R W HARDEN &ASSOCIATES INC
GROUNDWATER RESOURCE PROFESSIONALS
9009 Mountain Ridge Dr • Suite 100 • Austin Texas 78759 • ph (512) 345-2379

July 1st, 2026

Kelley Cochran
Groundwater Management Area No. 13 (GMA-13)
P.O. Box 1221
Seguin, Texas 78156

Re: Comments on the Proposed Desired Future Conditions/Modeled Available Groundwater (DFC/MAG) Scenario 26-17

Dear Ms. Cochran,

R. W. Harden & Associates, Inc. (RWH&A) has performed an evaluation of model Scenario 26-17 that was adopted by GMA-13 in April 2026, which is to be used in the development of new DFCs. Scenario 26-17 is comprised of a MODFLOW pumpage input file that is incorporated in the newly adopted Southern Carrizo-Wilcox-Queen City, Sparta Groundwater Availability (GAM) to predict aquifer responses through 2080.

Our evaluation focused on the predicted Carrizo aquifer response in the northern portion of the model domain, which includes the Evergreen Underground Water Conservation District (EUWCD), the Gonzales County Underground Water Conservation District (GCUWCD), the Guadalupe County Groundwater Conservation District (GCGCD), and the Plum Creek Conservation District (PCCD). Our primary findings are:

1) **Poor Aquifer Outcrop Accuracy** - The GAM performs poorly in areas where significant pumpage occurs in or near aquifer outcrop areas and should not be used to evaluate potential future declines in outcrop saturated thickness as defined by the current DFCs.

2) **Low ARWA/GBRA Pumpage** - The Carrizo pumpage included in Scenario 26-17 for the Alliance Regional Water Authority (ARWA) and Guadalupe Blanco River Authority (GBRA) well field region in southern Caldwell and northern Gonzales counties is approximately 7,840 acre-feet per year (acft/yr), which is about 25% of the 31,320 acft/yr that those entities will begin producing by 2030. Underrepresentation of production from these well fields results in artificially low simulated drawdown and MAG estimates.

3) **Low CRWA Pumpage** - The Carrizo pumpage included in Scenario 26-17 for the Canyon Regional Water Authority (CRWA) well field area in eastern Guadalupe and western Gonzales counties is approximately 5,000 acft/yr, which is about 41% of the 12,080 acft/yr that CRWA will produce by 2030. Underrepresentation of this well field artificially decreases the potential DFC limits and lowers corresponding MAG estimates.

The following sections provide discussions of the evaluation findings and recommendations. RWH&A used the two GAM simulations provided by GMA-13's hydrogeological consultant Dr. William Hutchinson:

- **Historical Simulation.** This GAM version includes recorded annual pumpage amounts over the interval 1980 through 2017 and was used to determine the accuracy of the new model's predictions. This GAM version was developed over the past several years and was adopted by the Texas Water Development Board (TWDB) and GMA-13 in early 2026 for use in regional water planning efforts.
- **Scenario 26-17 Historical/Predictive Simulation.** This scenario incorporates constant well pumpage (as provided by the GMA-13 member districts) over the interval 2018 through 2080.

In order to evaluate changes from the currently adopted DFCs, which are defined from a starting point at the end of 2012, RWH&A concatenated the two versions of the GAM into one simulation extending from 1980 through 2080.

POOR SIMULATED AQUIFER OUTCROP RESPONSE

Comparison of measured water levels with outputs from the recently adopted GAM indicates that the model performs poorly in aquifer outcrop areas located near significant pumpage centers. Specifically, inaccurate GAM predictions were noted in the outcrop near the ARWA, CRWA, and GBRA well fields. In those areas, the GAM shows widespread "dry" model cells where simulated water levels are below the bottom of the cells, while water level monitoring, conducted by both the GCUWCD and the GCGCD, indicates that the aquifer is saturated and has undergone relatively small declines over the last decade. Plate 1 shows the distribution of simulated dry cells at the beginning of the simulation (1980), current conditions (2026), and the end of the simulation (2080). The GCGCD Carrizo outcrop shows the greatest proportion of simulated dry cells, with dry conditions in approximately 22% of outcrop cells in 1980, 44% in 2026, and 62% in 2080. Similarly, simulated dry cells are widespread in the Carrizo outcrop in the northernmost portion of the GAM near the ARWA/GBRA well field area.

The current DFC limits allowable outcrop saturated thickness declines to a maximum of 25% in the interval between 2012 and 2080. In the GCGCD, the GAM results suggest that the saturated thickness decline between 2012 and 2026 of about 55%, while measurements from dedicated DFC monitoring sites indicate that the average decline over the past 13 years was approximately 10%. Stated another way, the GAM inaccurately simulates more than five times more drawdown than was observed in the GCGCD outcrop since 2012 and predicts that the DFC limits were surpassed several years ago.

In addition to simulated dry cells in areas known to be saturated, the GAM significantly overpredicts the water level declines (drawdown) near pumpage centers such as the CRWA well field, which straddles the Gonzales/Guadalupe county line southeast of Seguin, Texas. Plates 2 and 3 show hydrographs of measured and simulated water levels at sites monitored by the GCUWCD and the GCGCD. The blue points/lines plot the measured water level elevations at each monitoring site, while the heavy green line shows the water levels output from the current GAM with Scenario 26-17

pumpage, while the dashed green line shows the results of an additional simulation discussed below. At most sites, the simulated drawdown is significantly greater than measured drawdown. The greatest overprediction of drawdown occurs near the CRWA well field, with up to approximately 150 feet of excess simulated drawdown occurring at sites shown on Plate 2.

The excess simulated drawdown occurs because Dr. Hutchinson and GMA-13 chose to disregard numerous written comments provided by stakeholders during the GAM review process regarding the application of unreasonably low specific yield values, as well as many hydrogeological references. For example, the report distributed with the draft version of the GAM references the following in its discussion of specific yield:

Lohman, S. W., 1972, Ground-Water Hydraulics, Geologic Survey Professional Paper 708.

On page 8, Lohman writes: "the specific yield of most unconfined aquifers ranges from about 0.1 to about 0.3 and averages about 0.2.", which is consistent with other documented values for beds of unconsolidated quartz sand that comprise the majority of the aquifers modeled by the GAM. Evaluation of the current, final version of the GAM indicates that Dr. Hutchinson applied specific yield values that are significantly lower than suggested by Lohman and other hydrogeologic texts, with values ranging from 0.005 to 0.1 (unitless) in Carrizo outcrop areas.

The GAM calculates changes in water table levels in a model cell by calculating the difference in the volumes input and output from the cell. The volume of water in cells assigned a specific yield of 0.005 is approximately 40 times less than would result when using an established value of specific yield for sand-based aquifers. Consequently, the use of unrealistically low specific yield values results in significant overprediction of water table drawdown.

In order to provide perspective regarding the impact of specific yield on model accuracy, an alternate version of the GAM was generated for this evaluation that was identical to the adopted GAM (with Scenario 26-17 pumpage) except that a constant specific yield value of 0.2 was applied to the model layer representing the Carrizo (Layer 7). The results of this alternative GAM are plotted on the Plates 2 and 3 hydrographs as thinner, green, dashed lines labeled "WL Simulated (Sy = 0.2)". As shown, application of the increased specific yield values resulted in much stronger agreement between simulated and measured outcrop decline rates in areas near pumpage centers and a reduction in the occurrence of dry cells.

CONCLUSIONS AND RECOMMENDATIONS

The previous version of the GAM that was used during the last round of regional planning (2021) produced notoriously inaccurate results in outcrop areas. One of the primary incentives for constructing a new GAM was to improve the accuracy of outcrop predictions; however, both the occurrence of modeled dry cells and the overprediction of drawdown in the new GAM precludes its use as a useful tool for evaluation of future DFC outcrop saturated thickness declines and/or the current DFC drawdown limits near pumpage centers. Significantly increased simulation accuracy can be achieved through application of specific yield values that are consistent with available technical references. This change would greatly improve the GAM's usefulness in assessing potential outcrop DFC compliance. While the change can be made relatively rapidly and inexpensively, it could not be completed within this planning cycle's deadline; however, it is recommended that the GAM be

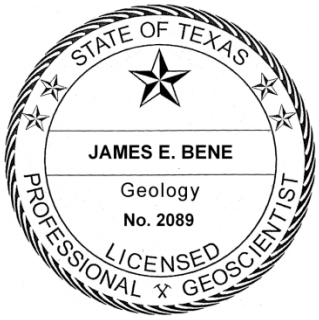
modified after this DFC/MAG planning cycle is complete so that it can be used to accurately assess potential aquifer responses to future pumpage in and near outcrop areas.

The Carrizo pumpage included in Scenario 26-17 for the ARWA, GBRA, and CRWA well fields is a fraction of what those entities will begin producing by 2030. Underrepresentation of these well fields will result in artificially low modeled drawdown and associated DFC limits. It is obvious that effective regional water planning and aquifer impact assessments require the inclusion of all permitted pumpage in the evaluation process for which the production, transmission, and treatment infrastructure exists or is currently under construction (as is the case for the ARWA, GBRA, and CRWA projects). The Scenario 26-17 pumpage inputs for these entities should be modified for consistency with the volumes that will be produced within the coming months.

Thank you for the opportunity to provide comments on the proposed DFC model/scenario, please let us know if we can provide additional information pertaining to the issues described above.

Sincerely,

James Bené, P.G.
R. W. Harden & Associates, Inc.



The seal appearing on this document was authorized by James E. Bené, P.G. 2089 on July 1st, 2026. R.W. Harden & Associates, Inc. TBPG Firm No. 50033.

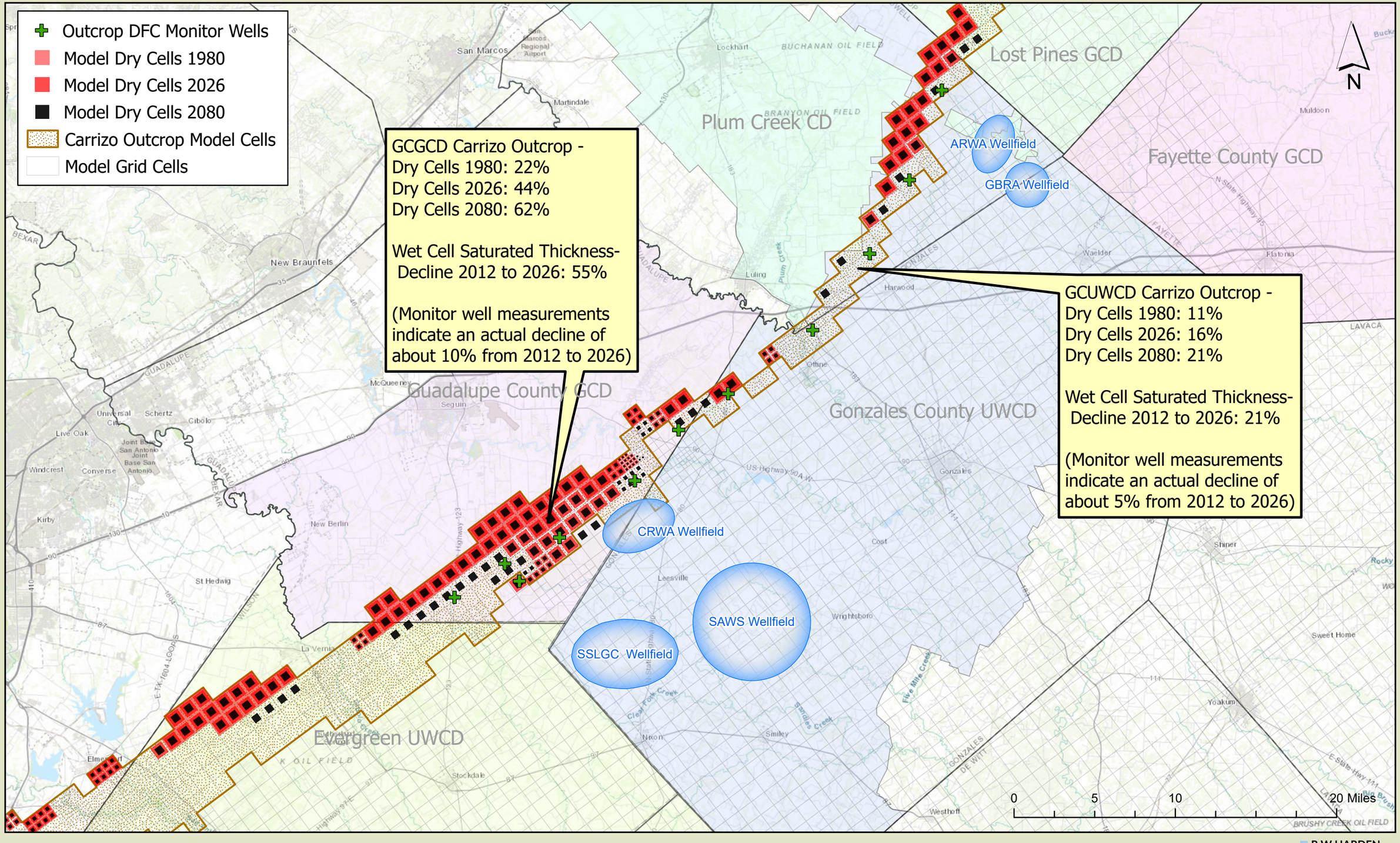


Plate 1. Simulated Carrizo (Layer 7) Outcrop Dry Cells and Saturated Thickness Declines

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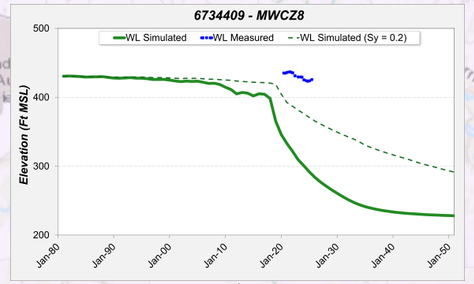
Carrizo Outcrop DFC Monitor Wells
Carrizo Outcrop Monitor Wells
Model Dry Cells 1980
Model Dry Cells 2026
Model Dry Cells 2080
Carrizo Outcrop Model Cells
Model Grid Cells

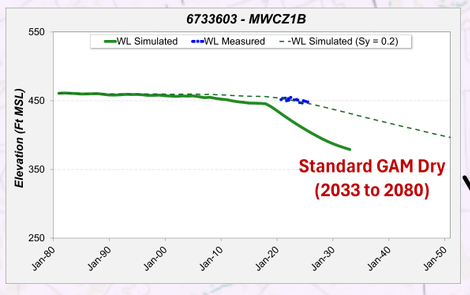
6727507 MWCZ-4
6727403 MWCZ-3
6726909 MWCZ-7
6735113 L180
6734301 J001
6734504 J002
6734601 B184
6735401 C054
6734409 MWCZ-8
6733603 MWCZ-1B
6733907 MWCZ-1A
6733805 MWCZ-2

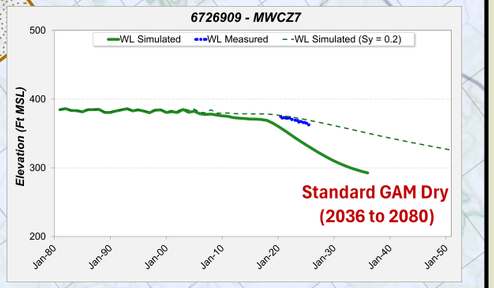
CRWA Wellfield

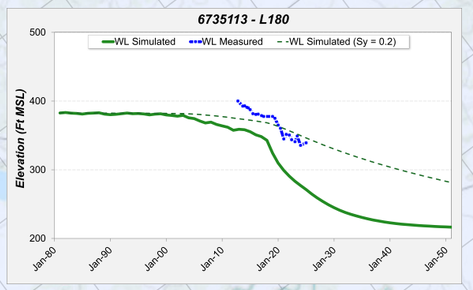
Guadalupe County GCD
Gonzales County UWCD

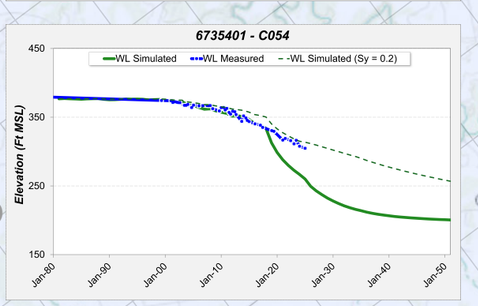
Nolte Island Recreation Area
Leesville
Cottonwood
Brushy Creek
Wrightsboro

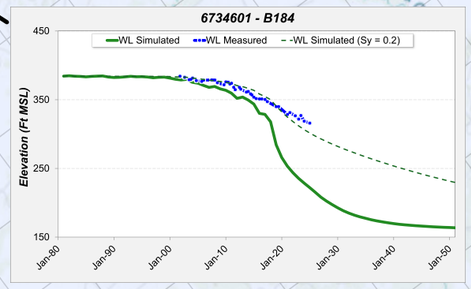


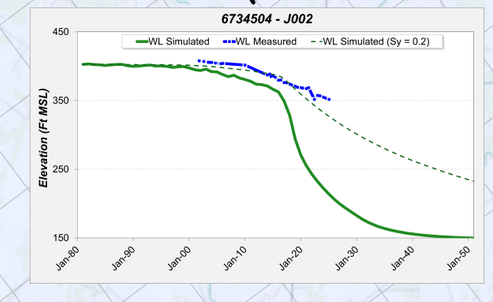


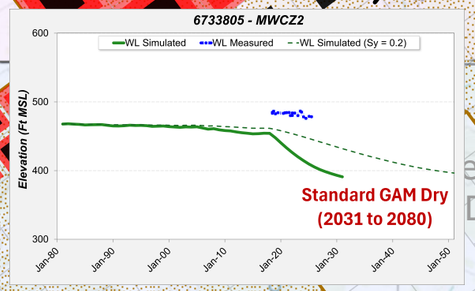


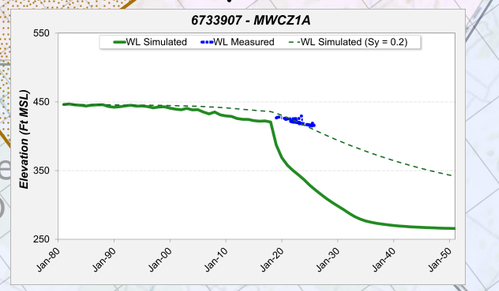












0 1 2 3 4 5 Miles

Plate 2. Measured versus Simulated Carrizo Outcrop Water Levels (Southwest Section)

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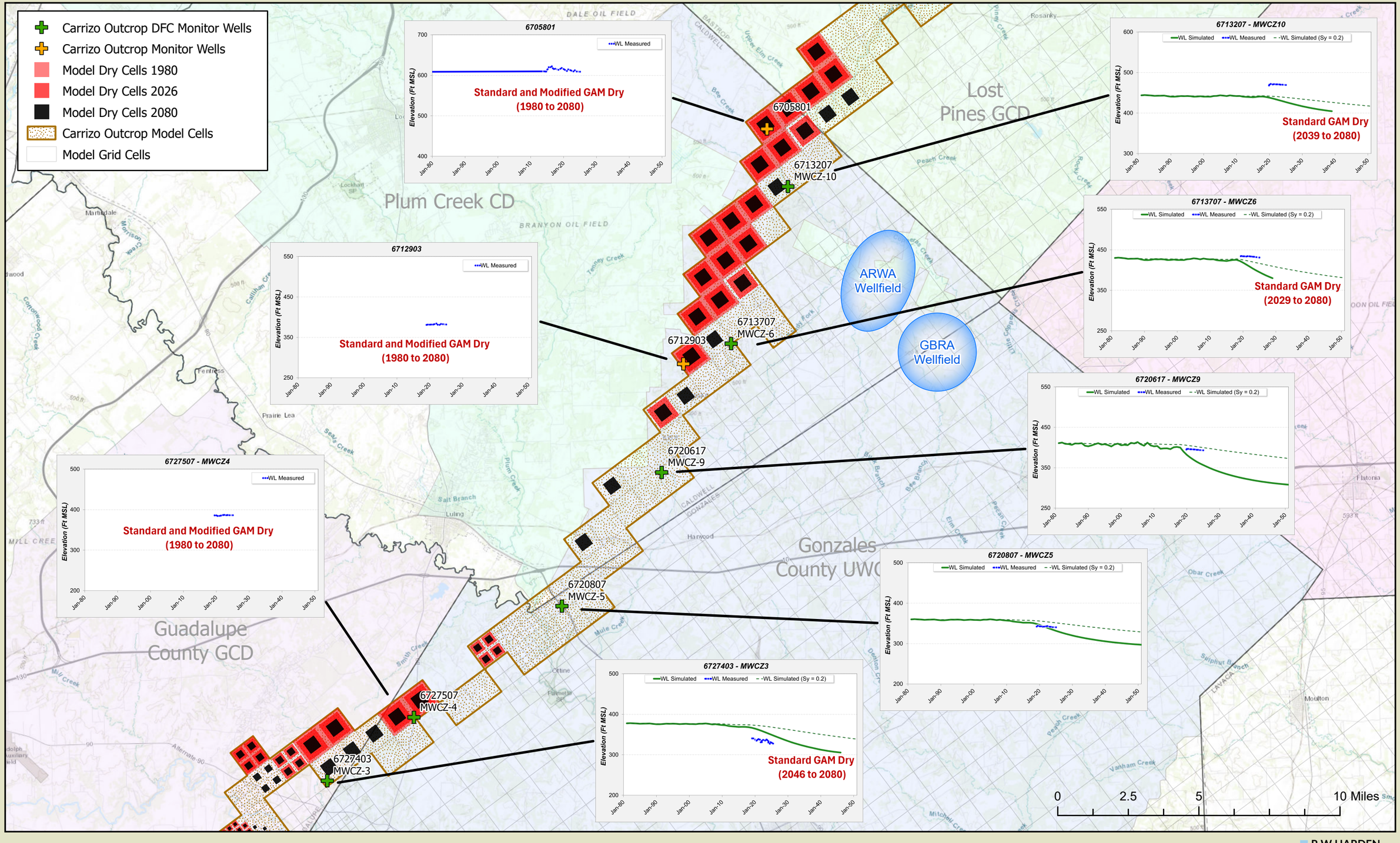

Plate 3. Measured versus Simulated Carrizo Outcrop Water Levels (Northeast Section)

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