GAM Run 08-59

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Groundwater Availability Modeling Section
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July 11, 2008

EXECUTIVE SUMMARY:

We ran the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer to simulate discharge to Salado Creek in Bell County and aggregated springs and streams in Williamson and Travis counties using average annual pumping rates of 7,500 acre-feet for Bell County, 15,000 acre-feet for Williamson County, and 5,600 acre-feet for Travis County. The results show that springs and streams continue to flow during every month of the simulation for Bell and Travis counties but not for Williamson County.

REQUESTOR:

Ms. Cheryl Maxwell of the Clearwater Underground Water Conservation District acting on behalf of Groundwater Management Area 8.

DESCRIPTION OF REQUEST:

Ms. Cheryl Maxwell requested we use the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer to determine projected discharge from model drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties for a simulation period beginning 2001 through 2020. Ms. Cheryl Maxwell asked that we use the same recharge model input files as used in previously requested model runs (Anaya, 2007a, and Anaya, 2007b). Ms. Cheryl Maxwell also requested that we adjust the pumpage in a manner consistent with previously requested model runs (Anaya, 2007a, and Anaya, 2007b) while using average annual pumping rates of 7,500 acre-feet for Bell County, 15,000 acre-feet for Williamson County, and 5,600 acre-feet for Travis County.

METHODS:

To address the request, we:

- used recharge distributions provided to us by staff at Turner, Collie and Braden, Incorporated, which were based on the historic monthly precipitation record for the model area during the period from 1940 to 1960;

- used initial spatial pumpage distributions provided to us by staff at Turner, Collie and Braden, Incorporated and adjusted to represent average annual pumping rates

- ran the model for 141 years, starting with a 100-year initial stress period (pre-1980) followed by 21 years of historical monthly stress periods (1980 to 2000), then 10 years of predictive annual stress periods (2001 to 2010), and ending with 10 years of predictive monthly stress periods (2011 to 2020) to represent a simulated repeat of the 1950s' drought of record (Please see Parameters and Assumptions Section about these stress periods);

- extracted projected discharge for drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties, respectively, for each of the stress periods from 2001 through 2020 (Please see Parameters and Assumptions Section);

- generated a table of discharge from drain cells representing Salado Creek in Bell County and drain cells representing aggregated springs and streams in Williamson and Travis counties for stress periods 254 through 383 (2001 to 2020); and

- generated hydrographs of discharge from drain cells representing Salado Creek in Bell County, and drain cells representing aggregated springs and streams in Williamson and Travis counties for stress periods 254 through 383 (2001 to 2020).

PARAMETERS AND ASSUMPTIONS:

- TWDB staff used version 1.01 of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer.

- See Jones (2003) for a more detailed discussion of assumptions and limitations of the groundwater availability model for the northern segment of the Edwards (Balcones Fault Zone) Aquifer.

- The model consists of one layer representing the northern segment of the Edwards (Balcones Fault Zone) Aquifer and assumes no hydraulic communication with the underlying Trinity Aquifer.

- The model utilizes the Drain package of MODFLOW to simulate discharge from springs and perennial streams with the assumption that the perennial streams are always gaining water from the aquifer.

- The root mean square error (a measure of the difference between simulated and actual water levels during model calibration) in the groundwater availability model is 32 feet for the 1980 steady-state calibration period (Jones, 2003).

- The initial 100-year stress period is for the model to reach equilibrium to known or observed conditions just prior to 1980. The 21 years of historical monthly stress periods from 1980 to 2000 represent the aquifer in a transient state for which the model was calibrated. The end of the 21 years of historical monthly stress periods also provides the initial conditions for starting the predictive portion of the model simulation. The next 10 years of annual stress periods represent the first phase of the predictive model simulation under normal recharge conditions and with predictive pumpage rate estimates for the period from 2001 to 2010. This 10-year period allows the modeled aquifer to reach equilibrium with predictive pumpage rates before being stressed by the simulated drought of record recharge. The final 10 years of monthly stress periods from 2011 to 2020 represent the simulated repeat of the recharge conditions during 1950s' drought of record with the predictive pumpage rate estimates.

- Initial distributed pumpage and recharge rates were developed by staff of Turner, Collie and Braden, Incorporated at the request of Ms. Cheryl Maxwell of the Clearwater Underground Water Conservation District acting on behalf of the groundwater districts in Groundwater Management Area 8. The spatial and temporal recharge distributions are based on the historic monthly precipitation record for the model area during the period from 1940 through 1960 and include the drought of record conditions of the 1950s'. The pumpage rates represent predictive estimates of pumpage for Travis and Williamson counties and drought management pumpage rates for Bell County. The spatial distribution of pumpage rates is based on the last year (2000) of the historical calibration period of the model.

RESULTS:

Discharge from the model drain cells representing Salado Creek in Bell County and aggregated natural springs and streams in Williamson and Travis counties (Figure 1) is listed in Table 1 for each annual stress period beginning with stress period number 254 to 263 (2001 to 2010) and for each monthly stress period beginning with stress period number 264 to 383 (2011 to 2020). The hydrographs (Figures 2, 3, and 4) show the response of the model drain cells to simulated model stresses of recharge and pumpage. The results show that springs and streams continue to flow during every month of the simulation for Bell and Travis counties but not for Williamson County.

REFERENCES:

Anaya, R., 2007a, GAM run 07-15: Texas Water Development Board, GAM Run 07-15 Report, 11 p.

Anaya, R., 2007b, GAM run 07-21: Texas Water Development Board, GAM Run 07-21 Report, 11 p.

Jones, I. C., 2003, Groundwater availability modeling: Northern Segment of the Edwards Aquifer: Texas Water Development Board, Report 358, 75 p.

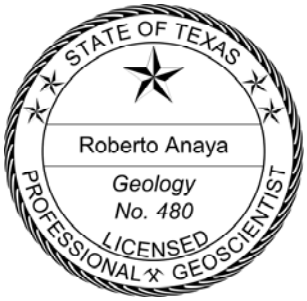

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Table 1. Discharge from model drain cells representing Salado Creek in Bell County and aggregated natural springs and streams in Williamson and Travis counties.

Time period	Stress period number	Salado Creek discharge (acre-feet per month)	Williamson County discharge (acre-feet per month)	Travis County discharge (acre-feet per month)
2001	254	1,981	3,292	203
2002	255	1,646	2,717	160
2003	256	1,851	3,178	198
2004	257	1,866	3,215	201
2005	258	1,500	2,450	143
2006	259	1,971	3,443	222
2007	260	988	1,399	106
2008	261	665	744	87
2009	262	1,374	2,122	109
2010	263	935	1,240	95
JAN2011	264	331	130	91
FEB2011	265	950	1,198	89
MAR2011	266	1,180	1,665	89
APR2011	267	661	695	88
MAY2011	268	1,438	2,246	92
JUN2011	269	1,410	2,208	109
JUL2011	270	563	542	92
AUG2011	271	321	124	88
SEP2011	272	1,858	3,083	109
OCT2011	273	661	628	88
NOV2011	274	533	343	85
DEC2011	275	274	43	80
JAN2012	276	143	0	73
FEB2012	277	659	411	70
MAR2012	278	792	814	69
APR2012	279	2,241	3,871	171
MAY2012	280	2,363	4,158	260
JUN2012	281	1,289	1,713	97
JUL2012	282	936	1,174	97
AUG2012	283	346	141	92
SEP2012	284	765	761	88
OCT2012	285	155	0	80
NOV2012	286	1,835	2,742	81
DEC2012	287	1,811	2,845	139
JAN2013	288	731	682	87
FEB2013	289	927	1,020	88
MAR2013	290	763	814	88
APR2013	291	1,497	2,302	93
MAY2013	292	1,514	2,349	120
JUN2013	293	758	845	94
JUL2013	294	682	690	92
AUG2013	295	1,220	1,832	92
SEP2013	296	1,273	1,892	92
OCT2013	297	2,917	5,707	357

Time period	Stress period number	Salado Creek discharge (acre-feet per month)	Williamson County discharge (acre-feet per month)	Travis County discharge (acre-feet per month)
NOV2013	298	1,249	1,483	104
DEC2013	299	2,155	3,570	200
JAN2014	300	950	1,048	108
FEB2014	301	473	259	103
MAR2014	302	212	23	95
APR2014	303	559	324	89
MAY2014	304	737	771	84
JUN2014	305	309	89	78
JUL2014	306	336	123	73
AUG2014	307	309	95	68
SEP2014	308	402	173	64
OCT2014	309	441	251	60
NOV2014	310	481	309	59
DEC2014	311	214	7	56
JAN2015	312	612	392	56
FEB2015	313	1,621	2,378	62
MAR2015	314	732	711	66
APR2015	315	790	873	69
MAY2015	316	2,040	3,444	159
JUN2015	317	1,912	3,137	182
JUL2015	318	999	1,249	92
AUG2015	319	1,316	1,993	97
SEP2015	320	784	886	94
OCT2015	321	354	132	89
NOV2015	322	354	110	83
DEC2015	323	382	116	77
JAN2016	324	516	266	72
FEB2016	325	721	661	70
MAR2016	326	224	10	66
APR2016	327	121	0	63
MAY2016	328	506	209	60
JUN2016	329	371	156	59
JUL2016	330	285	66	57
AUG2016	331	398	173	55
SEP2016	332	115	0	51
OCT2016	333	200	0	49
NOV2016	334	519	249	48
DEC2016	335	694	578	50
JAN2017	336	415	179	51
FEB2017	337	775	773	54
MAR2017	338	1,365	1,899	62
APR2017	339	4,208	9,239	536
MAY2017	340	2,936	5,105	319
JUN2017	341	2,801	4,887	313
JUL2017	342	1,118	1,166	113
AUG2017	343	763	674	107
SEP2017	344	2,567	4,565	237
OCT2017	345	3,949	8,488	540

Time period	Stress period number	Salado Creek discharge (acre-feet per month)	Williamson County discharge (acre-feet per month)	Travis County discharge (acre-feet per month)
NOV2017	346	2,681	4,438	292
DEC2017	347	1,477	1,809	127
JAN2018	348	1,459	2,011	123
FEB2018	349	2,811	5,296	331
MAR2018	350	1,637	2,367	143
APR2018	351	1,521	2,294	131
MAY2018	352	1,534	2,397	138
JUN2018	353	2,212	3,990	264
JUL2018	354	1,339	2,029	127
AUG2018	355	1,130	1,669	120
SEP2018	356	3,382	7,127	455
OCT2018	357	2,439	4,158	282
NOV2018	358	1,350	1,725	127
DEC2018	359	1,028	1,264	122
JAN2019	360	495	339	112
FEB2019	361	1,229	1,724	107
MAR2019	362	357	191	99
APR2019	363	1,765	2,910	105
MAY2019	364	1,380	2,102	107
JUN2019	365	1,774	3,010	165
JUL2019	366	1,386	2,184	121
AUG2019	367	2,594	5,049	327
SEP2019	368	1,845	2,933	176
OCT2019	369	3,326	6,839	453
NOV2019	370	1,839	2,655	158
DEC2019	371	1,907	2,995	171
JAN2020	372	1,399	2,000	127
FEB2020	373	1,579	2,489	138
MAR2020	374	959	1,261	120
APR2020	375	1,537	2,526	126
MAY2020	376	761	939	114
JUN2020	377	1,985	3,566	186
JUL2020	378	1,173	1,772	114
AUG2020	379	1,229	1,930	112
SEP2020	380	883	1,183	108
OCT2020	381	4,591	10,762	624
NOV2020	382	2,619	4,332	274
DEC2020	383	2,957	5,464	356

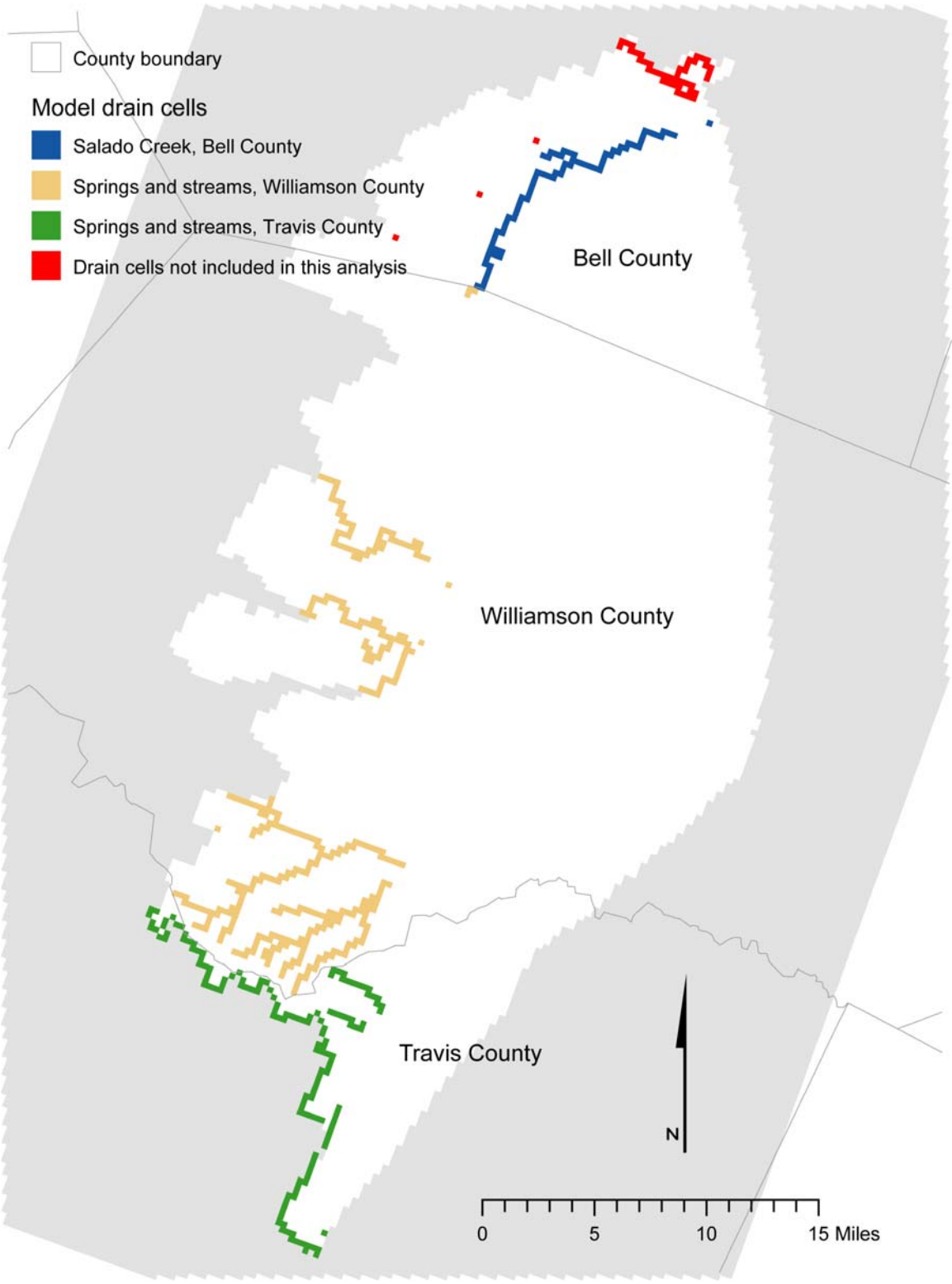

Figure 1: Model drain cells representing Salado Creek discharge in Bell County and natural spring-stream discharge in Williamson and Travis counties

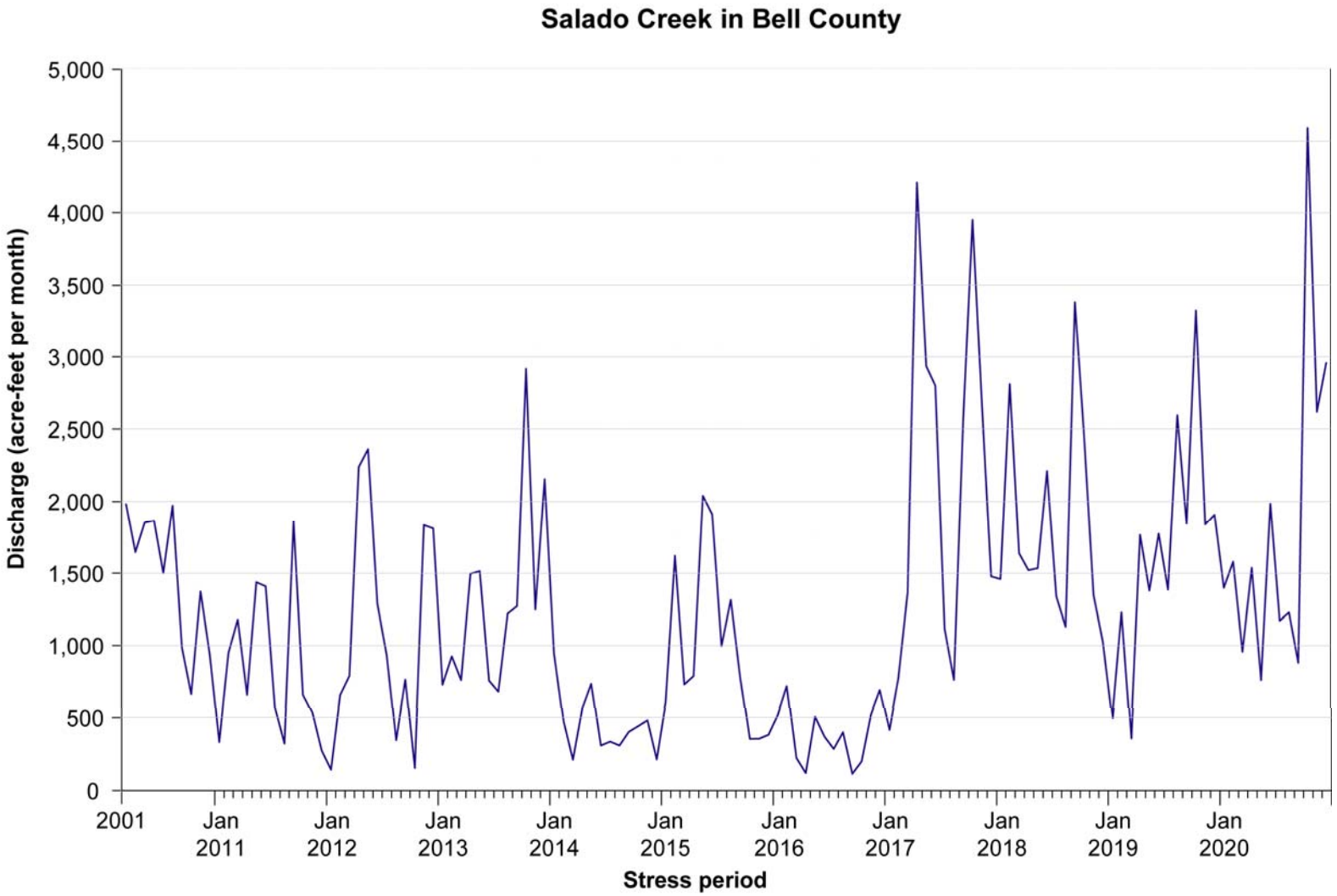

Figure 2: Hydrograph of simulated (2001 to 2020) discharge for Salado Creek in Bell County.

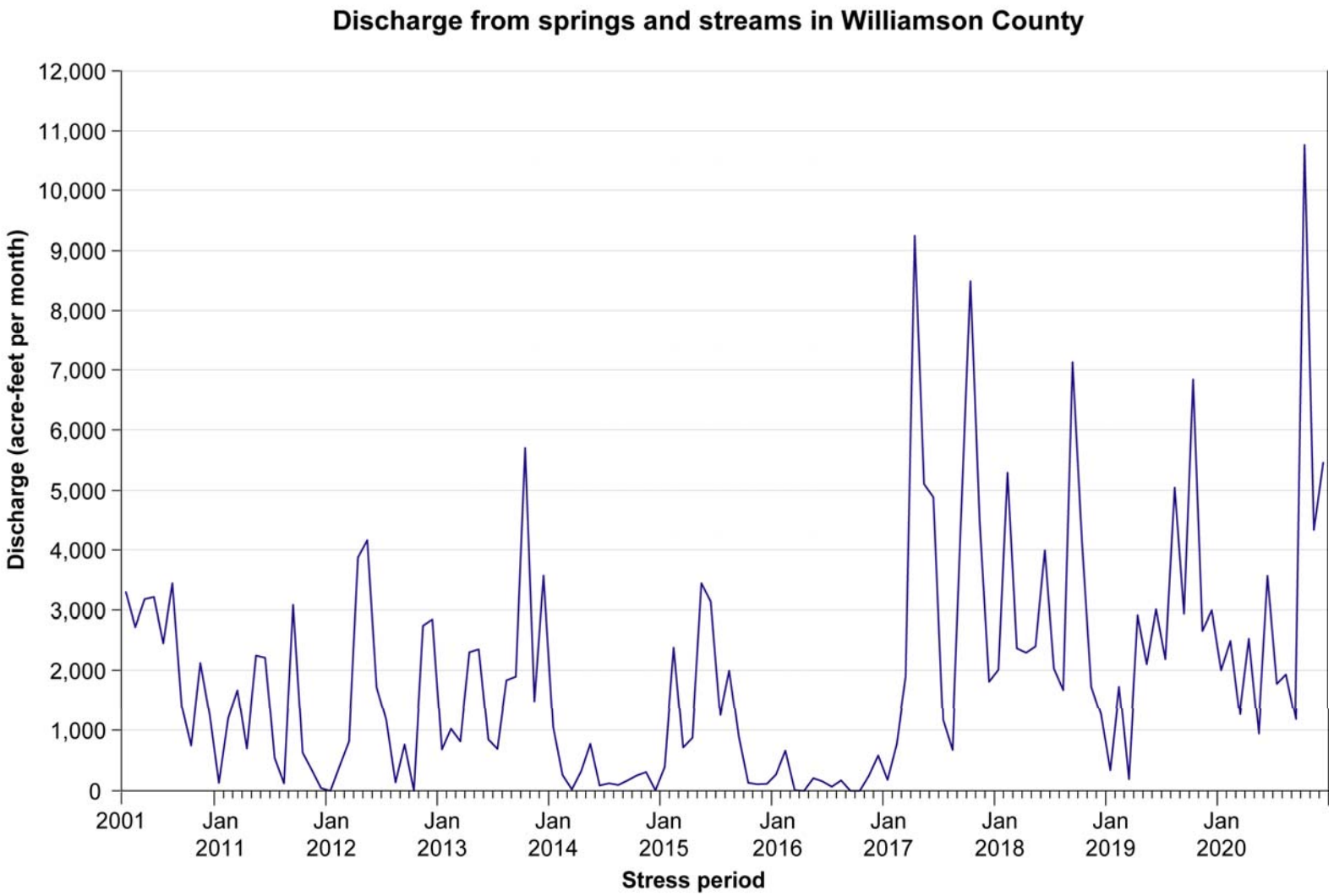

Figure 3: Hydrograph of simulated (2001 to 2020) aggregated natural spring-stream discharge in Williamson County.

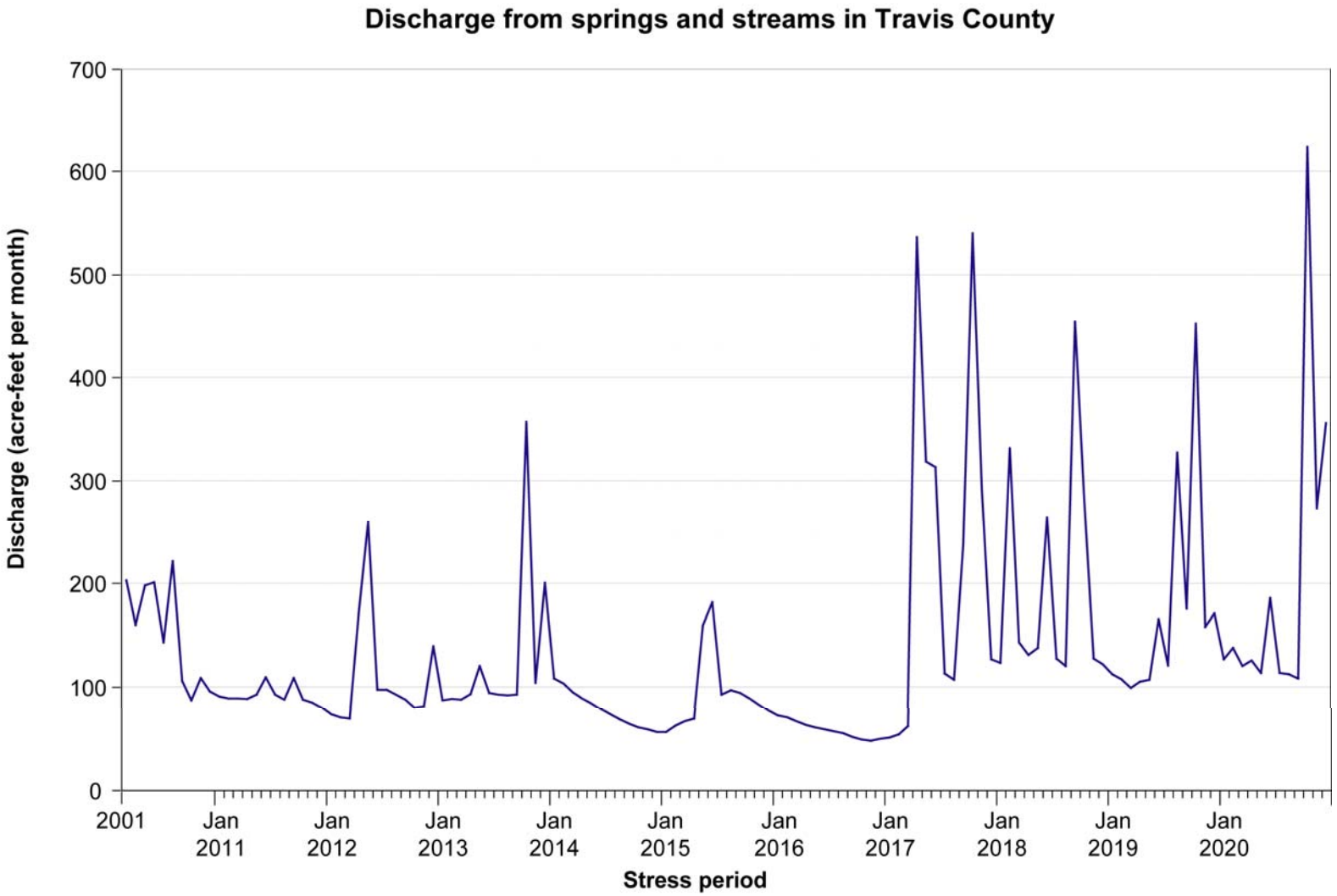

Figure 4: Hydrograph of simulated (2001 to 2020) aggregated natural spring-stream discharge in Travis County.