EAHCP Strategic Adaptive Management MODFLOW Modeling Assumptions

MODFLOW Assumptions

- **Goal of presentation and whitepaper:**
  - Identify SAMP model simulations
  - Identify assumptions underlying simulations
- **Model Construction**
  - EARIP Modeling – conducted by HDR (2011) with Lindgren et al. 2004 model
  - SAMP Modeling – conducted by EAA with Liu et al. 2017 model

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  - plainly identify assumptions underlying simulations
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  - SAMP Modeling – conducted by EAA with Liu et al. 2017 model

HDR, 2011. Evaluation of Water Management Programs and Alternatives for Springflow Protection of Endangered Species at Comal and San Marcos Springs. Appendix K EAHCP. 157 pp. Available at: http://www.eahcp.org/index.php/document_library_selected?c=11&c=11

Lindgren, RJ, Dutton, AR, Hovorka, SD, Worthington, SR, and Painter, S, 2004. Conceptualization and simulation of the Edwards Aquifer, San Antonio Region, Texas: U.S. Geological Survey Scientific Investigations Report 2004-5277, 143 pp.

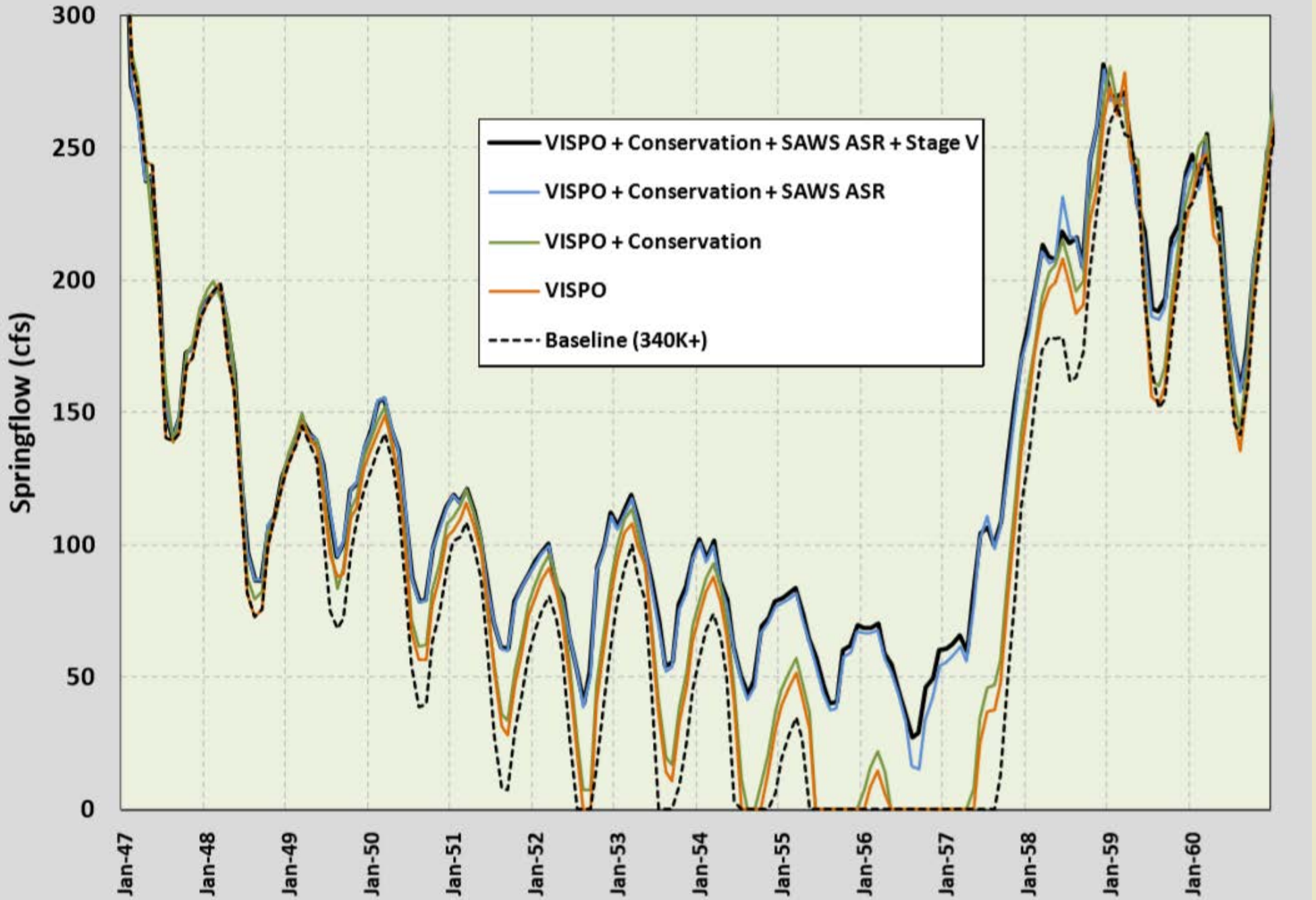
Liu, A, Troshanov, N, Winterle, J, Zhang, A, and Eason, S, 2017. Updates to the MODFLOW Groundwater Model of the San Antonio Segment of the Edwards Aquifer. 78 pp. Available at: https://www.edwardsaquifer.org/science-and-maps/research-and-scientific-reports/science-document-library

Types of Model Runs

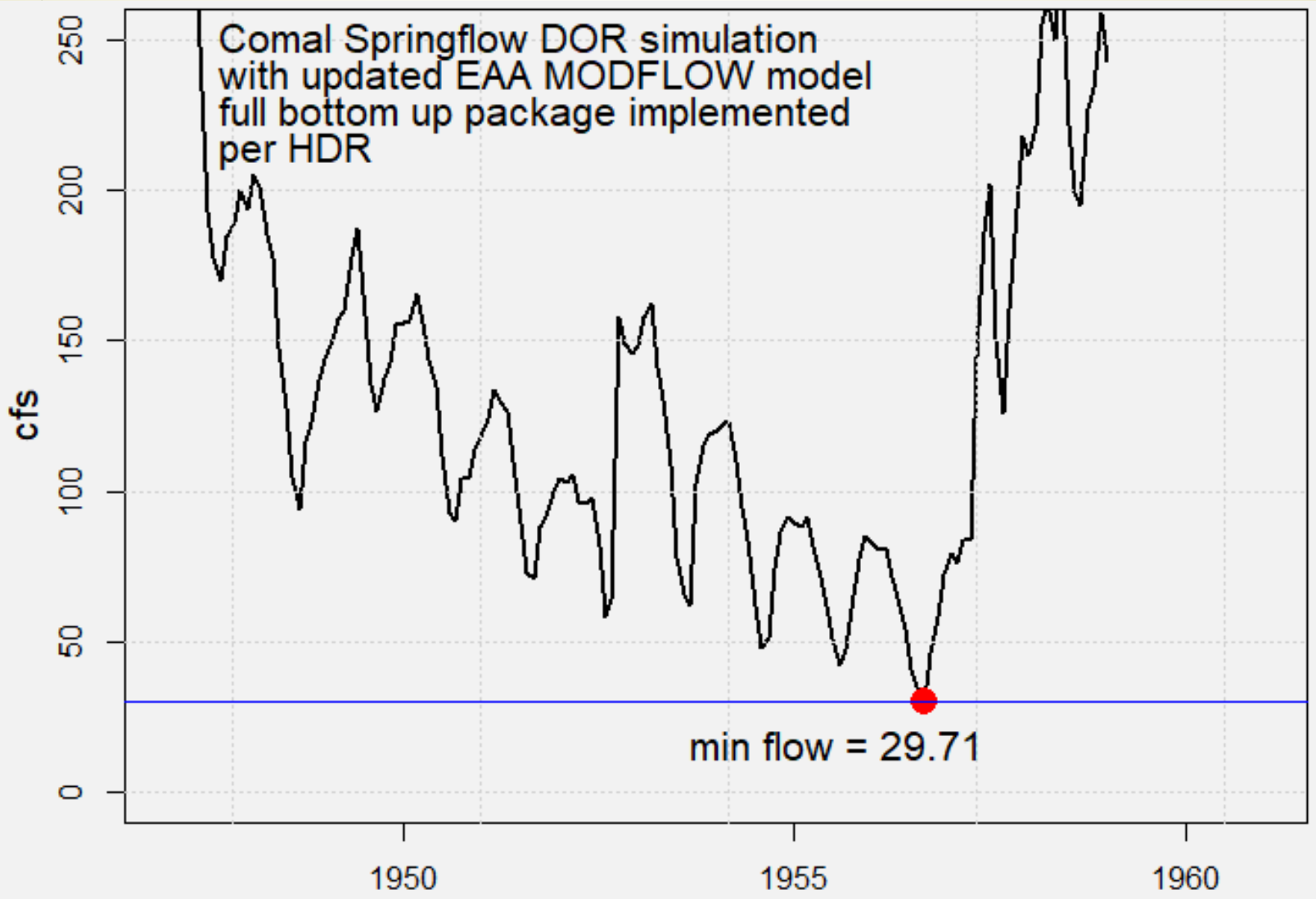
- Baseline Runs: Model Runs 1 and 2
- SAMP Runs: Model Runs 3 and 4
- SAMP Expanded Phase I CMs and/or Phase II CMs: Model Run 5

Baseline Runs. Model Run 1

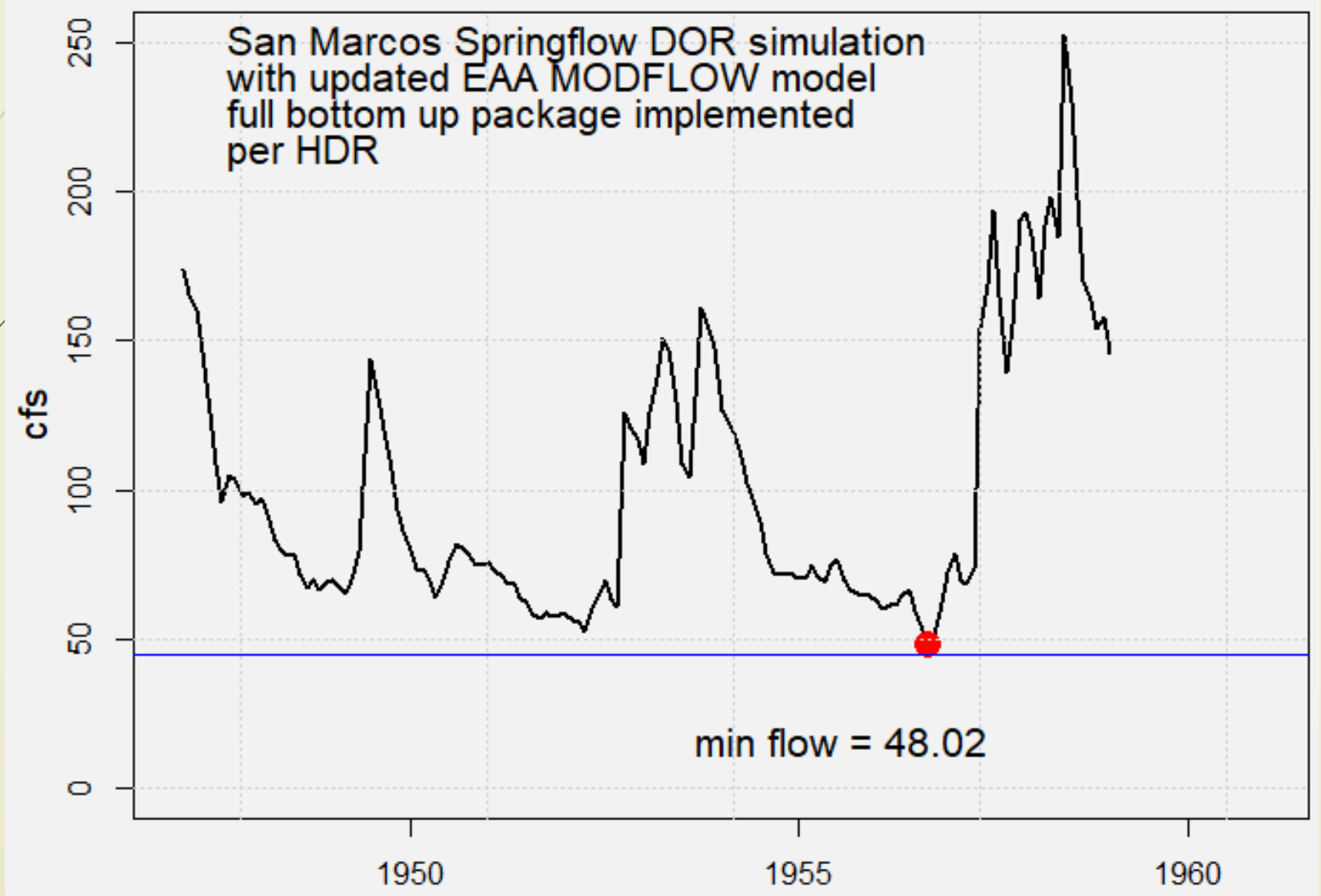
- Model Inputs: Implemented using same model inputs as HDR (2011)
- Simulation period: 1947-1958
- Goal: Determine whether springflow shortfalls identified during the HDR analysis still exist using the EAA updated model with HDR inputs.
- Timeline: Completed


Springflow (cfs)
300
250
200
150
100
50
0
Jan-47
Jan-48
Jan-49
Jan-50
Jan-51
Jan-52
Jan-53
Jan-54
Jan-55
Jan-56
Jan-57
Jan-58
Jan-59
Jan-60
VISPO + Conservation + SAWS ASR + Stage V
VISPO + Conservation + SAWS ASR
VISPO + Conservation
VISPO
Baseline (340K+)

Model Run 1 Results - Comal



Model Run 1 Results – San Marcos



Baseline Runs. Model Run 2

- Model Inputs: Implemented using same model inputs as HDR (2011)
- Simulation period: 1947-2000
- Goal: Determine the long-term average shortfall using the updated model with HDR inputs.
- Timeline: anticipated Fall 2018

SAMP Runs. Model Run 3

- Model Inputs: Implemented using actual data from HCP programs
- Simulation period: 1947-1958
- Goal: Determine whether springflow shortfalls exist using the updated model with inputs guided by actual HCP implementation.
- Timeline: December 2018

SAMP Runs. Model Run 4

- Model Inputs: Implemented using actual data from HCP programs
- Simulation period: 1947-2000
- Goal: Determine the long-term average shortfall using the updated model with inputs guided by actual HCP implementation.
- Timeline: December 2018

Model Runs 3 and 4 assumptions

- EAA bottom up package geographical distribution and volume assumptions for:
  - VISPO
  - ASR
  - RWCP
  - Stage V

Model Runs 3 and 4 assumptions

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  - Stage V
- Pumping Assumptions

Model Runs 3 and 4 assumptions

- EAA bottom up package geographical distribution and volume assumptions for:
  - VISPO
  - ASR
  - RWCP
  - Stage V
- Pumping Assumptions
- Overarching assumptions
  - Forbearance modeled at county resolution not at individual well (ASR exception).
  - Slightly more than half of the forbearance conservation measures in Uvalde county occur east of the Knippa Gap.

SAMP Runs. Model Runs 3 and 4 - VISPO

- Volume: 40,000 ac-ft/yr. Set by HCP – program is fully enrolled.
- Distribution: Based on current distribution of program.
- Assumptions: Geographic distribution of water will not significantly change from 2018-2027.

VISPO

County	Use	acft %	Total acft
Atascosa	Irrigation	0.87%	348.00
Bexar	Irrigation	6.00%	2,400.00
Hays	Irrigation	0.30%	120.00
Medina	Irrigation	27.95%	11,180.00
Uvalde	Irrigation	64.88%	25,952.00
		100.00%	40,000.00

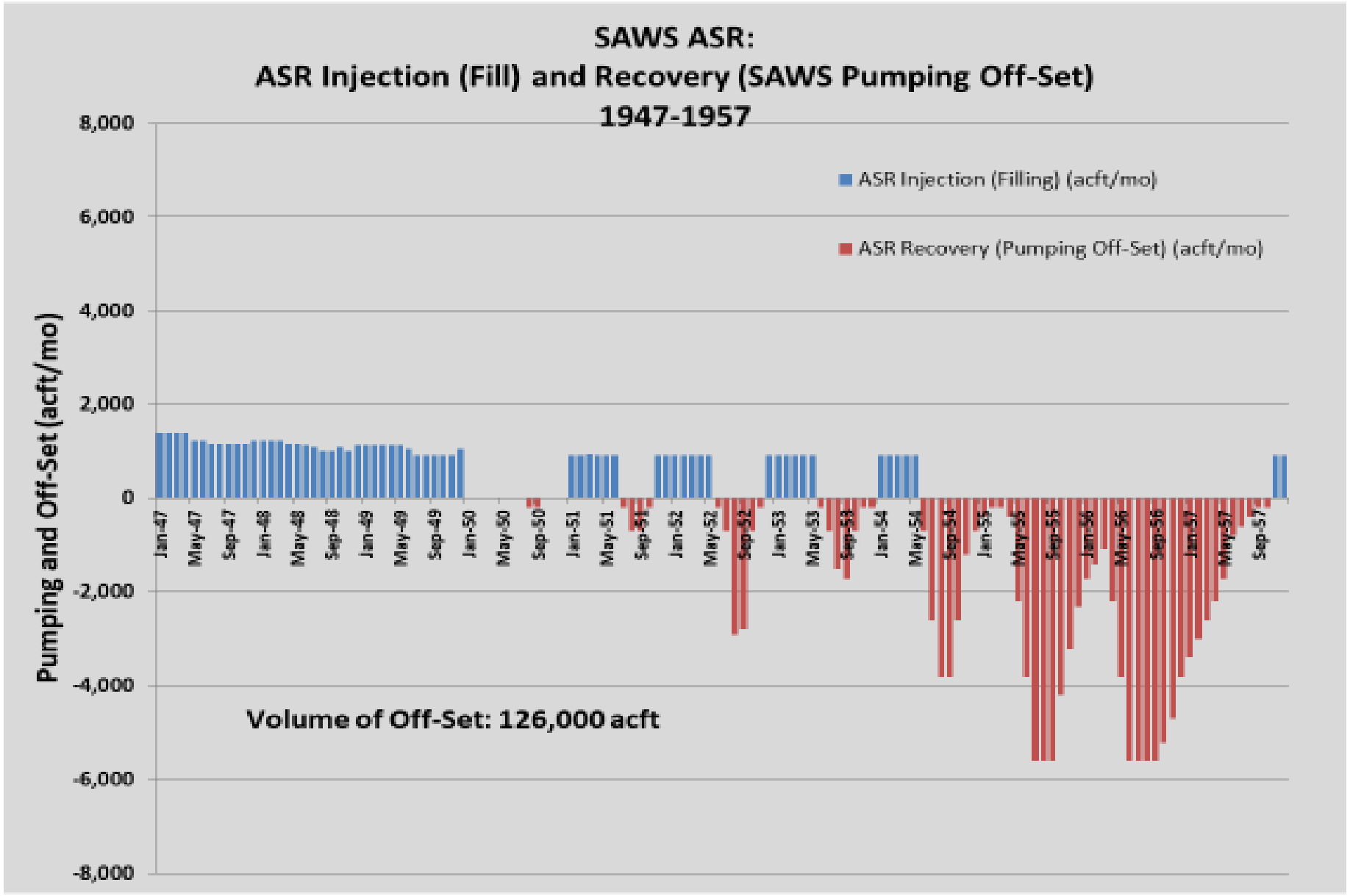
SAMP Runs. Model Runs 3 and 4 - ASR

- SAWS ASR activities for springflow protection are divided into:
  - SAWS forbearance and injection activities
  - EAA forbearance activities

SAMP Runs. Model Runs 3 and 4 - ASR

SAWS ASR forbearance and injection – Interlocal contract

- Volume: 126,000 ac-ft. Set by HCP.
- Distribution: The SAWS forbearance portion will be modeled by reducing pumping at 4 individual pump stations on the northeast side of the SAWS distribution system in an amount that on a monthly basis equals the amount of EAHCP water available from the ASR.
- Assumptions: begin the DOR with 126,000 ac-ft and no injection into ASR during the drought. Otherwise implemented as HDR.


SAWS ASR:
ASR Injection (Fill) and Recovery (SAWS Pumping Off-Set)
1947-1957
Pumping and Off-Set (acft/mo)
8,000
6,000
4,000
2,000
0
-2,000
-4,000
-6,000
-8,000
ASR Injection (Filling) (acft/mo)
ASR Recovery (Pumping Off-Set) (acft/mo)
Jan-47
May-47
Sep-47
Jan-48
May-48
Sep-48
Jan-49
May-49
Sep-49
Jan-50
May-50
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Jan-56
May-56
Sep-56
Jan-57
May-57
Sep-57
Volume of Off-Set: 126,000 acft

SAMP Runs. Model Runs 3 and 4 - ASR

EAA ASR forbearance – ASR AMP

- Volume: 50,000 ac-ft/yr
- Distribution: based on current leases and VISPO program
- Assumptions: enrollment for irrigators is similar to VISPO and Muni/Industrial is similar to existing 1-yr ASR leases

EAA ASR Forbearance

County	ac-ft %	Total ac-ft
Atascosa	3.65%	375.00
Bexar	38.58%	3,959.93
Medina	41.88%	4,298.69
Uvalde	15.88%	1,629.88
	100.00%	10,263.50

Long-Term ASR leases actual distribution

County	ac-ft %	Total ac-ft
Atascosa	0.0%	0.0
Bexar	6.00%	1,784.19
Hays	0.0%	0.0
Medina	28.53%	8,485.31
Uvalde	65.47%	19,467.00
	100.00%	29,736.50

Assumed ASR Irrigation leases based on VISPO distribution

County	ac-ft %	Total ac-ft
Bexar	51.59%	5175.69
Comal	28.00%	2784.89
Hays	0.01%	1.4
Medina	4.40%	439.57
Uvalde	16.00%	1598.45
	100.00%	10,000.00

Assumed ASR Muni/Industrial leases based on distribution of 1-yr ASR leases of those types

SAMP Runs. Model Runs 3 and 4 - RWCP

- Volume: 10,000 ac-ft/yr
- Distribution: Based on current distribution of program.
- Assumptions:

County	Use	ac-ft %	Total ac-ft
Bexar	Municipal	99.43%	9,943.00
Uvalde	Municipal	0.57%	57.00
		100.00%	10,000.00

Stage V critical period

- Stage V critical period requires a 44% reduction in permitted use and applies to both San Antonio and Uvalde pools.

TRIGGER (based on 10-day average)	CRITICAL PERIOD STAGE I	CRITICAL PERIOD STAGE II	CRITICAL PERIOD STAGE III	CRITICAL PERIOD STAGE IV	CRITICAL PERIOD STAGE V
Index Well J-17 Level (MSL)	<660	<650	<640	<630	<625
San Marcos Springs Flow (CFS)	<96	<80	N/A	N/A	N/A
Comal Springs Flow (CFS)	<225	<200	<150	<100	<45/40*
Withdrawal Reduction	20%	30%	35%	40%	44%

Uvalde Pool

The Uvalde Pool enters Critical Period at Stage II based on the 10-day average of aquifer level readings at the J-27 Index Well in Uvalde County.

TRIGGER (based on 10-day average)	CRITICAL PERIOD STAGE I	CRITICAL PERIOD STAGE II	CRITICAL PERIOD STAGE III	CRITICAL PERIOD STAGE IV	CRITICAL PERIOD STAGE V
Index Well J-27 Level (MSL)	N/A	<850	<845	<842	<840
San Marcos Springs Flow (CFS)	N/A	N/A	N/A	N/A	N/A
Comal Springs Flow (CFS)	N/A	N/A	N/A	N/A	N/A
Withdrawal Reduction	N/A	5%	20%	35%	44%

SAMP Expanded Phase I CMs and/or Phase II CMs. Model Run 5

- These model simulations will be conducted if springflow shortfalls still exist after analysis of SAMP Runs (Runs #3 and #4). The purpose of these runs would be to examine springflows under a different set of springflow conservation measures than currently exist in Phase I of the EACHP.

Pumping

- *Total Pumping:*
  - HDR EARIP Modeling = 593,240 acft
    - 573,037 (permitted) + 6,907 (federal) + 13,296 (domestic/livestock)
  - SAMP Modeling = 592,454 acft
    - 572,000 (permitted) + 6,000 (federal) + 54 (LPW) + 14,400 (domestic/livestock)

Pumping – Federal Exempt

HDR Modeling: 6,907 ac-ft/yr

SAMP pumping: 6,000 ac-ft/yr

Year	JBSA ac-ft	Hays ac-ft	Uvalde ac-ft	Total Reported
2007	6,714	193	0	6,907
2008	6,714	193	0	6,907
2009	4,483	309	169	4,961
2010	4,678	236	214	5,128
2011	5,160	195	28	5,383
2012	5,046	220	60	5,326
2013	-	195	209	404
2014	5,089	228	0	5,317
2015	-	230	0	230
2016	-	236	0	236
2017	-	254	-	254

Pumping – Limited Production Wells

New EAA program in 2014

SAMP pumping: 54 ac-ft/yr (average 2015-2017)

Year	Registered Wells	ac-ft
2014	57	9.859
2015	108	47.196
2016	124	61.958
2017	128	50.622

Pumping – Domestic and Livestock

HDR Modeling: 13,296 ac-ft/yr

SAMP pumping: 14,400 ac-ft/yr

Year	ac-ft
2010	13,600
2011	13,600
2012	13,700
2013	13,700
2014	13,900
2015	13,900
2016	13,900
2017	14,000