



Memorandum

To: SCDNR

From: CDM Smith

Date: June 30, 2021

Subject: 2021 Saluda SWAM Model Updates

1.0 Introduction and Overview

The Saluda Basin baseline water allocation model was updated to incorporate newly available water use and return data and to extend the baseline hydrologic period of the model. Model updates included recalculating baseline 10-year average water demands (2010 – 2019) for all water users, adding new water users, removing water users with inactive permits and extending the baseline simulation period from January 2014 through December 2019. Extending the baseline simulation period required using recent USGS streamflow gage data, combined with water use and return data and area transposition methods, to “un-impair” flow records and generate un-impaired model headwater boundary condition flows. Updated downstream flow records were then used to validate model hydrologic parameterization.

The result of this work is an updated model with more recent representation of water demands in the basin and a larger range of hydrologic variability captured by the simulation period. Previously calibrated hydrologic parameters throughout the basin were validated with comparisons of modeled and gaged flows for the simulation extension period.

The Saluda Basin baseline water allocation model was also updated to incorporate recent enhancements to SWAM, the most significant being the addition of a scenario planning module.

2.0 Model Object Changes

Table 1 (all tables and figures are included in **Attachment A**) lists the explicit tributaries and the gages and reference gages used for computing headwater flows. **Table 2** lists the implicit tributaries and their reference gages used for confluence flows. One new explicit tributary, Red Bank Creek which flows into Congaree Creek, was added as part of this update. **Table 3** lists all tributary objects, their confluence location, drainage area, headwater area, drainage area ratio and subbasin flow factors. **Table 4** lists the reservoir inputs and summarizes their operating rules. The evaporation time series was updated for each reservoir through 2019. **Table 5** lists the reservoir area-capacity relationship for all reservoirs. **Table 6** lists the flood control outflow settings. **Table 7** lists reservoir monthly storage targets.

New water users represent those that are newly registered or have just recently surpassed the minimum water use threshold for inclusion in the model of 3 million gallons per month (MGM). Several new water users were added to the model, and several inactive users/intakes were removed. Water demands associated with the new users were quantified based on the South Carolina Department of Health and Environmental Control (DHEC) reported water use and discharge databases. **Table 8** lists the surface water user objects included in the model and their sources of supply. Water demands are specified in the baseline model as monthly mean values for all water user objects.

To facilitate DNR model review, responses to SCDNR inquiries and suggested model updates from correspondence dated January 21, 2021, are included in **Attachment B**.

3.0 Baseline Period Extension

The baseline simulation period was extended by six years, from 1925 – 2013 to 1925 – 2019. For the extension, model boundary condition (headwater) flows were developed for the additional six years, on both a monthly and daily timestep. As done for the original model development, un-impaired gaged flow data were used to estimate flows at ungaged model input locations. The un-impaired process exactly followed the process detailed elsewhere (CDM Smith, 2015) whereby un-impaired flows were calculated by adding in all known upstream consumptive water withdrawals and subtracting out upstream discharges from a downstream USGS gaged flow record. The statistical methods employed, and the assignment of reference gages, are described elsewhere (CDM Smith, 2015).

The USGS gages serve as key reference points for ungaged flow estimates at model input points. Area transposition methods, based on ratios of drainage areas, were used to estimate monthly and daily flows for the period extension, for key model headwater input locations. Again, the assignment of reference gages for this exercise matched that employed during the original model development. Flows prior to 2014 were unchanged in the model, with the exception of Congaree Creek, which was extended and also impacted by the addition of Red Bank Creek which flows into it.

In addition to extending model flow inputs, water demand estimates were updated to more accurately reflect current conditions. New baseline water demand, discharge and consumptive use estimates for the 10-year period 2010 through 2019 were developed using the DHEC reported water use and discharge data. These calculations were consistent with methodologies employed for the original baseline model development (CDM Smith, 2017). Updated mean monthly water demands and discharge parameters were entered into the model for all water user objects. The updated baseline water demands are provided in **Table 9** for industrial (IN), mining (MI), power/thermal (PT) and water supply (WS) users and in **Table 10** for aquaculture (AQ), agriculture (IR) and golf course (GC) users. Transbasin imports are listed in **Table 11**. Model return (discharge) locations are listed in **Table 12**. Updated consumptive use percentages are provided in **Table 13**.

4.0 Model Validation

Existing model hydrologic parameters throughout the basin were validated using data associated with the extended simulation period. Comparison of modeled and gaged flow for the extension period (2014 – 2019) returned satisfactory results for basin gages used in the initial calibration and verification, thereby validating previous calibration work. Model validation results for the extension period that were generated using the updated baseline model are provided in **Attachment C**. Graphs depict the comparison of mean monthly and daily model simulated flows versus reported gage flows in cubic feet per second.

5.0 References

CDM Smith, 2015. Technical Memorandum – Methodology for Unimpaired Flow Development Saluda River Basin, South Carolina

CDM Smith, 2015. Technical Memorandum - Unimpaired Flow Dataset for the Saluda River Basin.

CDM Smith, 2017. South Carolina Surface Water Quantity Models – Saluda River Basin Model.

2021 Saluda SWAM Model Updates

Attachment A

Tables

Table 1. Gages and Reference Gages Used for Headwater Flows on Explicit Tributaries

Headwater Input				USGS Reference Gage (Unimpaired)		
Project ID	Type	USGS Number	SWAM Tributary	Project Gage ID	USGS Number	Stream
SLD201	Ungaged	-	South Saluda River	SLD01	02162290	South Saluda River
SLD200	Ungaged	-	North Saluda River	SLD03	021623975	North Saluda River
SLD203	Ungaged	-	Oolenoy River	SLD04	02162500	Mainstem (Saluda River)*
SLD204	Ungaged	-	Doddies Creek			
SLD206	Ungaged	-	Georges Creek	SLD06	02163000	Mainstem (Saluda River)*
SLD210	Ungaged	-	Hurricane Creek			
SLD211	Ungaged	-	Big Creek	SLD09	02163500	Mainstem (Saluda River)*
SLD213	Ungaged	-	Broad Mouth Creek			
SLD212	Ungaged	-	Laurel Creek	SLD11	02164110	Reedy River
SLD205	Ungaged	-	Reedy River	SLD13	021650905	Reedy River
SLD215	Ungaged	-	Wilson Creek	SLD18	02167000	Mainstem (Saluda River)*
SLD129	Ungaged	-	Little Saluda River	SLD19	02167450	Mainstem (Saluda River)*
SLD216	Ungaged	-	Little River			
SLD221	Ungaged	-	Clouds Creek			
SLD218	Ungaged	-	Big Beaverdam Creek	SLD21	02167563	Bush River
SLD222	Ungaged	-	West Creek	SLD25	02168504	Mainstem (Saluda River)*
SLD223	Ungaged	-	Twelvemile Creek	SLD26	02169000	Mainstem (Saluda River)*
SLD139	Ungaged	-	Congaree Creek	SLD28	02169550	Congaree Creek
SLD140	Ungaged	-	Red Bank Creek	SLD28	02169550	Congaree Creek
SLD226	Ungaged	-	Jackson Creek	SLD29	02169570	Gills Creek
SLD227	Ungaged	-	Gills Creek			
SLD225	Ungaged	-	Cedar Creek	SLD32	02169670	Cedar Creek
SLD207	Ungaged	-	Brushy Creek	SLD33	02162700	Middle Branch
SLD02	Gaged	02162350	Mainstem (Middle Saluda River)*	-	-	-
SLD05	Gaged	02162525	Hamilton Creek	-	-	-
SLD08	Gaged	021630967	Grove Creek	-	-	-
SLD14	Gaged	02165200	Rabon Creek (South Rabon Creek)*	-	-	-
SLD15	Gaged	021652801	North Rabon Creek	-	-	-
SLD17	Gaged	02166970	Ninety-Six Creek	-	-	-
SLD31	Gaged	02169630	Big Beaver Creek	-	-	-
SLD34	Gaged	02167557	Bush River	-	-	-

*Actual river name in parenthesis

Table 2. Reference Gages Used for Headwater Flows on Implicit Tributaries

Ungaged Basin		USGS Reference Gage (Unimpaired)		
Project ID	SWAM Tributary	Project Gage ID	USGS Number	Stream
SLD115	Turkey Creek	SLD16	02166501	Saluda River
SLD161	Halfway Swamp Creek	SLD17	02166970	Ninety-Six Creek
SLD163	Terrapin Creek			
SLD301	Lake Greenwood Inflow	SLD19	02167450	Little River
SLD160	Cane Creek			
SLD302	Lake Murray Inflow			
SLD162	Beaverdam Creek	SLD21	02167563	Bush River
SLD167	Buckhead Creek	SLD31	02169630	Big Beaver Creek
SLD164	Sandy Run	SLD32	02169670	Cedar Creek
SLD165	Mill Creek			
SLD166	Toms Creek			

Table 3. Model Tributary Inputs

SWAM Tributary Object	Tributary Type	Confluence Stream	Confluence Location (mile)	Confluence Drainage Area (ac)	Headwater ID	End Mile	Drainage Area Ratio	Subbasin Flow Factor (unitless)
Mainstem	Explicit	none	none	2,055,737	SLD02	32	NA	0.07*
						56		0.01*
						82		0.02*
						117		0*
						500		0.05*
Big Beaver Creek	Explicit	Mainstem	204	29,047	SLD31	9	4.6	4.6
Big Beaverdam Creek	Explicit	Bush River	16	7,766	SLD218	4	3.8	3.8
Big Creek	Explicit	Mainstem	60	12,452	SLD211	11	17.1	17.1
Broad Mouth Creek	Explicit	Mainstem	74	21,733	SLD213	14	8.3	8.3
Brushy Creek	Explicit	Mainstem	46	23,341	SLD207	11	18.2	18.2
Bush River	Explicit	Mainstem	139	77,215	SLD34	19	7.0	1.25
						26		2.53
						32		5
Cedar Creek	Explicit	Mainstem	221	103,061	SLD225	9	4.4	2.4
						24		4.4
Clouds Creek	Explicit	Mainstem	143	71,743	SLD221	1	46.0	4
						28		50
Congaree Creek	Explicit	Mainstem	185	101,614	SLD139	26	14.8	14.8
Doddies Creek	Explicit	Mainstem	23	7,207	SLD204	4	7.0	7
Georges Creek	Explicit	Mainstem	35	21,123	SLD206	9	9.3	9.3
Gills Creek	Explicit	Mainstem	186	47,111	SLD227	7	2.8	1.2
						15		2.8
Grove Creek	Explicit	Mainstem	57	22,217	SLD08	8	1.8	1.8
Hamilton Creek	Explicit	Georges Creek	6	2,581	SLD05	2	2.5	2.5
Hurricane Creek	Explicit	Mainstem	50	9,585	SLD210	6	15.0	15
Jackson Creek	Explicit	Gills Creek	3	12,291	SLD226	8	23.4	23.4
Laurel Creek	Explicit	Reedy River	15	7,449	SLD212	4	3.8	3.8
Little River	Explicit	Mainstem	128	147,256	SLD216	30	8.7	8.5
						41		8.7
Little Saluda River	Explicit	Mainstem	142	141,298	SLD129	27	12.2	12.2
Ninety-Six Creek	Explicit	Mainstem	110	91,523	SLD17	9	6.7	3.7
North Rabon Creek	Explicit	Rabon Creek	3	32,931	SLD15	4	1.4	1.4
North Saluda River	Explicit	Mainstem	19	48,294	SLD200	3	13.1	3
						23		13.1
Oolenoy River	Explicit	South Saluda River	18	31,454	SLD203	12	11.8	11.8
Rabon Creek	Explicit	Reedy River	65	81,324	SLD14	4	2.5	1
						18		2.5
Red Bank Creek	Explicit	Congaree Creek	9	20,590	SLD140	11	9.8	9.8
Reedy River	Explicit	Mainstem	95	257,031	SLD205	27.5	28.0	13
						59		24
						69		26
South Saluda	Explicit	Mainstem	12	66,442	SLD201	2	6.7	2
						21		6.7
Twelvemile Creek	Explicit	Mainstem	174	30,029	SLD223	18	11.1	11.1
West Creek	Explicit	Clouds Creek	19	15,019	SLD222	8	3.8	3.8
Wilson Creek	Explicit	Ninety-Six Creek	7	49,512	SLD215	11	1.5	1.5
Beaverdam Creek	Implicit	Mainstem	135	18,157	SLD162	0	1	1
Broad River	Implicit	Mainstem	176	3,412,232	NA	10	1	0.75
Buckhead Creek	Implicit	Mainstem	227	12,559	SLD167	0	1	1
Cane Creek	Implicit	Mainstem	99	20,426	SLD160	0	1	1
Greenwood Local Inflow	Implicit	Mainstem	100	59,014	SLD301	1	1	0.1
Halfway Swamp Creek	Implicit	Mainstem	113	22,496	SLD161	0	1	1
Mill Creek	Implicit	Mainstem	197	27,263	SLD165	0	1	1
Murray Local Inflow	Implicit	Mainstem	149	153,221	SLD302	1	1	0.75
Sandy Run	Implicit	Mainstem	195	25,537	SLD164	0	1	1
Terrapin Creek	Implicit	Mainstem	124	6,700	SLD163	0	1	1
Toms Creek	Implicit	Cedar Creek	22	32,183	SLD166	0	1	1
Turkey Creek	Implicit	Mainstem	88	28,989	SLD115	0	1	1

* On the Mainstem, these are referred to as "gain/loss factors", not "subbasin flow factors".

Table 4. Reservoir Inputs

Reservoir	Purpose	Receiving Stream	Temperature Station for Evaporation	Precipitation Station	Release Location (mi)	Storage Capacity (MG)	Initial Storage (MG)	Dead Pool (MG)	Area-Capacity Table	Operating Rules
Table Rock Reservoir	Water supply	South Saluda River	Clemson W381111	NA	2	8,856	5,000	3,577	Simple	No minimum releases or storage targets
North Saluda Reservoir	Water supply	North Saluda River	Greer W03870	NA	3	23,899	20,000	10,836	Simple	No minimum releases or storage targets
Saluda Lake	Power, water supply, and industry	Mainstem (Saluda River)	Clemson 381770	NA	30	2,450	2,000	0	Simple	No minimum releases or storage targets
Lake Rabon	Water supply, flood control & recreation	Rabon Creek	Union 388786	NA	4	2,946	2,500	0	Simple	No minimum releases or storage targets
Lake Greenwood	Power, recreation, and water supply	Mainstem (Saluda River)	Union 388786	USHCN Gage 385017	101	88,520	50,000	10,000	Simple	Minimum release at Buzzards Roost Hydro dependent on season and reservoir inflow ¹ ; Monthly storage targets
Lake Murray	Power, recreation, and water supply	Mainstem (Saluda River)	Columbia W13883	USHCN Gage 385200	169	654,238	500,000	447,354	Simple	Minimum release requirement to maintain 285 cfs at USGS gage 02169000 ² ; Monthly storage targets; The Low Inflow Protocol and the Striped Bass Enhancement Flow Regime of the pending FERC license are optional rules that can be selected ³

Note 1 - For Buzzard's Roost Hydro, during November through June (non-peak months), the minimum flow release is 400 cfs or the inflow, whichever is smaller. During July through October minimum flow release is 400 cfs when inflow is above 566 cfs; (b) 300 cfs when inflow is between 566 and 466 cfs; (c) 205 cfs when inflow is between 466 and 366 cfs; and (d) 225 cfs or inflow, whichever is less when inflow is below 366 cfs. During calibration, storage targets were set based on the guide curve in effect between 1993 and 2009.

Note 2 - For historical Lake Murray operations (calibration model only), the rules are based on maintaining at least 285 cfs at USGS gage 02169000 (just downstream of Twelvemile Creek), year round. If Twelvemile Creek confluence flow is ≥ 285 cfs in a given timestep, then there is no Lake Murray release requirement. If Twelvemile Creek flow is < 285 cfs, then the lake minimum release = $285 - \text{Twelvemile Creek flow}$. During calibration, the "Previous Existing Rule Curve" was used to set target reservoir elevations. The baseline model target elevations have been set per the new "Target Reservoir Elevation" curve, as contained in the pending FERC license. Lake levels suggest that this curve has been followed since 2009.

Note 3 - For Lake Murray, the pending FERC license includes a Maintenance, Emergency and Low Inflow Protocol (MELIP) and a Striped Bass Enhancement Flow Regime. The rules associated with these are summarized in Appendix D of the original Saluda Modeling Report.

Table 5. Reservoir Area-Capacity Relationship

Reservoir	Volume (MG)	Area (Acres)
Table Rock Reservoir	0	0
	5,619	380
	6,198	398
	6,522	407
	7,061	423
	7,622	443
	8,213	460
	8,826	476
	8,856	478
North Saluda Reservoir	0	0
	16,022	848
	16,667	865
	17,312	882
	17,957	899
	18,663	913
	19,261	931
	20,503	970
	21,789	1,003
	22,447	1,018
	23,121	1,033
	23,899	1,052
Saluda Lake	0	0
	3,000	330
Lake Rabon	0	0
	1,303	400
	3,258	600
	5,213	800
	7,168	1,000
	9,123	1,200
	11,078	1,400

Reservoir	Volume (MG)	Area (Acres)
Lake Greenwood	0	0
	2,781	2,459
	5,561	3,576
	11,122	4,694
	19,464	5,812
	29,869	6,929
	42,627	8,047
	56,749	9,165
	72,090	10,282
	78,443	10,729
	87,974	11,400
	108,745	12,518
Lake Murray	0	0
	447,354	35,600
	470,766	37,300
	495,375	39,100
	521,189	41,000
	548,296	43,000
	576,713	45,000
	606,558	47,000
	622,064	48,000
	637,967	49,000
	654,258	50,900

Table 6. Flood Control Outflow

Reservoir	% Volume	Outflow (cfs)
Table Rock	0	0
	100	0
North Saluda	0	0
	45	0
	100	0
Saluda Lake	0	0
	100	0
Lake Rabon	0	0
	89	0
	90	12
	100	12
Lake Greenwood	0	0
	100	0
Lake Murray	0	0
	100	0

Table 7. Reservoir Monthly Storage Targets (in Million Gallons)

Reservoir	Model	Jan	Feb	Mar	Apr	May	Jun
Lake Greenwood	Calibration	68,080	84,568	84,568	84,568	84,568	84,568
	Baseline	70,556	84,797	84,797	84,797	84,797	84,797
Lake Murray	Calibration	520,649	621,634	621,634	621,634	621,634	507,559
	Baseline	621,630	621,630	621,630	621,630	621,630	621,630

Reservoir	Model	Jul	Aug	Sep	Oct	Nov	Dec
Lake Greenwood	Calibration	84,568	84,568	76,978	76,978	76,978	76,978
	Baseline	84,797	84,797	84,797	84,797	70,556	70,556
Lake Murray	Calibration	507,559	507,559	507,559	507,559	507,559	507,559
	Baseline	621,630	621,630	591,107	591,107	591,107	561,920

Table 8. Water User Objects and Sources of Supply Included in the Saluda River Basin Model

Model Object ID	Facility Name	Source of Supply	Intake ID	Diversion Location (mi)	Permit Limit (MGM)	Note
AQ: Southland Fisheries	Southland Fisheries Inc	Cedar Creek	40AQ018S01	8	11.5	1
			40AQ018S02		11.5	1
GC: Cliffs Club	Cliffs Club At Valley	North Saluda River	23GC013S01	6.6	13.4	1
GC: Forest Lake	Forest Lake Club	Gills Creek	40GC002S01	4	11.3	1
GC: Furman	Furman University Golf Club	Reedy River	23GC004S01	1	41	1
			23GC004S02		26.8	
GC: Golden Hills	Golden Hills Golf & Country Club	Twelvemile Creek	32GC007S01	12	32.6	1
GC: Lexington	Country Club of Lexington	Twelvemile Creek	32GC004S01	6	22.3	1
GC: Ponderosa	Ponderosa Country Club	West Creek	32GC010S01	3.4	44.6	1
GC: Rolling Green	Rolling Green Golf Club	Doddies Creek	39GC002S01	1	15.8	1
GC: Smithfields	Smithfields Country Club	Brushy Creek	39GC003S01	1	44.6	1
GC: The Members	The Members Club At Wildewood	Jackson Creek	40GC005S03	1	9.8	1
			40GC005S05		6.7	
			40GC005S06		3.4	
GC: The Preserve	The Preserve At Verdae	Laurel Creek	23GC014S01	1	58	1
GC: The Rock	The Rock At Jocassee Gc	Oolenoy River	39GC006S01	1	7.1	1
IN: CMC Steel	CMC Steel South Carolina	Congaree River	32IN051S01	181	48.3	1
IN: DAK	DAK (Eastman Chemical /SC Operations)	Congaree River	09IN001S01	189	5491	1
IN: Shaw Industries	Shaw Industries Group Plant 8S	Saluda River	32IN006S01	171	1365	1
IR: Beechwood	Beechwood Farm	North Saluda River	23IR026S01	15	12	1,4
IR: Bush River Farms	Bush River Farms	Bush River	36IR035S01	14	17	1,4
IR: Clayton Rawl Farms	Clayton Rawl Farms	Red Bank Creek	32IR056S01	1	40	1
IR: Leslea Farms	Leslea Farms	Bush River	36IR037S01	10	3.8	1,4
		Big Beaverdam Creek	36IR037S02			
		Bush River	36IR037S03	2	12.1	1,4
IR: Mayer Farm	Mayer Farm	Bush River	36IR009S01	16	6.5	1,4
			36IR009S02			
IR: Merritt Bros	Merritt Bros Inc	Brushy Creek	37IR017S01	6	3	1,4
			37IR017S02		7	
		Hurricane Creek	37IR017S03	1	7	
			37IR017S04		0.6	
IR: Overbridge Farm	Overbridge Farm LLC	Big Beaverdam Creek	36IR002S01	1	10.6	1,4
IR: Satterwhite Farm	Satterwhite Farms	Bush River	36IR004S01	8	4	1,4
			36IR004S02	8	NA	1,4
IR: Sease Clinton	Sease Clinton Farms	Twelvemile Creek	32IR005S01	7	9.5	1,4
			32IR005S02		10.2	
			32IR005S03		10	
IR: Sease James	Sease James R Farms Inc	Twelvemile Creek	32IR021S01	3	5.6	1,4
			32IR021S02		20.4	
			32IR021S03		7.1	
			32IR021S04		6.7	
			32IR021S06	1	21.8	
IR: Stoneybrook	Stoneybrook	Big Creek	04IR002S01	1	3	1,4
IR: Titan Farms	Titan Farms	Clouds Creek	41IR014S01	4	20	1,4
			41IR014S03		40	
			41IR014S04		15	
		Little Saluda River	41IR014S08	2	25	

Note 1 indicates the withdrawal is currently active, and was included in both the baseline and calibration model.

Note 2 indicates the withdrawal was previously active, and was included in the calibration model.

Note 3 indicates the withdrawal occurs outside the Saluda Basin.

Note 4 indicates registered limit for irrigation

Table 8. Water User Objects and Sources of Supply Included in the Saluda River Basin Model (continued)

Model Object ID	Facility Name	Source of Supply	Intake ID	Diversion Location (mi)	Permit Limit (MGM)	Note
IR: Twin Oaks Farm	Twin Oaks Farm	Hurricane Creek	04IR001S01	3	3	1,4
IR: Walker Farm	Walker Farm	Cedar Creek	40IR001S01	1	3	1,4
IR: Watson Jerrold Farm	Watson Jerrold & Sons	Clouds Creek	02IR011S09	1	180	1,4
MI: Vulcan Mining	Vulcan Materials	Saluda River	04MI001S01	40	16	1
PT: Duke Lee Station	Duke Energy Carolinas LLC	Saluda River	04PT001S01	58	10081	1
PT: Dominion	Dominion - McMeekin Station	Saluda River/Lake Murray	32PT001S01	169	5175	1
WS: Belton Honea Path	Belton-Honea Path WTP	Saluda River	04WS005S01	65	124	1
WS: Cayce	City Of Cayce WTP	Congaree River	32WS004S02	182	722.3	1
WS: Columbia	City of Columbia - Lake Murray Water Plant	Saluda River/Lake Murray	40WS002S02	169	3875	1
	City of Columbia - Canal Water Plant	Out of basin (Broad)	40WS054S01	999	3875	1,3
WS: Easley	Easley Combined Utilities - D.L. Moore WTP	Saluda River	39WS001S01	30	1116	1
WS: Greenville	Greenville Water L.B. Stovall Plant	North Saluda River/North Saluda Res	23WS002S01	3	1860	1
		South Saluda River/Table Rock Res	23WS002S02	2	1085	1
		South Saluda River/Table Rock Res	23WS002S03	2	992	2
WS: Greenwood	City of Greenwood (Wise Plant)	Saluda River/Lake Greenwood	24WS001S01	101	852.5	1
			24WS001S03			
WS: Laurens	Laurens County Water and Sewer Commission	Little River	30WS002S01	1	NA	2
		Rabon Creek	30WS002S02	6	1106	1
		Rabon Creek/Lake Rabon	30WS002S03	4	911	1
		Saluda River/Lake Greenwood	30WS003S01	99	540	1
WS: NCWSA	NCWSA - Lake Murray WTP	Saluda River/Lake Murray	36WS002S01	169	186	1
WS: Newberry	City Of Newberry WTP	Saluda River	36WS001S01	129	682	1
WS: SCWSA	SCWSA - Raw Water Intake	Saluda River/Lake Murray	41WS003S01	169	465	1
WS: West Columbia	West Columbia WTP	Saluda River	32WS008S01	177	260.4	1
		Saluda River/Lake Murray	32WS052S01	169	1054	1

Note 1 indicates the withdrawal is currently active, and was included in both the baseline and calibration model.

Note 2 indicates the withdrawal was previously active, and was included only in the calibration model.

Note 3 indicates the withdrawal occurs outside the Saluda Basin.

Note 4 indicates registered limit for irrigation

Table 9. Baseline Model Average Monthly Demand for WS, IN, MI, and PT Water Users

Baseline Model Average Monthly Demand (MGD)									
Month	IN: CMC Steel	IN: DAK	IN: Shaw Industries	MI: Martin Marietta	PT: Dominion	PT: Duke Energy	WS: Belton Honea	WS: Cayce	WS: Columbia
Permit Limit (MGD)-->	1.6	180.6	44.9	2.2	170.2	336.0	4.1	23.8	127.5
Jan	0.18	45.8	23.2	0.0	162.5	3.9	1.75	2.9	53.4
Feb	0.23	45.7	22.5	0.0	167.1	15.0	1.64	2.9	52.0
Mar	0.21	46.7	20.9	0.0	67.9	4.0	1.62	2.9	51.6
Apr	0.23	51.8	23.9	0.0	140.7	4.2	1.71	3.2	57.9
May	0.20	57.6	24.7	0.0	153.4	4.6	1.92	3.4	65.2
Jun	0.24	63.2	27.1	0.0	165.8	67.7	2.07	3.6	71.0
Jul	0.23	67.1	29.1	0.0	156.0	93.3	2.03	3.6	73.2
Aug	0.21	64.5	28.9	0.0	167.2	93.0	1.95	3.7	71.8
Sep	0.24	61.2	27.7	0.0	167.2	9.0	1.91	3.6	68.4
Oct	0.24	55.0	27.0	0.0	127.1	4.6	1.77	3.3	62.5
Nov	0.25	49.9	22.8	0.0	167.2	4.6	1.69	3.0	56.8
Dec	0.21	46.7	21.1	0.0	167.2	3.2	1.63	2.9	53.0

Baseline Model Average Monthly Demand (MGD)								
Month	WS: Easley	WS: Greenville	WS: Greenwood	WS: Laurens	WS: NCWSA	WS: Newberry	WS: SCWA	WS: W. Columbia
Permit Limit (MGD)-->	36.7	129.5	56.1	84.1	6.1	22.4	15.3	43.2
Jan	7.9	28.3	6.11	2.33	0.84	1.10	1.50	10.8
Feb	7.2	28.9	6.04	2.32	0.82	1.22	1.50	10.7
Mar	7.2	28.7	6.08	2.30	0.80	0.91	1.97	11.1
Apr	8.0	31.4	6.54	2.40	0.83	1.09	2.17	13.4
May	9.4	39.5	7.17	2.37	0.87	1.63	2.52	15.8
Jun	10.0	42.6	7.66	2.46	0.96	1.91	2.50	16.8
Jul	10.3	43.9	7.77	2.63	0.97	1.92	2.74	17.2
Aug	9.8	41.1	7.64	2.66	0.96	2.01	2.61	16.3
Sep	9.6	42.0	7.34	2.63	0.94	1.96	2.67	15.5
Oct	8.9	36.7	6.95	2.49	0.90	1.82	2.39	13.3
Nov	7.9	31.1	6.38	2.28	0.87	1.53	2.43	11.5
Dec	7.5	27.5	5.99	2.21	0.85	0.90	2.26	10.8

Permit limits are shown in MGD rather than MGM for comparative purposes. Actual permit limits are in MGM.

Table 10. Baseline Model Average Monthly Demand for AQ, GC, and IR Water Users

Baseline Model Average Monthly Demand (MGD)											
Month	GC: Cliffs Club	GC: Forest Lake	GC: Furman	GC: Golden Hills	GC: Lexington	GC: Ponderosa	GC: Rolling Green	GC: Smithfield CC	GC: The Members	GC: The Preserve	GC: The Rock
Limit (MGD)-->	0.44	0.37	2.23*	1.07	0.73	1.47	0.52	1.47	0.65*	1.91	0.23
Jan	0.00	0.02	0.00	0.01	0.01	0.01	0.04	0.01	0.01	0.00	0.00
Feb	0.01	0.02	0.01	0.01	0.01	0.01	0.03	0.00	0.02	0.01	0.00
Mar	0.03	0.05	0.01	0.01	0.04	0.02	0.22	0.02	0.06	0.02	0.01
Apr	0.06	0.14	0.04	0.06	0.09	0.03	0.13	0.02	0.10	0.06	0.01
May	0.10	0.18	0.11	0.07	0.15	0.06	0.09	0.07	0.15	0.13	0.03
Jun	0.11	0.24	0.14	0.09	0.16	0.07	0.24	0.07	0.18	0.18	0.04
Jul	0.13	0.24	0.16	0.09	0.18	0.10	0.10	0.07	0.19	0.17	0.03
Aug	0.09	0.23	0.12	0.09	0.16	0.10	0.11	0.06	0.18	0.13	0.02
Sep	0.14	0.20	0.18	0.07	0.16	0.07	0.10	0.06	0.18	0.15	0.04
Oct	0.08	0.12	0.10	0.04	0.10	0.05	0.09	0.03	0.09	0.09	0.02
Nov	0.02	0.06	0.04	0.03	0.05	0.02	0.05	0.01	0.07	0.03	0.00
Dec	0.01	0.03	0.01	0.01	0.01	0.00	0.03	0.00	0.03	0.01	0.00

Baseline Model Average Monthly Demand (MGD)											
Month	AQ: Southland Fisheries	IR: Beechwood	IR: Bush River Farms	IR: Clayton Rawl Farms	IR: LesLea Farms	IR: Mayer Farm	IR: Merrit Bros	IR: Overbridge Farm	IR: Satterwhite Farm	IR: Sease Clinton	IR: Sease James
Limit (MGD)-->	0.77	0.39	0.56	1.33	0.52*	0.21*	0.58*	0.35	0.13*	0.33*	0.72*
Jan	0.01	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.09
Feb	0.02	0.00	0.12	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.14
Mar	0.13	0.03	0.35	0.04	0.00	0.02	0.00	0.00	0.04	0.01	0.24
Apr	0.17	0.11	0.37	0.09	0.01	0.02	0.00	0.02	0.04	0.02	0.40
May	0.15	0.12	0.36	0.13	0.05	0.02	0.01	0.02	0.06	0.08	0.59
Jun	0.19	0.17	0.38	0.19	0.16	0.00	0.04	0.03	0.07	0.17	0.59
Jul	0.17	0.29	0.37	0.17	0.14	0.00	0.06	0.04	0.08	0.24	0.55
Aug	0.20	0.29	0.37	0.07	0.06	0.00	0.05	0.07	0.08	0.20	0.65
Sep	0.14	0.33	0.39	0.18	0.03	0.00	0.03	0.02	0.06	0.17	0.78
Oct	0.06	0.12	0.30	0.09	0.00	0.00	0.00	0.00	0.05	0.10	0.74
Nov	0.04	0.02	0.14	0.03	0.00	0.00	0.00	0.00	0.04	0.05	0.44
Dec	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.14

Baseline Model Average Monthly Demand (MGD)					
Month	IR: Stonybrook	IR: Titan Farms	IR: Twin Oaks Farm	IR: Walker Farm	IR: Watson Jerrold
Limit (MGD)-->	0.10	0.82	0.11	0.10	5.92
Jan	0.00	0.06	0.00	0.00	0.19
Feb	0.01	0.07	0.00	0.00	0.19
Mar	0.01	0.77	0.00	0.00	0.35
Apr	0.01	1.47	0.00	0.00	0.50
May	0.01	2.06	0.01	0.00	0.77
Jun	0.01	2.41	0.02	0.01	0.90
Jul	0.02	2.15	0.03	0.00	0.98
Aug	0.04	1.66	0.05	0.00	0.97
Sep	0.06	1.43	0.04	0.00	0.85
Oct	0.02	0.63	0.00	0.00	0.64
Nov	0.00	0.04	0.00	0.00	0.35
Dec	0.00	0.00	0.00	0.00	0.28

"Limit" shown is the total permit limit (for golf courses) or registered limit (for agricultural irrigators).

Limits are shown in MGD rather than MGM for comparative purposes. Actual permit/registration limits are in MGM.

* Water users with multiple withdrawal locations. Withdrawal limits reflect the total permit or registration limit, accounting for all withdrawal locations.

Table 11. Baseline Model Average Monthly Transbasin Imports

	Baseline Model Avg Monthly Transbasin Import (MGD)
Month	WS: Columbia
Jan	26.3
Feb	25.4
Mar	25.3
Apr	29.1
May	31.8
Jun	35.3
Jul	36.7
Aug	37.4
Sep	34.7
Oct	31.7
Nov	28.4
Dec	25.9

Table 12. Returns and Associated Model Objects

Model Object ID	Facility Name	NPDES Pipe ID	Associated Water Permit	Discharge Tributary	Model River Mile	% of Return Flow
Returns Represented Within Water User Objects						
IN: DAK	Eastman Chemical/SC Operations	SC0001333-001	09IN001	Congaree River	191	100
		SC0001333-01A				
		SC0001333-01D				
		SC0001333-01E				
		SC0001333-01F				
		SC0001333-01G				
IN: Shaw Industries	Shaw Industries Group/Columbia	SC0003557-001	32IN006	Congaree River	172	100
		SC0003557-002				
		SC0003557-003				
MI: Vulcan Mining	Vulcan Const Mat/Lakeside	SCG730245-000	04MI001	Saluda River	41	100
PT: Duke	Duke Energy/Lee Steam Station	SC0002291-001	04PT001	Saluda River	59	100
		SC0002291-002				
		SC0002291-003				
		SC0002291-004				
PT: Dominion	Dominion/McMeekin Steam Station	SC0002046-001	32PT001	Saluda River	170	100
		SC0002046-002				
		SC0002046-003				
		SC0002046-004				
		SC0002046-005				
WS: Belton Honea Path	Due West WWTF	SC0022403-001	04WS005	Out of basin (Savannah)	1002	8
	Ware Shoals/Dairy Street	SC0020214-001		Saluda River	81	25
	Belton/Ducworth (Saluda)	SC0045896-001	04WS005	Saluda River	62	20
		SC0045896-002		Broad Mouth Creek	1	47
		SC0045896-003				
WS: Greenwood	Ware Shoals/Dairy Street	SC0020214-001	04WS005/24WS001	Saluda River	82	13
WS: Cayce/WS: W. Columbia	Cayce WWTF	SC0024147-001	32WS004/32WS008/32WS052	Congaree River	183/184	100
WS: Columbia	Alpine Utilities/Stoop Creek	SC0029483-001	40WS002	Saluda River	173	6
	East Rich CO PSD/Gills Creek	SC0038865-001		Congaree River	183	84
	Chapin, Town of	SC0040631-001		Out of basin (Broad)	1005	10
	Richland Co/Broad River WWTF	SC0046621-001			1005	10
WS: Columbia/WS: W. Columbia	Columbia/Metro Plant	SC0020940-001	40WS002/32WS008/32WS052	Congaree River	182.5/184	90/86
WS: Easley	Easley/Golden Creek Lagoon	SC0023035-001	39WS001	Out of basin (Savannah)	1003	5
	Easley/Georges Creek Lagoon	SC0023043-001		Georges Creek	1	14
	Easley/Middle Branch WWTP	SC0039853-001		Brushy Creek	3	81
WS: Greenville	ReWa/Marietta WWTP	SC0026883-001	23WS002	North Saluda River	15	9
	Greenville/N Saluda & Table Rock WTP	SCG646033				
	ReWa/Pelham WWTF	SC0033804-001		Out of basin (Broad)	1001	47
	ReWa/Durbin Creek	SC0040002-001			1001	47
	ReWa/Gilder Creek	SC0040525-001			1001	47
	ReWa/Mauldin Road	SC0041211-001		Reedy River	12	37
	ReWa/Piedmont Regional WWTP	SC0048470-001		Saluda River	49	7

Note: Returns outside of the Saluda River Basin are indicated in **bold**.

* Only represented in the calibration model (came off-line in 2014).

** Represented by a Water User object in the calibration model and a Discharge object in the baseline model.

Table 12. Returns and Associated Model Objects (continued)

Model Object ID	Facility Name	NPDES Pipe ID	Associated Water Permit	Discharge Tributary	Model River Mile	% of Return Flow
Returns Represented Within Water User Objects						
WS: Greenwood	Greenwood/Wilson Creek WWTF	SC0021709-001	24WS001	Wilson Creek	1	73
	Greenwood/West Alexander WWTF	SC0022870-001		Out of basin (Savannah)	1009	14
	Ninety Six WWTF	SC0036048-001		Ninety Six Creek	81.5	13
WS: Laurens	Laurens Comm of PW/Laurens	SC0020702-001	30WS002	Little River	2	100
	Laurens WTP	SCG646028				
		Laurens County Water and Sewer Commission -WTP	SC0037974	30WS003	Saluda River/Lake Greenwood	99
WS: NCWSA	NCW&SA/Cannons Creek WWTP	SC0048313	36WS002	Out of basin (Broad)	999	100
WS: Newberry	Aiken PSA/Horse Creek WWTF	SC0024457	36WS001	Out of basin (Savannah)	1011	13
	Newberry/Bush River WWTF	SC0024490-001		Bush River	20	75
	Saluda, Town of	SC0022381-001		Little Saluda River	8	12
	Newberry WTP	SCG646047				
WS: W. Columbia	Cayce WWTF	SC0024147-001	32WS008 /32WS052	Mainstem	183 (mid of two WWTFs)	100
	Metro WWTF	SC0020940-001		Mainstem		
Transbasin Imports Represented by Discharge Objects						
Clinton Import (Broad)	Laurens CO W&S/Clinton-Joanna	SC0037974-001	30WS001	Bush River	10	-
Greenville Import/Reedy (Savannah)	ReWa/Lower Reedy River Plant	SC0024261-001	23WS007	Reedy River	24	-
Greenville Import/Georges (Savannah)	ReWa/Georges Creek	SC0047309-001	23WS007	Saluda River	36	-
Greenville Import/Mauldin (Savannah)	ReWa/Mauldin Road	SC0041211-001	23WS007	Reedy River	12	-
Williamston Import/Big Crk (Savannah)**	Williamston/Big Creek East WWTP	SC0046841-001	04WS006	Big Creek	11	-
In-basin Returns Represented by Individual or Aggregated Discharge Objects						
Milliken	Milliken/Gayley Plant	SC0003191-001 SC0003191-T11	none	South Saluda River	19	-
Agg Discharge 1	CWS/Watergate Development	SC0027162-001	none	Saluda River	175	-
	Woodland Hills West SD	SC0029475-001				
	Bush River Utilities	SC0032743-001				
	CWS/I-20 Regional	SC0035564-001				
	CWS/Friarsgate SD	SC0036137-001				
Agg Discharge 2	Westinghouse Elec LLC/Columbia	SC0001848-001	none	Congaree River	195	-
	Devro Inc/Coria Division	SC0033367-001				
Air Products	Air Products & Chemicals, Inc	SC0048429-001	none	Saluda River	43	-
Ing Rand	Ingersoll Rand/G.W. Recovery Sys	SC0048534-001	none	Little River	10	-

Note: Returns outside of the Saluda River Basin are indicated in **bold**.

* Only represented in the calibration model (came off-line in 2014).

** Represented by a Water User object in the calibration model and a Discharge object in the baseline model.

Table 13. Baseline Model Monthly Consumptive Use Percentage

Monthly Consumptive Use (%)									
Month	IN: CMC Steel ¹	IN: DAK ²	IN: Shaw Industries	MI: Martin Marietta	PT: Dominion	PT: Duke Energy	WS: Belton Honea	WS: Cayce	WS: Columbia
Jan	100.0	0.0	11.2	50.0	2.15	95.1	22.7	4.0	9.0
Feb	100.0	0.0	11.4	50.0	2.15	25.1	19.3	2.4	4.6
Mar	100.0	0.0	12.6	50.0	2.15	93.5	23.4	3.9	6.1
Apr	100.0	0.0	11.9	50.0	2.15	85.0	32.4	9.0	13.5
May	100.0	0.0	10.5	50.0	2.15	98.6	42.8	14.0	27.3
Jun	100.0	0.0	10.0	50.0	2.15	3.1	52.8	18.5	32.9
Jul	100.0	0.0	9.0	50.0	2.15	5.2	50.8	19.4	37.0
Aug	100.0	0.0	6.7	50.0	2.15	5.1	49.8	17.6	32.0
Sep	100.0	0.0	5.9	50.0	2.15	51.5	55.1	15.1	31.5
Oct	100.0	0.0	6.3	50.0	2.15	98.6	49.2	10.3	23.9
Nov	100.0	0.0	8.2	50.0	2.15	98.5	42.1	7.5	18.5
Dec	100.0	0.0	9.0	50.0	2.15	91.8	31.2	4.3	12.6

Monthly Consumptive Use (%)								
Month	WS: Easley	WS: Greenville	WS: Greenwood	WS: Laurens	WS: NCWSA	WS: Newberry	WS: SCWSA ³	WS: W. Columbia
Jan	61.3	24.2	2.8	16.3	59.4	21.7	0.0	26.7
Feb	59.6	24.4	2.5	13.6	59.1	22.8	0.0	27.4
Mar	62.0	26.1	3.2	13.4	61.7	20.2	0.0	30.9
Apr	65.7	38.2	7.8	17.1	63.5	24.9	0.0	43.7
May	72.5	48.1	9.8	22.9	66.6	31.4	0.0	55.2
Jun	74.2	51.6	12.8	27.4	72.1	34.9	0.0	57.8
Jul	75.3	55.4	12.0	35.1	73.9	35.1	0.0	57.5
Aug	73.6	50.6	11.9	33.9	73.0	35.4	0.0	54.5
Sep	74.9	54.5	13.8	35.6	74.2	35.6	0.0	54.1
Oct	73.0	49.5	12.3	30.3	70.7	33.6	0.0	45.0
Nov	66.9	36.8	10.2	23.9	67.2	29.4	0.0	36.6
Dec	60.3	21.7	5.6	17.8	62.0	21.1	0.0	29.4

¹ No permitted discharge

² Reported discharge greater than withdrawal

³ Discharges outside the basin

2021 Saluda SWAM Model Updates

Attachment B

Responses to SCDNR Comments

Saluda SWAM Model Updates

SCDNR 1/21/21

Please find below a list of updates to the Saluda SWAM baseline model. The updates are grouped together by the type of update required.

A. General Updates

1. Replace all water demand and discharge data with data from new baseline period: 2009-2019. **This has been completed.**
2. Extend headwater flows through 2019. **This has been completed.**

B. To be verified with DHEC:

1. **WS: Greenwood (24WS001):** The recent DHEC's Surface Water permit intake data file (shapefile) has two intakes (24WS001S01 and 24WS001S02) on Lake Greenwood, each with a permit limit of 852.50 MGM. However, DHEC's historical water use file has reported withdrawals from Lake Greenwood for S01 and S03 (S02 inactive). The model currently has permit limit only for 24WS001S03 (852.5 MGM) from Lake Greenwood. Verify with DHEC if the intake included in the model is correct or if it needs any update. Edit the model notes if necessary. **The model has been updated to reflect two active intakes on Lake Greenwood and a combined permit of 1,705 MGM, per DHEC.**
2. **WS: Greenville (23WS002):** The recent DHEC's Surface Water Permit data file (shapefile) has 23WS002S03 intake on North Saluda River. 23WS002S01 and 23WS002S02 intakes are on Table rock. However, DHEC's historical water use database notes, shows the intake S02 and S03 on Table Rock and intake S01 on North Saluda. Under the source water 2 tab of the current model, intake S01 appears to withdraw from the North Saluda Reservoir. Verify the source of withdrawal for the intakes with DHEC and edit the model notes if necessary. **Based on DHEC's database and permit files, S01 should be on the North Saluda and S02 and S03 should be on Table Rock.**
3. **IR: Watson Joe Farm (41IR004):** Is now an inactive registration. Can be removed from the model after verifying with DHEC. **DHEC confirmed this is inactive and it has been removed from the model.**
4. **IR: Frick Farm (41IR010):** In DHEC's recent Agriculture Registration shapefile this intake is labelled as Titan Farms (Edisto basin). Could not find "Frick Farm" in the current active registration. Verify with DHEC if this intake (SourceID) was transferred. Also, update the correct registration value in the permit limit box (71 MGM) and edit the notes if necessary. **DHEC confirmed that this is now owned by Titan Farms. The only active intake for this registration is S01, which is in the Edisto Basin. S03 is inactive, and the object has been removed.**

C. Diversion location: These objects have their intakes assigned to a downstream tributary. Coordinate information shows their intake location on a smaller tributary or a pond **(For the following intakes, the diversion location as set in the model are satisfactory to**

DNR but would like CDM Smith to review them and make changes if necessary.) We have reviewed these and have decided to not add additional, small, high-order tributaries in each instance; however, in two cases, the withdrawal location has been adjusted by revising the river miles. Because these are typically near headwater locations and the withdrawals are low, there is little value in adding the high order tributaries to represent exact withdrawal locations. Such an approach adds complexity and uncertainty and does not increase its usefulness as a planning tool.

1. **GC: The Preserve (23GC014S01):** Model shows its intake on Laurels Creek. According to its lat long location, the intake is on a smaller creek that joins Laurel Creek (Checked on GIS Saluda map and on StreamStats).
 2. **GC: Rolling Green (39GC002S01):** Model shows its intake on Doddies Creek. According to its lat long location, the intake is on a smaller creek that joins Doddies Creek (Checked on GIS Saluda map and on StreamStats).
 3. **GC: Cliffs Club (23GC013):** Model shows its intake on North Saluda River at 7 RM. According to its lat long, the intake is near a pond above Terry and Beaverdam creek. These two creeks further join North Saluda River at 6.6 RM. **The intake was adjusted to North Saluda RM 6.6.**
 4. **GC: Ponderosa (32GC010):** In the model its intake is on West Creek at 3 RM. Lat long shows diversion from Ponderosa pond on Gin branch that further joins West Creek at ~3.4 RM. **The intake was adjusted to West Creek RM 3.4.**
 5. **IN: CMC Steel (32IN051):** In the model, diversion is on Mainstem. Lat Long location shows intake is near a pond close to the Congaree river near 181 RM. **Satellite imagery shows that the withdrawal is on ponds/canals that directly link to the Mainstem.**
- D. Return flow location: We understand there is no return flow for these intakes. However, the return flow location as set in the model might be confusing. Is there a better way of showing the “0 return flow value” for these users? Maybe by using the standard “9999” high value or adding a note. **Return locations for these golf courses have been adjusted to be just below the withdrawal location. While no return is expected, if a consumptive use of less than 100% is ever used, the return location will be appropriate.**
1. **GC: Rolling Green (39GC002S01):** The return location in the model is at 11 RM, but Doddies Creek is ~ 4.2 mi (Checked on GIS file and on StreamStats).
 2. **GC: Lexington (32GC004):** Return location in the model is at 55 mi on Twelvemile creek. Twelvemile creek is 18.3 mi.
 3. **GC: Ponderosa (32GC010):** The return location in the model is at 15 mi on West creek. West creek joins Clouds Creek at 8.4 RM.
 4. **GC: Forest Lake (40GC002):** The return location in the model is at 21 RM on Gills Creek. On GIS map, Gills Creek merges with the Saluda River at 15 RM (on Gills Creek).
 5. **GC: Golden Hills (32GC007):** The return location in the model is on TwelveMile Creek at 31 RM. End of the creek is ~ 18.4 mi.
- E. Permit/Registration Limit: Update registration limit for these Ag objects (Based on recent Ag Registration shapefile from DHEC). **Since registration limits are different than permit limits (i.e., they are not necessarily constraining), we have chosen to list 10000**

MGM in the permit box for IR objects with a single source. This prevents the model from constraining any monthly/daily withdrawal to under the registration limit. We still list the registration limit in the notes, for informational purposes. For IR objects with multiple surface water sources, we typically include a “false” permit limit in the Source Water 1 account so that water is also withdrawn from the other listed sources (assuming the actual withdrawal data reflects that). In the remaining source water accounts, we list 10000 MGM so as not to constrain the total withdrawal amount. We’ve made sure the notes in each object reflect the registration limits noted below.

1. **IR: Twin Oaks Farm (04IR001):** Registration limit is 3.2 MGM (Identifying notes has 3MGM). Replace 10000 MGM with registration limit of 3.2 MGM in the Permit Limit box and update the note.
 2. **IR: Sease James (32IR021):** S01-S04 total Registration limit is 39.8 MGM and S06 has 21.8 MGM registration limit. In the model, registration limit for S06 is correct. But for intakes (S01-S04) the model’s note has a registration limit of 29.8 MGM. Replace 10000 MGM with registration limit of 39.8 MGM in the Permit Limit box and update the note.
 3. **IR: Satterwhite Farm (36IR004):** S01 is active and S02 is inactive (S02 can be removed from notes). Registration limit is 3.99 MGM. Replace 10000 MGM with registration limit of 3.99 MGM in the Permit Limit box and update the note.
 4. **IR: Titan Farms (41IR014):** Intakes S01, S03, S04, and S08 are in the Saluda basin. For the source water 1 tab, add the respective sourceids (S01, S03, and S04) in the identifying notes. For source water 2 tab replace 10000 MGM with registration limit of 25 MGM (S08).
 5. **IR: Merritt Bros (37IR017):** For source water 2 tab replace 10000 MGM with registration limit of 10MGM.
- F. Check UserIDs: **These have been corrected**
1. **IN: DAK:** The userid for the intake is 09IN001. In the identifying notes of the model, it’s incorrectly labelled as 32IN051S01. Permit limit is correct.
 2. **IR: Leslea Farms (36IR035):** Note mentions userid 36IR035 (This is Bush River Farm’s intake). Userid should be corrected to 36IR037 (S02 and S03). S01 is now inactive. Registration limits are correct. Replace the userid and update the notes.
- G. New User and name change:
1. **PT: SCE&G (32PT001):** Is now Dominion Energy. Update the name. **Name has been updated and water use and consumptive use has been revised based on communication with Mike Moseley of Dominion Energy.**
 2. **WS: SCWSA (41WS003):** In the model, the intake is labelled as a new project with no intake values. This user has monthly withdrawals recorded for 2019. Add water use data and update the notes. Verify with DHEC if necessary. **Baseline withdrawals have been added that reflect 2019 monthly reported withdrawals except for Jan and Feb, which are estimated at 1.5 mgd, since the plant was just coming on-line during those months.**

H. Intakes not included in the model: Found some users in the Saluda basin that are included in the recent DHEC's SW permit and Ag registration file but not in the model. Review and add these intakes in the model. Verify with DHEC if necessary.

1. **32IR056 Clayton Rawl Farms Inc:** 40MGM Registration on Red bank creek that further joins Congaree Creek (close to TwelveMile Creek). Surface water use reported from 2015-2019. The user used groundwater before but now has surface water withdrawal. Groundwater intakes are now inactive. **Red Bank Creek has been added as a tributary to Congaree Creek, and this IR: object has been added.**
2. **40AQ018 Southland fisheries:** (S01-02) a total of 23 MGM registration on Duffie pond near Cedar Creek. (Surface water use from 2001-2019). The user also has active groundwater withdrawal (2001-2019). **This user has been added. Note that according to DHEC this user does not have a discharge, therefore consumptive use was set at 100%.**
3. **41WS004 Batesburg-Leesville Town:** Permit of 167.3 on Lake Murray. This user is included in DHEC's SW Permit Intakes shapefile and has 0 reported water use for 2017 and 2018. DHEC historical water use file have this intake marked as inactive. Verify with DHEC. **This intake is inactive and is therefore not represented in the model.**
4. **30WS003 (S01): Laurens County Water and Sewer Commission:** Permit limit of 540 MGM on Lake Greenwood. For intake S01 there is 0 reported water use from 2017-2019. The facility also purchased water from City of Clinton, Laurens CPW, and Greenville Water System until 2000 (According to DHEC's historical data). Review the new intake. **The new intake on Lake Greenwood has been added, but it is not yet withdrawing water. DHEC reports no withdrawals for 2020.**
5. **04PT001 Duke Energy Carolinas LLC (Lee Station Fossil Plant):** Permit limit of 10081 MGM on Saluda River. Reported surface water use from 1983-2019. This station used to be a coal plant and was later converted to natural gas and came back in 2018. The plant is probably using lesser water now, but we think this intake should be now be included in the model. Water use data should be based on 2019 reported water use. Can reach out to Duke Energy to know what their baseline monthly water use would be. **The object has been included in the model and estimated water use has been set based on an estimate from 2020, provided by Ed Bruce of Duke Energy (see table below).**

WS LEE STEAM STATION			
Month	Station Monthly Totals		
	Total		Total
	Withdrawal		Consumption
	Volume	Volume	
	[MG]	[MG]	
Jan	122		116
Feb	419		105
Mar	124		116
Apr	127		108
May	144		142
Jun	2,032		62
Jul	2,893		149
Aug	2,883		147
Sep	270		139
Oct	142		140
Nov	137		135
Dec	98		90
YR TOTAL:	9,391		1,449

2021 Saluda SWAM Model Updates

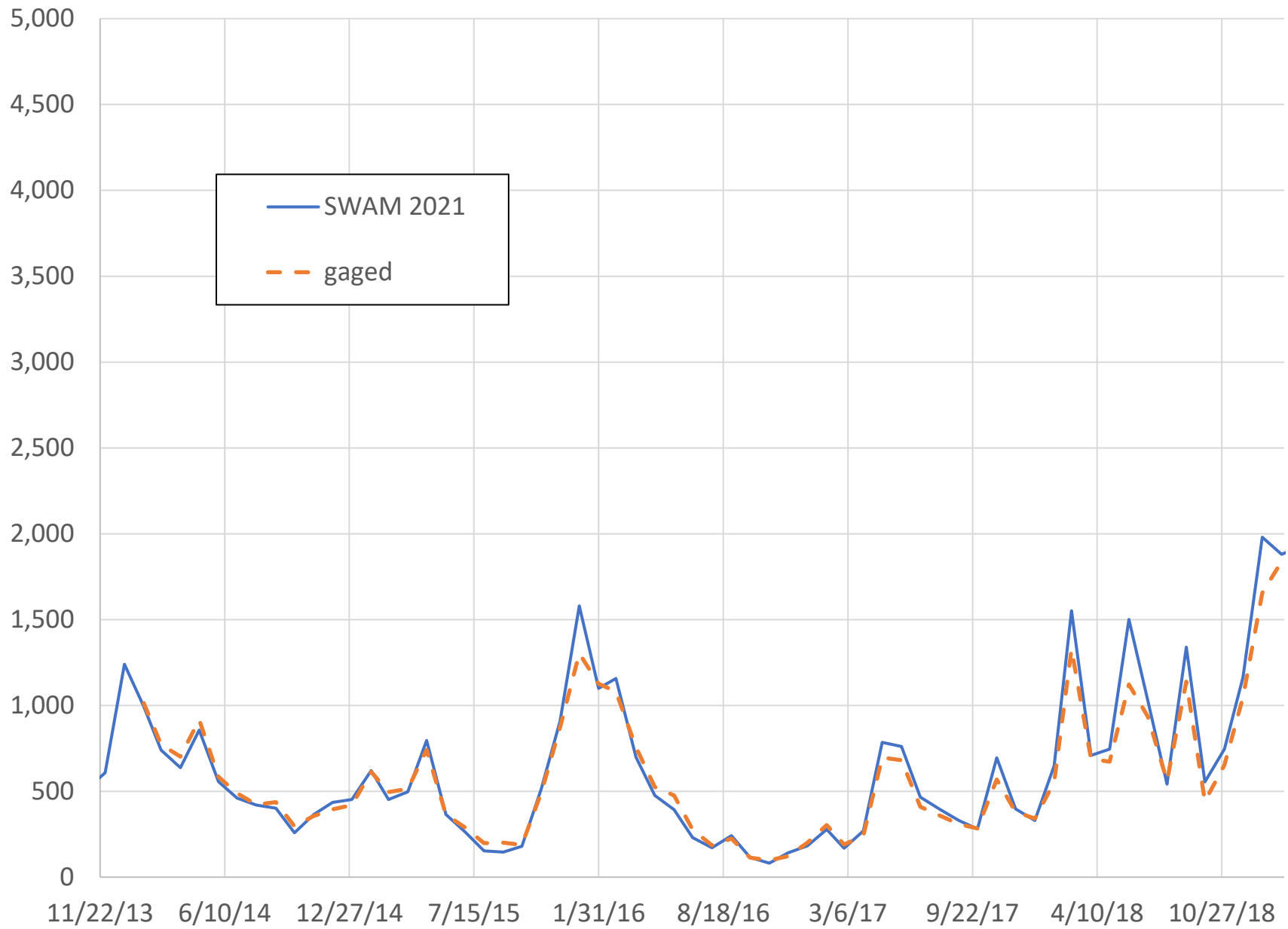
Attachment C

Validation Results

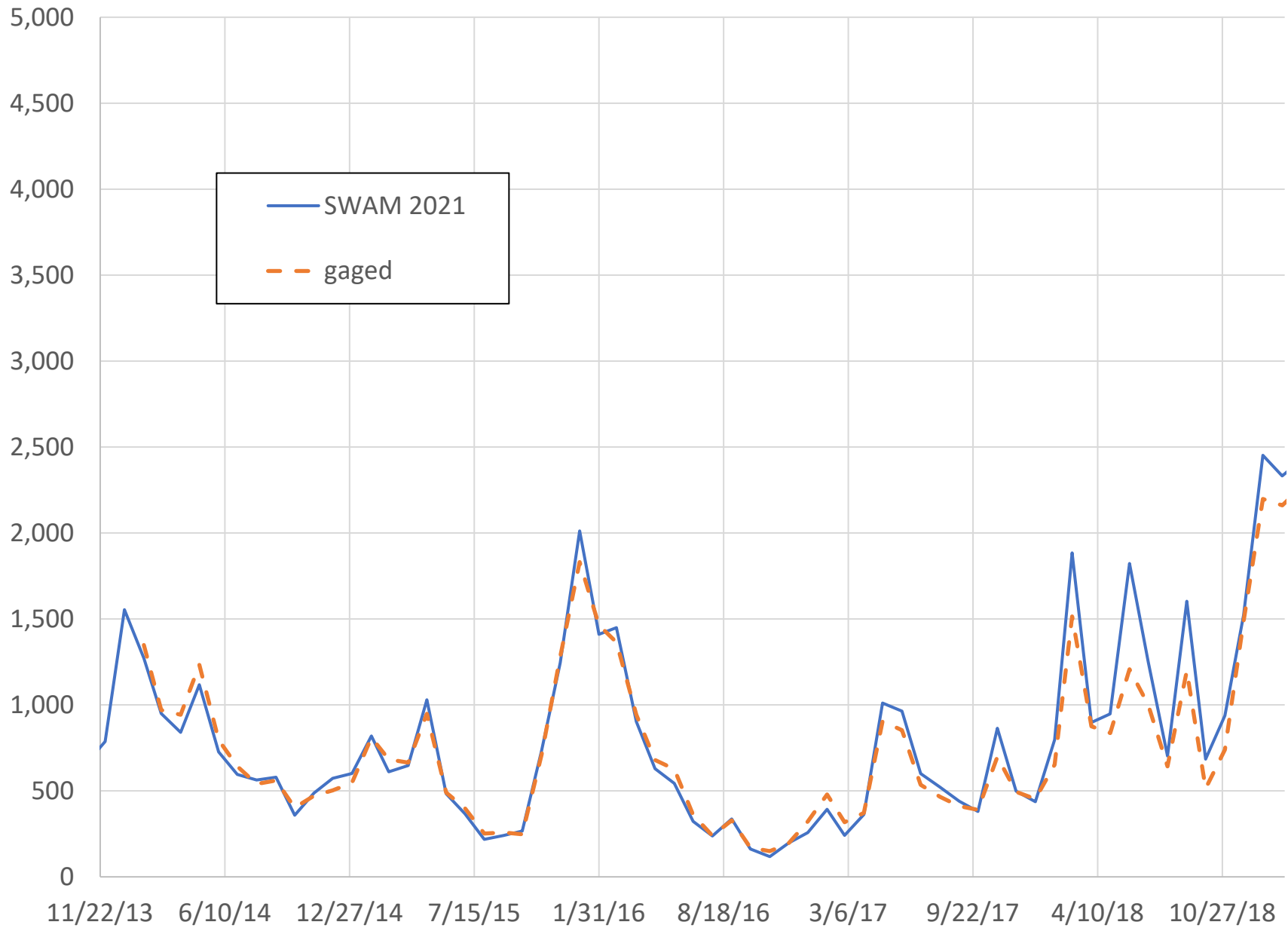
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Monthly Validation Results

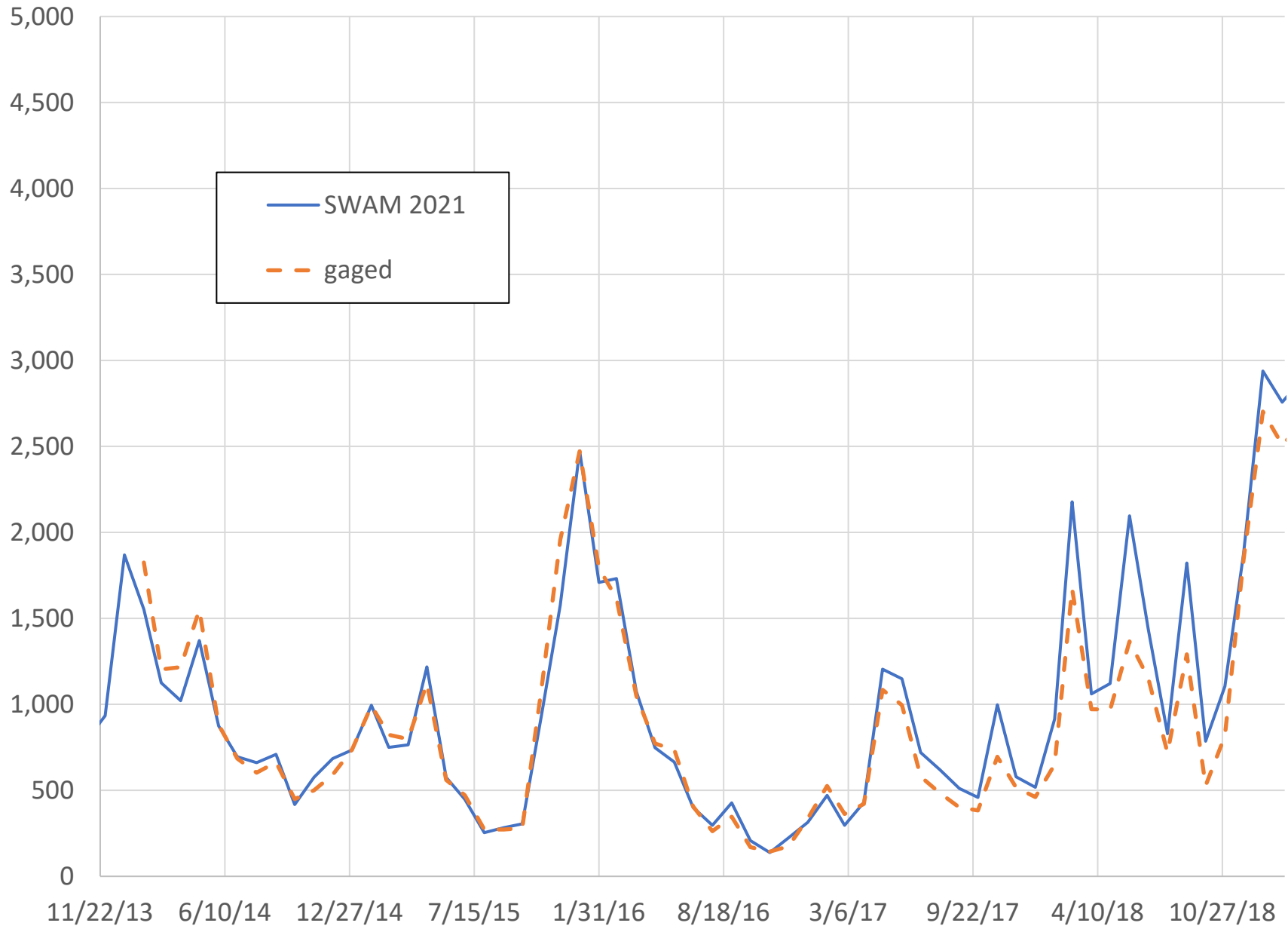
SLD04: Saluda River near Greenville (cfs)



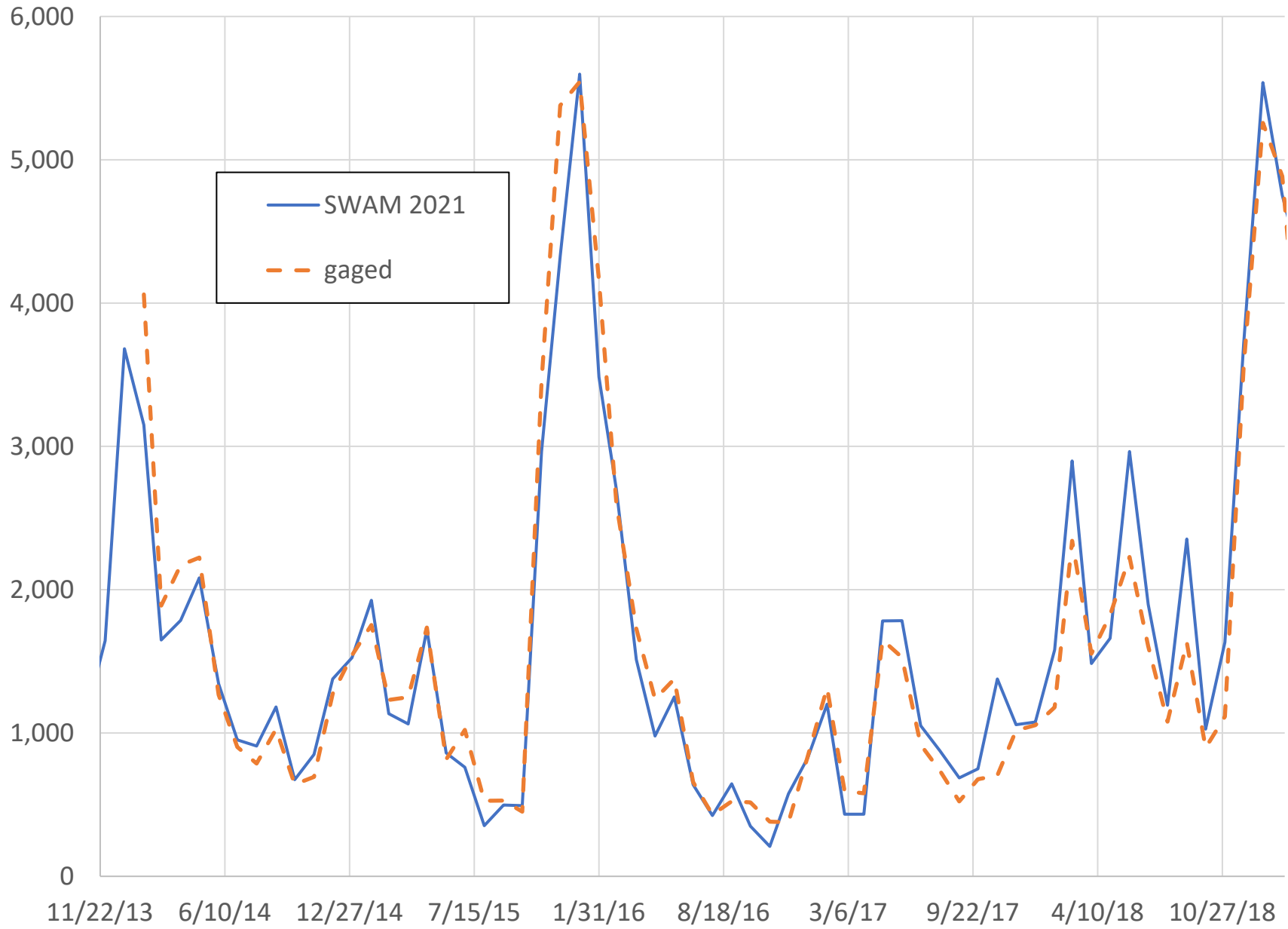
SLD07: Saluda River near Williamston (cfs)



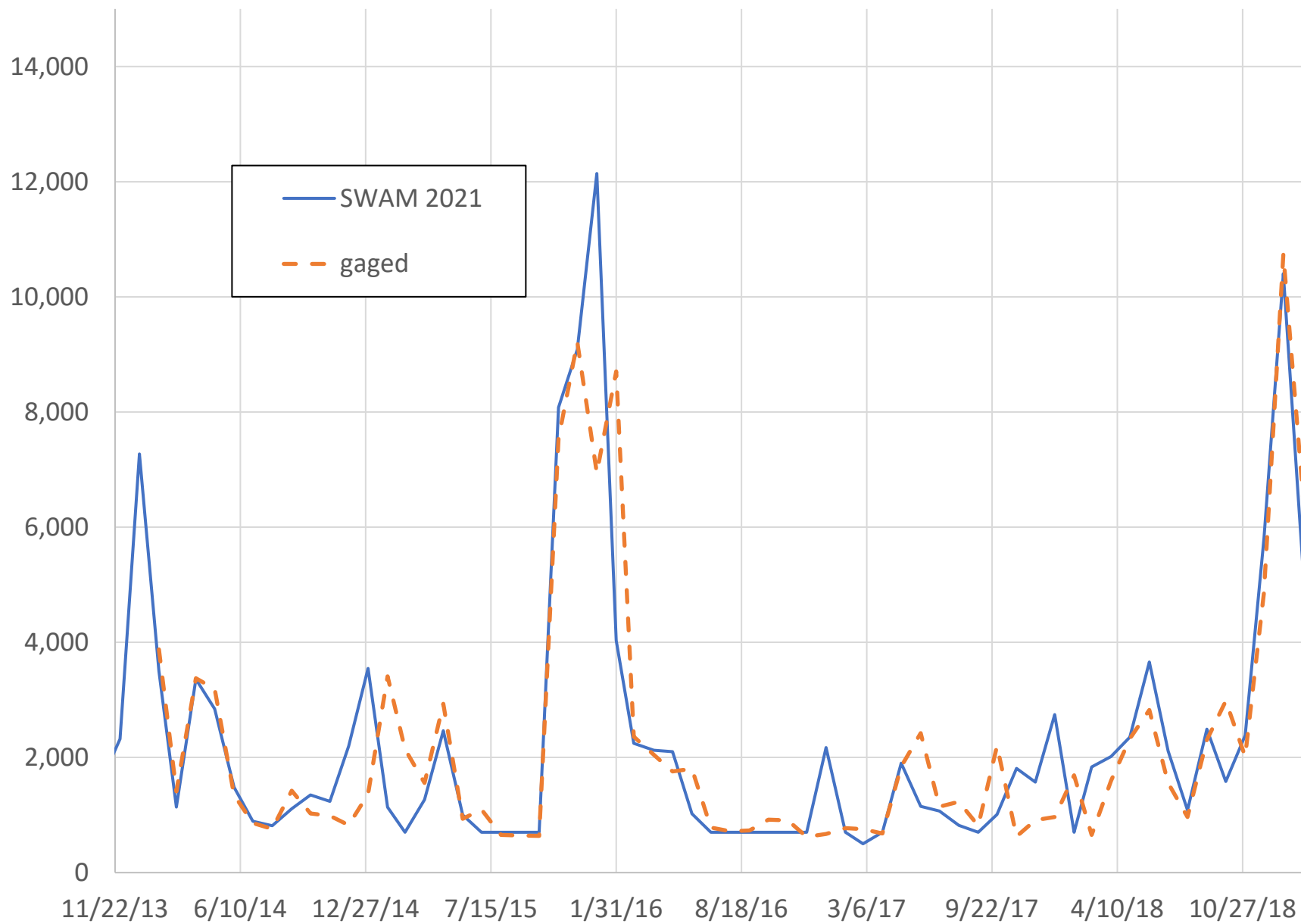
SLD09: Saluda River near Ware Shoals (cfs)



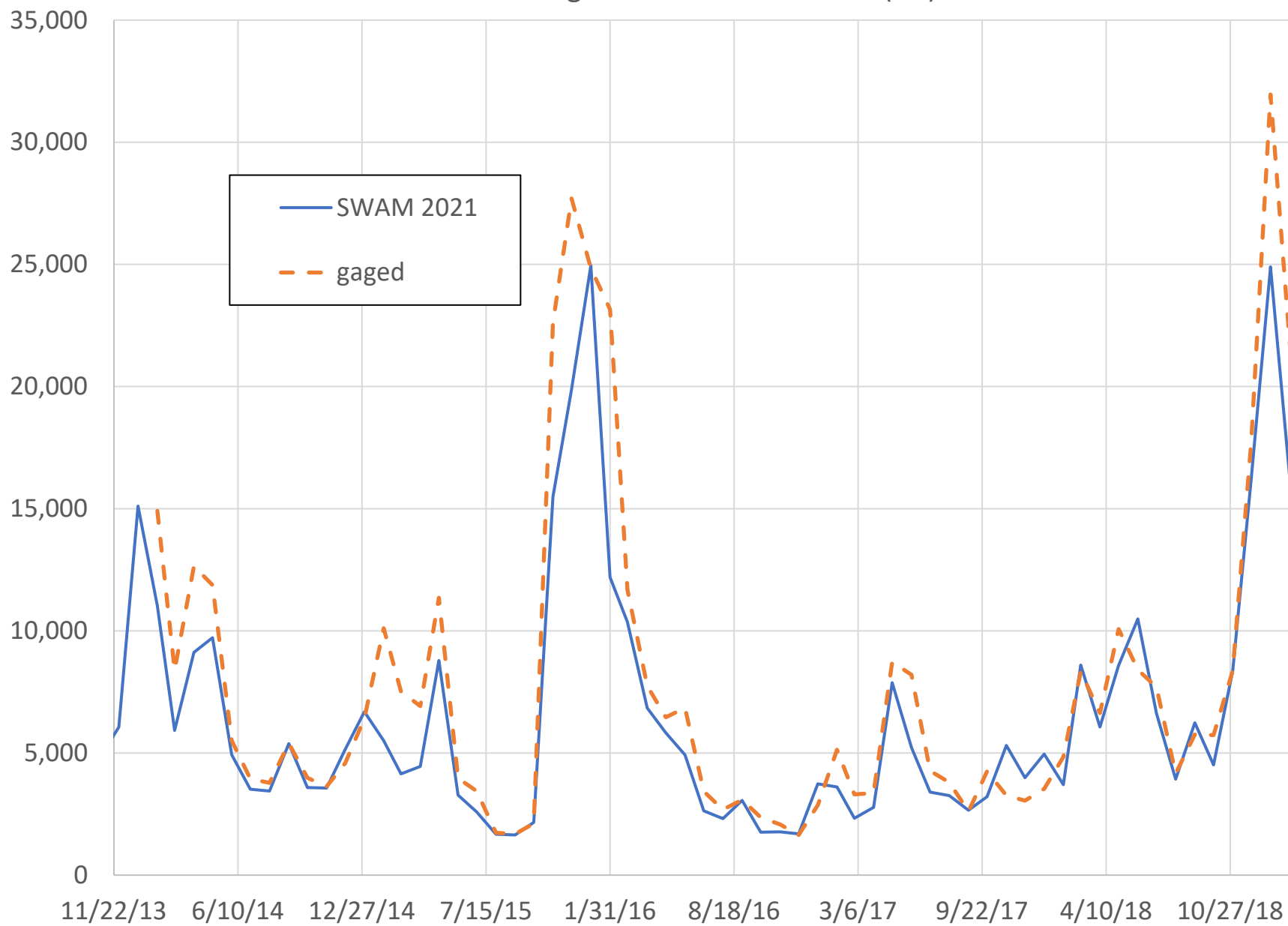
SLD18: Saluda River at Chappells (cfs)



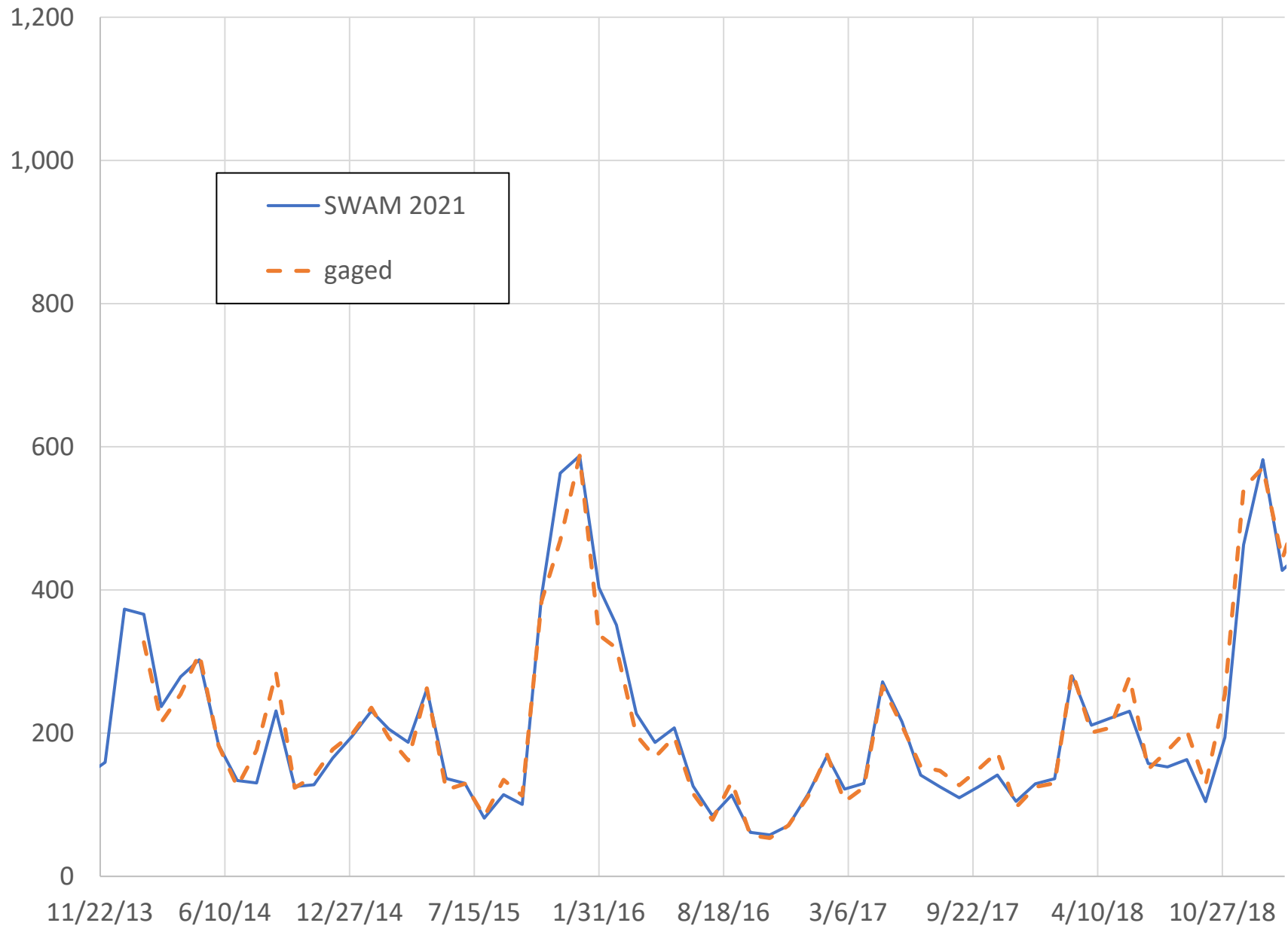
SLD25: Saluda River bl Lake Murray (cfs)



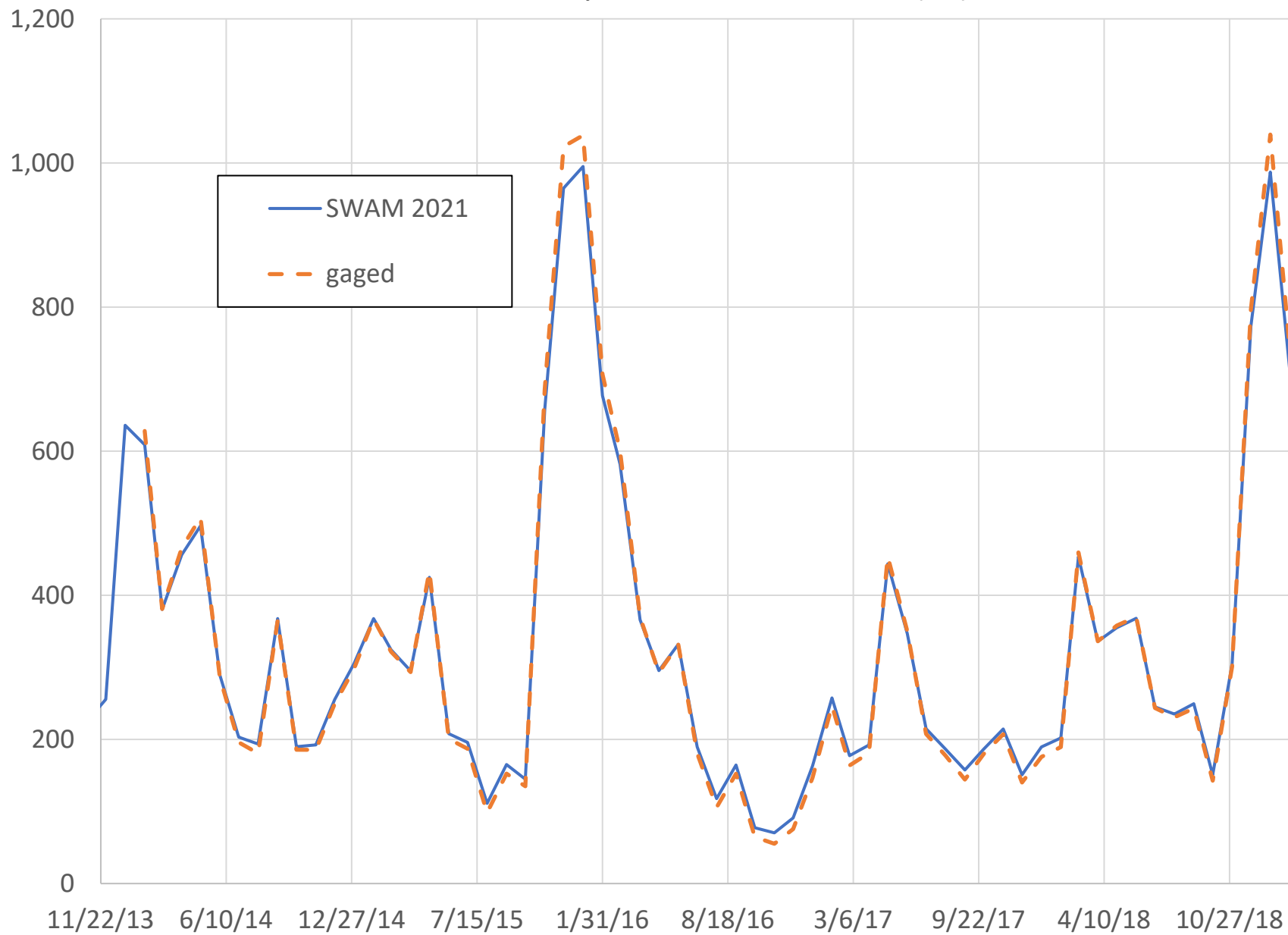
SLD27: Congaree River at Columbia (cfs)



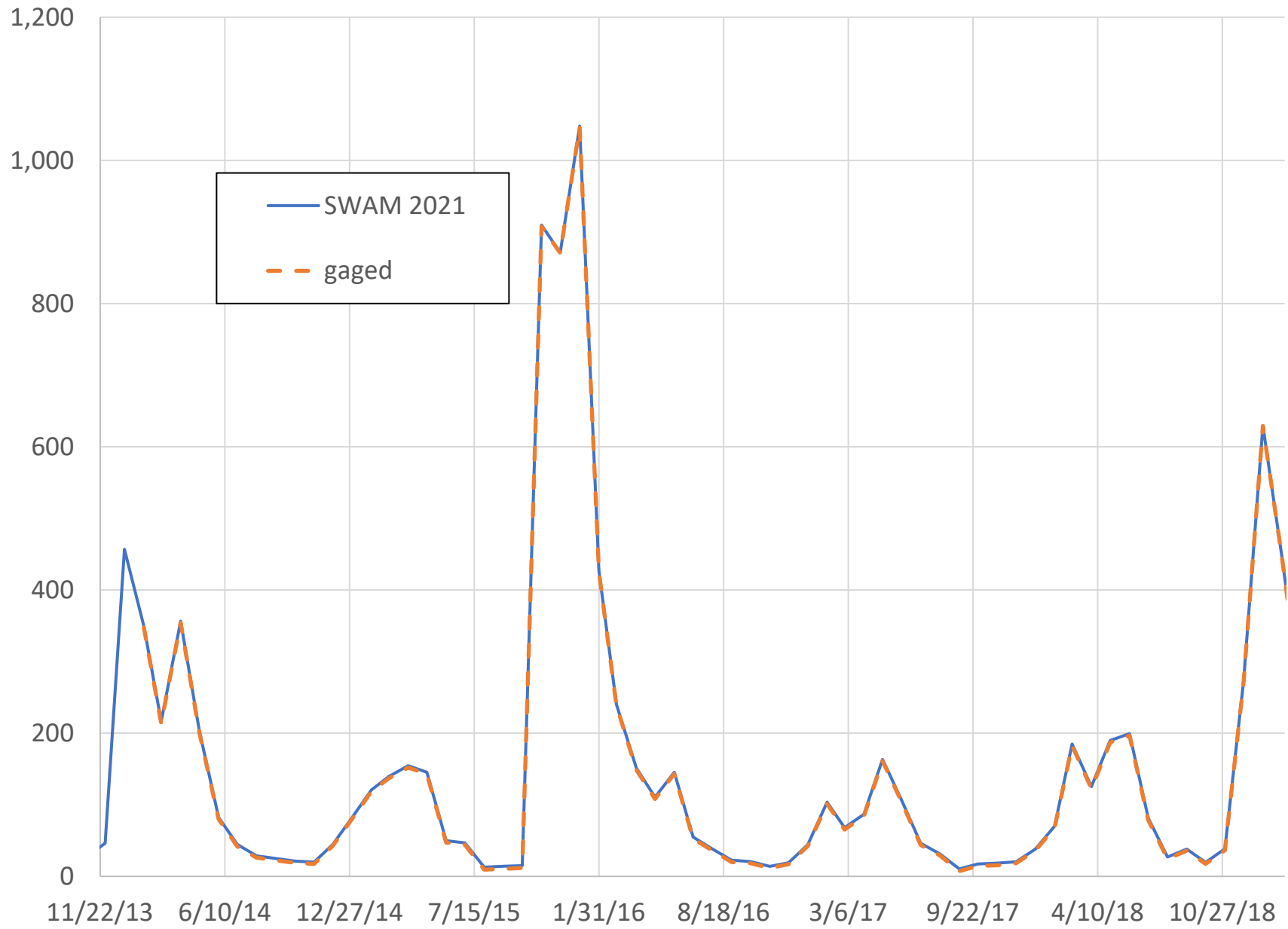
SLD11: Reedy River above Fork Shoals (cfs)



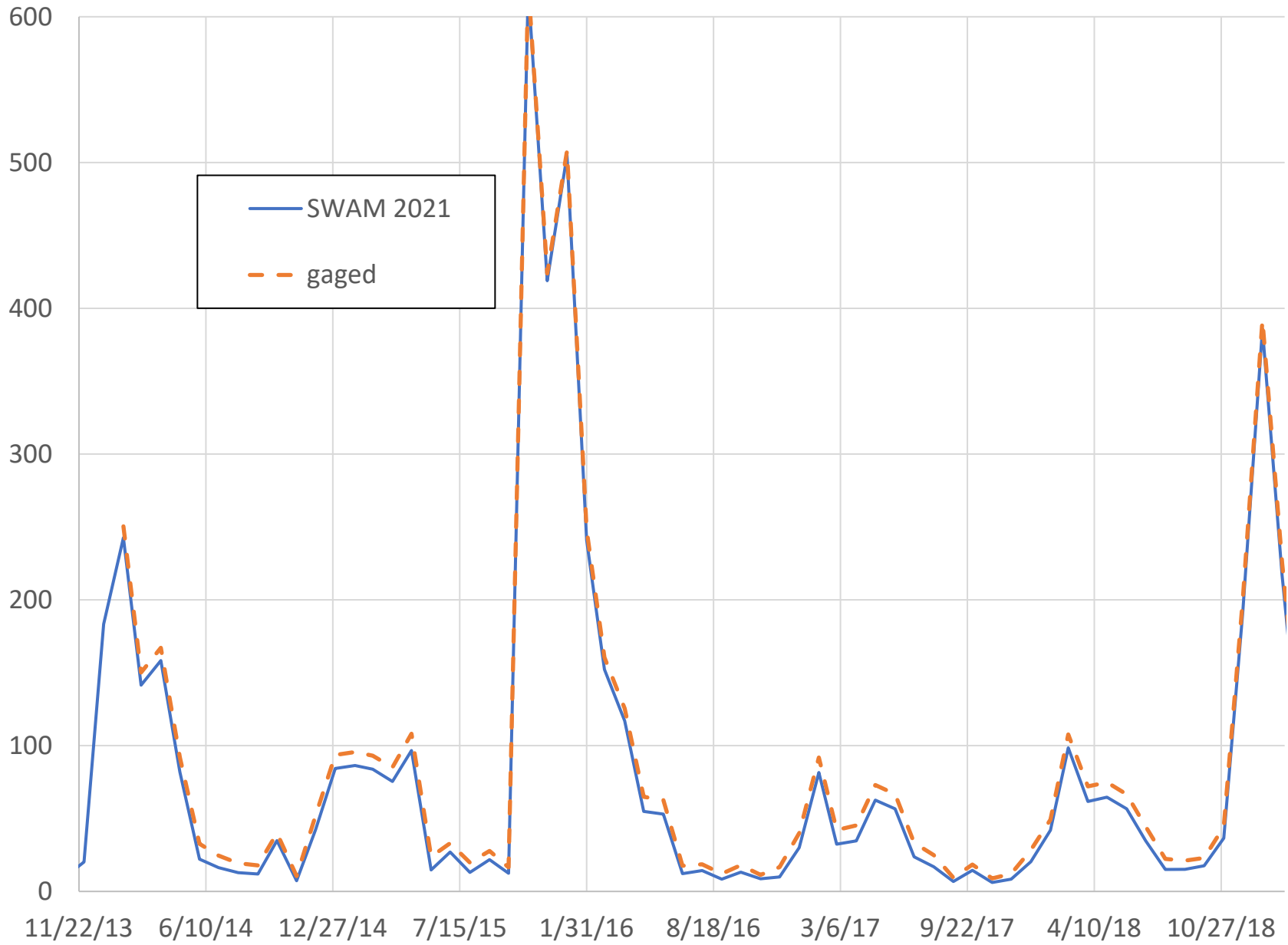
SLD12/13: Reedy River near Ware Shoals (cfs)



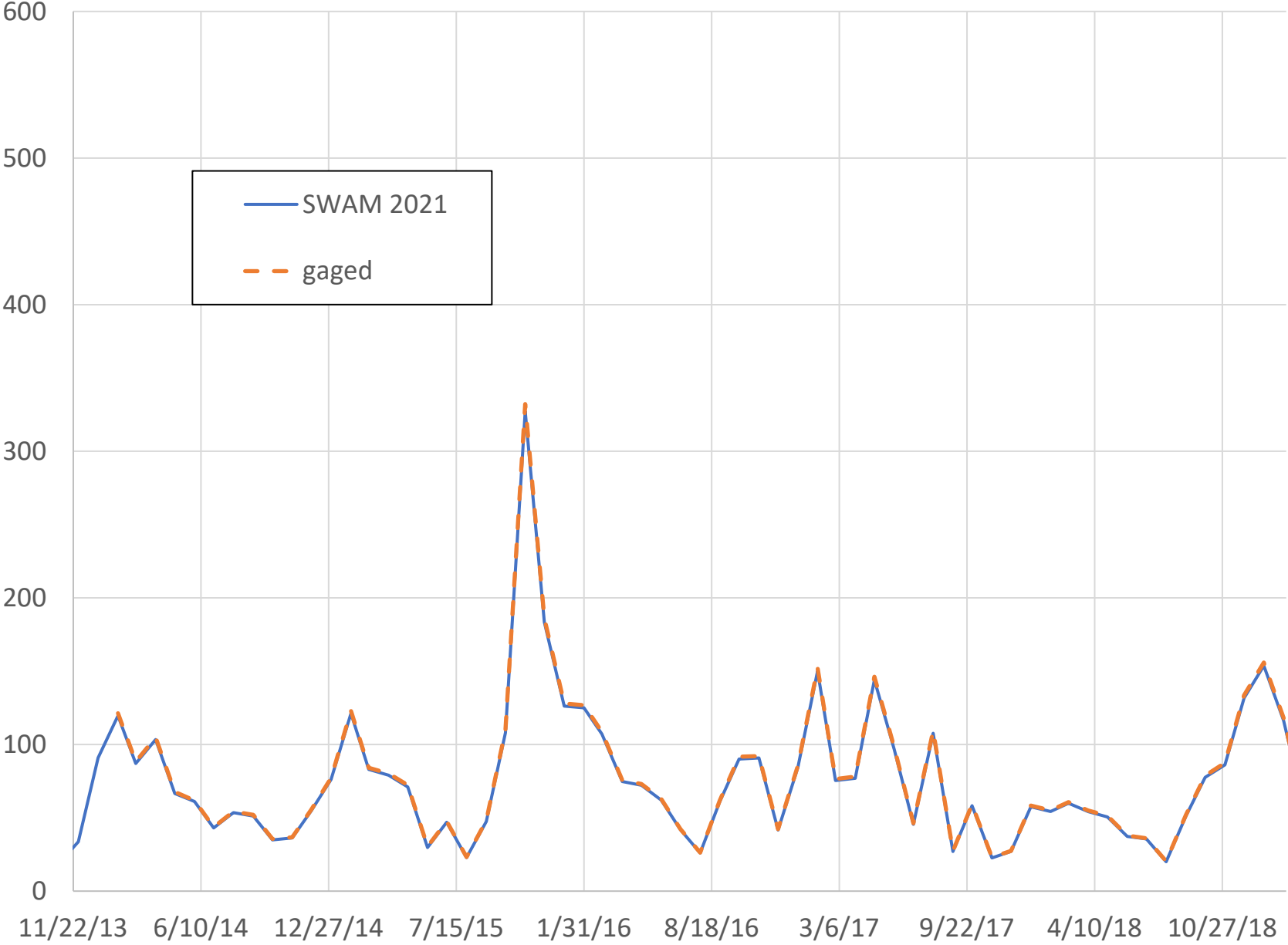
SLD19: Little River near Silverstreet (cfs)



SLD22: Bush River near Prosperity (cfs)



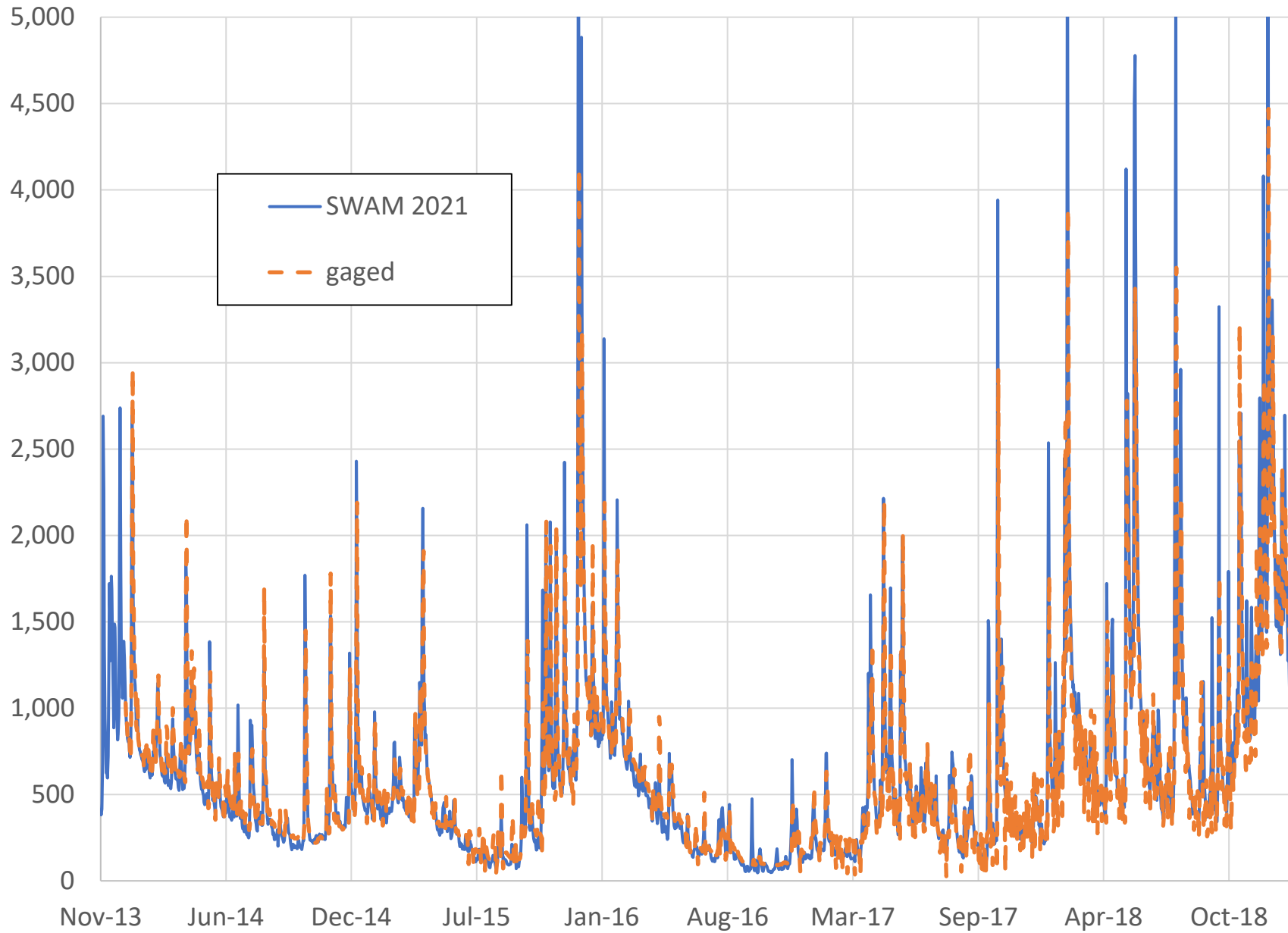
SLD29: Gills Creek at Columbia (cfs)



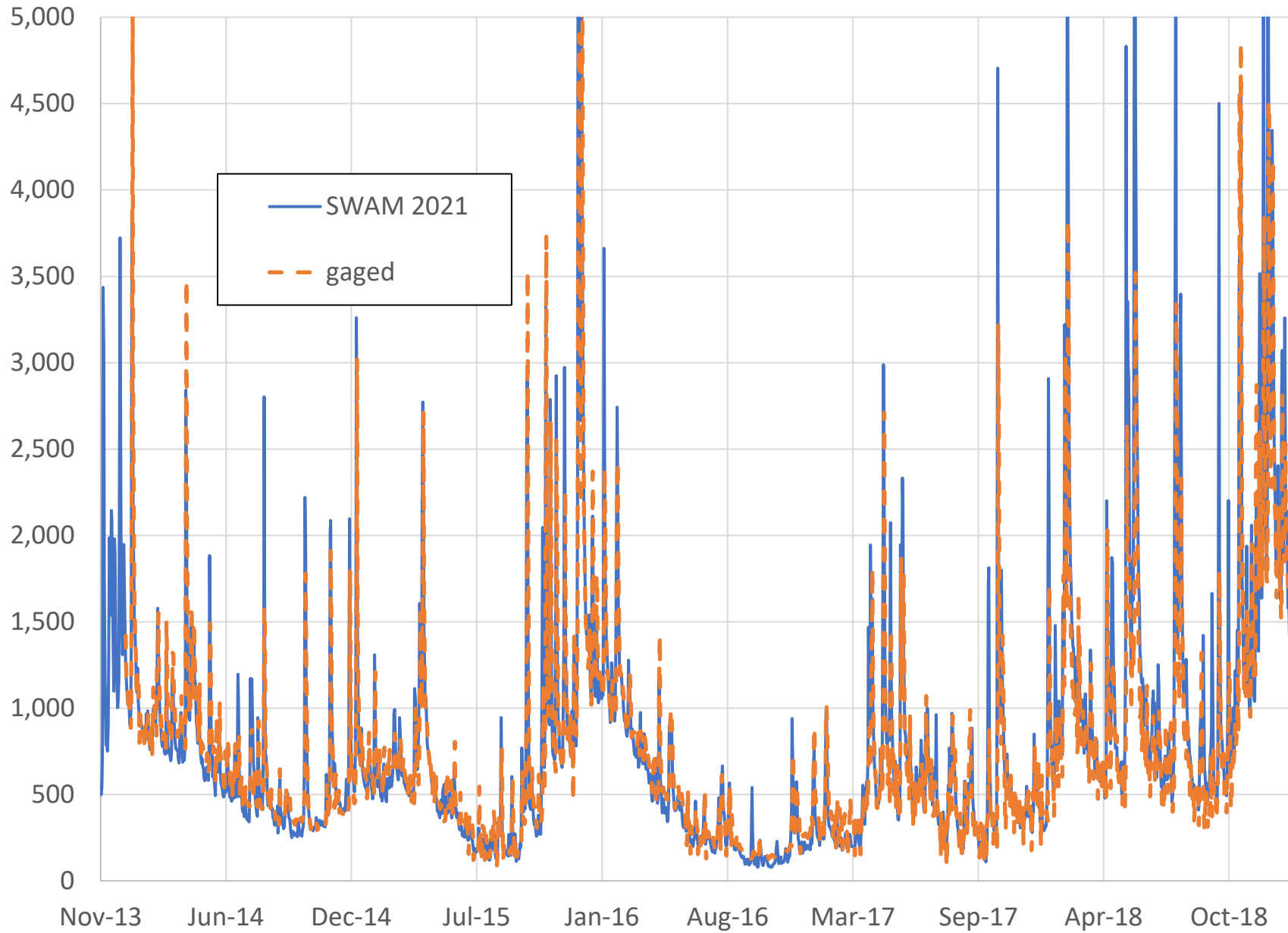
Attachment C

Daily Validation Results

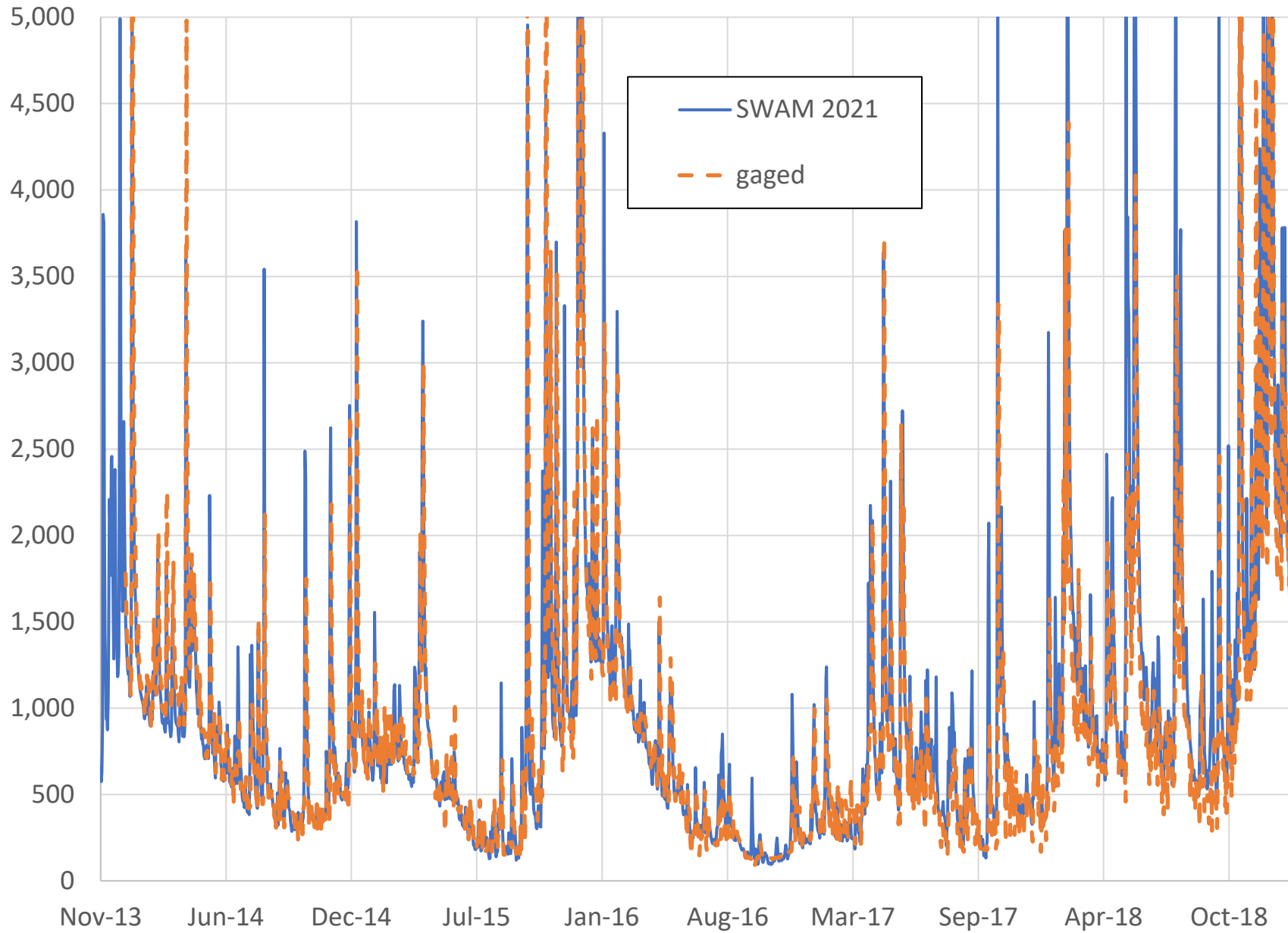
SLD04: Saluda River near Greenville (cfs)



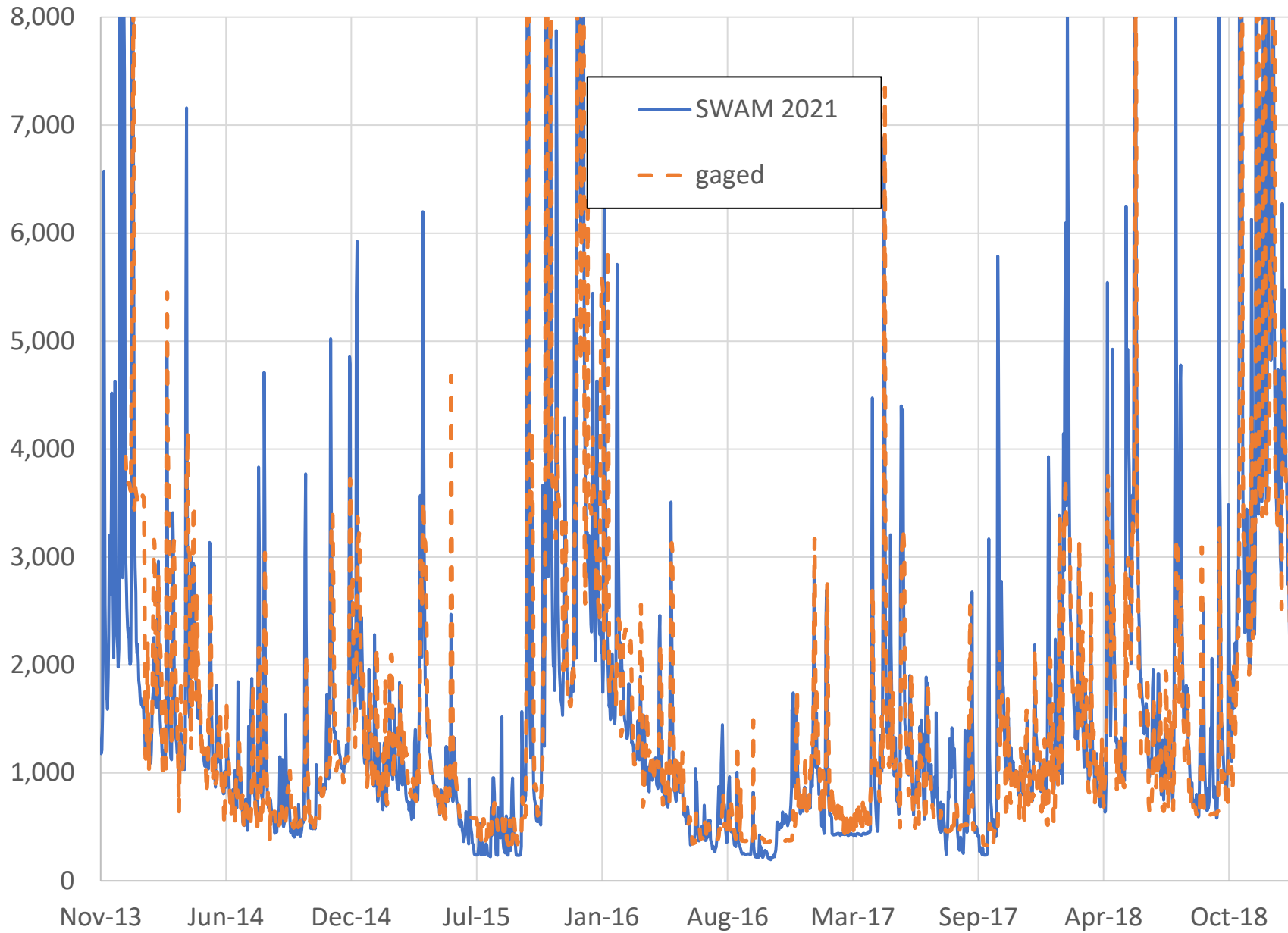
SLD07: Saluda River near Williamston (cfs)



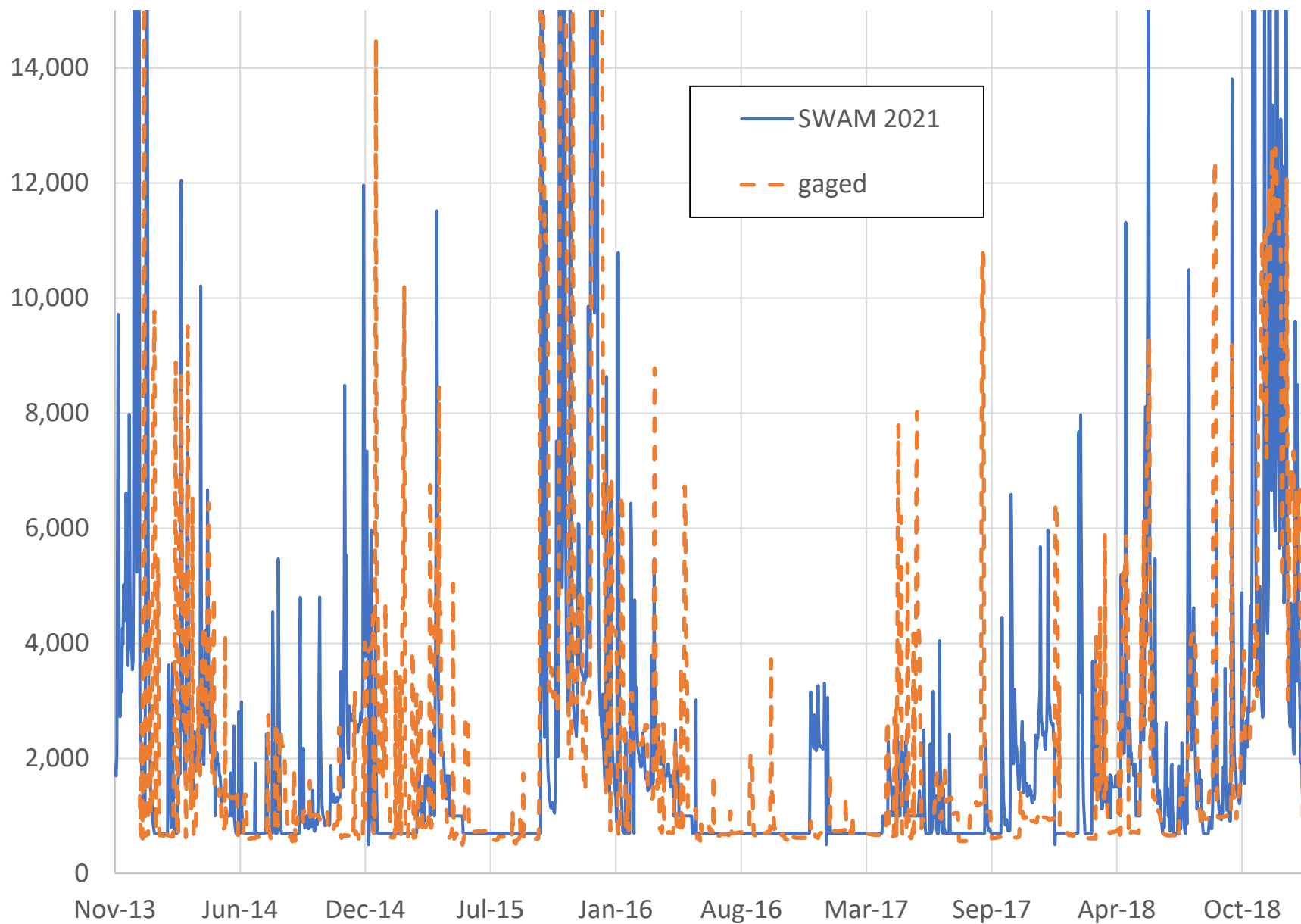
SLD09: Saluda River near Ware Shoals (cfs)



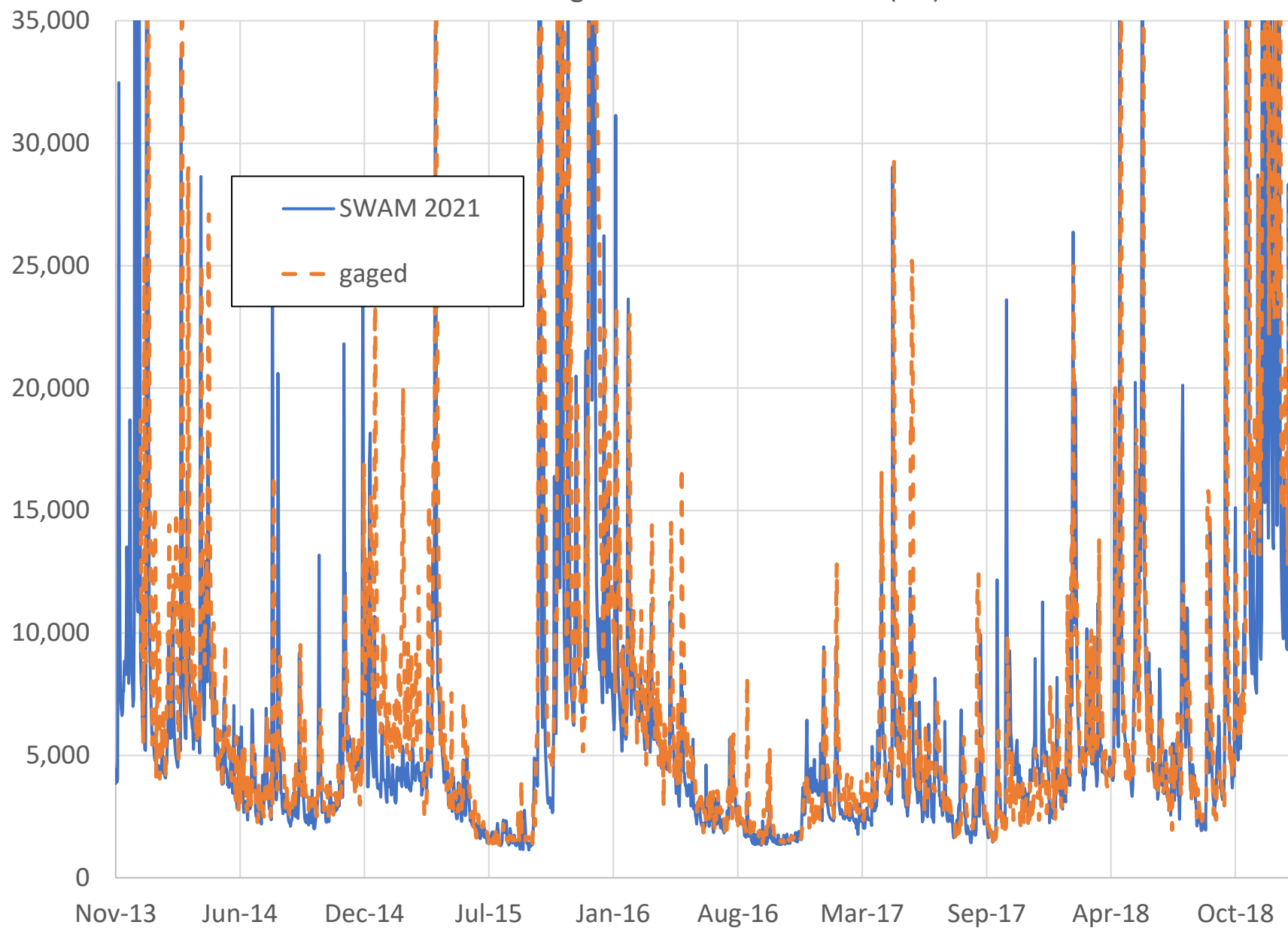
SLD18: Saluda River at Chappells (cfs)



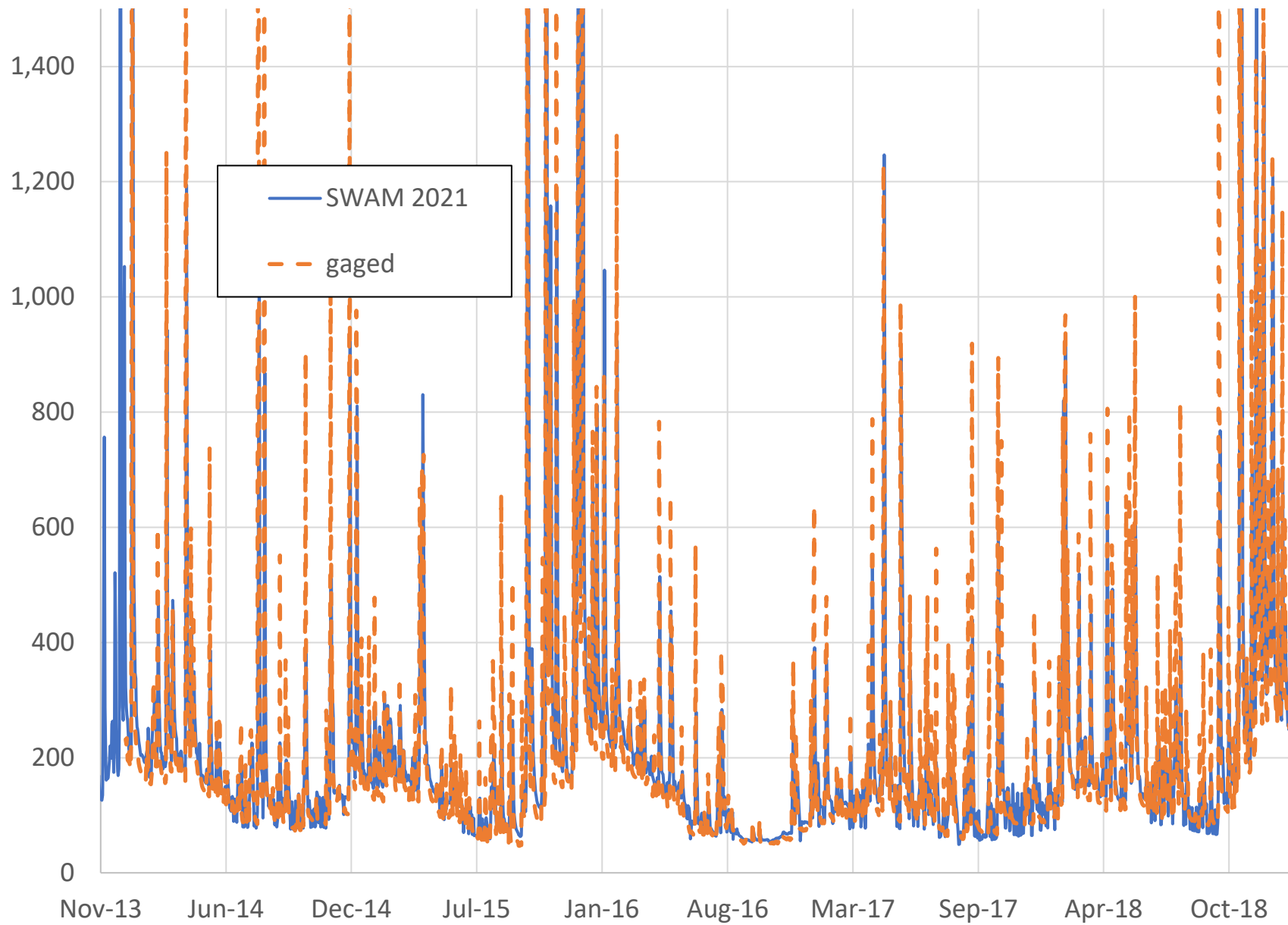
SLD25: Saluda River bl Lake Murray (cfs)



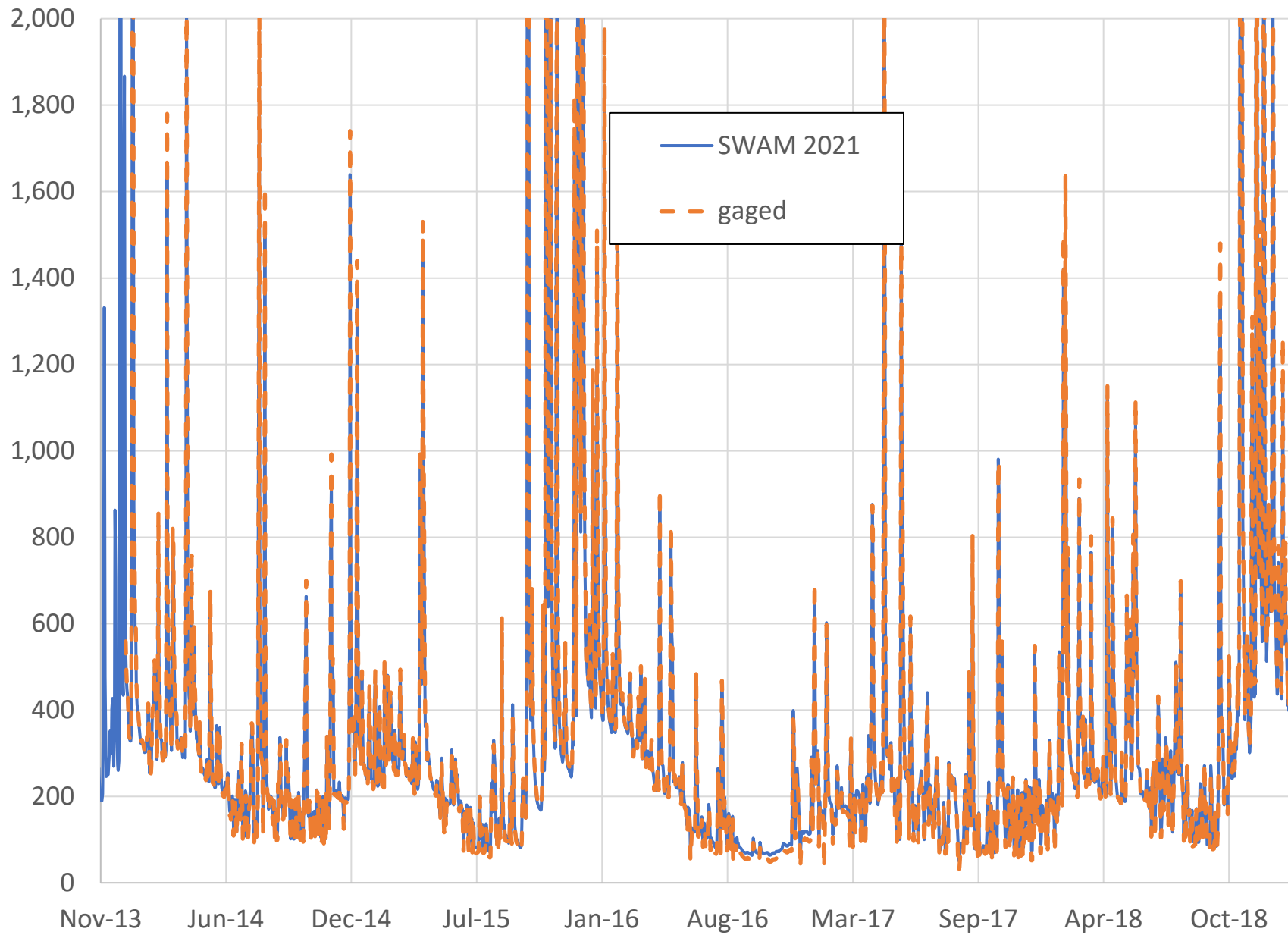
SLD27: Congaree River at Columbia (cfs)



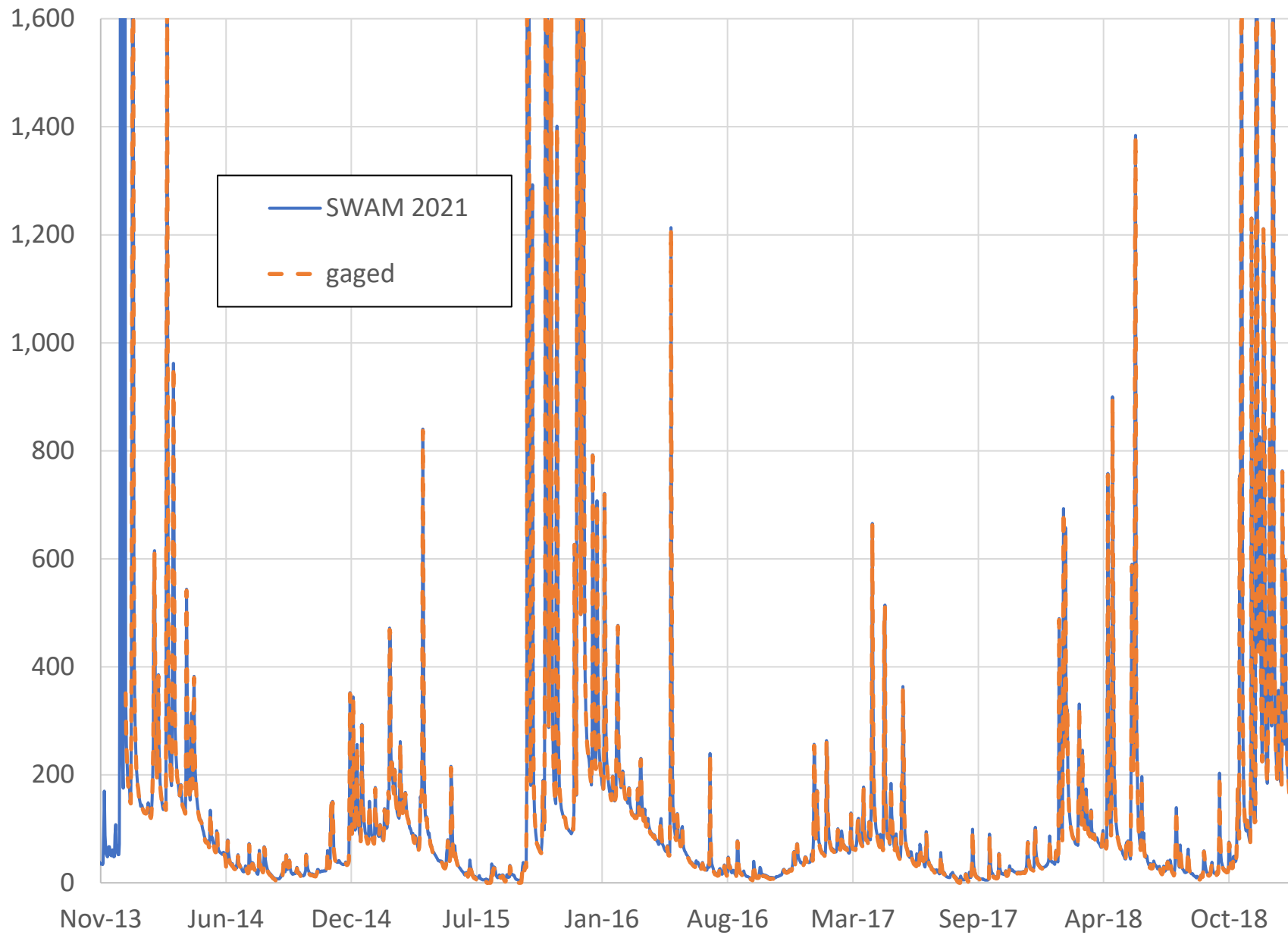
SLD11: Reedy River above Fork Shoals (cfs)



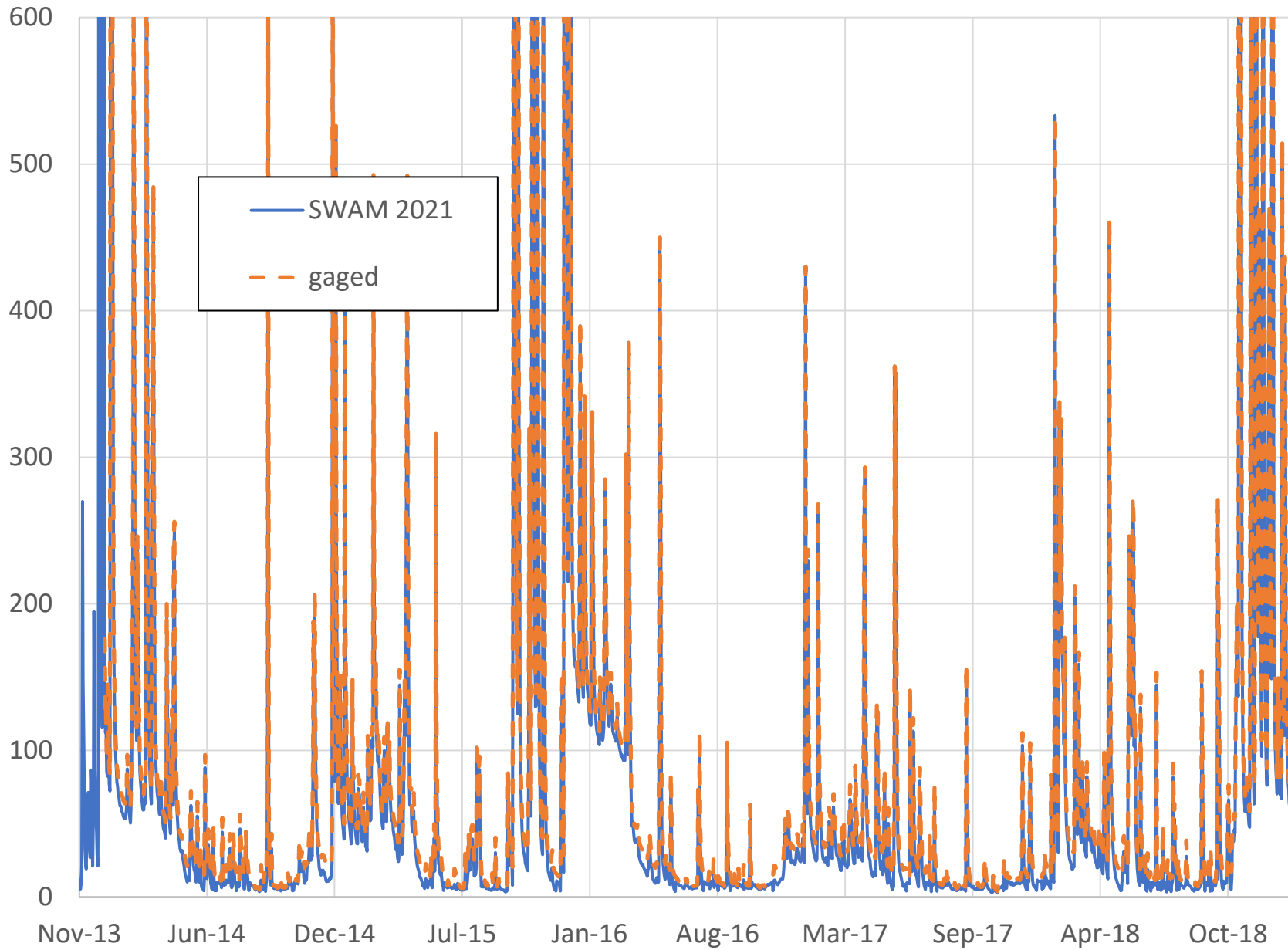
SLD12/13: Reedy River near Ware Shoals (cfs)



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