Use of Artesian Head as an Alternative DFC Metric/ Evaluation Tool

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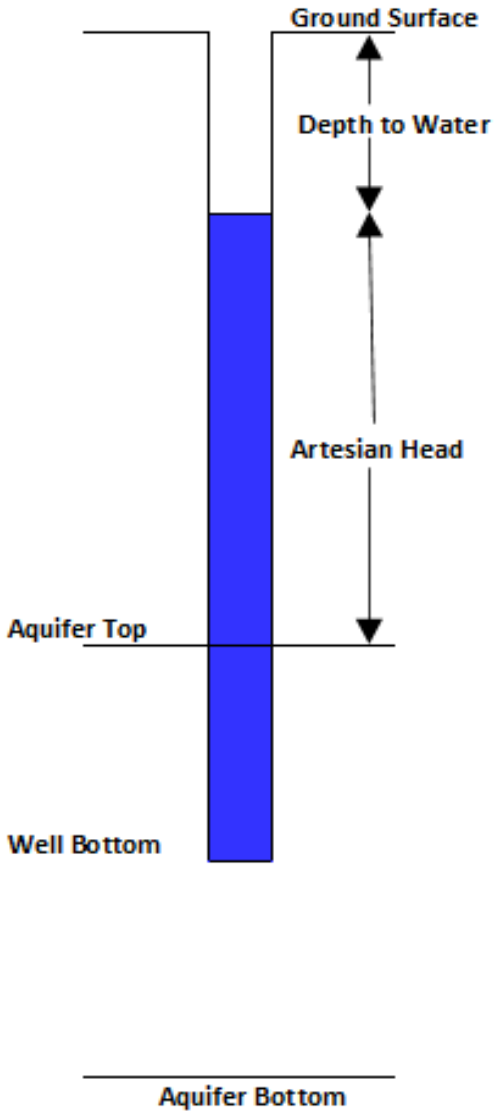
Lost Pines GCD Board Meeting

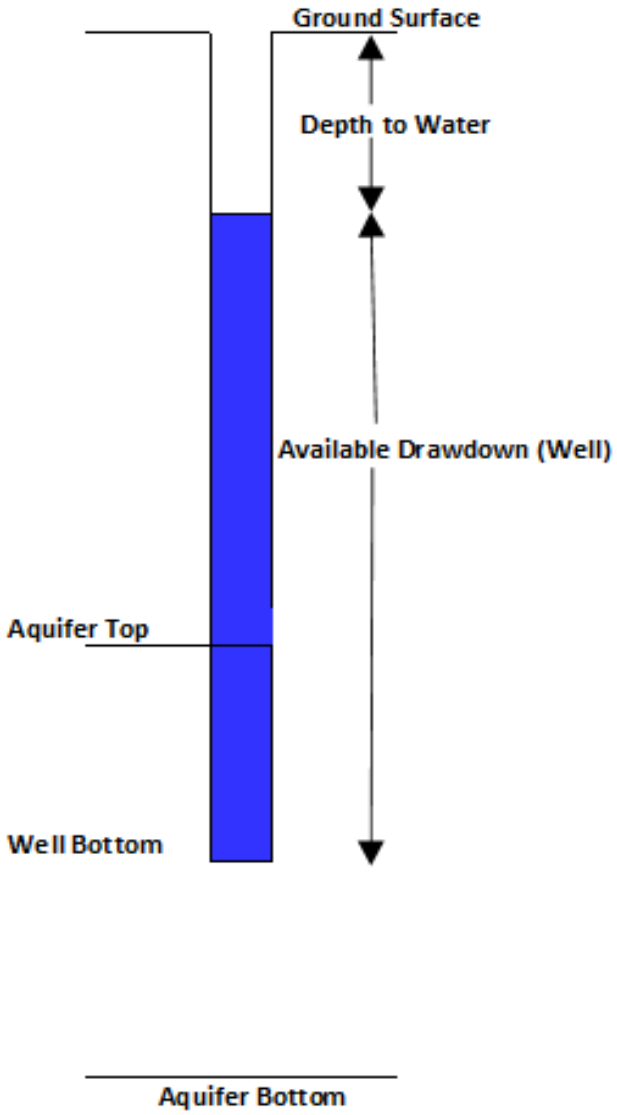
Alternative Ways to Evaluate GAM Results

- GAM output has been processed to calculate average drawdown over each GCD-aquifer unit
  - For example: LPGCD Simsboro DFC is 240 feet of average drawdown from 2011 to 2070
- Alternative calculations include:
  - Artesian Head
  - Available Drawdown (Well)
  - Available Drawdown (Aquifer)
- Please recall that GMA 14 used a well-based “available drawdown remaining” as a DFC metric in 2021

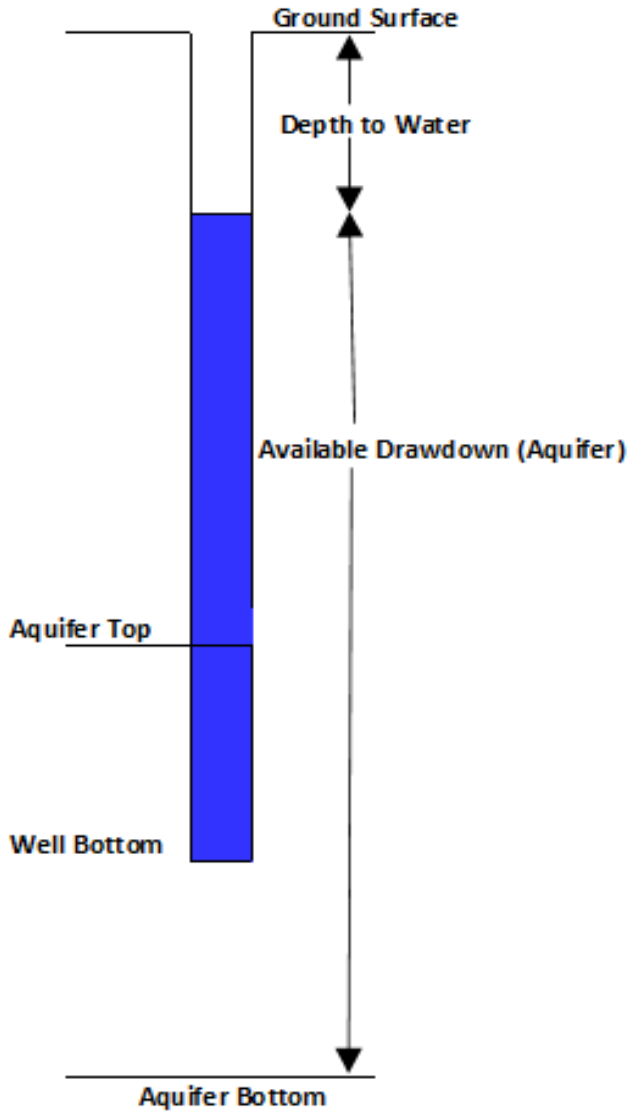
Artesian Head



Available Drawdown (Well)



Available Drawdown (Aquifer)



Available Drawdown (Well)

- Requires a database of wells with locations and depths to apply
  - LPGCD database was used to evaluate BVGCD permit simulation results
  - Good for LPGCD evaluation

Bluebonnet GCD Adoption of GMA 14 DFC

Table 1. Recommended BGCD-Specific DFCs
Based on GMA 14-Wide DFC: 70% Available Drawdown Remaining, One Foot Additional Average Subsidence, 30K Pumping Increase Limit, 2016 Pumping Distribution

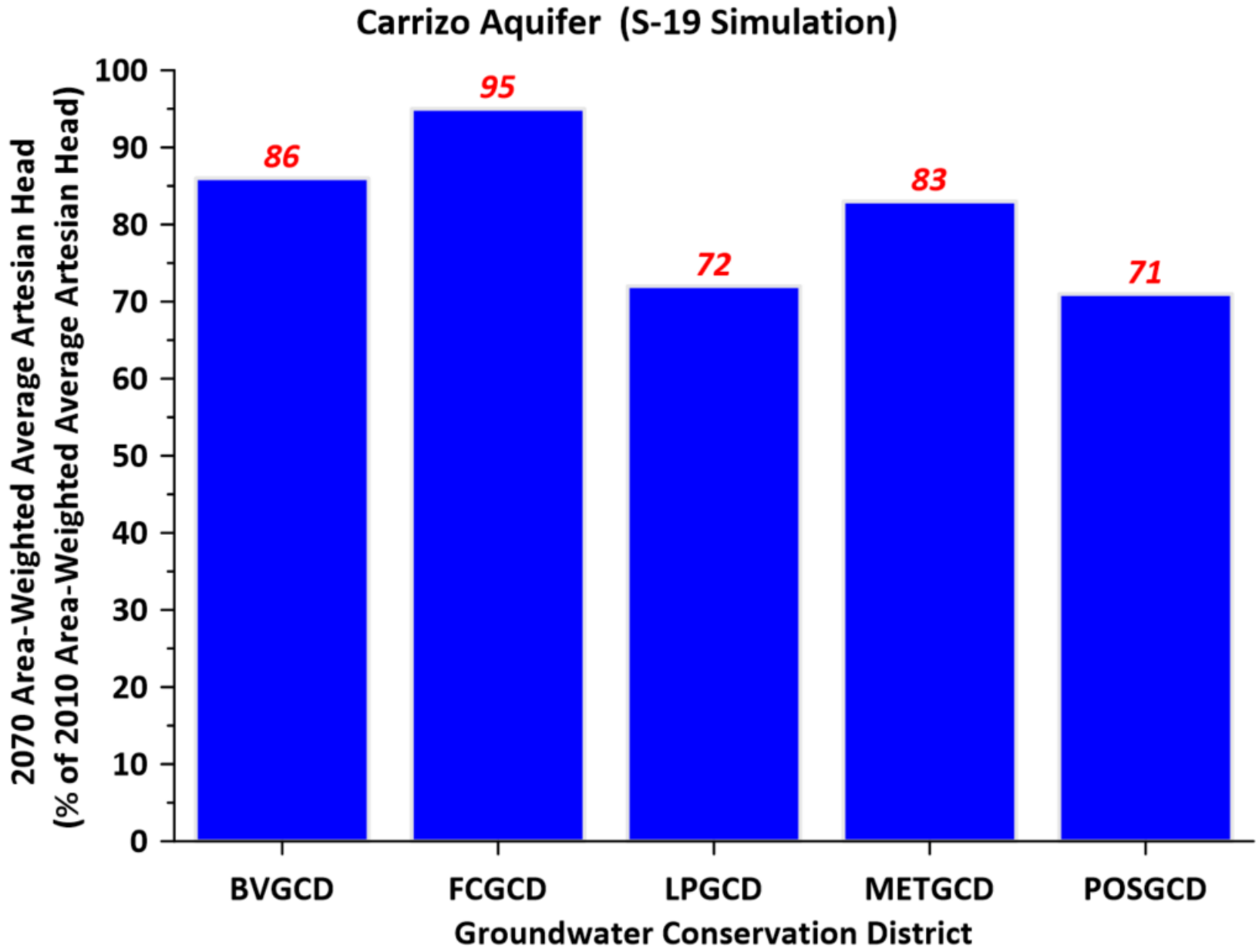
County	Aquifer	Recommended BGCD-Specific Desired Future Conditions		Expected Modeled Available Groundwater (Pumping in AF/yr from 2010 to 2080)
		Average Drawdown in ft from 2009 to 2080	Maximum Subsidence in ft from 1890 to 2080	
Austin	Chicot	54	3.39	2,892
	Evangeline	38		41,706
	Burkeville	39		0
	Jasper	165		1,971
Grimes	Chicot	35	0.25	0
	Evangeline	26		15,907
	Burkeville	26		0
	Jasper	147		35,546
Walker	Chicot	1	0.17	0
	Evangeline	16		3,141
	Burkeville	7		0
	Jasper	96		39,279
Waller	Chicot	50	5.39	791
	Evangeline	59		54,336
	Burkeville	60		0
	Jasper	218		329

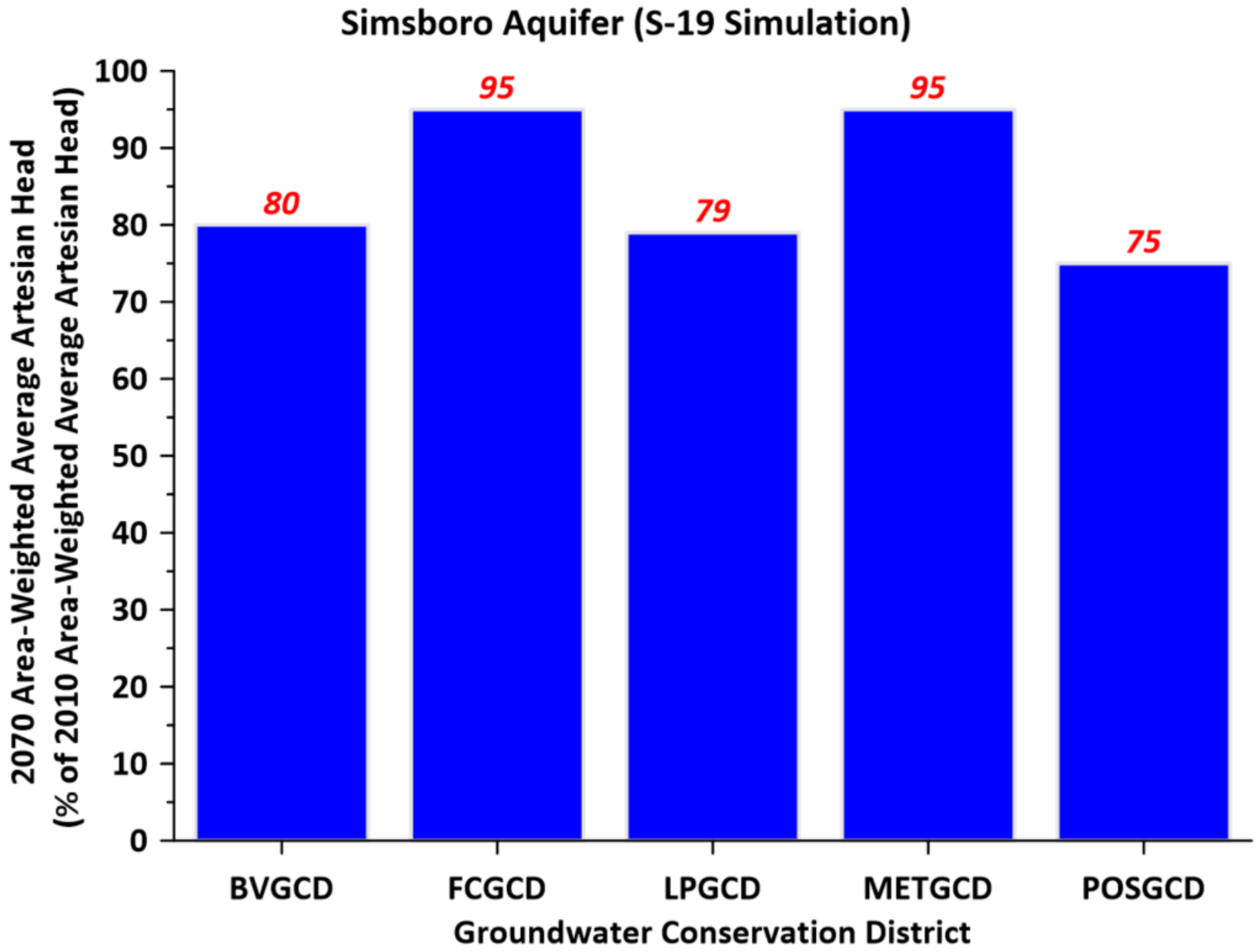
Available Drawdown (Aquifer)

- Can be applied for all areas of GMA 12 with GAM
- Implicitly assumes that portions of the aquifer below existing wells have the same characteristics (transmissivity and water quality)

Artesian Head

- Can be applied to all areas of GMA 12 with GAM
- Potential approach to evaluate DFCs and apply balancing test
- Calculated area-weighted artesian head for each cell organized by GCD-aquifer units
  - S-19 simulation (basis for 2021 DFC)
  - S-19 simulation plus Brazos Valley GCD permit approvals
  - Impact of turning off permitted pumping in LPGCD
- Summarized by Aquifer and GCD
  - Report = Complete Set
  - Presentation = Selected


Carrizo Aquifer (S-19 Simulation)
2070 Area-Weighted Average Artesian Head
(% of 2010 Area-Weighted Average Artesian Head)
100
90
80
70
60
50
40
30
20
10
0
86
95
72
83
71
BVGCD
FCGCD
LPGCD
METGCD
POSGCD
Groundwater Conservation District


Simsboro Aquifer (S-19 Simulation)
2070 Area-Weighted Average Artesian Head
(% of 2010 Area-Weighted Average Artesian Head)
100
90
80
70
60
50
40
30
20
10
0
80
95
79
95
75
BVGCD
FCGCD
LPGCD
METGCD
POSGCD
Groundwater Conservation District

Compare to Registered-Well Based Artesian Head

- Carrizo (Layer 7):
  - 158 registered downdip wells
  - 11 wells with negative artesian head in 2010
  - 23 well with positive artesian head in 2010, negative artesian head in 2070
  - Average artesian head in 2070 in 147 wells with positive artesian head in 2010 = 50% of 2010 artesian head (compare to 72% of all LPGCD Carrizo cells in GAM)
- Simsboro (Layer 9):
  - 208 registered downdip wells
  - 5 wells with negative artesian head in 2010
  - 38 well with positive artesian head in 2010, negative artesian head in 2070
  - Average artesian head in 2070 in 203 wells with positive artesian head in 2010 = 58% of 2010 artesian head (compare to 79% of all LPGCD Simsboro cells in GAM)

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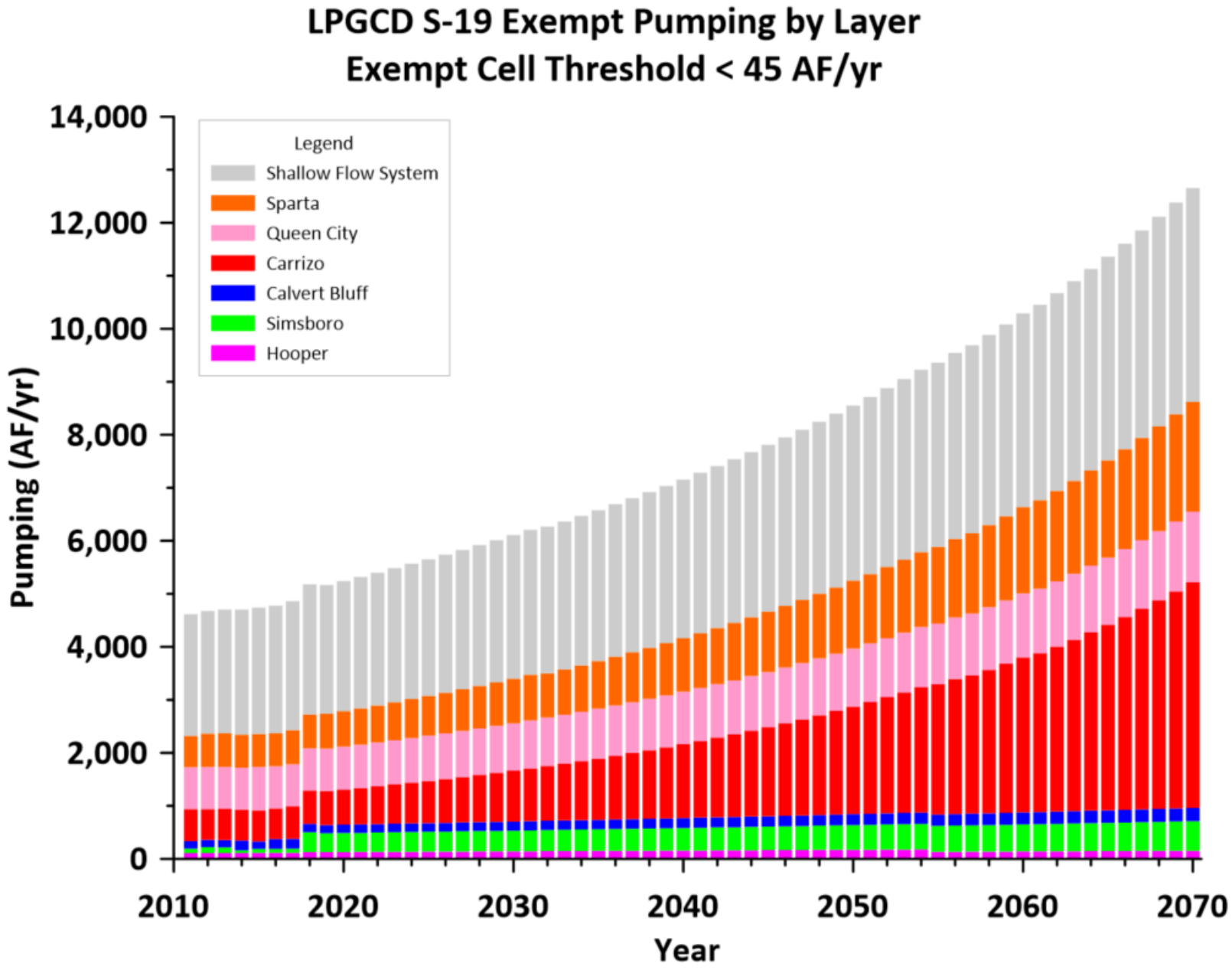
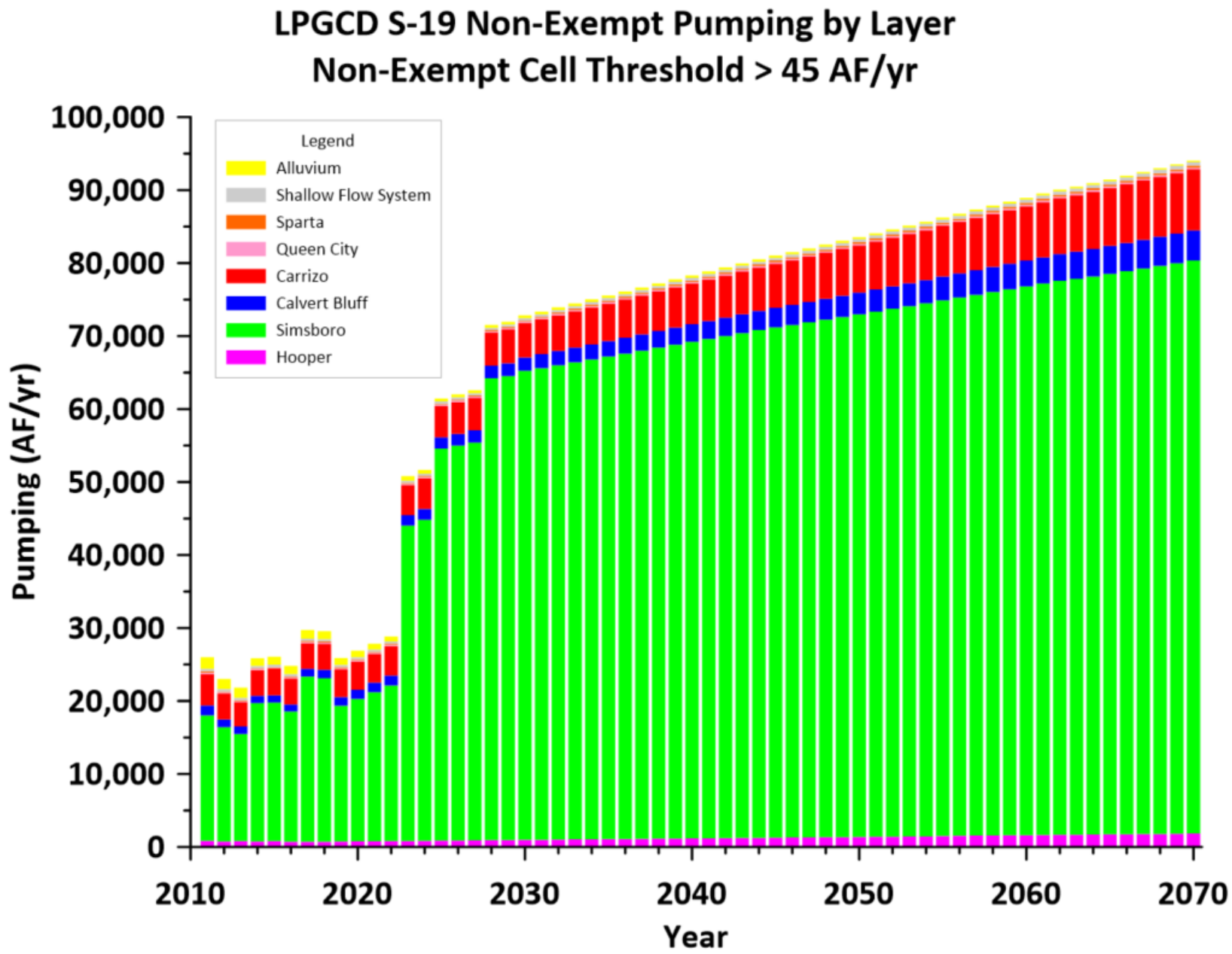
Sensitivity Simulations

- Scenario 1 = S-19 (base case)
- Scenario 2 = all non-exempt pumping in LPGCD = 0 (only exempt pumping included), all other pumping = S-19
- Scenario 3 to 8 = all non-exempt pumping in LPGCD ***layer*** = 0 (only exempt pumping included), all other pumping = S-19
  - Scenario 3 = ***Sparta***
  - Scenario 4 = ***Queen City***
  - Scenario 5 = ***Carrizo***
  - Scenario 6 = ***Calvert Bluff***
  - Scenario 7 = ***Simsboro***
  - Scenario 8 = ***Hooper***

Non-Exempt or Permitted Pumping

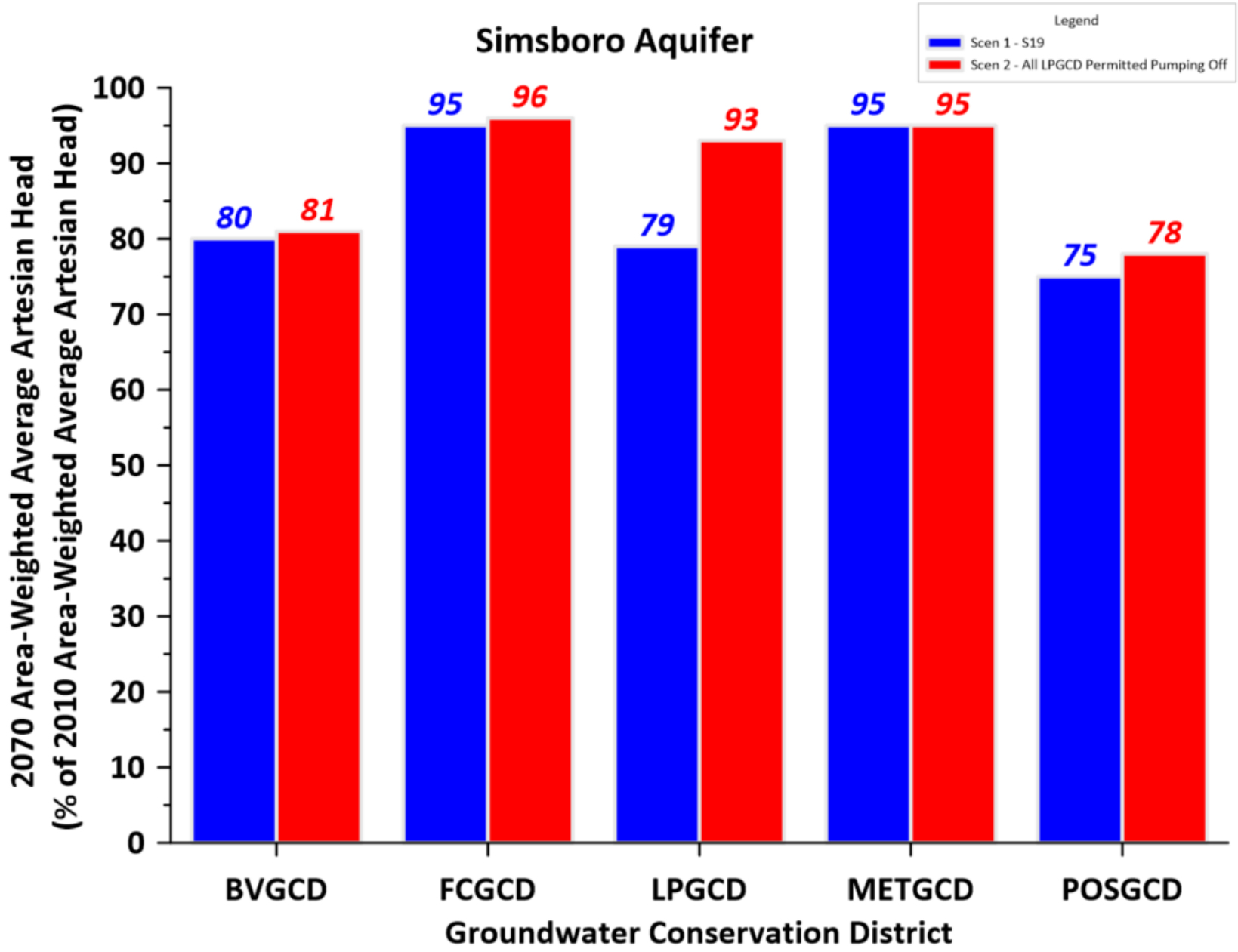
- LPGCD database of registered wells
- Non-exempt well locations were matched with S-19 pumping locations
  - Assumed that Total Pumping – Non-Exempt Pumping would equal exempt pumping
  - Unsatisfactory results (too much exempt pumping relative to total pumping for nearly all layers)
  - Need to address with an updated S-19 (separate task)
- Alternative approach:
  - If pumping in a cell > 45 AF/yr, assume non-exempt
  - If pumping in a cell < 45 AF/yr, assume exempt
  - Layer by layer results in report


LPGCD S-19 Exempt Pumping by Layer
Exempt Cell Threshold < 45 AF/yr
Legend
Shallow Flow System
Sparta
Queen City
Carrizo
Calvert Bluff
Simsboro
Hooper
Pumping (AF/yr)
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2010
2020
2030
2040
2050
2060
2070
Year


LPGCD S-19 Non-Exempt Pumping by Layer
Non-Exempt Cell Threshold > 45 AF/yr
Legend
Alluvium
Shallow Flow System
Sparta
Queen City
Carrizo
Calvert Bluff
Simsboro
Hooper
Pumping (AF/yr)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2010
2020
2030
2040
2050
2060
2070
Year

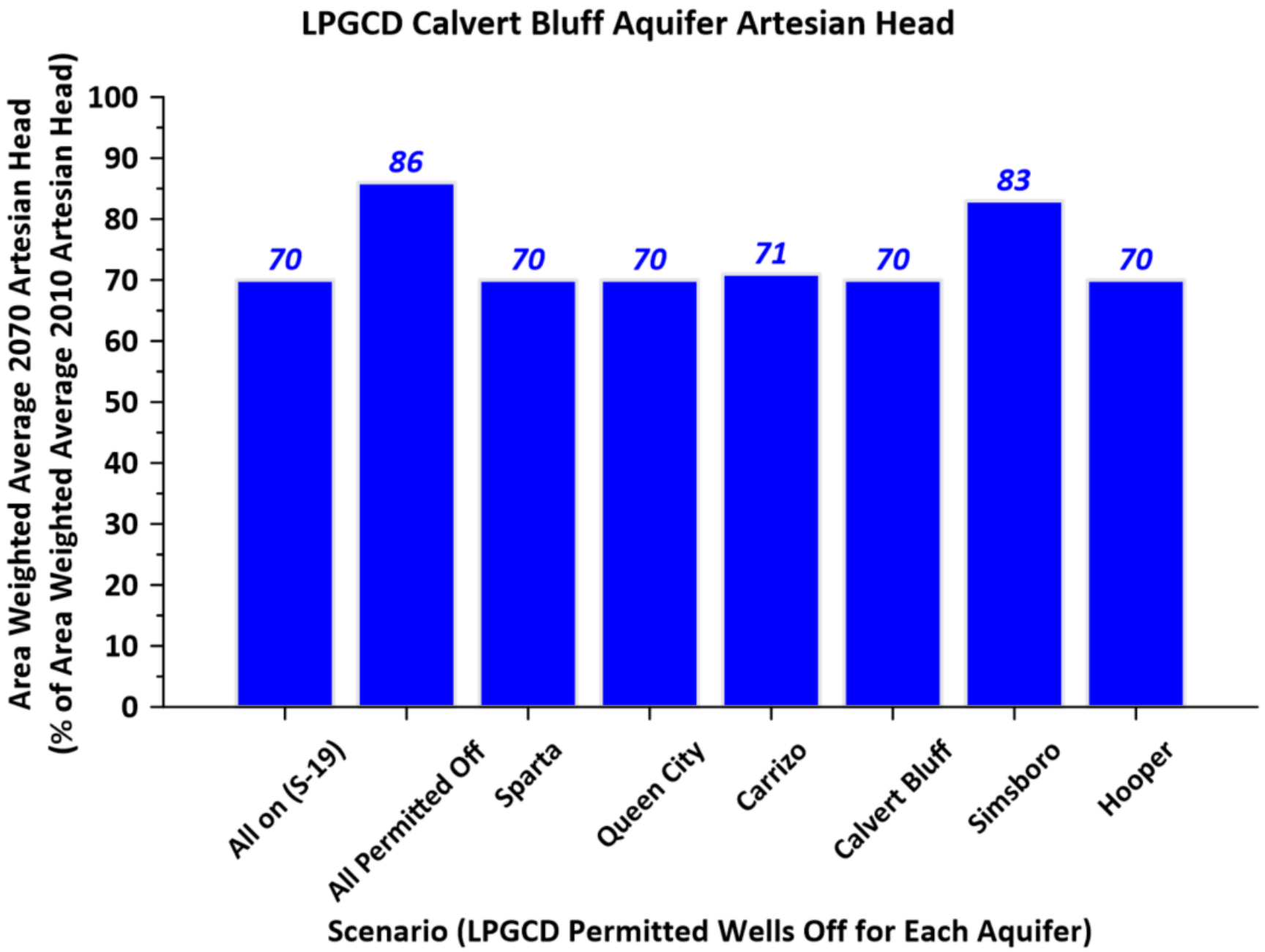
Compare 2070 Artesian Head for Scenarios 1 and 2

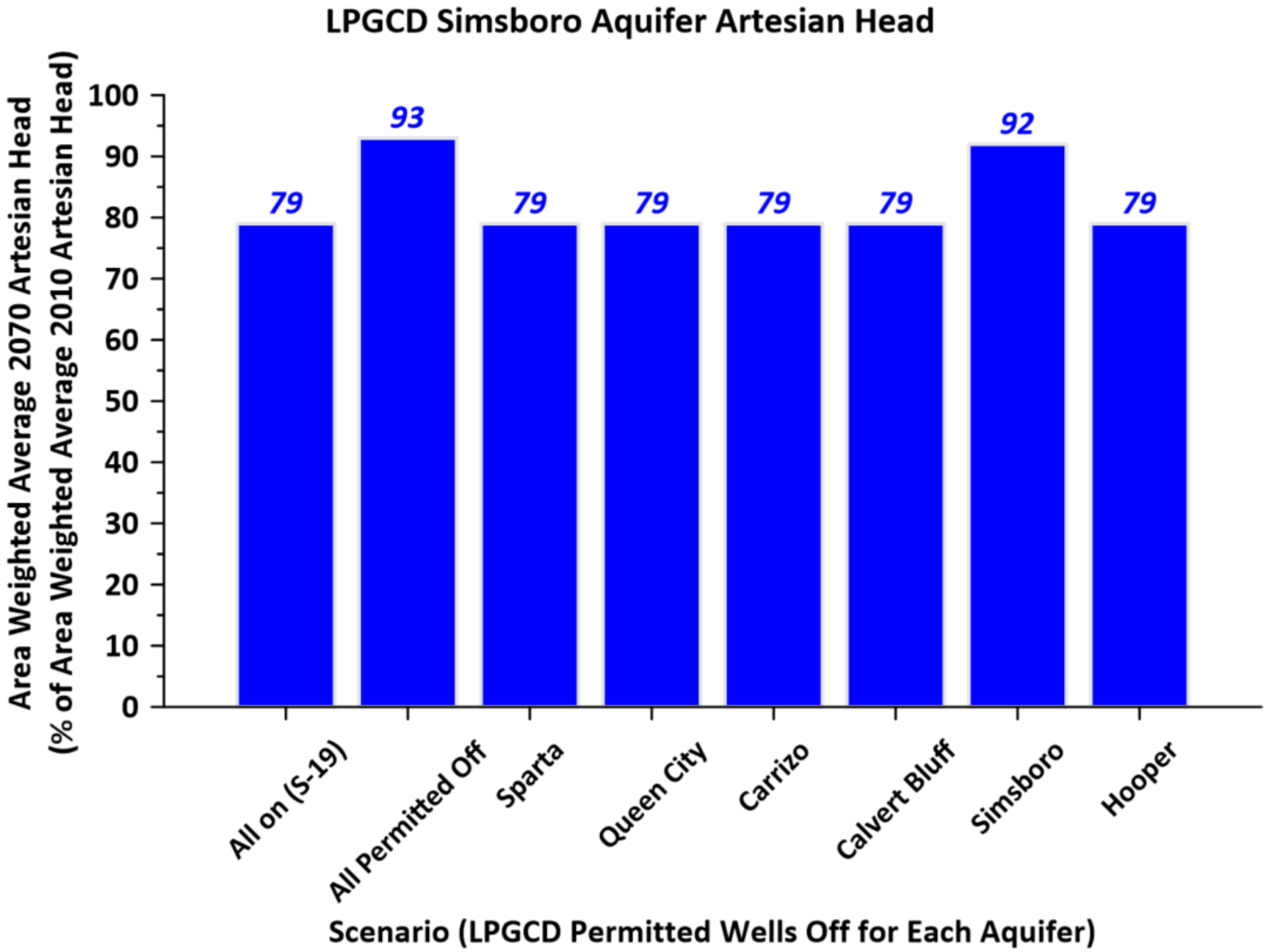
- Scenario 1 = S-19
  - 2070 LPGCD simulation pumping = 106,694 AF/yr
- Scenario 2 = All LPGCD non-exempt pumping =0
  - 2070 LPGCD simulation pumping = 12,656 AF/yr


Simsboro Aquifer
Legend
Scen 1 - S19
Scen 2 - All LPGCD Permitted Pumping Off
2070 Area-Weighted Average Artesian Head
(% of 2010 Area-Weighted Average Artesian Head)
100
90
80
70
60
50
40
30
20
10
0
80
81
95
96
79
93
95
95
75
78
BVGCD
FCGCD
LPGCD
METGCD
POSGCD
Groundwater Conservation District

LPGCD Results for Each Aquifer for All Scenarios

- Evaluate impact of reducing LPGCD pumping in one layer on artesian head in overlying and/or underlying layers


LPGCD Calvert Bluff Aquifer Artesian Head
Area Weighted Average 2070 Artesian Head
(% of Area Weighted Average 2010 Artesian Head)
100
90
80
70
60
50
40
30
20
10
0
70
86
70
70
71
70
83
70
All on (S-19)
All Permitted Off
Sparta
Queen City
Carrizo
Calvert Bluff
Simsboro
Hooper
Scenario (LPGCD Permitted Wells Off for Each Aquifer)


LPGCD Simsboro Aquifer Artesian Head
Area Weighted Average 2070 Artesian Head
(% of Area Weighted Average 2010 Artesian Head)
100
90
80
70
60
50
40
30
20
10
0
79
93
79
79
79
79
92
79
All on (S-19)
All Permitted Off
Sparta
Queen City
Carrizo
Calvert Bluff
Simsboro
Hooper
Scenario (LPGCD Permitted Wells Off for Each Aquifer)

Observations

- Highlights connection of components of Wilcox Aquifer
  - Calvert Bluff
  - Simsboro
  - Hooper
- Provides a baseline of LPGCD impacts vs impacts from other GCDs