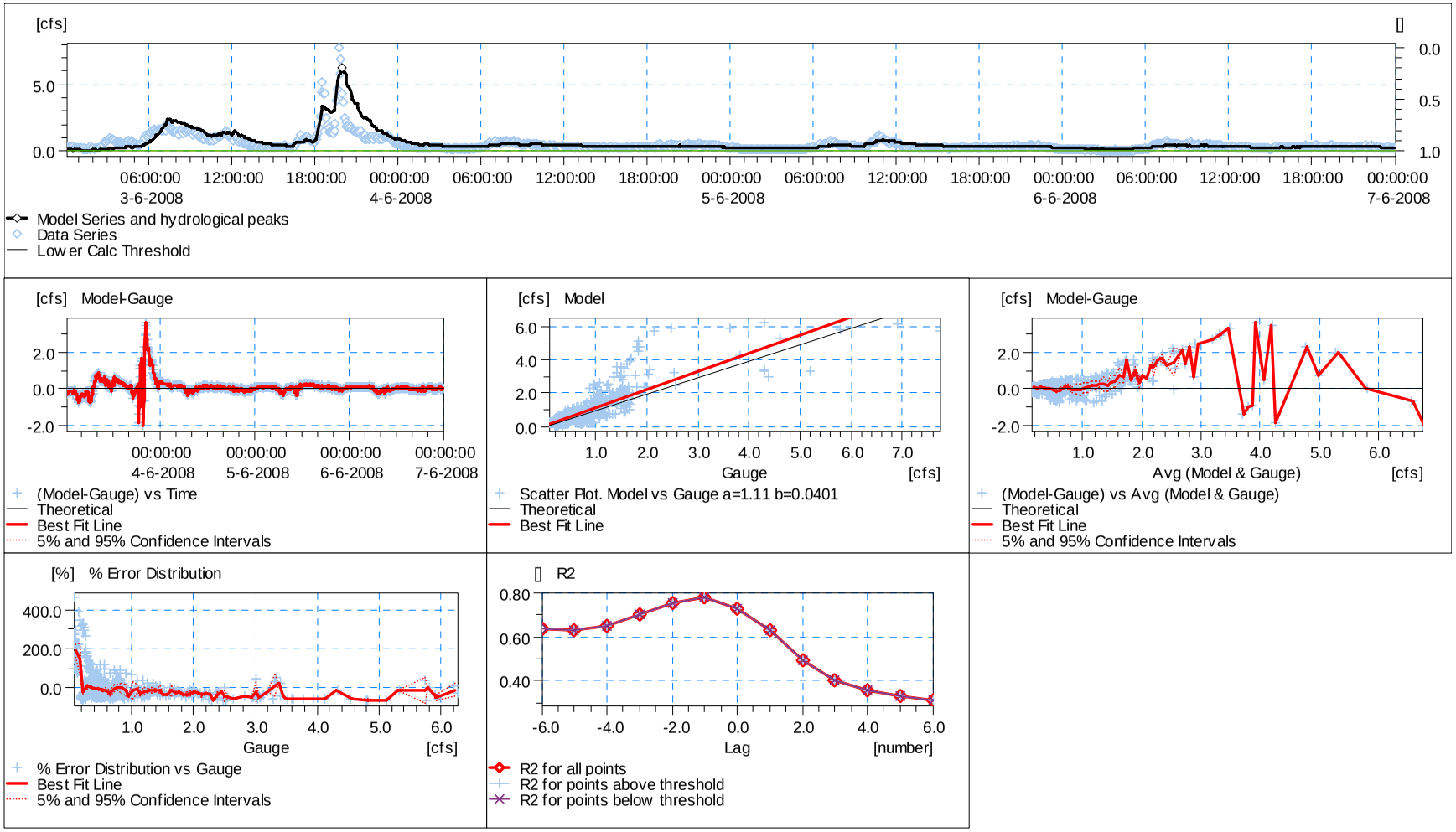
Link_2 (Node_4 -> 026-290) 17.50



R2 = 0.725

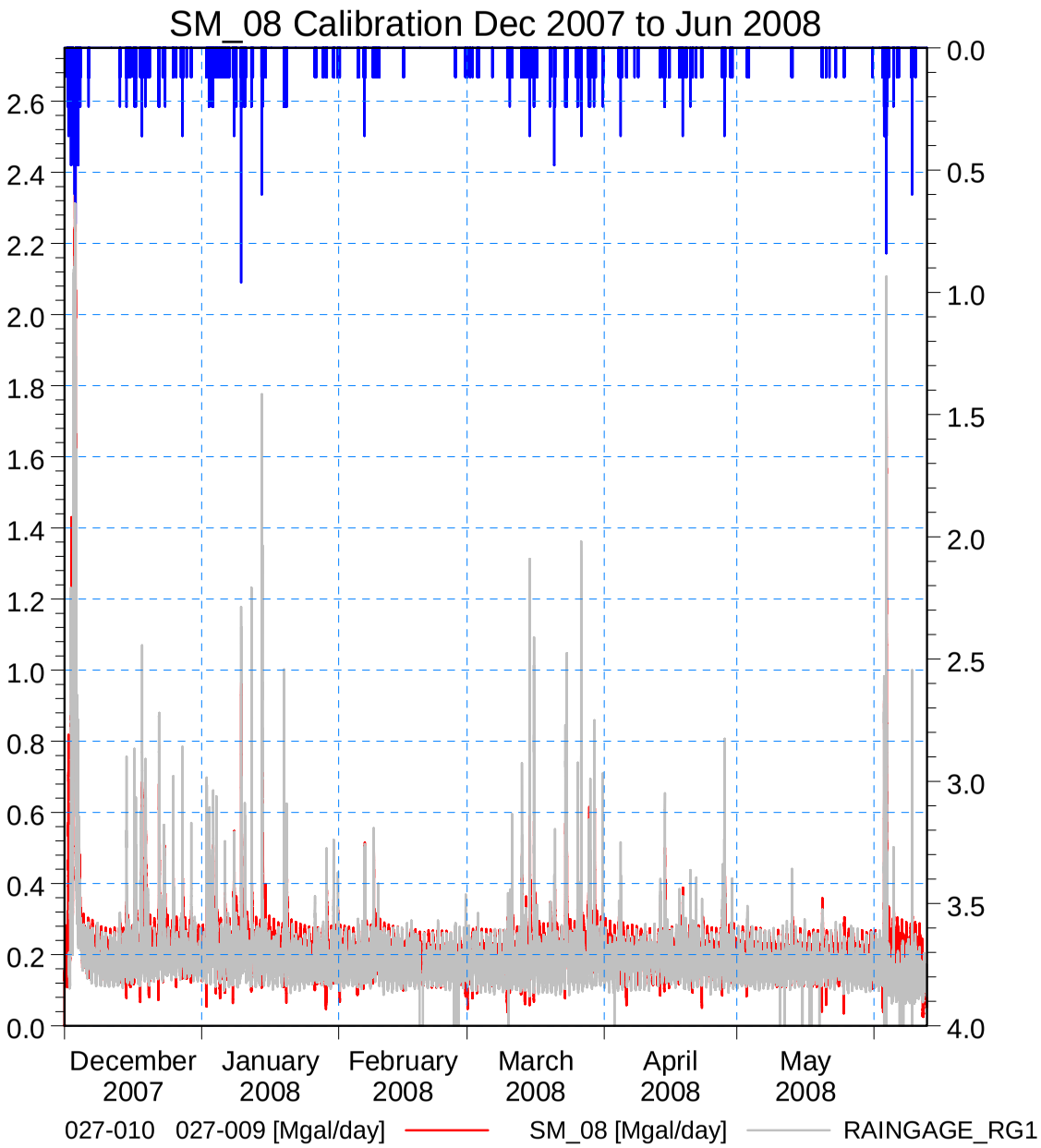
SM 07 Statistics

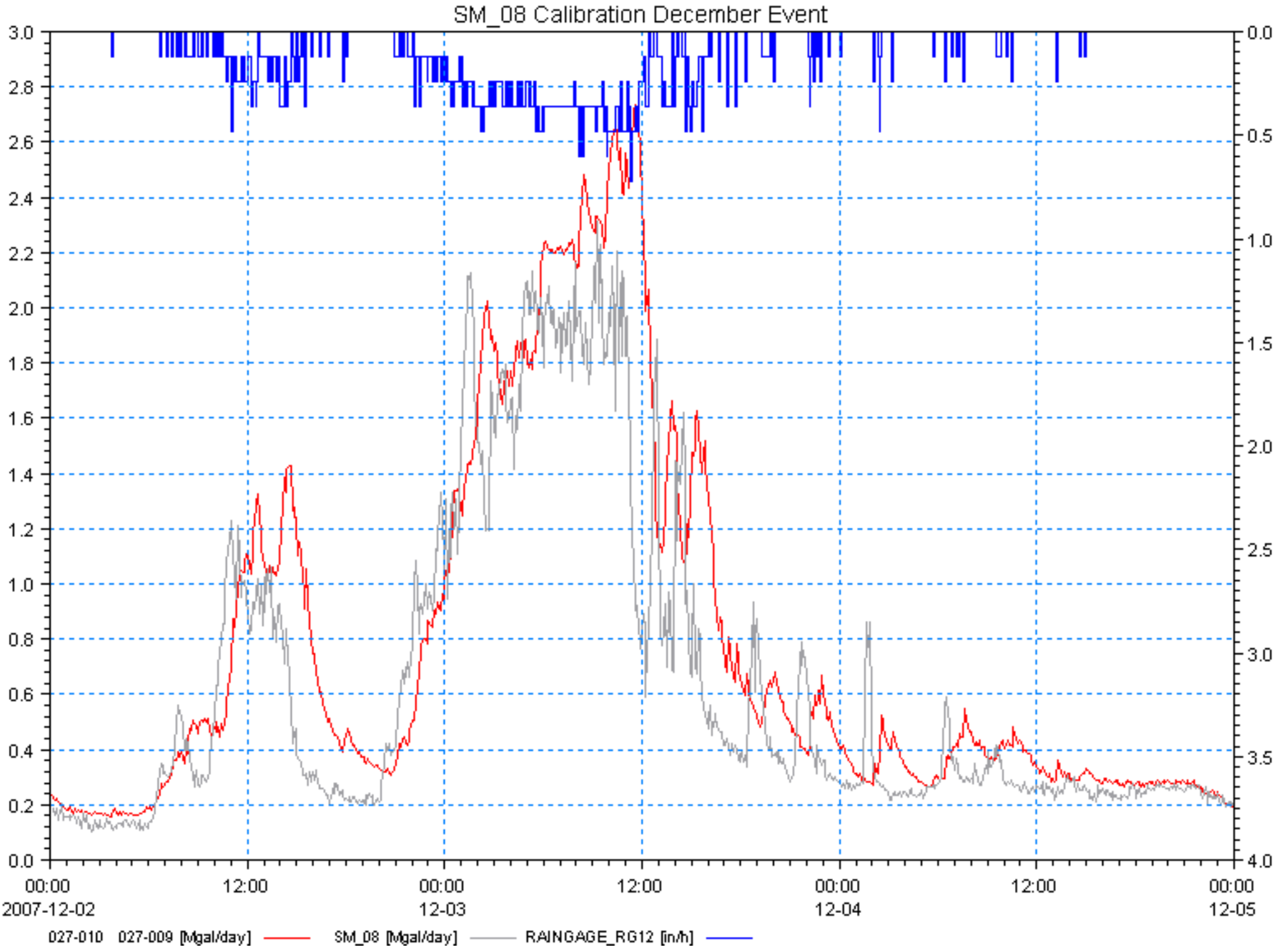
Link_2 (Node_4 -> 026-290) 17.50



R2 = 0.725

SM 07 Statistics


SM_08 Calibration Dec 2007 to Jun 2008
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
December 2007
January 2008
February 2008
March 2008
April 2008
May 2008
027-010 027-009 [Mgal/day]
SM_08 [Mgal/day]
RAINGAGE_RG1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4.0
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00:00
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SM_08 [Mgal/day]
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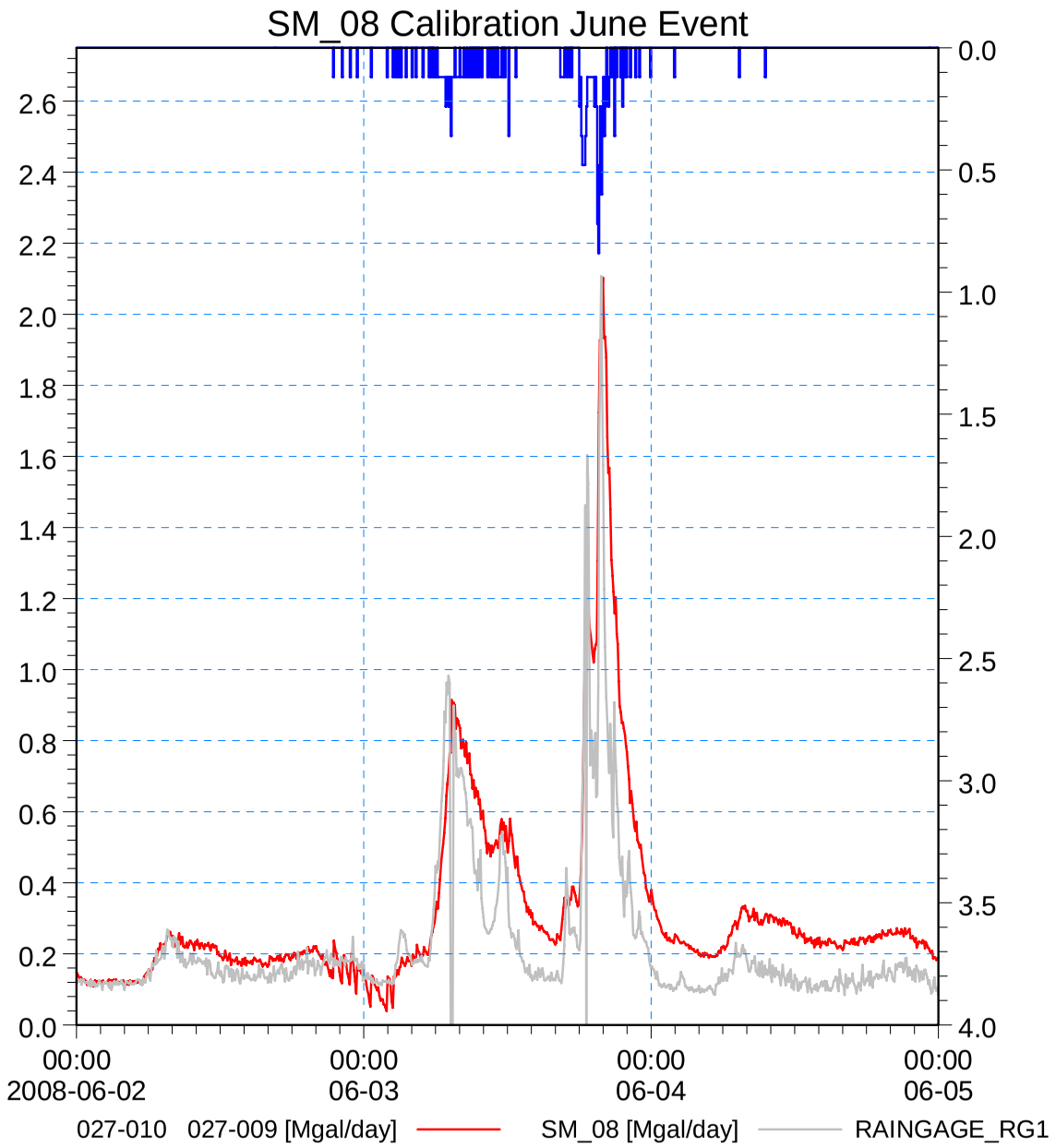
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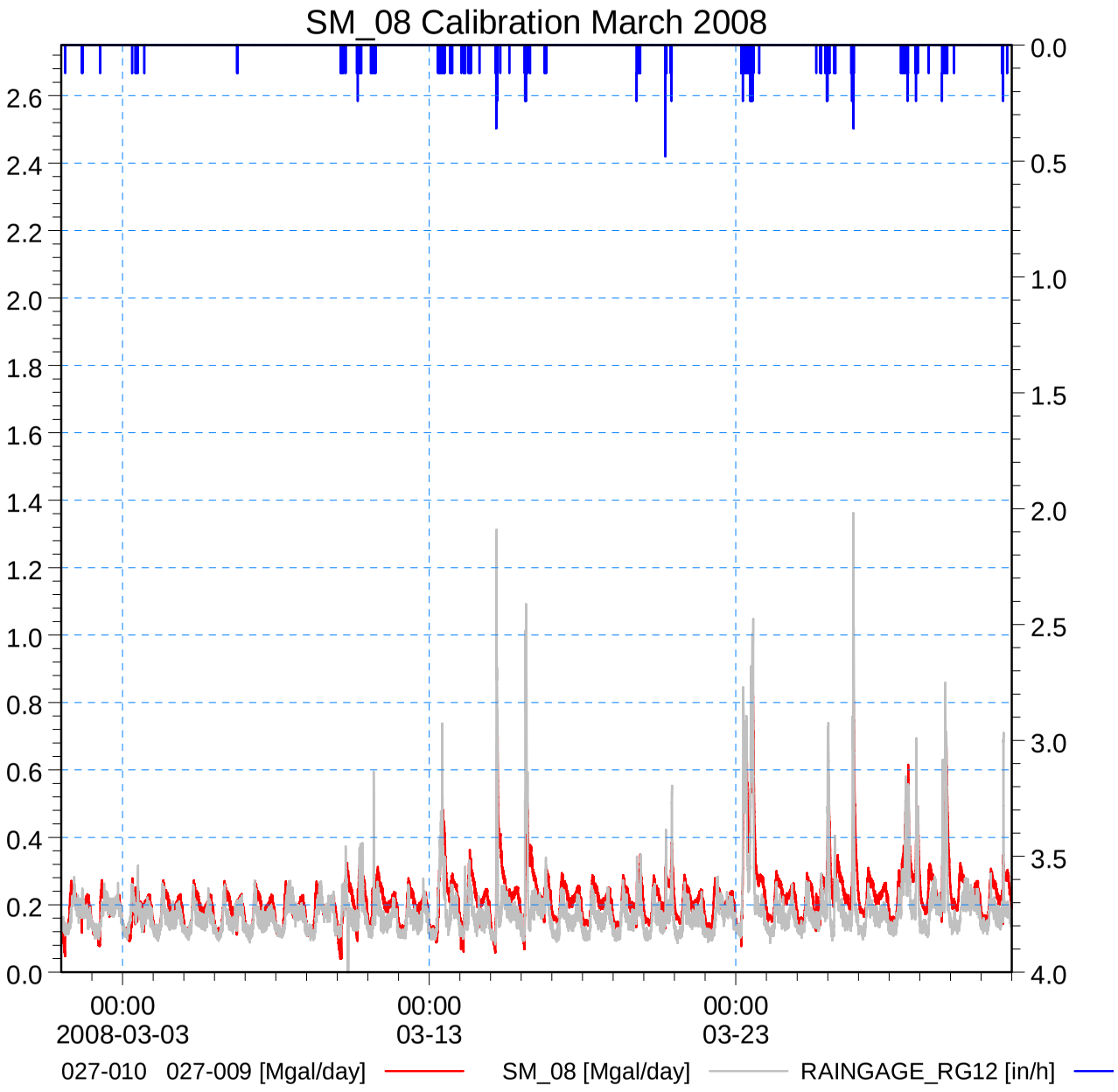
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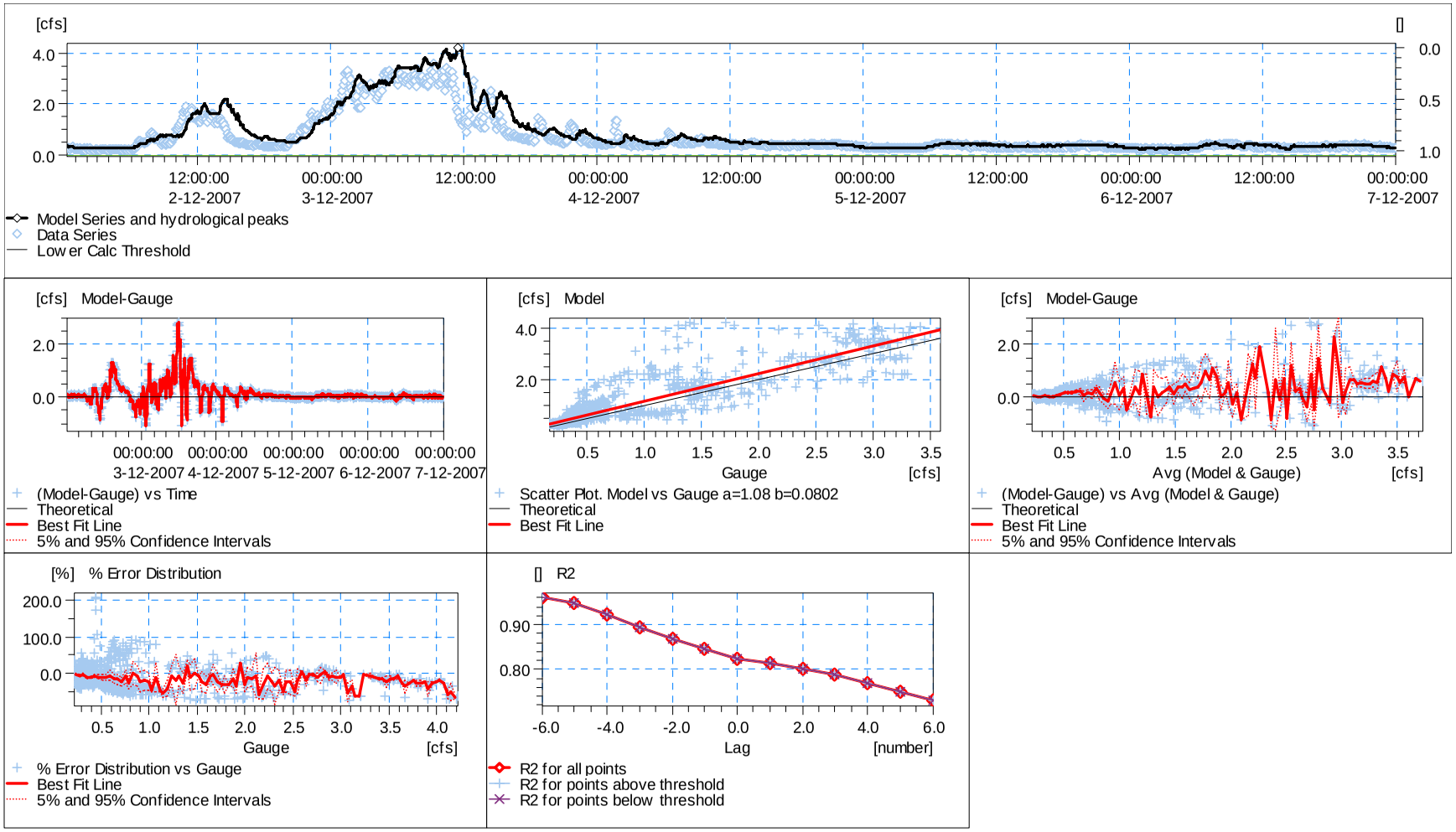

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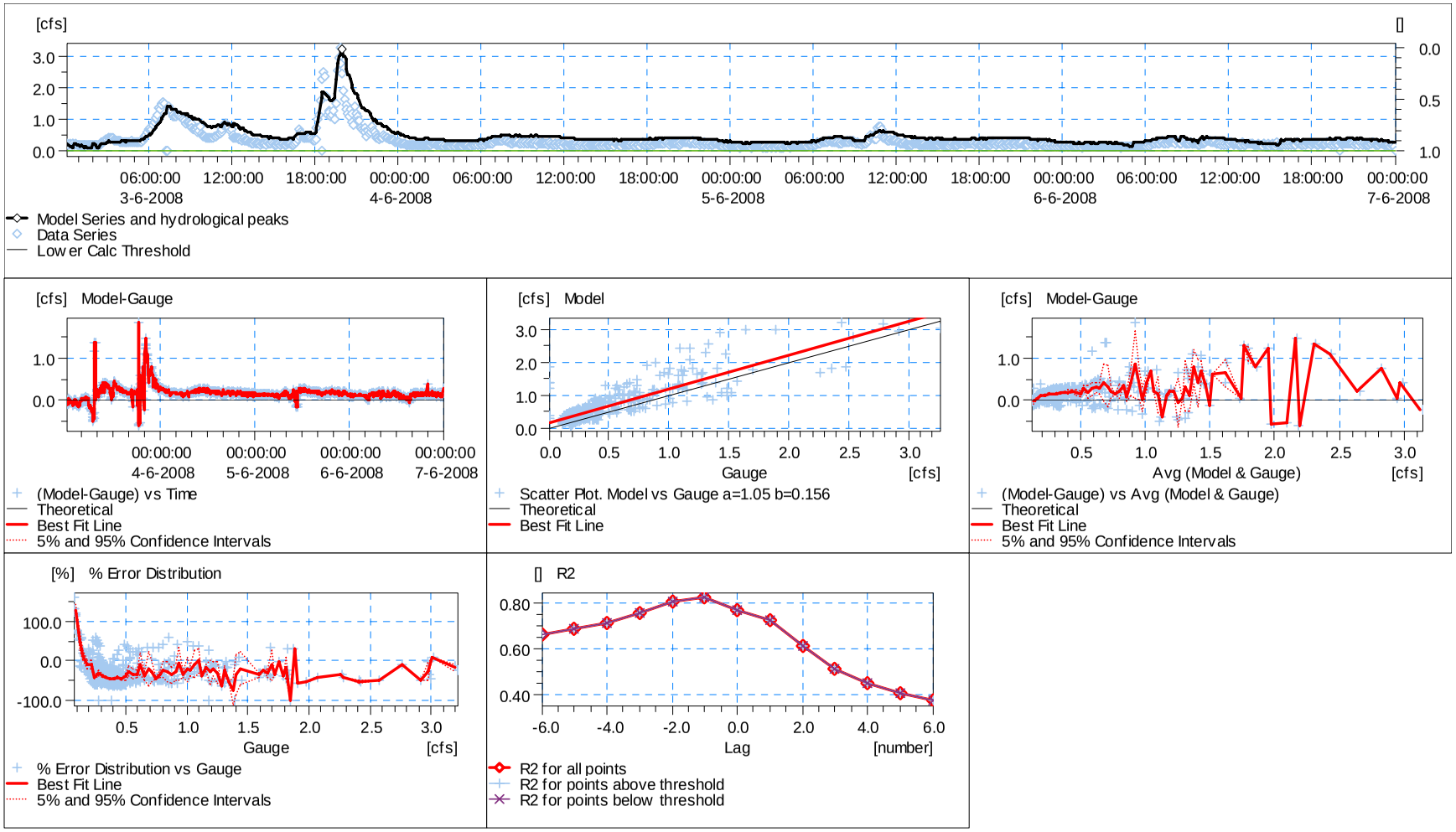

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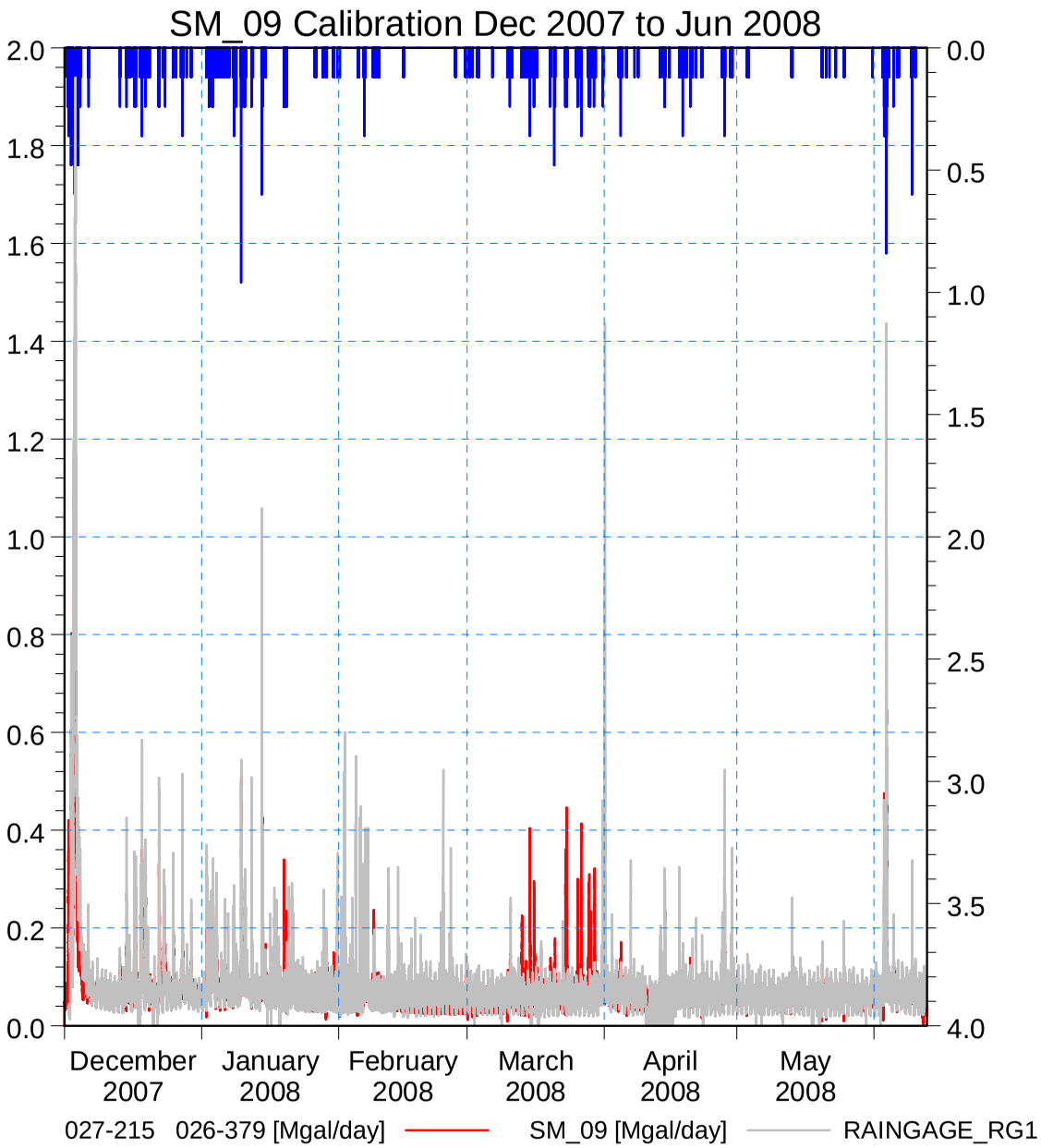
SM 08 Statistics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January 2008
February 2008
March 2008
April 2008
May 2008
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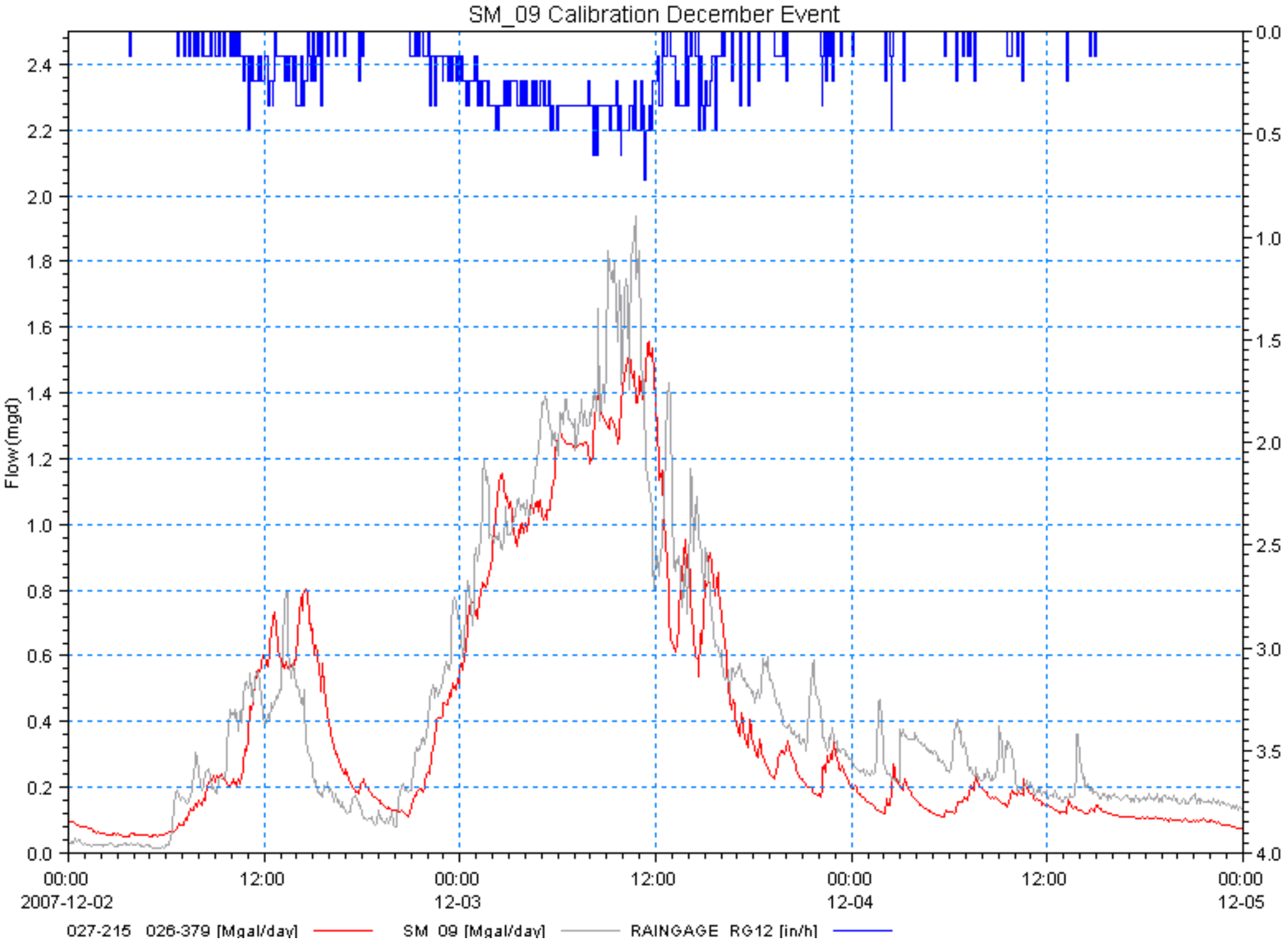
SM_09 [Mgal/day]
RAINGAGE_RG1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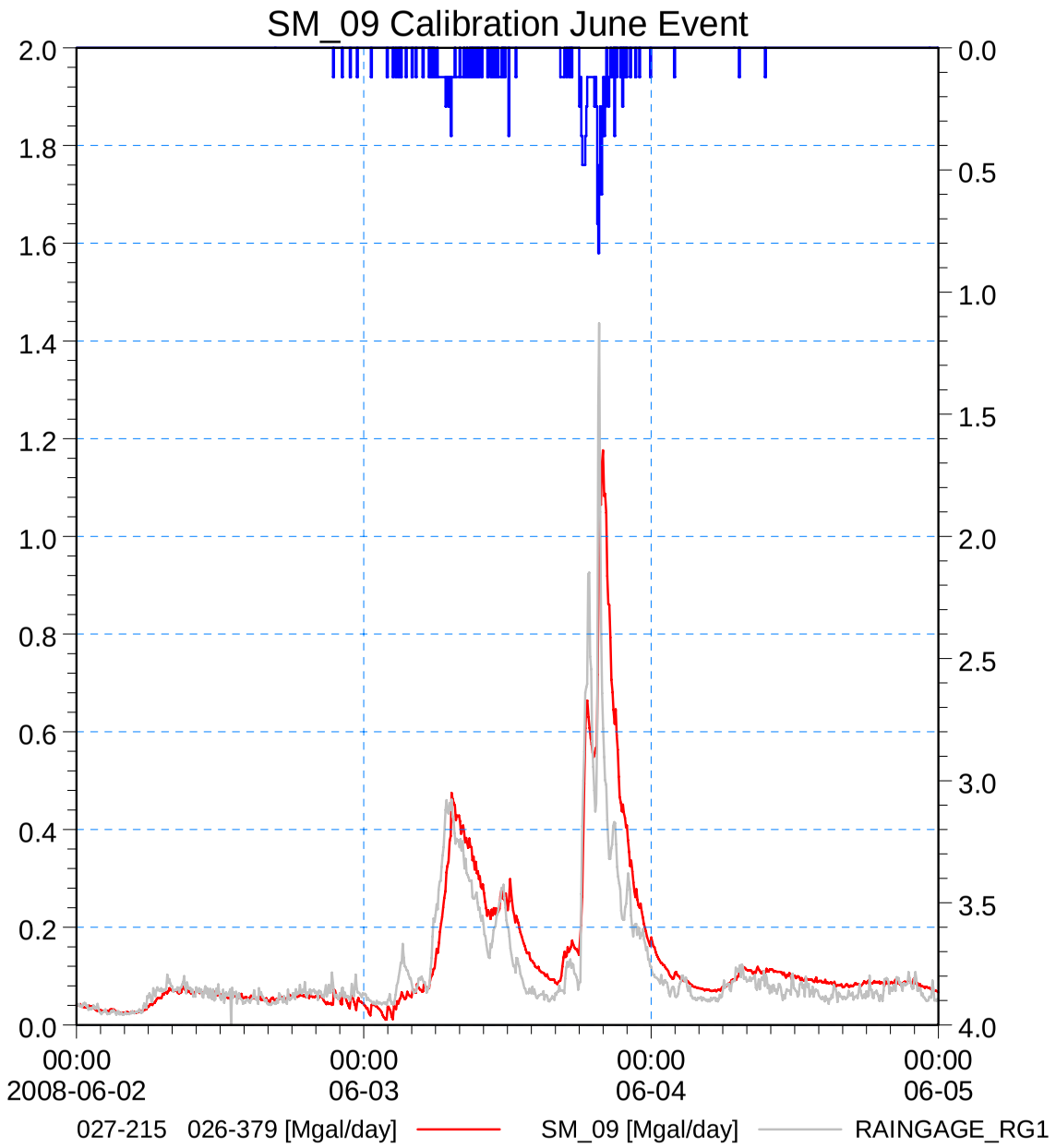
SM_09 [Mgal/day]
RAINGAGE RG12 [in/h]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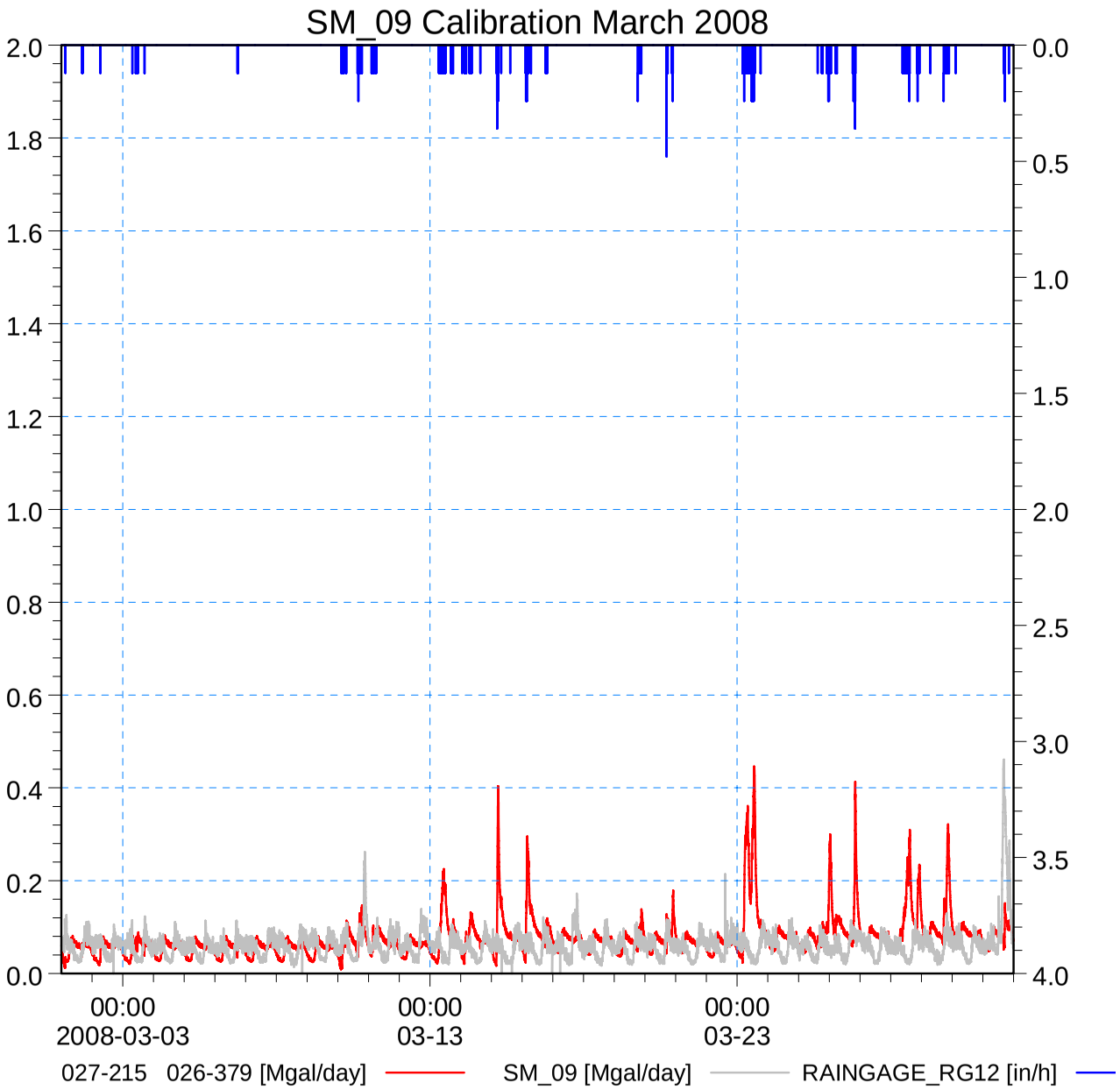
SM_09 [Mgal/day]
RAINGAGE_RG1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2008-03-03
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03-13
00:00
03-23
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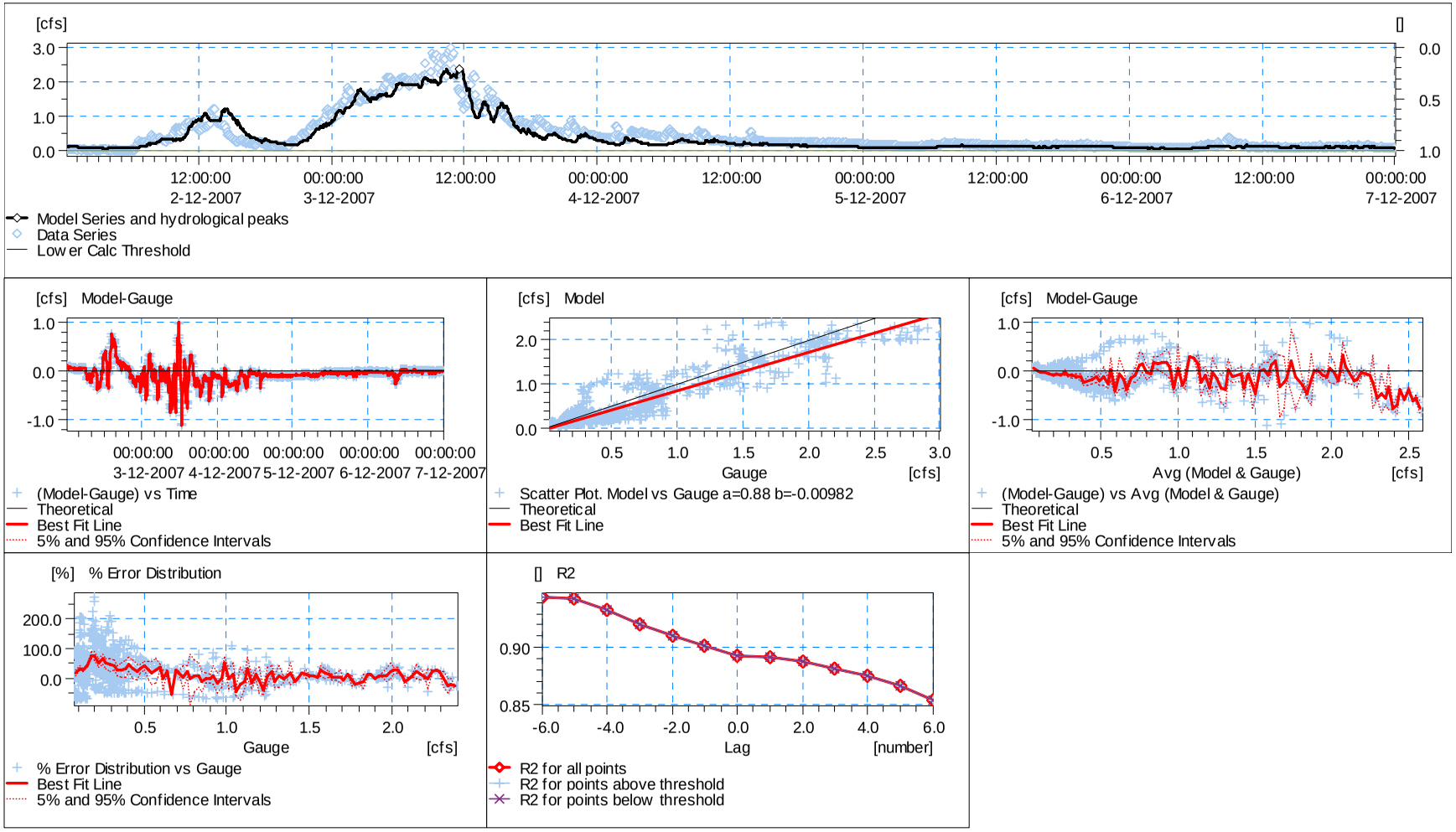

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SM 09 Statistics

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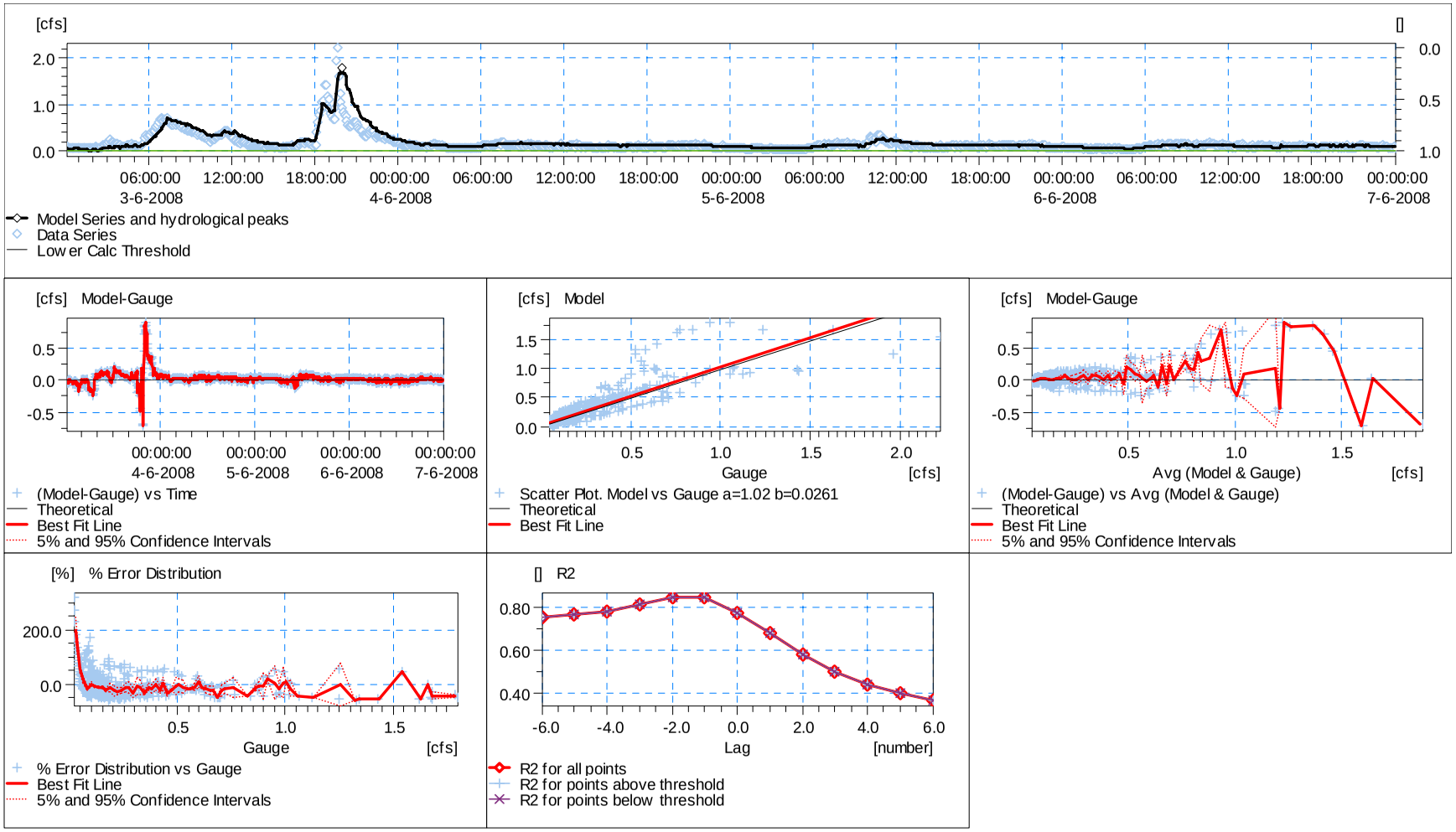

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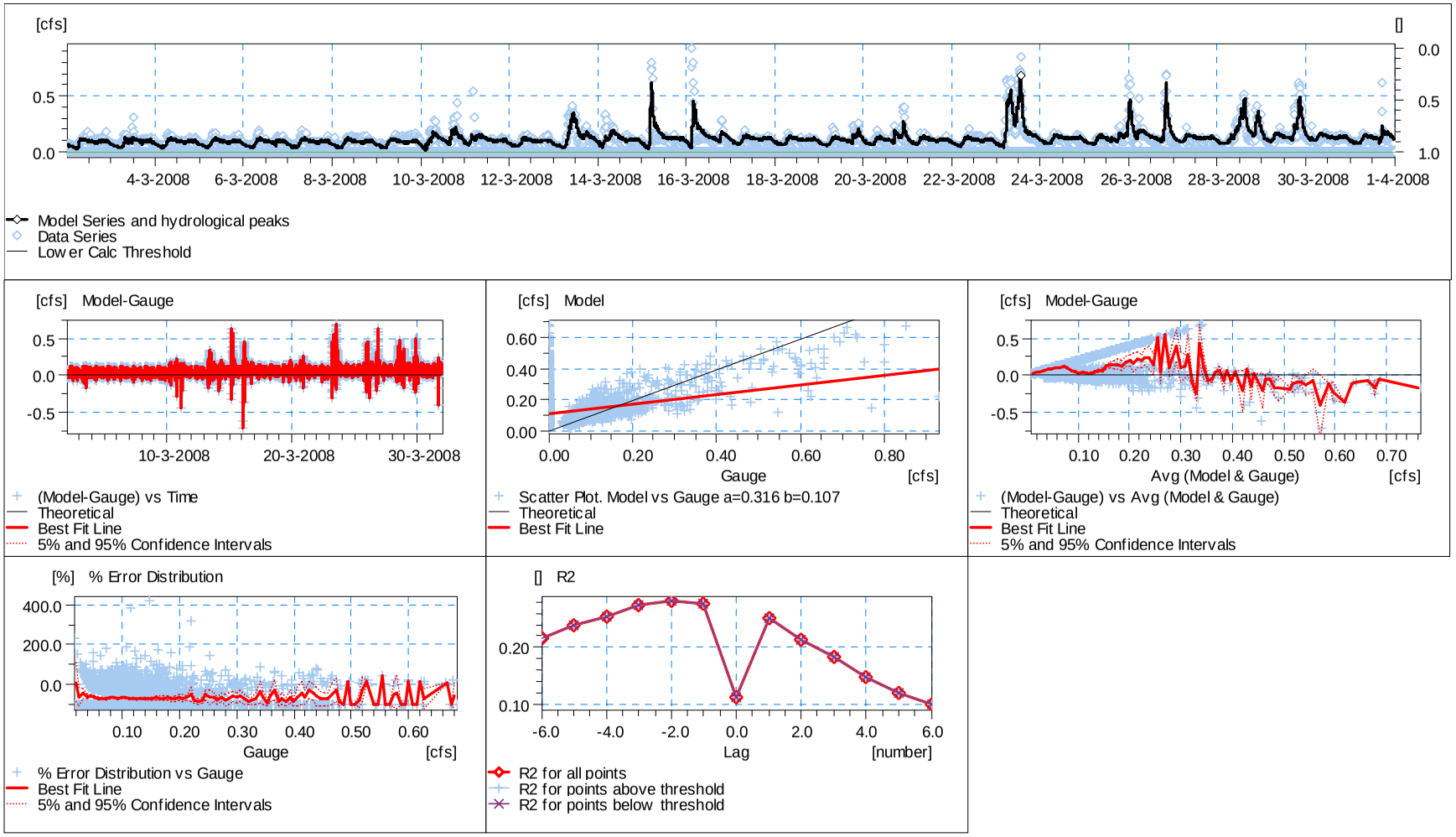

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SM 09 Statistics

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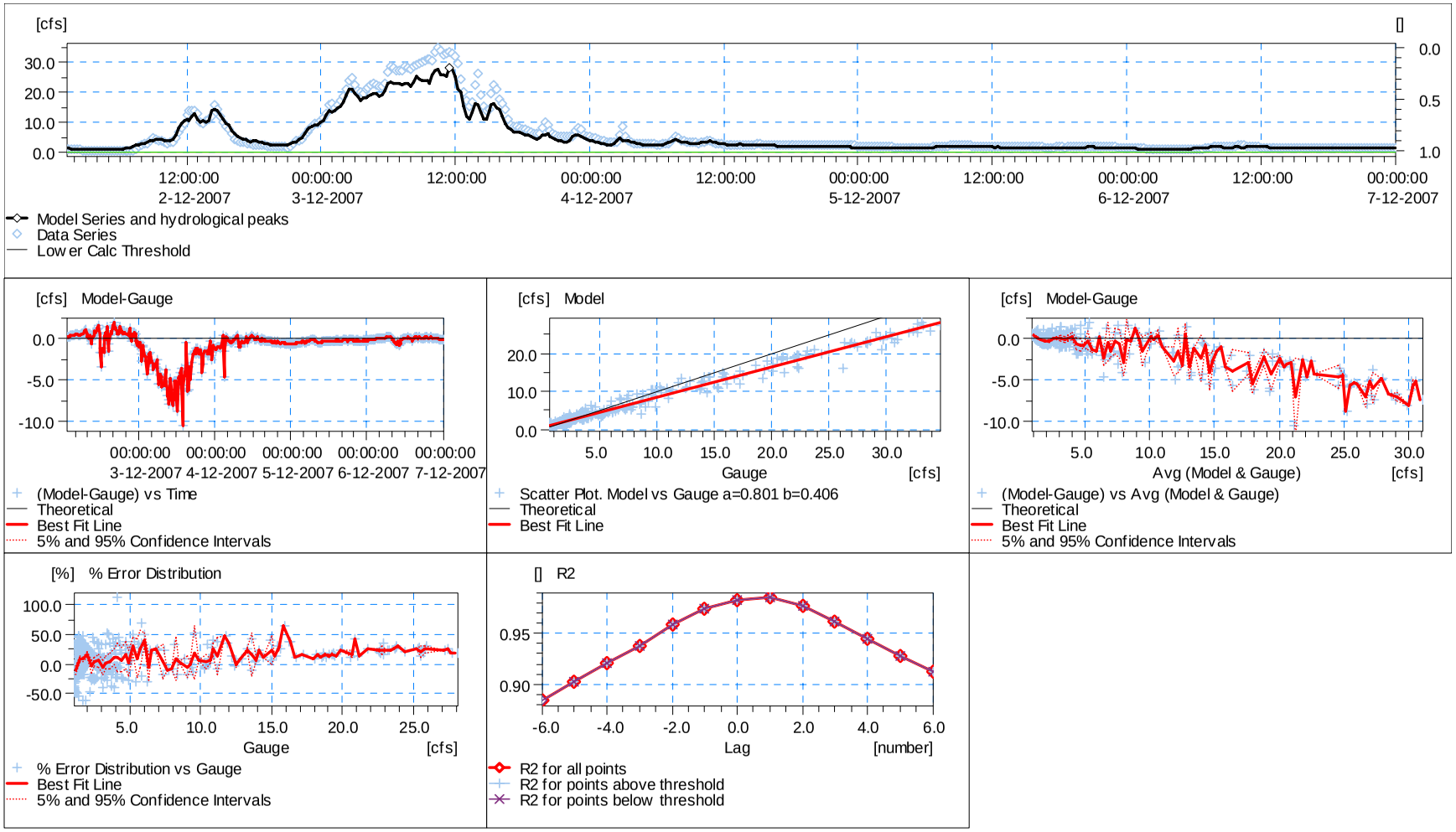

R2 = 0.982

MAG CSO Statistics

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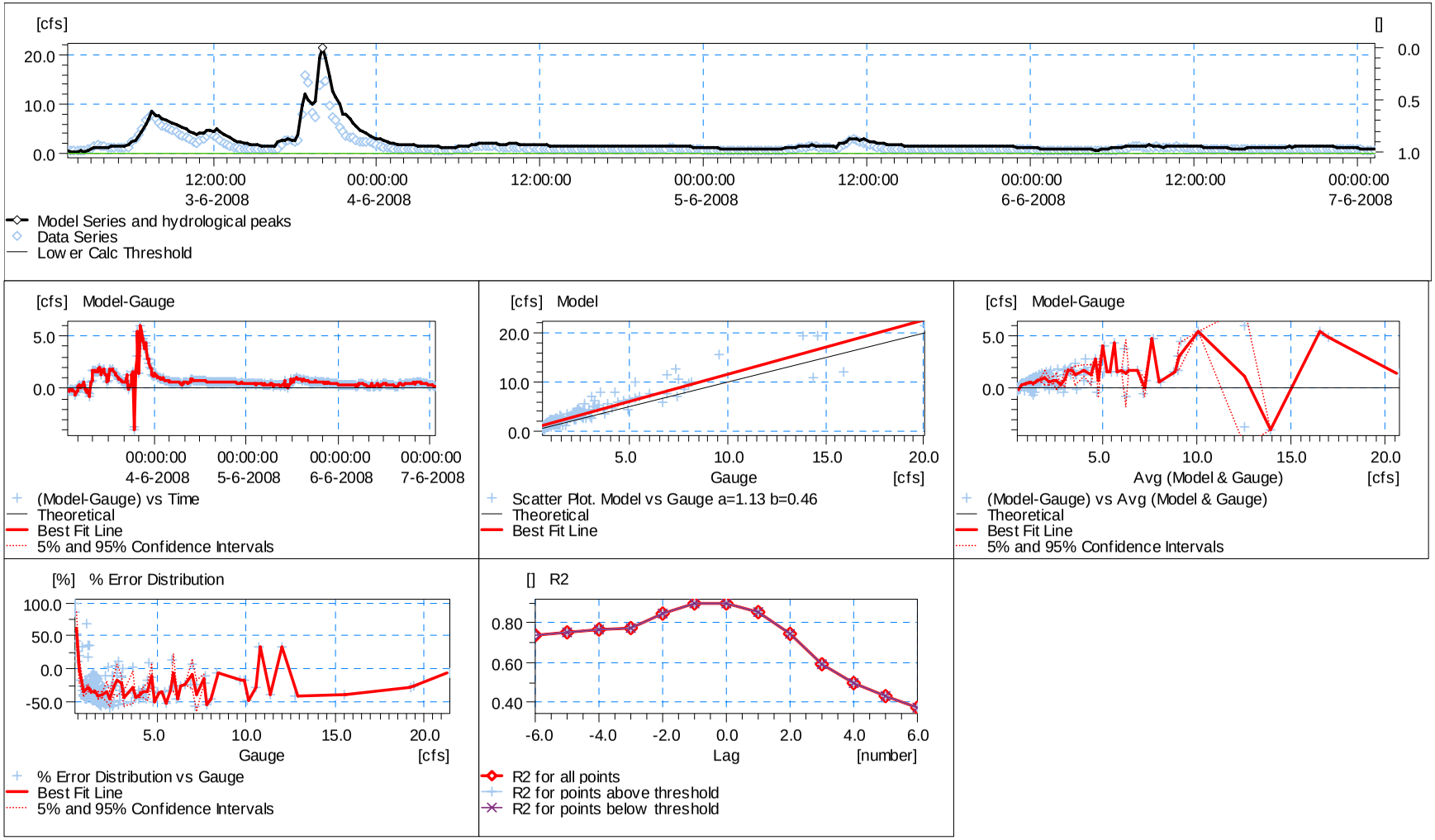

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MAG CSO Statistics

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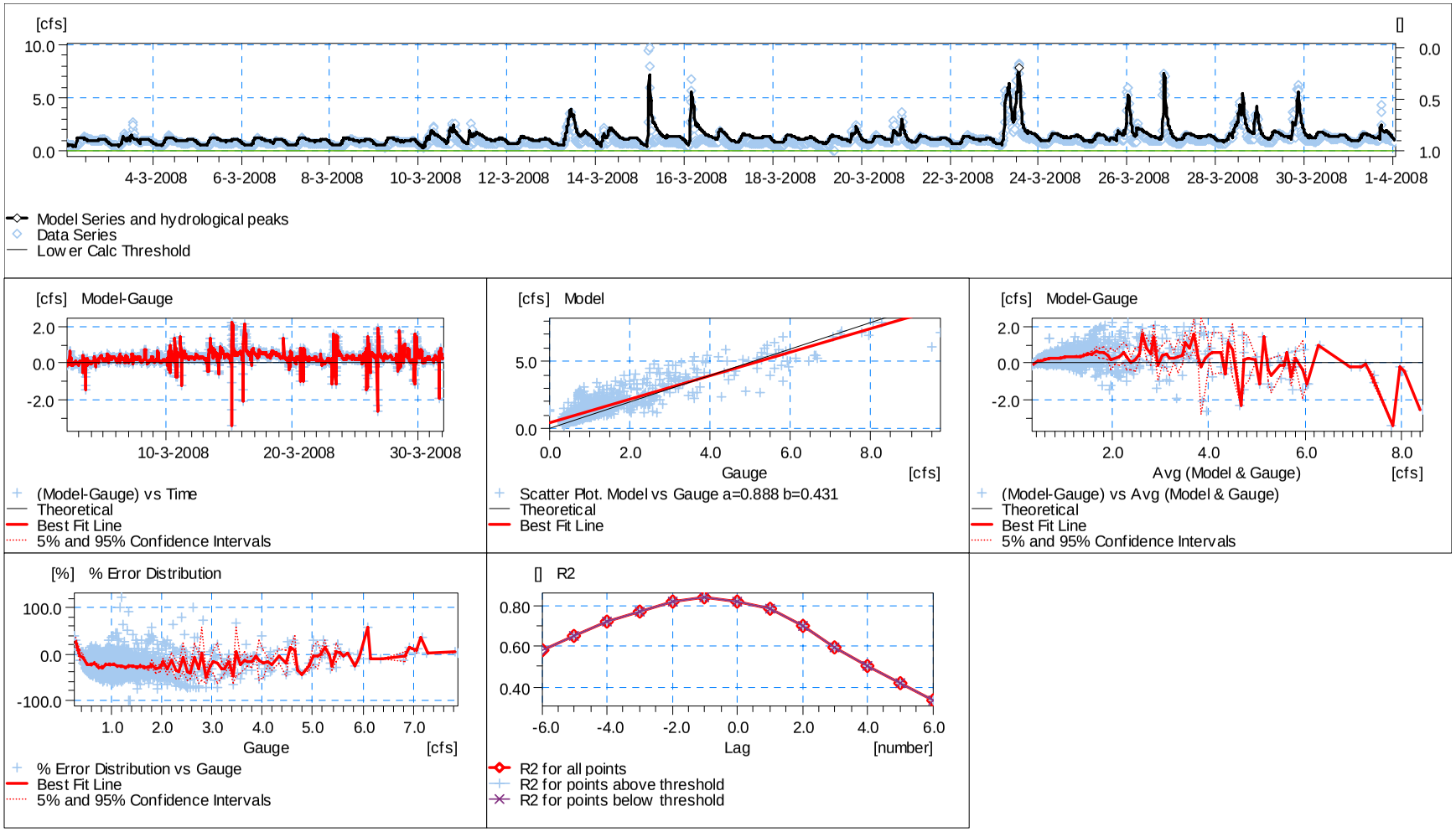

R2 = 0.818

MAG CSO Statistics

Appendix B-3

SOUTH MAGNOLIA AND NORTH BEACH BASINS POPULATION/ LAND USE ANALYSIS PROJECT MEMORANDUM, JANUARY 2008

PROJECT MEMORANDUM

Project Name:	CSO Planning/Predesign Services	**Date:**	01/06/2008
Client:	King County DNRP, Wastewater Treatment Division	**Project Number:**	7562A.10
Prepared By:	Jason Nikaido, Ed Wicklein		
Reviewed By:	Shawn Dent		
Subject:	South Magnolia and North Beach Basins Population/Land Use Analysis		
Distribution:	King County, Carollo Project Team		

Purpose

Based on comments from the Round 1 Magnolia/North Beach Calibration meeting, a detailed analysis was performed on the dry weather flow (DWF). Dry weather flow for the sum of the ADS meters was greater than the downstream County meters in both basins. A decision was made to adjust the ADS meter DWF to match the County DWF because this would result in the model predicting less DWF but more inflow/infiltration (I/I) at the meter locations (i.e. a more conservative estimate of I/I). As before, peak flows for the sum of the ADS meters and downstream meters would remain equal.

Methodology

Using GIS and spreadsheet calculations, the population (provided by the County for County CSO basins) was distributed to the metered basins.

Step 1: Compare County CSO Basin populations with ADS metered basin present use.

Step 2: Distribute population to ADS metered basins by weighted area of County CSO basins.

Step 3: Estimate base infiltration using flow meter data and Stevens-Schutzbach equation.

$$BI = \frac{0.4 \times MDWF}{1 - 0.6(MDWF/ADWF)^{ADWF^{0.7}}}$$

Where,

BI = Base infiltration
MDWF = Minimum average day flow
ADWF = Average dry weather flow

Step 4. Re-apportion dry weather flow in metered subbasins (ADS) to match downstream meters (County) (i.e. ADS subbasin flows proportionally adjusted down).

South Magnolia Basin

Figure 1 illustrates the Round 1 calibration for the MAGCSO meter. As discussed in the Round 1 calibration meeting, the ADS metered DWF is greater than the MAGCSO meter. This may be due to the low depths and high velocities (pipelines are on steep slopes) which could underestimate flows. However, the high wet weather flows (with greater depths) most likely produced more accurate results as shown by the peak flows corresponding well to each other.

Figure 1 - Sum of ADS meters vs. County meter

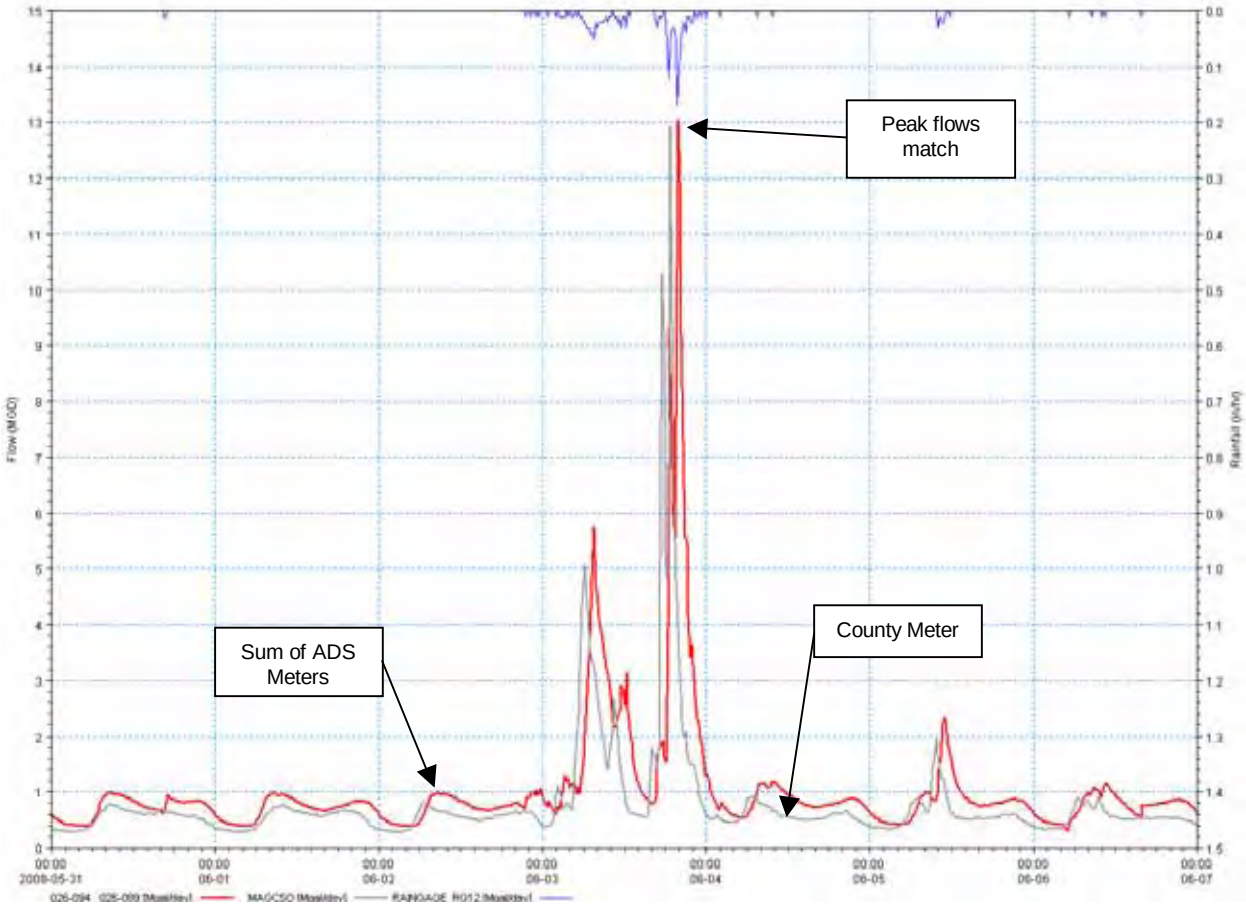

Table 1 presents a comparison for the total basin flow between the sum of the upstream meters and the basin meters. The sum of the meters unit factor of 141.5 gallons per capita per day (gpcd) is 2.6 times greater than the City of Seattle average of ~55 gpcd[1]. The basin meter unit factor of 90.8 is also higher than the City average by a factor of 1.7 but may be reasonable when considering basin to basin differences in wastewater generation.

[1] Per County Staff, 12/16/2008 teleconference.

Table 1 Magnolia basin comparison (ADS vs. County meter)				
Description	**Units**	**Sum of Meters(1)**	**Basin Meter(2)**	**Difference(3)**
Sanitary Flow	MGD(4)	0.626	0.401	+0.225
Base Infiltration	MGD	0.286	0.266	+0.020
ADWF(5)	MGD	0.861	0.668	+0.193
Population	Persons	4,422	4,422	0
Unit Factor	Gal/capita/day	141.5	90.8	+50.7

Notes:
1. Sum of Meters = SM02 + SM03 + SM05 + SM06 + SM07 + SM08 + SM09 + Unmetered area
2. Basin Meter = MAGCSO meter + SM02 + SM03
3. Difference = Sum of Meters - Basin Meter
4. MGD = million gallons per day
5. ADWF = Average dry weather flow

The ADS meter DWF was reduced to match the County's MAGCSO meter. In this process, several anomalies arose and are described below. Figure 2 and Tables 2-4 illustrate the population and present use in the basin and present the revised DWF values. Meters SM02 and SM03 are not tributary to the MAGCSO meter and were thus calibrated to the ADS meters. This explains the greatly varying unit factor for SM02 and SM03 when compared with the other meters.

<u>Anomalies</u>

- CSO Basin 151 contains no commercial area. The commercial population of 378 was not distributed to the model since it there was no corresponding present use.
- CSO Basin 153 has 545 residential parcels but only a population of 172.
- Large unmetered area (~14% of population).

TABLE 2
SOUTH MAGNOLIA CSO BASIN POPULATION

Meter	RES	COM	IND	Total
151[1]	1947	378	0	2325
152	856	264	9	1129
153	172	41	0	212
154	961	172	0	1133
Total	**3936**	**854**	**9**	**4799**

Notes:
(1) Present Use shows no COM area in CSO Basin 151.The 378 persons were NOT distributed to metered subbasins SM02 and SM03.

TABLE 4
SOUTH MAGNOLIA DRY WEATHER FLOW

Meter	Min DWF[1]	Max DWF[1]	Avg DWF[1]	San Flow[2]	BI[3]	BI% of Min	Unit Factor[4]
SM02	0.019	0.055	0.036	0.019	0.017	91.4%	32.8
SM03	0.032	0.110	0.071	0.043	0.028	85.2%	32.4
SM05	0.005	0.019	0.010	0.006	0.004	75.6%	135.4
SM06	0.013	0.192	0.102	0.062	0.040	64.4%	135.4
SM07	0.015	0.076	0.045	0.027	0.018	64.4%	135.4
SM08	0.155	0.288	0.215	0.131	0.084	54.5%	135.4
SM09	0.022	0.078	0.050	0.030	0.020	87.9%	135.4
Unmetered	0.079	0.197	0.138	0.082	0.056	68.5%	135.4
Total	**0.375**	**0.968**	**0.668**	**0.401**	**0.266**	**71.1%**	**90.8**

Notes:
(1) Flows in MGD.
(2) San Flow = Sanitary Flow in MGD
(3) BI = Base Infiltration in MGD. Calculated using Stevens-Schutzbach equation.
(4) Unit Factor in gallons per capita per day..

TABLE 3
SOUTH MAGNOLIA MODELED POPULATION

Meter	RES	COM	IND	Total
SM02[1]	586	0	0	586
SM03[1]	1333	0	0	1333
SM05	34	13	0	47
SM06	458	0	0	458
SM07	170	32	0	202
SM08	893	77	0	970
SM09	150	75	0	225
Unmetered	312	280	9	601
Total	**3936**	**476**	**9**	**4422**

Notes:
(1) Present Use shows no COM area in CSO Basin 151.The 378 persons were NOT distributed to metered subbasins SM02 and SM03.

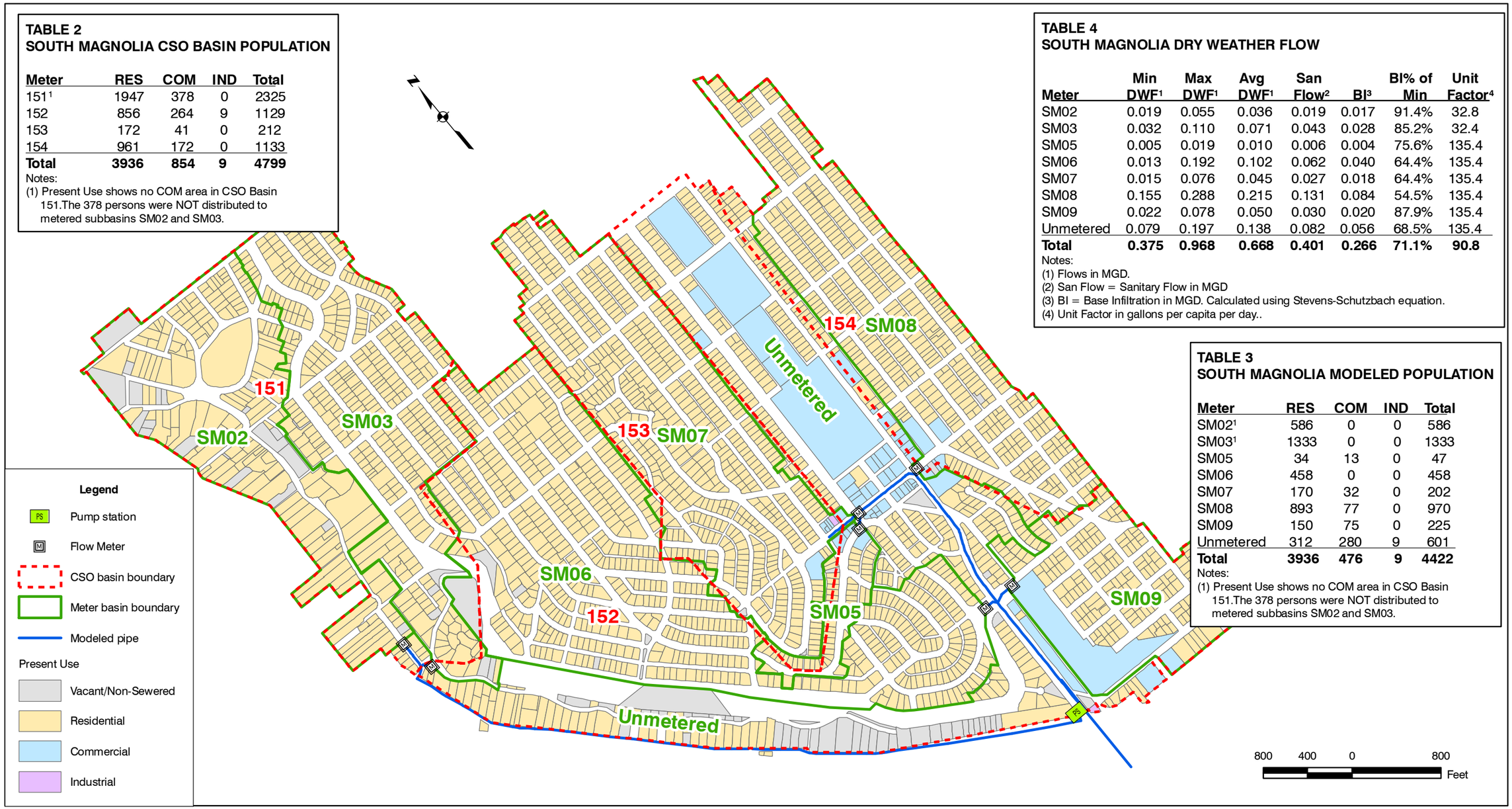

Figure 2
SOUTH MAGNOLIA POPULATION AND PRESENT USE
CSO PLANNING/PREDESIGN SERVICES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

King County

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Wednesday, December 03, 2008

North Beach

Figure 3 illustrates the Round 1 calibration for the NBEACHINLET meter. Like in the Magnolia basin, the ADS metered DWF in North Beach is also higher than the County's NBEACHINLET metered DWF. ADS meter locations in steep areas are likely contributing to low depths and underestimating of flow. However, wet weather flows with higher depths result in equivalent peak flows between ADS and NBEACHINLET meters.

Figure 3 - Sum of ADS meters vs. County meter

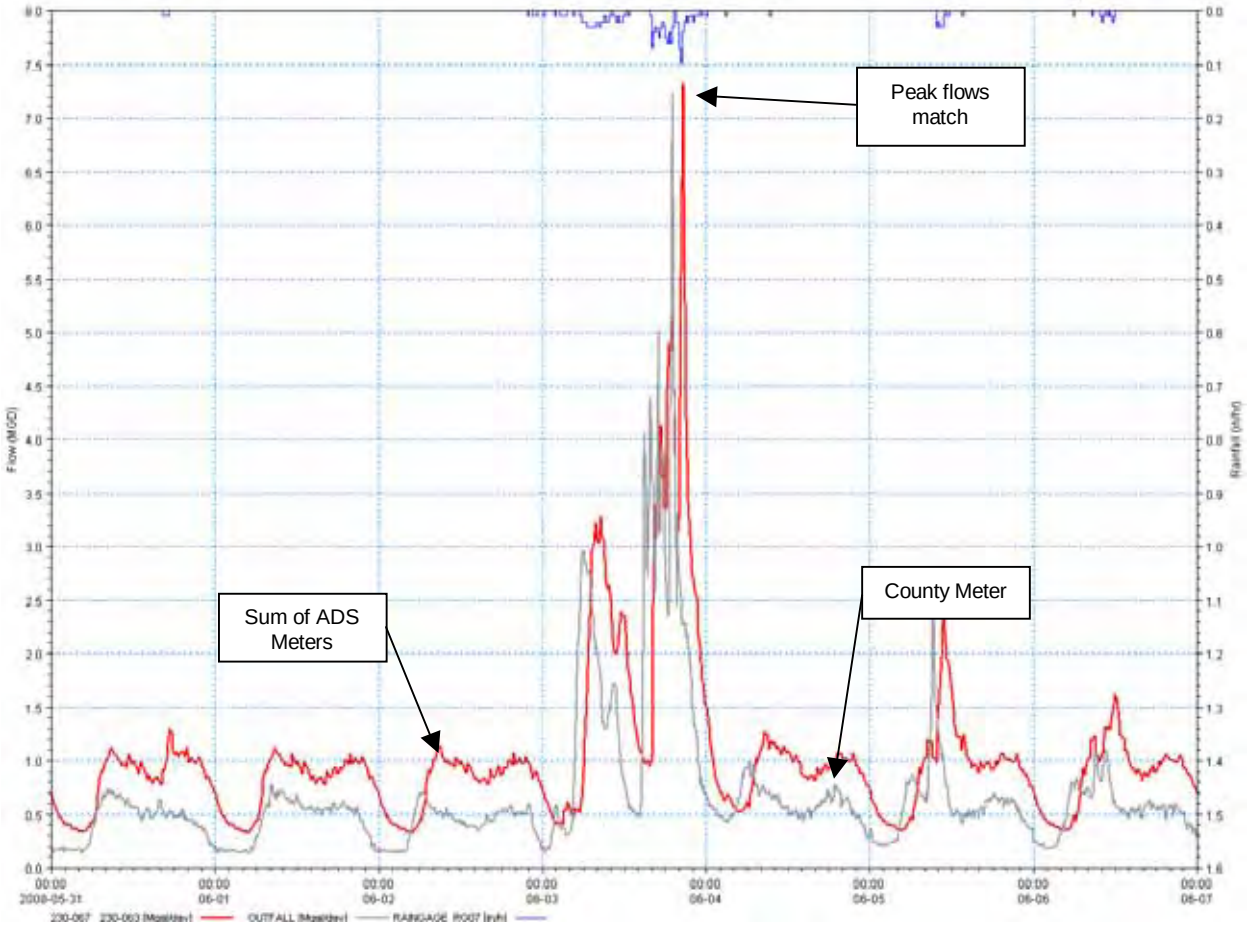


Table 1 presents a comparison for the total basin flow between the sum of the upstream meters and the basin meters. The sum of the meters unit factor of 118.6 gallons per capita per day (gpcd) is high when compared to the City of Seattle average of ~55 gpcd. The basin meter unit factor of 50.7 gpcd is close to the Seattle per capita average.

Table 5 North Beach basin comparison (ADS vs. County meter)				
Description	**Units**	**Sum of Meters(1)**	**Basin Meter(2)**	**Difference(3)**
Sanitary Flow	MGD(4)	0.484	0.309	+0.175
Base Infiltration	MGD	0.240	0.121	+0.119
ADWF(5)	MGD	0.724	0.430	+0.294
Population	Persons	6,101	6,101	0
Unit Factor	Gal/capita/day	118.6	50.7	+67.9

Notes:
1. Sum of Meters = NB01 + NB02 + NB03 + NB04 + NB05 + Unmetered area
2. Basin Meter = NBEACHINLET meter
3. Difference = Sum of Meters - Basin Meter
4. MGD = million gallons per day
5. ADWF = Average dry weather flow

Like the Magnolia basin, the ADS meter DWF in North Beach was also reduced to match the County's NBEACHINLET meter. In this process, several anomalies arose and are described below. Figure 4 and Tables 6-8 illustrate the population and present use in the basin and present the revised DWF values.

Anomalies

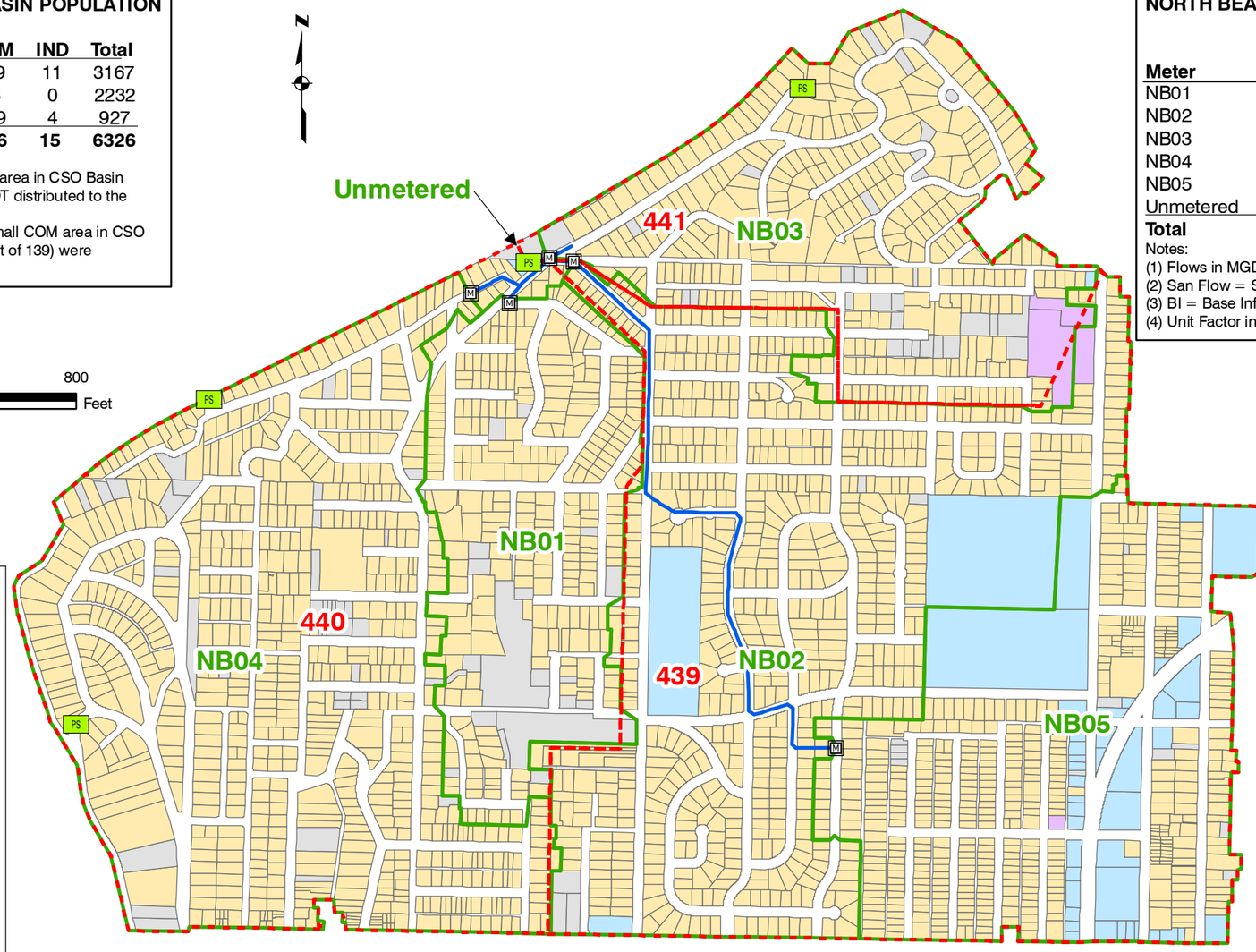
- CSO Basin 440 contains no commercial area. The commercial population of 88 was not distributed to the model since there was no corresponding present use.

- CSO Basin 441 has only one small commercial parcel. Only 2 of the 139 commercial population was distributed.

TABLE 6
NORTH BEACH CSO BASIN POPULATION

Meter	RES	COM	IND	Total
439	2697	459	11	3167
440[1]	2143	88	0	2232
441[2]	785	139	4	927
Total	**5625**	**686**	**15**	**6326**

Notes:
(1) Present Use shows no COM area in CSO Basin 440.The 88 persons were NOT distributed to the metered subbasins.
(2) Present Use shows only a small COM area in CSO Basin 441. Only 2 person (out of 139) were distributed to NB03.



Legend
- Pump station
- Flow Meter
- CSO basin boundary
- Meter basin boundary
- Modeled pipe

PresentUse
- Residential
- Commercial
- Industrial
- Vacant/Non-Sewered

TABLE 8
NORTH BEACH DRY WEATHER FLOW

Meter	Min DWF[1]	Max DWF[1]	Avg DWF[1]	San Flow[2]	BI[3]	BI% of Min	Unit Factor[4]
NB01	0.062	0.161	0.109	0.033	0.013	21.1%	53.8
NB02	0.121	0.477	0.295	0.095	0.037	30.4%	53.8
NB03	0.053	0.189	0.119	0.043	0.017	31.8%	43.1
NB04	0.040	0.223	0.097	0.064	0.033	80.9%	43.1
NB05	0.038	0.161	0.102	0.073	0.030	78.5%	51.6
Unmetered	0.001	0.002	0.001	0.001	0.000	0.0%	50.7
Total	**0.188**	**0.643**	**0.430**	**0.309**	**0.121**	**64.4%**	**50.7**

Notes:
(1) Flows in MGD.
(2) San Flow = Sanitary Flow in MGD
(3) BI = Base Infiltration in MGD. Calculated using Stevens-Schutzbach equation.
(4) Unit Factor in gallons per capita per day..

TABLE 7
NORTH BEACH MODELED POPULATION

Meter	RES	COM	IND	Total
NB01	622	0	0	622
NB02	1575	182	0	1758
NB03[1]	789	2	4	795
NB04	1491	0	0	1491
NB05	1120	276	11	1407
Unmetered[2]	28	0	0	28
Total	**5625**	**461**	**15**	**6101**

Notes:
(1) Present Use shows only a small COM area in CSO Basin 441. Only 2 person (out of 139) were distributed to NB03.
(2) Present Use shows no COM area in CSO Basin 440.The 88 persons were NOT distributed to the metered subbasins.
(3) Total population in model reduced from 6326 to 6101 due to conflicts with Present Use.

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Figure 4
NORTH BEACH POPULATION AND PRESENT USE
CSO PLANNING/PREDESIGN SERVICES
KING COUNTY DNRP, WASTEWATER TREATMENT DIVISION

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Thursday, December 04, 2008

Recommendation

Carollo recommends using the DWF's measured by the County's basin meter (and the adjustment of the subbasin ADS DWFs presented in Tables 4 and 8) rather than the higher ADS metered flows for the following reasons:

- Overall basin unit factors are reasonable,
- ADS and County meter peak flows correspond well to each other,
- Using the lower County DWF results in peak flows that are more conservative.

Action Items

County to decide whether to proceed with model calibration using methodology presented in this memo or revised population/land use values.

Appendix B-4

NORTH BEACH FLOW ADJUSTMENT PROJECT MEMORANDUM, JANUARY 2009

PROJECT MEMORANDUM

Project Name:	CSO Planning/Predesign Services	**Date:**	01/12/2009 (Orig) 01/21/2009 (Revised)
Client:	King County DNRP, Wastewater Treatment Division	**Project Number:**	7562A.10
Prepared By:	Jason Nikaido		
Reviewed By:	Shawn Dent, Allen deSteiguer		
Subject:	North Beach Flow Adjustment		
Distribution:	Carollo Project Team		

Objective

This Project Memorandum (PM) is to document the process by which downstream County flow hydrographs will be disaggregated to produce upstream subbasin hydrographs using observed ADS flow data. These disaggregated County hydrographs will then be the basis for calibration. This PM specifically documents the North Beach basin flow adjustments, but the same process will be used for the other three basins.

Methodology

It was decided after two meetings with King County that the downstream meters for each basin, owned by the County, represent more accurate flows for the basin in total than the sum of the observed ADS meters. Therefore, the individual subbasin flows will be disaggregated County flows based on observed ADS meters. The ADS meters will be used to determine factors to aid the disaggregation process. The disaggregated County hydrographs will generally match the observed ADS data. However, it is known that dry weather flow errors exist. These errors were corrected previously and also assumed that the downstream County meter was correct.

The disaggregation process includes applying factors to the total County metered flow, for each ADS meter, so that a new “adjusted” hydrograph can be developed for each ADS meter location. This process will also help the County to disaggregate downstream County flow meter data in the future by application of these factors.

Three factors are developed for each meter and applied to the County data. These include base infiltration (BI), sanitary flow (SF), and wet weather flow (WWF). Base infiltration (BI) is calculated using the Stevens-Schutzbach equation and along with sanitary flow make up average dry weather flow. Sanitary flow (SF) is flow generated only by customers and calculated as the average dry weather flow minus BI. Wet weather flow (WWF) is water that enters the system from rainfall events and is calculated as total flow minus BI minus SF. The process is as follows:

Step 1: County data and ADS data converted to common time step of 15 minutes. For the North Beach basin, the County meter is NBEACHINLET.

Step 2: County flow data disaggregated for each subbasin by applying the three component factors (BI, SF, WWF). The BI and SF values were presented previously in the South Magnolia and North

Beach Basins Population/Land Use Analysis Memo[1]. BI and SF are based on the dry weather flow period from 5/4/2008 to 5/11/2008. This period observed no rainfall with light to dry antecedent conditions. WWF for each meter, ADS and County, is calculated (Total flow - BI - SF). WWF factor based on weighted-average WWF.

Step 3: Each disaggregated County hydrograph is plotted against the observed ADS data. The three factors are adjusted until a good fit is accomplished for peak flows and volumes. The DWF's will obviously be different, since these are were the main adjustments need to be made. The peak WWF's should be very close for each measured data set.

Step 4: All disaggregated County hydrographs are added together and checked against the total County basin hydrograph. When the individual disaggregated County hydrographs match well to the observed ADS meter flow, and they add up to equal the downstream County hydrograph, the process is complete.

Based on this process, the factors in Table 1 were generated to produce an adequate fit to each subbasin. The sum of the disaggregated County hydrographs add up the County downstream flows.

Figures 1 through 5 represent the disaggregated County and observed ADS hydrographs for March 2008[2]. Figure 6 represents the County downstream metered flows and the sum of the disaggregated County hydrographs for March 2008. As expected, the two hydrographs are identical. It is assumed that little to no travel time for flows is apparent between the subbasin outlets and the basin outlet. Therefore, the four meters (NB05 is upstream of NB02) can be summed directly to equal the downstream County meter flows.

Figures 7 and 8 represent the County downstream metered flows and the sum of the observed ADS hydrographs for the December and June events, respectively. Figures 9 through 11 represent the statistical analysis for the County data and the sum of the observed ADS hydrographs.

Observations and Discussion

The following observations were noted based on this analysis.

1. For meters NB01 through NB04, ADS meters measured higher DWF than the adjusted flows.

2. The sum of the observed ADS meters measured more WWF than County meter for the large December wet weather event. Therefore, the sum of the ADS meters (during wet weather flows) will be used instead of the downstream County meter flows. However, the adjusted DWF's will still be applied during this wet weather period.

3. Generally, the WWF patterns between the disaggregated County and observed ADS flows match well, even when accounting for differences in DWF.

The disaggregated County hydrographs will be the basis for the calibration of the MIKE URBAN model. This same process will be applied to the other three basins.

1 South Magnolia and North Beach Basins Population/Land Use Analysis, January 6, 2009.
2 In the 1/12/2009 version of the memo, the entire flow monitoring period was shown. For the 1/21/2009 version, the period shown has been changed to March 2008 to better illustrate the correlation between the two data sets.

Table 1 BI, SF, and WWF Factors

Component	NB01	NB02[1]	NB03	NB04	NB05	Unmetered	Sum of ADS
BI[2]	10.14%	28.63%	12.94%	25.27%	23.02%	0.00%	100%
SF[3]	10.83%	30.59%	13.83%	20.79%	23.49%	0.46%	100%
WWF[4]	17.54%	16.22%	29.89%	24.02%	9.33%	3.00%	100%

Notes:

1. Factors for NB02 only. Upstream meter NB05 was subtracted out prior to analysis.
2. BI = Base Infiltration = $\dfrac{0.4 \times MDWF}{1 - 0.6(MDWF/ADWF)^{ADWF^{0.7}}}$

   Where,

   MDWF = Minimum average day flow (i.e. minimum of diurnal pattern average from 5/4/2008 through 5/11/2008)

   ADWF = Average dry weather flow

   BI% = $BI_i \times \dfrac{BI_i}{\sum_{i=NB01}^{NB05} BI_i}$

3. SF% = Sanitary Flow% = Average dry weather flow - BI = $\dfrac{SF_i}{SF_{County}}$

4. WWF = Wet Weather Flow = WWF - BI - SF

   WWF Factor = $\dfrac{\sum_{t=1}^{n} \dfrac{WWF_{ADS\,i}}{WWF_{County}}}{n}$

   Where,

   WWF_{ADS} = Wet weather flow of each ADS meter

   WWF_{County} = Wet weather flow of each downstream County meter

   WWF% = $WWF_i \times \dfrac{WWF_i}{\sum_{i=NB01}^{NB05} WWF_i}$

Figure 1

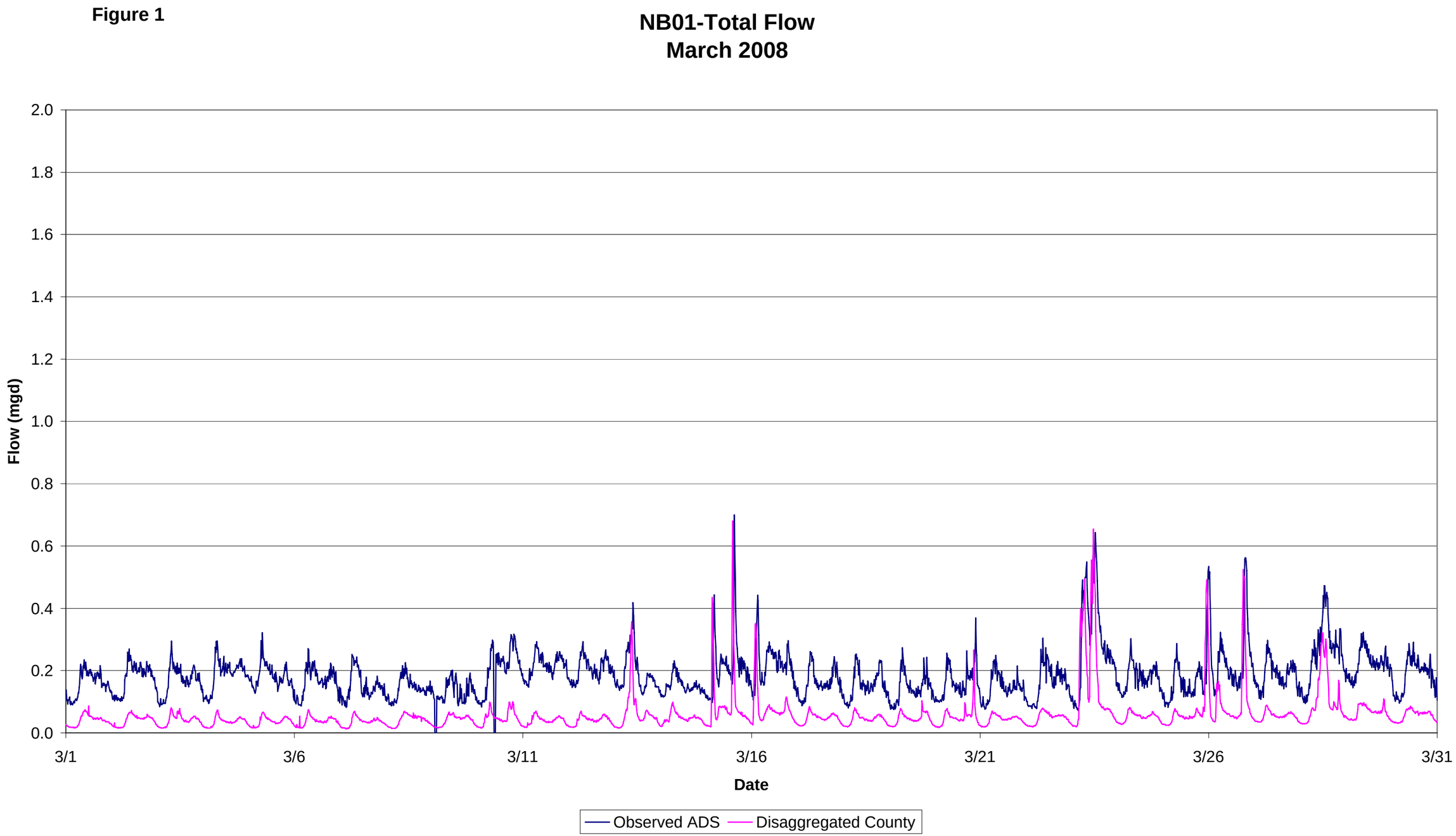

NB01-Total Flow
March 2008
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3/1
3/6
3/11
3/16
3/21
3/26
3/31
Date
Observed ADS
Disaggregated County

Figure 2

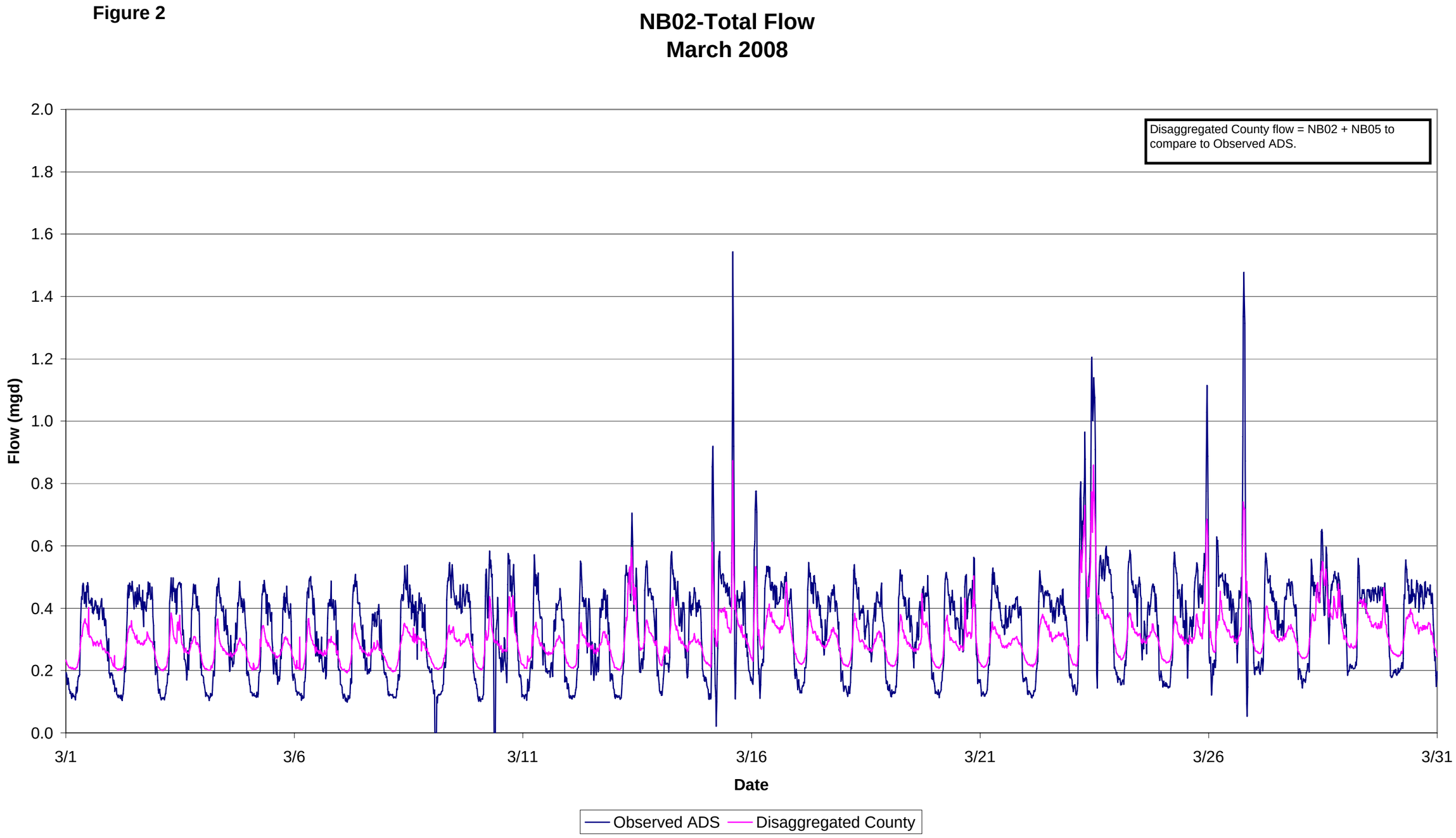

NB02-Total Flow
March 2008
Disaggregated County flow = NB02 + NB05 to compare to Observed ADS.
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3/1
3/6
3/11
3/16
3/21
3/26
3/31
Date
Observed ADS
Disaggregated County

Figure 3

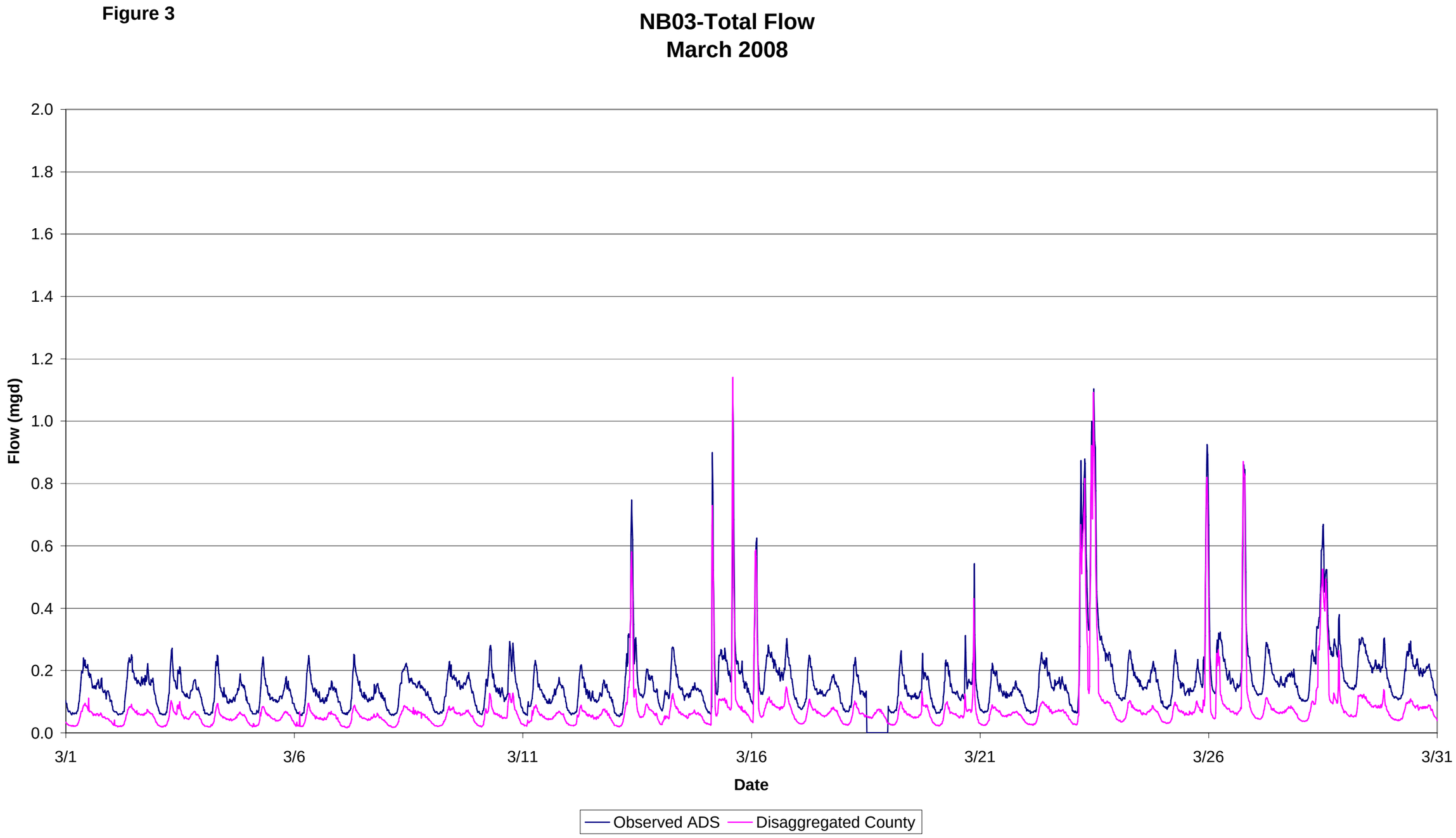

NB03-Total Flow
March 2008
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3/1
3/6
3/11
3/16
3/21
3/26
3/31
Date
Observed ADS
Disaggregated County

Figure 4

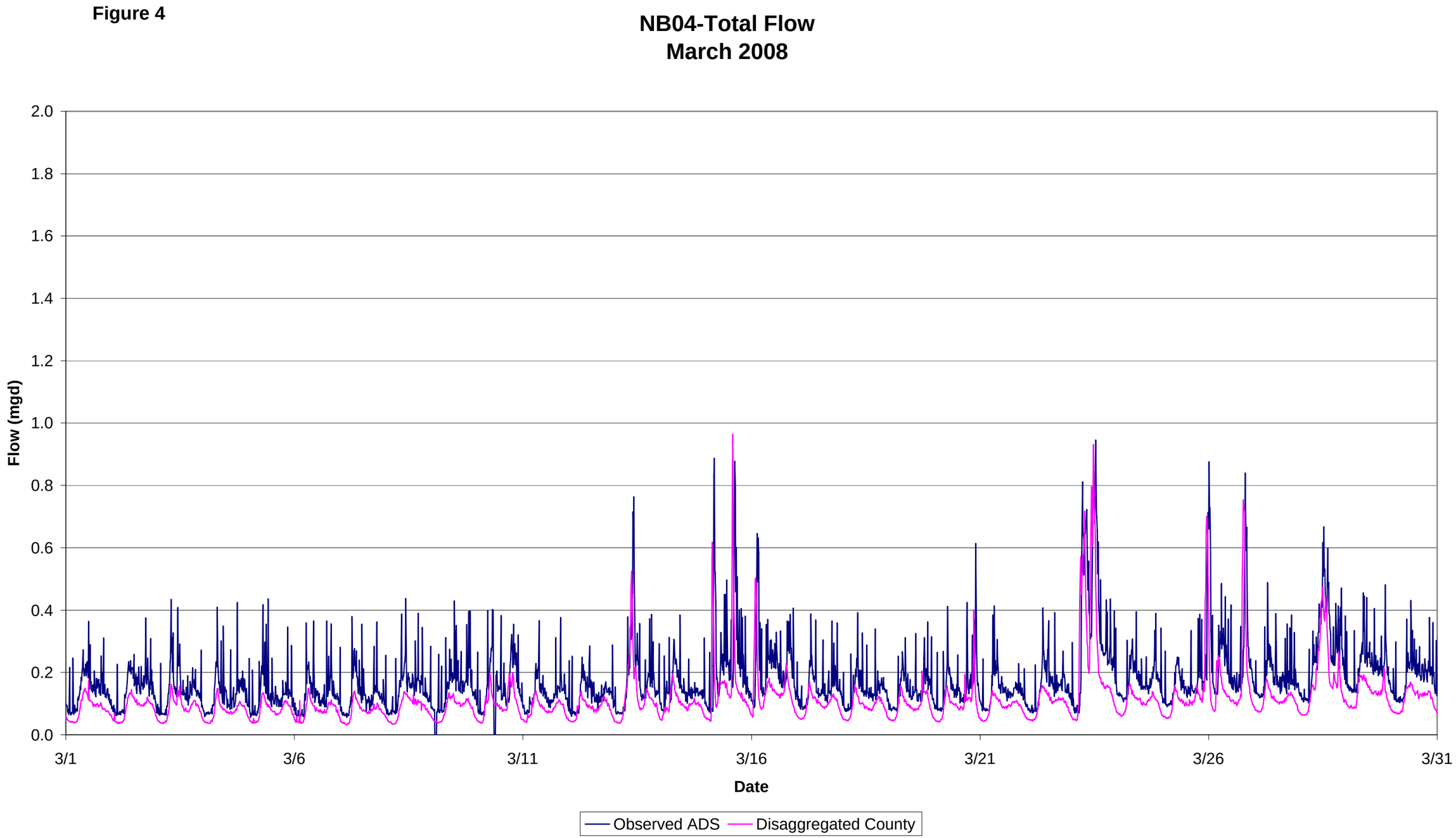

NB04-Total Flow
March 2008
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3/1
3/6
3/11
3/16
3/21
3/26
3/31
Date
Observed ADS
Disaggregated County

Figure 5

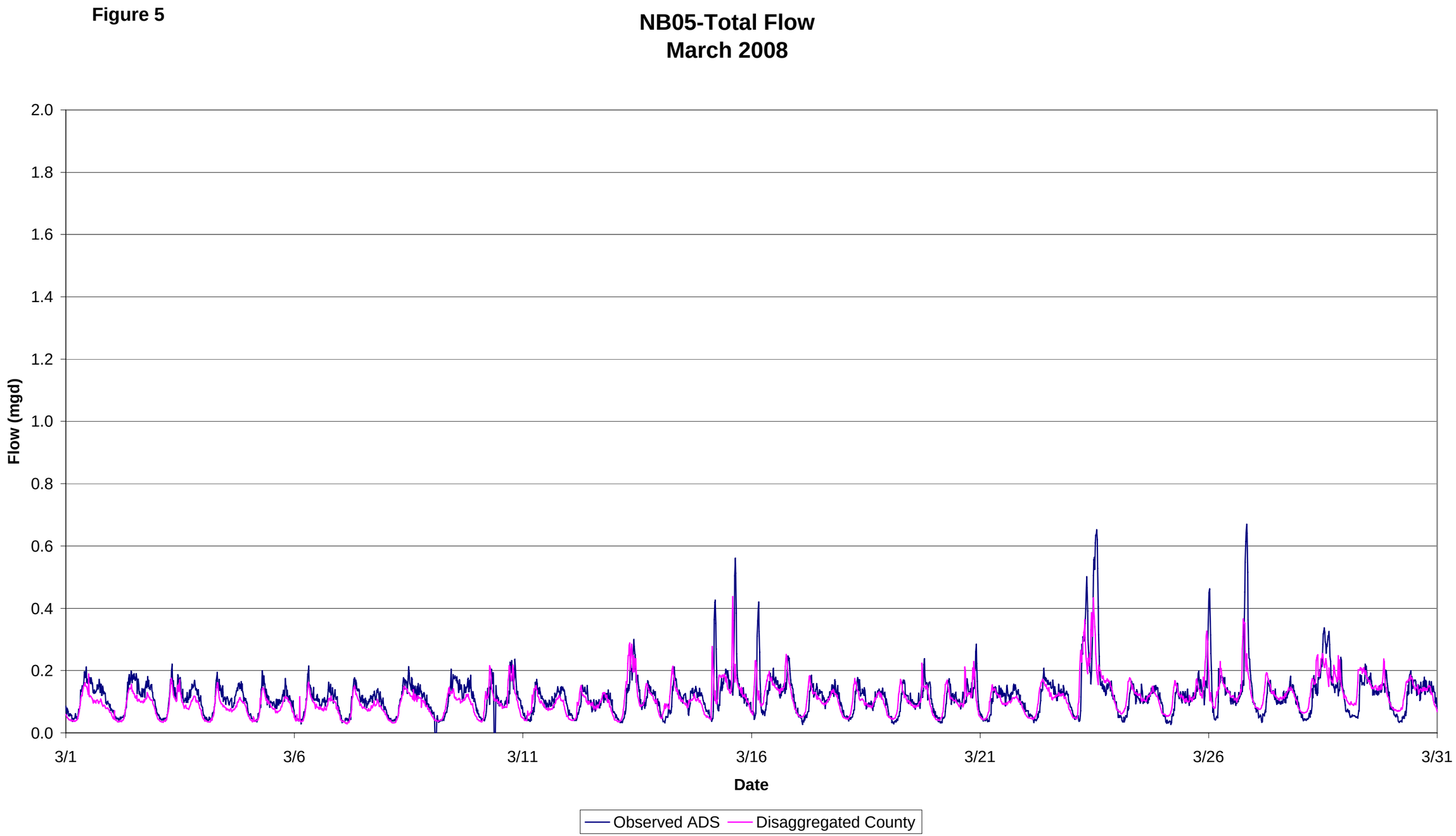

NB05-Total Flow
March 2008
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
3/1
3/6
3/11
3/16
3/21
3/26
3/31
Date
Observed ADS
Disaggregated County

Figure 6

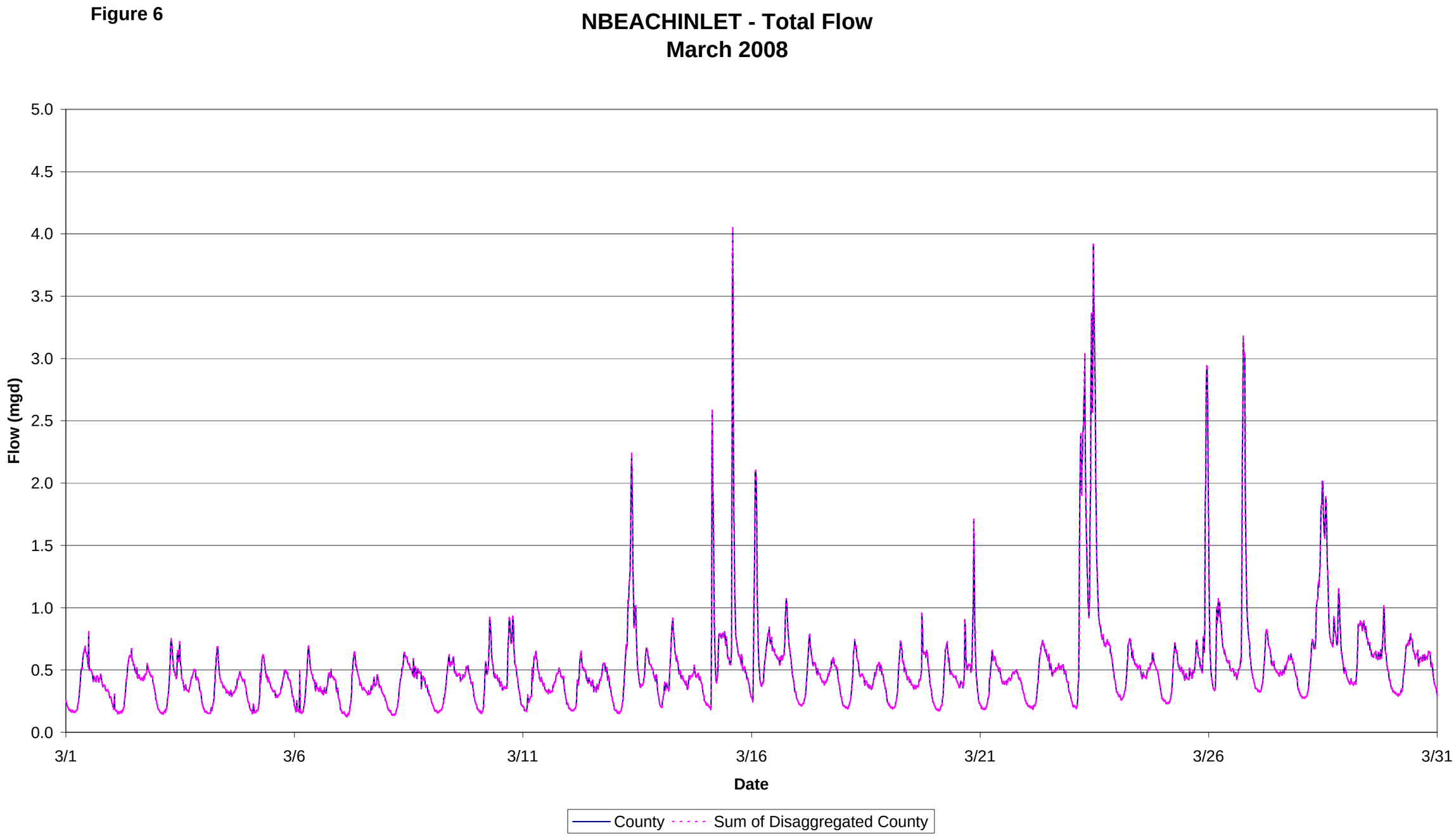

NBEACHINLET - Total Flow
March 2008
Flow (mgd)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
3/1
3/6
3/11
3/16
3/21
3/26
3/31
Date
County
Sum of Disaggregated County

Figure 7

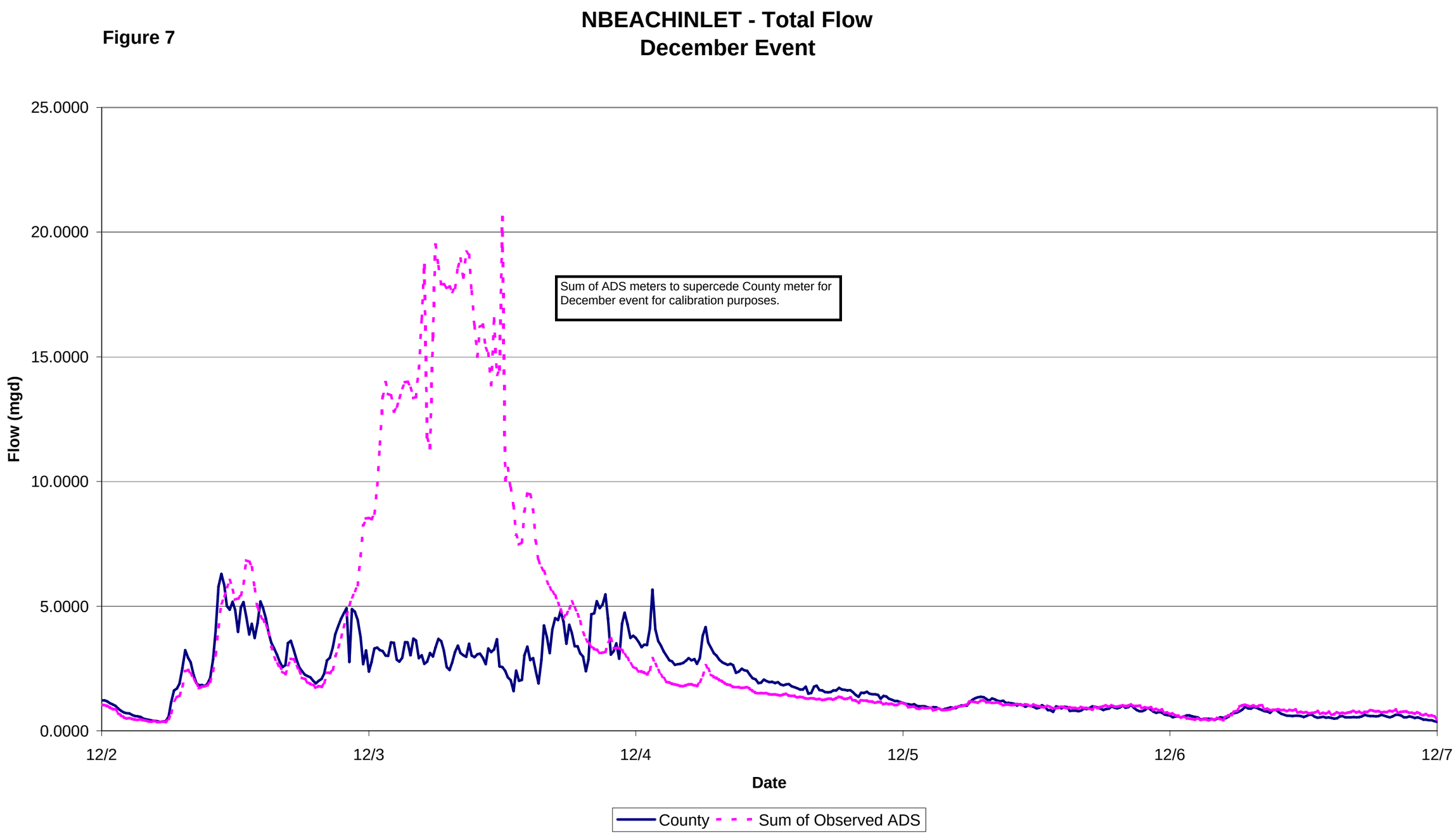

NBEACHINLET - Total Flow
December Event
25.0000
20.0000
15.0000
10.0000
5.0000
0.0000
Flow (mgd)
Sum of ADS meters to supercede County meter for December event for calibration purposes.
12/2
12/3
12/4
12/5
12/6
12/7
Date
County
Sum of Observed ADS

Figure 8

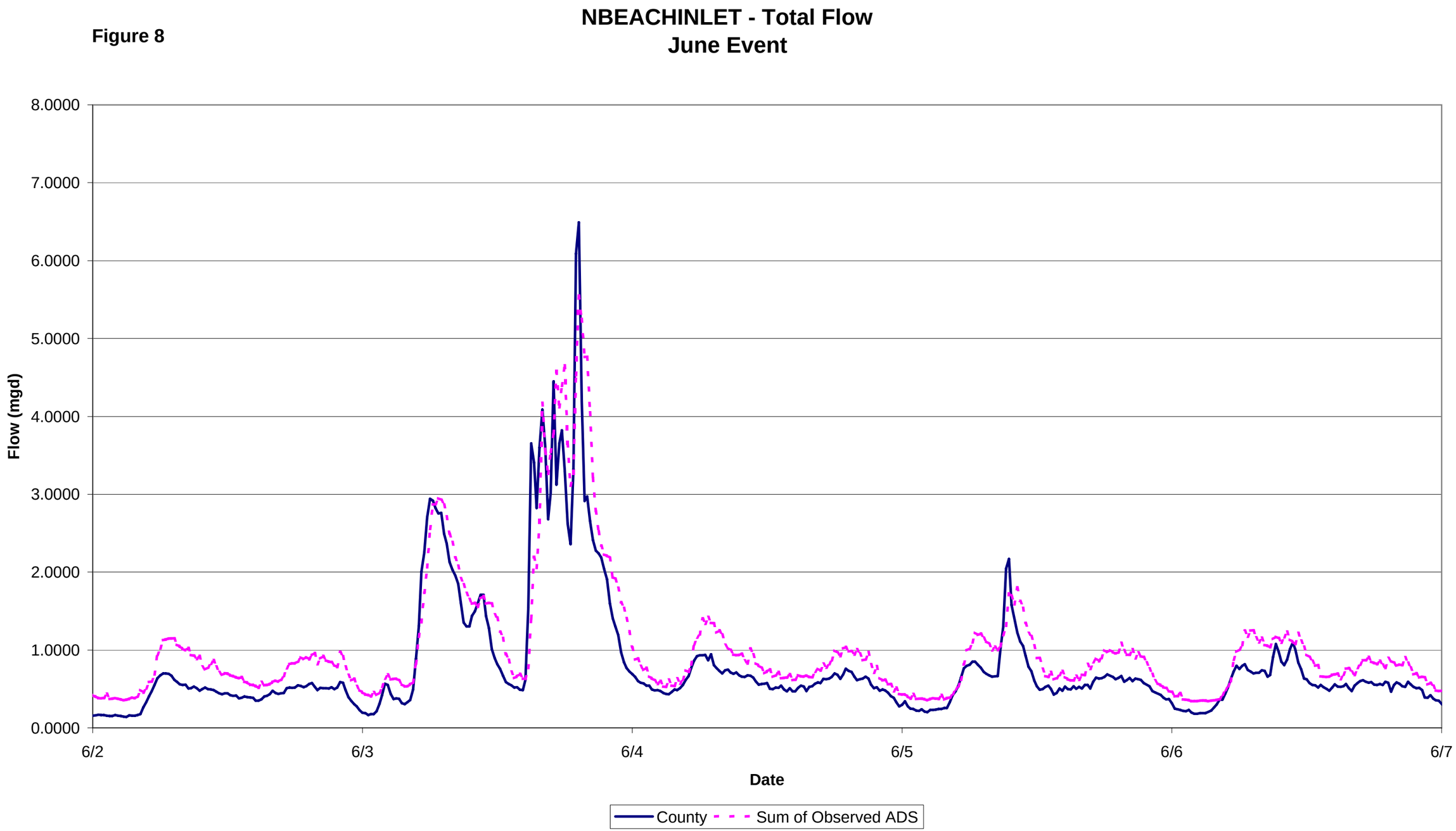
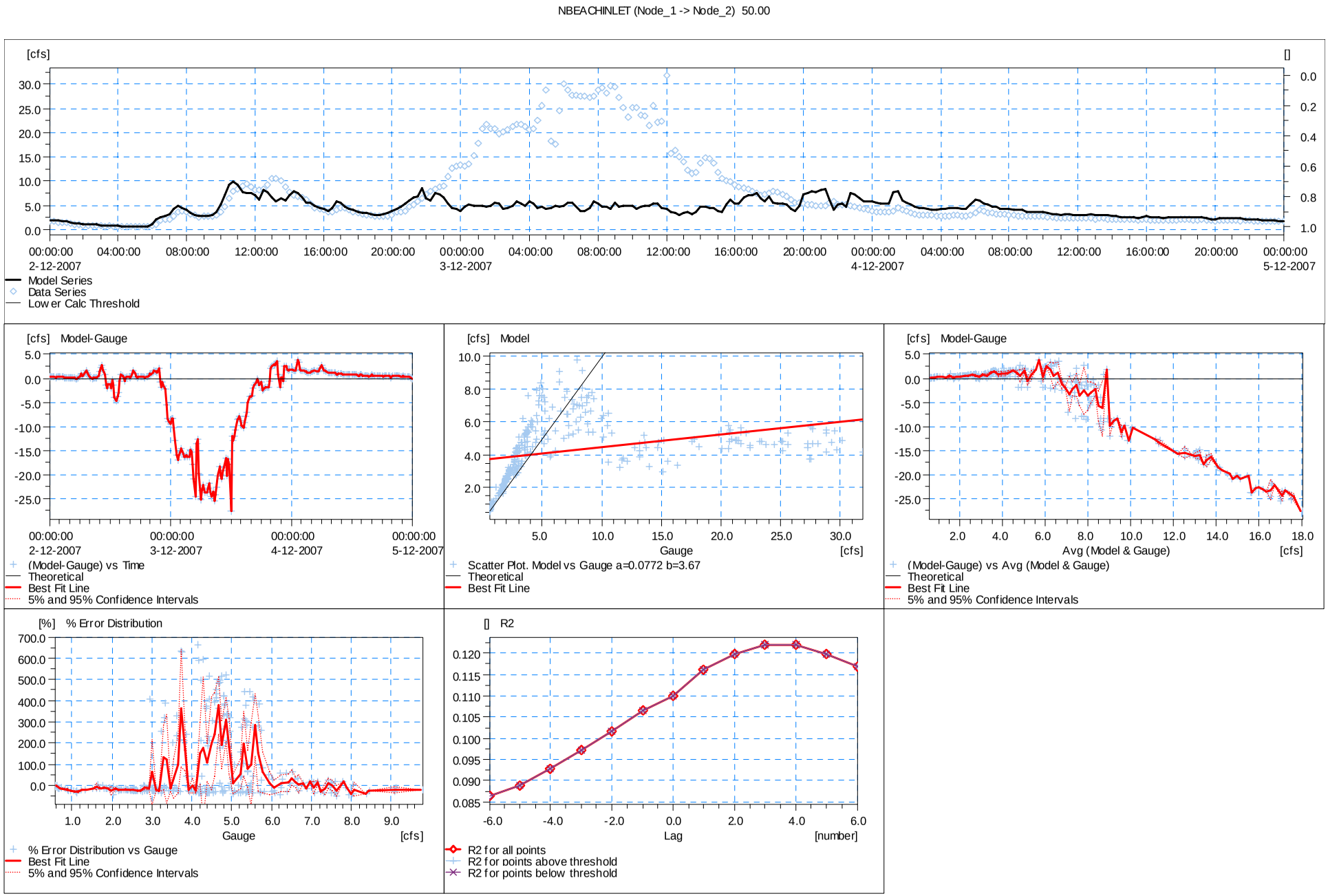
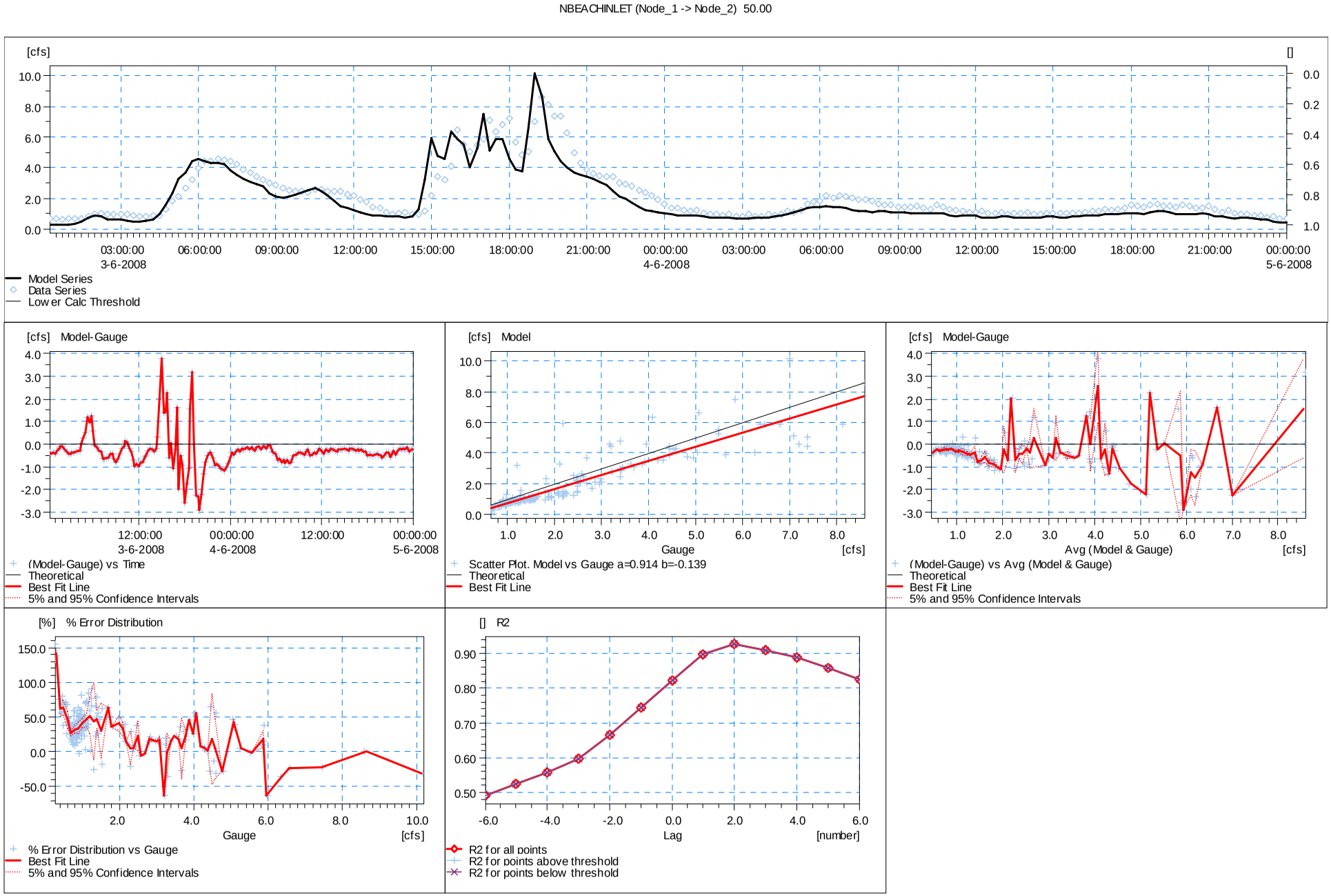

NBEACHINLET - Total Flow
June Event
8.0000
7.0000
6.0000
5.0000
4.0000
3.0000
2.0000
1.0000
0.0000
Flow (mgd)
6/2
6/3
6/4
6/5
6/6
6/7
Date
County
Sum of Observed ADS

Figure 9



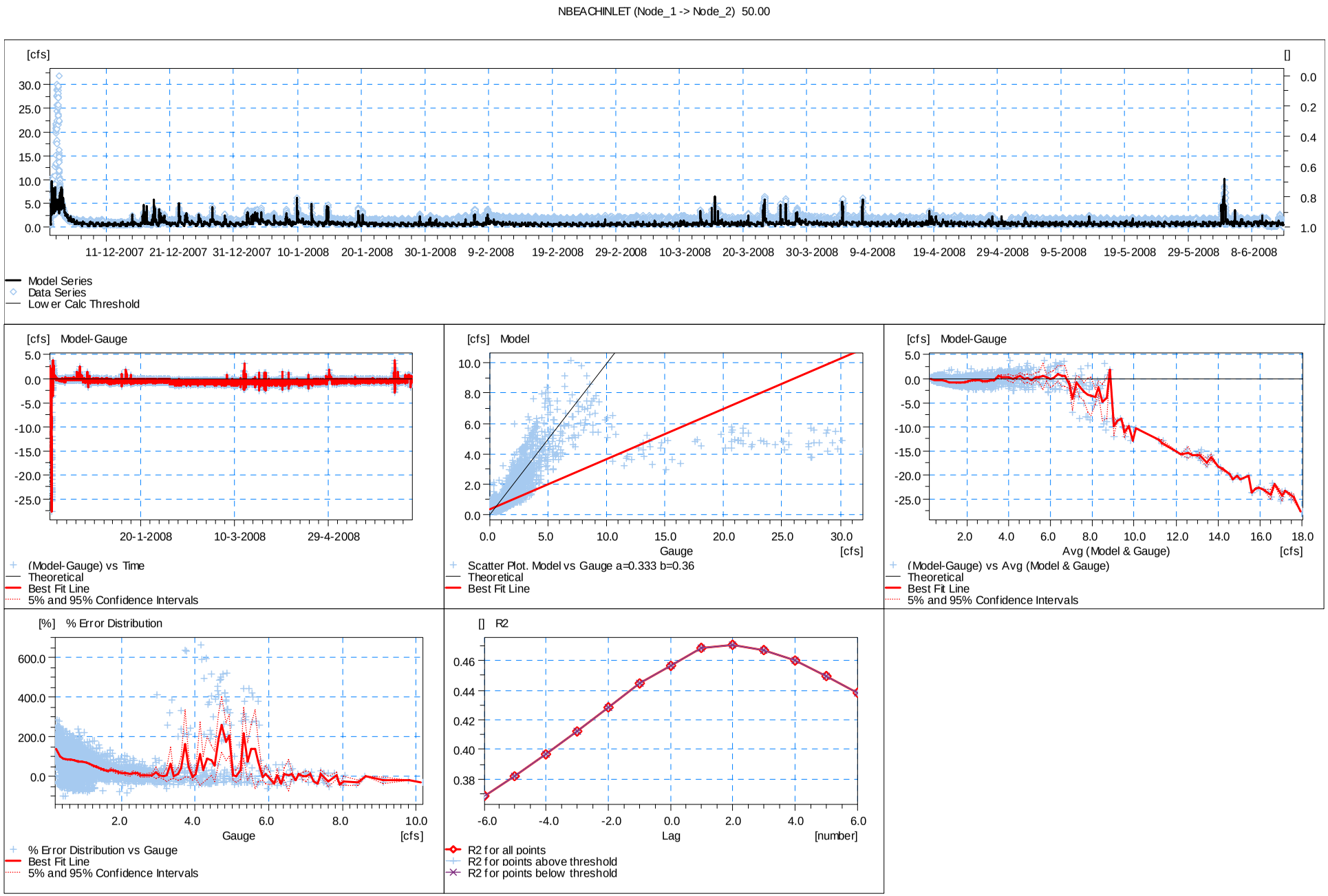
R2 = 0.110

Figure 10



R2 = 0.823

Figure 11



R2 = 0.457

Appendix B-5

SOUTH MAGNOLIA ROUND 3 CALIBRATION PROJECT MEMORANDUM, JUNE 2009

PROJECT MEMORANDUM

Project Name:	CSO Planning/Predesign Services	**Date:**	06/17/2009
Client:	King County DNRP, Wastewater Treatment Division	**Project Number:**	7562A.10
Prepared By:	Ed Wicklein		
Reviewed By:	Allen DeSteiguer, Brian Matson		
Subject:	South Magnolia Calibration, Round 3		
Distribution:	King County, Carollo Project Team		

INTRODUCTION AND BACKGROUND

This project memorandum (PM) summarizes the results of the round 3 wet weather calibration of South Magnolia sub-basins based on comments we have received from the county, ADS, DHI, and review of literature. The dry weather flow (DWF) and base infiltration (BI) used for the sub basins were summarized in a PM "South Magnolia and North Beach Basins Population/Land Use Analysis" dated 1/06/2009.

Wet weather calibration focused on meeting the recommendations on model verification contained in the "Code of Practice for the Hydraulic Modeling of Sewer Systems", version 3.001, published by the Wastewater Planning Group, a section of the Chartered Institution of Water and Environmental Management. The document is available at: http://www.ciwem.org/groups/wapug/code_of_practice.asp The recommendations summarized below are a portion of section 6.5.4 Storm Flow Verification, from the aforementioned document and are the basis of our model calibration:

- The comparison period between observed and modeled events should last until flow has substantially returned to DWF.
- Observed and modeled hydrographs should meet the criteria for two out of three events.
- The peak flow should be in the range +25% to -10%
- The volume of flow should be in the range of +20% to -10%

BASIS OF MODEL

The five largest storms that occurred during the flow-monitoring period of 12/1/2007 through 6/12/2008 at rain gage (RG) 12 are summarized in Table 1. The largest were used for model verification. Storms were defined by a period of at least 24 hours without rain before and after. Table 1 lists details of the rain events in order of size. The ADS data shows that generally the system returned to DWF conditions within 24 hours from a storm, including the 100+ year event in December 2007. Therefore the South Magnolia combined sewer flows are governed by direct sanitary flow, direct impervious connections, and pervious connections.

Table 1 - Storms Statistics Based on Period of Rain Record

Statistics - Subcatchment RG12_catchment Rainfall			
Rank for Monitoring Period		Event Duration (hours)	Event Total (in)
	Start Date		
1	12/1/2007	71.5	7.95
2	6/2/2008	28.8	1.86
3	12/16/2007	63.8	1.26
4	1/2/2008	74	1.17
5	3/13/2008	69	0.81

Attempts to calibrate to the largest storm that occurred on 12/1/07 were not successful and data was not available for all meters. Therefore calibration focused on the next two larges storms, on in June 2008, and on starting on December 16, 2007. Comparisons were made between the model and the next two smaller storms, beginning on January 2, 2008, and March 13, 2008.

The model was built and calibrated using Mike Urban Model B+RDI. Model B calculates the fast response curve (FRC), and RDI calculates the slow response curve (SRC). These models have a large number of parameters that can be adjusted, although only a few are significant. The parameters used and the model results summaries are contained in the following tables. There are figures showing the hydrographs from the events.

Parameter	MU name	Units	Meter SM02	SM03	SM05	SM06	SM07	SM08	SM09	Unmetered
Catchment Geometry										
Drainage Area	Area	Acres	83.396	93.194	13.27	156.247	109.255	95.797	56.291	8.268
Kinematic Wave (B)										
Length	Length	Feet	350.00	260.00	150.00	3000.00	300.00	250.00	250.00	250.00
Slope	Slope	0/00	30	30	15	20	30	30	30	30
Steep Impervious Area	AISteep	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flat Impervious Area	AIFlat	%	0.77	2.52	6.25	17.5	6.1	5.55	4.9	1
Small Pervious Area	APSmall	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Pervious Area	APMedium	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Large Pervious Area	APLarge	%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manning number, steep impervious area	ManningSteep	---	na	na	na	na	na	na	na	na
Manning number, flat impervious area	ManningFlat	---	0.0300	0.0250	0.0550	0.0200	0.0200	0.0200	0.0200	0.0140
Manning number, small pervious area	ManningSmall	---	na	na	na	na	na	na	na	na
Manning number, medium pervious area	ManningMedium	---	na	na	na	na	na	na	na	na
Manning number, large pervious area	ManningLarge	---	na	na	na	na	na	na	na	na
RDI										
Area	RdiiArea	%	2.450	7.150	9.200	6.900	23.600	1.350	4.900	2.000
Surface storage (Umax)	Umax	Inches	0.44	0.4	0.445	0.025	0.34	0.25	0.25	0.25
Root zone storage (Lmax)	Lmax	Inches	8	8	8	8	8	8	4	4
Overland coefficient (CQof)	Cqof	---	0.04	0.3	0.65	0.05	0.3	0.4	0.5	0.5
Groundwater coefficient (Carea)	GwCarea	---	1	1	1	1	1	1	1	1
TC overland flow (CK)	Ck	Hours	1.4	0.8	0.025	0.025	0.55	0.75	0.5	0.5
TC interflow (CKif)	Ckif	Hours	42	1.5	14.5	8	24	48	1.75	1.75
TC baseflow (BF)	Ckof	Hours	210	2.5	120	210	144	168	96	96
Overland flow threshold (Tof)	Tof	%	0	0	0	0	0	0	0	0
Interflow threshold (Tif)	Tif	%	0	0	0	0	0	0	0	0
Groundwater threshold (Tg)	Tg	%	0	0	0	0	0	0	0	0
Specific yield (Sy)	GwSy	---	0.2	0.2	0.4	0.2	0.25	0.2	0.2	0.2
Minimum groundwater depth (GWLmin)	GwLmin	Feet	8	8	8	8	8	8	4	4
Maximum groundwater depth causing baseflow (GWLbf0)	GWLbf0	Feet	0	0	0	0	0	0	0	0
Groundwater depth for unit capilary flux (GWLfl1)	GWLfl1	Feet	0	0	0	0	0	0	0	0
Initial surface storage (U)	InitU	Inches	0	0	0	0	0	0	0	0
Initial root zone moisture (L)	InitL	Inches	8	8	8	8	8	8	4	4
Initial groundwater depth (GWL)	InitGwl	Feet	0	0	0	0	0	0	0	0
Initial overland flow (OF)	InitOf	Inches/hour	18	18	18	18	18	18	18	18
Initial interflow (IF)	InitIf	Inches/hour	1	1	1	1	1	1	1	1

South Magnolia Sub Basin 2

6/2/2008 Storm

Correlation coeficient R2	0.681	
Max. positive difference	0.104	cfs
Max. negative difference	-0.14	cfs
Volume observed	16985.79	CF
Volume modelled	18408.1	CF
Volume error	8.374	%
Peak observed value	0.398	cfs
Peak modelled value	0.502	cfs
Peak error	26.271	%

12/16/2007 Storm

Correlation coeficient R2	0.284	
Max. positive difference	0.157	cfs
Max. negative difference	-0.187	cfs
Volume observed	37237.69	CF
Volume modelled	37521.93	CF
Volume error	0.763	%
Peak observed value	0.288	cfs
Peak modelled value	0.279	cfs
Peak error	-3.065	%

1/2/2008 Storm

Correlation coeficient R2	0.23	
Max. positive difference	0.1	cfs
Max. negative difference	-0.2	cfs
Volume observed	64297	CF
Volume modelled	56290	CF
Volume error	-12.5	%
Peak observed value	0.2	cfs
Peak modelled value	0.2	cfs
Peak error	-34.3	%

3/13/2008 Storm

Correlation coeficient R2	0.59	
Max. positive difference	0.1	cfs
Max. negative difference	-0.2	cfs
Volume observed	31304	CF
Volume modelled	34433	CF
Volume error	10.0	%
Peak observed value	0.345	cfs
Peak modelled value	0.213	cfs
Peak error	-38.2	%

Volume Comparison
December 1, 2007 to June 13, 2008

Volume observed	1072945	CF
Volume modelled	1111797	CF
Volume error	3.62	%

CF

South Magnolia Sub Basin 3

12/2/2007 Storm

Correlation coeficient R2	0.88	
Max. positive difference	0.6	cfs
Max. negative difference	-5.6	cfs
Volume observed	402550	CF
Volume modelled	277274	CF
Volume error	-31.1	%
Peak observed value	9.3	cfs
Peak modelled value	4.2	cfs
Peak error	-55.2	%

1/2/2008 Storm

Correlation coeficient R2	0.65	
Max. positive difference	0.4	cfs
Max. negative difference	-0.3	cfs
Volume observed	133599	CF
Volume modelled	131642	CF
Volume error	-1.5	%
Peak observed value	0.732	cfs
Peak modelled value	0.712	cfs
Peak error	-2.7	%

6/2/2008 Storm

Correlation coeficient R2	0.90	
Max. positive difference	0.8	cfs
Max. negative difference	-0.2	cfs
Volume observed	61265	CF
Volume modelled	73883	CF
Volume error	20.6	%
Peak observed value	2.0	cfs
Peak modelled value	2.4	cfs
Peak error	21.6	%

3/13/2008 Storm

Correlation coeficient R2	0.70	
Max. positive difference	0.4	cfs
Max. negative difference	-0.4	cfs
Volume observed	70542	CF
Volume modelled	80250	CF
Volume error	13.8	%
Peak observed value	0.928	cfs
Peak modelled value	0.807	cfs
Peak error	-13.1	%

12/16/2007 Storm

Correlation coeficient R2	0.61	
Max. positive difference	0.7	cfs
Max. negative difference	-0.4	cfs
Volume observed	85572	CF
Volume modelled	82356	CF
Volume error	-3.8	%
Peak observed value	0.9	cfs
Peak modelled value	1.0	cfs
Peak error	6.8	%

Volume Comparison

December 1, 2007 to June 13, 2008

Volume observed	2132194	CF
Volume modelled	2291142	CF
Volume error	7.46	%
DWF volume	1909611	CF
Storm Volume Measured	222583	CF
Storm Volume Modeled	381530	CF
Storm Volume error	71.41	%

CF

South Magnolia Sub Basin 5

6/2/2008 Storm

Correlation coeficient R2	0.803	
Max. positive difference	0.401	cfs
Max. negative difference	-0.255	cfs
Volume observed	11505.58	CF
Volume modelled	13924.53	CF
Volume error	21.024	%
Peak observed value	0.893	cfs
Peak modelled value	0.801	cfs
Peak error	-10.249	%

12/16/2007 Storm

Correlation coeficient R2	0.648	
Max. positive difference	0.176	cfs
Max. negative difference	-0.06	cfs
Volume observed	15323.83	CF
Volume modelled	15335.08	CF
Volume error	0.073	%
Peak observed value	0.192	cfs
Peak modelled value	0.242	cfs
Peak error	26.064	%

1/2/2008 Storm

Correlation coeficient R2	0.59	
Max. positive difference	0.1	cfs
Max. negative difference	-0.1	cfs
Volume observed	25172	CF
Volume modelled	23358	CF
Volume error	-7.2	%
Peak observed value	0.1	cfs
Peak modelled value	0.1	cfs
Peak error	15.4	%

3/13/2008 Storm

Correlation coeficient R2	0.54	
Max. positive difference	0.2	cfs
Max. negative difference	-0.2	cfs
Volume observed	16243	CF
Volume modelled	14005	CF
Volume error	-13.8	%
Peak observed value	0.303	cfs
Peak modelled value	0.253	cfs
Peak error	-16.5	%

Volume Comparison
December 1, 2007 to June 13, 2008

Volume observed	492860	CF
Volume modelled	369912	CF
Volume error	-24.95	%

CF

South Magnolia Sub Basin 6

6/2/2008 Storm

Correlation coeficient R2	0.877	
Max. positive difference	4.666	cfs
Max. negative difference	-2.958	cfs
Volume observed	162018.5	CF
Volume modelled	207691.2	CF
Volume error	28.19	%
Peak observed value	16.014	cfs
Peak modelled value	13.055	cfs
Peak error	-18.474	%

12/16/2007 Storm

Correlation coeficient R2	0.882	
Max. positive difference	1.822	cfs
Max. negative difference	-0.464	cfs
Volume observed	254500.9	CF
Volume modelled	224079.6	CF
Volume error	-11.953	%
Peak observed value	3.023	cfs
Peak modelled value	3.783	cfs
Peak error	25.13	%

1/2/2008 Storm

Correlation coeficient R2	0.86	
Max. positive difference	0.9	cfs
Max. negative difference	-0.5	cfs
Volume observed	412018	CF
Volume modelled	328698	CF
Volume error	-20.2	%
Peak observed value	1.9	cfs
Peak modelled value	2.6	cfs
Peak error	39.3	%

3/13/2008 Storm

Correlation coeficient R2	0.88	
Max. positive difference	2.1	cfs
Max. negative difference	-0.5	cfs
Volume observed	216479	CF
Volume modelled	180033	CF
Volume error	-16.8	%
Peak observed value	3.896	cfs
Peak modelled value	5.222	cfs
Peak error	34.0	%

Volume Comparison
December 1, 2007 to June 13, 2008

Volume observed	6095393	CF
Volume modelled	4662321	CF
Volume error	-23.51	%

CF

South Magnolia Sub Basin 7

6/2/2008 Storm

Correlation coeficient R2	0.78	
Max. positive difference	3.2	cfs
Max. negative difference	-1.6	cfs
Volume observed	127622	CF
Volume modelled	159469	CF
Volume error	25.0	%
Peak observed value	7.7	cfs
Peak modelled value	7.0	cfs
Peak error	-9.3	%

1/2/2008 Storm

Correlation coeficient R2	0.49	
Max. positive difference	0.8	cfs
Max. negative difference	-1.2	cfs
Volume observed	398778	CF
Volume modelled	312159	CF
Volume error	-21.7	%
Peak observed value	1.7	cfs
Peak modelled value	1.7	cfs
Peak error	-0.9	%

12/16/2007 Storm

Correlation coeficient R2	0.59	
Max. positive difference	1.7	cfs
Max. negative difference	-1.0	cfs
Volume observed	239553	CF
Volume modelled	223324	CF
Volume error	-6.8	%
Peak observed value	2.0	cfs
Peak modelled value	2.5	cfs
Peak error	28.3	%

3/13/2008 Storm

Correlation coeficient R2	0.66	
Max. positive difference	0.8	cfs
Max. negative difference	-2.0	cfs
Volume observed	216748	CF
Volume modelled	185422	CF
Volume error	-14.5	%
Peak observed value	3.32	cfs
Peak modelled value	2.235	cfs
Peak error	-32.7	%

Volume Comparison
December 1, 2007 to June 13, 2008

Volume observed	7032877	CF
Volume modelled	4724413	CF
Volume error	-32.82	%

CF

South Magnolia Sub Basin 8

6/2/2008 Storm

Correlation coeficient R2	0.73	
Max. positive difference	2.6	cfs
Max. negative difference	-1.2	cfs
Volume observed	68592	CF
Volume modelled	79717	CF
Volume error	16.2	%
Peak observed value	3.3	cfs
Peak modelled value	3.8	cfs
Peak error	15.5	%

12/16/2007 Storm

Correlation coeficient R2	0.54	
Max. positive difference	1.4	cfs
Max. negative difference	-0.8	cfs
Volume observed	134342	CF
Volume modelled	127893	CF
Volume error	-4.8	%
Peak observed value	1.7	cfs
Peak modelled value	1.8	cfs
Peak error	11.6	%

1/2/2008 Storm

Correlation coeficient R2	0.51	
Max. positive difference	0.8	cfs
Max. negative difference	-0.7	cfs
Volume observed	216443	CF
Volume modelled	210414	CF
Volume error	-2.8	%
Peak observed value	1.1	cfs
Peak modelled value	1.3	cfs
Peak error	18.2	%

3/13/2008 Storm

Correlation coeficient R2	0.68	
Max. positive difference	1.1	cfs
Max. negative difference	-0.8	cfs
Volume observed	127955	CF
Volume modelled	132169	CF
Volume error	3.3	%
Peak observed value	2.0	cfs
Peak modelled value	1.8	cfs
Peak error	-12.7	%

Volume Comparison
December 1, 2007 to June 13, 2008

Volume observed	4326679	CF
Volume modelled	4362702	CF
Volume error	0.83	%

CF

South Magnolia Sub Basin 9

6/2/2008 Storm

Correlation coeficient R2	0.83	
Max. positive difference	0.8	cfs
Max. negative difference	-0.7	cfs
Volume observed	38530	CF
Volume modelled	46036	CF
Volume error	19.5	%
Peak observed value	2.2	cfs
Peak modelled value	2.2	cfs
Peak error	-1.4	%

1/2/2008 Storm

Correlation coeficient R2	0.69	
Max. positive difference	0.3	cfs
Max. negative difference	-0.3	cfs
Volume observed	96002	CF
Volume modelled	86548	CF
Volume error	-9.8	%
Peak observed value	0.6	cfs
Peak modelled value	0.7	cfs
Peak error	15.6	%

12/16/2007 Storm

Correlation coeficient R2	0.65	
Max. positive difference	0.8	cfs
Max. negative difference	-0.4	cfs
Volume observed	57365	CF
Volume modelled	54151	CF
Volume error	-5.6	%
Peak observed value	0.9	cfs
Peak modelled value	1.0	cfs
Peak error	8.4	%

3/13/2008 Storm

Correlation coeficient R2		
Max. positive difference		cfs
Max. negative difference		cfs
Volume observed		CF
Volume modelled		CF
Volume error		%
Peak observed value	0.928	cfs
Peak modelled value	0.93	cfs
Peak error	0.1	%

Volume Comparison
December 1, 2007 to June 13, 2008

Volume observed	1112071.36	CF
Volume modelled	1538766.74	CF
Volume error	38.369	%

CF

South Magnolia MAGCSO

6/2/2008 Storm

Correlation coeficient R2	0.93	
Max. positive difference	10.2	cfs
Max. negative difference	-2.6	cfs
Volume observed	378282	CF
Volume modelled	521837	CF
Volume error	37.9	%
Peak observed value	20.0	cfs
Peak modelled value	24.1	cfs
Peak error	20.2	%

1/2/2008 Storm

Correlation	0.41	
Max. positi	3.8	cfs
Max. negat	-3.3	cfs
Volume ob	1008858	CF
Volume mo	952128	CF
Volume err	-5.6	%
Peak obse	5.4	cfs
Peak mode	5.7	cfs
Peak error	6.2	%

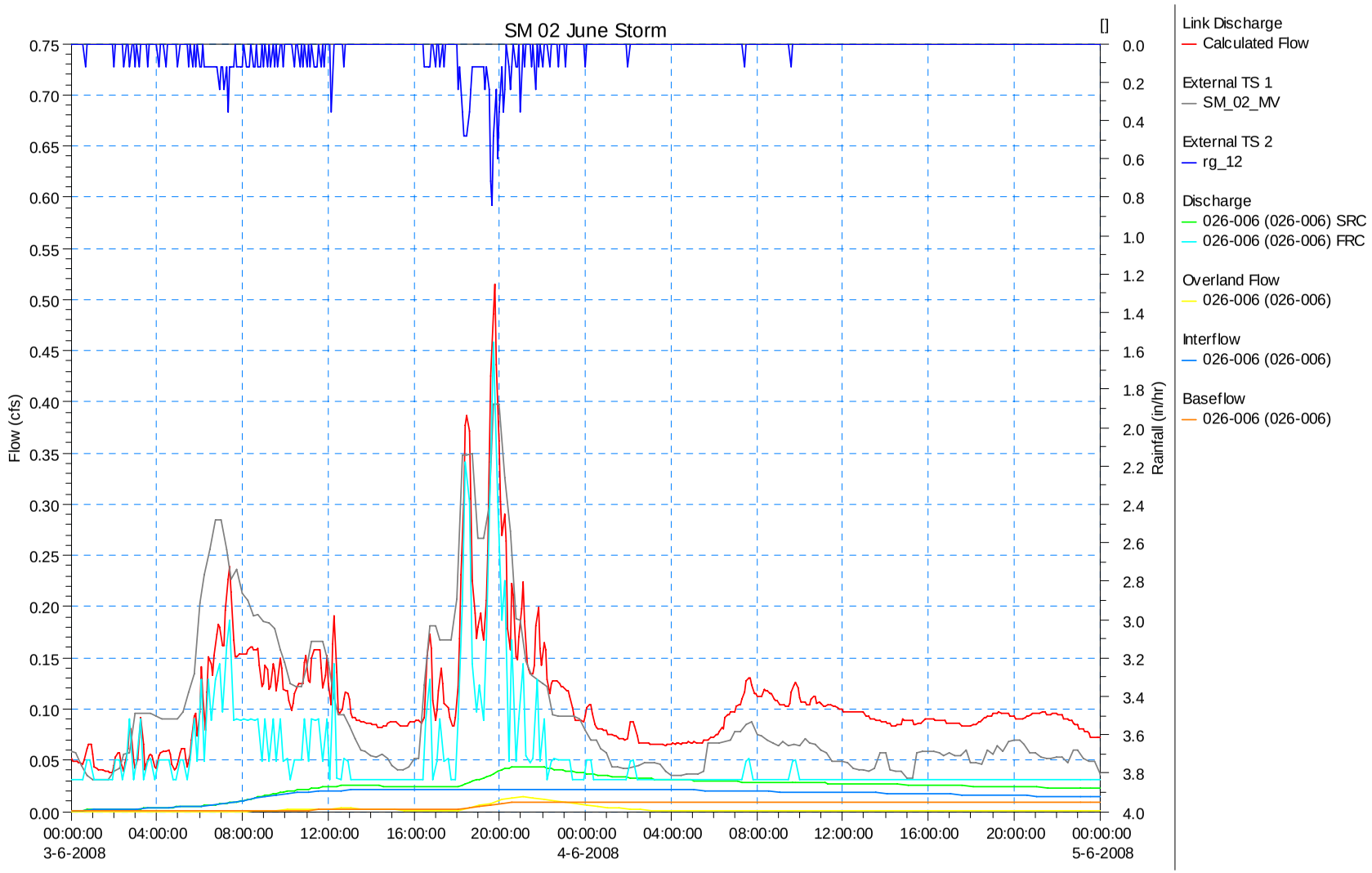
12/16/2007 Storm

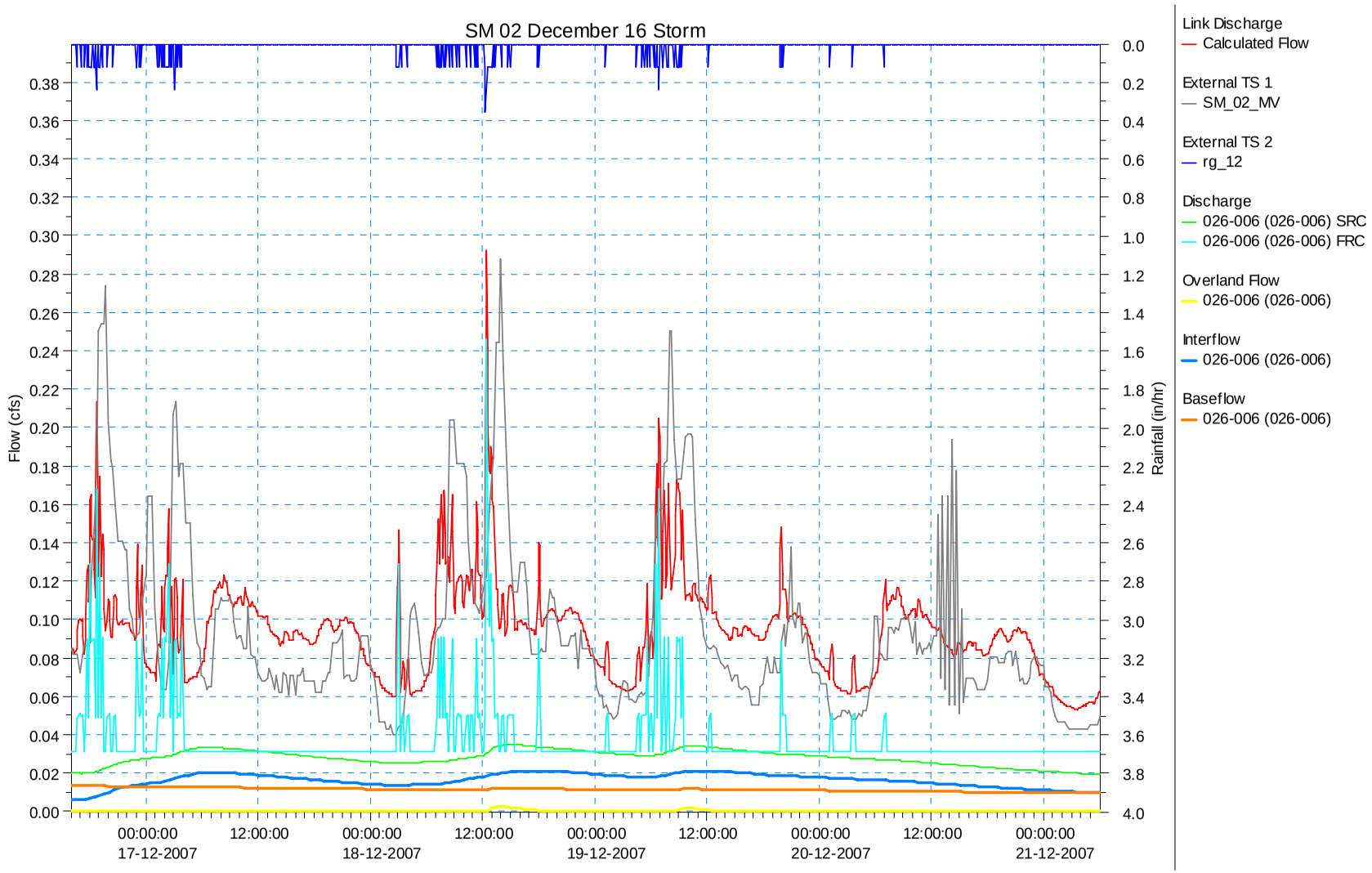
Correlation coeficient R2	0.29	
Max. positive difference	5.9	cfs
Max. negative difference	-6.9	cfs
Volume observed	658680	CF
Volume modelled	678087	CF
Volume error	2.9	%
Peak observed value	10.0	cfs
Peak modelled value	7.6	cfs
Peak error	-24.5	%

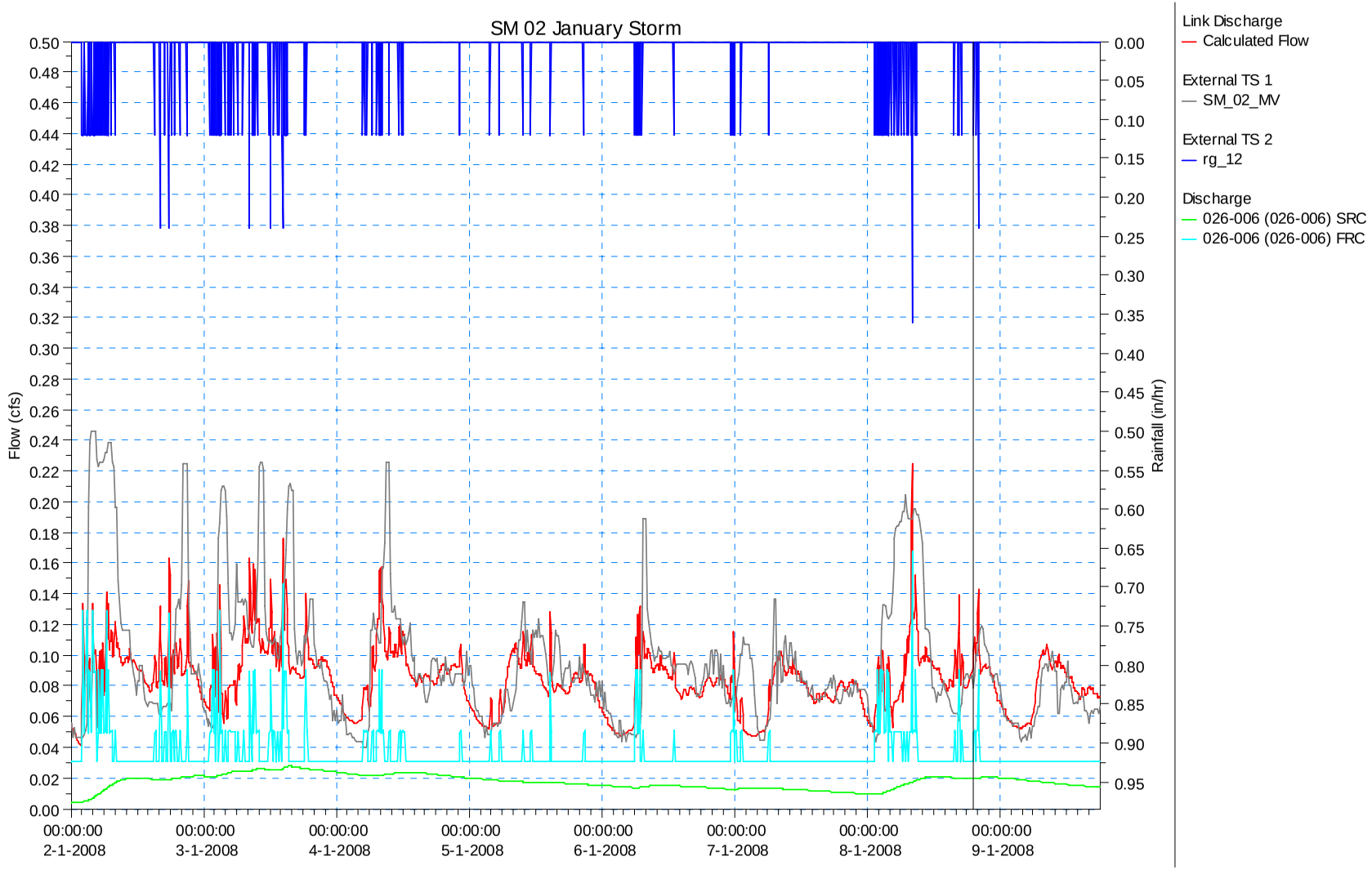
3/13/2008 Storm

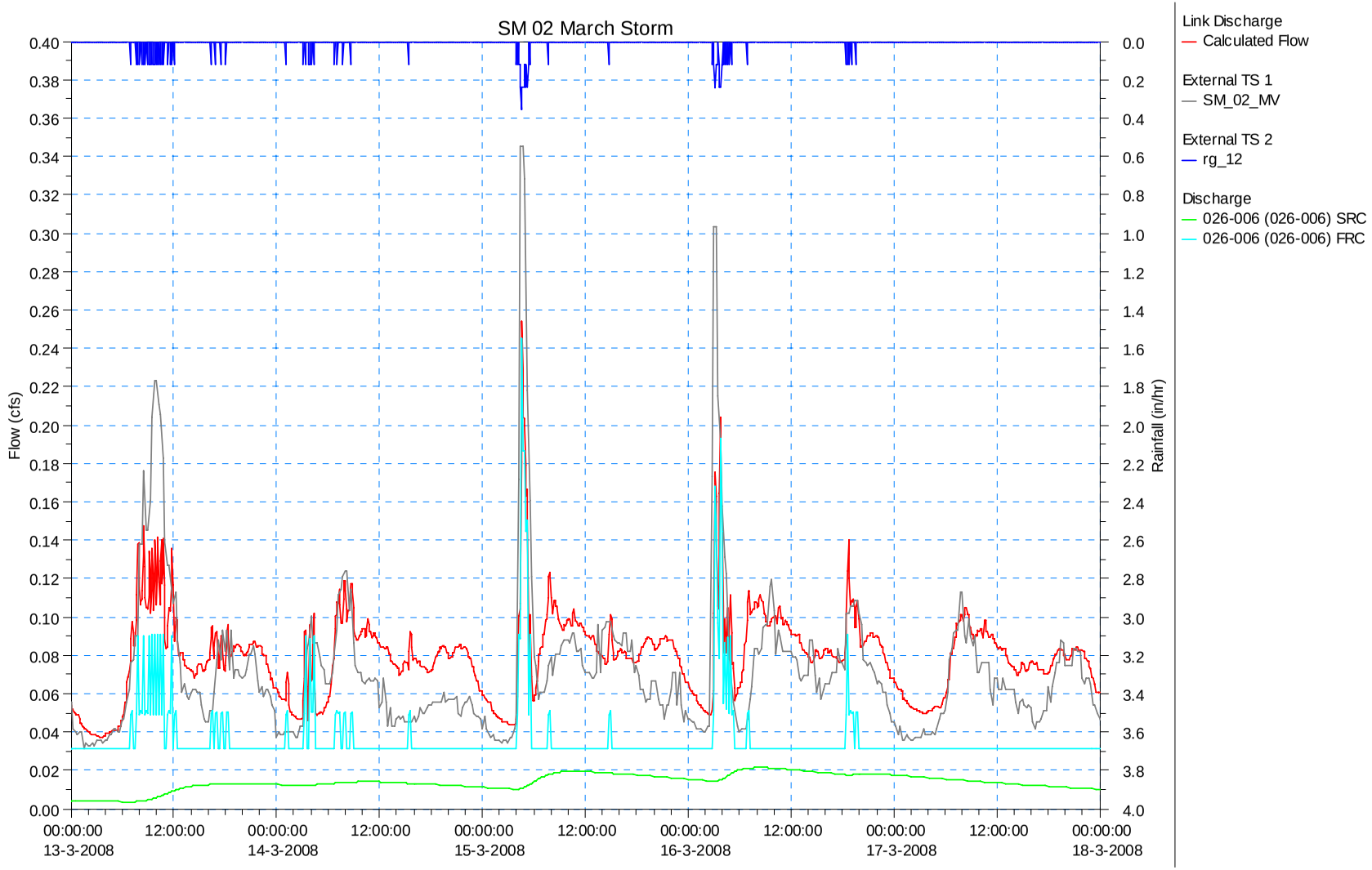
Correlation	0.83	
Max. positi	5.4	cfs
Max. negat	-1.6	cfs
Volume ob	424054	CF
Volume mo	600608	CF
Volume err	41.6	%
Peak obse	9.7	cfs
Peak mode	9.0	cfs
Peak error	-7.8	%

SM 02

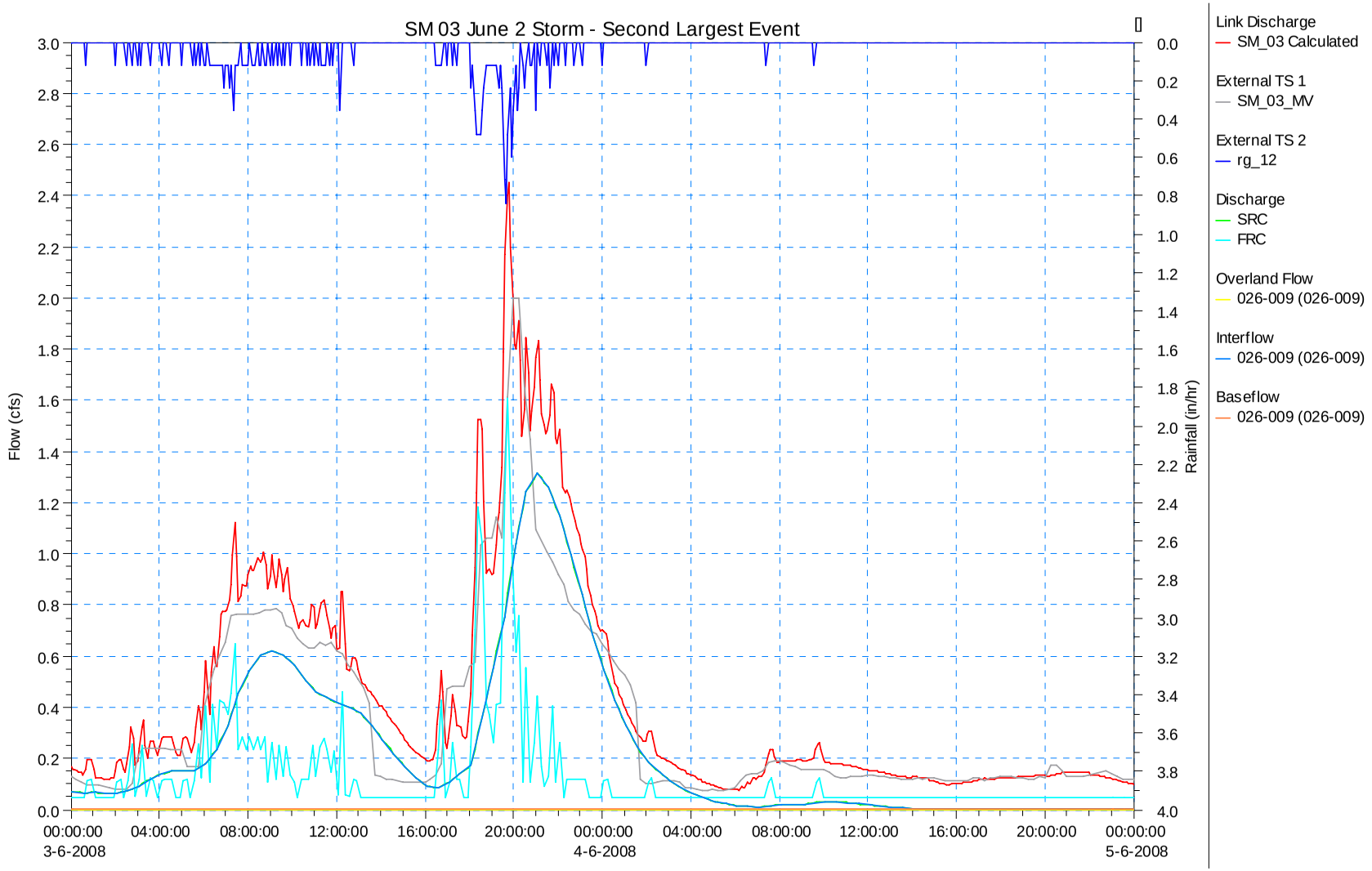

SM 02 June Storm
[]
Flow (cfs)
Rainfall (in/hr)
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00 4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00 5-6-2008
Link Discharge
Calculated Flow
External TS 1
SM_02_MV
External TS 2
rg_12
Discharge
026-006 (026-006) SRC
026-006 (026-006) FRC
Overland Flow
026-006 (026-006)
Interflow
026-006 (026-006)
Baseflow
026-006 (026-006)

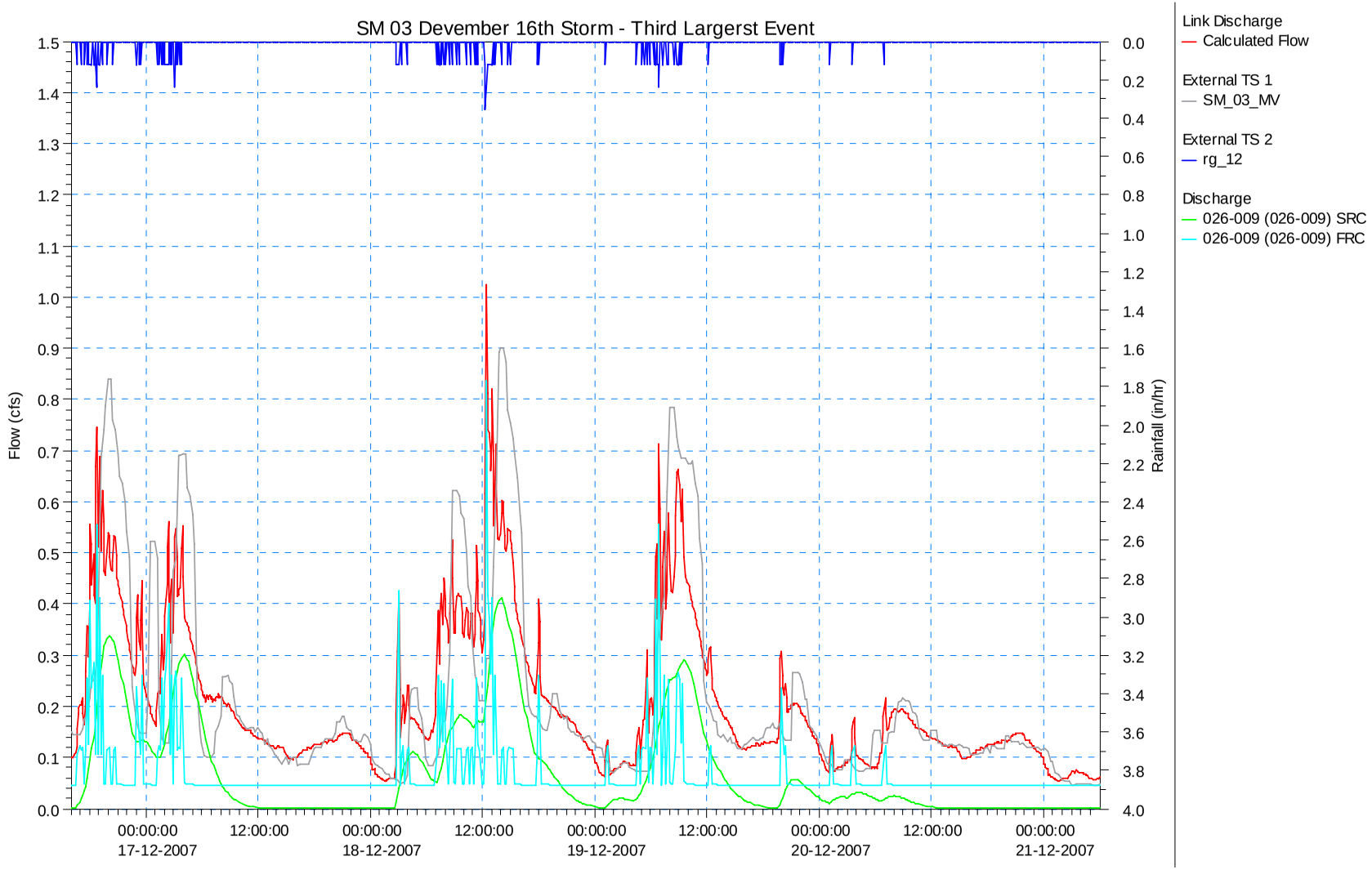

SM 02 December 16 Storm
Flow (cfs)
Rainfall (in/hr)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28
0.30
0.32
0.34
0.36
0.38
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
SM_02_MV
External TS 2
rg_12
Discharge
026-006 (026-006) SRC
026-006 (026-006) FRC
Overland Flow
026-006 (026-006)
Interflow
026-006 (026-006)
Baseflow
026-006 (026-006)

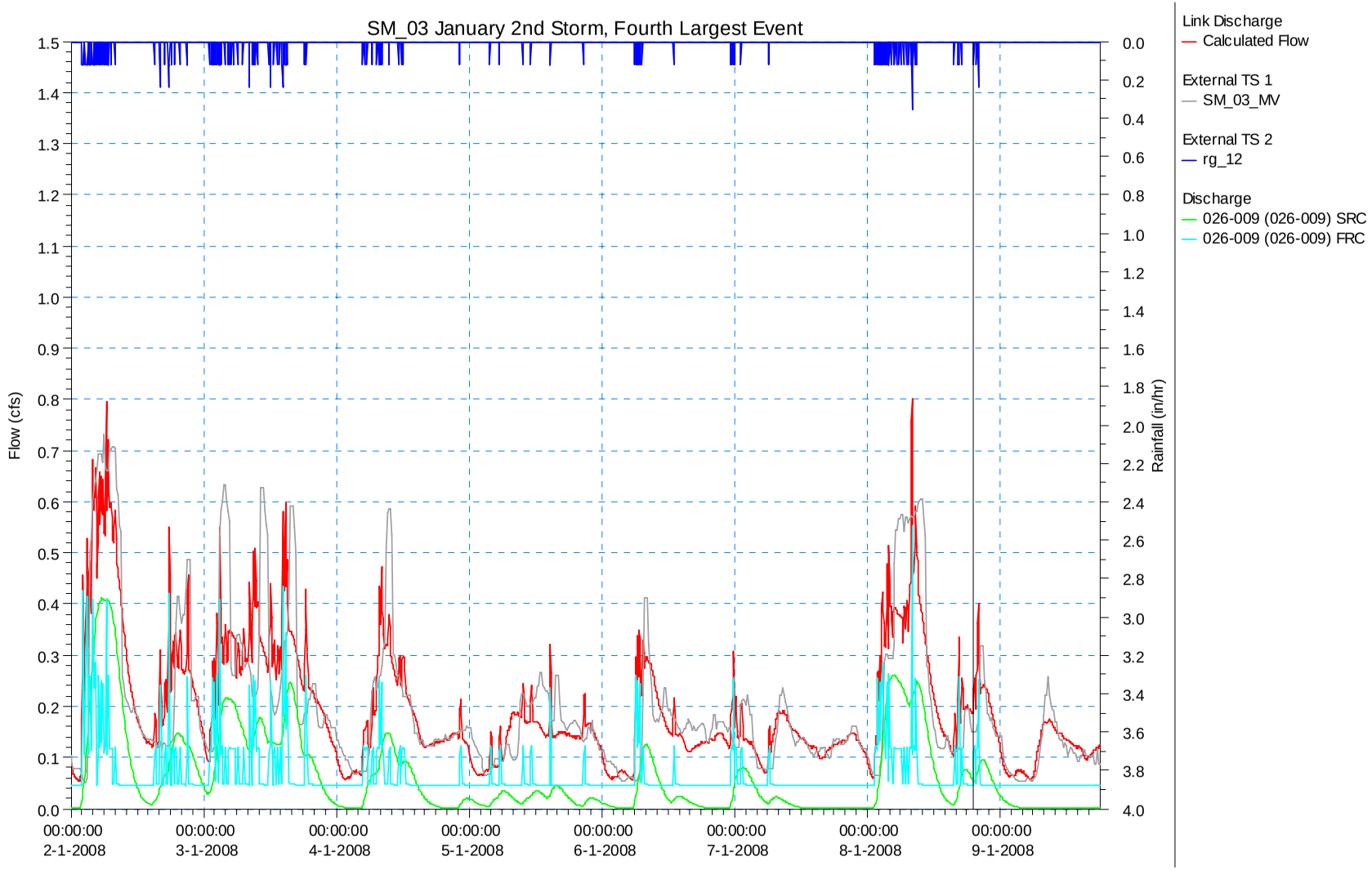

SM 02 January Storm
Flow (cfs)
Rainfall (in/hr)
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_02_MV
External TS 2
rg_12
Discharge
026-006 (026-006) SRC
026-006 (026-006) FRC

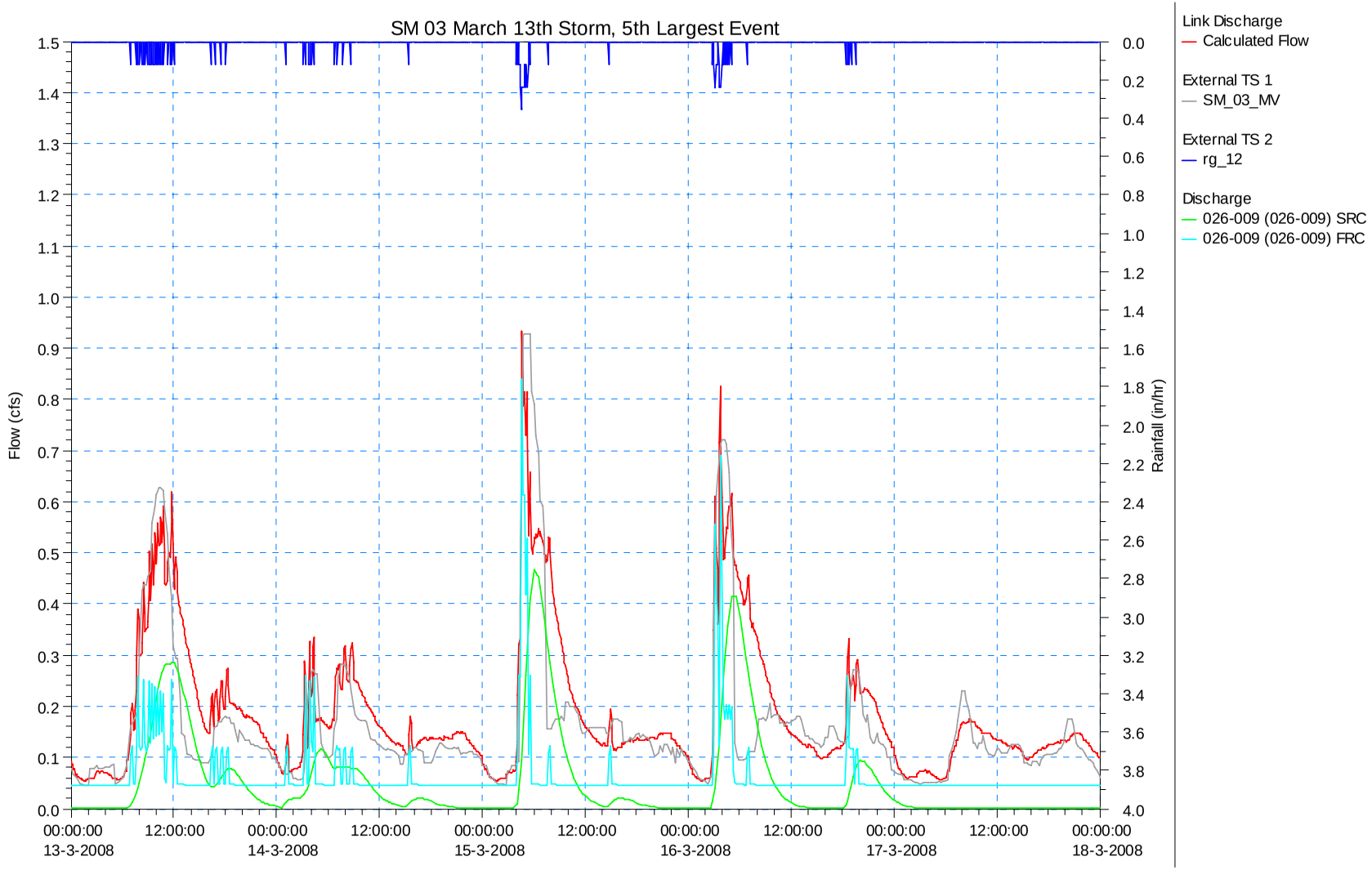

SM 02 March Storm
Flow (cfs)
Rainfall (in/hr)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 13-3-2008
12:00:00
00:00:00 14-3-2008
12:00:00
00:00:00 15-3-2008
12:00:00
00:00:00 16-3-2008
12:00:00
00:00:00 17-3-2008
12:00:00
00:00:00 18-3-2008
Link Discharge
Calculated Flow
External TS 1
SM_02_MV
External TS 2
rg_12
Discharge
026-006 (026-006) SRC
026-006 (026-006) FRC

SM 03

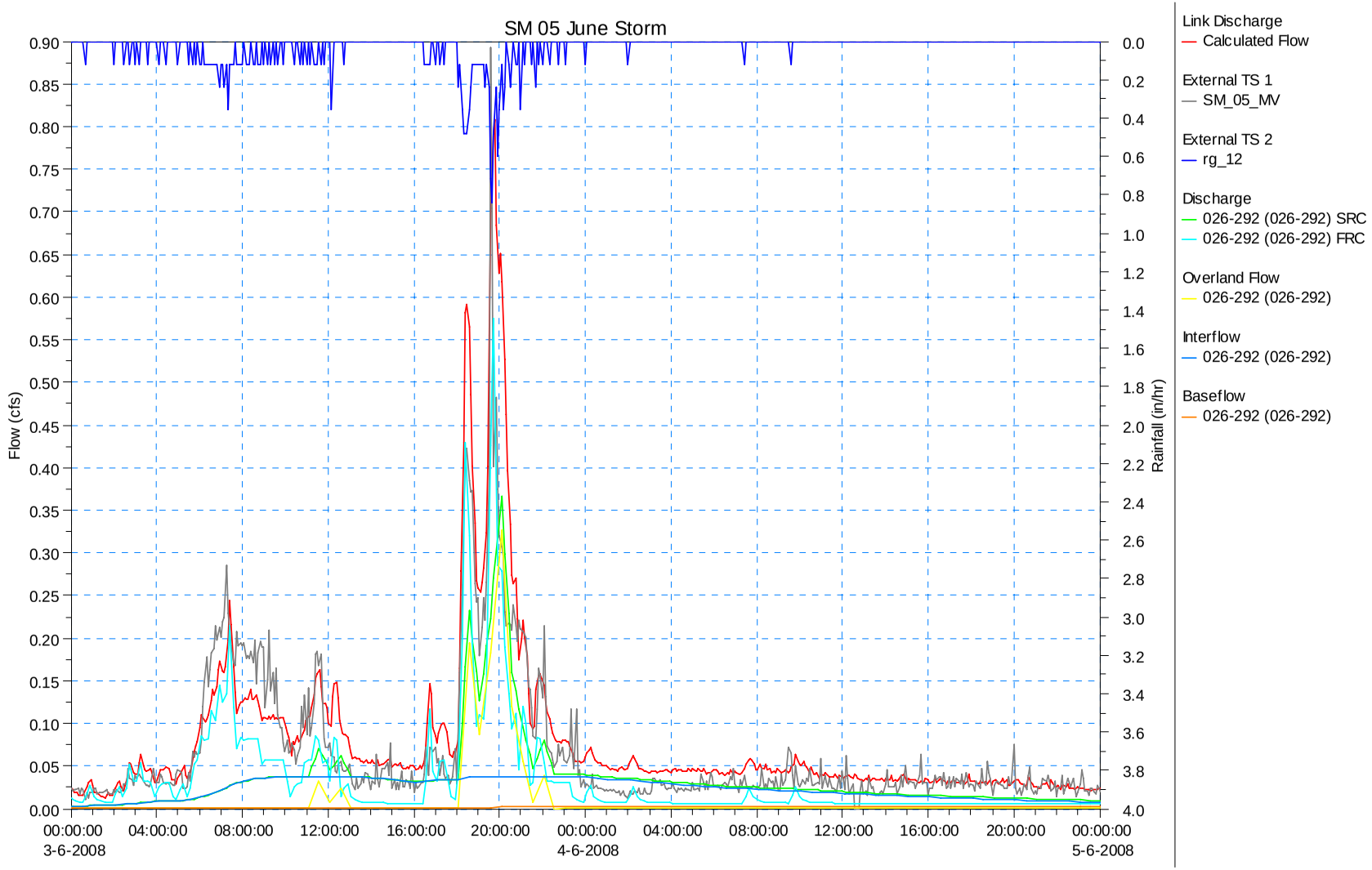

SM 03 June 2 Storm - Second Largest Event
Flow (cfs)
Rainfall (in/hr)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00
3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
5-6-2008
Link Discharge
SM_03 Calculated
External TS 1
SM_03_MV
External TS 2
rg_12
Discharge
SRC
FRC
Overland Flow
026-009 (026-009)
Interflow
026-009 (026-009)
Baseflow
026-009 (026-009)

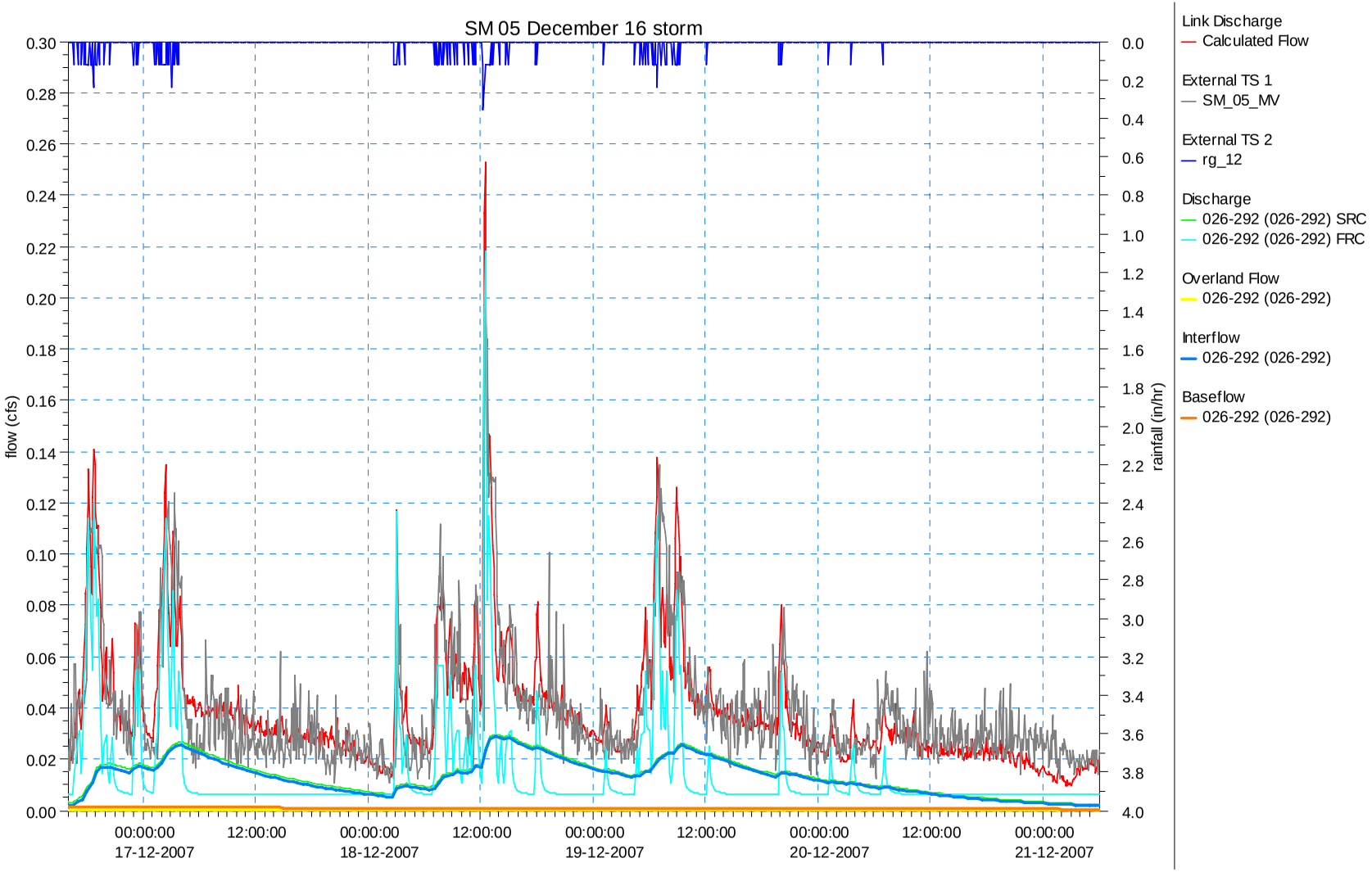

SM 03 Devember 16th Storm - Third Largerst Event
Flow (cfs)
Rainfall (in/hr)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
SM_03_MV
External TS 2
rg_12
Discharge
026-009 (026-009) SRC
026-009 (026-009) FRC

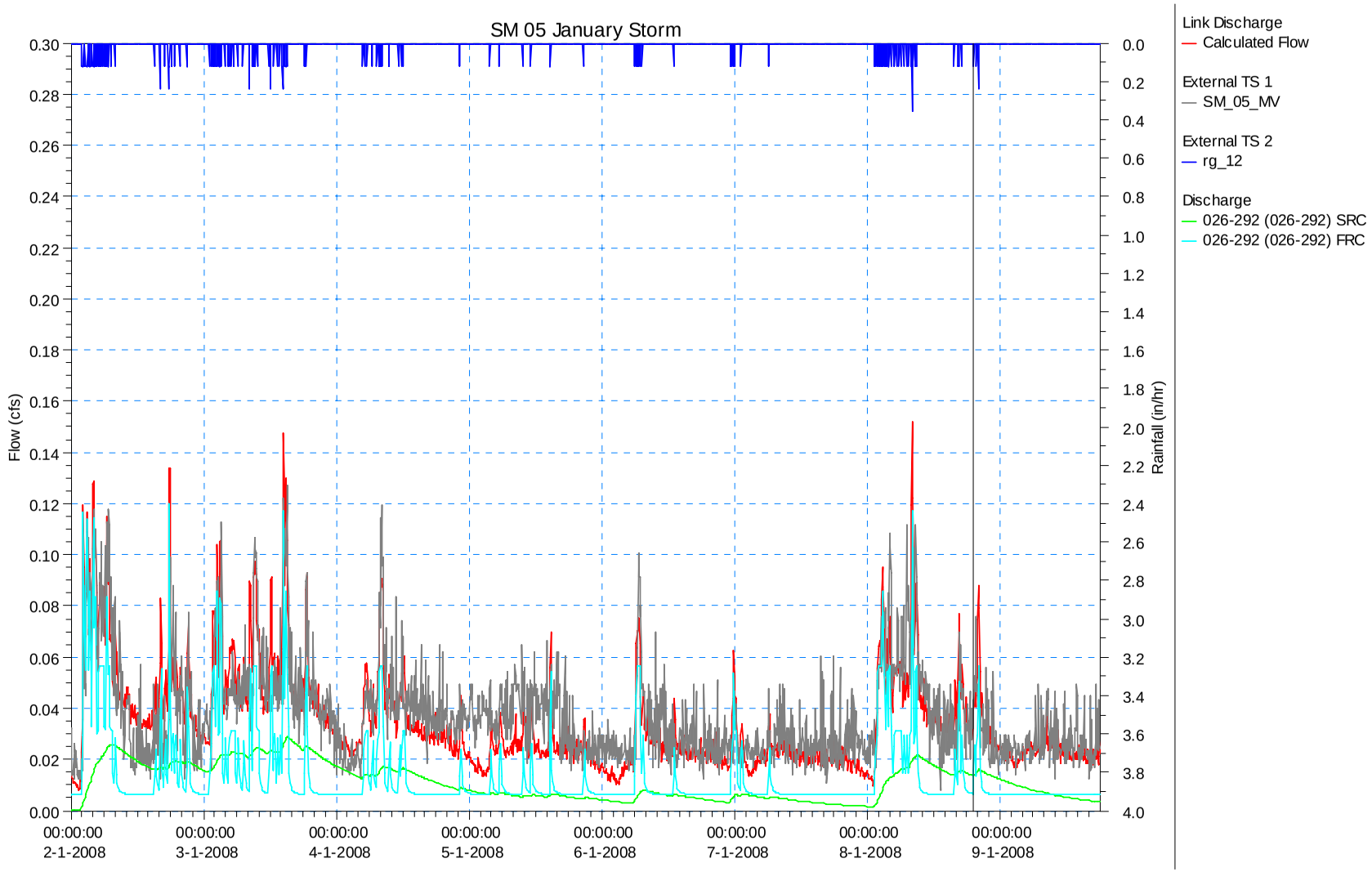

SM_03 January 2nd Storm, Fourth Largest Event
Flow (cfs)
Rainfall (in/hr)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_03_MV
External TS 2
rg_12
Discharge
026-009 (026-009) SRC
026-009 (026-009) FRC

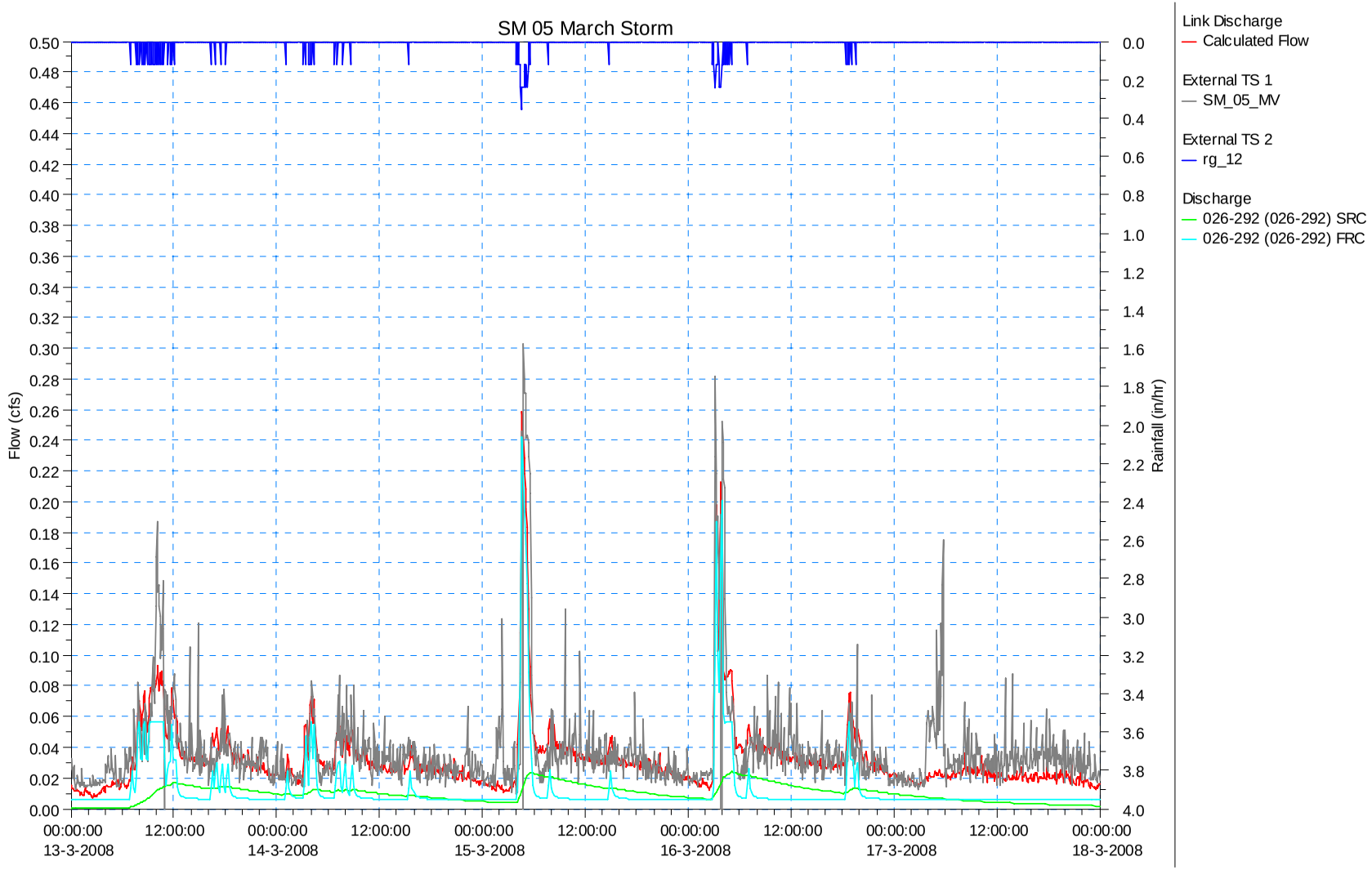

SM 03 March 13th Storm, 5th Largest Event
Flow (cfs)
Rainfall (in/hr)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 13-3-2008
12:00:00
00:00:00 14-3-2008
12:00:00
00:00:00 15-3-2008
12:00:00
00:00:00 16-3-2008
12:00:00
00:00:00 17-3-2008
12:00:00
00:00:00 18-3-2008
Link Discharge
Calculated Flow
External TS 1
SM_03_MV
External TS 2
rg_12
Discharge
026-009 (026-009) SRC
026-009 (026-009) FRC

SM 05

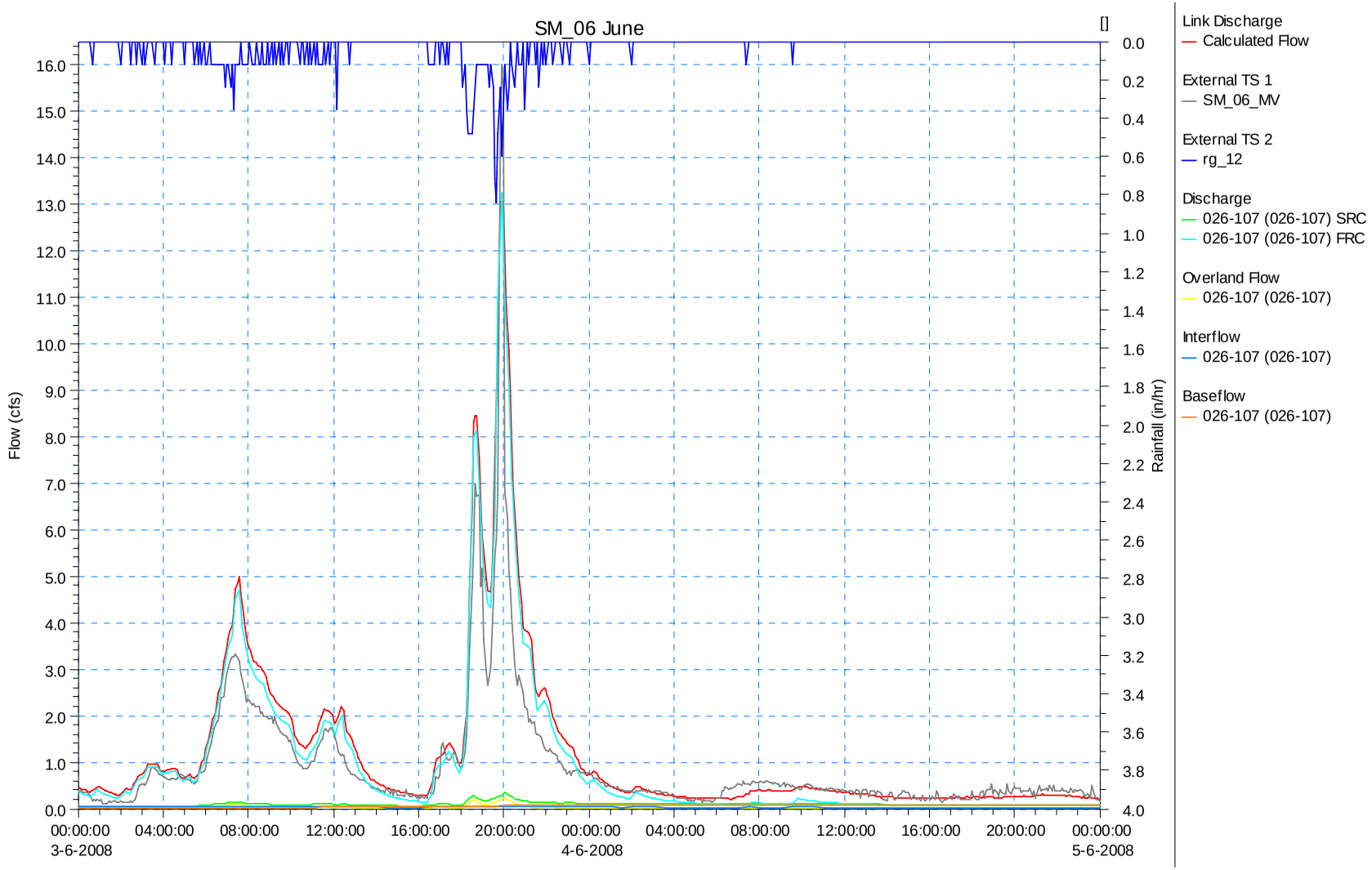

SM 05 June Storm
Flow (cfs)
Rainfall (in/hr)
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00 4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00 5-6-2008
Link Discharge
Calculated Flow
External TS 1
SM_05_MV
External TS 2
rg_12
Discharge
026-292 (026-292) SRC
026-292 (026-292) FRC
Overland Flow
026-292 (026-292)
Interflow
026-292 (026-292)
Baseflow
026-292 (026-292)

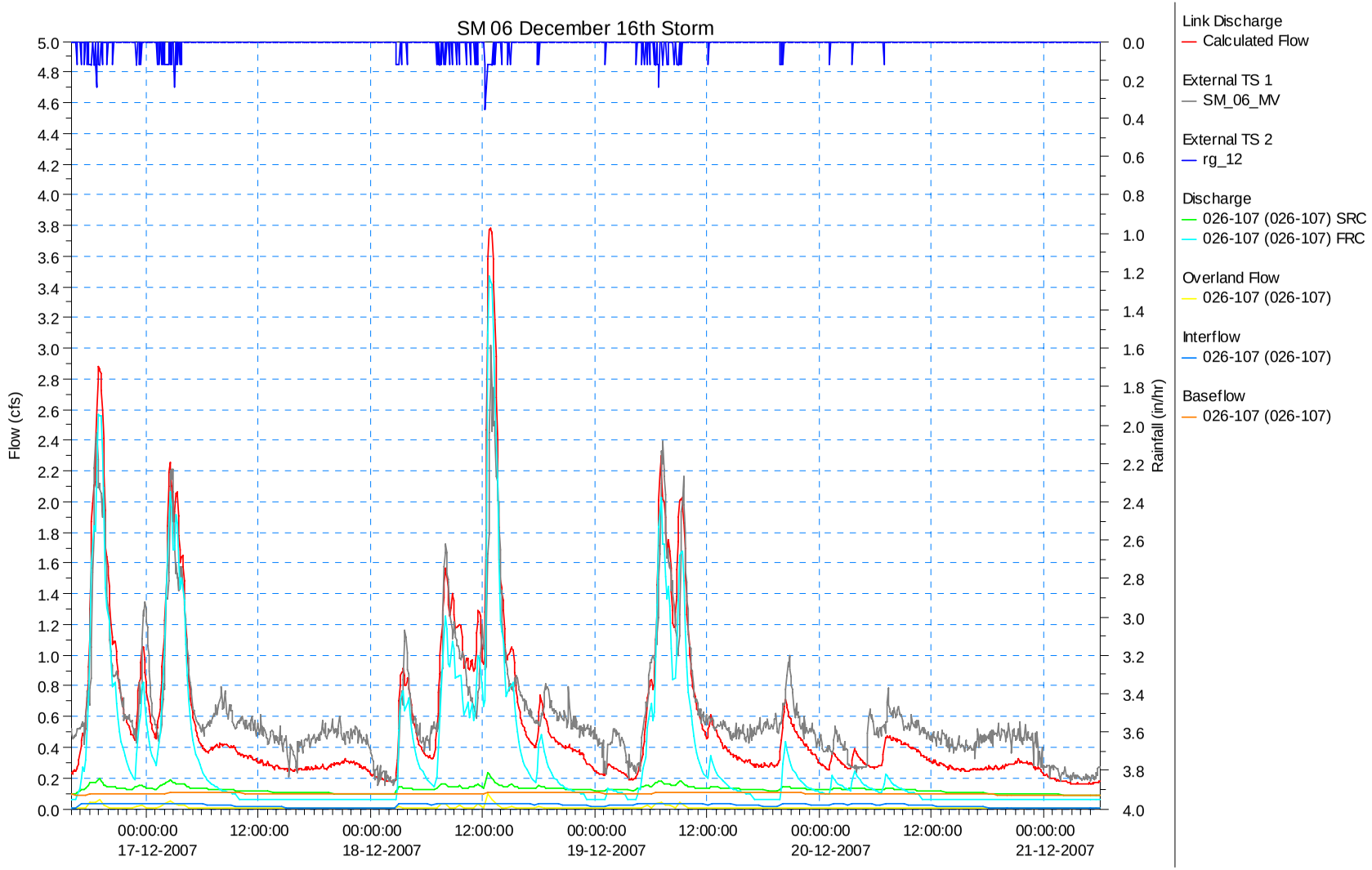

SM 05 December 16 storm
flow (cfs)
rainfall (in/hr)
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
SM_05_MV
External TS 2
rg_12
Discharge
026-292 (026-292) SRC
026-292 (026-292) FRC
Overland Flow
026-292 (026-292)
Interflow
026-292 (026-292)
Baseflow
026-292 (026-292)

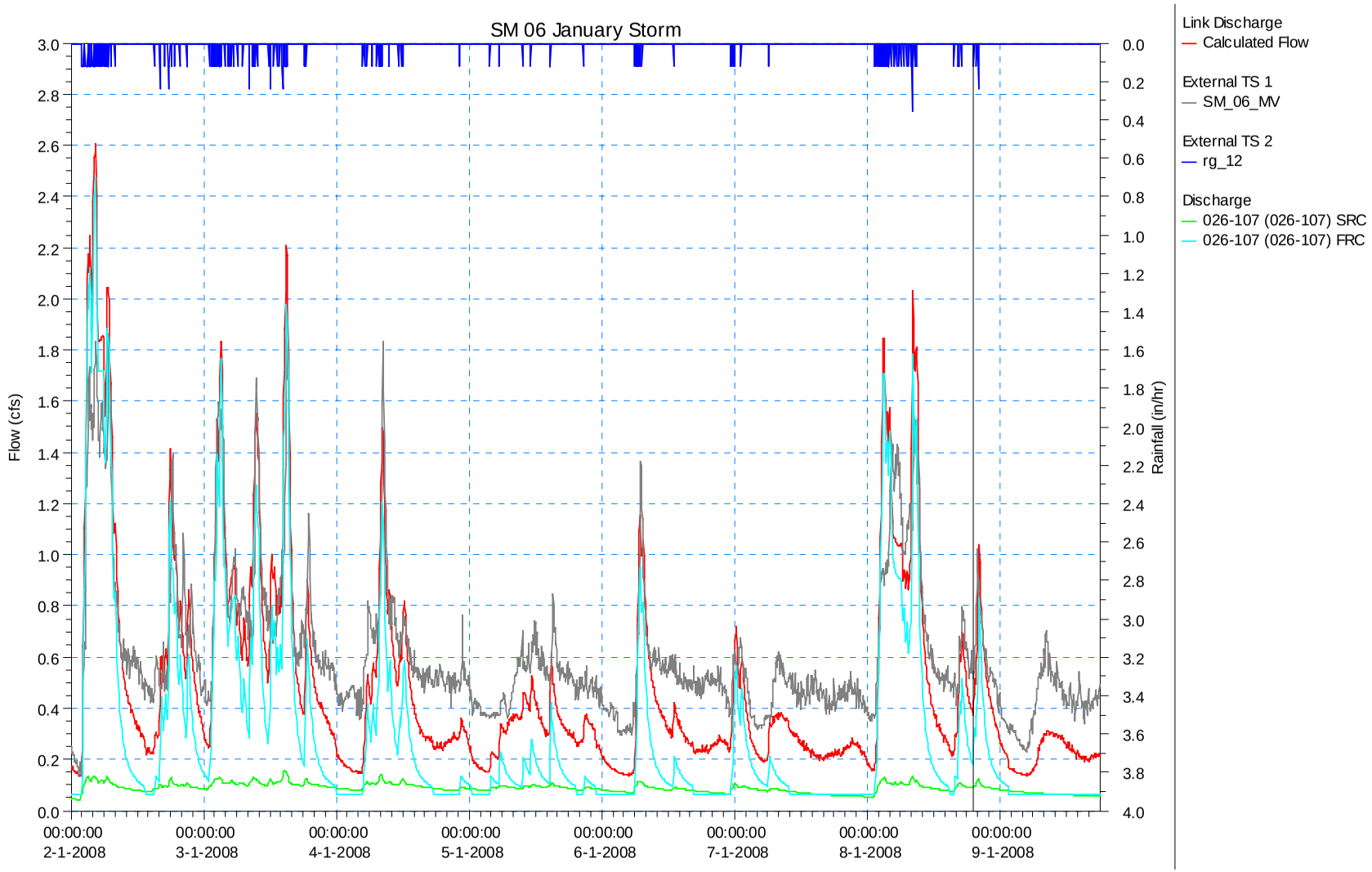

SM 05 January Storm
Flow (cfs)
Rainfall (in/hr)
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_05_MV
External TS 2
rg_12
Discharge
026-292 (026-292) SRC
026-292 (026-292) FRC

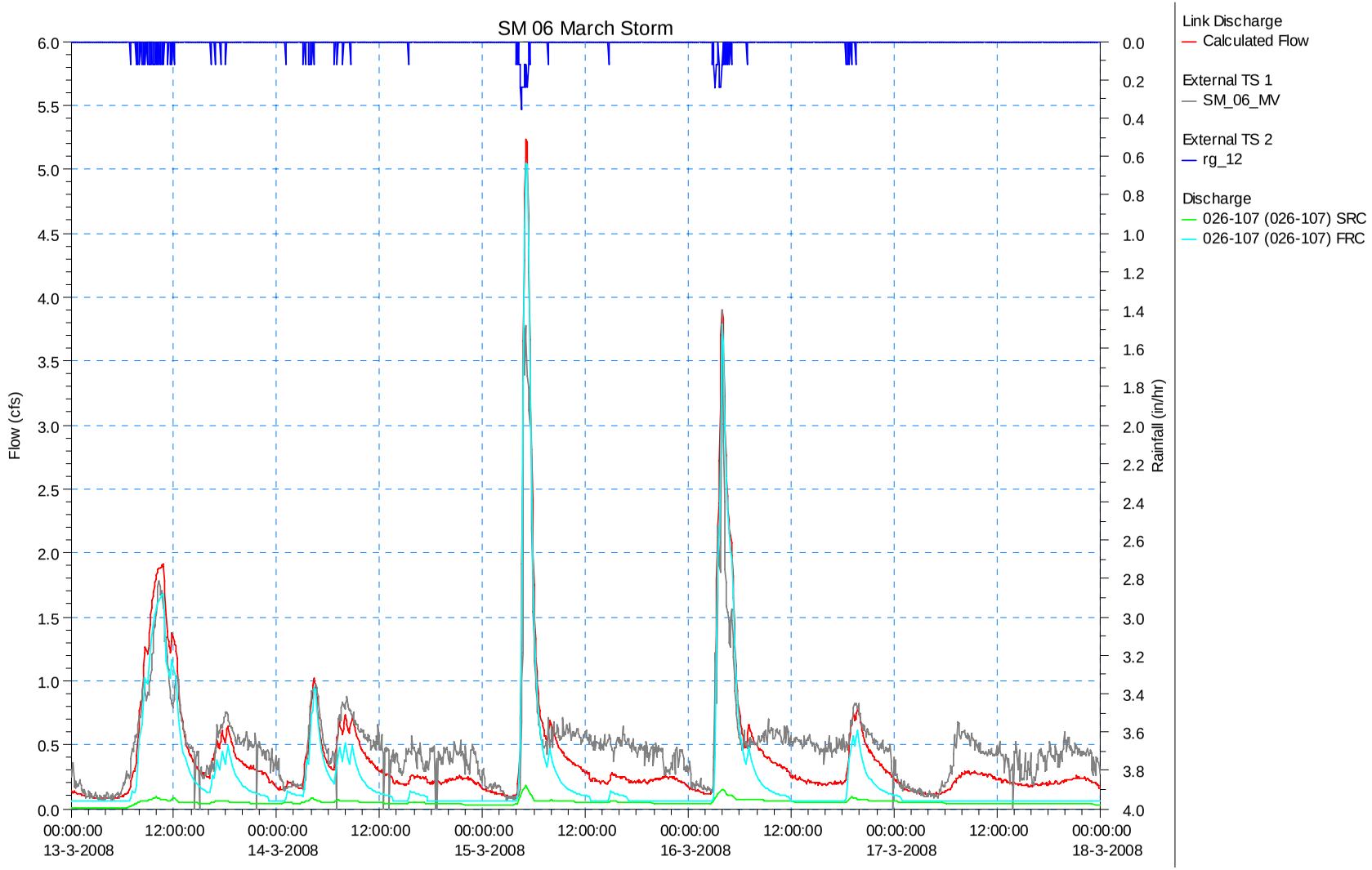

SM 05 March Storm
Flow (cfs)
Rainfall (in/hr)
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 13-3-2008
12:00:00
00:00:00 14-3-2008
12:00:00
00:00:00 15-3-2008
12:00:00
00:00:00 16-3-2008
12:00:00
00:00:00 17-3-2008
12:00:00
00:00:00 18-3-2008
Link Discharge
Calculated Flow
External TS 1
SM_05_MV
External TS 2
rg_12
Discharge
026-292 (026-292) SRC
026-292 (026-292) FRC

SM 06

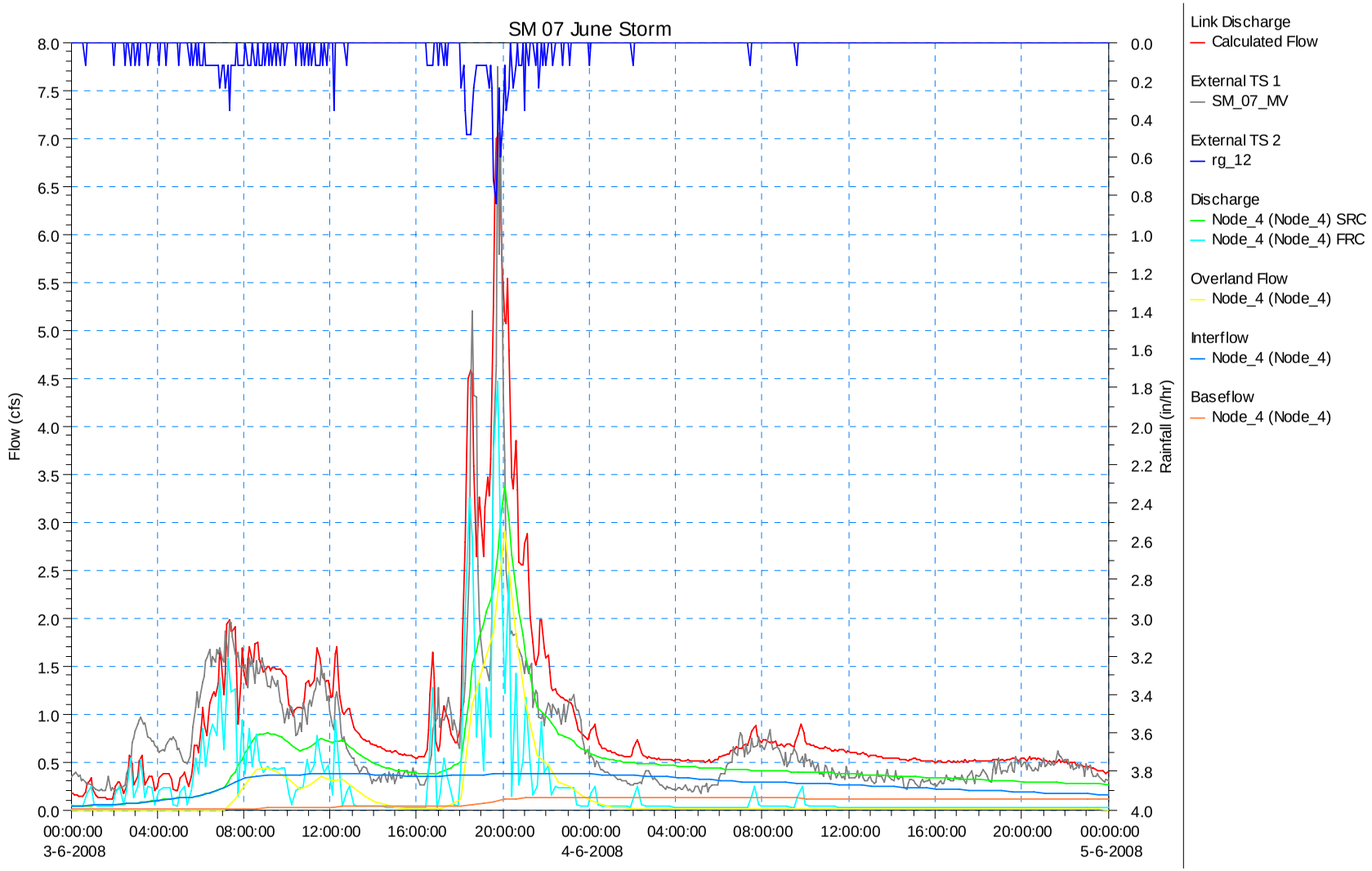

SM_06 June
[]
Flow (cfs)
Rainfall (in/hr)
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00
3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
5-6-2008
Link Discharge
Calculated Flow
External TS 1
SM_06_MV
External TS 2
rg_12
Discharge
026-107 (026-107) SRC
026-107 (026-107) FRC
Overland Flow
026-107 (026-107)
Interflow
026-107 (026-107)
Baseflow
026-107 (026-107)

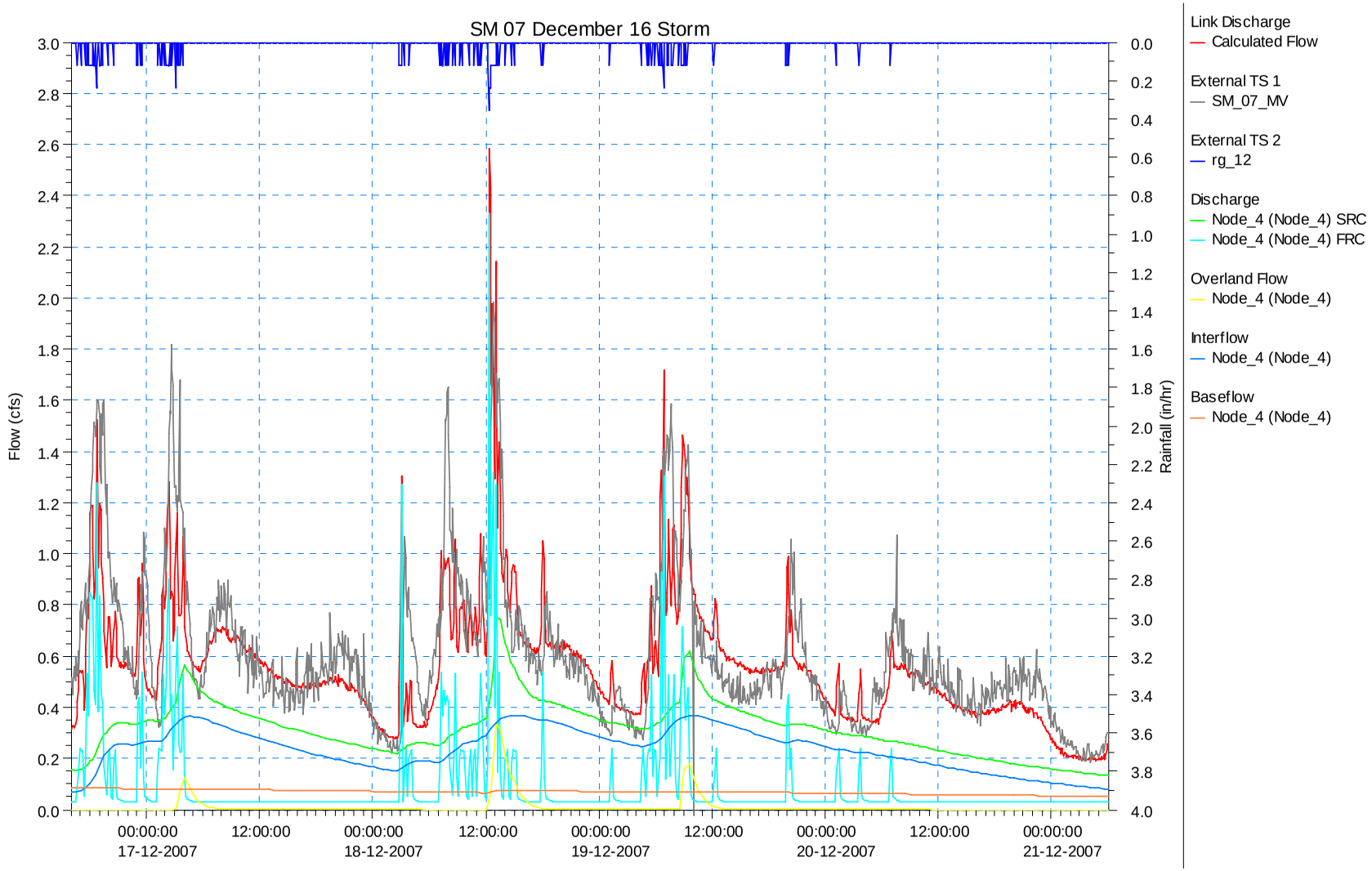

SM 06 December 16th Storm
Flow (cfs)
Rainfall (in/hr)
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
SM_06_MV
External TS 2
rg_12
Discharge
026-107 (026-107) SRC
026-107 (026-107) FRC
Overland Flow
026-107 (026-107)
Interflow
026-107 (026-107)
Baseflow
026-107 (026-107)

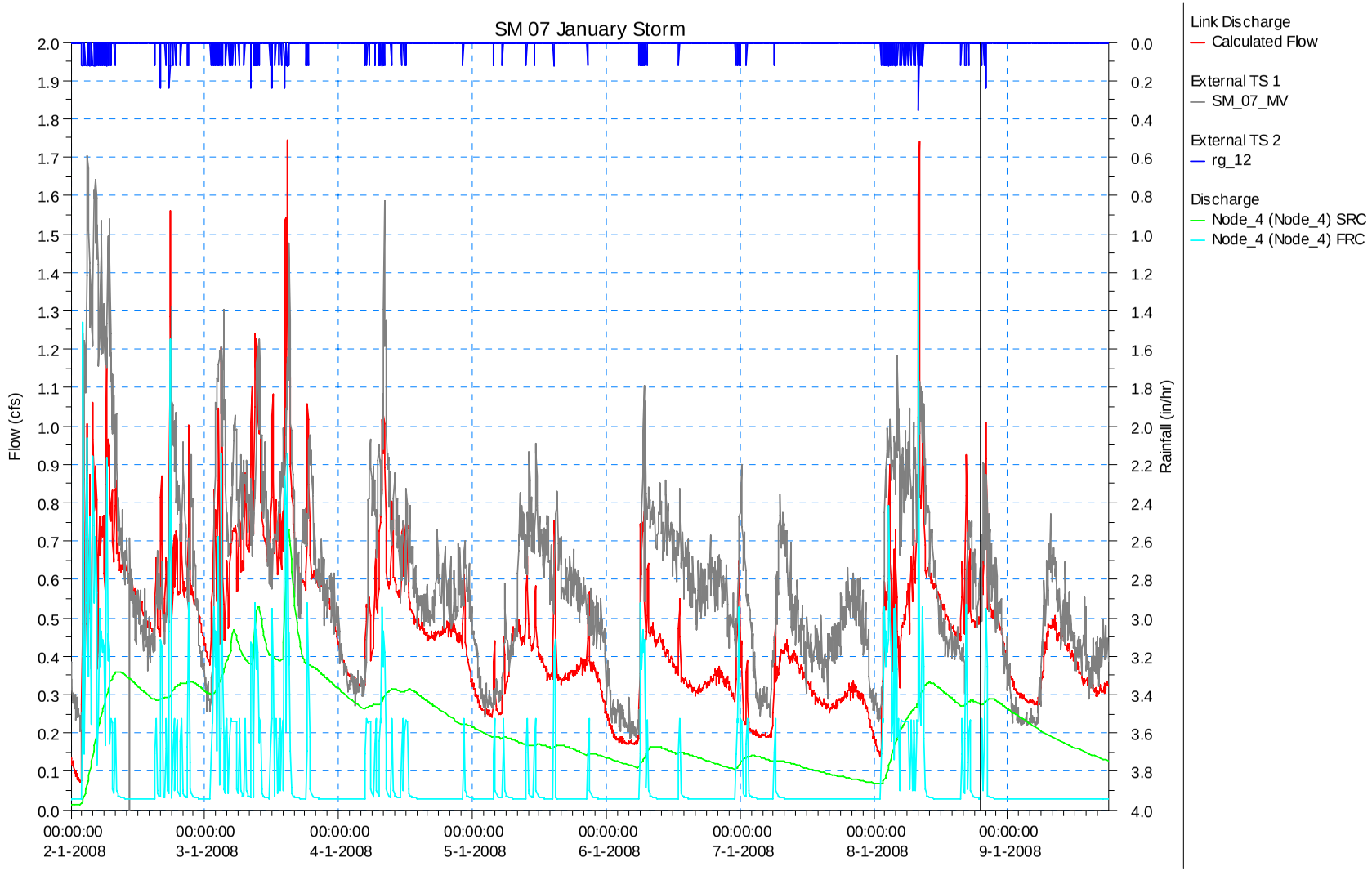

SM 06 January Storm
Flow (cfs)
Rainfall (in/hr)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_06_MV
External TS 2
rg_12
Discharge
026-107 (026-107) SRC
026-107 (026-107) FRC

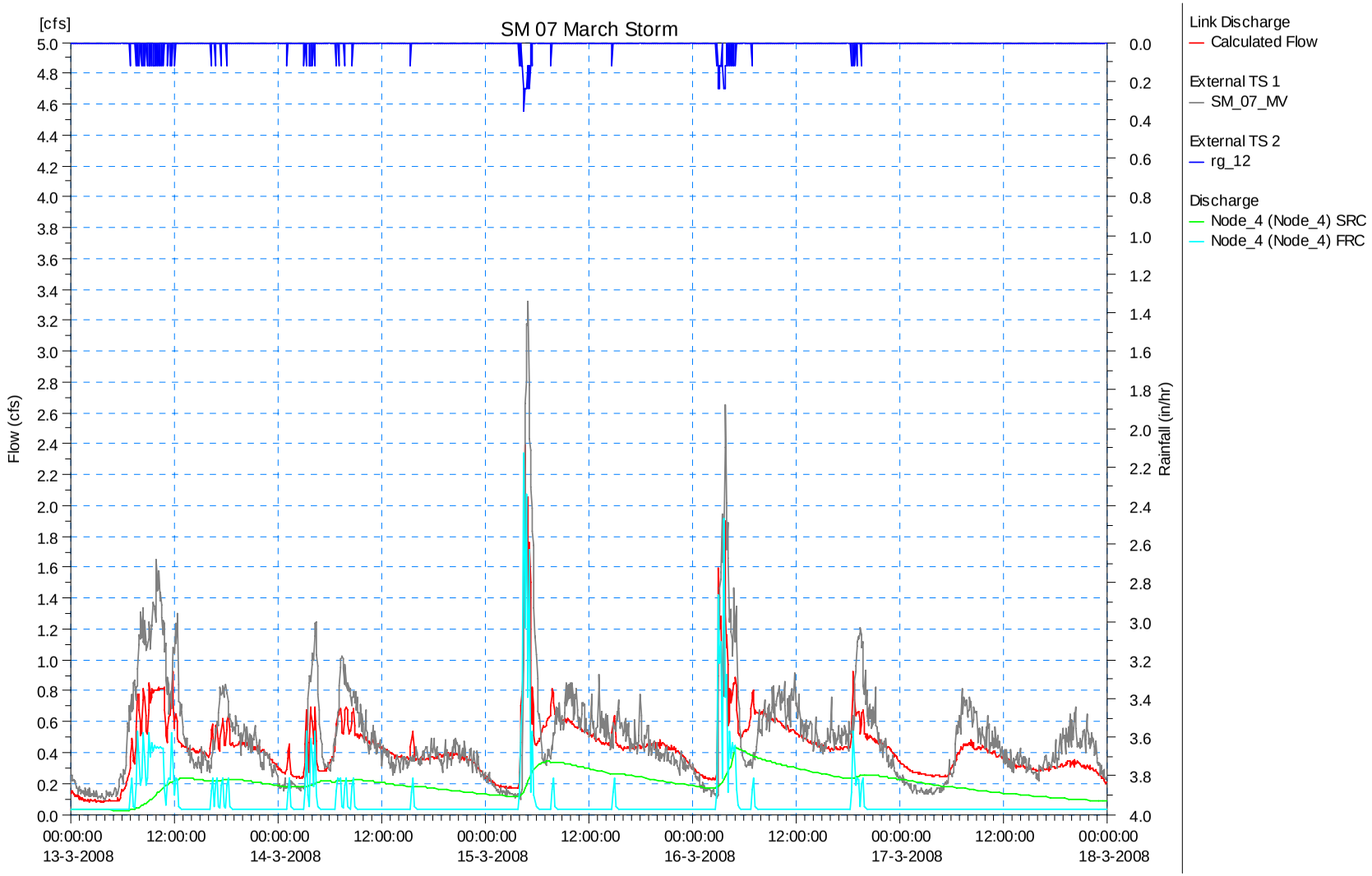

SM 06 March Storm
Flow (cfs)
Rainfall (in/hr)
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 13-3-2008
12:00:00
00:00:00 14-3-2008
12:00:00
00:00:00 15-3-2008
12:00:00
00:00:00 16-3-2008
12:00:00
00:00:00 17-3-2008
12:00:00
00:00:00 18-3-2008
Link Discharge
Calculated Flow
External TS 1
SM_06_MV
External TS 2
rg_12
Discharge
026-107 (026-107) SRC
026-107 (026-107) FRC

SM 07

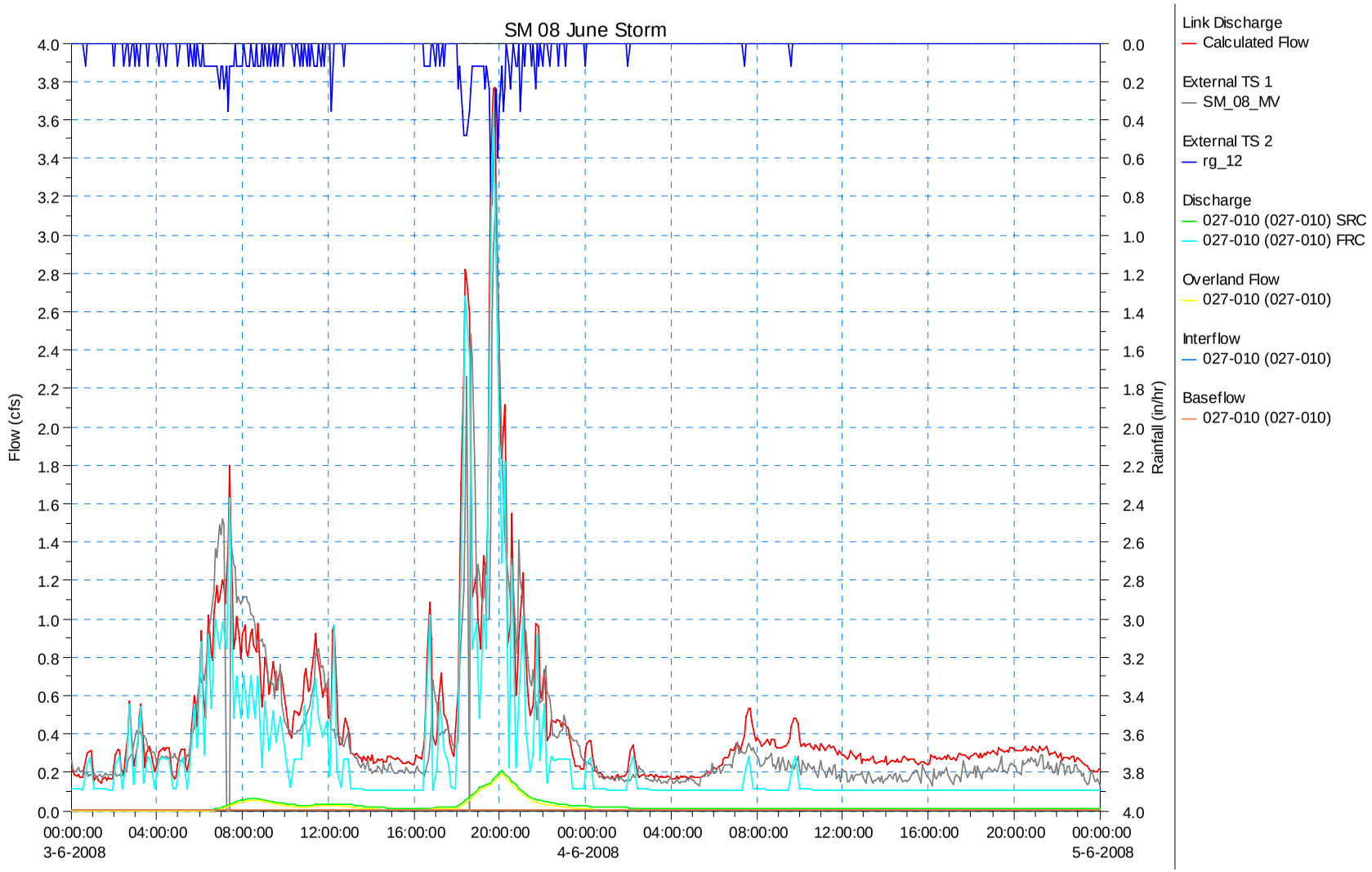

SM 07 June Storm
Flow (cfs)
Rainfall (in/hr)
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00
3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
5-6-2008
Link Discharge
Calculated Flow
External TS 1
SM_07_MV
External TS 2
rg_12
Discharge
Node_4 (Node_4) SRC
Node_4 (Node_4) FRC
Overland Flow
Node_4 (Node_4)
Interflow
Node_4 (Node_4)
Baseflow
Node_4 (Node_4)

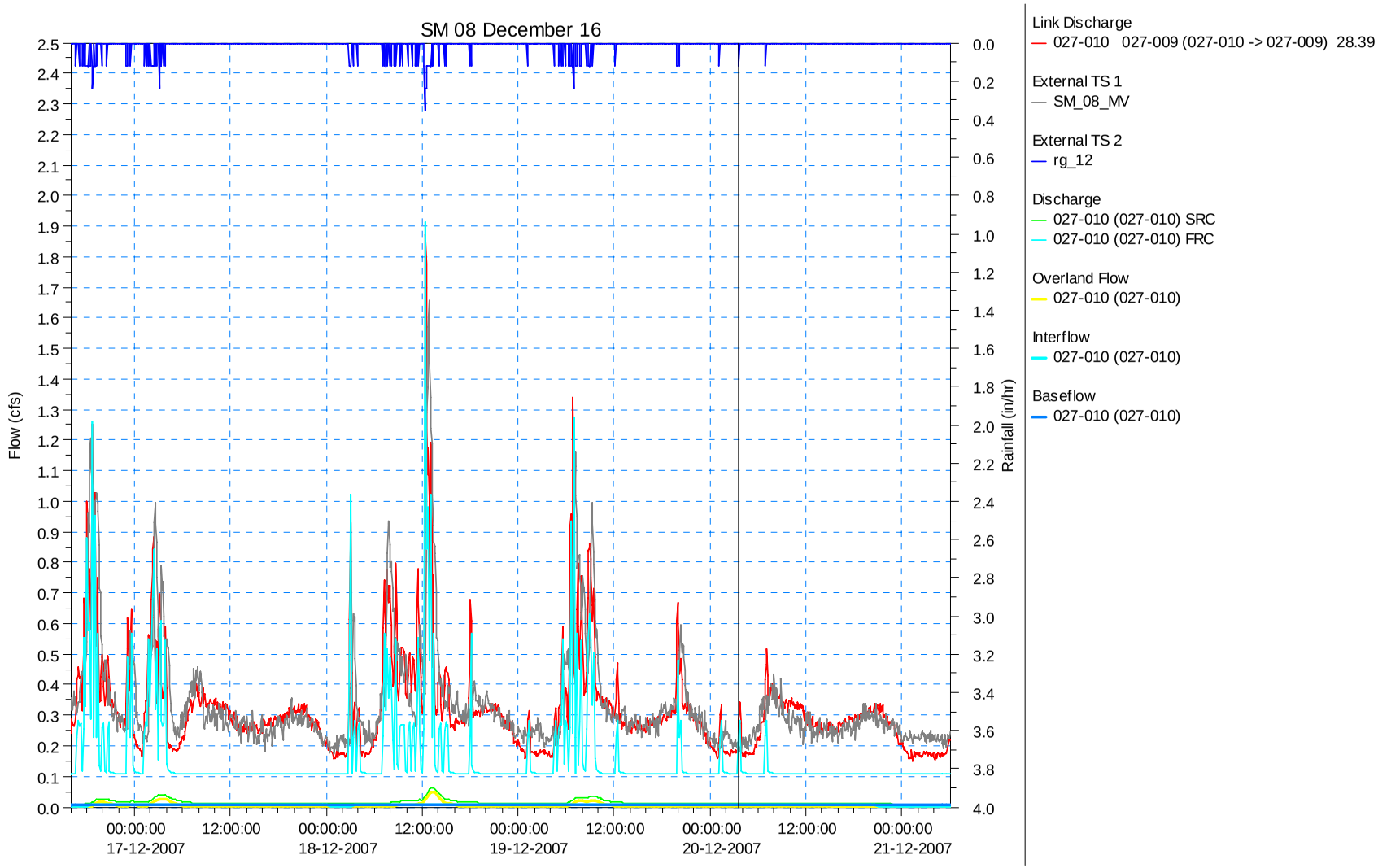

SM 07 December 16 Storm
Flow (cfs)
Rainfall (in/hr)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
SM_07_MV
External TS 2
rg_12
Discharge
Node_4 (Node_4) SRC
Node_4 (Node_4) FRC
Overland Flow
Node_4 (Node_4)
Interflow
Node_4 (Node_4)
Baseflow
Node_4 (Node_4)

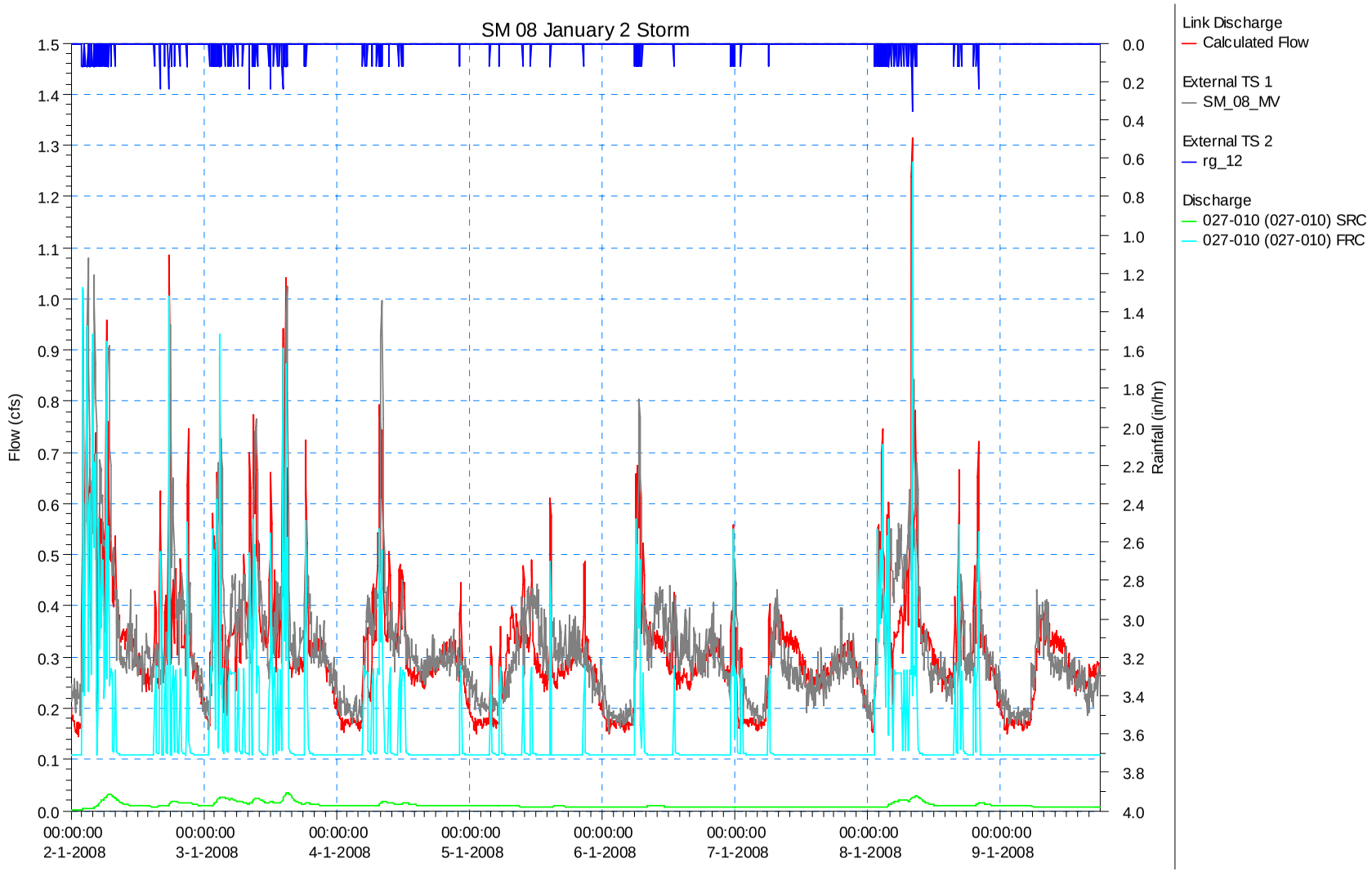

SM 07 January Storm
Flow (cfs)
Rainfall (in/hr)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_07_MV
External TS 2
rg_12
Discharge
Node_4 (Node_4) SRC
Node_4 (Node_4) FRC

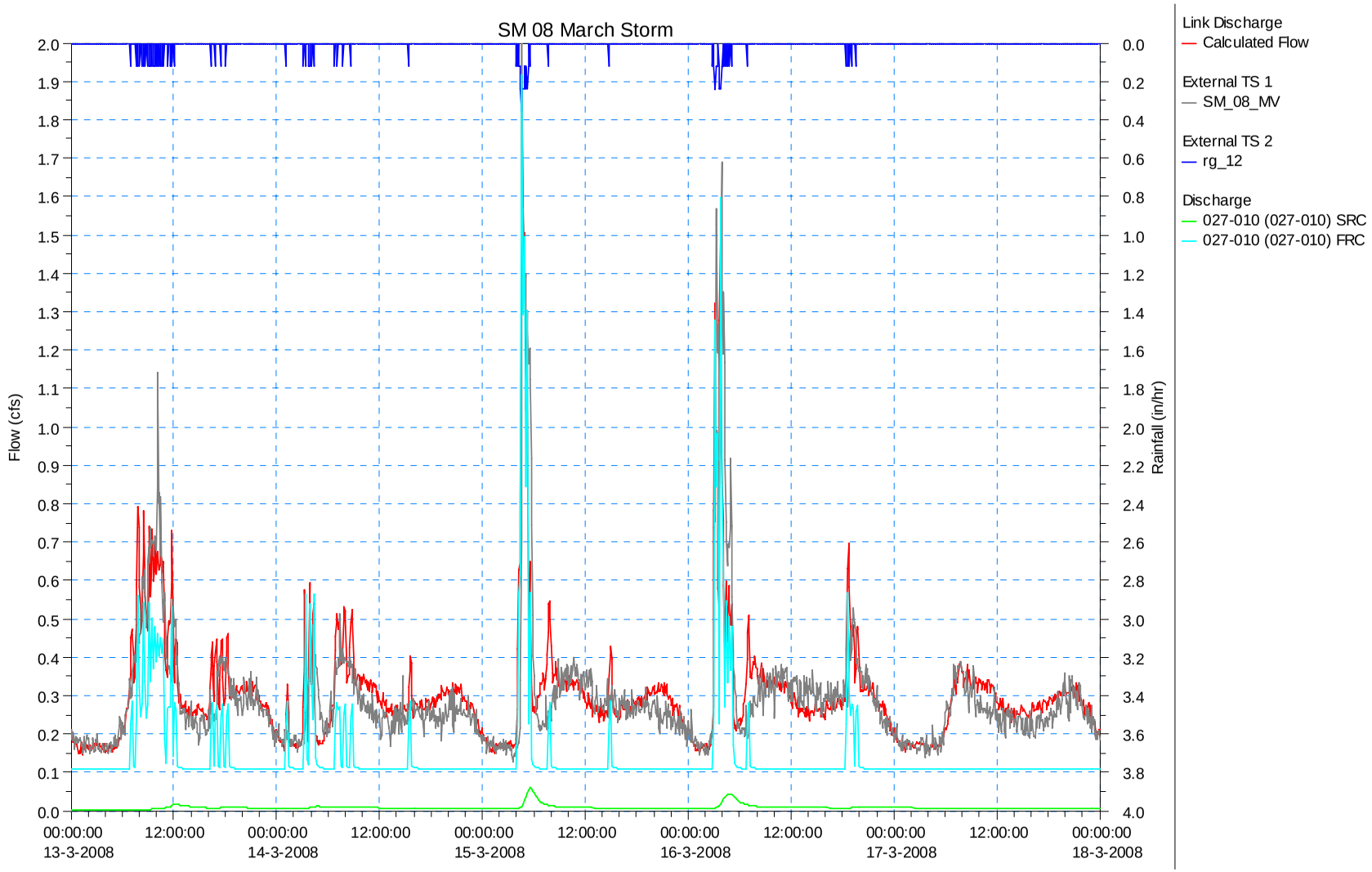

SM 07 March Storm
[cfs]
Flow (cfs)
Rainfall (in/hr)
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 13-3-2008
12:00:00
00:00:00 14-3-2008
12:00:00
00:00:00 15-3-2008
12:00:00
00:00:00 16-3-2008
12:00:00
00:00:00 17-3-2008
12:00:00
00:00:00 18-3-2008
Link Discharge
Calculated Flow
External TS 1
SM_07_MV
External TS 2
rg_12
Discharge
Node_4 (Node_4) SRC
Node_4 (Node_4) FRC

SM 08

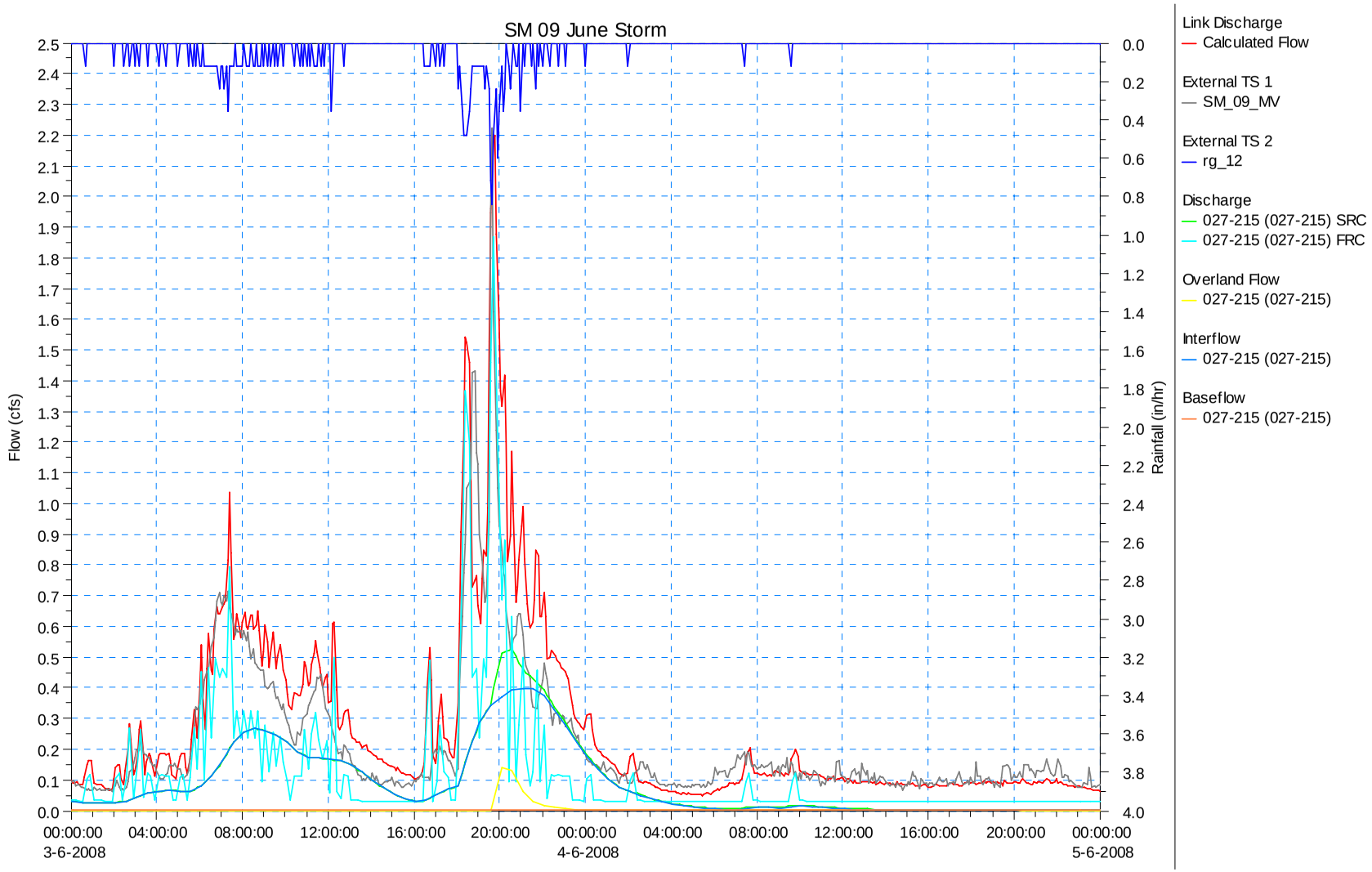

SM 08 June Storm
Flow (cfs)
Rainfall (in/hr)
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
00:00:00
3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00
5-6-2008
Link Discharge
Calculated Flow
External TS 1
SM_08_MV
External TS 2
rg_12
Discharge
027-010 (027-010) SRC
027-010 (027-010) FRC
Overland Flow
027-010 (027-010)
Interflow
027-010 (027-010)
Baseflow
027-010 (027-010)

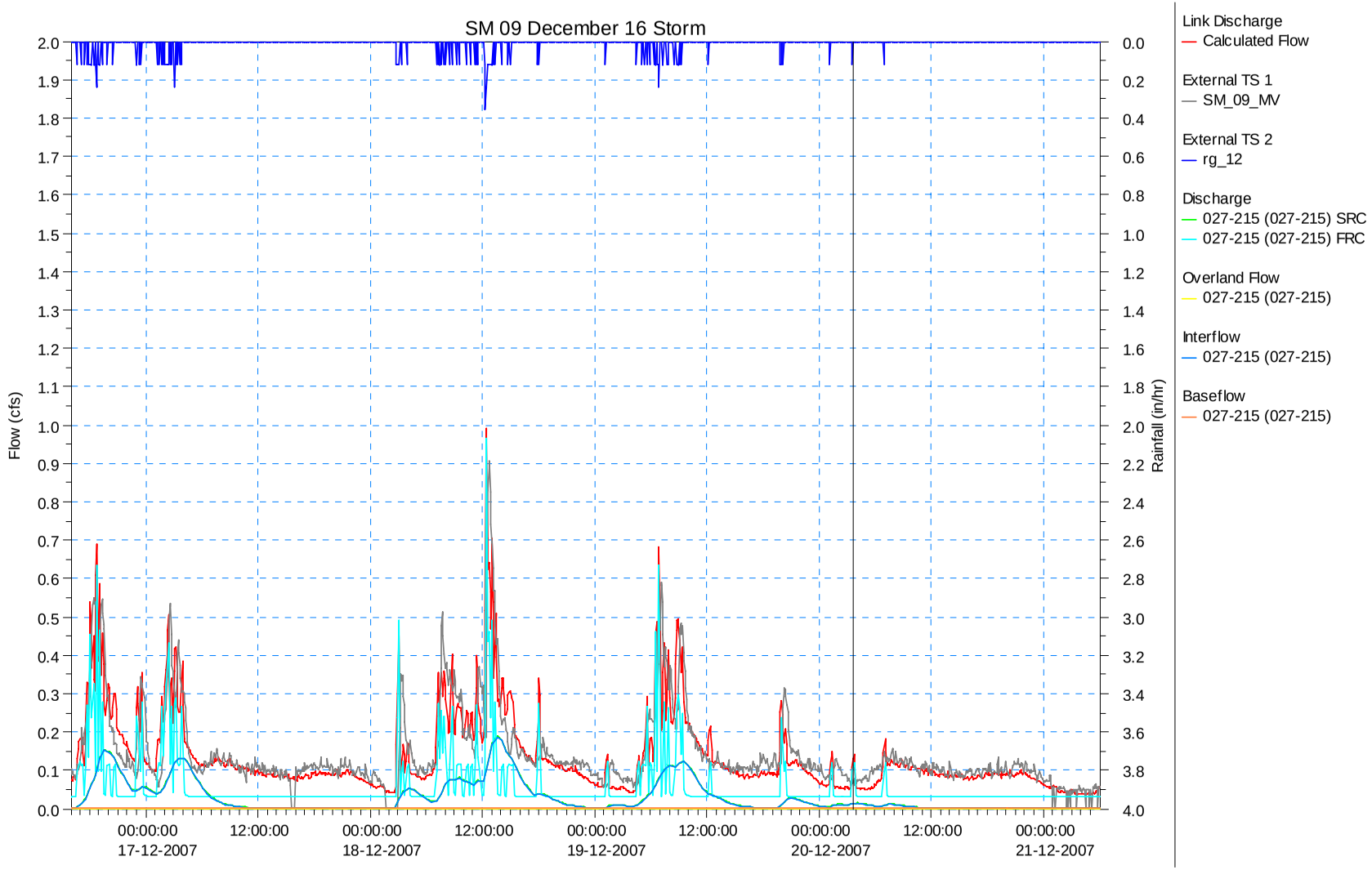

SM 08 December 16
Flow (cfs)
Rainfall (in/hr)
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
027-010 027-009 (027-010 -> 027-009) 28.39
External TS 1
SM_08_MV
External TS 2
rg_12
Discharge
027-010 (027-010) SRC
027-010 (027-010) FRC
Overland Flow
027-010 (027-010)
Interflow
027-010 (027-010)
Baseflow
027-010 (027-010)

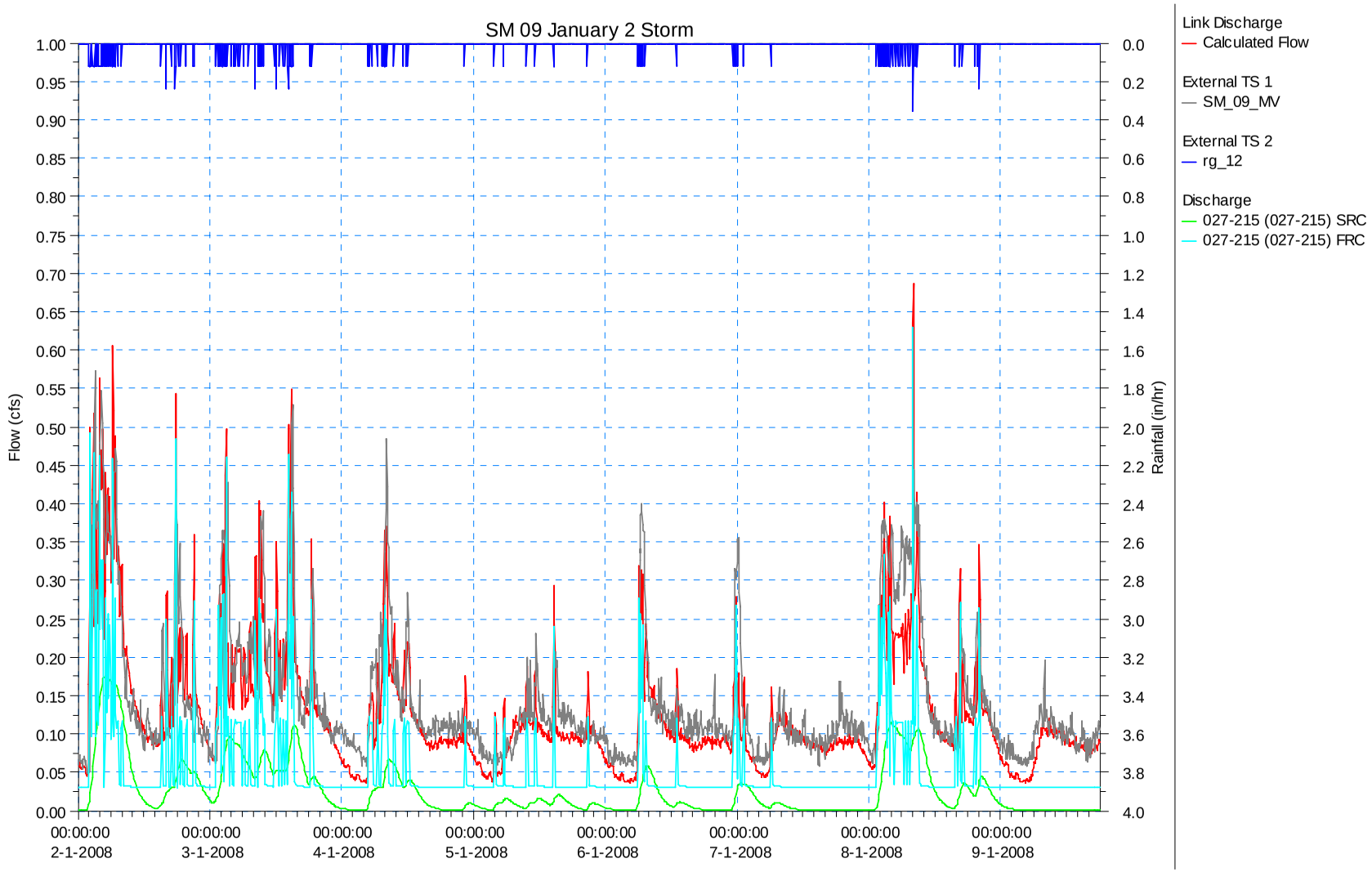

SM 08 January 2 Storm
Flow (cfs)
Rainfall (in/hr)
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_08_MV
External TS 2
rg_12
Discharge
027-010 (027-010) SRC
027-010 (027-010) FRC

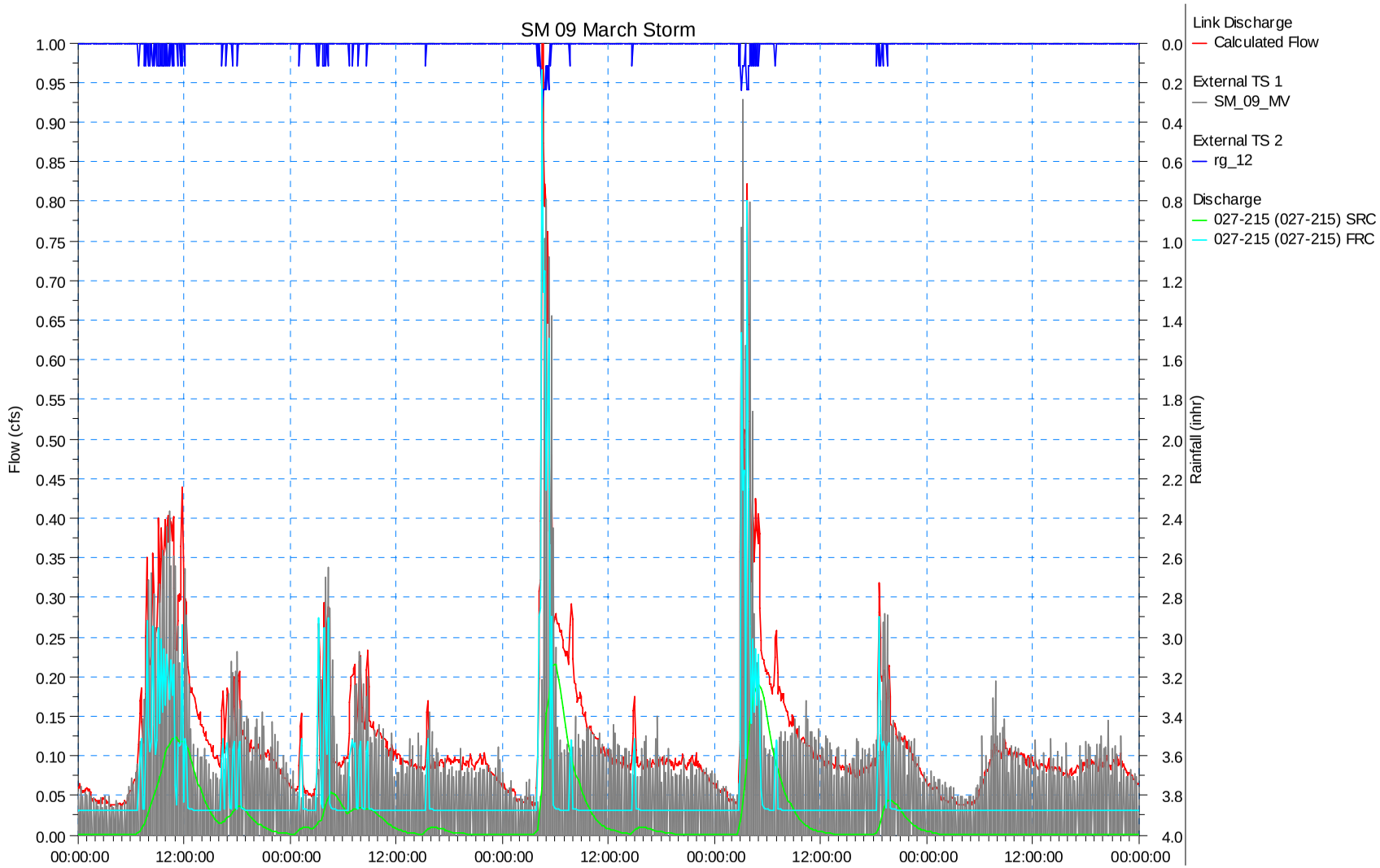

SM 08 March Storm
Flow (cfs)
Rainfall (in/hr)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 13-3-2008
12:00:00
00:00:00 14-3-2008
12:00:00
00:00:00 15-3-2008
12:00:00
00:00:00 16-3-2008
12:00:00
00:00:00 17-3-2008
12:00:00
00:00:00 18-3-2008
Link Discharge
Calculated Flow
External TS 1
SM_08_MV
External TS 2
rg_12
Discharge
027-010 (027-010) SRC
027-010 (027-010) FRC

SM 09

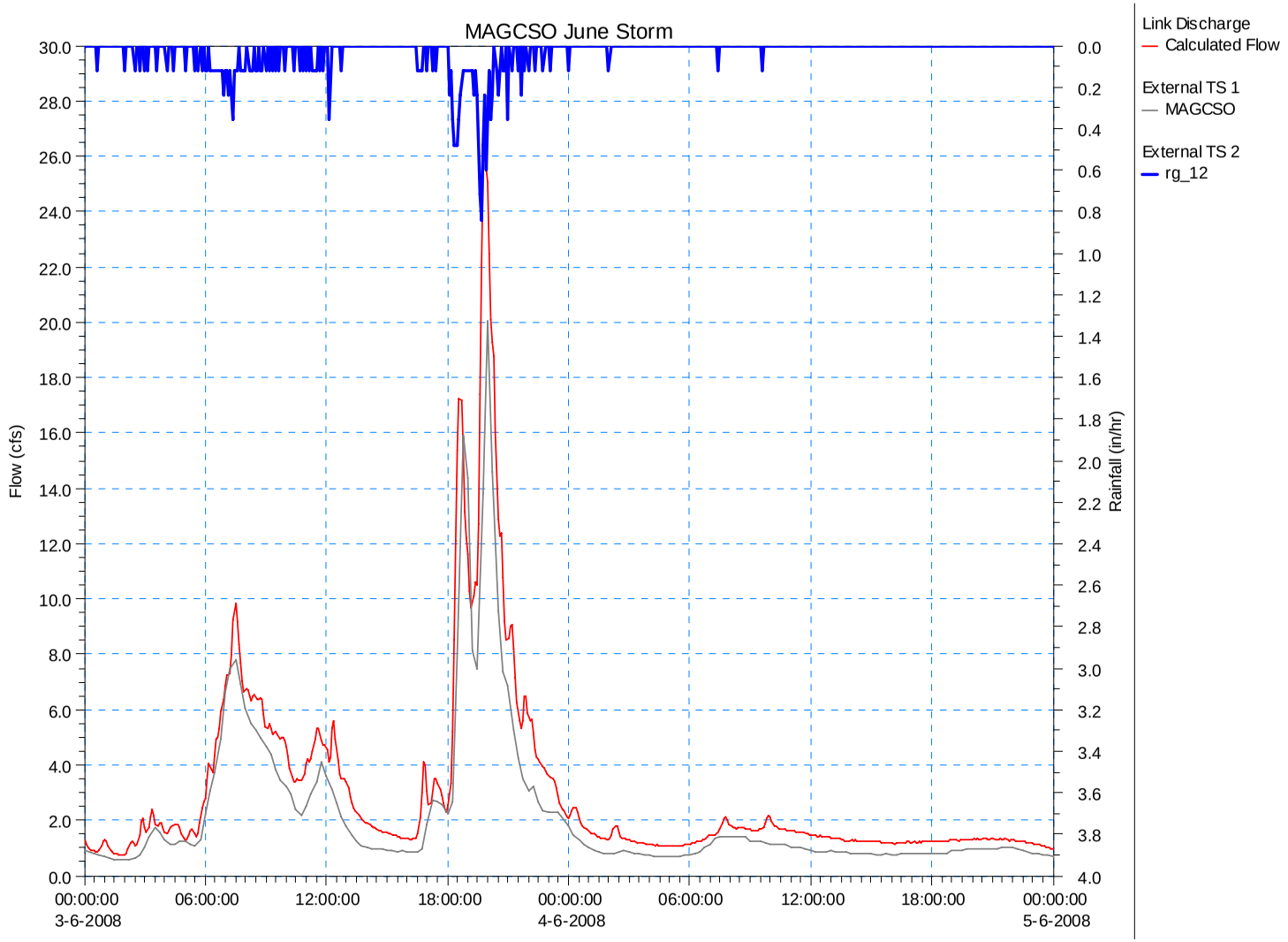

SM 09 June Storm
Flow (cfs)
Rainfall (in/hr)
00:00:00 3-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00 4-6-2008
04:00:00
08:00:00
12:00:00
16:00:00
20:00:00
00:00:00 5-6-2008
Link Discharge
Calculated Flow
External TS 1
SM_09_MV
External TS 2
rg_12
Discharge
027-215 (027-215) SRC
027-215 (027-215) FRC
Overland Flow
027-215 (027-215)
Interflow
027-215 (027-215)
Baseflow
027-215 (027-215)

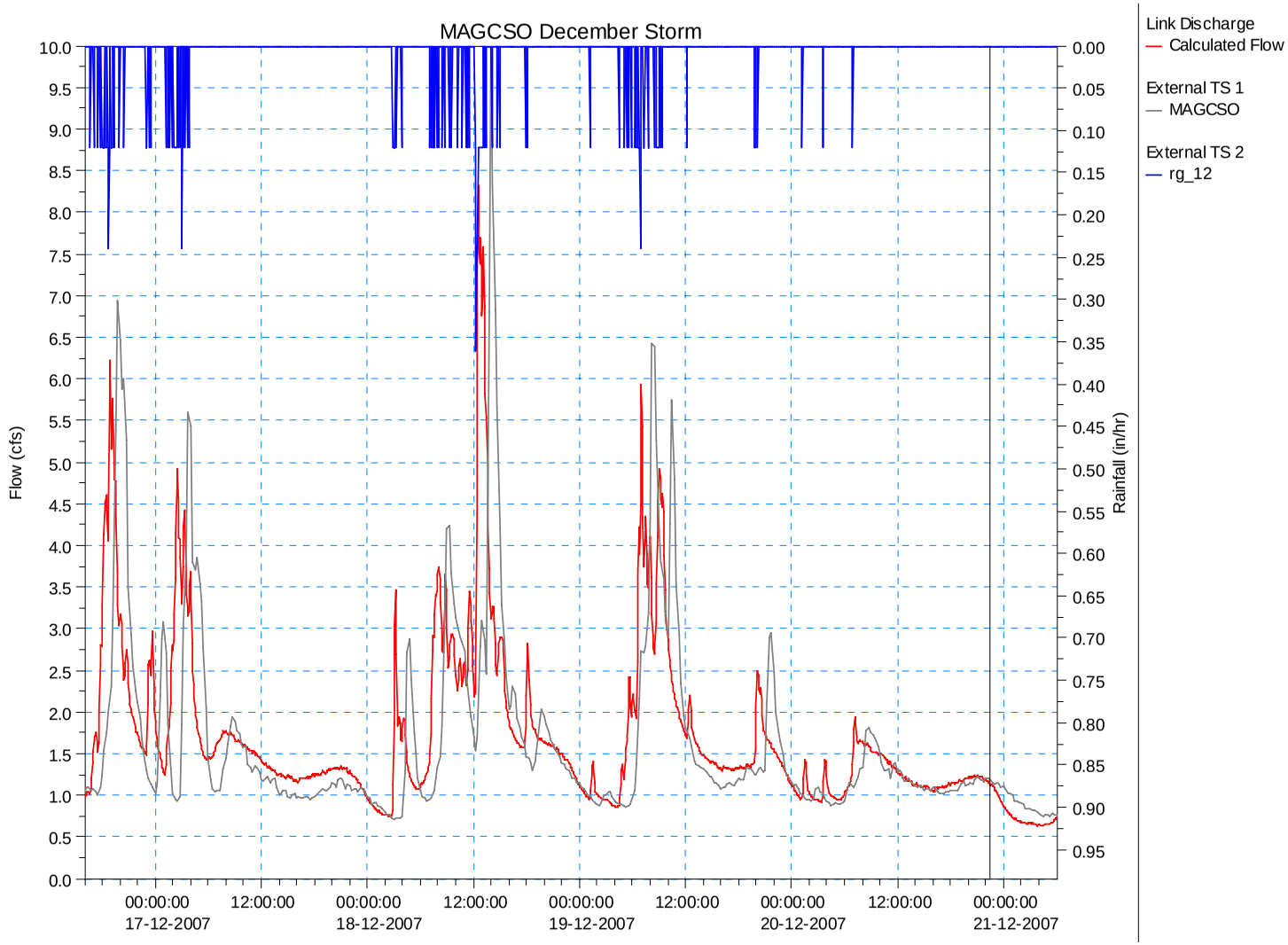

SM 09 December 16 Storm
Flow (cfs)
Rainfall (in/hr)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
SM_09_MV
External TS 2
rg_12
Discharge
027-215 (027-215) SRC
027-215 (027-215) FRC
Overland Flow
027-215 (027-215)
Interflow
027-215 (027-215)
Baseflow
027-215 (027-215)


SM 09 January 2 Storm
Flow (cfs)
Rainfall (in/hr)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00 2-1-2008
00:00:00 3-1-2008
00:00:00 4-1-2008
00:00:00 5-1-2008
00:00:00 6-1-2008
00:00:00 7-1-2008
00:00:00 8-1-2008
00:00:00 9-1-2008
Link Discharge
Calculated Flow
External TS 1
SM_09_MV
External TS 2
rg_12
Discharge
027-215 (027-215) SRC
027-215 (027-215) FRC


SM 09 March Storm
Flow (cfs)
Rainfall (inhr)
Link Discharge
Calculated Flow
External TS 1
SM_09_MV
External TS 2
rg_12
Discharge
027-215 (027-215) SRC
027-215 (027-215) FRC
00:00:00
12:00:00

MAGCSO


MAGCSO June Storm
Flow (cfs)
Rainfall (in/hr)
30.0
28.0
26.0
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
00:00:00
3-6-2008
06:00:00
12:00:00
18:00:00
00:00:00
4-6-2008
06:00:00
12:00:00
18:00:00
00:00:00
5-6-2008
Link Discharge
Calculated Flow
External TS 1
MAGCSO
External TS 2
rg_12


MAGCSO December Storm
Flow (cfs)
Rainfall (in/hr)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
0.70
0.75
0.80
0.85
0.90
0.95
00:00:00 17-12-2007
12:00:00
00:00:00 18-12-2007
12:00:00
00:00:00 19-12-2007
12:00:00
00:00:00 20-12-2007
12:00:00
00:00:00 21-12-2007
Link Discharge
Calculated Flow
External TS 1
MAGCSO
External TS 2
rg_12

Appendix B-6

UPDATED CSO CONTROL VOLUMES FOR PUGET SOUND BEACH CSOs, JUNE 2010

Technical Memorandum

Date: June 15, 2010

To: Shahrzad Namini

From: Bob Swarner (revised by Kevin Schock)

Cc: Bob Swarner

Subject: Updated CSO Control Volumes for Puget Sound Beach CSOs

This is a summary technical memorandum presenting the updated CSO control volumes for use in the Puget Sound Beach CSO Projects. A detailed technical memo is being written to provide more information and documentation comparing the results from two models and recent flow and overflow data.

King County calibrated each of the Puget Sound Beach CSO project areas using the County's Runoff Model and approximately 2 years of data collected prior to 2007. Subsequently Carollo Engineers calibrated the MOUSE model for sub-basins in each of the project basins using flowmeters that were placed in the sewers for 6 months from December 2007 through June 6, 2008. Both calibrated models were run for a 30-year long-term simulation to obtain the 1-year storage volume for each project basin. The resulting 1-year control volumes from each model differed from the other model's estimates, which is to be expected when to using a different model and a different calibration period.

A comparison of each model to the data gathered from early 2007 through June 2008 for each project area was performed (Schock, 2010). Flow data near the downstream portions of the basins were used to compare with the model output. For the Barton, Murray, and South Magnolia basins, it was concluded that we should continue to use the storage volume estimates I sent to you on October 8, 2009. The MOUSE model tends to underestimate flow more often than the Runoff model in the Barton and S. Magnolia basins and may be underestimating the required storage volume in those basins. In the Murray basin, the MOUSE model tends to overestimate flow when compared to the magnetic flowmeters at the pump stations and overestimates the number of overflow events.

For the North Beach basin, the MOUSE model matches the flow data near the pump station and the number of overflow events much better than the Runoff model, so I am recommending using the storage volume that is estimated using the MOUSE model. This volume is significantly lower than the previous volume estimate. The main reason for the difference is that, subsequent to the Runoff model calibration, a pump test revealed that the upstream meters used for the calibration were reading much higher flows than indicated by the pump test. Meters near the pump station were reading much closer to pump test flow results. This finding was used when providing Carollo with direction in

calibrating the MOUSE model. The meters near the pump station were used to adjust upstream meter data so that the total flow matched the "good" downstream meters. It was expected that the resulting storage volume from the MOUSE model would be lower than the original County 1-year CSO volume estimate for this basin. At North Beach Pump Station, the MOUSE model matches well with the flow data collected in 2007 and 2008.

The following is a table containing the updated CSO control volumes associated with the 3 conditions that WTD management has requested. The 3 conditions are:

1. The long-term average from the entire rainfall record;
2. The average of 20-year averages (e.g., the 1-year control volume is computed for each 20-year period in the 30 year record; then the eleven 1-year control volumes are averaged); and
3. The maximum 20 year rainfall period in the entire rainfall record. (The rainfall record is not repeated for this calculation.)

CSO storage Volumes for the 3 Conditions Specified by WTD Management and Peak flows.

Condition	Barton	Murray	South Magnolia	North Beach
	Design Vol. (MG)	Design Vol. (MG)	Design Vol. (MG)	Design Vol. (MG)
Long term Average [1]	0.11 [2]	0.99	1.8	0.19 [3]
Avg. of 20-year averages	0.05	0.81	1.8	0.18
Maximum 20-year Average [4]	0.16	0.97	1.9	0.19
Peak Flow (MGD)	48	46	12	8.5

1 – Rainfall record in simulation: July 1, 1978 – June 30, 2008
2 – Assumes Barton Pump Station will be upgraded to 33 mgd capacity.
3 – Assumes a pump station capacity of 3.4 mgd. Recent tests revealed that the pump station and force main capacity is 2.8 to 3 mgd.
4 – Without repeating the rainfall record.

The Barton CSO control volume in the table is based on the assumption that the Barton Pump Station will be upgraded from about 22 mgd to 33 mgd. The North Beach CSO volume is based on the assumption that the North Beach Pump Station and/or force main will be improved to achieve 3.4 mgd capacity. Currently it only has a capacity of 2.9 mgd, according to the December 11, 2009 tech memo from Mika Kaplan. The estimated North Beach CSO volume, pump capacity, and flow meter errors are discussed by Schock (2010).

Reference:

Schock, Kevin, 2010. Comparing Modeled Flow Events against Observed Events: Determining Preferred Model for Estimating CSO Storage Volumes. King County, DNRP.

Appendix B-7

FINAL CSO STORAGE VOLUMES FOR THE 3 CONDITIONS SPECIFIED BY WTD MANAGEMENT, AND PEAK FLOW RATE DECEMBER 2010

Final CSO Storage Volumes for the 3 Conditions Specified by WTD Management, and Peak Flow Rate (December 2010)

Condition	South Magnolia
	Design Criteria[2]
Long Term Average[1]	1.83 MG
Ave. of 20-year averages	1.83 MG
Maximum 20-year average[3]	1.90 MG
1-yr Recurrence interval Peak Flow	20.11 mgd

1 - Rainfaill record in simulation: July 1, 1978 -- June 30, 2008

2 - South Magnolia Trunk Capacity of 4.3 mgd

3 - Without repeating rainfall record

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)	
1	12/28/96 13:35	1/4/97 10:25	68.75	73.05	
2	4/3/91 6:57	4/7/91 14:44	56.68	60.98	
3	8/22/04 2:26	8/22/04 23:39	35.23	39.53	
4	12/1/07 19:33	12/6/07 16:07	34.22	38.52	
5	2/17/83 6:40	2/17/83 20:52	33.96	38.26	
6	11/2/78 18:55	11/4/78 1:39	31.05	35.35	
7	10/5/81 12:11	10/8/81 20:52	27.13	31.43	
8	9/12/97 1:39	9/12/97 15:16	26.37	30.67	
9	8/22/01 15:42	8/23/01 11:35	21.81	26.11	
10	12/14/06 10:18	12/15/06 1:21	21.24	25.54	
11	5/26/04 7:30	5/27/04 15:45	19.34	23.64	
12	12/4/03 20:13	12/5/03 23:40	19.34	23.64	
13	8/17/80 20:16	8/18/80 0:04	19.27	23.57	
14	9/27/81 5:58	9/29/81 2:25	19.22	23.52	
15	9/5/84 7:11	9/5/84 16:01	18.85	23.15	
16	8/9/91 2:18	8/9/91 20:38	18.64	22.94	
17	9/16/05 7:41	9/16/05 9:22	18.44	22.74	
18	8/12/78 16:01	8/12/78 16:47	18.13	22.43	
19	9/22/84 4:51	9/22/84 7:59	18.01	22.31	
20	6/10/83 0:26	6/10/83 3:31	17.97	22.27	
21	9/3/96 10:11	9/3/96 19:05	17.84	22.14	
22	6/3/08 6:31	6/3/08 22:38	17.19	21.49	
23	8/30/85 15:40	8/30/85 17:28	16.47	20.77	
24	10/25/86 1:29	10/26/86 17:59	16.31	20.61	
25	6/4/97 21:04	6/4/97 21:56	16.26	20.56	
26	12/1/87 1:40	12/3/87 6:47	16.19	20.49	
27	2/17/81 21:34	2/19/81 7:34	16.12	20.42	
28	5/15/05 2:25	5/15/05 8:15	16.08	20.38	
29	3/22/98 4:31	3/23/98 14:55	16.05	20.35	
30	**10/24/85 3:45**	**10/25/85 0:02**	**15.81**	**20.11**	1-yr recurrence peak flow
31	9/22/78 16:03	9/23/78 12:08	15.56	19.86	
32	6/27/01 7:38	6/28/01 0:29	15.33	19.63	
33	10/20/03 1:36	10/22/03 17:04	14.97	19.27	
34	10/17/07 16:17	10/19/07 17:15	14.94	19.24	
35	8/24/97 14:56	8/24/97 18:05	14.81	19.11	
36	5/20/07 15:16	5/21/07 21:46	14.74	19.04	
37	11/20/80 22:04	11/21/80 13:22	14.71	19.01	
38	11/23/90 14:18	11/25/90 14:04	14.40	18.70	
39	4/19/97 17:02	4/20/97 1:42	14.09	18.39	
40	11/11/05 14:01	11/11/05 16:17	14.01	18.31	
41	10/1/97 12:37	10/4/97 15:38	13.93	18.23	
42	8/28/05 18:36	8/28/05 19:46	13.91	18.21	
43	1/6/02 15:37	1/8/02 11:35	13.69	17.99	
44	9/3/92 21:00	9/4/92 2:52	13.03	17.33	
45	12/19/05 9:18	12/25/05 7:24	12.87	17.17	
46	8/30/96 11:31	8/30/96 12:17	12.87	17.17	
47	9/30/05 23:40	10/1/05 17:09	12.79	17.09	
48	1/15/86 19:27	1/20/86 19:36	12.50	16.80	
49	8/24/78 18:40	8/25/78 17:46	12.42	16.72	
50	11/5/80 18:08	11/7/80 16:01	12.36	16.66	
51	10/1/81 18:34	10/1/81 21:07	12.34	16.64	
52	4/16/92 10:47	4/17/92 21:10	12.34	16.64	
53	11/17/03 17:51	11/21/03 9:21	12.22	16.52	
54	4/22/96 12:28	4/25/96 17:00	12.21	16.51	
55	12/3/82 5:04	12/4/82 6:32	12.11	16.41	
56	10/13/96 0:20	10/13/96 7:37	12.04	16.34	
57	3/17/80 16:58	3/17/80 19:42	11.90	16.20	
58	9/15/97 15:17	9/17/97 17:12	11.85	16.15	

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
59	4/12/79 13:08	4/12/79 20:15	11.64	15.94
60	3/13/00 21:00	3/14/00 18:30	11.56	15.86
61	12/13/02 19:01	12/16/02 7:52	11.51	15.81
62	11/10/95 17:25	11/11/95 3:01	11.48	15.78
63	10/15/96 14:57	10/15/96 15:44	11.28	15.58
64	6/1/99 14:06	6/1/99 15:28	11.17	15.47
65	10/26/79 20:59	10/27/79 15:31	11.10	15.40
66	1/4/83 14:58	1/6/83 12:55	11.08	15.38
67	12/16/79 20:49	12/21/79 19:01	10.95	15.25
68	5/31/97 5:41	5/31/97 13:10	10.90	15.20
69	10/8/01 14:37	10/8/01 21:11	10.80	15.10
70	4/29/97 12:57	4/30/97 19:08	10.79	15.09
71	11/21/88 5:34	11/24/88 20:51	10.78	15.08
72	11/2/04 2:40	11/2/04 22:21	10.66	14.96
73	9/10/83 11:36	9/10/83 13:13	10.62	14.92
74	3/31/96 17:36	4/1/96 10:15	10.59	14.89
75	10/9/00 9:12	10/9/00 10:14	10.48	14.78
76	7/1/83 8:44	7/2/83 15:56	10.08	14.38
77	1/23/98 7:39	1/24/98 18:57	10.05	14.35
78	11/3/05 7:16	11/4/05 12:55	9.95	14.25
79	3/19/07 19:18	3/20/07 20:04	9.94	14.24
80	4/13/93 18:33	4/13/93 21:05	9.89	14.19
81	4/16/05 4:49	4/16/05 9:47	9.84	14.14
82	6/8/81 7:11	6/8/81 10:59	9.80	14.10
83	4/26/97 20:34	4/27/97 7:17	9.77	14.07
84	12/2/89 11:38	12/4/89 22:30	9.77	14.07
85	1/9/90 4:17	1/9/90 20:33	9.73	14.03
86	4/29/01 8:38	4/30/01 9:25	9.59	13.89
87	4/16/01 22:25	4/17/01 0:11	9.56	13.86
88	11/13/01 14:02	11/16/01 6:10	9.50	13.80
89	1/31/06 14:19	2/2/06 17:14	9.35	13.65
90	1/5/90 15:00	1/8/90 2:53	9.31	13.61
91	10/11/03 9:23	10/11/03 18:14	9.29	13.59
92	1/9/06 1:59	1/12/06 17:07	9.28	13.58
93	11/11/81 7:43	11/12/81 3:28	9.25	13.55
94	11/1/83 11:22	11/4/83 4:15	9.18	13.48
95	12/2/96 8:20	12/2/96 10:16	9.17	13.47
96	1/27/87 16:17	1/28/87 18:27	9.17	13.47
97	11/1/84 11:03	11/3/84 15:25	9.13	13.43
98	1/4/03 5:05	1/4/03 12:34	9.13	13.43
99	11/19/86 16:24	11/20/86 15:35	9.12	13.42
100	1/12/88 23:59	1/15/88 20:44	9.10	13.40
101	11/4/06 13:48	11/7/06 14:48	9.04	13.34
102	9/16/85 8:10	9/17/85 2:44	9.00	13.30
103	11/28/95 16:21	11/29/95 14:19	9.00	13.30
104	5/16/88 0:44	5/16/88 13:05	9.00	13.30
105	3/18/97 6:37	3/20/97 19:49	8.99	13.29
106	6/22/93 14:28	6/22/93 15:03	8.99	13.29
107	5/12/88 19:28	5/12/88 21:02	8.94	13.24
108	11/30/94 2:54	11/30/94 9:10	8.80	13.10
109	1/10/80 12:26	1/12/80 9:56	8.74	13.04
110	9/13/96 19:26	9/15/96 4:11	8.73	13.03
111	5/16/03 19:05	5/16/03 21:20	8.69	12.99
112	3/5/87 11:26	3/6/87 0:19	8.68	12.98
113	11/28/01 6:05	12/1/01 19:34	8.65	12.95
114	12/17/94 2:06	12/18/94 5:11	8.61	12.91
115	10/26/85 5:21	10/27/85 21:26	8.57	12.87
116	10/28/96 14:28	10/28/96 18:00	8.57	12.87

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
117	9/23/92 12:46	9/23/92 19:33	8.55	12.85
118	12/4/90 2:40	12/4/90 12:01	8.52	12.82
119	12/19/94 9:37	12/20/94 22:23	8.41	12.71
120	10/29/97 5:48	10/30/97 20:20	8.39	12.69
121	11/27/96 9:04	11/27/96 20:39	8.38	12.68
122	10/11/85 14:49	10/11/85 15:28	8.38	12.68
123	2/23/99 18:41	2/24/99 19:00	8.34	12.64
124	6/14/86 13:18	6/14/86 13:53	8.33	12.63
125	6/24/99 1:31	6/24/99 9:00	8.24	12.54
126	2/8/96 2:51	2/9/96 11:04	8.22	12.52
127	11/16/02 8:34	11/16/02 14:56	8.18	12.48
128	6/26/82 8:19	6/26/82 9:15	8.15	12.45
129	4/15/78 16:06	4/16/78 9:16	8.13	12.43
130	12/11/06 4:18	12/12/06 22:27	8.09	12.39
131	10/27/98 17:34	10/27/98 22:50	8.06	12.36
132	5/8/83 16:12	5/8/83 17:19	8.05	12.35
133	1/5/06 7:53	1/6/06 0:03	7.97	12.27
134	10/25/94 18:40	10/27/94 3:26	7.96	12.26
135	11/13/84 12:09	11/13/84 18:57	7.92	12.22
136	10/8/97 6:17	10/8/97 19:06	7.90	12.20
137	1/1/03 10:45	1/2/03 23:43	7.79	12.09
138	10/23/78 19:47	10/23/78 21:50	7.74	12.04
139	1/9/08 22:30	1/10/08 0:18	7.73	12.03
140	11/2/88 7:17	11/5/88 16:57	7.71	12.01
141	12/30/05 14:44	12/31/05 4:02	7.71	12.01
142	8/16/99 13:28	8/16/99 14:02	7.69	11.99
143	7/24/91 13:43	7/24/91 15:08	7.62	11.92
144	11/23/97 19:01	11/23/97 20:45	7.60	11.90
145	11/16/82 6:48	11/17/82 13:37	7.58	11.88
146	2/5/96 10:02	2/6/96 10:37	7.54	11.84
147	12/5/87 11:31	12/6/87 18:49	7.47	11.77
148	3/2/87 14:08	3/4/87 8:00	7.45	11.75
149	10/2/95 4:01	10/2/95 4:44	7.39	11.69
150	12/2/03 18:57	12/2/03 19:41	7.37	11.67
151	3/22/85 5:01	3/24/85 13:06	7.32	11.62
152	**1/29/06 14:06**	**1/30/06 10:52**	**7.31**	11.61
153	5/28/01 10:03	5/28/01 10:48	7.27	11.57
154	7/9/79 22:33	7/10/79 3:34	7.26	11.56
155	1/2/84 2:17	1/3/84 2:28	7.23	11.53
156	12/4/81 18:29	12/6/81 5:52	7.19	11.49
157	12/26/06 16:29	12/27/06 2:12	7.16	11.46
158	9/3/94 8:58	9/3/94 11:05	7.15	11.45
159	12/24/80 1:54	12/27/80 0:59	7.15	11.45
160	3/9/91 11:48	3/9/91 12:23	7.14	11.44
161	4/1/89 17:53	4/1/89 18:42	7.10	11.40
162	10/21/82 16:12	10/22/82 13:01	7.05	11.35
163	10/24/07 12:09	10/24/07 19:47	7.03	11.33
164	7/16/78 4:41	7/16/78 9:08	7.02	11.32
165	1/19/02 7:51	1/19/02 8:29	7.02	11.32
166	11/15/07 15:48	11/16/07 1:33	6.97	11.27
167	1/17/05 4:02	1/18/05 22:23	6.88	11.18
168	12/2/80 7:09	12/2/80 17:08	6.88	11.18
169	2/22/96 19:37	2/22/96 21:19	6.86	11.16
170	10/24/06 6:11	10/24/06 8:26	6.84	11.14
171	11/17/07 11:45	11/17/07 13:38	6.81	11.11
172	9/3/07 23:41	9/4/07 8:53	6.80	11.10
173	4/9/02 13:39	4/10/02 0:30	6.79	11.09
174	12/13/01 20:04	12/13/01 21:04	6.78	11.08

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
175	1/13/03 21:40	1/13/03 22:32	6.74	11.04
176	8/29/06 20:26	8/29/06 21:09	6.69	10.99
177	8/23/93 15:31	8/23/93 16:10	6.68	10.98
178	4/7/87 20:01	4/7/87 22:39	6.63	10.93
179	10/22/85 1:48	10/22/85 13:59	6.62	10.92
180	12/15/81 0:29	12/15/81 12:22	6.62	10.92
181	4/8/80 20:31	4/9/80 16:21	6.61	10.91
182	5/15/78 12:19	5/15/78 13:43	6.61	10.91
183	3/10/82 21:46	3/11/82 2:39	6.56	10.86
184	10/14/79 20:53	10/14/79 21:54	6.49	10.79
185	9/16/02 18:41	9/16/02 19:19	6.49	10.79
186	7/26/78 12:45	7/26/78 18:06	6.48	10.78
187	11/10/89 10:28	11/10/89 14:07	6.47	10.77
188	11/23/86 4:39	11/24/86 12:34	6.47	10.77
189	4/29/93 14:18	4/30/93 5:05	6.39	10.69
190	11/7/95 5:56	11/8/95 12:36	6.37	10.67
191	**12/28/86 11:47**	**12/29/86 13:19**	**6.37**	10.67
192	2/3/91 7:39	2/4/91 20:54	6.33	10.63
193	4/30/87 4:14	4/30/87 20:17	6.33	10.63
194	11/28/80 23:04	11/29/80 1:28	6.26	10.56
195	12/9/95 17:06	12/14/95 19:58	6.26	10.56
196	2/13/81 21:33	2/14/81 13:25	6.24	10.54
197	1/29/95 1:48	2/1/95 13:09	6.20	10.50
198	5/28/02 20:35	5/28/02 21:23	6.17	10.47
199	1/28/04 9:09	1/30/04 1:22	6.14	10.44
200	3/1/91 11:07	3/2/91 22:49	6.11	10.41
201	2/21/02 1:44	2/23/02 9:13	6.10	10.40
202	5/15/01 5:11	5/15/01 7:26	6.08	10.38
203	1/31/87 2:51	2/1/87 4:05	6.07	10.37
204	6/22/05 7:30	6/22/05 9:29	6.07	10.37
205	11/24/95 15:28	11/24/95 18:28	6.06	10.36
206	11/25/86 17:41	11/26/86 22:24	6.04	10.34
207	4/8/84 16:20	4/9/84 20:24	6.02	10.32
208	5/24/85 16:00	5/24/85 20:42	6.01	10.31
209	11/15/96 4:03	11/15/96 9:33	6.00	10.30
210	9/1/79 22:58	9/3/79 11:41	6.00	10.30
211	11/8/06 19:23	11/8/06 21:34	5.95	10.25
212	5/30/90 15:24	5/30/90 23:36	5.94	10.24
213	1/27/92 8:06	1/31/92 20:46	5.93	10.23
214	10/19/00 21:22	10/20/00 8:47	5.92	10.22
215	11/5/05 15:07	11/5/05 21:05	5.92	10.22
216	11/5/86 13:00	11/5/86 20:23	5.91	10.21
217	11/10/84 6:14	11/11/84 3:52	5.89	10.19
218	11/13/87 8:15	11/13/87 10:28	5.89	10.19
219	11/19/82 10:10	11/19/82 12:14	5.88	10.18
220	2/18/95 9:44	2/19/95 22:08	5.88	10.18
221	9/1/83 1:37	9/1/83 19:13	5.87	10.17
222	12/14/84 13:26	12/14/84 16:11	5.86	10.16
223	12/20/80 10:30	12/21/80 17:05	5.86	10.16
224	11/12/06 18:30	11/13/06 1:41	5.76	10.06
225	1/17/99 14:04	1/18/99 17:55	5.75	10.05
226	10/4/90 13:16	10/4/90 19:00	5.75	10.05
227	10/3/98 16:35	10/3/98 18:11	5.74	10.04
228	12/12/02 12:07	12/12/02 16:51	5.71	10.01
229	2/19/91 2:38	2/19/91 7:47	5.69	9.99
230	1/23/82 17:59	1/23/82 20:31	5.68	9.98
231	8/29/83 20:10	8/30/83 1:23	5.67	9.97
232	6/20/84 10:25	6/20/84 22:26	5.65	9.95

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
233	10/28/90 12:19	10/28/90 13:05	5.63	9.93
234	6/20/86 12:41	6/20/86 13:12	5.61	9.91
235	3/5/89 15:00	3/6/89 22:51	5.54	9.84
236	2/16/03 15:37	2/16/03 17:57	5.53	9.83
237	9/1/78 1:23	9/1/78 19:34	5.53	9.83
238	2/4/86 17:03	2/4/86 18:51	5.52	9.82
239	2/27/99 2:05	2/28/99 15:03	5.51	9.81
240	11/24/98 22:18	11/26/98 10:56	5.50	9.80
241	3/5/92 21:31	3/5/92 22:28	5.50	9.80
242	11/23/83 22:58	11/24/83 7:08	5.45	9.75
243	1/7/07 5:17	1/7/07 7:59	5.45	9.75
244	6/10/78 16:38	6/10/78 17:09	5.42	9.72
245	1/20/06 1:52	1/20/06 2:57	5.41	9.71
246	10/16/01 11:07	10/16/01 14:09	5.41	9.71
247	1/1/07 18:15	1/3/07 8:28	5.40	9.70
248	1/24/02 23:49	1/25/02 8:02	5.38	9.68
249	5/22/96 2:56	5/22/96 19:43	5.34	9.64
250	7/13/81 5:30	7/13/81 12:05	5.27	9.57
251	3/21/03 18:35	3/22/03 6:47	5.26	9.56
252	12/1/81 17:11	12/2/81 7:13	5.23	9.53
253	6/16/05 22:50	6/17/05 0:29	5.21	9.51
254	8/6/97 15:52	8/6/97 16:21	5.19	9.49
255	12/9/87 8:55	12/9/87 18:33	5.19	9.49
256	7/16/99 0:41	7/16/99 22:11	5.18	9.48
257	9/24/88 14:20	9/25/88 6:49	5.17	9.47
258	9/25/98 12:41	9/25/98 13:51	5.16	9.46
259	1/13/98 2:18	1/14/98 18:00	5.15	9.45
260	12/3/80 19:21	12/3/80 20:15	5.15	9.45
261	3/29/05 13:23	3/29/05 13:59	5.15	9.45
262	2/21/92 5:11	2/21/92 22:06	5.14	9.44
263	3/23/86 13:17	3/23/86 18:26	5.14	9.44
264	2/6/05 8:29	2/6/05 14:47	5.13	9.43
265	11/7/97 4:44	11/7/97 14:24	5.13	9.43
266	10/24/79 6:42	10/25/79 4:43	5.12	9.42
267	11/25/05 6:10	11/25/05 17:04	5.12	9.42
268	1/14/08 14:46	1/14/08 18:31	5.10	9.40
269	2/3/06 23:59	2/4/06 8:51	5.10	9.40
270	4/2/94 23:18	4/3/94 20:45	5.07	9.37
271	6/6/90 7:28	6/6/90 9:52	5.05	9.35
272	6/12/78 10:29	6/13/78 17:46	5.05	9.35
273	1/14/96 17:11	1/15/96 19:34	5.02	9.32
274	11/19/83 8:56	11/20/83 7:24	5.02	9.32
275	11/20/98 5:05	11/22/98 0:09	5.00	9.30
276	12/21/81 10:42	12/21/81 11:27	4.99	9.29
277	5/28/92 17:00	5/28/92 17:59	4.99	9.29
278	8/26/97 13:16	8/27/97 17:14	4.97	9.27
279	10/17/96 17:22	10/17/96 21:22	4.97	9.27
280	1/28/90 10:58	1/29/90 16:01	4.97	9.27
281	11/16/91 9:14	11/17/91 14:40	4.96	9.26
282	11/17/88 5:36	11/17/88 7:48	4.95	9.25
283	8/6/95 13:52	8/6/95 18:05	4.94	9.24
284	10/28/89 3:14	10/28/89 3:50	4.89	9.19
285	12/25/03 17:19	12/25/03 18:55	4.88	9.18
286	5/10/04 13:01	5/11/04 2:07	4.88	9.18
287	4/30/88 14:21	4/30/88 15:31	4.87	9.17
288	9/8/78 17:59	9/9/78 17:26	4.86	9.16
289	6/5/95 0:01	6/5/95 7:39	4.86	9.16
290	5/23/06 9:25	5/23/06 10:19	4.84	9.14

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
291	9/1/04 6:14	9/1/04 6:47	4.83	9.13
292	5/4/03 17:23	5/5/03 19:11	4.83	9.13
293	7/3/98 5:34	7/3/98 9:22	4.80	9.10
294	3/26/05 3:58	3/27/05 7:00	4.77	9.07
295	4/11/81 12:48	4/12/81 9:29	4.77	9.07
296	8/21/79 12:31	8/21/79 12:59	4.77	9.07
297	5/31/93 6:15	5/31/93 10:30	4.76	9.06
298	1/14/06 16:51	1/14/06 19:53	4.70	9.00
299	6/2/88 16:14	6/2/88 20:43	4.67	8.97
300	11/14/81 0:03	11/15/81 15:08	4.63	8.93
301	10/31/92 16:00	11/1/92 18:27	4.62	8.92
302	3/25/88 19:17	3/26/88 17:28	4.59	8.89
303	1/5/07 18:38	1/5/07 22:09	4.59	8.89
304	10/3/07 15:51	10/3/07 16:26	4.58	8.88
305	4/18/78 20:44	4/19/78 18:45	4.51	8.81
306	12/14/82 11:33	12/17/82 19:51	4.50	8.80
307	12/9/04 19:06	12/11/04 1:42	4.49	8.79
308	7/4/92 7:19	7/5/92 16:11	4.47	8.77
309	4/28/80 0:15	4/28/80 0:49	4.44	8.74
310	10/23/89 9:56	10/23/89 11:19	4.42	8.72
311	10/28/82 13:23	10/28/82 19:13	4.38	8.68
312	6/1/88 12:34	6/1/88 13:24	4.37	8.67
313	11/19/97 10:56	11/19/97 23:38	4.37	8.67
314	11/15/06 5:43	11/15/06 18:19	4.37	8.67
315	3/28/85 19:46	3/28/85 22:07	4.36	8.66
316	3/1/82 1:58	3/1/82 7:41	4.36	8.66
317	12/10/96 15:33	12/10/96 16:12	4.36	8.66
318	2/25/80 23:12	2/27/80 15:04	4.33	8.63
319	3/8/07 3:48	3/8/07 4:40	4.30	8.60
320	3/15/81 20:39	3/15/81 21:55	4.30	8.60
321	5/11/84 5:09	5/11/84 7:50	4.29	8.59
322	1/5/86 10:43	1/5/86 14:12	4.29	8.59
323	10/19/79 14:21	10/19/79 15:50	4.28	8.58
324	7/25/83 9:37	7/25/83 16:16	4.28	8.58
325	12/1/79 12:34	12/2/79 1:05	4.26	8.56
326	12/4/96 8:50	12/4/96 14:59	4.24	8.54
327	2/7/00 16:35	2/8/00 17:23	4.23	8.53
328	4/7/88 14:02	4/7/88 14:35	4.19	8.49
329	11/15/03 14:47	11/16/03 11:49	4.18	8.48
330	12/21/86 9:14	12/22/86 19:26	4.18	8.48
331	8/16/95 22:54	8/17/95 9:31	4.15	8.45
332	8/21/89 16:44	8/21/89 22:12	4.14	8.44
333	4/23/98 11:31	4/23/98 14:01	4.13	8.43
334	7/6/81 22:36	7/7/81 2:24	4.13	8.43
335	3/12/03 10:28	3/13/03 21:44	4.13	8.43
336	3/20/84 12:55	3/20/84 18:47	4.13	8.43
337	11/17/81 9:43	11/17/81 12:23	4.11	8.41
338	5/1/84 11:45	5/1/84 20:13	4.11	8.41
339	4/18/85 23:06	4/19/85 5:05	4.08	8.38
340	3/11/89 3:33	3/11/89 7:28	4.07	8.37
341	12/15/01 14:11	12/16/01 23:19	4.06	8.36
342	4/17/86 16:19	4/17/86 20:09	4.05	8.35
343	10/20/85 1:11	10/20/85 7:59	4.04	8.34
344	1/16/98 4:36	1/17/98 7:40	4.04	8.34
345	3/29/83 10:13	3/30/83 16:42	4.03	8.33
346	11/22/01 8:07	11/22/01 18:46	4.02	8.32
347	10/6/93 17:09	10/6/93 18:10	4.00	8.30
348	6/1/80 6:03	6/2/80 6:54	4.00	8.30

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
349	3/25/04 17:37	3/25/04 19:17	4.00	8.30
350	6/3/97 15:21	6/3/97 15:52	3.99	8.29
351	3/25/08 23:55	3/26/08 20:42	3.98	8.28
352	10/15/03 9:41	10/17/03 7:50	3.96	8.26
353	2/1/86 6:30	2/1/86 6:57	3.96	8.26
354	11/26/06 9:46	11/27/06 1:03	3.96	8.26
355	2/8/83 23:47	2/9/83 5:49	3.95	8.25
356	6/12/95 20:50	6/12/95 21:51	3.94	8.24
357	12/9/91 4:58	12/9/91 5:48	3.93	8.23
358	4/4/92 14:05	4/4/92 14:49	3.93	8.23
359	5/7/81 13:46	5/7/81 18:43	3.93	8.23
360	11/30/96 16:47	11/30/96 17:24	3.92	8.22
361	11/12/02 6:51	11/12/02 21:21	3.91	8.21
362	4/12/01 17:29	4/12/01 18:23	3.91	8.21
363	3/15/08 4:37	3/16/08 4:20	3.91	8.21
364	8/6/92 8:07	8/6/92 12:22	3.89	8.19
365	9/9/88 19:52	9/9/88 20:19	3.89	8.19
366	2/5/90 14:14	2/5/90 14:52	3.89	8.19
367	12/15/84 17:36	12/15/84 21:01	3.89	8.19
368	12/1/94 18:20	12/1/94 18:49	3.89	8.19
369	7/2/90 3:06	7/2/90 7:59	3.88	8.18
370	2/24/79 15:29	2/25/79 18:36	3.87	8.17
371	11/2/06 7:32	11/3/06 12:05	3.86	8.16
372	5/4/85 14:55	5/4/85 15:28	3.82	8.12
373	12/11/98 12:17	12/13/98 20:49	3.82	8.12
374	6/9/08 15:03	6/9/08 15:42	3.80	8.10
375	6/15/98 12:04	6/15/98 20:43	3.78	8.08
376	6/6/85 11:36	6/7/85 17:58	3.77	8.07
377	1/3/01 18:09	1/4/01 19:54	3.77	8.07
378	3/3/81 16:46	3/3/81 21:11	3.76	8.06
379	1/25/82 20:42	1/26/82 10:07	3.72	8.02
380	10/12/90 13:22	10/12/90 13:54	3.72	8.02
381	9/7/79 22:28	9/7/79 23:34	3.71	8.01
382	11/20/06 16:47	11/23/06 11:24	3.70	8.00
383	12/7/83 16:22	12/10/83 16:18	3.70	8.00
384	8/2/96 7:54	8/2/96 18:27	3.69	7.99
385	11/19/01 7:59	11/21/01 4:56	3.68	7.98
386	4/7/02 2:01	4/7/02 2:28	3.65	7.95
387	4/12/95 22:34	4/14/95 13:52	3.64	7.94
388	3/15/92 3:42	3/15/92 9:09	3.63	7.93
389	6/2/90 23:22	6/4/90 13:33	3.63	7.93
390	10/10/01 23:07	10/10/01 23:36	3.63	7.93
391	9/13/04 5:19	9/13/04 6:17	3.63	7.93
392	12/8/93 11:36	12/10/93 8:17	3.63	7.93
393	2/16/89 13:50	2/18/89 3:32	3.61	7.91
394	6/2/01 17:00	6/3/01 2:00	3.61	7.91
395	5/3/97 12:16	5/3/97 16:31	3.61	7.91
396	4/15/02 14:38	4/15/02 18:13	3.57	7.87
397	10/9/84 21:18	10/10/84 22:48	3.57	7.87
398	6/28/93 6:30	6/28/93 7:04	3.57	7.87
399	4/29/06 13:18	4/29/06 17:18	3.57	7.87
400	10/28/05 2:04	10/28/05 18:02	3.56	7.86
401	5/17/82 1:21	5/17/82 2:04	3.55	7.85
402	10/29/06 9:37	10/29/06 10:18	3.55	7.85
403	3/8/83 13:30	3/10/83 3:48	3.53	7.83
404	1/20/96 6:51	1/21/96 5:54	3.50	7.80
405	6/10/01 14:26	6/11/01 21:51	3.49	7.79
406	3/15/97 10:00	3/15/97 16:45	3.49	7.79

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
407	11/20/81 23:48	11/23/81 7:21	3.49	7.79
408	5/26/82 7:23	5/26/82 10:58	3.48	7.78
409	12/20/06 21:26	12/21/06 16:18	3.48	7.78
410	2/22/83 19:27	2/23/83 9:19	3.47	7.77
411	11/30/93 21:38	12/1/93 14:53	3.45	7.75
412	9/9/94 18:19	9/9/94 22:58	3.45	7.75
413	4/13/02 17:09	4/13/02 23:31	3.44	7.74
414	12/24/98 11:43	12/25/98 18:06	3.44	7.74
415	11/10/83 5:45	11/11/83 4:21	3.44	7.74
416	7/1/93 23:44	7/2/93 8:50	3.43	7.73
417	1/26/98 0:25	1/26/98 0:56	3.42	7.72
418	4/17/82 13:02	4/17/82 13:36	3.42	7.72
419	4/8/91 17:32	4/9/91 14:13	3.42	7.72
420	2/16/01 15:08	2/16/01 20:00	3.41	7.71
421	2/11/79 18:55	2/13/79 7:35	3.40	7.70
422	7/9/95 10:20	7/9/95 14:00	3.40	7.70
423	5/14/83 19:30	5/15/83 1:56	3.39	7.69
424	2/11/84 5:46	2/11/84 7:31	3.37	7.67
425	10/6/82 4:11	10/6/82 9:49	3.35	7.65
426	5/22/97 14:03	5/22/97 14:29	3.35	7.65
427	3/16/93 18:37	3/16/93 20:32	3.35	7.65
428	9/10/04 22:28	9/11/04 1:19	3.35	7.65
429	11/26/07 17:56	11/26/07 19:36	3.32	7.62
430	6/20/97 22:44	6/21/97 0:30	3.31	7.61
431	1/9/89 23:44	1/10/89 0:17	3.30	7.60
432	3/7/78 2:58	3/7/78 19:36	3.30	7.60
433	12/18/81 9:09	12/19/81 13:10	3.30	7.60
434	11/4/85 2:05	11/4/85 2:42	3.29	7.59
435	6/24/80 22:57	6/25/80 2:18	3.29	7.59
436	10/30/05 21:56	10/31/05 5:07	3.29	7.59
437	2/1/78 10:41	2/2/78 17:24	3.28	7.58
438	3/12/83 11:04	3/12/83 13:57	3.28	7.58
439	9/10/85 4:37	9/10/85 5:56	3.27	7.57
440	5/13/78 23:54	5/14/78 11:29	3.24	7.54
441	12/24/06 13:15	12/24/06 20:35	3.23	7.53
442	2/13/94 2:09	2/13/94 9:13	3.23	7.53
443	5/3/81 15:27	5/3/81 16:25	3.22	7.52
444	10/30/83 19:29	10/30/83 19:57	3.20	7.50
445	1/16/06 17:17	1/16/06 22:55	3.19	7.49
446	12/13/81 14:59	12/13/81 16:39	3.18	7.48
447	12/3/95 19:01	12/3/95 21:17	3.16	7.46
448	3/11/07 12:07	3/11/07 13:37	3.16	7.46
449	11/8/00 3:01	11/8/00 10:18	3.15	7.45
450	9/9/82 3:31	9/9/82 4:48	3.13	7.43
451	11/11/89 15:08	11/12/89 3:33	3.11	7.41
452	1/25/83 23:59	1/26/83 0:42	3.11	7.41
453	4/1/03 17:26	4/1/03 20:32	3.10	7.40
454	1/5/98 4:11	1/5/98 10:07	3.10	7.40
455	1/11/91 2:06	1/12/91 8:58	3.09	7.39
456	1/27/90 6:40	1/27/90 8:21	3.07	7.37
457	5/9/05 18:28	5/10/05 0:58	3.06	7.36
458	3/14/84 20:44	3/14/84 21:25	3.06	7.36
459	12/26/94 0:20	12/27/94 10:28	3.06	7.36
460	11/23/84 6:07	11/23/84 11:39	3.06	7.36
461	2/17/96 6:16	2/17/96 16:09	3.05	7.35
462	2/14/78 17:04	2/14/78 22:51	3.05	7.35
463	11/21/93 10:04	11/21/93 13:37	3.05	7.35
464	1/31/80 17:59	2/2/80 13:43	3.04	7.34

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
465	12/16/97 6:29	12/17/97 13:27	3.04	7.34
466	2/18/82 10:00	2/20/82 3:01	3.03	7.33
467	4/6/88 3:26	4/6/88 6:30	3.03	7.33
468	4/12/96 17:30	4/12/96 18:54	3.03	7.33
469	1/6/04 20:58	1/8/04 11:26	3.02	7.32
470	4/13/82 0:24	4/13/82 1:30	3.02	7.32
471	12/14/79 19:14	12/14/79 20:57	3.00	7.30
472	3/10/02 11:39	3/12/02 8:12	2.99	7.29
473	10/10/95 5:45	10/11/95 3:46	2.98	7.28
474	6/16/80 14:45	6/16/80 15:30	2.98	7.28
475	12/18/07 12:33	12/19/07 9:23	2.94	7.24
476	1/19/08 14:40	1/19/08 15:48	2.92	7.22
477	1/21/03 11:04	1/23/03 3:05	2.92	7.22
478	11/12/07 6:12	11/12/07 11:31	2.91	7.21
479	11/30/98 17:32	12/2/98 0:02	2.91	7.21
480	2/10/83 16:51	2/12/83 5:03	2.89	7.19
481	7/26/95 1:07	7/26/95 3:31	2.89	7.19
482	11/3/96 15:55	11/3/96 16:27	2.88	7.18
483	6/16/06 11:03	6/16/06 12:07	2.87	7.17
484	1/2/86 12:29	1/2/86 20:47	2.86	7.16
485	11/12/90 19:56	11/13/90 5:51	2.85	7.15
486	9/8/85 21:53	9/8/85 22:34	2.85	7.15
487	12/13/04 9:01	12/13/04 20:17	2.84	7.14
488	11/13/83 17:30	11/17/83 16:48	2.83	7.13
489	3/23/08 5:38	3/23/08 14:04	2.82	7.12
490	10/12/01 18:31	10/12/01 19:07	2.82	7.12
491	3/22/93 6:38	3/23/93 0:11	2.82	7.12
492	12/10/92 4:47	12/10/92 21:23	2.81	7.11
493	4/22/97 18:59	4/22/97 22:33	2.80	7.10
494	4/23/90 16:08	4/23/90 17:09	2.80	7.10
495	12/26/05 7:33	12/28/05 9:35	2.80	7.10
496	11/19/06 8:08	11/19/06 11:31	2.79	7.09
497	11/29/78 14:07	11/30/78 23:32	2.78	7.08
498	2/17/95 3:39	2/17/95 8:28	2.76	7.06
499	5/29/87 23:12	5/30/87 6:56	2.76	7.06
500	11/26/84 23:06	11/27/84 23:38	2.76	7.06
501	4/15/96 22:30	4/16/96 0:20	2.76	7.06
502	10/16/90 6:25	10/16/90 6:59	2.75	7.05
503	6/30/81 15:38	6/30/81 16:18	2.74	7.04
504	10/13/88 8:37	10/13/88 20:06	2.74	7.04
505	5/17/99 15:44	5/17/99 16:19	2.73	7.03
506	4/13/92 18:14	4/13/92 18:55	2.72	7.02
507	5/2/88 10:08	5/2/88 12:39	2.72	7.02
508	3/23/95 3:03	3/23/95 18:10	2.72	7.02
509	12/26/81 17:02	12/26/81 17:47	2.72	7.02
510	2/15/94 18:01	2/17/94 20:46	2.71	7.01
511	1/14/00 8:07	1/14/00 11:12	2.71	7.01
512	1/1/02 15:20	1/2/02 0:30	2.70	7.00
513	6/28/97 21:33	6/29/97 4:59	2.70	7.00
514	9/14/87 9:51	9/14/87 12:12	2.68	6.98
515	10/14/90 21:03	10/14/90 21:48	2.68	6.98
516	11/17/04 23:21	11/18/04 0:11	2.67	6.97
517	4/25/99 8:32	4/25/99 9:16	2.66	6.96
518	8/13/82 8:03	8/13/82 8:46	2.66	6.96
519	4/23/04 12:35	4/23/04 13:18	2.65	6.95
520	6/17/86 20:12	6/17/86 20:50	2.64	6.94
521	5/9/99 3:25	5/9/99 4:32	2.64	6.94
522	3/24/04 5:27	3/24/04 6:26	2.61	6.91

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
523	9/16/04 15:50	9/17/04 19:18	2.61	6.91
524	10/20/89 20:46	10/21/89 1:05	2.61	6.91
525	11/7/92 1:06	11/7/92 7:05	2.60	6.90
526	2/20/84 10:24	2/20/84 13:12	2.60	6.90
527	4/24/85 18:15	4/24/85 19:01	2.59	6.89
528	12/3/81 15:38	12/3/81 16:11	2.59	6.89
529	1/20/79 17:28	1/21/79 2:14	2.58	6.88
530	11/3/82 21:49	11/4/82 0:14	2.58	6.88
531	1/27/83 7:08	1/27/83 10:33	2.58	6.88
532	6/24/98 5:30	6/24/98 7:59	2.55	6.85
533	10/3/02 7:42	10/3/02 8:25	2.53	6.83
534	11/8/94 18:39	11/8/94 21:36	2.53	6.83
535	12/29/88 10:41	12/30/88 5:32	2.53	6.83
536	10/13/89 6:19	10/14/89 5:19	2.52	6.82
537	5/9/00 10:30	5/9/00 17:52	2.51	6.81
538	6/12/81 10:46	6/12/81 11:12	2.51	6.81
539	3/22/00 7:50	3/22/00 8:41	2.51	6.81
540	3/15/87 19:42	3/16/87 5:10	2.50	6.80
541	9/29/80 15:58	9/29/80 16:58	2.50	6.80
542	2/21/03 17:15	2/21/03 18:21	2.49	6.79
543	11/7/85 20:20	11/8/85 18:14	2.48	6.78
544	11/24/91 16:12	11/24/91 16:37	2.47	6.77
545	10/25/82 19:40	10/25/82 22:31	2.46	6.76
546	1/23/92 10:37	1/23/92 19:32	2.44	6.74
547	4/2/82 19:11	4/2/82 20:32	2.43	6.73
548	1/31/04 15:50	1/31/04 17:50	2.43	6.73
549	3/2/99 22:01	3/3/99 14:24	2.42	6.72
550	4/18/80 21:00	4/20/80 0:55	2.42	6.72
551	11/1/05 5:34	11/1/05 13:51	2.42	6.72
552	4/2/01 5:56	4/2/01 6:31	2.42	6.72
553	11/19/91 13:29	11/19/91 17:00	2.41	6.71
554	2/29/00 7:44	2/29/00 15:37	2.41	6.71
555	12/3/79 6:13	12/3/79 23:54	2.40	6.70
556	11/25/00 14:09	11/26/00 22:15	2.40	6.70
557	2/14/86 23:39	2/15/86 18:25	2.40	6.70
558	4/13/03 4:29	4/13/03 7:24	2.40	6.70
559	4/28/05 1:55	4/28/05 2:25	2.40	6.70
560	1/21/01 4:57	1/21/01 12:55	2.38	6.68
561	10/28/00 1:31	10/28/00 2:24	2.38	6.68
562	9/30/78 6:03	9/30/78 6:25	2.37	6.67
563	9/30/07 10:02	9/30/07 15:51	2.36	6.66
564	3/15/79 15:58	3/15/79 17:00	2.36	6.66
565	9/25/97 20:56	9/26/97 19:03	2.34	6.64
566	12/22/07 8:28	12/22/07 10:31	2.34	6.64
567	9/26/87 1:00	9/26/87 1:24	2.34	6.64
568	6/28/84 14:30	6/28/84 23:34	2.34	6.64
569	6/22/83 14:59	6/22/83 15:25	2.33	6.63
570	7/28/93 8:45	7/28/93 11:23	2.33	6.63
571	10/29/90 15:57	10/29/90 20:46	2.32	6.62
572	3/24/98 17:37	3/24/98 18:09	2.31	6.61
573	7/19/93 22:39	7/20/93 1:14	2.30	6.60
574	2/22/99 9:46	2/22/99 16:24	2.30	6.60
575	8/6/04 11:34	8/6/04 14:33	2.29	6.59
576	12/25/86 19:02	12/25/86 22:09	2.28	6.58
577	6/10/81 10:03	6/10/81 10:27	2.26	6.56
578	3/11/80 15:10	3/11/80 15:42	2.26	6.56
579	2/24/83 22:04	2/25/83 19:33	2.26	6.56
580	2/13/84 8:02	2/13/84 8:46	2.26	6.56

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
581	2/16/04 9:46	2/16/04 18:11	2.26	6.56
582	3/4/94 2:32	3/4/94 3:08	2.25	6.55
583	12/5/96 20:07	12/8/96 3:17	2.24	6.54
584	6/8/80 7:46	6/8/80 11:20	2.23	6.53
585	1/25/03 20:33	1/26/03 7:58	2.22	6.52
586	4/6/01 19:18	4/6/01 19:55	2.22	6.52
587	12/8/84 2:10	12/8/84 19:52	2.22	6.52
588	1/23/79 17:26	1/23/79 20:00	2.21	6.51
589	11/20/78 10:05	11/20/78 15:57	2.20	6.50
590	6/17/94 22:57	6/18/94 15:51	2.19	6.49
591	3/9/88 17:26	3/9/88 17:53	2.19	6.49
592	10/21/83 23:33	10/22/83 0:18	2.18	6.48
593	4/1/83 13:25	4/1/83 16:08	2.17	6.47
594	2/11/85 2:44	2/11/85 9:24	2.17	6.47
595	3/13/95 15:54	3/14/95 11:38	2.16	6.46
596	5/17/96 17:07	5/18/96 18:02	2.15	6.45
597	12/25/90 13:41	12/25/90 14:05	2.14	6.44
598	10/16/91 6:26	10/16/91 6:58	2.13	6.43
599	11/29/84 11:01	11/29/84 13:19	2.13	6.43
600	6/28/02 12:25	6/28/02 19:04	2.12	6.42
601	1/30/97 4:25	1/30/97 5:56	2.12	6.42
602	2/11/81 22:04	2/11/81 22:36	2.11	6.41
603	6/6/93 11:46	6/6/93 22:37	2.11	6.41
604	4/8/79 16:35	4/9/79 17:23	2.11	6.41
605	10/10/89 8:51	10/10/89 9:38	2.10	6.40
606	12/16/00 15:52	12/16/00 17:33	2.09	6.39
607	10/16/04 10:21	10/17/04 11:35	2.08	6.38
608	9/14/06 1:36	9/14/06 4:31	2.07	6.37
609	1/1/98 12:19	1/1/98 13:51	2.06	6.36
610	10/22/89 5:45	10/22/89 9:43	2.06	6.36
611	2/21/86 17:55	2/21/86 18:57	2.06	6.36
612	10/20/92 12:46	10/20/92 13:14	2.06	6.36
613	10/30/84 12:29	10/30/84 12:54	2.06	6.36
614	1/28/88 10:28	1/28/88 22:13	2.05	6.35
615	12/17/02 9:11	12/17/02 9:43	2.03	6.33
616	12/12/03 7:28	12/12/03 8:21	2.03	6.33
617	12/31/98 5:23	12/31/98 16:13	2.01	6.31
618	3/8/95 5:47	3/10/95 4:54	2.01	6.31
619	9/18/83 7:30	9/18/83 11:30	2.01	6.31
620	2/17/92 15:27	2/18/92 8:17	2.01	6.31
621	7/9/97 12:27	7/9/97 12:53	2.01	6.31
622	2/21/98 16:12	2/21/98 21:06	1.99	6.29
623	11/12/01 10:25	11/12/01 11:35	1.99	6.29
624	8/11/83 6:54	8/11/83 11:24	1.98	6.28
625	11/4/89 0:51	11/4/89 1:13	1.97	6.27
626	10/4/96 11:44	10/4/96 17:46	1.96	6.26
627	7/7/02 16:53	7/7/02 23:36	1.95	6.25
628	11/22/95 7:17	11/23/95 9:13	1.95	6.25
629	11/17/95 17:52	11/18/95 14:49	1.94	6.24
630	2/11/90 8:40	2/11/90 9:23	1.94	6.24
631	4/8/03 20:26	4/8/03 21:58	1.94	6.24
632	1/27/97 19:19	1/27/97 22:50	1.94	6.24
633	12/27/98 13:14	12/27/98 19:37	1.92	6.22
634	3/8/06 12:58	3/8/06 16:08	1.92	6.22
635	3/24/01 19:09	3/25/01 5:01	1.91	6.21
636	11/17/80 6:02	11/17/80 7:02	1.91	6.21
637	12/30/80 10:27	12/30/80 22:04	1.91	6.21
638	12/29/02 22:56	12/30/02 0:22	1.91	6.21

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
639	12/4/78 6:11	12/4/78 12:02	1.88	6.18
640	1/19/99 18:27	1/19/99 19:03	1.88	6.18
641	1/19/85 17:34	1/19/85 18:48	1.87	6.17
642	4/28/88 18:05	4/28/88 18:44	1.87	6.17
643	1/22/86 14:55	1/22/86 20:16	1.86	6.16
644	7/16/89 10:45	7/16/89 12:59	1.86	6.16
645	8/29/91 6:42	8/29/91 7:53	1.86	6.16
646	4/2/88 12:25	4/2/88 19:05	1.86	6.16
647	6/30/82 8:43	6/30/82 10:19	1.85	6.15
648	1/11/03 18:24	1/12/03 10:54	1.85	6.15
649	10/31/80 6:43	11/1/80 14:14	1.85	6.15
650	5/19/86 20:55	5/19/86 22:31	1.84	6.14
651	9/13/86 11:04	9/13/86 11:28	1.83	6.13
652	1/4/00 0:20	1/4/00 3:22	1.82	6.12
653	10/24/80 17:00	10/24/80 17:29	1.82	6.12
654	7/2/99 0:56	7/2/99 17:07	1.81	6.11
655	1/16/97 22:19	1/19/97 1:26	1.81	6.11
656	8/18/00 11:03	8/18/00 12:35	1.81	6.11
657	10/30/01 15:09	10/31/01 3:38	1.80	6.10
658	4/7/95 5:56	4/7/95 21:33	1.80	6.10
659	12/2/95 0:02	12/2/95 0:35	1.79	6.09
660	3/28/97 16:26	3/28/97 17:42	1.78	6.08
661	4/22/89 21:06	4/22/89 22:01	1.78	6.08
662	12/31/00 7:25	12/31/00 8:33	1.77	6.07
663	2/22/00 16:25	2/22/00 18:02	1.77	6.07
664	12/20/96 10:49	12/20/96 11:14	1.77	6.07
665	3/23/81 6:48	3/23/81 15:10	1.76	6.06
666	3/13/90 19:20	3/13/90 21:26	1.76	6.06
667	11/14/98 20:33	11/15/98 19:26	1.76	6.06
668	6/4/84 21:03	6/4/84 21:29	1.75	6.05
669	5/13/99 0:09	5/13/99 1:08	1.75	6.05
670	11/16/94 5:33	11/16/94 6:29	1.75	6.05
671	1/21/81 1:40	1/21/81 2:07	1.74	6.04
672	5/10/86 8:13	5/10/86 9:40	1.73	6.03
673	6/17/96 18:26	6/17/96 18:47	1.73	6.03
674	5/10/81 20:25	5/10/81 20:51	1.73	6.03
675	1/12/08 6:24	1/12/08 7:04	1.72	6.02
676	8/28/83 14:44	8/28/83 18:32	1.72	6.02
677	11/18/78 4:42	11/18/78 6:08	1.72	6.02
678	4/3/87 9:28	4/3/87 12:25	1.72	6.02
679	8/9/85 22:18	8/9/85 22:58	1.70	6.00
680	11/18/86 6:25	11/18/86 7:58	1.69	5.99
681	11/3/80 12:21	11/3/80 13:51	1.69	5.99
682	3/7/86 18:16	3/7/86 18:47	1.69	5.99
683	1/1/86 2:59	1/1/86 4:54	1.69	5.99
684	4/15/86 7:24	4/15/86 22:30	1.69	5.99
685	12/28/95 19:32	12/29/95 17:05	1.67	5.97
686	12/16/03 11:44	12/16/03 12:57	1.65	5.95
687	6/15/00 14:15	6/15/00 14:36	1.65	5.95
688	11/5/82 8:23	11/5/82 9:04	1.65	5.95
689	5/21/80 4:36	5/21/80 5:23	1.65	5.95
690	12/9/81 16:12	12/10/81 14:18	1.65	5.95
691	3/31/05 21:03	4/1/05 0:57	1.64	5.94
692	1/2/87 19:02	1/3/87 4:33	1.64	5.94
693	3/1/94 15:27	3/2/94 13:51	1.63	5.93
694	11/15/85 7:29	11/15/85 17:06	1.63	5.93
695	6/3/81 14:23	6/3/81 14:44	1.62	5.92
696	2/12/82 22:26	2/13/82 22:29	1.62	5.92

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
697	1/25/93 7:25	1/25/93 8:10	1.62	5.92
698	1/31/90 18:21	1/31/90 22:40	1.62	5.92
699	11/19/88 7:33	11/19/88 8:02	1.62	5.92
700	3/1/98 2:14	3/1/98 2:43	1.61	5.91
701	3/7/90 10:32	3/7/90 20:24	1.61	5.91
702	7/1/79 6:24	7/1/79 16:50	1.61	5.91
703	9/20/80 15:58	9/20/80 16:18	1.61	5.91
704	12/10/02 10:42	12/10/02 14:11	1.60	5.90
705	12/20/82 2:55	12/20/82 10:27	1.60	5.90
706	10/16/88 4:35	10/16/88 4:59	1.60	5.90
707	11/23/89 5:09	11/23/89 6:36	1.60	5.90
708	3/18/95 7:58	3/18/95 8:22	1.60	5.90
709	7/6/97 5:09	7/6/97 5:30	1.59	5.89
710	4/14/80 13:48	4/14/80 14:08	1.58	5.88
711	2/26/82 8:24	2/26/82 14:31	1.58	5.88
712	12/12/88 10:55	12/12/88 13:36	1.56	5.86
713	11/5/98 5:34	11/5/98 11:26	1.56	5.86
714	12/6/90 14:42	12/6/90 15:26	1.56	5.86
715	1/10/79 0:54	1/10/79 9:14	1.56	5.86
716	11/15/78 21:37	11/15/78 22:20	1.54	5.84
717	5/3/78 5:22	5/3/78 5:56	1.54	5.84
718	2/26/94 9:11	2/26/94 10:33	1.54	5.84
719	12/5/88 23:59	12/6/88 3:05	1.53	5.83
720	9/11/82 20:25	9/11/82 20:52	1.52	5.82
721	12/11/93 18:15	12/11/93 18:45	1.52	5.82
722	11/22/79 2:14	11/22/79 15:21	1.50	5.80
723	4/10/87 7:18	4/10/87 7:52	1.50	5.80
724	1/1/87 4:15	1/1/87 4:43	1.49	5.79
725	6/9/93 7:37	6/9/93 11:04	1.49	5.79
726	1/13/95 8:09	1/13/95 8:54	1.48	5.78
727	12/29/98 4:48	12/29/98 12:28	1.48	5.78
728	5/28/88 0:15	5/28/88 6:36	1.48	5.78
729	4/11/82 2:29	4/11/82 14:25	1.48	5.78
730	10/14/05 22:31	10/14/05 23:31	1.47	5.77
731	11/17/85 7:29	11/17/85 8:48	1.46	5.76
732	11/23/00 7:49	11/23/00 8:34	1.46	5.76
733	9/3/78 14:22	9/3/78 14:59	1.46	5.76
734	11/12/91 8:35	11/12/91 8:57	1.45	5.75
735	1/30/86 7:53	1/30/86 10:06	1.45	5.75
736	2/15/95 4:27	2/15/95 7:21	1.44	5.74
737	8/27/84 8:31	8/27/84 9:06	1.43	5.73
738	2/7/78 11:19	2/7/78 11:59	1.43	5.73
739	5/12/96 15:06	5/13/96 14:41	1.42	5.72
740	4/4/86 15:02	4/4/86 15:39	1.42	5.72
741	1/24/83 5:33	1/24/83 6:23	1.42	5.72
742	1/26/87 10:29	1/26/87 13:52	1.41	5.71
743	2/25/98 8:04	2/25/98 8:43	1.41	5.71
744	5/22/84 9:42	5/22/84 15:37	1.40	5.70
745	11/8/91 4:43	11/8/91 5:04	1.40	5.70
746	1/30/03 20:29	1/30/03 21:01	1.40	5.70
747	10/17/00 22:30	10/17/00 23:06	1.39	5.69
748	2/5/79 6:31	2/5/79 9:23	1.38	5.68
749	12/12/83 12:43	12/13/83 3:45	1.37	5.67
750	3/8/02 9:47	3/8/02 10:21	1.36	5.66
751	5/21/90 22:53	5/21/90 23:16	1.36	5.66
752	1/28/06 0:10	1/28/06 4:01	1.35	5.65
753	10/8/04 5:45	10/8/04 17:13	1.35	5.65
754	12/29/83 17:19	12/29/83 21:35	1.34	5.64

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
755	12/5/98 13:19	12/5/98 16:02	1.34	5.64
756	12/31/93 23:21	1/1/94 0:47	1.33	5.63
757	9/29/05 22:19	9/29/05 22:57	1.33	5.63
758	2/5/99 16:28	2/6/99 12:08	1.33	5.63
759	2/15/84 5:17	2/16/84 0:43	1.33	5.63
760	5/11/00 16:55	5/11/00 17:20	1.33	5.63
761	12/15/94 18:11	12/15/94 19:37	1.32	5.62
762	1/13/87 18:08	1/13/87 19:11	1.30	5.60
763	3/24/91 6:12	3/24/91 7:11	1.29	5.59
764	10/15/06 8:56	10/15/06 11:40	1.28	5.58
765	3/26/80 19:41	3/26/80 20:03	1.28	5.58
766	12/27/02 1:32	12/27/02 2:09	1.27	5.57
767	12/2/85 15:22	12/2/85 21:35	1.26	5.56
768	5/9/81 7:32	5/9/81 7:58	1.24	5.54
769	7/30/82 6:43	7/30/82 7:03	1.23	5.53
770	4/4/89 23:59	4/5/89 0:54	1.23	5.53
771	3/11/97 18:22	3/11/97 18:56	1.23	5.53
772	10/13/94 22:13	10/13/94 22:38	1.22	5.52
773	11/2/79 23:34	11/3/79 4:26	1.22	5.52
774	5/9/93 19:29	5/9/93 20:04	1.21	5.51
775	2/20/90 1:34	2/20/90 5:00	1.18	5.48
776	6/11/05 13:38	6/11/05 14:08	1.18	5.48
777	1/7/06 12:04	1/7/06 12:27	1.18	5.48
778	3/2/89 13:52	3/2/89 15:47	1.17	5.47
779	11/5/83 17:26	11/5/83 17:52	1.17	5.47
780	11/27/80 4:45	11/27/80 9:50	1.17	5.47
781	6/17/97 15:32	6/17/97 15:54	1.17	5.47
782	3/5/83 16:53	3/5/83 20:06	1.16	5.46
783	12/5/91 9:02	12/5/91 15:34	1.16	5.46
784	11/8/78 11:07	11/9/78 1:47	1.15	5.45
785	11/21/92 9:57	11/21/92 12:52	1.15	5.45
786	12/26/84 8:15	12/27/84 3:14	1.15	5.45
787	4/2/99 22:10	4/3/99 2:00	1.12	5.42
788	3/19/95 23:23	3/20/95 12:27	1.12	5.42
789	10/21/91 8:03	10/21/91 10:16	1.12	5.42
790	1/31/97 22:55	1/31/97 23:37	1.12	5.42
791	3/29/01 23:07	3/29/01 23:32	1.12	5.42
792	3/11/84 21:08	3/12/84 1:12	1.11	5.41
793	12/27/07 15:53	12/27/07 16:29	1.11	5.41
794	1/7/83 22:07	1/7/83 22:35	1.10	5.40
795	2/3/99 17:56	2/4/99 6:12	1.10	5.40
796	12/23/06 1:30	12/23/06 6:00	1.10	5.40
797	11/24/79 10:27	11/24/79 10:55	1.08	5.38
798	12/22/78 9:31	12/22/78 9:59	1.08	5.38
799	12/20/87 15:39	12/20/87 18:01	1.07	5.37
800	1/4/92 4:19	1/4/92 5:51	1.07	5.37
801	4/5/03 0:47	4/5/03 1:13	1.06	5.36
802	11/10/06 6:24	11/10/06 12:15	1.05	5.35
803	11/10/88 11:28	11/10/88 11:49	1.04	5.34
804	11/24/96 15:56	11/24/96 16:27	1.04	5.34
805	12/14/00 15:56	12/14/00 17:04	1.04	5.34
806	12/7/93 6:05	12/7/93 7:08	1.03	5.33
807	2/15/82 22:29	2/17/82 9:05	1.02	5.32
808	10/23/93 17:07	10/23/93 18:10	1.02	5.32
809	1/22/84 2:18	1/22/84 4:07	1.02	5.32
810	12/7/04 12:42	12/8/04 9:07	1.01	5.31
811	3/12/91 17:47	3/12/91 18:14	1.01	5.31
812	8/31/91 5:49	8/31/91 7:12	1.00	5.30

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
813	10/7/07 15:44	10/7/07 16:01	1.00	5.30
814	3/14/99 17:24	3/14/99 17:38	0.99	5.29
815	4/18/87 20:39	4/18/87 21:31	0.99	5.29
816	2/7/99 15:17	2/7/99 16:01	0.99	5.29
817	8/20/97 17:36	8/20/97 18:06	0.99	5.29
818	2/25/00 16:26	2/25/00 16:53	0.98	5.28
819	3/23/78 9:29	3/23/78 10:34	0.98	5.28
820	4/14/78 15:02	4/14/78 15:24	0.97	5.27
821	3/30/82 6:12	3/30/82 21:25	0.97	5.27
822	12/29/84 17:45	12/29/84 22:21	0.97	5.27
823	3/25/87 19:22	3/25/87 20:04	0.97	5.27
824	11/15/95 9:14	11/15/95 9:39	0.96	5.26
825	11/29/93 8:55	11/29/93 11:22	0.96	5.26
826	2/9/85 9:52	2/9/85 10:25	0.96	5.26
827	4/27/78 22:10	4/27/78 22:36	0.95	5.25
828	1/5/80 4:12	1/5/80 4:32	0.94	5.24
829	5/2/85 19:21	5/2/85 19:54	0.94	5.24
830	11/13/05 1:29	11/13/05 2:12	0.92	5.22
831	5/13/85 20:12	5/13/85 23:19	0.92	5.22
832	10/16/00 14:02	10/16/00 16:51	0.92	5.22
833	1/12/02 17:28	1/12/02 17:46	0.91	5.21
834	3/7/03 16:08	3/7/03 18:12	0.91	5.21
835	4/27/02 1:11	4/27/02 1:45	0.91	5.21
836	8/14/89 14:27	8/14/89 14:47	0.91	5.21
837	2/23/78 5:09	2/23/78 5:44	0.91	5.21
838	8/29/90 11:42	8/29/90 12:07	0.90	5.20
839	7/2/94 2:45	7/2/94 3:03	0.90	5.20
840	4/15/97 16:24	4/15/97 16:49	0.90	5.20
841	2/2/01 3:17	2/2/01 8:21	0.89	5.19
842	10/26/01 20:04	10/27/01 7:39	0.89	5.19
843	3/27/96 15:52	3/27/96 16:05	0.89	5.19
844	11/11/87 0:08	11/11/87 1:01	0.88	5.18
845	10/16/85 4:34	10/16/85 4:51	0.88	5.18
846	6/23/96 16:19	6/23/96 16:40	0.86	5.16
847	3/19/05 16:16	3/19/05 17:46	0.86	5.16
848	2/6/79 14:49	2/6/79 17:29	0.86	5.16
849	1/11/82 7:26	1/11/82 15:30	0.86	5.16
850	11/12/96 8:06	11/13/96 0:12	0.85	5.15
851	5/11/99 12:53	5/11/99 13:18	0.85	5.15
852	5/5/97 17:12	5/5/97 17:38	0.85	5.15
853	2/18/99 10:40	2/18/99 20:22	0.85	5.15
854	2/12/98 5:08	2/12/98 19:26	0.84	5.14
855	4/17/90 6:28	4/17/90 6:59	0.84	5.14
856	3/29/99 8:43	3/29/99 8:57	0.84	5.14
857	10/22/79 18:16	10/23/79 2:49	0.83	5.13
858	3/12/89 14:54	3/12/89 17:56	0.83	5.13
859	1/28/01 23:28	1/29/01 4:51	0.83	5.13
860	11/19/80 0:55	11/19/80 1:15	0.82	5.12
861	10/21/96 20:02	10/21/96 22:00	0.82	5.12
862	12/17/95 23:10	12/18/95 1:31	0.81	5.11
863	2/11/97 15:01	2/11/97 19:20	0.81	5.11
864	7/27/83 10:32	7/27/83 11:24	0.81	5.11
865	4/5/81 6:06	4/5/81 6:29	0.81	5.11
866	10/12/98 8:09	10/12/98 22:32	0.80	5.10
867	7/29/81 6:18	7/29/81 6:39	0.80	5.10
868	5/27/97 10:15	5/27/97 10:44	0.79	5.09
869	4/12/94 7:49	4/12/94 8:15	0.79	5.09
870	12/22/88 9:42	12/22/88 12:14	0.78	5.08

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
871	4/3/05 7:36	4/3/05 10:08	0.78	5.08
872	10/27/81 13:24	10/28/81 0:36	0.78	5.08
873	1/18/98 20:50	1/18/98 22:23	0.78	5.08
874	10/18/92 10:27	10/18/92 10:51	0.77	5.07
875	4/11/84 21:49	4/12/84 11:45	0.77	5.07
876	11/1/90 4:56	11/1/90 5:10	0.77	5.07
877	6/7/84 14:59	6/7/84 15:19	0.77	5.07
878	1/23/81 19:40	1/24/81 16:45	0.77	5.07
879	5/6/83 20:34	5/6/83 20:54	0.77	5.07
880	10/20/95 5:07	10/20/95 5:37	0.76	5.06
881	3/28/84 15:09	3/28/84 15:24	0.76	5.06
882	5/18/00 18:52	5/18/00 21:20	0.76	5.06
883	11/21/86 17:37	11/21/86 17:58	0.75	5.05
884	6/3/85 21:45	6/3/85 22:09	0.75	5.05
885	2/8/84 16:28	2/9/84 4:15	0.75	5.05
886	7/9/87 8:37	7/9/87 9:03	0.75	5.05
887	3/1/84 21:27	3/1/84 21:45	0.75	5.05
888	3/13/83 19:20	3/13/83 19:42	0.74	5.04
889	8/30/90 13:46	8/30/90 14:07	0.74	5.04
890	4/25/93 9:17	4/25/93 9:34	0.73	5.03
891	1/13/89 14:16	1/13/89 14:34	0.73	5.03
892	3/9/87 21:08	3/9/87 22:25	0.73	5.03
893	2/3/96 22:03	2/3/96 23:33	0.73	5.03
894	12/13/86 10:11	12/13/86 10:42	0.72	5.02
895	3/13/86 16:32	3/13/86 16:53	0.71	5.01
896	2/6/02 20:17	2/7/02 23:43	0.71	5.01
897	2/3/87 22:12	2/3/87 22:33	0.71	5.01
898	10/21/90 11:03	10/21/90 11:28	0.70	5.00
899	10/18/89 8:54	10/18/89 9:16	0.70	5.00
900	3/1/97 8:21	3/1/97 9:39	0.70	5.00
901	4/5/80 1:07	4/6/80 4:00	0.70	5.00
902	4/8/93 5:45	4/8/93 23:25	0.69	4.99
903	10/24/96 16:05	10/24/96 16:27	0.69	4.99
904	4/20/89 2:55	4/20/89 3:19	0.68	4.98
905	3/4/00 3:49	3/4/00 4:11	0.67	4.97
906	7/15/01 19:39	7/15/01 19:55	0.67	4.97
907	1/10/92 7:05	1/10/92 7:26	0.67	4.97
908	3/10/84 20:28	3/10/84 20:43	0.67	4.97
909	2/15/01 5:53	2/15/01 6:09	0.66	4.96
910	3/28/08 14:32	3/28/08 15:02	0.66	4.96
911	8/27/91 3:06	8/27/91 6:34	0.66	4.96
912	9/21/81 15:57	9/21/81 16:12	0.66	4.96
913	10/24/91 2:57	10/24/91 7:40	0.66	4.96
914	4/7/84 7:49	4/7/84 8:19	0.66	4.96
915	6/10/88 3:53	6/10/88 4:58	0.65	4.95
916	9/17/86 21:15	9/17/86 22:42	0.65	4.95
917	4/1/86 9:34	4/1/86 9:50	0.65	4.95
918	11/9/91 16:25	11/9/91 16:42	0.65	4.95
919	7/8/97 4:02	7/8/97 9:11	0.64	4.94
920	1/5/02 11:02	1/5/02 11:25	0.64	4.94
921	1/16/99 0:12	1/16/99 0:31	0.64	4.94
922	2/16/99 19:59	2/16/99 20:51	0.63	4.93
923	8/18/78 20:16	8/18/78 20:47	0.63	4.93
924	1/28/81 19:19	1/28/81 23:24	0.62	4.92
925	1/25/00 9:05	1/25/00 9:21	0.62	4.92
926	2/20/80 0:43	2/20/80 1:36	0.61	4.91
927	3/6/83 22:46	3/7/83 9:10	0.61	4.91
928	6/16/83 22:18	6/16/83 22:51	0.61	4.91

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
929	12/13/79 11:30	12/13/79 12:00	0.60	4.90
930	12/25/02 21:54	12/25/02 22:22	0.60	4.90
931	6/10/95 15:29	6/10/95 15:47	0.60	4.90
932	4/14/08 15:06	4/14/08 15:25	0.60	4.90
933	12/13/96 7:33	12/13/96 7:48	0.59	4.89
934	1/21/98 17:02	1/21/98 17:24	0.59	4.89
935	12/7/98 8:46	12/7/98 10:39	0.59	4.89
936	10/20/78 7:20	10/20/78 7:59	0.59	4.89
937	3/16/97 23:39	3/17/97 0:42	0.58	4.88
938	12/22/00 8:18	12/22/00 8:39	0.58	4.88
939	3/29/08 19:57	3/29/08 21:07	0.58	4.88
940	3/16/03 11:05	3/16/03 11:15	0.58	4.88
941	3/26/98 13:58	3/26/98 14:15	0.58	4.88
942	1/29/03 9:25	1/29/03 9:52	0.57	4.87
943	3/29/82 3:45	3/29/82 4:26	0.57	4.87
944	3/11/96 0:07	3/11/96 0:23	0.57	4.87
945	4/16/88 10:25	4/16/88 10:39	0.56	4.86
946	3/20/94 13:45	3/21/94 9:18	0.56	4.86
947	11/18/92 23:40	11/19/92 0:42	0.56	4.86
948	3/27/01 16:15	3/27/01 16:38	0.56	4.86
949	4/4/78 7:07	4/4/78 7:32	0.54	4.84
950	5/31/05 15:57	5/31/05 16:12	0.54	4.84
951	12/16/07 18:29	12/16/07 19:28	0.53	4.83
952	1/20/93 3:59	1/20/93 4:37	0.52	4.82
953	11/20/96 13:52	11/20/96 14:40	0.52	4.82
954	11/30/82 14:04	11/30/82 14:30	0.52	4.82
955	12/20/88 13:30	12/20/88 14:41	0.52	4.82
956	5/7/91 19:05	5/7/91 19:25	0.51	4.81
957	12/5/82 21:21	12/5/82 21:51	0.51	4.81
958	3/8/99 18:25	3/8/99 18:48	0.51	4.81
959	1/14/99 5:07	1/14/99 5:47	0.50	4.80
960	2/8/98 9:24	2/8/98 9:44	0.50	4.80
961	10/21/01 8:26	10/21/01 9:20	0.50	4.80
962	2/10/07 20:44	2/10/07 21:01	0.49	4.79
963	10/14/97 4:53	10/14/97 5:09	0.49	4.79
964	2/17/79 19:46	2/17/79 19:57	0.49	4.79
965	3/24/06 10:47	3/24/06 10:56	0.49	4.79
966	5/18/05 5:03	5/18/05 5:27	0.49	4.79
967	1/14/04 15:45	1/14/04 16:10	0.48	4.78
968	1/7/91 6:50	1/7/91 7:55	0.47	4.77
969	9/27/07 22:40	9/28/07 0:53	0.47	4.77
970	1/21/99 5:39	1/21/99 7:32	0.46	4.76
971	5/28/93 19:21	5/28/93 19:47	0.46	4.76
972	9/5/79 5:56	9/5/79 6:09	0.46	4.76
973	2/24/04 6:53	2/24/04 7:06	0.45	4.75
974	3/10/06 18:12	3/10/06 18:31	0.45	4.75
975	5/28/89 15:26	5/28/89 18:12	0.45	4.75
976	11/27/82 8:45	11/28/82 0:03	0.45	4.75
977	2/24/81 14:08	2/24/81 15:31	0.44	4.74
978	10/30/92 15:19	10/30/92 15:37	0.44	4.74
979	1/20/97 17:34	1/20/97 17:52	0.44	4.74
980	11/19/84 14:36	11/19/84 15:03	0.44	4.74
981	8/7/99 0:04	8/7/99 0:15	0.43	4.73
982	7/17/96 8:55	7/17/96 9:11	0.43	4.73
983	10/31/94 1:14	10/31/94 7:44	0.43	4.73
984	7/31/85 23:38	8/1/85 0:20	0.41	4.71
985	2/28/87 16:44	2/28/87 17:35	0.40	4.70
986	1/24/84 15:54	1/25/84 0:05	0.40	4.70

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
987	2/13/87 4:23	2/13/87 4:35	0.40	4.70
988	10/16/79 11:45	10/16/79 12:05	0.40	4.70
989	10/18/79 4:52	10/18/79 5:37	0.40	4.70
990	9/18/81 23:09	9/18/81 23:49	0.39	4.69
991	2/2/92 14:41	2/2/92 15:01	0.39	4.69
992	1/25/92 11:38	1/25/92 11:55	0.39	4.69
993	4/10/05 22:48	4/10/05 23:27	0.39	4.69
994	1/27/99 20:59	1/28/99 16:16	0.39	4.69
995	1/22/94 21:55	1/22/94 22:34	0.39	4.69
996	2/2/04 8:24	2/2/04 8:42	0.38	4.68
997	12/30/93 16:09	12/30/93 16:50	0.37	4.67
998	1/23/04 17:45	1/23/04 18:01	0.36	4.66
999	1/22/83 19:46	1/22/83 20:07	0.36	4.66
1000	2/18/96 17:47	2/18/96 18:08	0.35	4.65
1001	4/15/06 14:41	4/15/06 15:00	0.35	4.65
1002	8/7/85 18:38	8/7/85 18:47	0.35	4.65
1003	2/19/02 5:49	2/19/02 6:03	0.35	4.65
1004	5/5/83 5:28	5/5/83 5:57	0.34	4.64
1005	2/3/80 16:47	2/3/80 17:03	0.33	4.63
1006	3/9/94 22:56	3/9/94 23:12	0.33	4.63
1007	2/6/08 20:16	2/6/08 20:33	0.33	4.63
1008	10/30/86 23:59	10/31/86 0:12	0.33	4.63
1009	11/19/81 14:48	11/19/81 15:04	0.33	4.63
1010	12/7/89 19:48	12/7/89 20:04	0.33	4.63
1011	3/4/93 2:23	3/4/93 2:39	0.32	4.62
1012	3/31/97 15:28	3/31/97 15:44	0.32	4.62
1013	3/9/89 21:07	3/9/89 21:24	0.32	4.62
1014	12/12/82 9:48	12/12/82 10:07	0.32	4.62
1015	2/18/80 11:41	2/18/80 12:13	0.31	4.61
1016	2/21/83 18:42	2/21/83 18:58	0.31	4.61
1017	5/23/89 0:43	5/23/89 0:55	0.30	4.60
1018	3/16/02 8:54	3/16/02 17:18	0.30	4.60
1019	3/2/03 18:08	3/2/03 18:26	0.30	4.60
1020	5/26/80 10:05	5/26/80 10:56	0.29	4.59
1021	3/25/81 1:52	3/25/81 2:03	0.28	4.58
1022	11/4/94 7:54	11/4/94 8:03	0.28	4.58
1023	2/3/90 11:43	2/3/90 12:17	0.28	4.58
1024	8/20/07 10:25	8/20/07 10:33	0.28	4.58
1025	1/11/88 2:40	1/11/88 2:56	0.27	4.57
1026	12/9/06 10:59	12/9/06 11:16	0.27	4.57
1027	4/15/93 6:46	4/15/93 7:02	0.27	4.57
1028	11/25/89 22:02	11/25/89 22:54	0.27	4.57
1029	4/4/95 7:48	4/4/95 8:02	0.25	4.55
1030	10/22/04 14:02	10/22/04 14:16	0.25	4.55
1031	11/27/88 7:55	11/27/88 8:32	0.25	4.55
1032	1/26/81 4:27	1/26/81 4:33	0.24	4.54
1033	5/8/05 17:48	5/8/05 18:13	0.24	4.54
1034	1/12/87 0:27	1/12/87 1:44	0.22	4.52
1035	1/2/94 8:18	1/2/94 8:33	0.22	4.52
1036	1/14/85 8:25	1/14/85 8:32	0.21	4.51
1037	5/5/79 12:48	5/5/79 13:01	0.21	4.51
1038	11/23/94 1:19	11/23/94 2:22	0.20	4.50
1039	11/19/02 15:38	11/19/02 15:54	0.20	4.50
1040	9/8/94 15:19	9/8/94 15:32	0.19	4.49
1041	12/10/01 15:08	12/10/01 15:21	0.19	4.49
1042	10/26/89 4:39	10/26/89 9:13	0.18	4.48
1043	9/26/92 11:26	9/26/92 11:31	0.18	4.48
1044	11/6/02 5:31	11/6/02 5:44	0.17	4.47

Magnolia Storm Rank by Peak Flow
Cutoff flow: 4.3 mgd
Peak Flow: Peak Flow Net + 4.3 mgd

Rank	Start Time	End Time	Peak Flow Net(mgd	Peak Flow (mgd)
1045	6/13/94 14:25	6/13/94 14:31	0.17	4.47
1046	6/10/90 0:08	6/10/90 0:22	0.17	4.47
1047	11/17/84 16:08	11/17/84 16:20	0.17	4.47
1048	12/3/01 10:17	12/3/01 10:23	0.17	4.47
1049	11/19/94 20:59	11/19/94 21:12	0.17	4.47
1050	5/12/04 8:08	5/12/04 8:13	0.17	4.47
1051	10/11/96 7:33	10/11/96 7:50	0.16	4.46
1052	9/23/86 2:54	9/23/86 3:10	0.15	4.45
1053	2/24/89 21:54	2/24/89 22:03	0.15	4.45
1054	1/8/08 8:18	1/8/08 8:23	0.14	4.44
1055	12/18/91 6:49	12/18/91 8:23	0.14	4.44
1056	2/24/85 11:05	2/24/85 11:20	0.13	4.43
1057	12/23/90 12:34	12/23/90 13:02	0.13	4.43
1058	12/8/92 3:38	12/8/92 3:43	0.13	4.43
1059	2/20/96 4:48	2/20/96 4:51	0.12	4.42
1060	4/8/86 21:19	4/8/86 21:25	0.12	4.42
1061	3/5/97 18:58	3/5/97 19:02	0.11	4.41
1062	12/4/01 22:16	12/4/01 22:22	0.11	4.41
1063	3/16/94 21:03	3/16/94 21:32	0.11	4.41
1064	1/8/86 0:59	1/8/86 1:02	0.11	4.41
1065	1/2/08 6:54	1/2/08 7:01	0.11	4.41
1066	9/20/78 13:07	9/20/78 13:11	0.10	4.40
1067	11/17/97 4:34	11/17/97 4:42	0.10	4.40
1068	11/29/90 7:39	11/29/90 9:30	0.10	4.40
1069	3/13/80 4:49	3/13/80 5:02	0.10	4.40
1070	9/10/00 7:28	9/10/00 7:44	0.10	4.40
1071	10/14/96 12:19	10/14/96 12:31	0.09	4.39
1072	10/1/82 21:47	10/1/82 21:51	0.09	4.39
1073	5/13/90 15:28	5/13/90 15:31	0.09	4.39
1074	8/12/91 17:29	8/12/91 17:30	0.09	4.39
1075	4/18/03 3:49	4/18/03 4:01	0.09	4.39
1076	10/29/86 13:47	10/29/86 13:52	0.08	4.38
1077	2/27/00 5:28	2/27/00 5:33	0.08	4.38
1078	7/20/07 18:09	7/20/07 18:20	0.08	4.38
1079	3/3/93 1:49	3/3/93 2:01	0.08	4.38
1080	5/8/04 13:49	5/8/04 13:56	0.07	4.37
1081	1/17/82 13:18	1/17/82 14:01	0.07	4.37
1082	11/9/80 8:17	11/9/80 8:21	0.07	4.37
1083	1/16/07 13:47	1/16/07 13:56	0.07	4.37
1084	5/17/89 9:47	5/17/89 9:56	0.07	4.37
1085	11/13/89 8:16	11/13/89 8:20	0.06	4.36
1086	12/31/79 23:49	12/31/79 23:51	0.06	4.36
1087	4/6/92 15:08	4/6/92 15:10	0.06	4.36
1088	2/21/96 16:19	2/21/96 16:22	0.05	4.35
1089	10/9/98 3:19	10/9/98 3:20	0.04	4.34
1090	5/7/93 10:09	5/7/93 10:11	0.03	4.33
1091	4/29/92 4:09	4/29/92 4:10	0.02	4.32
1092	1/19/83 3:48	1/19/83 3:50	0.02	4.32
1093	7/11/81 4:49	7/11/81 4:50	0.02	4.32
1094	1/1/06 18:09	1/1/06 18:10	0.02	4.32
1095	6/30/89 17:19	6/30/89 17:20	0.01	4.31
1096	11/27/92 3:09	11/27/92 3:10	0.01	4.31
1097	3/25/84 10:59	3/25/84 11:00	0.01	4.31
1098	5/3/94 22:29	5/3/94 22:30	0.00	4.30
1099	11/29/98 12:09	11/29/98 12:20	0.00	4.30
1100	11/16/92 15:49	11/16/92 15:50	0.00	4.30

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)	
1	12/1/07 19:33	12/6/07 16:07	23.20	
2	12/28/96 13:35	1/4/97 10:25	15.15	
3	10/5/81 12:11	10/8/81 20:52	8.00	
4	1/15/86 19:27	1/20/86 19:36	8.00	
5	10/20/03 1:36	10/22/03 17:04	7.94	
6	3/18/97 6:37	3/20/97 19:49	6.45	
7	12/16/79 20:49	12/21/79 19:01	5.90	
8	4/3/91 6:57	4/7/91 14:44	5.11	
9	11/17/03 17:51	11/21/03 9:21	4.75	
10	11/13/01 14:02	11/16/01 6:10	4.55	
11	4/22/96 12:28	4/25/96 17:00	4.45	
12	11/23/90 14:18	11/25/90 14:04	3.91	
13	12/2/89 11:38	12/4/89 22:30	3.70	
14	8/22/04 2:26	8/22/04 23:39	3.32	
15	2/8/96 2:51	2/9/96 11:04	2.89	
16	1/4/83 14:58	1/6/83 12:55	2.88	
17	12/3/82 5:04	12/4/82 6:32	2.75	
18	11/2/78 18:55	11/4/78 1:39	2.48	
19	11/24/98 22:18	11/26/98 10:56	2.41	
20	3/2/87 14:08	3/4/87 8:00	2.32	
21	12/19/94 9:37	12/20/94 22:23	2.29	
22	12/19/05 9:18	12/25/05 7:24	2.28	
23	11/1/84 11:03	11/3/84 15:25	2.26	
24	10/25/86 1:29	10/26/86 17:59	2.23	
25	11/23/86 4:39	11/24/86 12:34	2.13	
26	1/9/90 4:17	1/9/90 20:33	2.01	
27	**12/28/86 11:47**	**12/29/86 13:19**	**1.90**	Maximum 20-Yr Average and Max net peak flow 33.96 (MGD)
28	1/12/88 23:59	1/15/88 20:44	1.88	
29	1/6/02 15:37	1/8/02 11:35	1.84	
30	**1/29/06 14:06**	**1/30/06 10:52**	**1.83**	Average of 20-Yr Averages and Approximate Long term average
31	12/14/06 10:18	12/15/06 1:21	1.72	
32	10/26/85 5:21	10/27/85 21:26	1.67	
33	11/20/80 22:04	11/21/80 13:22	1.64	
34	6/6/85 11:36	6/7/85 17:58	1.64	
35	2/18/95 9:44	2/19/95 22:08	1.61	
36	1/31/87 2:51	2/1/87 4:05	1.59	
37	11/7/95 5:56	11/8/95 12:36	1.55	
38	11/28/01 6:05	12/1/01 19:34	1.53	
39	8/22/01 15:42	8/23/01 11:35	1.46	
40	12/1/87 1:40	12/3/87 6:47	1.44	
41	1/10/80 12:26	1/12/80 9:56	1.44	
42	12/24/80 1:54	12/27/80 0:59	1.41	
43	12/15/01 14:11	12/16/01 23:19	1.37	
44	11/11/81 7:43	11/12/81 3:28	1.34	
45	9/5/84 7:11	9/5/84 16:01	1.30	
46	1/5/90 15:00	1/8/90 2:53	1.29	
47	1/17/05 4:02	1/18/05 22:23	1.28	
48	11/4/06 13:48	11/7/06 14:48	1.25	
49	12/9/95 17:06	12/14/95 19:58	1.24	
50	9/22/78 16:03	9/23/78 12:08	1.23	
51	2/21/02 1:44	2/23/02 9:13	1.22	
52	11/28/95 16:21	11/29/95 14:19	1.22	

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
53	11/2/88 7:17	11/5/88 16:57	1.22
54	5/31/97 5:41	5/31/97 13:10	1.19
55	1/1/03 10:45	1/2/03 23:43	1.19
56	6/3/08 6:31	6/3/08 22:38	1.19
57	11/2/04 2:40	11/2/04 22:21	1.18
58	1/9/06 1:59	1/12/06 17:07	1.12
59	1/27/92 8:06	1/31/92 20:46	1.11
60	12/26/94 0:20	12/27/94 10:28	1.10
61	8/9/91 2:18	8/9/91 20:38	1.09
62	1/6/04 20:58	1/8/04 11:26	1.03
63	12/4/90 2:40	12/4/90 12:01	1.00
64	12/26/06 16:29	12/27/06 2:12	0.99
65	11/1/83 11:22	11/4/83 4:15	0.99
66	12/4/81 18:29	12/6/81 5:52	0.98
67	2/23/99 18:41	2/24/99 19:00	0.98
68	10/29/97 5:48	10/30/97 20:20	0.95
69	4/19/97 17:02	4/20/97 1:42	0.95
70	3/26/05 3:58	3/27/05 7:00	0.91
71	2/17/83 6:40	2/17/83 20:52	0.91
72	6/24/99 1:31	6/24/99 9:00	0.90
73	12/7/83 16:22	12/10/83 16:18	0.90
74	11/10/95 17:25	11/11/95 3:01	0.87
75	1/29/95 1:48	2/1/95 13:09	0.86
76	11/25/05 6:10	11/25/05 17:04	0.86
77	11/27/96 9:04	11/27/96 20:39	0.84
78	12/1/79 12:34	12/2/79 1:05	0.83
79	11/23/83 22:58	11/24/83 7:08	0.83
80	12/17/94 2:06	12/18/94 5:11	0.82
81	11/16/82 6:48	11/17/82 13:37	0.80
82	3/1/91 11:07	3/2/91 22:49	0.79
83	11/5/80 18:08	11/7/80 16:01	0.79
84	9/3/92 21:00	9/4/92 2:52	0.77
85	1/23/98 7:39	1/24/98 18:57	0.77
86	3/25/88 19:17	3/26/88 17:28	0.76
87	1/13/98 2:18	1/14/98 18:00	0.75
88	9/16/05 7:41	9/16/05 9:22	0.73
89	12/9/04 19:06	12/11/04 1:42	0.70
90	2/25/80 23:12	2/27/80 15:04	0.70
91	6/20/84 10:25	6/20/84 22:26	0.69
92	1/28/04 9:09	1/30/04 1:22	0.68
93	11/21/88 5:34	11/24/88 20:51	0.67
94	3/12/03 10:28	3/13/03 21:44	0.67
95	12/4/96 8:50	12/4/96 14:59	0.66
96	5/26/04 7:30	5/27/04 15:45	0.66
97	1/5/06 7:53	1/6/06 0:03	0.66
98	11/19/86 16:24	11/20/86 15:35	0.65
99	12/5/87 11:31	12/6/87 18:49	0.65
100	11/30/94 2:54	11/30/94 9:10	0.65
101	10/1/97 12:37	10/4/97 15:38	0.63
102	10/17/07 16:17	10/19/07 17:15	0.63
103	12/13/02 19:01	12/16/02 7:52	0.62
104	11/26/84 23:06	11/27/84 23:38	0.61
105	10/24/85 3:45	10/25/85 0:02	0.60
106	11/3/05 7:16	11/4/05 12:55	0.59

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
107	9/12/97 1:39	9/12/97 15:16	0.59
108	12/14/82 11:33	12/17/82 19:51	0.59
109	10/4/90 13:16	10/4/90 19:00	0.58
110	11/12/06 18:30	11/13/06 1:41	0.58
111	10/13/96 0:20	10/13/96 7:37	0.57
112	12/9/87 8:55	12/9/87 18:33	0.57
113	3/17/80 16:58	3/17/80 19:42	0.57
114	2/17/81 21:34	2/19/81 7:34	0.56
115	12/11/98 12:17	12/13/98 20:49	0.54
116	5/20/07 15:16	5/21/07 21:46	0.54
117	4/16/92 10:47	4/17/92 21:10	0.53
118	9/3/96 10:11	9/3/96 19:05	0.52
119	12/4/03 20:13	12/5/03 23:40	0.51
120	10/27/98 17:34	10/27/98 22:50	0.51
121	6/27/01 7:38	6/28/01 0:29	0.51
122	2/16/89 13:50	2/18/89 3:32	0.50
123	11/20/98 5:05	11/22/98 0:09	0.49
124	10/25/94 18:40	10/27/94 3:26	0.49
125	10/15/03 9:41	10/17/03 7:50	0.49
126	12/15/81 0:29	12/15/81 12:22	0.49
127	11/11/89 15:08	11/12/89 3:33	0.48
128	10/19/00 21:22	10/20/00 8:47	0.48
129	11/5/05 15:07	11/5/05 21:05	0.48
130	10/28/82 13:23	10/28/82 19:13	0.48
131	8/29/83 20:10	8/30/83 1:23	0.47
132	1/1/07 18:15	1/3/07 8:28	0.47
133	7/16/78 4:41	7/16/78 9:08	0.47
134	11/22/01 8:07	11/22/01 18:46	0.47
135	7/13/81 5:30	7/13/81 12:05	0.47
136	11/19/83 8:56	11/20/83 7:24	0.47
137	12/11/06 4:18	12/12/06 22:27	0.46
138	11/13/83 17:30	11/17/83 16:48	0.46
139	9/13/96 19:26	9/15/96 4:11	0.45
140	4/15/78 16:06	4/16/78 9:16	0.45
141	4/7/87 20:01	4/7/87 22:39	0.45
142	12/8/93 11:36	12/10/93 8:17	0.45
143	2/3/91 7:39	2/4/91 20:54	0.45
144	5/15/05 2:25	5/15/05 8:15	0.45
145	2/13/81 21:33	2/14/81 13:25	0.44
146	1/3/01 18:09	1/4/01 19:54	0.43
147	3/22/98 4:31	3/23/98 14:55	0.43
148	10/24/79 6:42	10/25/79 4:43	0.42
149	9/15/97 15:17	9/17/97 17:12	0.42
150	12/2/80 7:09	12/2/80 17:08	0.42
151	12/20/80 10:30	12/21/80 17:05	0.42
152	1/11/91 2:06	1/12/91 8:58	0.42
153	2/5/96 10:02	2/6/96 10:37	0.41
154	10/8/97 6:17	10/8/97 19:06	0.41
155	5/29/87 23:12	5/30/87 6:56	0.40
156	8/24/97 14:56	8/24/97 18:05	0.40
157	10/1/81 18:34	10/1/81 21:07	0.40
158	10/21/82 16:12	10/22/82 13:01	0.39
159	2/1/78 10:41	2/2/78 17:24	0.39
160	6/10/01 14:26	6/11/01 21:51	0.39

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
161	9/27/81 5:58	9/29/81 2:25	0.38
162	11/15/06 5:43	11/15/06 18:19	0.38
163	5/16/03 19:05	5/16/03 21:20	0.38
164	9/16/85 8:10	9/17/85 2:44	0.38
165	2/24/79 15:29	2/25/79 18:36	0.38
166	1/4/03 5:05	1/4/03 12:34	0.37
167	6/2/90 23:22	6/4/90 13:33	0.37
168	6/10/83 0:26	6/10/83 3:31	0.37
169	1/14/96 17:11	1/15/96 19:34	0.37
170	8/17/80 20:16	8/18/80 0:04	0.37
171	11/19/01 7:59	11/21/01 4:56	0.36
172	2/11/79 18:55	2/13/79 7:35	0.36
173	1/2/84 2:17	1/3/84 2:28	0.36
174	11/13/84 12:09	11/13/84 18:57	0.36
175	9/22/84 4:51	9/22/84 7:59	0.36
176	11/2/06 7:32	11/3/06 12:05	0.36
177	11/10/89 10:28	11/10/89 14:07	0.36
178	3/5/87 11:26	3/6/87 0:19	0.36
179	2/19/91 2:38	2/19/91 7:47	0.35
180	11/15/07 15:48	11/16/07 1:33	0.35
181	12/10/92 4:47	12/10/92 21:23	0.34
182	10/26/79 20:59	10/27/79 15:31	0.34
183	9/24/88 14:20	9/25/88 6:49	0.34
184	11/23/97 19:01	11/23/97 20:45	0.34
185	12/8/84 2:10	12/8/84 19:52	0.32
186	2/15/94 18:01	2/17/94 20:46	0.32
187	9/30/05 23:40	10/1/05 17:09	0.32
188	3/13/00 21:00	3/14/00 18:30	0.32
189	11/7/97 4:44	11/7/97 14:24	0.32
190	5/22/96 2:56	5/22/96 19:43	0.32
191	7/1/83 8:44	7/2/83 15:56	0.32
192	5/12/88 19:28	5/12/88 21:02	0.32
193	11/10/84 6:14	11/11/84 3:52	0.32
194	1/17/99 14:04	1/18/99 17:55	0.31
195	1/31/06 14:19	2/2/06 17:14	0.31
196	12/30/05 14:44	12/31/05 4:02	0.31
197	10/22/85 1:48	10/22/85 13:59	0.31
198	10/30/05 21:56	10/31/05 5:07	0.31
199	11/16/02 8:34	11/16/02 14:56	0.30
200	8/6/95 13:52	8/6/95 18:05	0.30
201	10/10/95 5:45	10/11/95 3:46	0.30
202	11/19/82 10:10	11/19/82 12:14	0.30
203	8/24/78 18:40	8/25/78 17:46	0.30
204	3/31/96 17:36	4/1/96 10:15	0.30
205	1/24/02 23:49	1/25/02 8:02	0.30
206	11/30/98 17:32	12/2/98 0:02	0.29
207	6/1/99 14:06	6/1/99 15:28	0.29
208	11/28/80 23:04	11/29/80 1:28	0.29
209	2/16/01 15:08	2/16/01 20:00	0.29
210	10/6/82 4:11	10/6/82 9:49	0.29
211	8/28/05 18:36	8/28/05 19:46	0.29
212	3/22/93 6:38	3/23/93 0:11	0.29
213	1/31/80 17:59	2/2/80 13:43	0.28
214	7/24/91 13:43	7/24/91 15:08	0.28

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
215	10/23/78 19:47	10/23/78 21:50	0.28
216	4/16/05 4:49	4/16/05 9:47	0.28
217	12/26/05 7:33	12/28/05 9:35	0.28
218	10/16/01 11:07	10/16/01 14:09	0.28
219	1/5/86 10:43	1/5/86 14:12	0.28
220	1/5/07 18:38	1/5/07 22:09	0.28
221	4/29/06 13:18	4/29/06 17:18	0.28
222	12/2/96 8:20	12/2/96 10:16	0.27
223	11/20/78 10:05	11/20/78 15:57	0.27
224	4/8/84 16:20	4/9/84 20:24	0.27
225	10/9/84 21:18	10/10/84 22:48	0.27
226	6/4/97 21:04	6/4/97 21:56	0.27
227	8/30/85 15:40	8/30/85 17:28	0.27
228	12/24/98 11:43	12/25/98 18:06	0.27
229	10/17/96 17:22	10/17/96 21:22	0.27
230	11/15/03 14:47	11/16/03 11:49	0.27
231	11/12/07 6:12	11/12/07 11:31	0.27
232	3/10/82 21:46	3/11/82 2:39	0.27
233	4/13/02 17:09	4/13/02 23:31	0.26
234	11/29/78 14:07	11/30/78 23:32	0.26
235	3/15/97 10:00	3/15/97 16:45	0.26
236	6/8/81 7:11	6/8/81 10:59	0.26
237	4/26/97 20:34	4/27/97 7:17	0.26
238	4/12/79 13:08	4/12/79 20:15	0.26
239	8/12/78 16:01	8/12/78 16:47	0.26
240	11/25/86 17:41	11/26/86 22:24	0.26
241	11/17/07 11:45	11/17/07 13:38	0.25
242	12/3/79 6:13	12/3/79 23:54	0.25
243	5/4/03 17:23	5/5/03 19:11	0.25
244	10/8/01 14:37	10/8/01 21:11	0.25
245	1/21/03 11:04	1/23/03 3:05	0.25
246	9/10/83 11:36	9/10/83 13:13	0.25
247	4/17/86 16:19	4/17/86 20:09	0.25
248	11/23/84 6:07	11/23/84 11:39	0.24
249	2/16/03 15:37	2/16/03 17:57	0.24
250	2/14/86 23:39	2/15/86 18:25	0.24
251	3/10/02 11:39	3/12/02 8:12	0.24
252	1/27/87 16:17	1/28/87 18:27	0.24
253	10/3/98 16:35	10/3/98 18:11	0.24
254	7/4/92 7:19	7/5/92 16:11	0.24
255	7/26/78 12:45	7/26/78 18:06	0.24
256	2/22/96 19:37	2/22/96 21:19	0.24
257	9/8/78 17:59	9/9/78 17:26	0.24
258	6/24/80 22:57	6/25/80 2:18	0.24
259	5/15/78 12:19	5/15/78 13:43	0.24
260	5/26/82 7:23	5/26/82 10:58	0.23
261	6/2/88 16:14	6/2/88 20:43	0.23
262	12/14/84 13:26	12/14/84 16:11	0.23
263	4/30/87 4:14	4/30/87 20:17	0.23
264	4/13/93 18:33	4/13/93 21:05	0.23
265	4/29/93 14:18	4/30/93 5:05	0.23
266	5/30/90 15:24	5/30/90 23:36	0.23
267	12/18/81 9:09	12/19/81 13:10	0.23
268	11/11/05 14:01	11/11/05 16:17	0.23

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
269	11/8/00 3:01	11/8/00 10:18	0.23
270	5/31/93 6:15	5/31/93 10:30	0.23
271	5/1/84 11:45	5/1/84 20:13	0.23
272	1/27/83 7:08	1/27/83 10:33	0.23
273	9/30/07 10:02	9/30/07 15:51	0.23
274	11/16/91 9:14	11/17/91 14:40	0.23
275	10/20/85 1:11	10/20/85 7:59	0.23
276	11/20/81 23:48	11/23/81 7:21	0.22
277	2/8/83 23:47	2/9/83 5:49	0.22
278	2/21/92 5:11	2/21/92 22:06	0.22
279	11/1/05 5:34	11/1/05 13:51	0.22
280	8/16/95 22:54	8/17/95 9:31	0.22
281	5/15/01 5:11	5/15/01 7:26	0.22
282	2/27/99 2:05	2/28/99 15:03	0.22
283	12/29/88 10:41	12/30/88 5:32	0.22
284	3/22/85 5:01	3/24/85 13:06	0.22
285	3/23/08 5:38	3/23/08 14:04	0.22
286	11/21/93 10:04	11/21/93 13:37	0.21
287	9/3/94 8:58	9/3/94 11:05	0.21
288	3/5/89 15:00	3/6/89 22:51	0.21
289	10/9/00 9:12	10/9/00 10:14	0.21
290	2/14/78 17:04	2/14/78 22:51	0.21
291	12/21/86 9:14	12/22/86 19:26	0.21
292	11/10/83 5:45	11/11/83 4:21	0.21
293	3/8/83 13:30	3/10/83 3:48	0.21
294	9/18/83 7:30	9/18/83 11:30	0.21
295	3/15/92 3:42	3/15/92 9:09	0.20
296	5/9/05 18:28	5/10/05 0:58	0.20
297	2/12/82 22:26	2/13/82 22:29	0.20
298	10/28/96 14:28	10/28/96 18:00	0.20
299	2/4/86 17:03	2/4/86 18:51	0.20
300	6/22/05 7:30	6/22/05 9:29	0.20
301	8/6/92 8:07	8/6/92 12:22	0.20
302	6/28/97 21:33	6/29/97 4:59	0.20
303	7/6/81 22:36	7/7/81 2:24	0.20
304	11/26/06 9:46	11/27/06 1:03	0.20
305	4/29/01 8:38	4/30/01 9:25	0.20
306	2/13/94 2:09	2/13/94 9:13	0.20
307	8/30/96 11:31	8/30/96 12:17	0.19
308	5/16/88 0:44	5/16/88 13:05	0.19
309	4/29/97 12:57	4/30/97 19:08	0.19
310	10/11/03 9:23	10/11/03 18:14	0.19
311	10/15/96 14:57	10/15/96 15:44	0.19
312	10/22/89 5:45	10/22/89 9:43	0.19
313	2/18/82 10:00	2/20/82 3:01	0.19
314	5/10/04 13:01	5/11/04 2:07	0.19
315	11/25/00 14:09	11/26/00 22:15	0.19
316	1/7/07 5:17	1/7/07 7:59	0.19
317	10/24/06 6:11	10/24/06 8:26	0.18
318	3/21/03 18:35	3/22/03 6:47	0.18
319	9/1/78 1:23	9/1/78 19:34	0.18
320	6/6/90 7:28	6/6/90 9:52	0.18
321	9/1/79 22:58	9/3/79 11:41	0.18
322	9/1/83 1:37	9/1/83 19:13	0.18

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
323	8/21/89 16:44	8/21/89 22:12	0.18
324	1/16/06 17:17	1/16/06 22:55	0.18
325	12/16/97 6:29	12/17/97 13:27	0.18
326	4/18/78 20:44	4/19/78 18:45	0.18
327	12/20/06 21:26	12/21/06 16:18	0.18
328	12/25/86 19:02	12/25/86 22:09	0.18
329	1/14/08 14:46	1/14/08 18:31	0.18
330	2/20/84 10:24	2/20/84 13:12	0.17
331	10/31/92 16:00	11/1/92 18:27	0.17
332	12/3/95 19:01	12/3/95 21:17	0.17
333	7/9/95 10:20	7/9/95 14:00	0.17
334	4/6/88 3:26	4/6/88 6:30	0.17
335	6/5/95 0:01	6/5/95 7:39	0.17
336	3/19/07 19:18	3/20/07 20:04	0.17
337	12/1/81 17:11	12/2/81 7:13	0.17
338	1/20/96 6:51	1/21/96 5:54	0.16
339	1/16/98 4:36	1/17/98 7:40	0.16
340	12/24/06 13:15	12/24/06 20:35	0.16
341	2/6/05 8:29	2/6/05 14:47	0.16
342	2/11/85 2:44	2/11/85 9:24	0.16
343	12/20/82 2:55	12/20/82 10:27	0.16
344	1/16/97 22:19	1/19/97 1:26	0.16
345	5/8/83 16:12	5/8/83 17:19	0.16
346	10/19/79 14:21	10/19/79 15:50	0.16
347	1/23/82 17:59	1/23/82 20:31	0.16
348	1/31/90 18:21	1/31/90 22:40	0.15
349	7/26/95 1:07	7/26/95 3:31	0.15
350	3/23/86 13:17	3/23/86 18:26	0.15
351	4/18/80 21:00	4/20/80 0:55	0.15
352	4/18/85 23:06	4/19/85 5:05	0.15
353	11/17/81 9:43	11/17/81 12:23	0.15
354	2/7/00 16:35	2/8/00 17:23	0.15
355	7/9/79 22:33	7/10/79 3:34	0.15
356	9/23/92 12:46	9/23/92 19:33	0.15
357	1/27/97 19:19	1/27/97 22:50	0.15
358	6/16/05 22:50	6/17/05 0:29	0.15
359	12/13/01 20:04	12/13/01 21:04	0.15
360	11/14/81 0:03	11/15/81 15:08	0.15
361	1/1/02 15:20	1/2/02 0:30	0.15
362	4/8/80 20:31	4/9/80 16:21	0.15
363	11/17/88 5:36	11/17/88 7:48	0.15
364	6/26/82 8:19	6/26/82 9:15	0.15
365	4/23/98 11:31	4/23/98 14:01	0.14
366	11/19/97 10:56	11/19/97 23:38	0.14
367	3/15/08 4:37	3/16/08 4:20	0.14
368	11/12/02 6:51	11/12/02 21:21	0.14
369	12/25/03 17:19	12/25/03 18:55	0.14
370	3/11/89 3:33	3/11/89 7:28	0.14
371	6/2/01 17:00	6/3/01 2:00	0.14
372	2/22/83 19:27	2/23/83 9:19	0.14
373	1/21/01 4:57	1/21/01 12:55	0.14
374	10/31/80 6:43	11/1/80 14:14	0.14
375	9/25/98 12:41	9/25/98 13:51	0.14
376	3/13/95 15:54	3/14/95 11:38	0.14

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
377	1/25/82 20:42	1/26/82 10:07	0.14
378	10/14/79 20:53	10/14/79 21:54	0.14
379	4/16/01 22:25	4/17/01 0:11	0.14
380	11/26/07 17:56	11/26/07 19:36	0.13
381	4/2/94 23:18	4/3/94 20:45	0.13
382	7/25/83 9:37	7/25/83 16:16	0.13
383	1/2/87 19:02	1/3/87 4:33	0.13
384	6/12/78 10:29	6/13/78 17:46	0.13
385	10/25/82 19:40	10/25/82 22:31	0.13
386	10/11/85 14:49	10/11/85 15:28	0.13
387	6/1/80 6:03	6/2/80 6:54	0.13
388	3/15/81 20:39	3/15/81 21:55	0.13
389	11/30/93 21:38	12/1/93 14:53	0.13
390	5/13/78 23:54	5/14/78 11:29	0.13
391	5/11/84 5:09	5/11/84 7:50	0.13
392	11/19/06 8:08	11/19/06 11:31	0.13
393	1/9/08 22:30	1/10/08 0:18	0.13
394	12/13/81 14:59	12/13/81 16:39	0.13
395	3/7/78 2:58	3/7/78 19:36	0.13
396	10/23/89 9:56	10/23/89 11:19	0.13
397	2/11/84 5:46	2/11/84 7:31	0.13
398	10/13/88 8:37	10/13/88 20:06	0.12
399	10/16/04 10:21	10/17/04 11:35	0.12
400	5/14/83 19:30	5/15/83 1:56	0.12
401	10/24/07 12:09	10/24/07 19:47	0.12
402	10/6/93 17:09	10/6/93 18:10	0.12
403	12/14/79 19:14	12/14/79 20:57	0.12
404	3/16/93 18:37	3/16/93 20:32	0.12
405	11/20/06 16:47	11/23/06 11:24	0.12
406	4/9/02 13:39	4/10/02 0:30	0.12
407	12/30/80 10:27	12/30/80 22:04	0.12
408	1/28/90 10:58	1/29/90 16:01	0.12
409	8/6/04 11:34	8/6/04 14:33	0.12
410	1/20/79 17:28	1/21/79 2:14	0.12
411	9/3/07 23:41	9/4/07 8:53	0.12
412	6/6/93 11:46	6/6/93 22:37	0.12
413	11/13/87 8:15	11/13/87 10:28	0.12
414	1/14/06 16:51	1/14/06 19:53	0.12
415	11/8/94 18:39	11/8/94 21:36	0.12
416	8/2/96 7:54	8/2/96 18:27	0.12
417	1/23/79 17:26	1/23/79 20:00	0.12
418	3/5/92 21:31	3/5/92 22:28	0.12
419	11/8/06 19:23	11/8/06 21:34	0.12
420	6/12/95 20:50	6/12/95 21:51	0.11
421	11/24/95 15:28	11/24/95 18:28	0.11
422	6/28/02 12:25	6/28/02 19:04	0.11
423	3/25/04 17:37	3/25/04 19:17	0.11
424	3/28/85 19:46	3/28/85 22:07	0.11
425	1/27/90 6:40	1/27/90 8:21	0.11
426	10/2/95 4:01	10/2/95 4:44	0.11
427	1/13/03 21:40	1/13/03 22:32	0.11
428	4/1/89 17:53	4/1/89 18:42	0.11
429	2/10/83 16:51	2/12/83 5:03	0.11
430	1/20/06 1:52	1/20/06 2:57	0.11

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
431	10/28/05 2:04	10/28/05 18:02	0.11
432	9/9/82 3:31	9/9/82 4:48	0.11
433	4/2/88 12:25	4/2/88 19:05	0.11
434	4/1/83 13:25	4/1/83 16:08	0.11
435	6/22/93 14:28	6/22/93 15:03	0.11
436	4/30/88 14:21	4/30/88 15:31	0.11
437	4/13/03 4:29	4/13/03 7:24	0.11
438	11/29/84 11:01	11/29/84 13:19	0.11
439	6/9/93 7:37	6/9/93 11:04	0.11
440	12/2/03 18:57	12/2/03 19:41	0.11
441	5/2/88 10:08	5/2/88 12:39	0.11
442	12/5/88 23:59	12/6/88 3:05	0.11
443	8/29/06 20:26	8/29/06 21:09	0.11
444	9/7/79 22:28	9/7/79 23:34	0.10
445	5/23/06 9:25	5/23/06 10:19	0.10
446	5/28/01 10:03	5/28/01 10:48	0.10
447	1/2/86 12:29	1/2/86 20:47	0.10
448	9/10/04 22:28	9/11/04 1:19	0.10
449	6/14/86 13:18	6/14/86 13:53	0.10
450	4/12/96 17:30	4/12/96 18:54	0.10
451	1/19/02 7:51	1/19/02 8:29	0.10
452	5/28/02 20:35	5/28/02 21:23	0.10
453	8/23/93 15:31	8/23/93 16:10	0.10
454	1/14/00 8:07	1/14/00 11:12	0.10
455	11/3/82 21:49	11/4/82 0:14	0.10
456	3/20/84 12:55	3/20/84 18:47	0.10
457	11/19/91 13:29	11/19/91 17:00	0.10
458	5/24/85 16:00	5/24/85 20:42	0.10
459	12/4/78 6:11	12/4/78 12:02	0.10
460	2/26/82 8:24	2/26/82 14:31	0.10
461	9/16/02 18:41	9/16/02 19:19	0.10
462	12/3/80 19:21	12/3/80 20:15	0.10
463	12/22/07 8:28	12/22/07 10:31	0.10
464	3/1/82 1:58	3/1/82 7:41	0.10
465	2/22/99 9:46	2/22/99 16:24	0.10
466	12/12/02 12:07	12/12/02 16:51	0.10
467	3/8/06 12:58	3/8/06 16:08	0.10
468	11/5/86 13:00	11/5/86 20:23	0.09
469	3/25/08 23:55	3/26/08 20:42	0.09
470	1/1/98 12:19	1/1/98 13:51	0.09
471	10/28/90 12:19	10/28/90 13:05	0.09
472	8/16/99 13:28	8/16/99 14:02	0.09
473	1/25/03 20:33	1/26/03 7:58	0.09
474	1/10/79 0:54	1/10/79 9:14	0.09
475	4/15/02 14:38	4/15/02 18:13	0.09
476	11/22/79 2:14	11/22/79 15:21	0.09
477	6/15/98 12:04	6/15/98 20:43	0.09
478	5/28/92 17:00	5/28/92 17:59	0.09
479	3/31/05 21:03	4/1/05 0:57	0.09
480	7/16/99 0:41	7/16/99 22:11	0.09
481	2/3/06 23:59	2/4/06 8:51	0.09
482	5/9/99 3:25	5/9/99 4:32	0.09
483	7/3/98 5:34	7/3/98 9:22	0.09
484	7/2/90 3:06	7/2/90 7:59	0.09

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
485	1/31/04 15:50	1/31/04 17:50	0.09
486	8/26/97 13:16	8/27/97 17:14	0.09
487	3/9/91 11:48	3/9/91 12:23	0.09
488	11/15/96 4:03	11/15/96 9:33	0.08
489	7/1/93 23:44	7/2/93 8:50	0.08
490	2/15/95 4:27	2/15/95 7:21	0.08
491	12/21/81 10:42	12/21/81 11:27	0.08
492	12/16/00 15:52	12/16/00 17:33	0.08
493	9/25/97 20:56	9/26/97 19:03	0.08
494	12/12/83 12:43	12/13/83 3:45	0.08
495	1/5/98 4:11	1/5/98 10:07	0.08
496	4/11/81 12:48	4/12/81 9:29	0.08
497	2/17/92 15:27	2/18/92 8:17	0.08
498	6/8/80 7:46	6/8/80 11:20	0.08
499	6/30/82 8:43	6/30/82 10:19	0.08
500	3/2/99 22:01	3/3/99 14:24	0.08
501	9/9/94 18:19	9/9/94 22:58	0.08
502	5/19/86 20:55	5/19/86 22:31	0.08
503	4/13/82 0:24	4/13/82 1:30	0.08
504	8/28/83 14:44	8/28/83 18:32	0.08
505	9/14/87 9:51	9/14/87 12:12	0.08
506	6/24/98 5:30	6/24/98 7:59	0.08
507	6/1/88 12:34	6/1/88 13:24	0.08
508	3/3/81 16:46	3/3/81 21:11	0.08
509	4/12/01 17:29	4/12/01 18:23	0.08
510	12/15/84 17:36	12/15/84 21:01	0.08
511	1/19/08 14:40	1/19/08 15:48	0.07
512	2/5/99 16:28	2/6/99 12:08	0.07
513	3/11/07 12:07	3/11/07 13:37	0.07
514	12/27/98 13:14	12/27/98 19:37	0.07
515	4/23/90 16:08	4/23/90 17:09	0.07
516	3/8/07 3:48	3/8/07 4:40	0.07
517	4/1/03 17:26	4/1/03 20:32	0.07
518	2/29/00 7:44	2/29/00 15:37	0.07
519	12/9/91 4:58	12/9/91 5:48	0.07
520	9/13/04 5:19	9/13/04 6:17	0.07
521	4/12/95 22:34	4/14/95 13:52	0.07
522	8/11/83 6:54	8/11/83 11:24	0.07
523	11/7/85 20:20	11/8/85 18:14	0.07
524	6/20/86 12:41	6/20/86 13:12	0.07
525	4/4/92 14:05	4/4/92 14:49	0.07
526	3/29/05 13:23	3/29/05 13:59	0.07
527	6/20/97 22:44	6/21/97 0:30	0.07
528	9/16/04 15:50	9/17/04 19:18	0.07
529	1/30/97 4:25	1/30/97 5:56	0.07
530	3/8/95 5:47	3/10/95 4:54	0.07
531	8/6/97 15:52	8/6/97 16:21	0.07
532	11/18/78 4:42	11/18/78 6:08	0.07
533	7/19/93 22:39	7/20/93 1:14	0.07
534	2/17/96 6:16	2/17/96 16:09	0.07
535	12/18/07 12:33	12/19/07 9:23	0.07
536	10/28/89 3:14	10/28/89 3:50	0.06
537	5/7/81 13:46	5/7/81 18:43	0.06
538	11/5/98 5:34	11/5/98 11:26	0.06

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
539	12/13/04 9:01	12/13/04 20:17	0.06
540	7/16/89 10:45	7/16/89 12:59	0.06
541	1/22/86 14:55	1/22/86 20:16	0.06
542	1/4/00 0:20	1/4/00 3:22	0.06
543	2/21/86 17:55	2/21/86 18:57	0.06
544	4/15/96 22:30	4/16/96 0:20	0.06
545	11/22/95 7:17	11/23/95 9:13	0.06
546	4/8/91 17:32	4/9/91 14:13	0.06
547	10/3/07 15:51	10/3/07 16:26	0.06
548	12/10/96 15:33	12/10/96 16:12	0.06
549	9/1/04 6:14	9/1/04 6:47	0.06
550	3/23/95 3:03	3/23/95 18:10	0.06
551	1/1/86 2:59	1/1/86 4:54	0.06
552	2/16/04 9:46	2/16/04 18:11	0.06
553	11/30/96 16:47	11/30/96 17:24	0.06
554	10/29/06 9:37	10/29/06 10:18	0.06
555	5/3/81 15:27	5/3/81 16:25	0.06
556	11/7/92 1:06	11/7/92 7:05	0.06
557	11/3/80 12:21	11/3/80 13:51	0.06
558	2/21/03 17:15	2/21/03 18:21	0.06
559	7/7/02 16:53	7/7/02 23:36	0.06
560	5/22/84 9:42	5/22/84 15:37	0.06
561	7/1/79 6:24	7/1/79 16:50	0.06
562	11/17/95 17:52	11/18/95 14:49	0.06
563	3/15/79 15:58	3/15/79 17:00	0.06
564	3/12/83 11:04	3/12/83 13:57	0.06
565	6/10/78 16:38	6/10/78 17:09	0.06
566	4/7/88 14:02	4/7/88 14:35	0.06
567	2/5/90 14:14	2/5/90 14:52	0.06
568	12/5/96 20:07	12/8/96 3:17	0.06
569	3/2/89 13:52	3/2/89 15:47	0.06
570	6/17/94 22:57	6/18/94 15:51	0.06
571	2/21/98 16:12	2/21/98 21:06	0.06
572	3/24/04 5:27	3/24/04 6:26	0.06
573	4/2/82 19:11	4/2/82 20:32	0.06
574	12/31/98 5:23	12/31/98 16:13	0.06
575	3/29/83 10:13	3/30/83 16:42	0.06
576	4/28/80 0:15	4/28/80 0:49	0.06
577	6/9/08 15:03	6/9/08 15:42	0.06
578	10/13/89 6:19	10/14/89 5:19	0.05
579	11/12/90 19:56	11/13/90 5:51	0.05
580	8/29/91 6:42	8/29/91 7:53	0.05
581	5/3/97 12:16	5/3/97 16:31	0.05
582	1/19/85 17:34	1/19/85 18:48	0.05
583	12/29/02 22:56	12/30/02 0:22	0.05
584	5/17/82 1:21	5/17/82 2:04	0.05
585	8/21/79 12:31	8/21/79 12:59	0.05
586	6/16/80 14:45	6/16/80 15:30	0.05
587	10/30/01 15:09	10/31/01 3:38	0.05
588	11/14/98 20:33	11/15/98 19:26	0.05
589	11/23/89 5:09	11/23/89 6:36	0.05
590	7/28/93 8:45	7/28/93 11:23	0.05
591	3/7/90 10:32	3/7/90 20:24	0.05
592	10/28/00 1:31	10/28/00 2:24	0.05

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
593	1/23/92 10:37	1/23/92 19:32	0.05
594	12/31/93 23:21	1/1/94 0:47	0.05
595	12/29/83 17:19	12/29/83 21:35	0.05
596	11/27/80 4:45	11/27/80 9:50	0.05
597	1/25/83 23:59	1/26/83 0:42	0.05
598	11/17/85 7:29	11/17/85 8:48	0.05
599	5/13/99 0:09	5/13/99 1:08	0.05
600	6/3/97 15:21	6/3/97 15:52	0.05
601	1/26/87 10:29	1/26/87 13:52	0.05
602	12/26/81 17:02	12/26/81 17:47	0.05
603	4/15/86 7:24	4/15/86 22:30	0.05
604	11/12/01 10:25	11/12/01 11:35	0.05
605	11/15/85 7:29	11/15/85 17:06	0.05
606	10/20/89 20:46	10/21/89 1:05	0.05
607	3/15/87 19:42	3/16/87 5:10	0.05
608	10/14/90 21:03	10/14/90 21:48	0.05
609	3/1/94 15:27	3/2/94 13:51	0.05
610	1/28/06 0:10	1/28/06 4:01	0.05
611	8/13/82 8:03	8/13/82 8:46	0.05
612	9/9/88 19:52	9/9/88 20:19	0.05
613	6/28/93 6:30	6/28/93 7:04	0.05
614	10/16/00 14:02	10/16/00 16:51	0.05
615	10/12/90 13:22	10/12/90 13:54	0.05
616	11/17/04 23:21	11/18/04 0:11	0.05
617	4/17/82 13:02	4/17/82 13:36	0.05
618	12/28/95 19:32	12/29/95 17:05	0.05
619	4/24/85 18:15	4/24/85 19:01	0.05
620	12/29/98 4:48	12/29/98 12:28	0.05
621	5/9/00 10:30	5/9/00 17:52	0.05
622	3/14/84 20:44	3/14/84 21:25	0.05
623	12/9/81 16:12	12/10/81 14:18	0.05
624	5/28/88 0:15	5/28/88 6:36	0.05
625	12/15/94 18:11	12/15/94 19:37	0.05
626	2/26/94 9:11	2/26/94 10:33	0.05
627	12/5/91 9:02	12/5/91 15:34	0.05
628	4/22/97 18:59	4/22/97 22:33	0.05
629	11/17/80 6:02	11/17/80 7:02	0.05
630	9/8/85 21:53	9/8/85 22:34	0.05
631	4/25/99 8:32	4/25/99 9:16	0.05
632	12/10/02 10:42	12/10/02 14:11	0.05
633	10/21/83 23:33	10/22/83 0:18	0.05
634	11/4/85 2:05	11/4/85 2:42	0.05
635	12/12/03 7:28	12/12/03 8:21	0.05
636	5/17/96 17:07	5/18/96 18:02	0.04
637	5/4/85 14:55	5/4/85 15:28	0.04
638	1/11/03 18:24	1/12/03 10:54	0.04
639	9/29/80 15:58	9/29/80 16:58	0.04
640	1/30/86 7:53	1/30/86 10:06	0.04
641	12/23/06 1:30	12/23/06 6:00	0.04
642	12/1/94 18:20	12/1/94 18:49	0.04
643	4/23/04 12:35	4/23/04 13:18	0.04
644	2/17/95 3:39	2/17/95 8:28	0.04
645	12/2/85 15:22	12/2/85 21:35	0.04
646	5/12/96 15:06	5/13/96 14:41	0.04

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
647	4/8/79 16:35	4/9/79 17:23	0.04
648	1/9/89 23:44	1/10/89 0:17	0.04
649	4/13/92 18:14	4/13/92 18:55	0.04
650	6/17/86 20:12	6/17/86 20:50	0.04
651	10/12/01 18:31	10/12/01 19:07	0.04
652	10/10/89 8:51	10/10/89 9:38	0.04
653	10/3/02 7:42	10/3/02 8:25	0.04
654	3/24/01 19:09	3/25/01 5:01	0.04
655	9/10/85 4:37	9/10/85 5:56	0.04
656	2/1/86 6:30	2/1/86 6:57	0.04
657	4/3/87 9:28	4/3/87 12:25	0.04
658	8/18/00 11:03	8/18/00 12:35	0.04
659	6/30/81 15:38	6/30/81 16:18	0.04
660	12/7/04 12:42	12/8/04 9:07	0.04
661	2/13/84 8:02	2/13/84 8:46	0.04
662	10/29/90 15:57	10/29/90 20:46	0.04
663	11/16/94 5:33	11/16/94 6:29	0.04
664	7/2/99 0:56	7/2/99 17:07	0.04
665	5/22/97 14:03	5/22/97 14:29	0.04
666	1/26/98 0:25	1/26/98 0:56	0.04
667	12/5/98 13:19	12/5/98 16:02	0.04
668	10/10/01 23:07	10/10/01 23:36	0.04
669	4/8/03 20:26	4/8/03 21:58	0.04
670	10/26/01 20:04	10/27/01 7:39	0.04
671	5/17/99 15:44	5/17/99 16:19	0.04
672	4/7/02 2:01	4/7/02 2:28	0.04
673	1/13/87 18:08	1/13/87 19:11	0.04
674	6/16/06 11:03	6/16/06 12:07	0.04
675	10/27/81 13:24	10/28/81 0:36	0.04
676	1/4/92 4:19	1/4/92 5:51	0.04
677	3/22/00 7:50	3/22/00 8:41	0.04
678	4/22/89 21:06	4/22/89 22:01	0.04
679	12/17/95 23:10	12/18/95 1:31	0.04
680	10/16/90 6:25	10/16/90 6:59	0.04
681	12/16/03 11:44	12/16/03 12:57	0.04
682	12/31/00 7:25	12/31/00 8:33	0.04
683	6/28/84 14:30	6/28/84 23:34	0.04
684	11/3/96 15:55	11/3/96 16:27	0.04
685	9/14/06 1:36	9/14/06 4:31	0.04
686	10/30/83 19:29	10/30/83 19:57	0.04
687	2/11/90 8:40	2/11/90 9:23	0.04
688	3/11/84 21:08	3/12/84 1:12	0.03
689	4/6/01 19:18	4/6/01 19:55	0.03
690	12/3/81 15:38	12/3/81 16:11	0.03
691	2/22/00 16:25	2/22/00 18:02	0.03
692	3/13/90 19:20	3/13/90 21:26	0.03
693	4/2/01 5:56	4/2/01 6:31	0.03
694	4/3/05 7:36	4/3/05 10:08	0.03
695	10/8/04 5:45	10/8/04 17:13	0.03
696	3/24/91 6:12	3/24/91 7:11	0.03
697	12/14/00 15:56	12/14/00 17:04	0.03
698	2/24/83 22:04	2/25/83 19:33	0.03
699	2/15/82 22:29	2/17/82 9:05	0.03
700	2/3/99 17:56	2/4/99 6:12	0.03

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
701	5/21/80 4:36	5/21/80 5:23	0.03
702	3/5/83 16:53	3/5/83 20:06	0.03
703	12/29/84 17:45	12/29/84 22:21	0.03
704	10/15/06 8:56	10/15/06 11:40	0.03
705	11/18/86 6:25	11/18/86 7:58	0.03
706	5/10/86 8:13	5/10/86 9:40	0.03
707	3/4/94 2:32	3/4/94 3:08	0.03
708	1/28/88 10:28	1/28/88 22:13	0.03
709	3/24/98 17:37	3/24/98 18:09	0.03
710	1/12/08 6:24	1/12/08 7:04	0.03
711	12/26/84 8:15	12/27/84 3:14	0.03
712	12/6/90 14:42	12/6/90 15:26	0.03
713	8/31/91 5:49	8/31/91 7:12	0.03
714	12/7/93 6:05	12/7/93 7:08	0.03
715	2/12/98 5:08	2/12/98 19:26	0.03
716	10/14/05 22:31	10/14/05 23:31	0.03
717	3/12/89 14:54	3/12/89 17:56	0.03
718	10/24/91 2:57	10/24/91 7:40	0.03
719	11/15/78 21:37	11/15/78 22:20	0.03
720	4/11/82 2:29	4/11/82 14:25	0.03
721	1/19/99 18:27	1/19/99 19:03	0.03
722	11/5/82 8:23	11/5/82 9:04	0.03
723	3/23/78 9:29	3/23/78 10:34	0.03
724	4/28/88 18:05	4/28/88 18:44	0.03
725	11/29/93 8:55	11/29/93 11:22	0.03
726	12/17/02 9:11	12/17/02 9:43	0.03
727	1/25/93 7:25	1/25/93 8:10	0.03
728	4/28/05 1:55	4/28/05 2:25	0.03
729	10/21/96 20:02	10/21/96 22:00	0.03
730	2/11/81 22:04	2/11/81 22:36	0.03
731	1/24/83 5:33	1/24/83 6:23	0.03
732	3/11/80 15:10	3/11/80 15:42	0.03
733	11/10/06 6:24	11/10/06 12:15	0.03
734	1/13/95 8:09	1/13/95 8:54	0.03
735	8/9/85 22:18	8/9/85 22:58	0.03
736	11/23/00 7:49	11/23/00 8:34	0.03
737	1/18/98 20:50	1/18/98 22:23	0.03
738	10/16/91 6:26	10/16/91 6:58	0.03
739	2/20/90 1:34	2/20/90 5:00	0.03
740	11/24/91 16:12	11/24/91 16:37	0.03
741	2/6/02 20:17	2/7/02 23:43	0.03
742	1/22/84 2:18	1/22/84 4:07	0.02
743	12/12/88 10:55	12/12/88 13:36	0.02
744	3/1/97 8:21	3/1/97 9:39	0.02
745	10/4/96 11:44	10/4/96 17:46	0.02
746	2/18/99 10:40	2/18/99 20:22	0.02
747	8/27/91 3:06	8/27/91 6:34	0.02
748	12/2/95 0:02	12/2/95 0:35	0.02
749	5/13/85 20:12	5/13/85 23:19	0.02
750	6/12/81 10:46	6/12/81 11:12	0.02
751	3/19/95 23:23	3/20/95 12:27	0.02
752	2/3/96 22:03	2/3/96 23:33	0.02
753	2/25/98 8:04	2/25/98 8:43	0.02
754	6/10/81 10:03	6/10/81 10:27	0.02

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
755	4/4/89 23:59	4/5/89 0:54	0.02
756	3/9/88 17:26	3/9/88 17:53	0.02
757	4/10/87 7:18	4/10/87 7:52	0.02
758	6/22/83 14:59	6/22/83 15:25	0.02
759	10/12/98 8:09	10/12/98 22:32	0.02
760	2/7/78 11:19	2/7/78 11:59	0.02
761	3/23/81 6:48	3/23/81 15:10	0.02
762	10/20/92 12:46	10/20/92 13:14	0.02
763	6/4/84 21:03	6/4/84 21:29	0.02
764	8/27/84 8:31	8/27/84 9:06	0.02
765	4/4/86 15:02	4/4/86 15:39	0.02
766	9/3/78 14:22	9/3/78 14:59	0.02
767	4/8/93 5:45	4/8/93 23:25	0.02
768	5/3/78 5:22	5/3/78 5:56	0.02
769	9/30/78 6:03	9/30/78 6:25	0.02
770	2/7/99 15:17	2/7/99 16:01	0.02
771	9/29/05 22:19	9/29/05 22:57	0.02
772	12/7/98 8:46	12/7/98 10:39	0.02
773	2/6/79 14:49	2/6/79 17:29	0.02
774	1/31/97 22:55	1/31/97 23:37	0.02
775	3/7/86 18:16	3/7/86 18:47	0.02
776	9/13/86 11:04	9/13/86 11:28	0.02
777	9/26/87 1:00	9/26/87 1:24	0.02
778	10/24/80 17:00	10/24/80 17:29	0.02
779	3/9/87 21:08	3/9/87 22:25	0.02
780	4/7/95 5:56	4/7/95 21:33	0.02
781	2/5/79 6:31	2/5/79 9:23	0.02
782	1/21/81 1:40	1/21/81 2:07	0.02
783	10/21/91 8:03	10/21/91 10:16	0.02
784	10/16/88 4:35	10/16/88 4:59	0.02
785	10/17/00 22:30	10/17/00 23:06	0.02
786	7/9/97 12:27	7/9/97 12:53	0.02
787	5/10/81 20:25	5/10/81 20:51	0.02
788	3/1/98 2:14	3/1/98 2:43	0.02
789	3/8/02 9:47	3/8/02 10:21	0.02
790	12/25/90 13:41	12/25/90 14:05	0.02
791	12/27/02 1:32	12/27/02 2:09	0.02
792	12/11/93 18:15	12/11/93 18:45	0.02
793	4/2/99 22:10	4/3/99 2:00	0.02
794	12/27/07 15:53	12/27/07 16:29	0.02
795	10/30/84 12:29	10/30/84 12:54	0.02
796	4/18/87 20:39	4/18/87 21:31	0.02
797	9/11/82 20:25	9/11/82 20:52	0.02
798	3/11/97 18:22	3/11/97 18:56	0.02
799	1/30/03 20:29	1/30/03 21:01	0.02
800	5/9/93 19:29	5/9/93 20:04	0.02
801	11/19/88 7:33	11/19/88 8:02	0.02
802	3/28/97 16:26	3/28/97 17:42	0.02
803	6/15/00 14:15	6/15/00 14:36	0.02
804	7/27/83 10:32	7/27/83 11:24	0.02
805	11/12/91 8:35	11/12/91 8:57	0.02
806	12/20/87 15:39	12/20/87 18:01	0.02
807	1/23/81 19:40	1/24/81 16:45	0.02
808	11/2/79 23:34	11/3/79 4:26	0.02

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
809	10/23/93 17:07	10/23/93 18:10	0.02
810	1/1/87 4:15	1/1/87 4:43	0.02
811	6/17/96 18:26	6/17/96 18:47	0.02
812	12/20/96 10:49	12/20/96 11:14	0.02
813	11/4/89 0:51	11/4/89 1:13	0.02
814	3/16/97 23:39	3/17/97 0:42	0.02
815	6/11/05 13:38	6/11/05 14:08	0.02
816	11/11/87 0:08	11/11/87 1:01	0.02
817	3/25/87 19:22	3/25/87 20:04	0.02
818	3/19/05 16:16	3/19/05 17:46	0.01
819	5/9/81 7:32	5/9/81 7:58	0.01
820	3/20/94 13:45	3/21/94 9:18	0.01
821	2/20/80 0:43	2/20/80 1:36	0.01
822	6/10/88 3:53	6/10/88 4:58	0.01
823	11/24/96 15:56	11/24/96 16:27	0.01
824	11/8/78 11:07	11/9/78 1:47	0.01
825	2/15/84 5:17	2/16/84 0:43	0.01
826	3/18/95 7:58	3/18/95 8:22	0.01
827	11/12/96 8:06	11/13/96 0:12	0.01
828	5/18/00 18:52	5/18/00 21:20	0.01
829	12/22/78 9:31	12/22/78 9:59	0.01
830	5/21/90 22:53	5/21/90 23:16	0.01
831	8/20/97 17:36	8/20/97 18:06	0.01
832	1/28/81 19:19	1/28/81 23:24	0.01
833	6/3/81 14:23	6/3/81 14:44	0.01
834	3/30/82 6:12	3/30/82 21:25	0.01
835	4/11/84 21:49	4/12/84 11:45	0.01
836	11/21/92 9:57	11/21/92 12:52	0.01
837	4/27/02 1:11	4/27/02 1:45	0.01
838	2/9/85 9:52	2/9/85 10:25	0.01
839	2/16/99 19:59	2/16/99 20:51	0.01
840	1/11/82 7:26	1/11/82 15:30	0.01
841	4/5/80 1:07	4/6/80 4:00	0.01
842	10/13/94 22:13	10/13/94 22:38	0.01
843	2/11/97 15:01	2/11/97 19:20	0.01
844	3/29/08 19:57	3/29/08 21:07	0.01
845	9/20/80 15:58	9/20/80 16:18	0.01
846	4/14/80 13:48	4/14/80 14:08	0.01
847	1/28/01 23:28	1/29/01 4:51	0.01
848	11/5/83 17:26	11/5/83 17:52	0.01
849	7/6/97 5:09	7/6/97 5:30	0.01
850	1/7/83 22:07	1/7/83 22:35	0.01
851	11/13/05 1:29	11/13/05 2:12	0.01
852	5/11/00 16:55	5/11/00 17:20	0.01
853	11/24/79 10:27	11/24/79 10:55	0.01
854	4/5/03 0:47	4/5/03 1:13	0.01
855	11/15/95 9:14	11/15/95 9:39	0.01
856	2/23/78 5:09	2/23/78 5:44	0.01
857	1/7/91 6:50	1/7/91 7:55	0.01
858	8/29/90 11:42	8/29/90 12:07	0.01
859	3/12/91 17:47	3/12/91 18:14	0.01
860	5/2/85 19:21	5/2/85 19:54	0.01
861	2/25/00 16:26	2/25/00 16:53	0.01
862	6/17/97 15:32	6/17/97 15:54	0.01

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
863	10/20/78 7:20	10/20/78 7:59	0.01
864	3/26/80 19:41	3/26/80 20:03	0.01
865	12/13/86 10:11	12/13/86 10:42	0.01
866	4/17/90 6:28	4/17/90 6:59	0.01
867	1/27/99 20:59	1/28/99 16:16	0.01
868	11/8/91 4:43	11/8/91 5:04	0.01
869	3/29/01 23:07	3/29/01 23:32	0.01
870	9/17/86 21:15	9/17/86 22:42	0.01
871	2/2/01 3:17	2/2/01 8:21	0.01
872	1/7/06 12:04	1/7/06 12:27	0.01
873	3/29/82 3:45	3/29/82 4:26	0.01
874	7/30/82 6:43	7/30/82 7:03	0.01
875	3/6/83 22:46	3/7/83 9:10	0.01
876	11/20/96 13:52	11/20/96 14:40	0.01
877	3/7/03 16:08	3/7/03 18:12	0.01
878	10/20/95 5:07	10/20/95 5:37	0.01
879	5/5/97 17:12	5/5/97 17:38	0.01
880	4/15/97 16:24	4/15/97 16:49	0.01
881	5/27/97 10:15	5/27/97 10:44	0.01
882	5/11/99 12:53	5/11/99 13:18	0.01
883	9/27/07 22:40	9/28/07 0:53	0.01
884	8/18/78 20:16	8/18/78 20:47	0.01
885	4/27/78 22:10	4/27/78 22:36	0.01
886	4/14/78 15:02	4/14/78 15:24	0.01
887	3/28/08 14:32	3/28/08 15:02	0.01
888	2/28/87 16:44	2/28/87 17:35	0.01
889	10/31/94 1:14	10/31/94 7:44	0.01
890	12/16/07 18:29	12/16/07 19:28	0.01
891	4/12/94 7:49	4/12/94 8:15	0.01
892	7/9/87 8:37	7/9/87 9:03	0.01
893	8/14/89 14:27	8/14/89 14:47	0.01
894	1/20/93 3:59	1/20/93 4:37	0.01
895	12/13/79 11:30	12/13/79 12:00	0.01
896	5/26/80 10:05	5/26/80 10:56	0.01
897	6/3/85 21:45	6/3/85 22:09	0.01
898	10/21/90 11:03	10/21/90 11:28	0.01
899	11/10/88 11:28	11/10/88 11:49	0.01
900	10/22/79 18:16	10/23/79 2:49	0.01
901	10/18/92 10:27	10/18/92 10:51	0.01
902	2/8/84 16:28	2/9/84 4:15	0.01
903	5/28/89 15:26	5/28/89 18:12	0.01
904	8/30/90 13:46	8/30/90 14:07	0.01
905	1/14/99 5:07	1/14/99 5:47	0.01
906	4/5/81 6:06	4/5/81 6:29	0.01
907	4/7/84 7:49	4/7/84 8:19	0.01
908	7/2/94 2:45	7/2/94 3:03	0.01
909	1/5/80 4:12	1/5/80 4:32	0.01
910	12/20/88 13:30	12/20/88 14:41	0.01
911	12/22/88 9:42	12/22/88 12:14	0.01
912	4/20/89 2:55	4/20/89 3:19	0.01
913	5/6/83 20:34	5/6/83 20:54	0.01
914	1/10/92 7:05	1/10/92 7:26	0.01
915	6/23/96 16:19	6/23/96 16:40	0.01
916	12/25/02 21:54	12/25/02 22:22	0.01

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
917	10/24/96 16:05	10/24/96 16:27	0.01
918	11/19/80 0:55	11/19/80 1:15	0.01
919	1/5/02 11:02	1/5/02 11:25	0.01
920	6/16/83 22:18	6/16/83 22:51	0.01
921	3/1/84 21:27	3/1/84 21:45	0.01
922	12/30/93 16:09	12/30/93 16:50	0.01
923	7/29/81 6:18	7/29/81 6:39	0.01
924	1/12/02 17:28	1/12/02 17:46	0.01
925	1/24/84 15:54	1/25/84 0:05	0.01
926	10/7/07 15:44	10/7/07 16:01	0.01
927	1/29/03 9:25	1/29/03 9:52	0.01
928	2/24/81 14:08	2/24/81 15:31	0.01
929	10/18/89 8:54	10/18/89 9:16	0.01
930	11/30/82 14:04	11/30/82 14:30	0.01
931	3/13/83 19:20	3/13/83 19:42	0.01
932	10/21/01 8:26	10/21/01 9:20	0.01
933	12/5/82 21:21	12/5/82 21:51	0.01
934	4/25/93 9:17	4/25/93 9:34	0.01
935	6/7/84 14:59	6/7/84 15:19	0.01
936	10/18/79 4:52	10/18/79 5:37	0.01
937	11/21/86 17:37	11/21/86 17:58	0.01
938	1/13/89 14:16	1/13/89 14:34	0.01
939	11/18/92 23:40	11/19/92 0:42	0.01
940	1/21/98 17:02	1/21/98 17:24	0.01
941	5/18/05 5:03	5/18/05 5:27	0.01
942	3/13/86 16:32	3/13/86 16:53	0.01
943	1/22/94 21:55	1/22/94 22:34	0.01
944	5/28/93 19:21	5/28/93 19:47	0.01
945	4/4/78 7:07	4/4/78 7:32	0.01
946	11/19/84 14:36	11/19/84 15:03	0.01
947	10/16/85 4:34	10/16/85 4:51	0.01
948	2/3/87 22:12	2/3/87 22:33	0.01
949	3/8/99 18:25	3/8/99 18:48	0.01
950	3/4/00 3:49	3/4/00 4:11	0.01
951	4/14/08 15:06	4/14/08 15:25	0.01
952	3/10/84 20:28	3/10/84 20:43	0.01
953	1/14/04 15:45	1/14/04 16:10	0.01
954	3/14/99 17:24	3/14/99 17:38	0.00
955	3/27/01 16:15	3/27/01 16:38	0.00
956	9/21/81 15:57	9/21/81 16:12	0.00
957	3/11/96 0:07	3/11/96 0:23	0.00
958	3/26/98 13:58	3/26/98 14:15	0.00
959	11/25/89 22:02	11/25/89 22:54	0.00
960	2/8/98 9:24	2/8/98 9:44	0.00
961	12/22/00 8:18	12/22/00 8:39	0.00
962	1/16/99 0:12	1/16/99 0:31	0.00
963	3/29/99 8:43	3/29/99 8:57	0.00
964	7/8/97 4:02	7/8/97 9:11	0.00
965	4/10/05 22:48	4/10/05 23:27	0.00
966	2/3/90 11:43	2/3/90 12:17	0.00
967	10/16/79 11:45	10/16/79 12:05	0.00
968	2/18/80 11:41	2/18/80 12:13	0.00
969	3/28/84 15:09	3/28/84 15:24	0.00
970	3/27/96 15:52	3/27/96 16:05	0.00

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
971	5/5/83 5:28	5/5/83 5:57	0.00
972	1/21/99 5:39	1/21/99 7:32	0.00
973	11/9/91 16:25	11/9/91 16:42	0.00
974	4/1/86 9:34	4/1/86 9:50	0.00
975	5/7/91 19:05	5/7/91 19:25	0.00
976	6/10/95 15:29	6/10/95 15:47	0.00
977	2/15/01 5:53	2/15/01 6:09	0.00
978	5/31/05 15:57	5/31/05 16:12	0.00
979	11/27/88 7:55	11/27/88 8:32	0.00
980	11/1/90 4:56	11/1/90 5:10	0.00
981	9/18/81 23:09	9/18/81 23:49	0.00
982	7/15/01 19:39	7/15/01 19:55	0.00
983	1/22/83 19:46	1/22/83 20:07	0.00
984	1/25/00 9:05	1/25/00 9:21	0.00
985	1/20/97 17:34	1/20/97 17:52	0.00
986	3/10/06 18:12	3/10/06 18:31	0.00
987	7/31/85 23:38	8/1/85 0:20	0.00
988	12/13/96 7:33	12/13/96 7:48	0.00
989	2/3/80 16:47	2/3/80 17:03	0.00
990	2/10/07 20:44	2/10/07 21:01	0.00
991	4/16/88 10:25	4/16/88 10:39	0.00
992	2/2/92 14:41	2/2/92 15:01	0.00
993	10/30/92 15:19	10/30/92 15:37	0.00
994	2/18/96 17:47	2/18/96 18:08	0.00
995	2/2/04 8:24	2/2/04 8:42	0.00
996	10/14/97 4:53	10/14/97 5:09	0.00
997	7/17/96 8:55	7/17/96 9:11	0.00
998	1/25/92 11:38	1/25/92 11:55	0.00
999	1/23/04 17:45	1/23/04 18:01	0.00
1000	3/9/94 22:56	3/9/94 23:12	0.00
1001	3/31/97 15:28	3/31/97 15:44	0.00
1002	2/6/08 20:16	2/6/08 20:33	0.00
1003	3/9/89 21:07	3/9/89 21:24	0.00
1004	5/8/05 17:48	5/8/05 18:13	0.00
1005	2/19/02 5:49	2/19/02 6:03	0.00
1006	12/12/82 9:48	12/12/82 10:07	0.00
1007	4/15/93 6:46	4/15/93 7:02	0.00
1008	4/15/06 14:41	4/15/06 15:00	0.00
1009	12/7/89 19:48	12/7/89 20:04	0.00
1010	9/5/79 5:56	9/5/79 6:09	0.00
1011	3/16/02 8:54	3/16/02 17:18	0.00
1012	3/16/03 11:05	3/16/03 11:15	0.00
1013	3/2/03 18:08	3/2/03 18:26	0.00
1014	11/19/81 14:48	11/19/81 15:04	0.00
1015	11/27/82 8:45	11/28/82 0:03	0.00
1016	10/30/86 23:59	10/31/86 0:12	0.00
1017	2/24/04 6:53	2/24/04 7:06	0.00
1018	12/18/91 6:49	12/18/91 8:23	0.00
1019	3/4/93 2:23	3/4/93 2:39	0.00
1020	4/4/95 7:48	4/4/95 8:02	0.00
1021	2/17/79 19:46	2/17/79 19:57	0.00
1022	2/21/83 18:42	2/21/83 18:58	0.00
1023	2/13/87 4:23	2/13/87 4:35	0.00
1024	11/23/94 1:19	11/23/94 2:22	0.00

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
1025	8/7/99 0:04	8/7/99 0:15	0.00
1026	11/29/90 7:39	11/29/90 9:30	0.00
1027	3/24/06 10:47	3/24/06 10:56	0.00
1028	12/9/06 10:59	12/9/06 11:16	0.00
1029	1/11/88 2:40	1/11/88 2:56	0.00
1030	12/23/90 12:34	12/23/90 13:02	0.00
1031	1/2/94 8:18	1/2/94 8:33	0.00
1032	12/10/01 15:08	12/10/01 15:21	0.00
1033	5/5/79 12:48	5/5/79 13:01	0.00
1034	5/23/89 0:43	5/23/89 0:55	0.00
1035	11/19/02 15:38	11/19/02 15:54	0.00
1036	3/16/94 21:03	3/16/94 21:32	0.00
1037	10/22/04 14:02	10/22/04 14:16	0.00
1038	9/8/94 15:19	9/8/94 15:32	0.00
1039	3/25/81 1:52	3/25/81 2:03	0.00
1040	8/7/85 18:38	8/7/85 18:47	0.00
1041	6/10/90 0:08	6/10/90 0:22	0.00
1042	10/11/96 7:33	10/11/96 7:50	0.00
1043	1/12/87 0:27	1/12/87 1:44	0.00
1044	11/4/94 7:54	11/4/94 8:03	0.00
1045	11/17/84 16:08	11/17/84 16:20	0.00
1046	9/23/86 2:54	9/23/86 3:10	0.00
1047	11/19/94 20:59	11/19/94 21:12	0.00
1048	9/10/00 7:28	9/10/00 7:44	0.00
1049	11/6/02 5:31	11/6/02 5:44	0.00
1050	8/20/07 10:25	8/20/07 10:33	0.00
1051	3/13/80 4:49	3/13/80 5:02	0.00
1052	2/24/85 11:05	2/24/85 11:20	0.00
1053	1/26/81 4:27	1/26/81 4:33	0.00
1054	1/17/82 13:18	1/17/82 14:01	0.00
1055	3/3/93 1:49	3/3/93 2:01	0.00
1056	10/14/96 12:19	10/14/96 12:31	0.00
1057	1/14/85 8:25	1/14/85 8:32	0.00
1058	2/24/89 21:54	2/24/89 22:03	0.00
1059	9/26/92 11:26	9/26/92 11:31	0.00
1060	6/13/94 14:25	6/13/94 14:31	0.00
1061	4/18/03 3:49	4/18/03 4:01	0.00
1062	7/20/07 18:09	7/20/07 18:20	0.00
1063	10/26/89 4:39	10/26/89 9:13	0.00
1064	12/3/01 10:17	12/3/01 10:23	0.00
1065	4/8/86 21:19	4/8/86 21:25	0.00
1066	11/17/97 4:34	11/17/97 4:42	0.00
1067	12/4/01 22:16	12/4/01 22:22	0.00
1068	5/12/04 8:08	5/12/04 8:13	0.00
1069	1/2/08 6:54	1/2/08 7:01	0.00
1070	1/8/08 8:18	1/8/08 8:23	0.00
1071	5/17/89 9:47	5/17/89 9:56	0.00
1072	12/8/92 3:38	12/8/92 3:43	0.00
1073	3/5/97 18:58	3/5/97 19:02	0.00
1074	5/8/04 13:49	5/8/04 13:56	0.00
1075	1/16/07 13:47	1/16/07 13:56	0.00
1076	9/20/78 13:07	9/20/78 13:11	0.00
1077	10/1/82 21:47	10/1/82 21:51	0.00
1078	1/8/86 0:59	1/8/86 1:02	0.00

Magnolia Storm Rank by Overflow Volume
Cutoff flow: 4.3 mgd

Rank	Format: Start Time	End Time	Volume Net (MG)
1079	10/29/86 13:47	10/29/86 13:52	0.00
1080	2/20/96 4:48	2/20/96 4:51	0.00
1081	2/27/00 5:28	2/27/00 5:33	0.00
1082	12/31/79 23:49	12/31/79 23:51	0.00
1083	11/9/80 8:17	11/9/80 8:21	0.00
1084	11/13/89 8:16	11/13/89 8:20	0.00
1085	5/13/90 15:28	5/13/90 15:31	0.00
1086	8/12/91 17:29	8/12/91 17:30	0.00
1087	4/6/92 15:08	4/6/92 15:10	0.00
1088	2/21/96 16:19	2/21/96 16:22	0.00
1089	7/11/81 4:49	7/11/81 4:50	0.00
1090	1/19/83 3:48	1/19/83 3:50	0.00
1091	3/25/84 10:59	3/25/84 11:00	0.00
1092	6/30/89 17:19	6/30/89 17:20	0.00
1093	4/29/92 4:09	4/29/92 4:10	0.00
1094	11/16/92 15:49	11/16/92 15:50	0.00
1095	11/27/92 3:09	11/27/92 3:10	0.00
1096	5/7/93 10:09	5/7/93 10:11	0.00
1097	5/3/94 22:29	5/3/94 22:30	0.00
1098	10/9/98 3:19	10/9/98 3:20	0.00
1099	11/29/98 12:09	11/29/98 12:20	0.00
1100	1/1/06 18:09	1/1/06 18:10	0.00