Appendix D
Quantitative Climate Change Analysis

Technical Memorandum

Subject:	**Analysis of Climate Change Impact on Water Resources in the American River Basin (ARB) Region**
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1 Introduction

California's water resources are experiencing the effects of climate change. Climate change is expected to impact both the availability of, and demand for water supply. Climate change is also expected to impact the quantity and timing of precipitation and evapotranspiration. Local and regional aquifers are expected to be impacted as shortages in water deliveries and increases in demand for water force local water agencies to rely more on groundwater for municipal and agricultural uses.

This study presents the results of evaluation of the impacts of climate change on water resources in the American River Basin (ARB) Region through modeling and data gathering and analysis. The future reliability of the groundwater and surface water systems in the region under climate change conditions is evaluated using the hydrologic, surface water delivery, and climate change models of the area. Several models were needed to evaluate the impact of climate change in the area. A summary of these models are presented in the following sections.

The Sacramento Area Integrated Water Resources Model (SacIWRM) was used to evaluate the impacts of climate change on the water resources in the ARB Region. SacIWRM is an integrated hydrologic model that simulates the groundwater and surface water resources in the ARB Region from Bear River in the north to the Mokelumne River in the south. The model uses various input data, most significant of which from a water supply perspective are: precipitation, streamflows, land use, agricultural and urban water demand, surface water deliveries, groundwater production for beneficial use, remediation operations, and geologic and aquifer conditions.

This analysis combined information from the CalSIM and the climate change models along with the SacIWRM to assess the effects of global climate change on the ARB Region's surface water and groundwater resources. The results of this analysis will allow an assessment of the level of reliability of the groundwater and surface water facilities in the ARB Region. Specifically, changes in the streamflow and groundwater levels, as well as changes to groundwater storage will be evaluated in the context of the Water Forum Agreement and the Lower American River Flow Standard.

2 Scope of Work

This work was conducted in two phases as follows:

2.1 Phase 1 – Climate Change Data Development

The purpose of this phase was to develop climate change related data to be used for development of input data files for the SacIWRM model. Two available modeling efforts were used for development of the climate change related data. These modeling works are:

- CalSIM model run that includes surface water deliveries from the American and Sacramento rivers to local water agencies. CalSIM estimates are based on a single median future climate projection of 12 mid-century climate projections
- Downscaled global precipitation data from Max Plank Institute (MPI) of Meteorology's MPI-ECHAM5 global climate model run
- Variable Infiltration Capacity (VIC) model

These models were used to provide information regarding changes in precipitation and surface water flows.

Phase 1 work included development of climate change related time series data for use in the SacIWRM model of the ARB Region. The time series data were extracted from CalSIM, MPI-ECHAM5, and VIC models included the following:

- Precipitation Data
- Unimpaired flows to system reservoirs
- Reservoir releases
- Surface water deliveries

The smallest resolution of available data from the CalSIM and MPI-ECHAM5 models were extracted and included in Excel files for use in the SacIWRM model of the ARB Region. The deliverables for Phase 1 are excel files with climate change time series data.

2.2 Phase 2 – Climate Change Simulations

Phase 2 work consist of the following tasks:

Task 1 – Development of Baseline Conditions

A baseline simulation with a 100-year simulation time and with the future level of land and water use (2030 level of development) in the ARB Region was developed. This Future Condition Baseline was verified to ensure that it reflects the latest information on the projected water supply facilities, including the groundwater wells, remediation operations, water conservation assumptions, recycled water planned operations, and surface water deliveries throughout the model area. The Future Condition Baseline scenario was run assuming no climate change for comparison to simulations with climate change scenarios.

Task 2 – Global Climate Change Scenarios

To simulate the conditions of the basin under a single median future climate change projection, two scenarios were developed:

- Scenario 1 – Global Climate Change Scenario with Baseline Water Demand and Supplies
    - This scenario represents the conditions of the basin assuming that land and water use conditions stay as in the baseline. However, the hydrologic conditions, including streamflows, precipitation, reservoir operations, and surface water supplies will reflect those under the climate change scenario.

- Scenario 2 – Global Climate Change Scenario with Reduced Surface Water Deliveries
    - Scenario 2 is similar to Scenario 1with additional cuts in surface water deliveries. It was assumed that all of the surface water deliveries in the model area would decrease by 10% for the months that the unimpaired American River flows are below 2,000 cfs. The reductions in surface water deliveries were met by additional groundwater extraction.

Task 3 – Prepare Modeling Technical Memorandum(TM)
A TM documenting the assumptions, methodology, and results of work completed was prepared. The TM includes sub-regional summaries (representing water supply service areas) of impacts to supply and demand, groundwater elevations, and streamflows.

Task 4 – Project Management and Coordination
This subtask includes time for management and coordination of the project with RWA staff, as well as preparation of progress reports and invoices. The coordination included preparation for and attending meetings and conference calls with the project team members and stakeholders.

3 Climate Change Information Sources

There are numerous climate change studies available for water resources studies. However, this project is based on a recent climate change study of California Department of Water Resources (DWR) which is based on a single median future climate projection selected from 12 mid-century climate projections. DWR climate change study is presented in the following documents:

1) *Isolated and integrated effects of sea level rise, seasonal runoffs shifts, and annual runoff volume on California's largest water supply*. **Journal of Hydrology. 2011**. Authors: J. Wang, H. Yin, and F. Chung.
2) *Using future climate projections to support water resources decision making in California.* **Report from California Climate Change Center, 2009**. Prepared by California Department of Water Resources. Authors: Francis Chung and several DWR staff.
3) *The State Water Project Final Delivery Reliability Report 2011.* CalSIM-II studies for State Water Project (SWP) Delivery Reliability report of 2031 Future Conditions with and without climate change. Prepared by DWR in 2012.

Additionally, climate change information from California Applications Project[1] (CAP) of Climate Research Division of University of California, San Diego, was used for this project.

4 Models Used for Climate Change Study

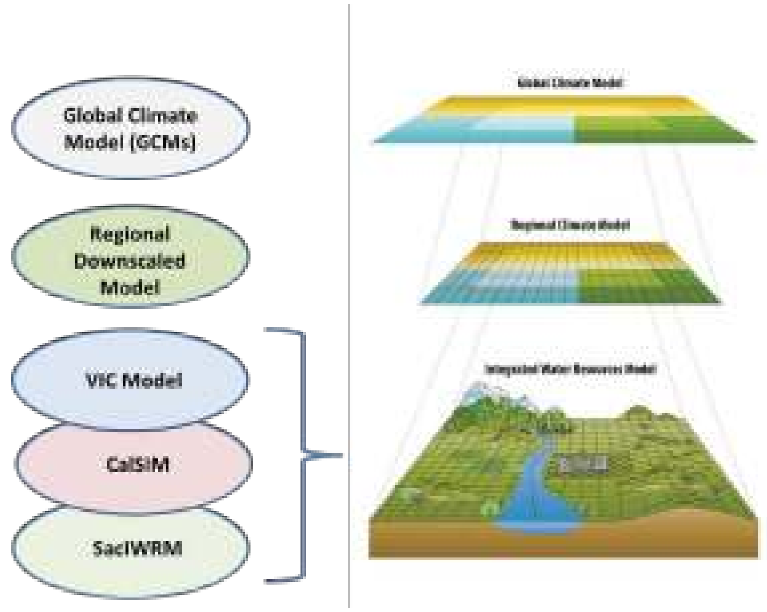
Climate change studies usually involve models at different scales, starting with global climate models (GCMs)[2] and gradually downscaling to local levels. The models used in this project are described below[3]:

- **Global Model** - DWR has used six different GCMs for climate change studies. MPI-ECHAM5[4] model generated the average future conditions of all six GCMs. MPI-ECHAM5 model was used for the SWP Delivery Reliability Report. GCMs simulate two future greenhouse gas (GHG)

[1] http:// meteora.ucsd.edu/cap/scen08_data.html
[2] GCMs are also called general circulation models.
[3] Figures are from second reference above.
[4] Max Planck Institute of Meteorology

emission scenarios of A2 (higher GHG emissions) and B1 (lower GHG emissions). A2 scenario was used for the SWP Delivery Reliability Report.

- **Regional Downscaling** - GCMs provide data at a coarse resolution of only about six grid points over all of California. Coarse-scale climate data (air temperature and precipitation) from the GCMs are converted to regional-scale data using statistical downscaling method. The regional data is at 1/8 degree (12 km x 12 km) resolution. The Bias Correction and Spatial Disaggregation or Downscaling (BCSD) method was used for this study.



Models used for evaluation of climate change impacts

- **Rainfall-Runoff Modeling** - A macro-scale hydrologic model called the Variable Infiltration Capacity (VIC) model, operating on a 1/8 degree grid and using downscaled GCM data, generates rainfall and snowmelt runoff. The VIC model routes the generated runoffs through river system model to obtain streamflows at 18 locations including North Fork of American River and American River at Folsom Lake.
- **Impact Analysis** - SWP and Central Valley Project (CVP) operation is simulated by CalSIM-II model. CalSIM-II uses observed historical inflows (1922-2003) to simulate the operation of SWP and CVP. A three-step perturbation method was used to modify the historical inflows of CalSIM-II to represent the climate change impacts (Appendix A). The perturbation ratios are the ratios between climate model-projected inflow for the future (2030-2059) and climate model-simulated inflow for the past (1961-1990).
- **Local Integrated Hydrolgic Modeling** – The SacIWRM was used as the local integrated hydrologic model to evaluate the impact of climate change on local water resources conditions in Sacramento area. SacIWRM has been used in the Sacramento region since 1992. This model has been used for evaluating land and water use plans, water supply alternatives, conjunctive use options, water quality conditions, and other surface water and groundwater planning. This climate change impact study is the latest application of SacIWRM. SacIWRM covers an area of 1,400 squiare miles in Sacramento area. This model simulates the daily hydrologic processes in the surface and subsurface environment as one integrated system. SacIWRM is calibrated for the 1970-2004 period. It includes a land and water use model that simulates the crop water use, evapotranspiration, infiltration, and unsaturated zone flow.

5 Assumptions

The future climate change impacts are expected to include changes in the quantity and timing of precipitation and evapotranspiration (ET). As the available data is not conclusive about future changes in ET, it was assumed that ET will not be impacted by climate change. Thus, the ET data sets were not changed in this study. However, agricultural irrigation water demand was estimated based on availability of rainfall.

6 Description of Climate Change Data

Several data files of SacIWRM were revised based on estimated impacts of future climate change. The revised data files include precipitation, stream inflow, reservoir releases, and surface water deliveries. Sources of climate change information and details of the changes made to the SacIWRM data files are described below.

6.1 Precipitation Data

Precipitation data for climate change conditions were obtained from the global climate change models. This data was used to revise the SacIWRM precipitation data files to represent the rainfall under climate change conditions. The sources of climate change precipitation data and the methodology for incorporation of this data in SacIWRM are discussed in the following subsections.

6.1.1 Precipitation Data Under Climate Change Conditions

Downscaled global precipitation data for Sacramento Area were downloaded from UC San Diego[5]. Global precipitation data has the following details:

- **Global Climate Model:** MPI-ECHAM5
- **Climate Change Scenario:** A2 (high emission)
- **Downscaling Method:** BCSD
- **Time Period :** Daily (1950 to 2099)
- **Data Scale:** 1/8 degree (~ 12 km x 12 km)

6.1.2 SacIWRM Precipitation Data Under Climate Change Conditions

The seventeen rainfall gauges used for the SacIWRM model were mapped to the closest climate change model grid cell center. SacIWRM precipitation data was adjusted with the downscaled global precipitation data for each rainfall gage using the three-step perturbation method described Appendix A. Downscaled global precipitation data from 1961 to 1990 was used as the historical conditions (no climate change) and data from 2030 to 2059 was used as the future conditions (climate change) for the three-step method. The long-term monthly average and 1970-2004 annual rainfall data for SacIWRM with and without climate change conditions are shown in Figures 1a and 1b. These two figures show the average conditions for all rainfall gages in SacIWRM model area. The annual rainfall in Sacramento model area is projected to decrease by an average of 7% (Figure 1a). However, the long-term average monthly rainfall is projected to increase in March (+17%) and December (+18%) under climate change conditions (Figure 1b).

6.2 Stream Inflows/Reservoir Releases

Stream inflows/reservoir releases data for climate change conditions were obtained from the CalSIM and VIC models. These data were used to revise the SacIWRM stream inflow data files so the model would represent the streamflows under climate change conditions. The sources of climate change streamflows data and the methodology for incorporation of this data in SacIWRM are discussed in the following subsections.

6.2.1 Stream Inflows/Reservoir Releases Data under Climate Change Conditions

Stream inflows and reservoir releases data are available for CalSIM and VIC models as discussed below.

[5] http:// meteora.ucsd.edu/cap/scen08_data.html

- **CalSIM** - CalSIM provides streamflow data for Sacramento River, American River, Cosumnes River, and Mokelumne River at different locations within the model area. The time resolution of the average flow data is monthly and is expressed in cfs from 1922 to 2003.
- **VIC** - VIC model provides streamflow data for Sacramento River, American River, North Fork American River, Feather River, Cosumnes River, and Mokelumne River in daily and monthly intervals from 1950 to 2099. Streamflow data is expressed in cfs.

6.2.2 SacIWRM Stream Inflows/ Reservoir Releases Data Under Climate Change Conditions

- **Sacramento River:** SacIWRM inflow data for Sacramento River at Verona was adjusted with the CalSIM flow data using the three-step perturbation method. CalSIM flow data for no climate change scenario was used as the past data (baseline, no climate change) and data from climate change scenario was used as the future data (scenario, climate change) for the three-step method. The long-term monthly average and 1970-2004 annual Sacramento River flows at Verona data for SacIWRM with and without climate change conditions are shown in Figures 2a and 2b. The annual Sacramento River flows are projected to decrease by an average of 1% (Figure 2a). However, the long-term average monthly streamflows are projected to increase in March (+2%), April (+1%), July (+4%), August (+8%) and October (+9%) under climate change conditions (Figure 2b).
- **American River:** SacIWRM inflow data for American River at Folsom Lake was adjusted with the CalSIM data for Folsom Lake releases using the three-step perturbation method. CalSIM release data for no climate change scenario was used as the past data (baseline, no climate change) and data from climate change scenario was used as the future data (scenario, climate change) for the three-step method. The long-term monthly average and 1970-2004 annual American River flow (releases from Folsom Lake) data for SacIWRM with and without climate change conditions are shown in Figures 3a and 3b. The annual releases from Folsom Reservoir is projected to decrease by an average of 8% (Figure 3a). However, the long-term average monthly reservoir releases is projected to increase in March (+17%), April (+6%) and October (+23%) under climate change conditions (Figure 3b).
- **Cosumnes River:** CalSIM does not have any flow data that can be used to estimate the Cosumnes River inflows for SacIWRM. CalSIM data consists of Cosumnes River flows at the point where it flows into the Mokelumne River. SacIWRM inflow data for Cosumnes River at Michigan Bar was adjusted with the flow data out of VIC model (at Michigan Bar) using the three-step perturbation method. VIC model flow data at Michigan Bar from 1961 to 1990 was used as the past data (baseline, no climate change) and data from 2030 to 2059 was used as the future data (scenario, climate change) for the three-step method. The long-term monthly average and 1970-2004 annual Cosumnes River flows at Michigan Bar data for SacIWRM with and without climate change conditions are shown in Figures 4a and 4b. The annual Cosumnes River flows are projected to decrease by an average of 9% (Figure 4a). However, the long-term average monthly Cosumnes River flows are projected to increase in December (+11%) under climate change conditions (Figure 4b).
- **Dry Creek, Deer Creek, Mokelumne River:** Neither CalSIM nor VIC has inflow data that can be used to adjust the inflow for Dry Creek, Deer Creek, and Mokelumne River. SacIWRM inflow data for these rivers were adjusted with the flow data for Cosumnes River out of VIC model (at Michigan Bar) using the three-step perturbation method.
- **Bear River:** SacIWRM inflow data for Bear River at Camp Far West was adjusted with the CalSIM Camp Far West release data using the three-step perturbation method. CalSIM release data for no climate change scenario was used as the past data (baseline, no climate change) and data from climate change scenario was used as the future data (scenario, climate change) for the

three-step method. The long-term monthly average and 1970-2004 annual Bear River flows (releases from Camp Far West Reservoir) data for SacIWRM with and without climate change conditions are shown in Figures 5a and 5b. The annual Bear River flows are projected to decrease by an average of 7% (Figure 5a). However, the long-term average monthly Bear River flows are projected to increase in March (+10%), October (+13%), and December (+8%) under climate change conditions (Figure 5b).

- **Feather River:** SacIWRM inflow data for Feather River at the mouth was adjusted with the CalSIM Feather River at the mouth flow data using the three-step perturbation method. CalSIM flow data for no climate change scenario was used as the past data (baseline, no climate change) and data from climate change scenario was used as the future data (scenario, climate change) for the three-step method. The long-term monthly average and 1970-2004 annual Feather River flows data for SacIWRM with and without climate change conditions are shown in Figures 6a and 6b. The annual Feather River flows are projected to decrease by an average of 6% (Figure 6a). However, the long-term average monthly Feather River flows are projected to increase in March (+3%) and August (+10%) under climate change conditions (Figure 6b).
- **Auburn Ravine:** SacIWRM inflow data for Auburn Ravine was adjusted with the CalSIM North Fork American River flows at North Fork Dam data using the three-step perturbation method. CalSIM flow data for no climate change scenario was used as the past data (baseline, no climate change) and data from climate change scenario was used as the future data (scenariao, climate change) for the three-step method. The long-term monthly average and 1970-2004 annual Auburn Ravine streamflow data for SacIWRM with and without climate change conditions are shown in Figures 7a and 7b. The annual Feather River flows are projected to decrease by an average of 8% (Figure 7a). However, the long-term average monthly Feather River flows are projected to increase in March (+13%), April (+9%) and December (+23%) under climate change conditions (Figure 7b).
- **Inflow to smaller streams and creeks:** Small watershed boundary inflow module of SacIWRM was used to simulate the inflow to smaller streams and creeks. Adjusted SacIWRM precipitation data described above was used for the small watershed boundary inflow module to incorporate the effects of the climate change.

6.3 Surface Water Deliveries

Surface water deliveries data for climate change conditions were obtained from the CalSIM model. These data were used to revise the SacIWRM surface water delivery data file so the model would represent the surface water deliveries under climate change conditions. The source of climate change surface water delivery data and the methodology for incorporation of this data in SacIWRM are discussed in the following subsections.

6.3.1 Surface Water Delivery Data under Climate Change Conditions

CalSIM provides surface water delivery data out of Sacramento River, American River, and Feather River at different locations within the model area. The time resolution of the surface water delivery data is monthly and is expressed in cfs from 1922 to 2003.

6.3.2 SacIWRM Data Preparation Approach

SacIWRM surface water deliveries were mapped to the CalSIM surface water deliveries. SacIWRM surface water delivery data was adjusted with the mapped CalSIM surface water delivery data using the three-step perturbation method. CalSIM surface water delivery data for no climate change scenario was used as the past data (baseline, no climate change) and data from climate change scenario was used as the future data (scenario, climate change) for the three-step method. Changes to surface water deliveries under climate change conditions are summarized below.

- **City of Sacramento -** The long-term monthly average and 1970-2004 annual surface water deliveries for city of Sacramento data for SacIWRM with and without climate change conditions are shown in Figures 8a and 8b. The annual surface water deliveries to city of Sacramento are projected to increase by an average of 2% (Figure 8a). The highest long-term average monthly surface water delivery increases are projected to occur in May (+5%), July (+3%), and August (+3%) under climate change conditions (Figure 8b).
- **Natomas Central Mutual Water Company -** The long-term monthly average and 1970-2004 annual surface water deliveries for Natomas Central MWC (NCMWC) data for SacIWRM with and without climate change conditions are shown in Figures 9a and 9b. The annual surface water deliveries to NCMWC are projected not to change (Figure 9a). However, the long-term average monthly surface water deliveries reduce by 7% to 10% from April to June and increase by 8% from July to September under climate change conditions (Figure 9b).
- **Freeport -** The long-term monthly average and 1970-2004 annual surface water deliveries at Freeport data for SacIWRM with and without climate change conditions are shown in Figures 10a and 10b. The annual surface water deliveries at Freeport are projected to increase by 2% (Figure 10a). The long-term average monthly surface water deliveries increase by 3% to 9% from May to July and decrease by 9% from August to September under climate change conditions (Figure 10b).
- **Folsom South Canal -** The long-term monthly average and 1970-2004 annual surface water deliveries at Folsom South Canal data for SacIWRM with and without climate change conditions are shown in Figures 11a and 11b. The annual surface water deliveries at Folsom South Canal are projected to decrease by 4% (Figure 11a). The long-term average monthly surface water deliveries decrease by 3% to 4% from January to December under climate change conditions (Figure 11b).
- **City of Folsom -** The long-term monthly average and 1970-2004 annual surface water deliveries to City of Folsom data for SacIWRM with and without climate change conditions are shown in Figures 12a and 12b. The annual surface water deliveries to City of Folsom are projected to decrease by 1% (Figure 12a). The long-term average monthly surface water deliveries decrease by 1% to 2% from January to December under climate change conditions (Figure 12b).
- **Sac Suburban Water District (SSWD) -** The long-term monthly average and 1970-2004 annual surface water deliveries to SSWD data for SacIWRM with and without climate change conditions are shown in Figures 13a and 13b. The annual surface water deliveries to SSWD are projected to decrease by 2% (Figure 13a). The long-term average monthly surface water deliveries decrease by 1% to 2% from April to October under climate change conditions (Figure 13b).
- **Placer County Water Agency (PCWA) -** The long-term monthly average and 1970-2004 annual surface water deliveries to PCWA data for SacIWRM with and without climate change conditions are shown in Figures 14a and 14b. The annual surface water deliveries to PCWA are projected to decrease by 3% (Figure 14a). The long-term average monthly surface water deliveries decrease by 2% to 3% from January to December under climate change conditions (Figure 14b).
- **San Juan Family -** The long-term monthly average and 1970-2004 annual surface water deliveries to San Juan Family data for SacIWRM with and without climate change conditions are shown in Figures 15a and 15b. The annual surface water deliveries to San Juan Family are projected to decrease by 2% (Figure 15a). The long-term average monthly surface water deliveries decrease by 1% to 3% from January to December under climate change conditions (Figure 15b).

7 Climate Change Simulations

As explained in subsection 2.2, the modeling tasks of this project consisted of development of model simulations for a future conditions baseline and two climate change scenarios. These simulations are explained below. The impact of climate change on water resources conditions in the model area was studied by comparing the results of the climate change scenarios with the future conditions baseline.

7.1 Future Conditions Baseline

The simulation for the future conditions (FC) baseline represents the land and water use conditions in 2030. These projections are primarily based the Urban Water Management Plan (UWMP) for each purveyor. It includes the 20% reduction in urban water demand as specified by the 20x2020 Water Conservation Plan. The FC Baseline includes all of the municipal wells in the model area including those for the cities of Roseville and Lincoln, and PCWA.

7.2 Scenario 1 – Future Conditions with Climate Change

Scenario 1 was developed to represent future land and water use under climate change conditions. This Scenario was developed based on FC Baseline and by modifying the input data files for precipitation, streamflows, surface water deliveries, and agricultural water demand. The modified files were developed based on the methodology presented in Section 6 above to represent the future conditions under climate change conditions.

7.3 Scenario 2 – Future Conditions with Climate Change plus Reduced Surface Water Deliveries

Scenario 2 is similar to Scenario 1; however, it represents further reduction in surface water deliveries. It was assumed that further reductions in surface water deliveries may be implemented in the future under climate change conditions when the unimpaired flow in the American River is singnificantly lower than the unimpaired flows under no climate change conditions. Comparison of American River unimpaired flow exceedance charts revealed that streamflows under climate change conditions are lower than streamflows under no climate change conditions when the streamflows are 2,000 cubic feet per second (cfs) or less (Figure 16). Therefore, for Scenario 2 it was assumed that all of the agricultural and urban surface water deliveries in the model area would be reduced by 10% for any month that the average monthly American River unimpaired flows are less than 2,000 cfs. This additional reduction in surface water deliveries would occur mostly in dry years such as 1976-77 period and average years (Figure 17). On average, most reductions in surface water deliveries would occur from July to November (Figure 18).

8 Results

The impact of climate change on water resources conditions in the SacIWRM area was analyzed by comparing the results of Scenarios 1 and 2 with the results of FC Baseline. This comparison included changes in agricultural water demand, groundwater elevation, and deep percolation. The results of the simulations are presented in the following subsections.

8.1 Agricultural Water Demand

Agricultural water demand is mostly dependent on ET and effective precipitation. Temperature changes under climate change most likely would result in changes in ET; however, as explained in Section 5, ET changes were not incorporated in estimating agricultural water demand under climate change. Precipitation changes, presented in Subsection 6.1, would result in changes in availability of rainfall for crop irrigation and soil moisture content. As estimated by SacIWRM, due to average rainfall reduction of 7%, the long-term average agricultural water demand increases would be approximately 0.5 inches per year. Distribution of increases in agricultural water demand in the SacIWRM area is illustrated in Figure 19.

The increased agricultural water demand along with reduction in surface water deliveries would result in increased use of groundwater to meet the crop water demand. The increase in groundwater extraction would in turn result in lower groundwater levels.

8.2 Groundwater Pumping

Under climate change conditions, reduced precipitation and surface water deliveries are expected to result in increased groundwater pumping to meet the urban demand and increased agricultural water demand. Figures 20a and 21a illustrate the distribution of agricultural and urban groundwater pumping increases in the model area, respectively. Increases in agricultural pumping are noticeable in predominantly agricultural areas and urban pumping increases are apparent in urban areas. Under Scenario 2, with additional reduction in surface water deliveries, groundwater pumping would be higher than groundwater pumping under Scenario 1. Figures 20b and 21b illustrate the distribution of groundwater pumping increases in the model area to meet the agricultural and urban water demands.

The increase in long-term average groundwater pumping would be within the Water Forum Sustainable Yield for the North and Central Basins (Table 1). However, groundwater pumping in South Basin would potentially be at the Sustainable Yield under Scenario 1 and increase beyond the Sustainable Yield under Scenario 2.

Table 1 – Comparison of simulated long-term average groundwater pumping to Water Forum Sustainability Yield (TAF/year)

Basin	Baseline	Scenario 1	Scenario 2	Water Forum Sustainability Yield
North Area	63	68	77	131
Central Area	205	210	217	273
South Area	110	112	118	115
North American River Area*	240	253	264	N/A
Other**	125	126	128	N/A
Total	743	769	804	N/A

* - Placer and Sutter Counties
** - Amador WA, San Joaquin County WCD, North Delta WA

8.3 Deep Percolation

Lower precipitation under climate change conditions is expected to result in reduced deep percolation to groundwater. Figures 22a and 22b illustrate the distribution of deep percolation decreases under Scenarios 1 and 2, respectively. The pattern of deep percolation decreases generally follows the distribution of hydrological soil type in the model area. Areas with soil type A (with more sand and coarser materials) show more reduction in deep percolation. In contrast, areas with soil type D (with more clay and finer materials) show no significant changes in deep percolation.

8.4 Groundwater Elevations

Groundwater elevations are dependent on deep percolation, groundwater pumping, boundary inflows and stream-aquifer interaction. Changes in any of these parameters would result in changes in groundwater elevations. Under climate change conditions, deep percolation is expected to decrease due to reduced precipitation, groundwater pumping is expected to increase due to reduced surface water deliveries, and stream seepage is expected to increase due to increase stream-aquifer head difference. Underflow from model boundaries are expected to increase as groundwater elevations are expected to decline in the model area.

The changes in groundwater elevations as a result of combined effect of changes in groundwater inflow and outflow components are shown by the groundwater elevation hydrographs of Appendix A at several representative wells. The locations of these wells are illustrated in Figure 23. The hydrographs show that groundwater elevations could drop by up to 20 feet.

Contour maps of groundwater elevation differences for average, wet, and dry years for Scenario 1 and Scenario 2 are presented in Figures 24a-c and 25a-c, respectively. The contour maps show that the groundwater elevations drop are minimal in the vicinity of major rivers and gradually increase to more than 20 feet in areas farthest away from the Sacramento River and American River.

9 Conclusions

The purpose of this study was to evaluate the impacts of climate change on water resources in the American River Basin (ARB) Region through modeling and data gathering and analysis. The future reliability of the groundwater and surface water systems in the region under climate change conditions is evaluated using a combination of several hydrologic, surface water delivery, and climate change models of the area. In general, future potential climate change conditions are expected to reduce the availability of surface water from American River, Folsom Reservoir, and other surface water supply sources. To that end, the purveyors who have access to groundwater would potentially increase the use of groundwater to meet their needs. This would potentially result in additional declines in the groundwater levels in the long-term. The increase in groundwater use, though, would be within the Water Forum Sustainable Yield for the North and Central Basins. However, groundwater pumping in South Basin would potentially be at Sustainable Yield under the more moderate climate change scenario (Scenario 1) and increase beyond the Sustainable Yield under the more extreme climate change scenario (Scenario 2).

The major conclusions of this study are as follows:

- **Precipitation** – Monthly distribution of rainfall is expected to change under climate change conditions. March and December precipitation would increase by approximately 17%, while precipitation would be reduced in other months. The long-term average precipitation is expected to reduce by 7%.
- **Streamflow –** The changes in precipitation would result in similar changes in streamflows. American River annual flows would decline by an average of 8%, while the long-term average monthly reservoir releases would increase in March (+17%), April (+6%) and October (+23%) under climate change conditions. Similarly, Cosumnes River annual flows would decline by an average of 9%, but in contrast, the long-term average monthly Cosumnes River flows would only increase in December (+11%) under climate change conditions. Sacramento River annual flows would decrease by an average of 1%, while the long-term average monthly flows would increase in July (+4%), August (+8%), and October (+9%).
- **Surface Water Deliveries –** Changes in streamflows would result in significant changes in surface water deliveries from American River and Folsom Reservoir. Changes in deliveries to each purveyor would depend on availability of surface water and water rights of the purveyors. The annual surface water deliveries to City of Folsom, SSWD, PCWA, and the San Juan Family would decrease by 1%, 6%, 3%, and 2%, respectively based on the information from the DWR simulations. The summertime decreases for these purveyors are 2%, 12%, 3%, and 2%, respectively. In contrast, average annual deliveries to urban purveyors on the Sacramento River would increase by approximately 2%.

- **Groundwater –** Reduced precipitation and surface water deliveries would result in increased groundwater pumping to meet the urban and agricultural water demands. Increased groundwater pumping could result in lowering groundwater elevations by up to 20 feet in dry years and in areas farthest from the American River and Sacramento River. Areas closer to these rivers would have less significant drop in groundwater elevations as seepage from the rivers tend to compensate for additional groundwater pumping.

Figures

Appendices

A – Three-step perturbation method.
B1 – Representative groundwater elevation hydrographs in NAR Area (north of Sacramento County Line)
B2 – Representative groundwater elevation hydrographs in Sacramento County

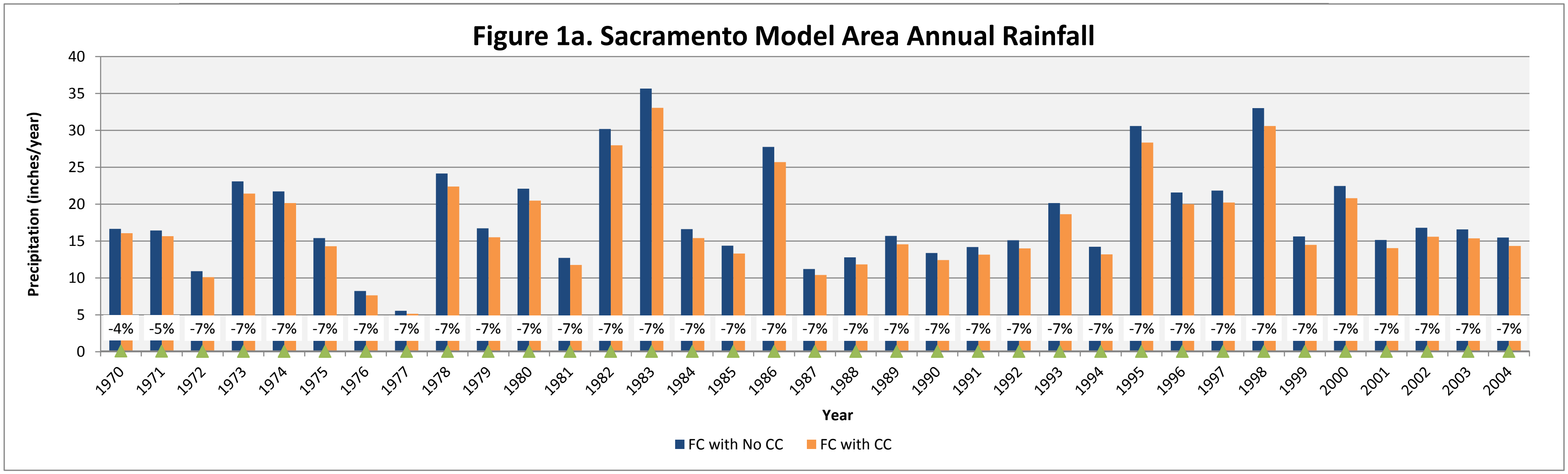


Figure 1a. Sacramento Model Area Annual Rainfall
Precipitation (inches/year)
40
35
30
25
20
15
10
5
0
-4%
-5%
-7%
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Year
FC with No CC
FC with CC

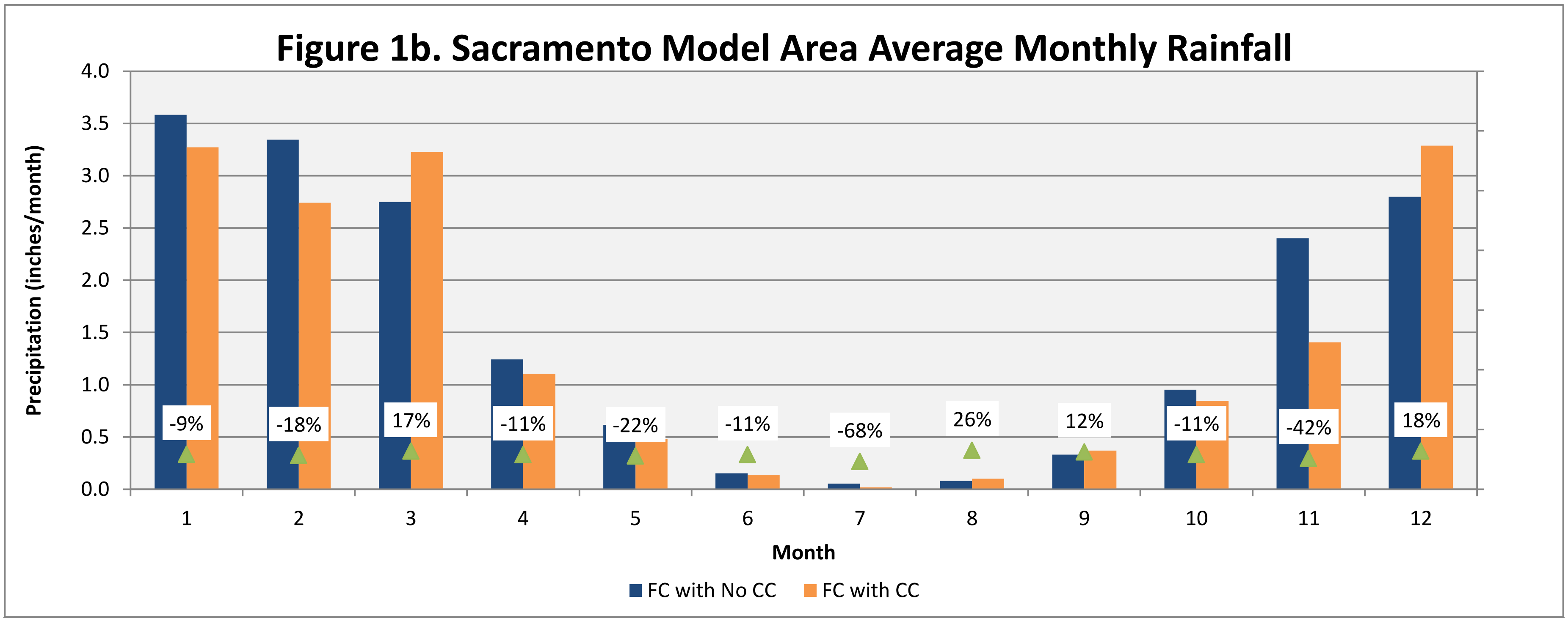


Figure 1b. Sacramento Model Area Average Monthly Rainfall
Precipitation (inches/month)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-9%
-18%
17%
-11%
-22%
-11%
-68%
26%
12%
-11%
-42%
18%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC with No CC
FC with CC

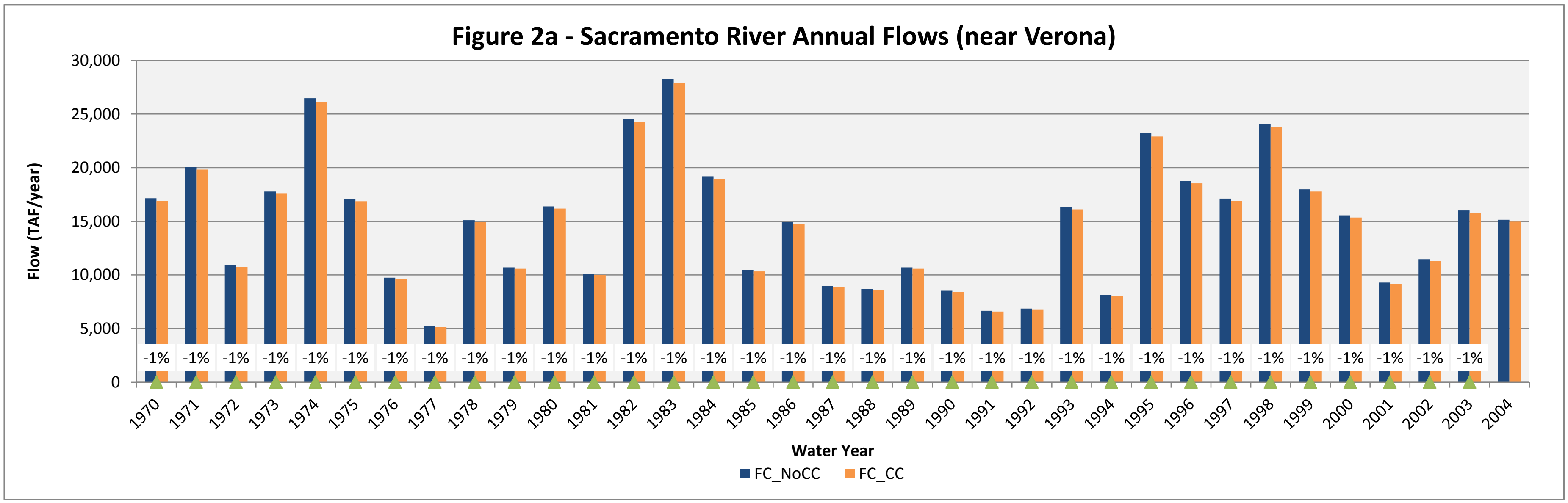
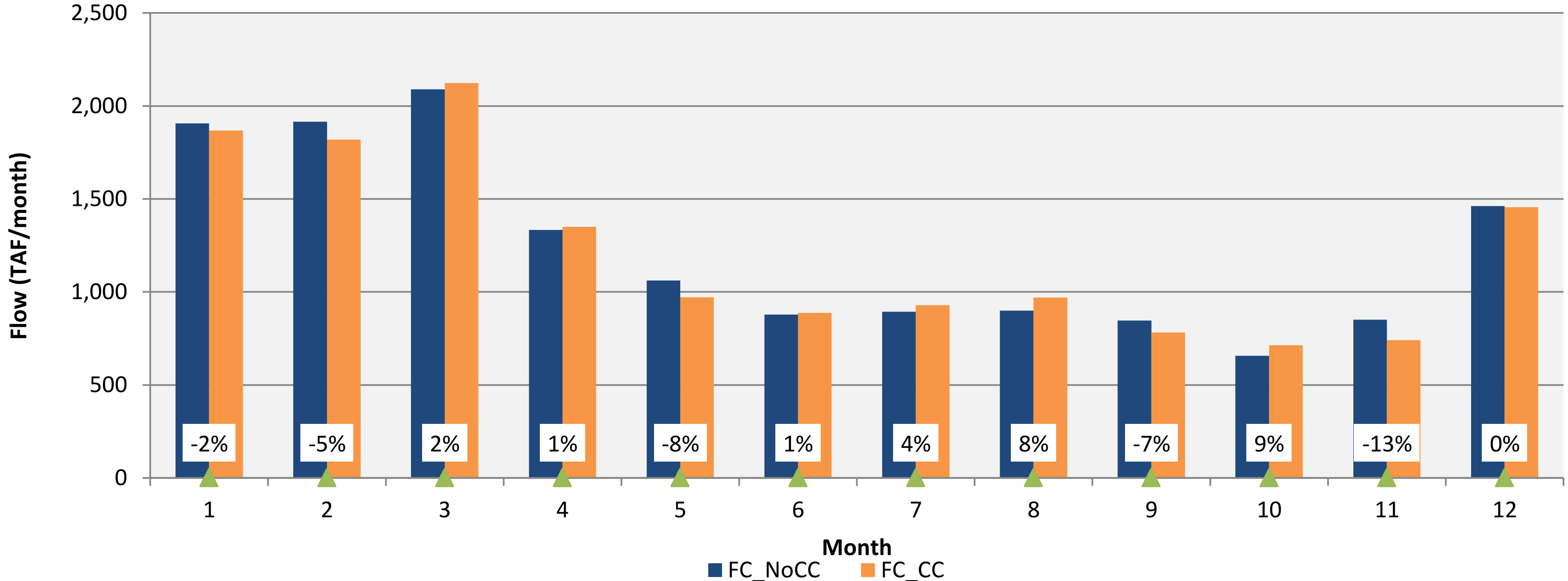


Figure 2a - Sacramento River Annual Flows (near Verona)
Flow (TAF/year)
30,000
25,000
20,000
15,000
10,000
5,000
0
-1%
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
Water Year
FC_NoCC
FC_CC

Figure 2b - Sacramento River Average Monthly Flows (near Verona)



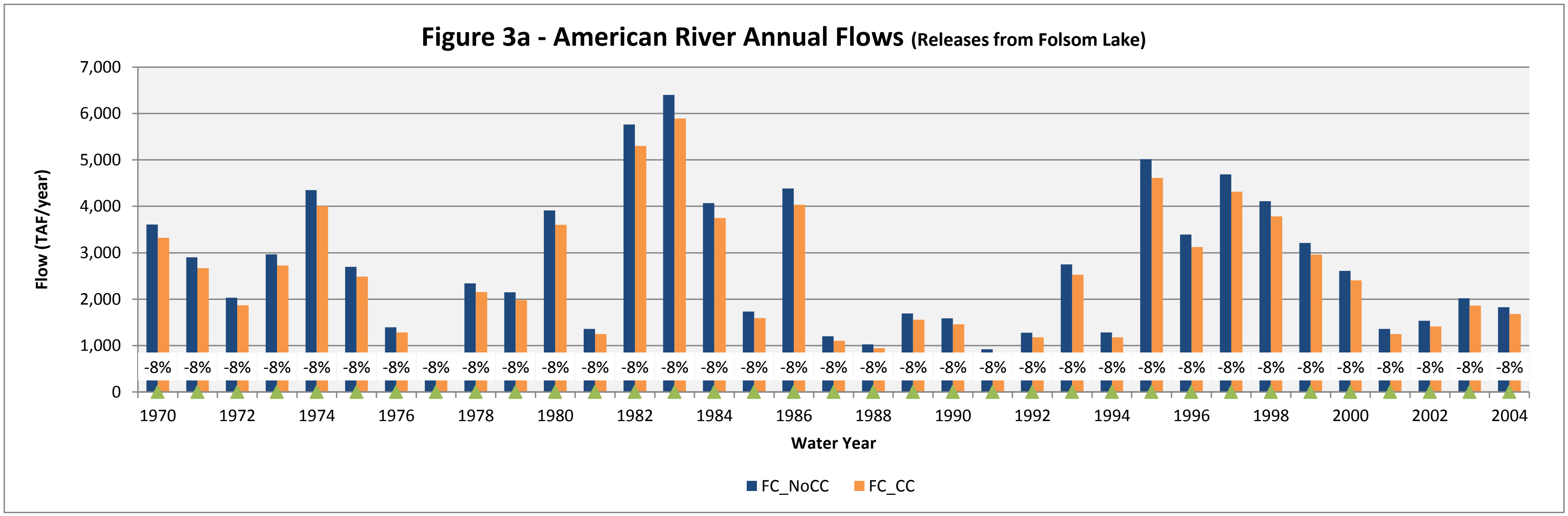


Figure 3a - American River Annual Flows (Releases from Folsom Lake)
Flow (TAF/year)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-8%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC
FC_CC

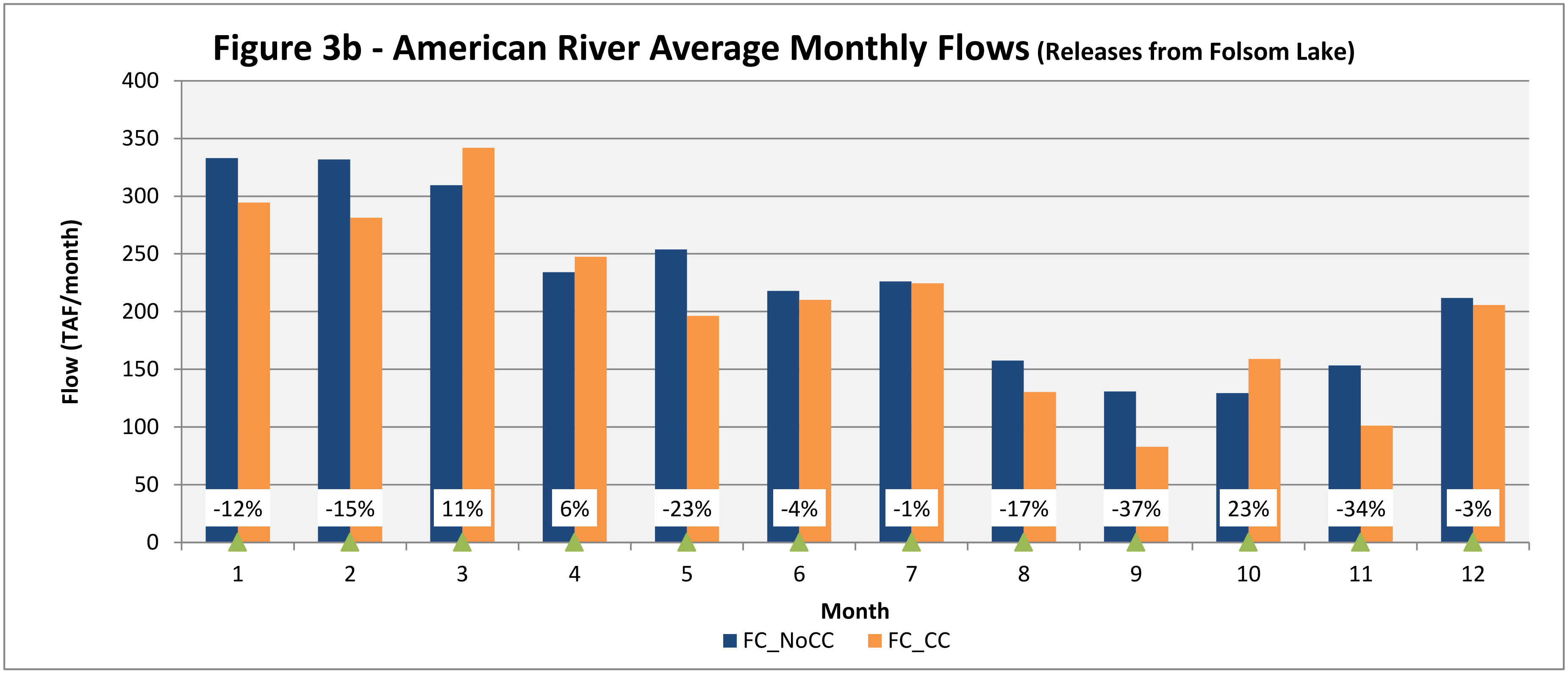


Figure 3b - American River Average Monthly Flows (Releases from Folsom Lake)
Flow (TAF/month)
400
350
300
250
200
150
100
50
0
-12%
-15%
11%
6%
-23%
-4%
-1%
-17%
-37%
23%
-34%
-3%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC
FC_CC

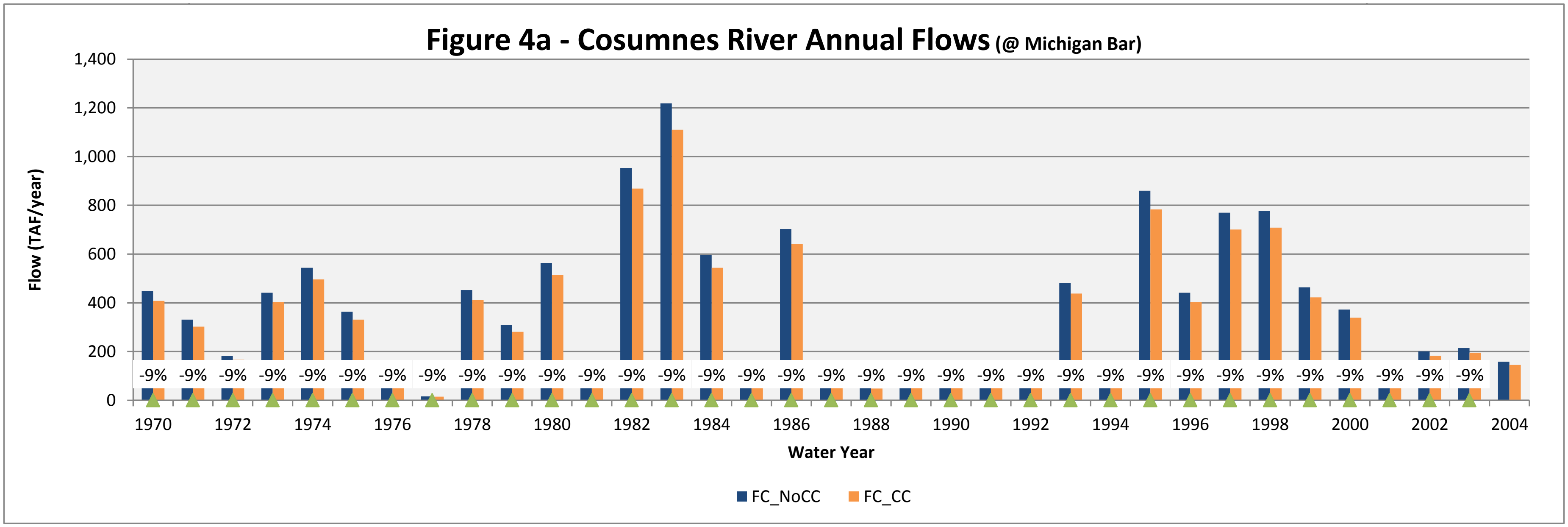


Figure 4a - Cosumnes River Annual Flows (@ Michigan Bar)
Flow (TAF/year)
1,400
1,200
1,000
800
600
400
200
0
-9%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC
FC_CC

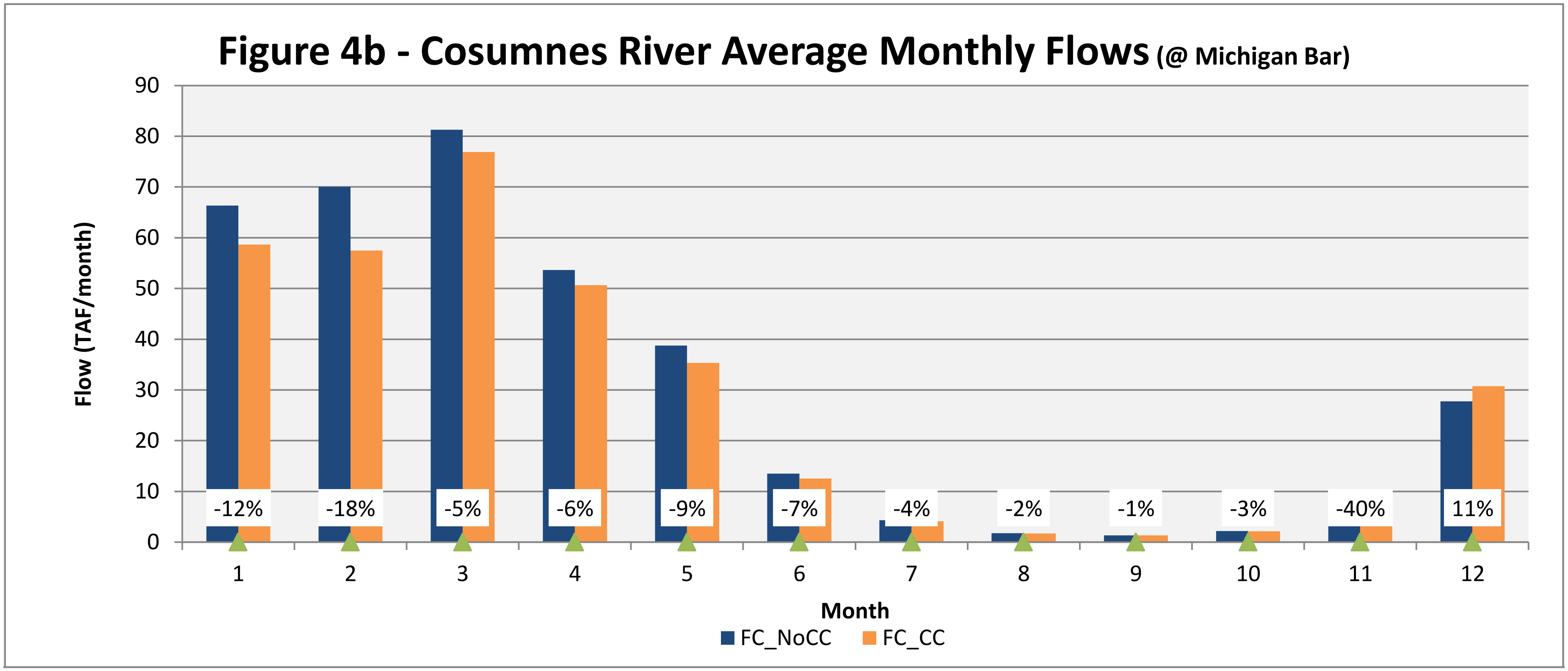


Figure 4b - Cosumnes River Average Monthly Flows (@ Michigan Bar)
Flow (TAF/month)
90
80
70
60
50
40
30
20
10
0
-12%
-18%
-5%
-6%
-9%
-7%
-4%
-2%
-1%
-3%
-40%
11%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC
FC_CC

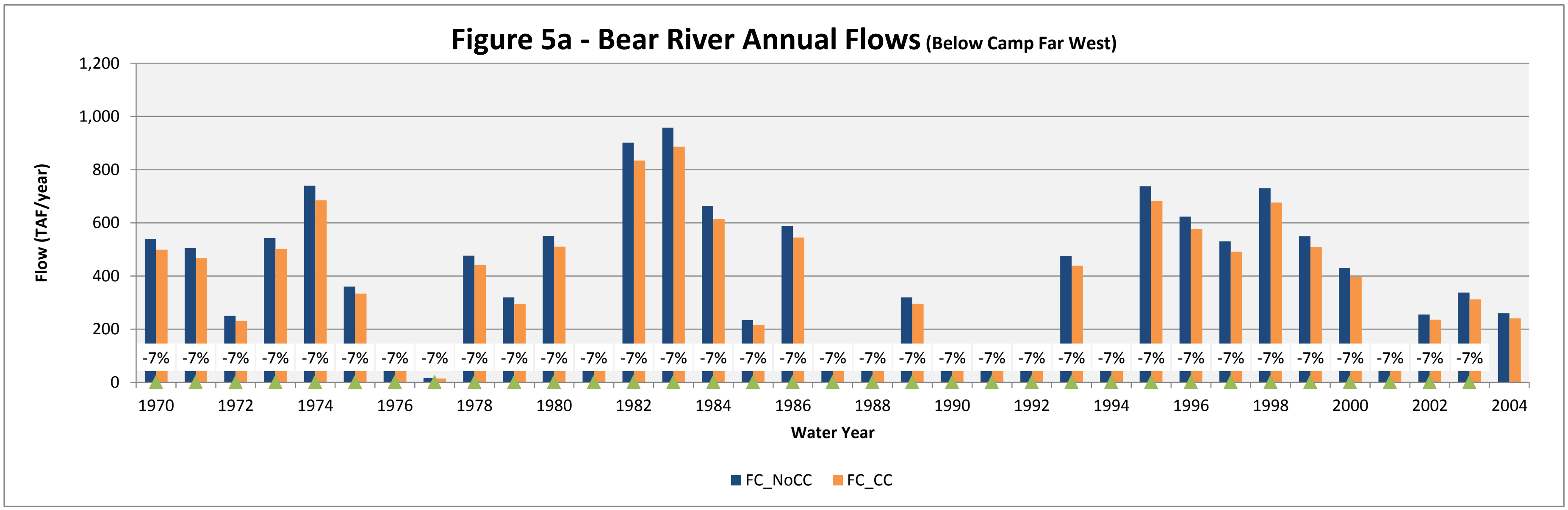


Figure 5a - Bear River Annual Flows (Below Camp Far West)
Flow (TAF/year)
1,200
1,000
800
600
400
200
0
-7%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC
FC_CC

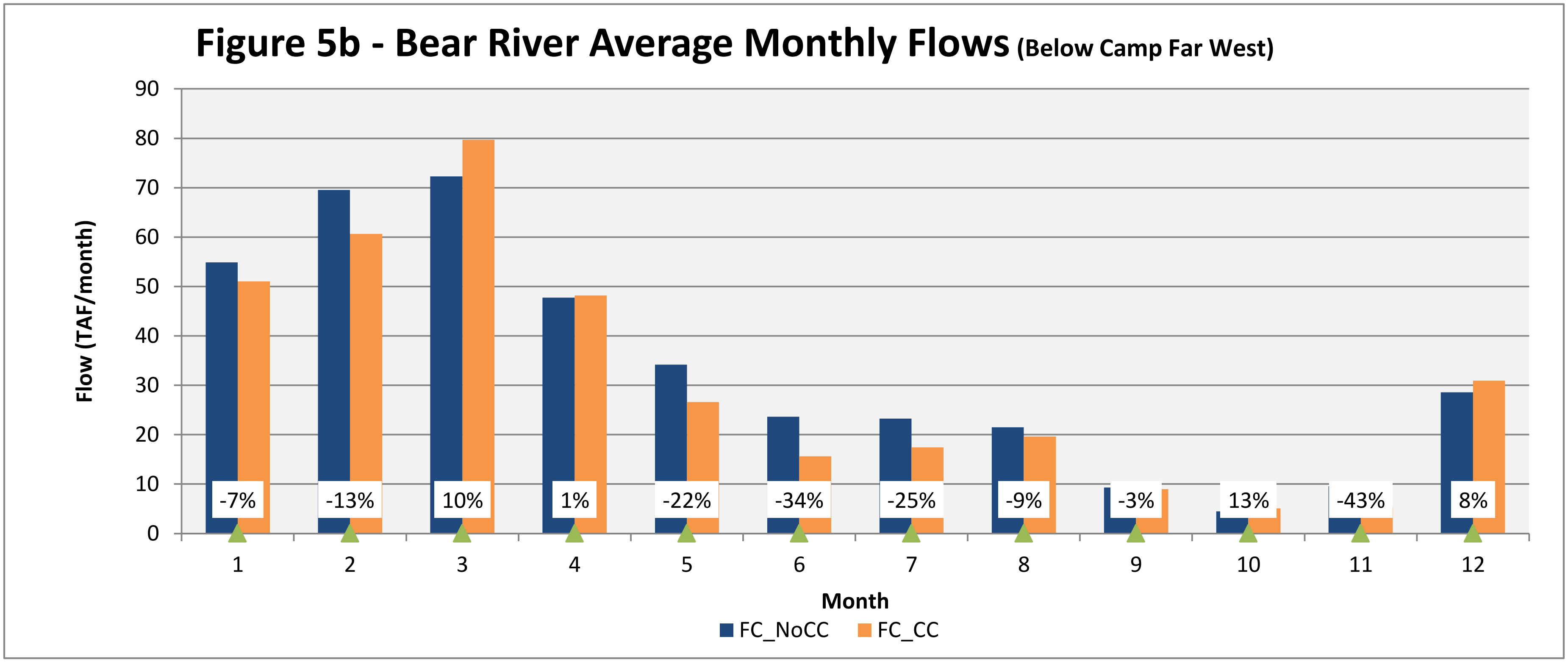


Figure 5b - Bear River Average Monthly Flows (Below Camp Far West)
Flow (TAF/month)
90
80
70
60
50
40
30
20
10
0
-7%
-13%
10%
1%
-22%
-34%
-25%
-9%
-3%
13%
-43%
8%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC
FC_CC

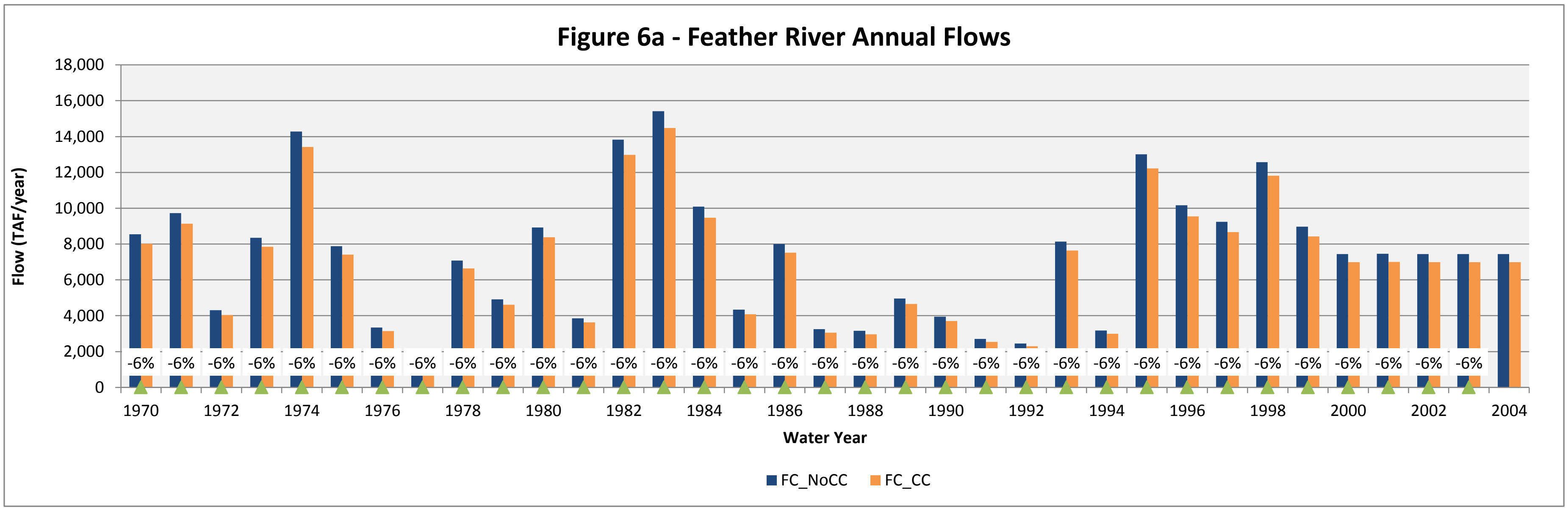


Figure 6a - Feather River Annual Flows
Flow (TAF/year)
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-6%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC
FC_CC

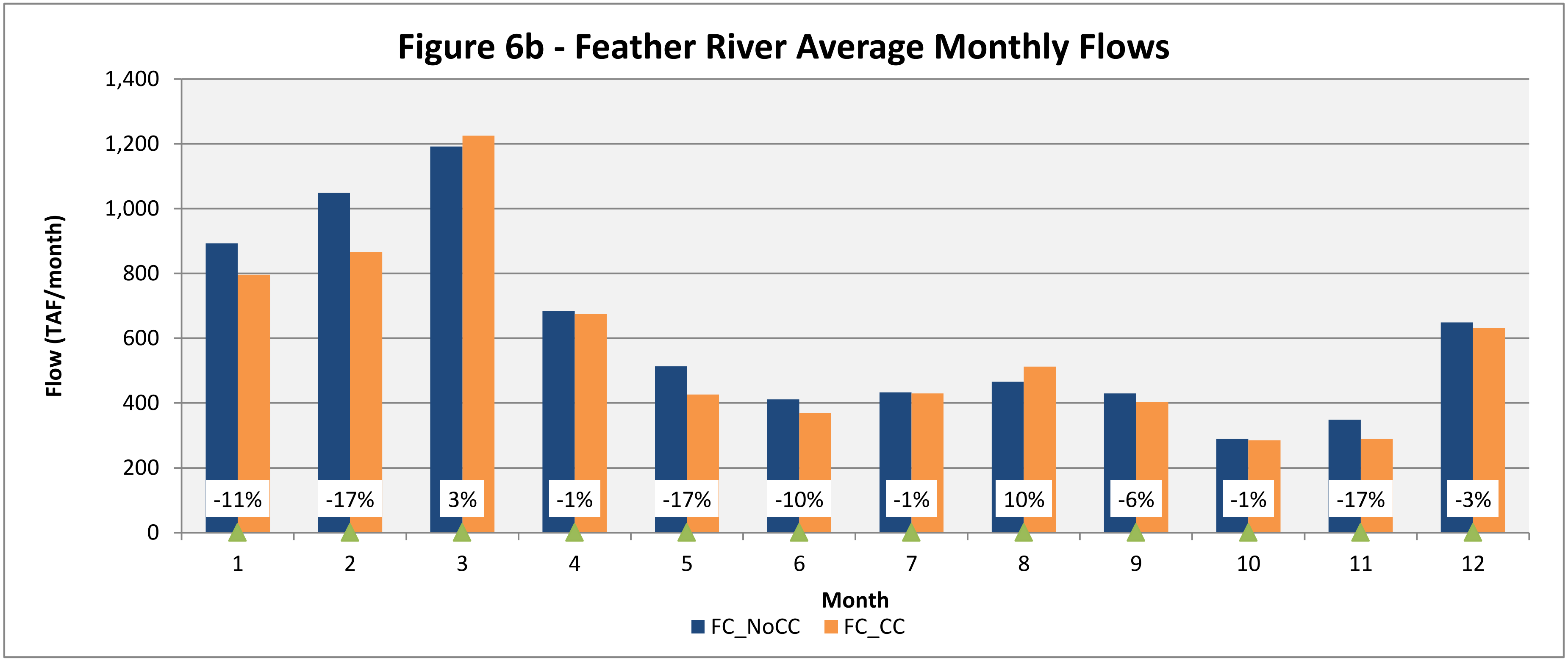


Figure 6b - Feather River Average Monthly Flows
Flow (TAF/month)
1,400
1,200
1,000
800
600
400
200
0
-11%
-17%
3%
-1%
-17%
-10%
-1%
10%
-6%
-1%
-17%
-3%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC
FC_CC

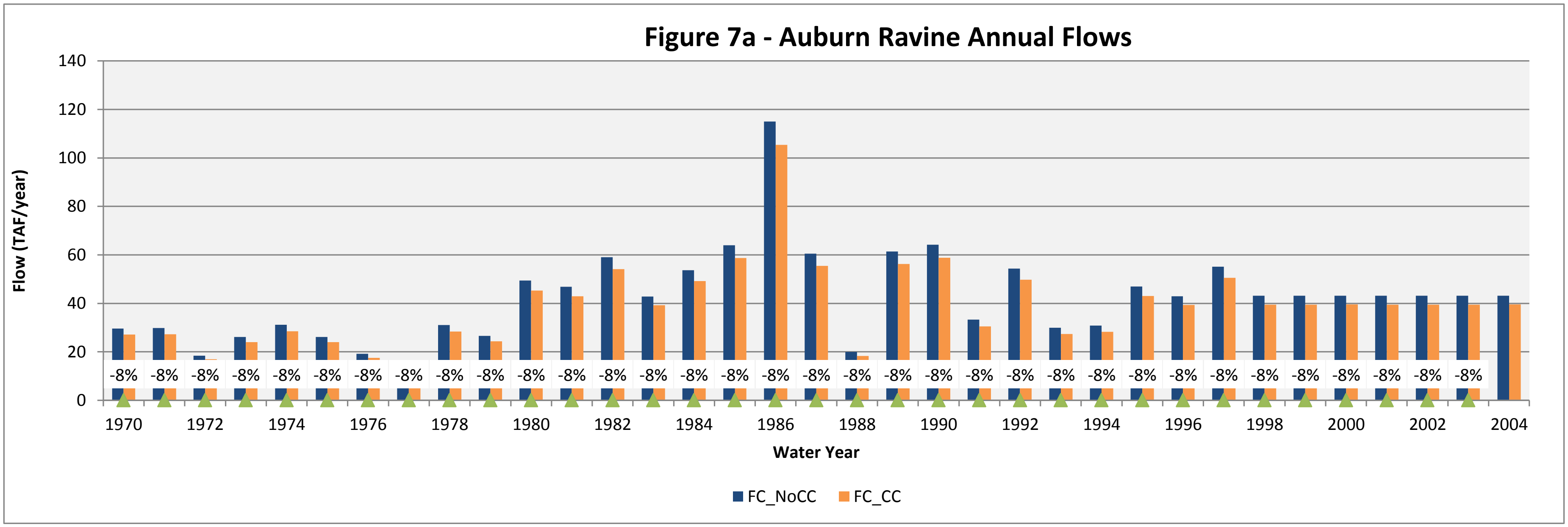


Figure 7a - Auburn Ravine Annual Flows
Flow (TAF/year)
140
120
100
80
60
40
20
0
-8%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC
FC_CC

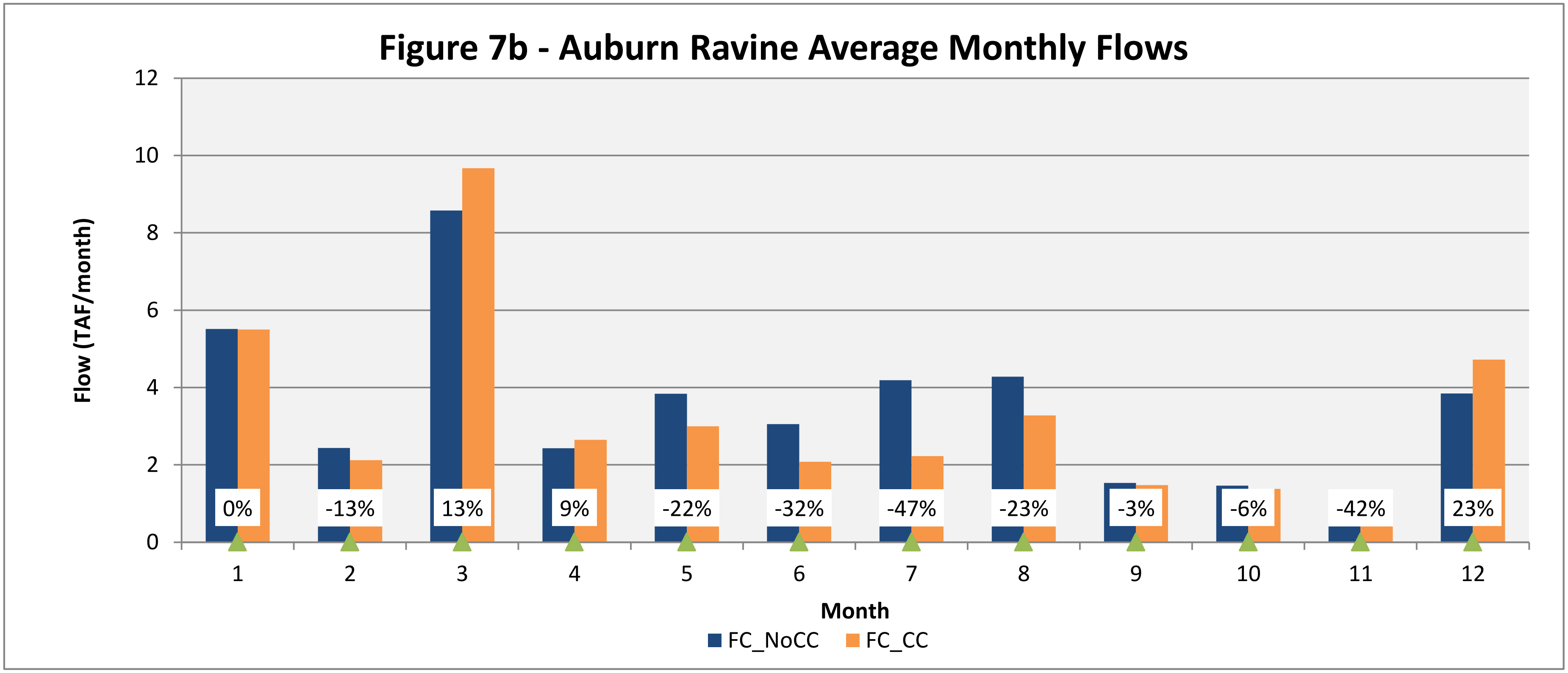


Figure 7b - Auburn Ravine Average Monthly Flows
Flow (TAF/month)
12
10
8
6
4
2
0
0%
-13%
13%
9%
-22%
-32%
-47%
-23%
-3%
-6%
-42%
23%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC
FC_CC

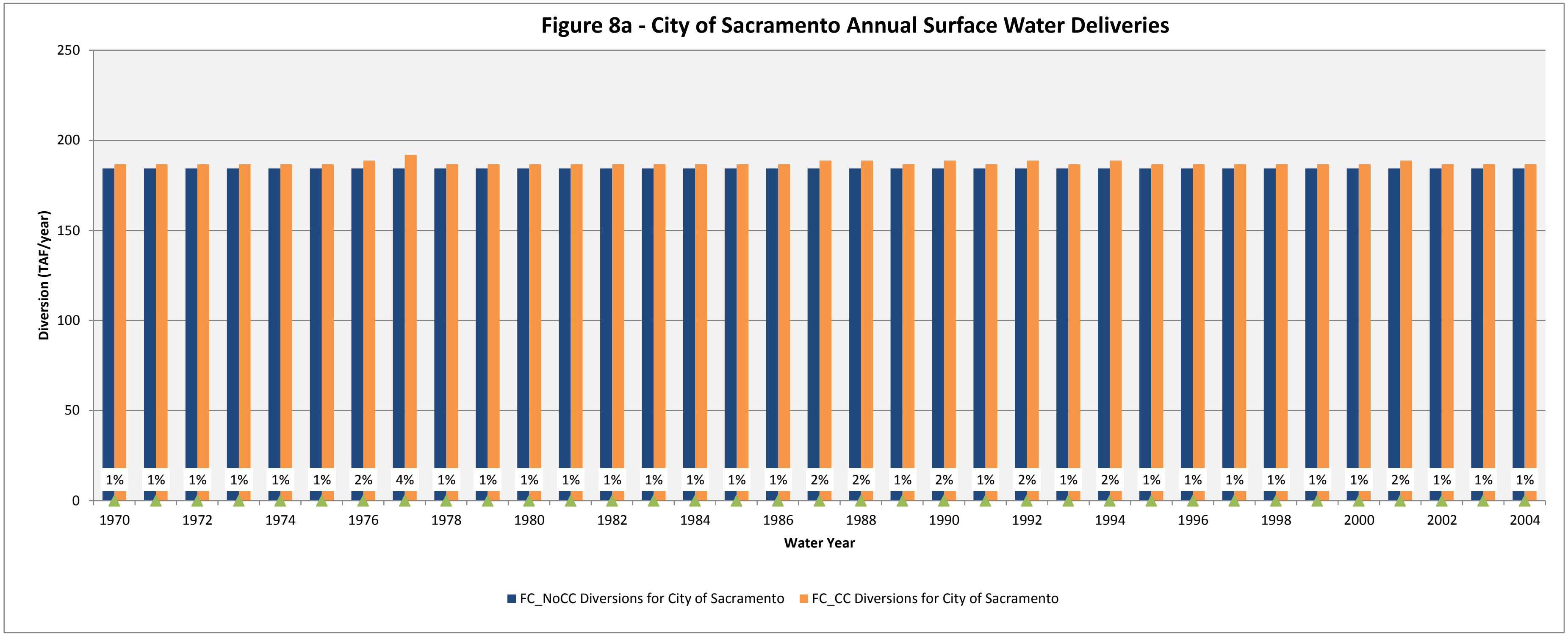


Figure 8a - City of Sacramento Annual Surface Water Deliveries
Diversion (TAF/year)
250
200
150
100
50
0
1% 1% 1% 1% 1% 1% 2% 4% 1% 1% 1% 1% 1% 1% 1% 1% 1% 2% 2% 1% 2% 1% 2% 1% 2% 1% 1% 1% 1% 1% 1% 2% 1% 1% 1%
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004
Water Year
FC_NoCC Diversions for City of Sacramento
FC_CC Diversions for City of Sacramento

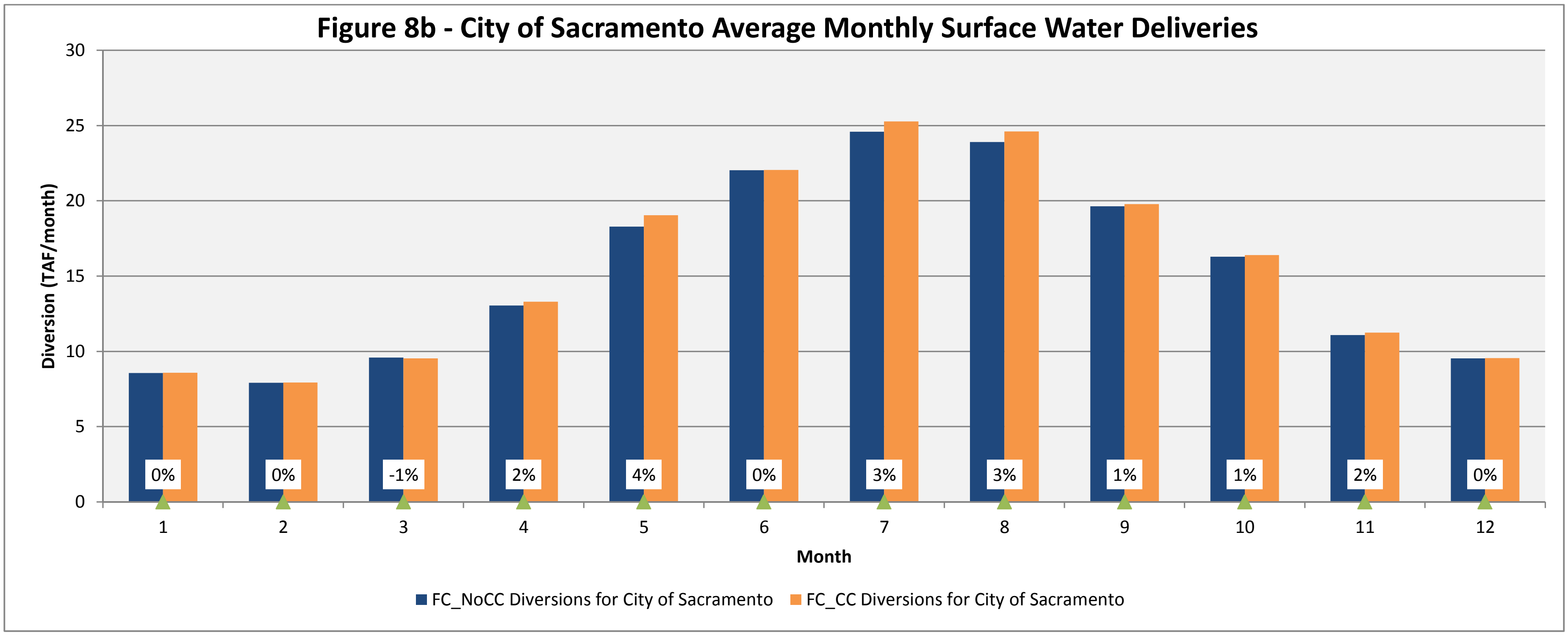


Figure 8b - City of Sacramento Average Monthly Surface Water Deliveries
Diversion (TAF/month)
30
25
20
15
10
5
0
0%
0%
-1%
2%
4%
0%
3%
3%
1%
1%
2%
0%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions for City of Sacramento
FC_CC Diversions for City of Sacramento

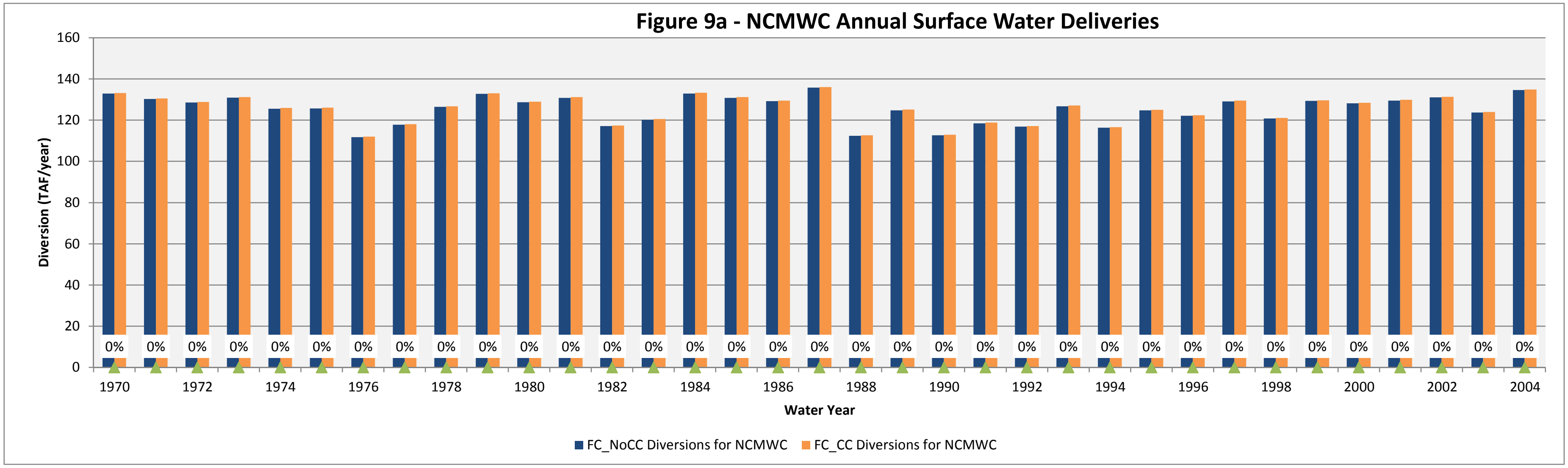


Figure 9a - NCMWC Annual Surface Water Deliveries
Diversion (TAF/year)
160
140
120
100
80
60
40
20
0
0%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC Diversions for NCMWC
FC_CC Diversions for NCMWC

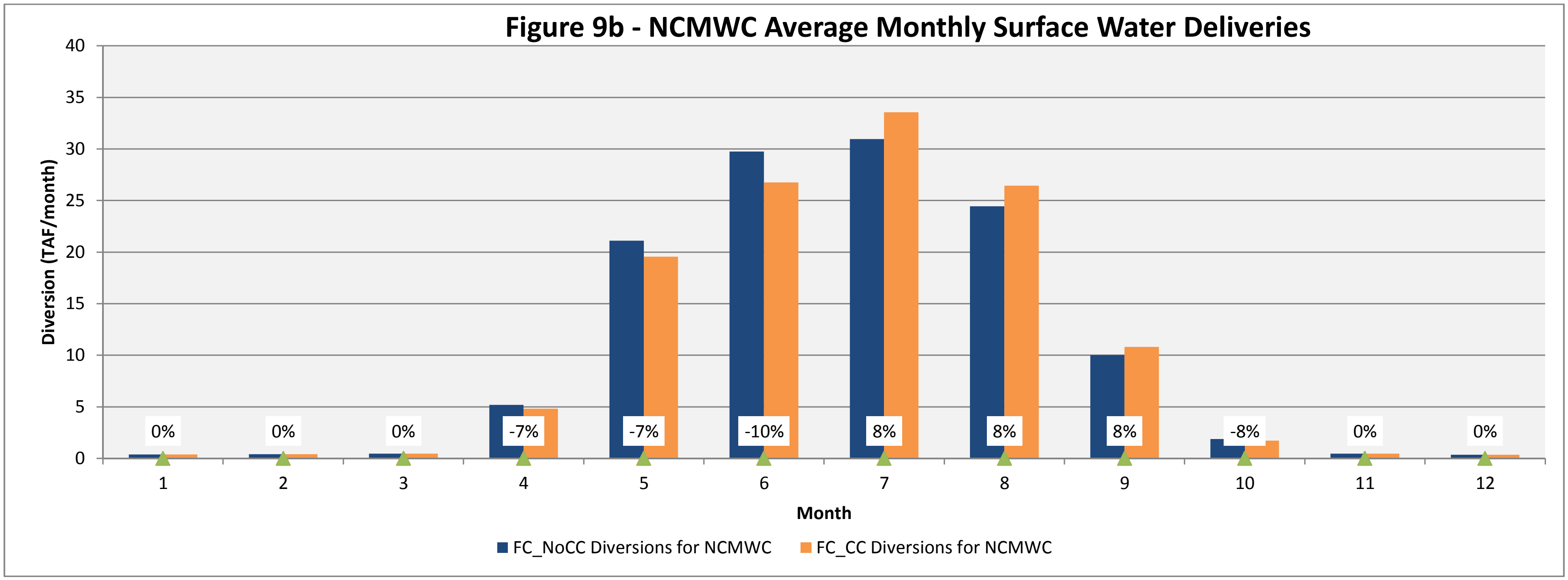


Figure 9b - NCMWC Average Monthly Surface Water Deliveries
Diversion (TAF/month)
40
35
30
25
20
15
10
5
0
0%
0%
0%
-7%
-7%
-10%
8%
8%
8%
-8%
0%
0%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions for NCMWC
FC_CC Diversions for NCMWC

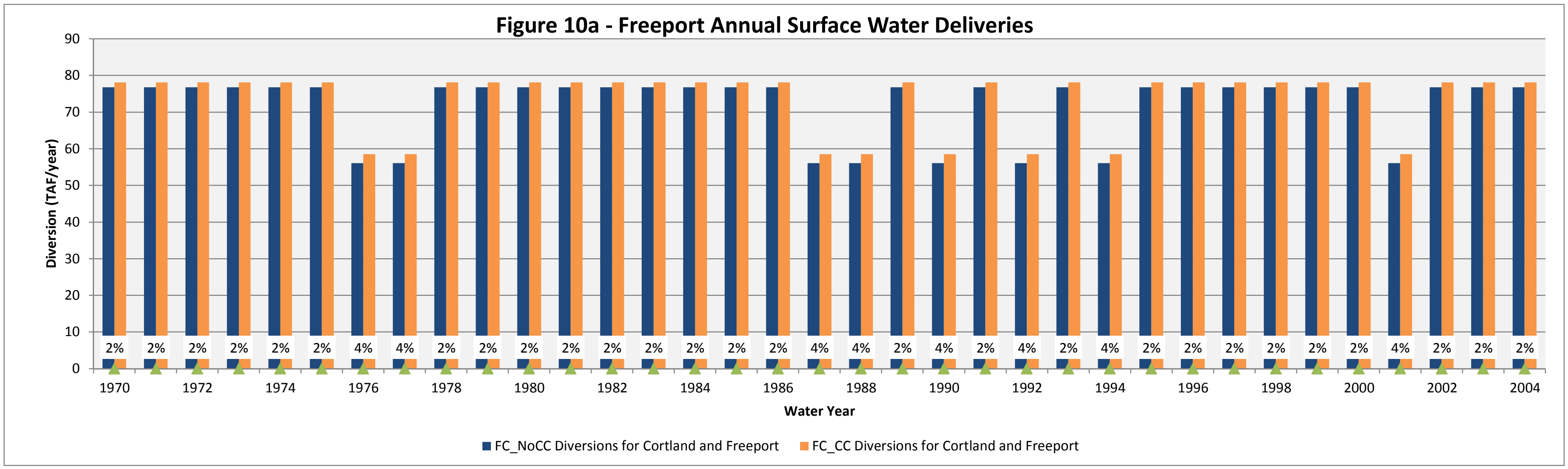


Figure 10a - Freeport Annual Surface Water Deliveries
Diversion (TAF/year)
Water Year
0
10
20
30
40
50
60
70
80
90
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2% 2% 2% 2% 2% 2% 4% 4% 2% 2% 2% 2% 2% 2% 2% 2% 2% 4% 4% 2% 4% 2% 4% 2% 4% 2% 2% 2% 2% 2% 2% 4% 2% 2% 2%
FC_NoCC Diversions for Cortland and Freeport
FC_CC Diversions for Cortland and Freeport

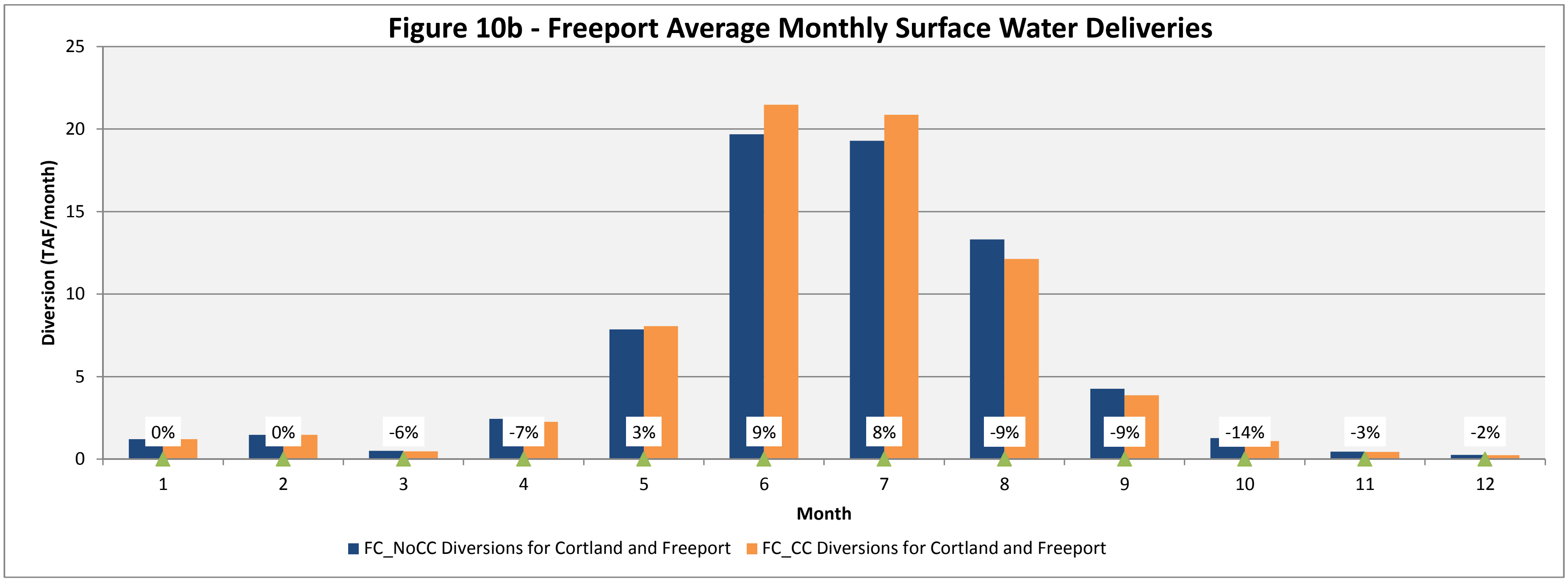


Figure 10b - Freeport Average Monthly Surface Water Deliveries
Diversion (TAF/month)
25
20
15
10
5
0
0%
0%
-6%
-7%
3%
9%
8%
-9%
-9%
-14%
-3%
-2%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions for Cortland and Freeport
FC_CC Diversions for Cortland and Freeport

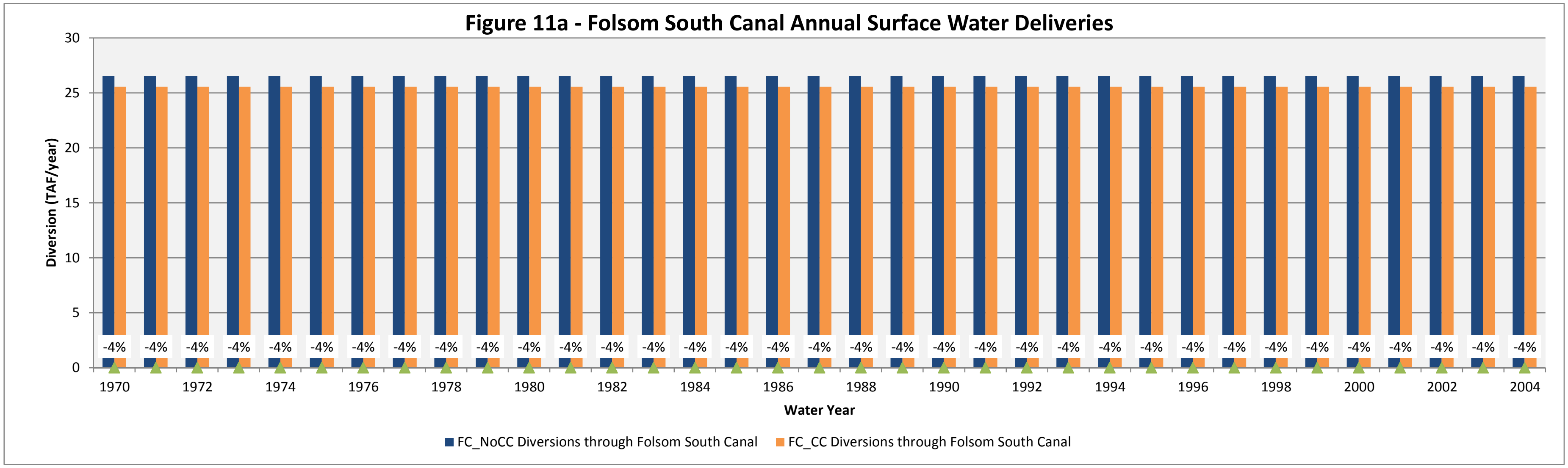


Figure 11a - Folsom South Canal Annual Surface Water Deliveries
Diversion (TAF/year)
30
25
20
15
10
5
0
-4%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC Diversions through Folsom South Canal
FC_CC Diversions through Folsom South Canal

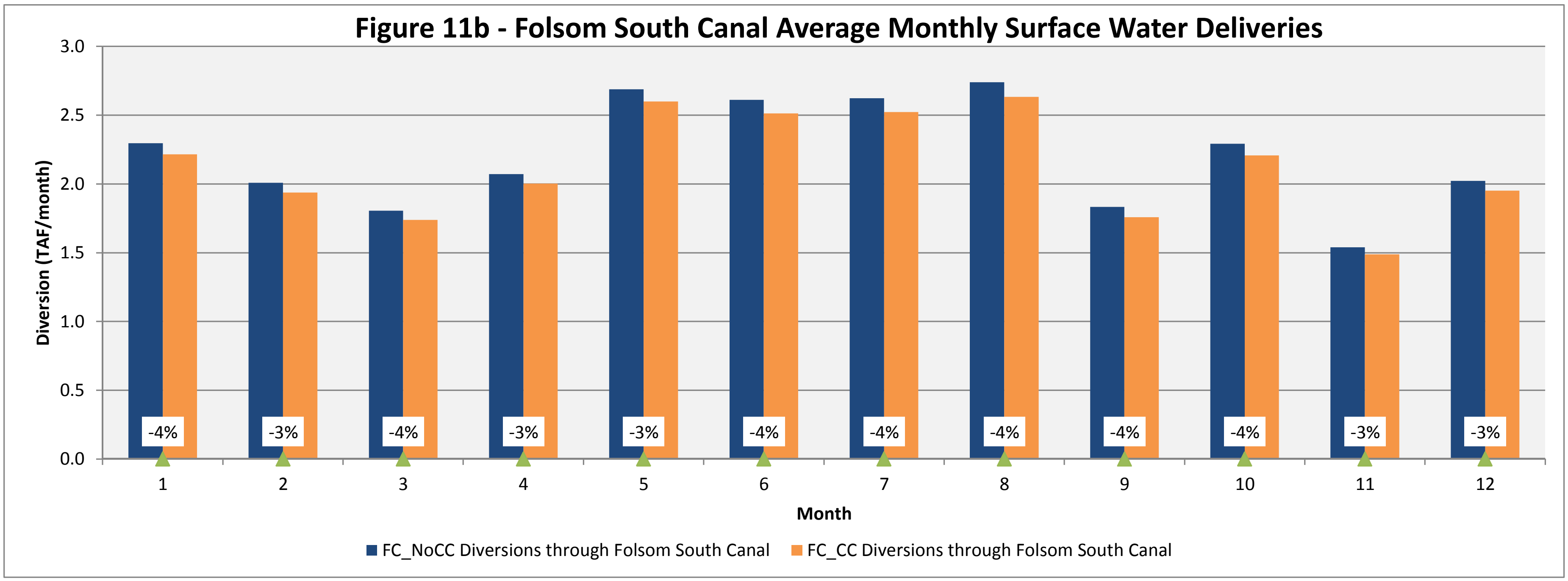


Figure 11b - Folsom South Canal Average Monthly Surface Water Deliveries
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Diversion (TAF/month)
-4%
-3%
-4%
-3%
-3%
-4%
-4%
-4%
-4%
-4%
-3%
-3%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions through Folsom South Canal
FC_CC Diversions through Folsom South Canal

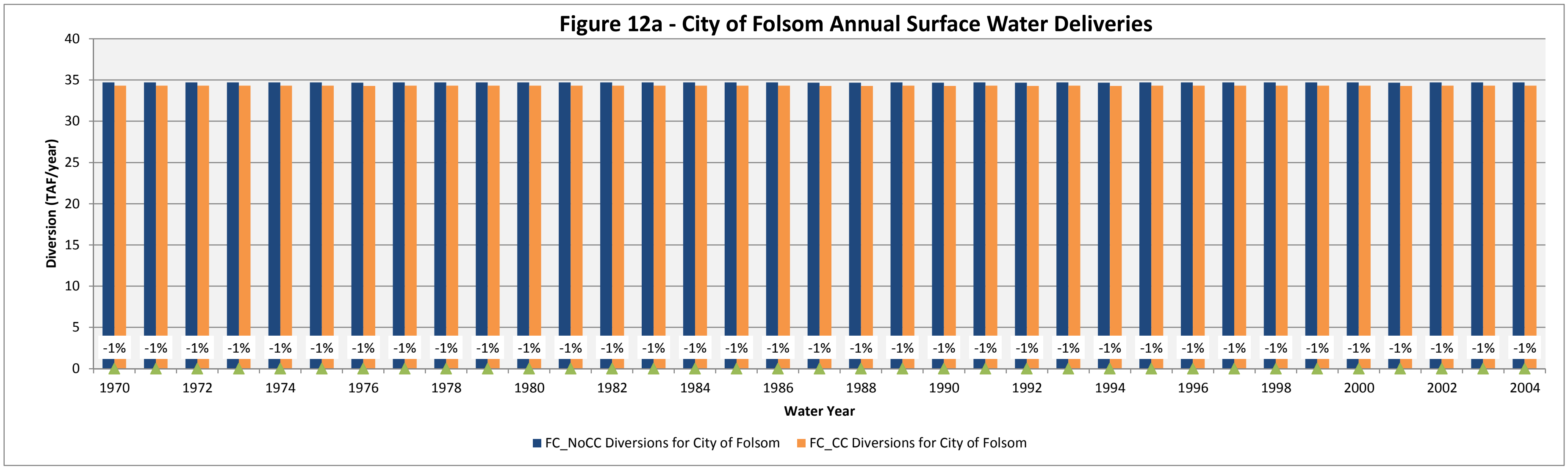


Figure 12a - City of Folsom Annual Surface Water Deliveries
Diversion (TAF/year)
40
35
30
25
20
15
10
5
0
-1%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC Diversions for City of Folsom
FC_CC Diversions for City of Folsom

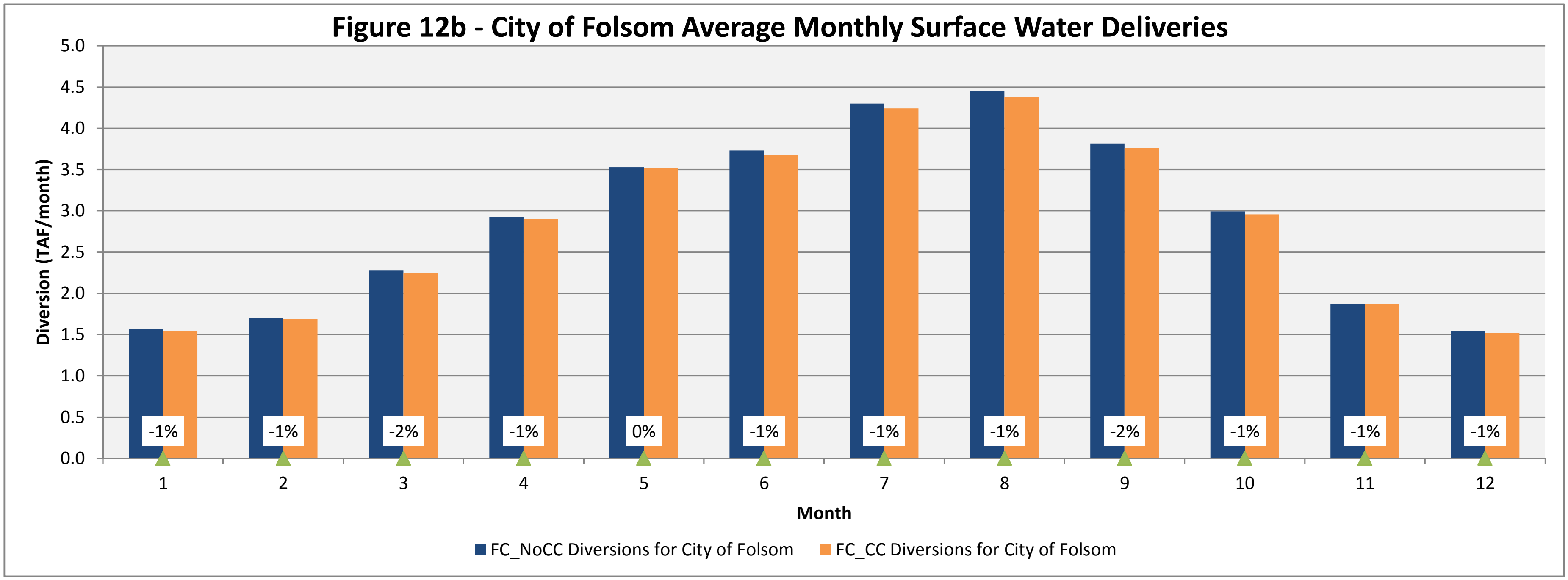


Figure 12b - City of Folsom Average Monthly Surface Water Deliveries
Diversion (TAF/month)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-1%
-1%
-2%
-1%
0%
-1%
-1%
-1%
-2%
-1%
-1%
-1%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions for City of Folsom
FC_CC Diversions for City of Folsom

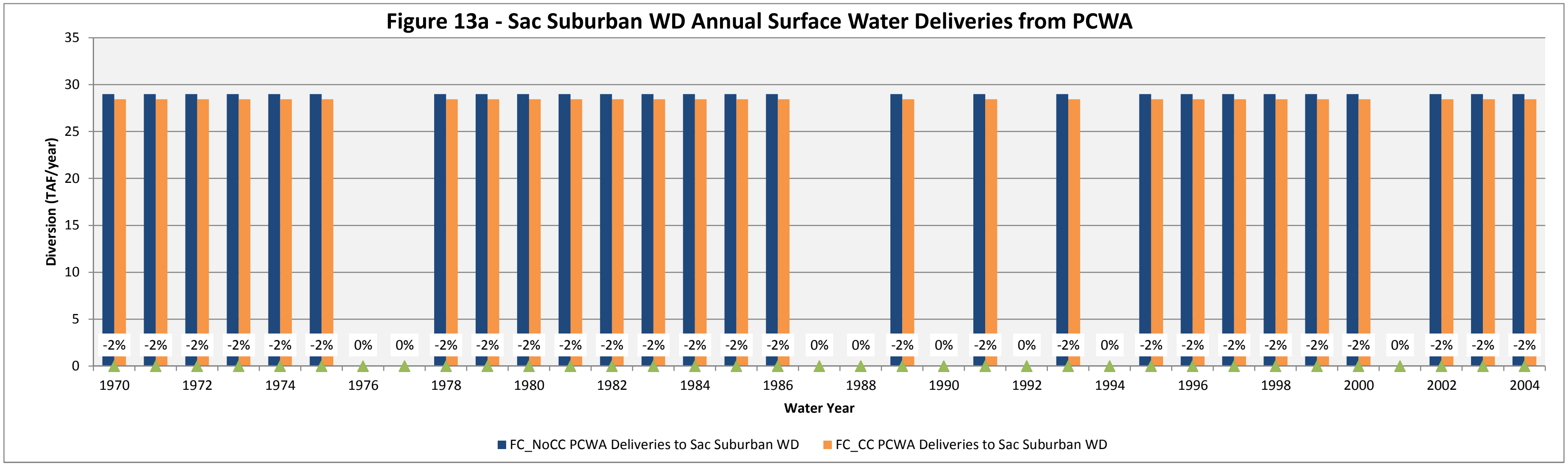


Figure 13a - Sac Suburban WD Annual Surface Water Deliveries from PCWA
Diversion (TAF/year)
Water Year
0
5
10
15
20
25
30
35
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
-2%
0%
FC_NoCC PCWA Deliveries to Sac Suburban WD
FC_CC PCWA Deliveries to Sac Suburban WD

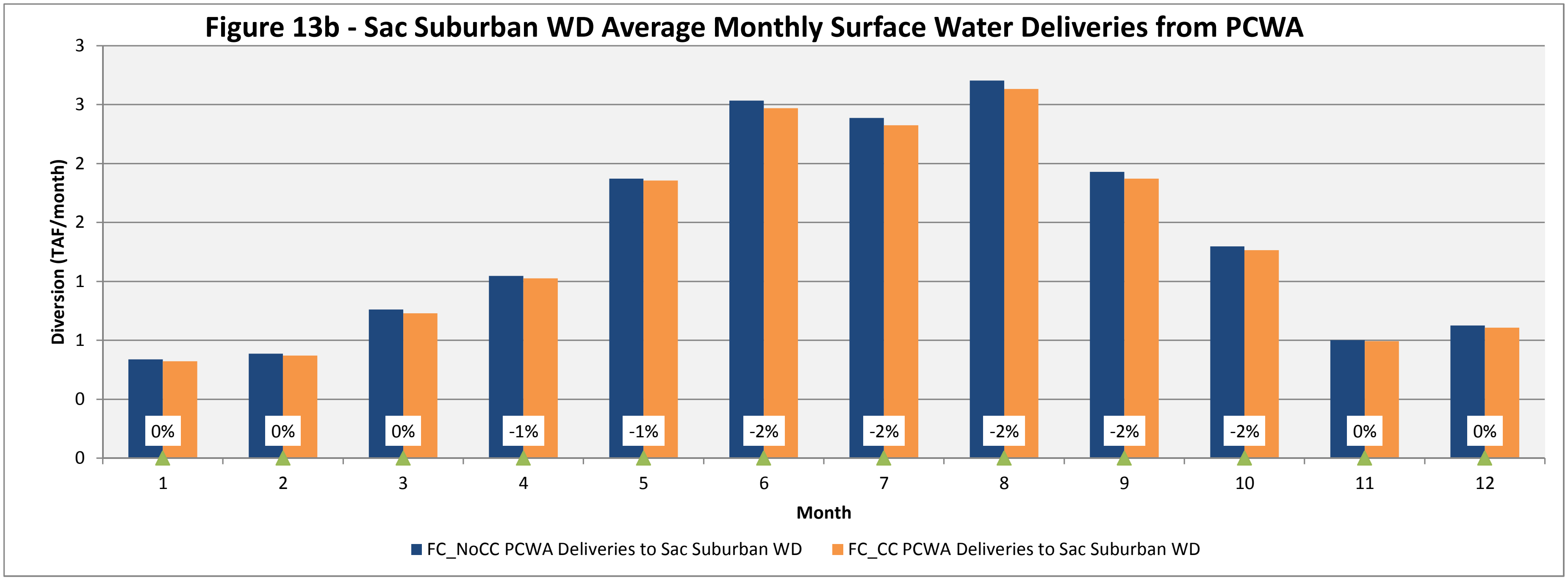


Figure 13b - Sac Suburban WD Average Monthly Surface Water Deliveries from PCWA
Diversion (TAF/month)
3
3
2
2
1
1
0
0
0%
0%
0%
-1%
-1%
-2%
-2%
-2%
-2%
-2%
0%
0%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC PCWA Deliveries to Sac Suburban WD
FC_CC PCWA Deliveries to Sac Suburban WD

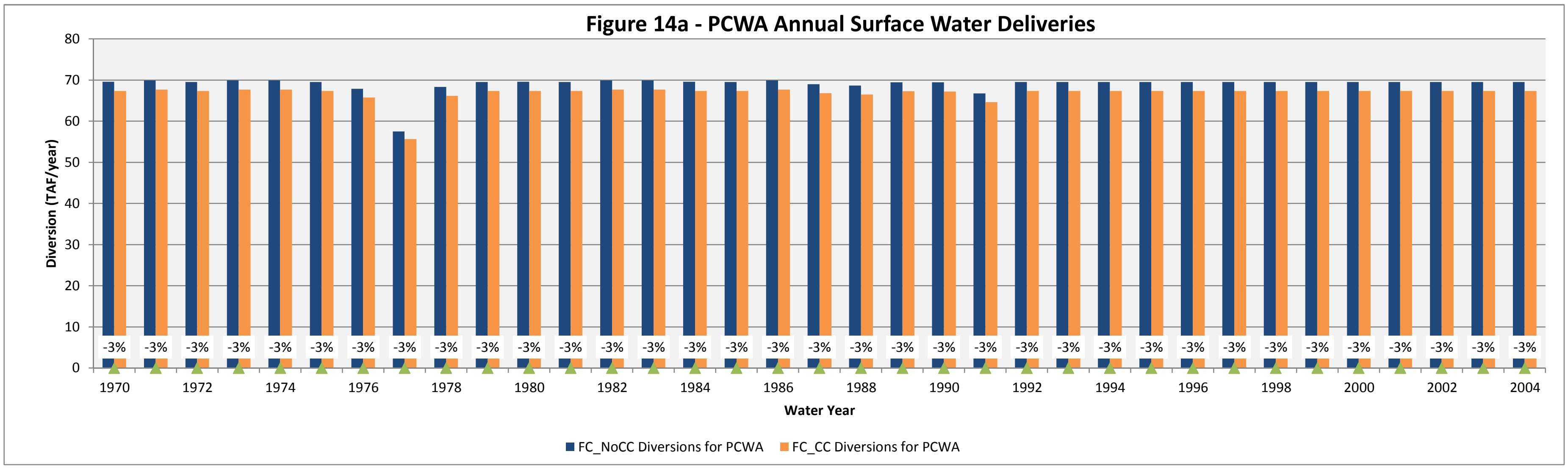


Figure 14a - PCWA Annual Surface Water Deliveries
Diversion (TAF/year)
0
10
20
30
40
50
60
70
80
-3%
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Water Year
FC_NoCC Diversions for PCWA
FC_CC Diversions for PCWA

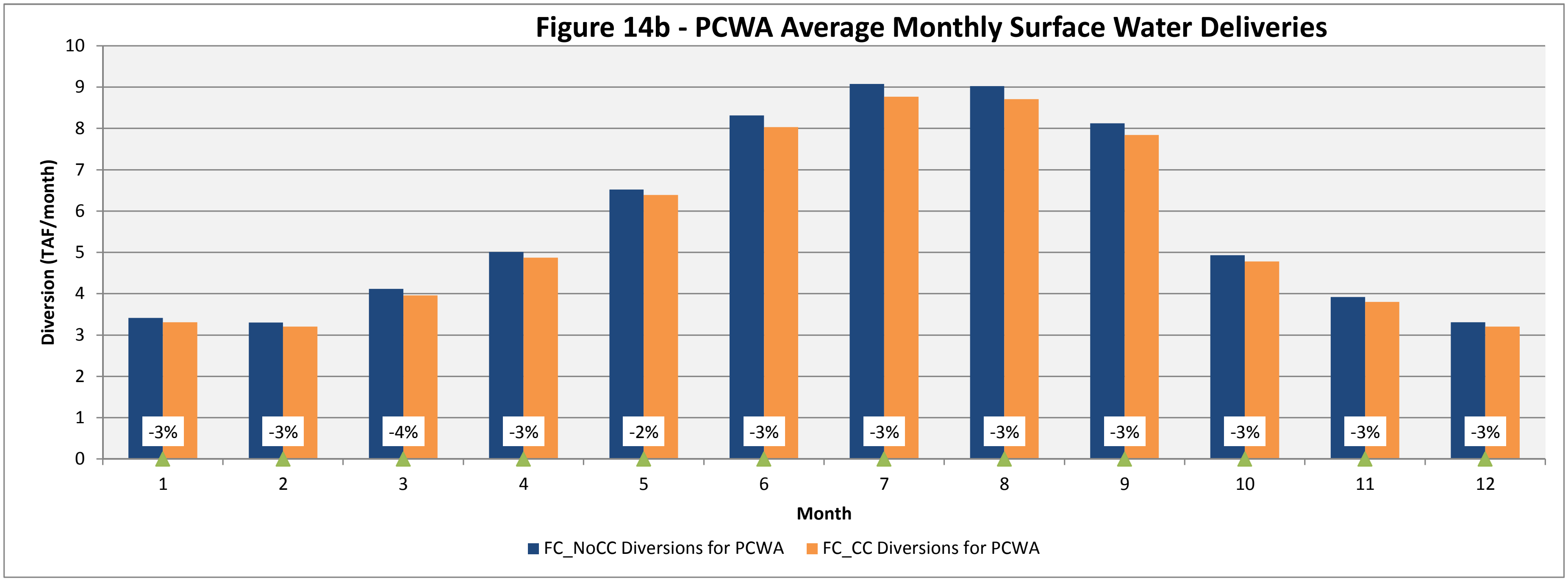


Figure 14b - PCWA Average Monthly Surface Water Deliveries
Diversion (TAF/month)
10
9
8
7
6
5
4
3
2
1
0
-3%
-3%
-4%
-3%
-2%
-3%
-3%
-3%
-3%
-3%
-3%
-3%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions for PCWA
FC_CC Diversions for PCWA

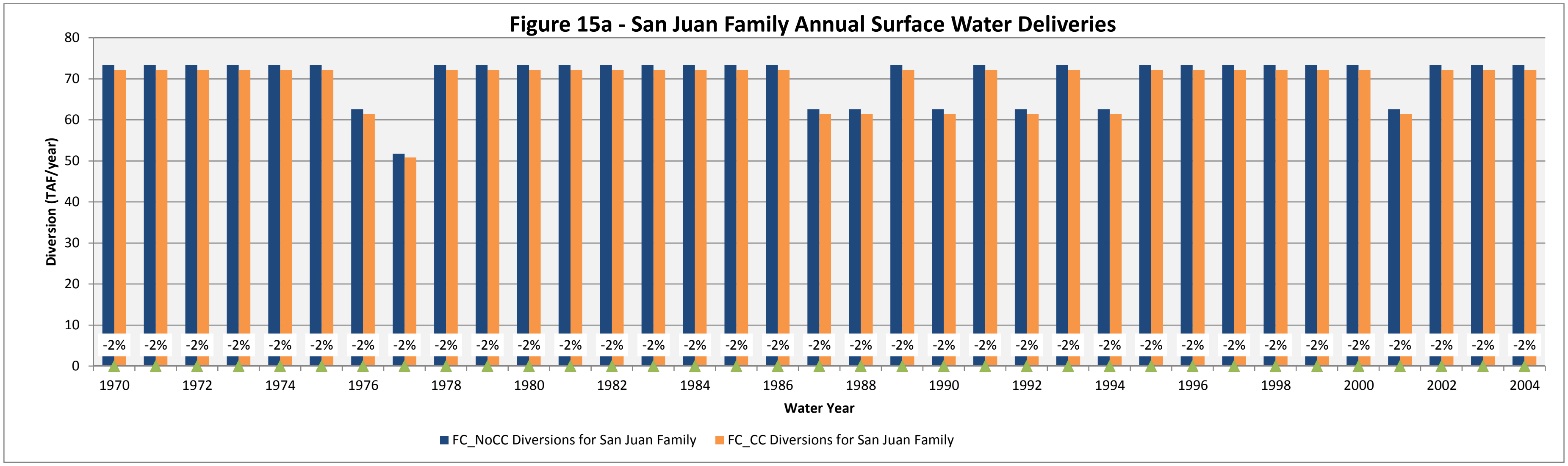


Figure 15a - San Juan Family Annual Surface Water Deliveries
Diversion (TAF/year)
Water Year
FC_NoCC Diversions for San Juan Family
FC_CC Diversions for San Juan Family
-2%

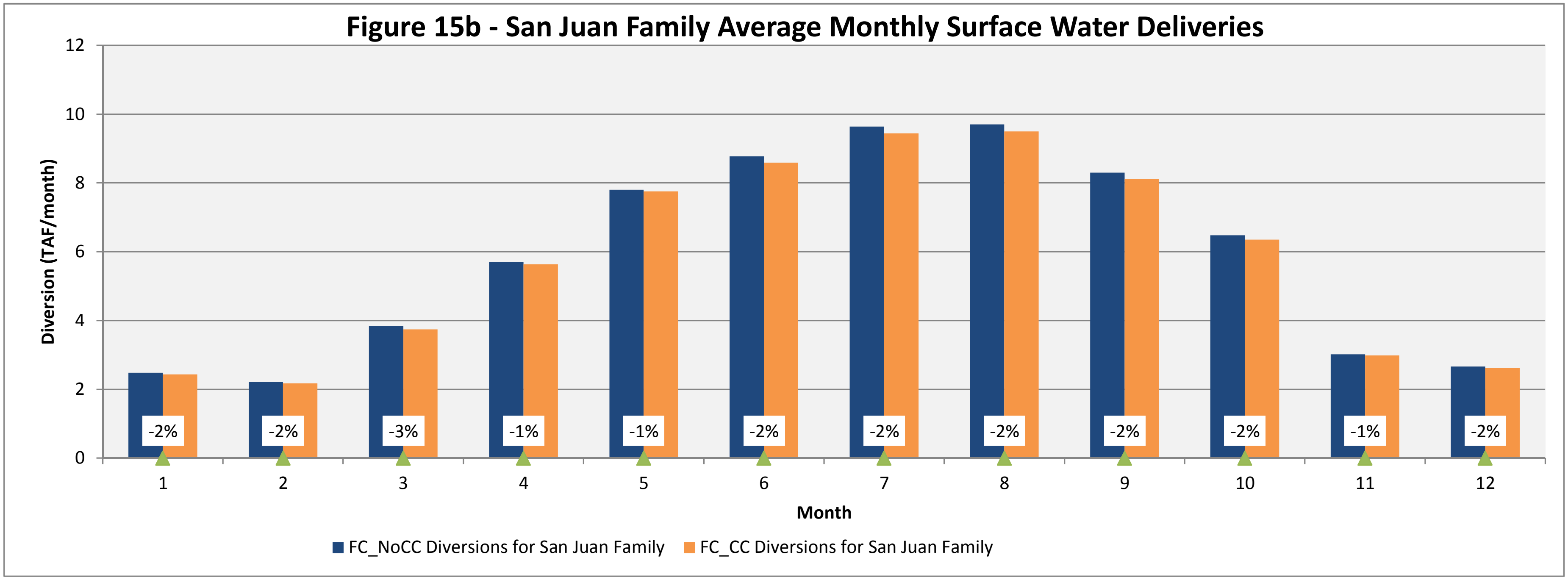


Figure 15b - San Juan Family Average Monthly Surface Water Deliveries
Diversion (TAF/month)
0
2
4
6
8
10
12
-2%
-2%
-3%
-1%
-1%
-2%
-2%
-2%
-2%
-2%
-1%
-2%
1
2
3
4
5
6
7
8
9
10
11
12
Month
FC_NoCC Diversions for San Juan Family
FC_CC Diversions for San Juan Family

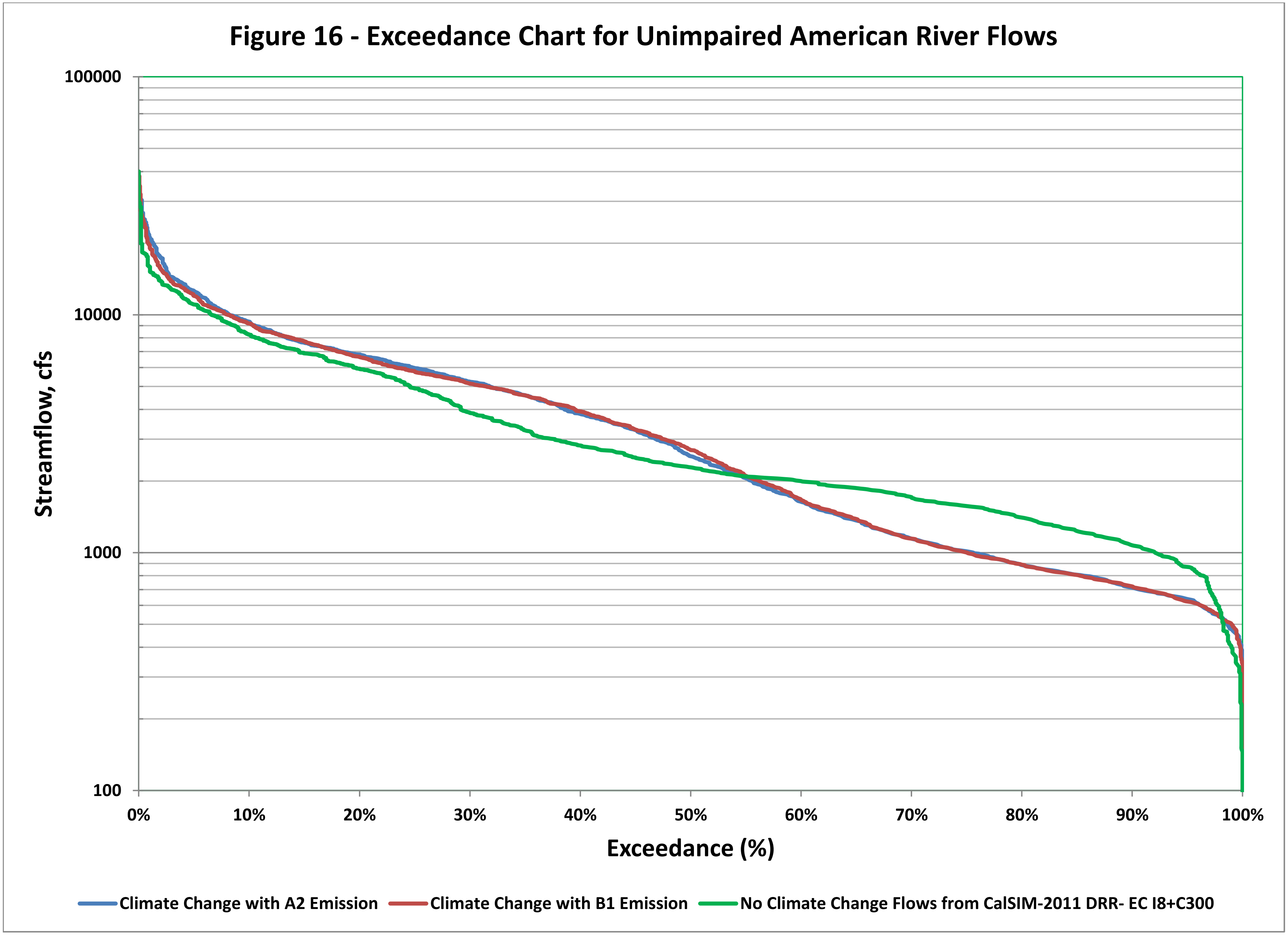


Figure 16 - Exceedance Chart for Unimpaired American River Flows
100000
10000
1000
100
Streamflow, cfs
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Exceedance (%)
Climate Change with A2 Emission
Climate Change with B1 Emission
No Climate Change Flows from CalSIM-2011 DRR- EC I8+C300

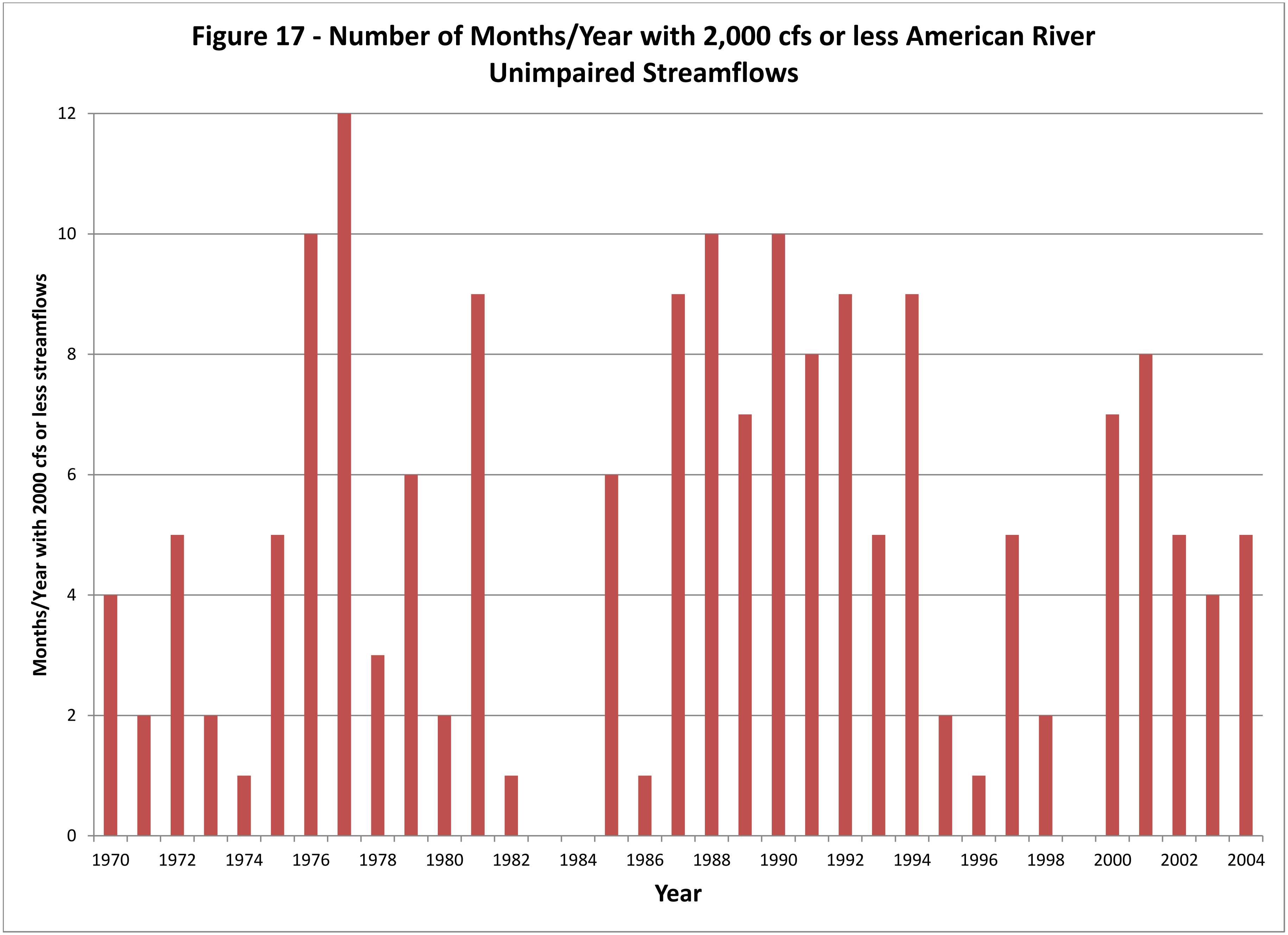


Figure 17 - Number of Months/Year with 2,000 cfs or less American River
Unimpaired Streamflows
Months/Year with 2000 cfs or less streamflows
0
2
4
6
8
10
12
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year

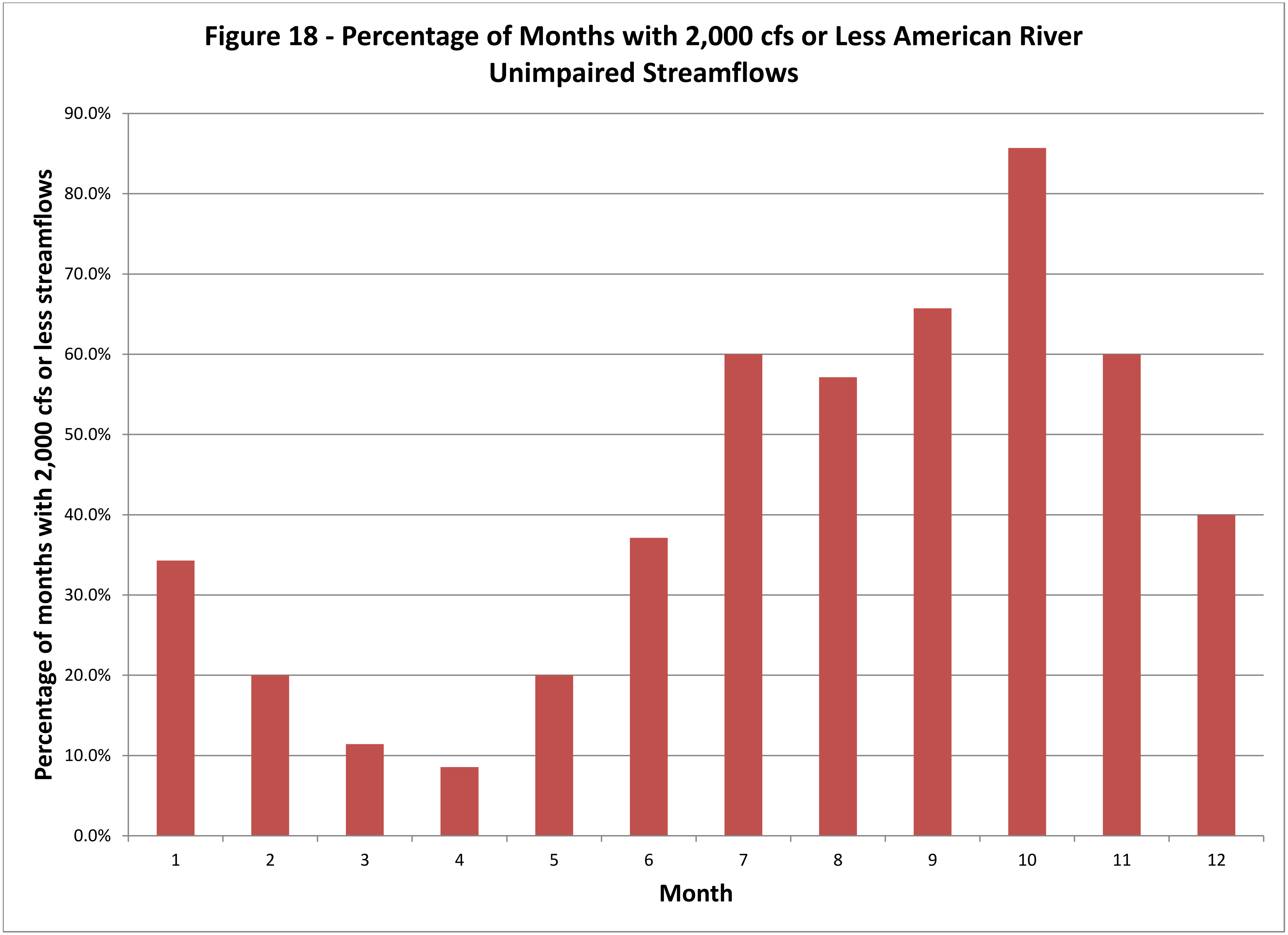


Figure 18 - Percentage of Months with 2,000 cfs or Less American River Unimpaired Streamflows
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Percentage of months with 2,000 cfs or less streamflows
1
2
3
4
5
6
7
8
9
10
11
12
Month

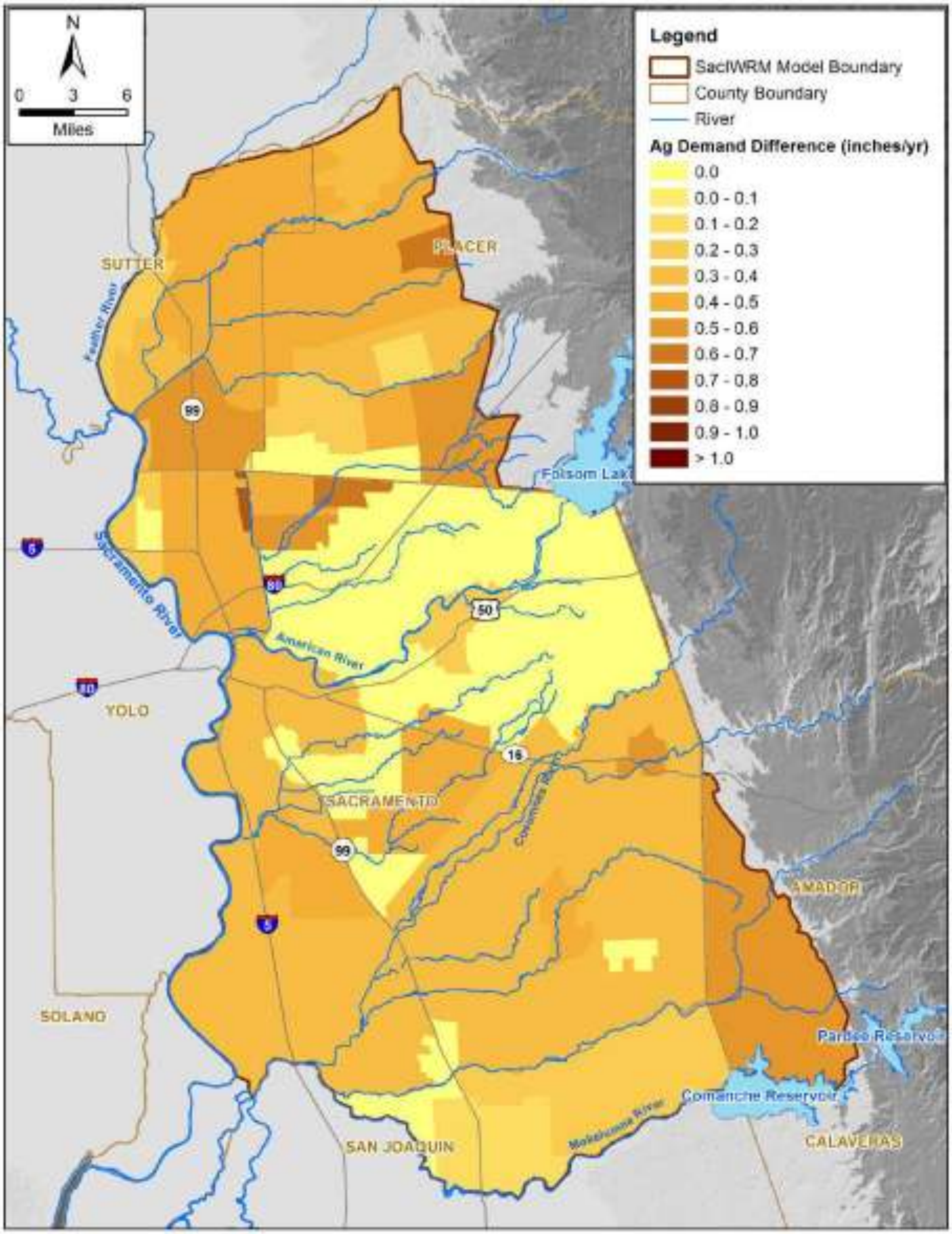


Figure 19 – Increase in Agricultural Water Demand in the SacIWRM Area

[Note: Increase in Agricultural Water Demand in Subregion i (inches/yr) =
Increase in Agricultural Water Demand in Subregion i (AF/yr) /Area of Subregion i (acres) * 12 inches/foot]

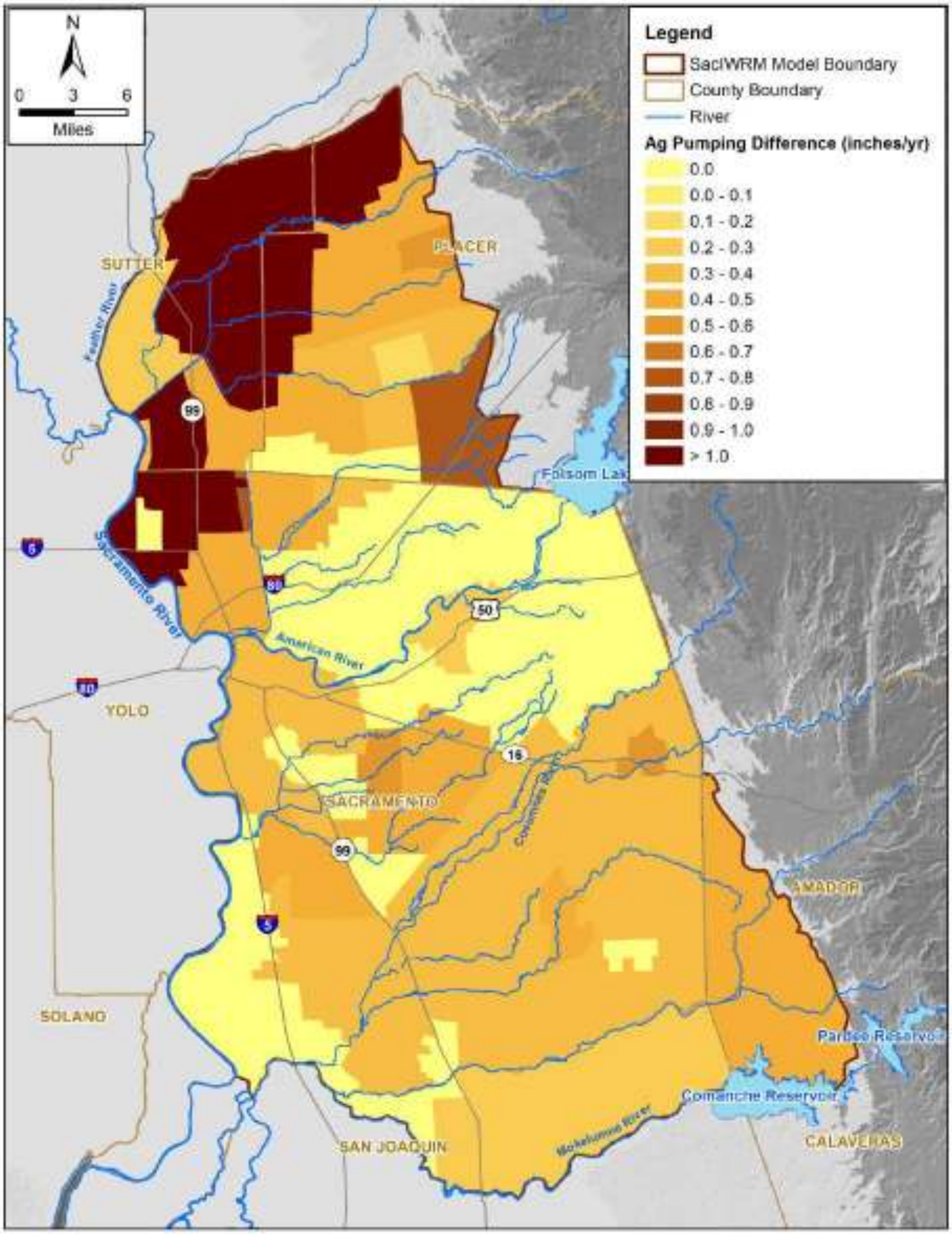


Figure 20a – Increase in Agricultural Groundwater Pumping in the SacIWRM Area for Scenario 1

[Note: Increase in Agricultural Groundwater Pumping in Subregion i (inches/yr) =
Increase in Agricultural Groundwater Pumping in Subregion i (AF/yr) /Area of Subregion i (acres) * 12 inches/foot]

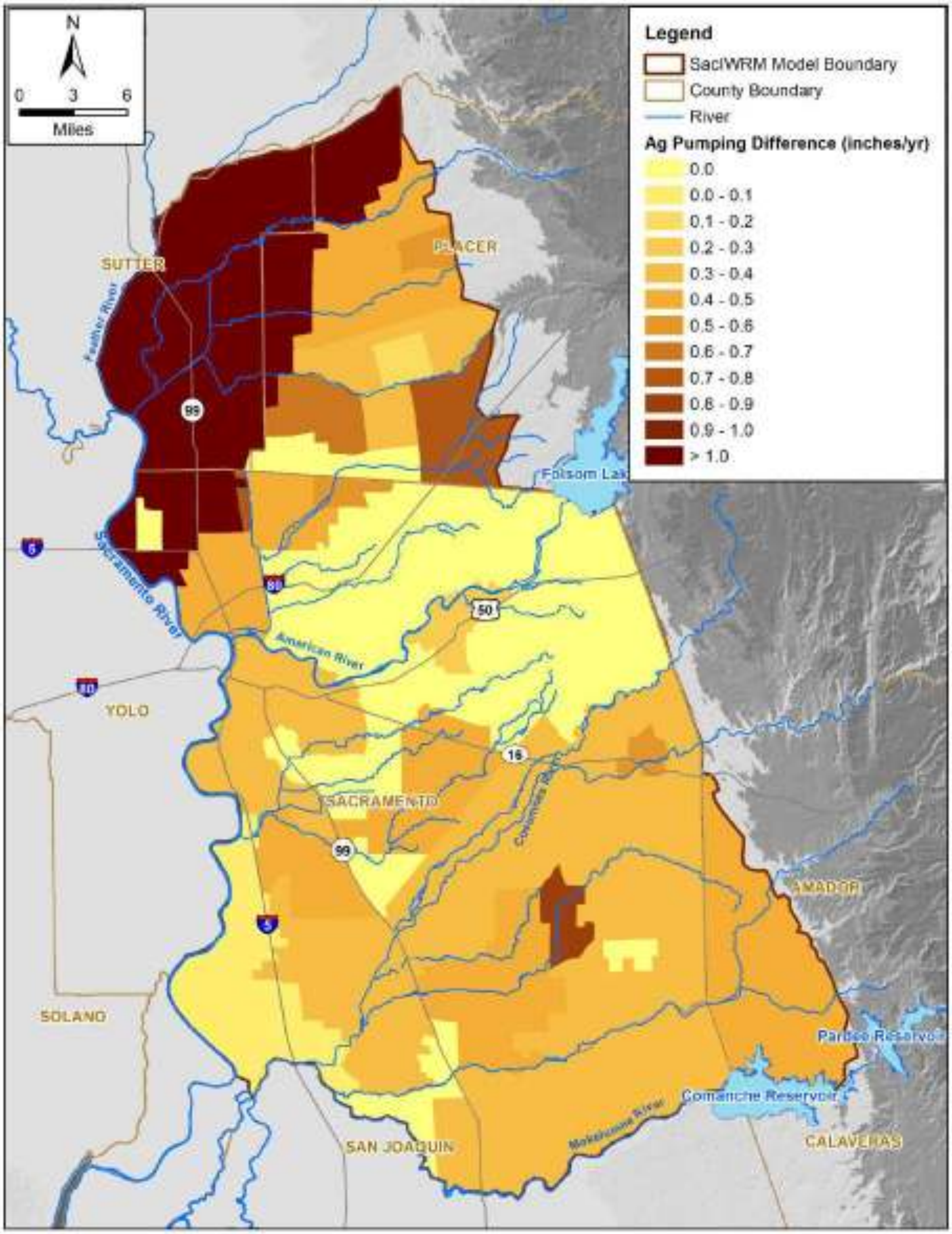


Figure 20b – Increase in Agricultural Groundwater Pumping in the SacIWRM Area for Scenario 2

[Note: Increase in Agricultural Groundwater Pumping in Subregion i (inches/yr) =
Increase in Agricultural Groundwater Pumping in Subregion i (AF/yr) /Area of Subregion i (acres) * 12 inches/foot]

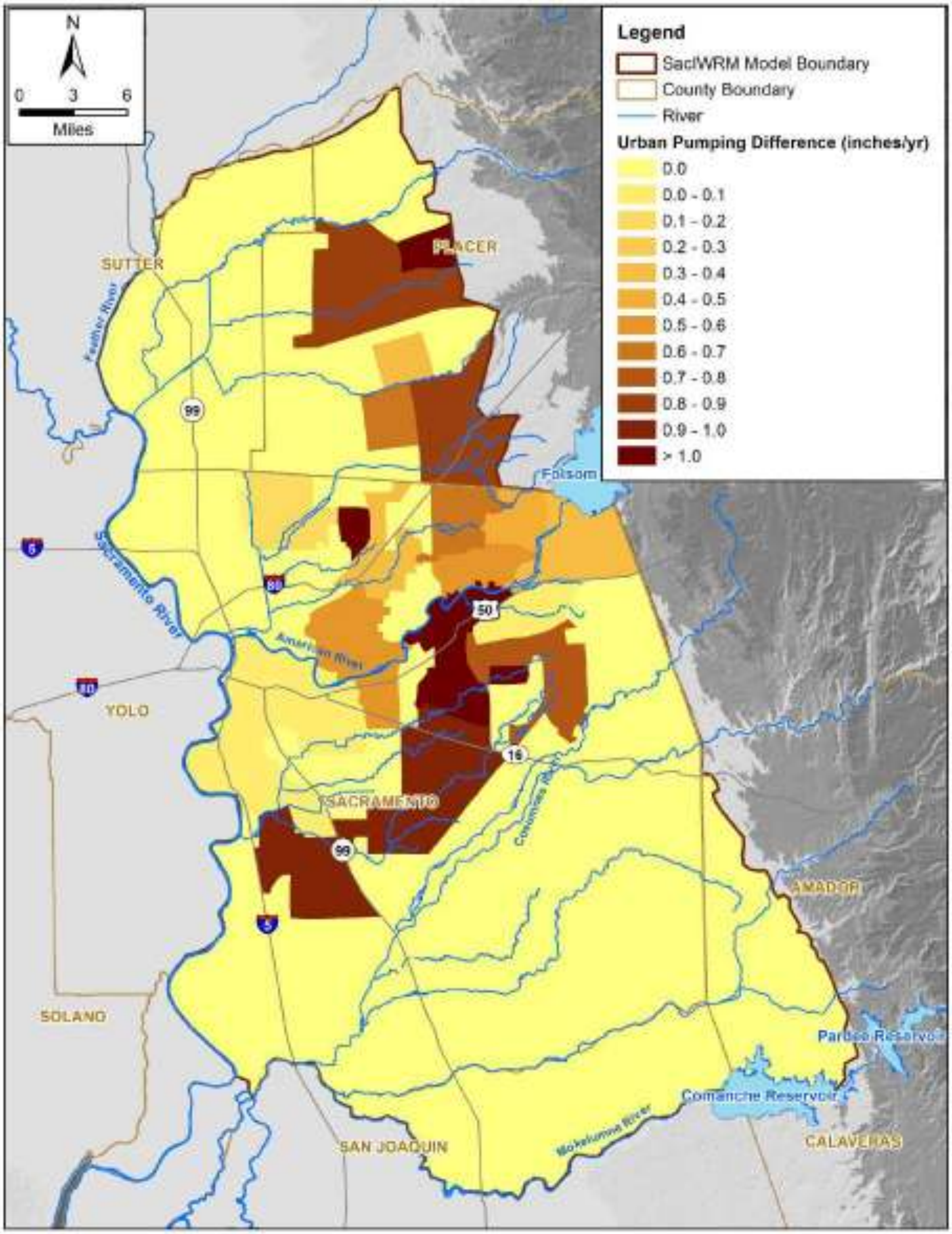


Figure 21a – Increase in Urban Groundwater Pumping in the SacIWRM Area for Scenario 1

[Note: Increase in Urban Groundwater Pumping in Subregion i (inches/yr) =
Increase in Urban Groundwater Pumping in Subregion i (AF/yr) /Area of Subregion i (acres) * 12 inches/foot]

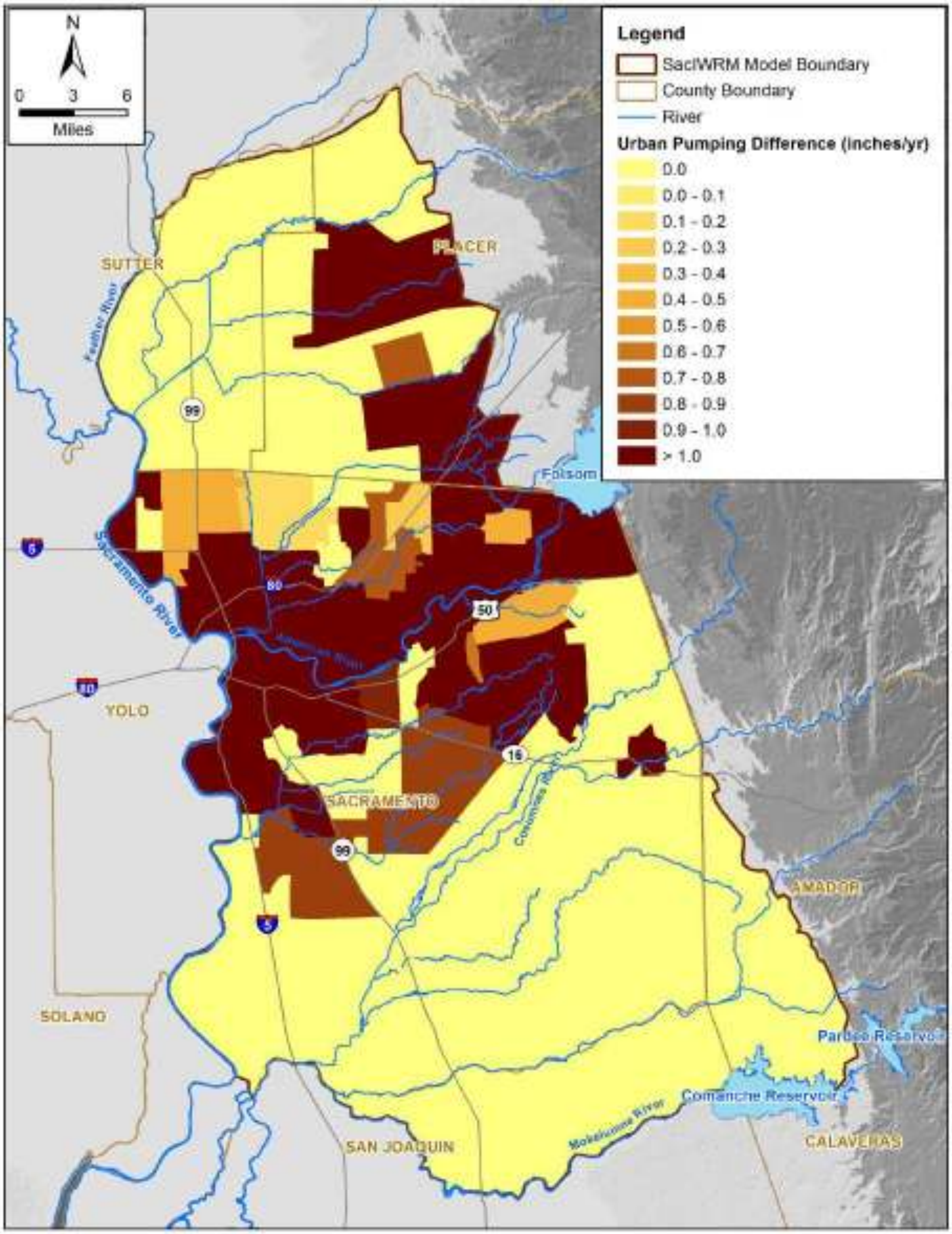


Figure 21b – Increase in Urban Groundwater Pumping in the SacIWRM Area for Scenario 2

[Note: Increase in Urban Groundwater Pumping in Subregion i (inches/yr) =
Increase in Urban Groundwater Pumping in Subregion i (AF/yr) /Area of Subregion i (acres) * 12 inches/foot]

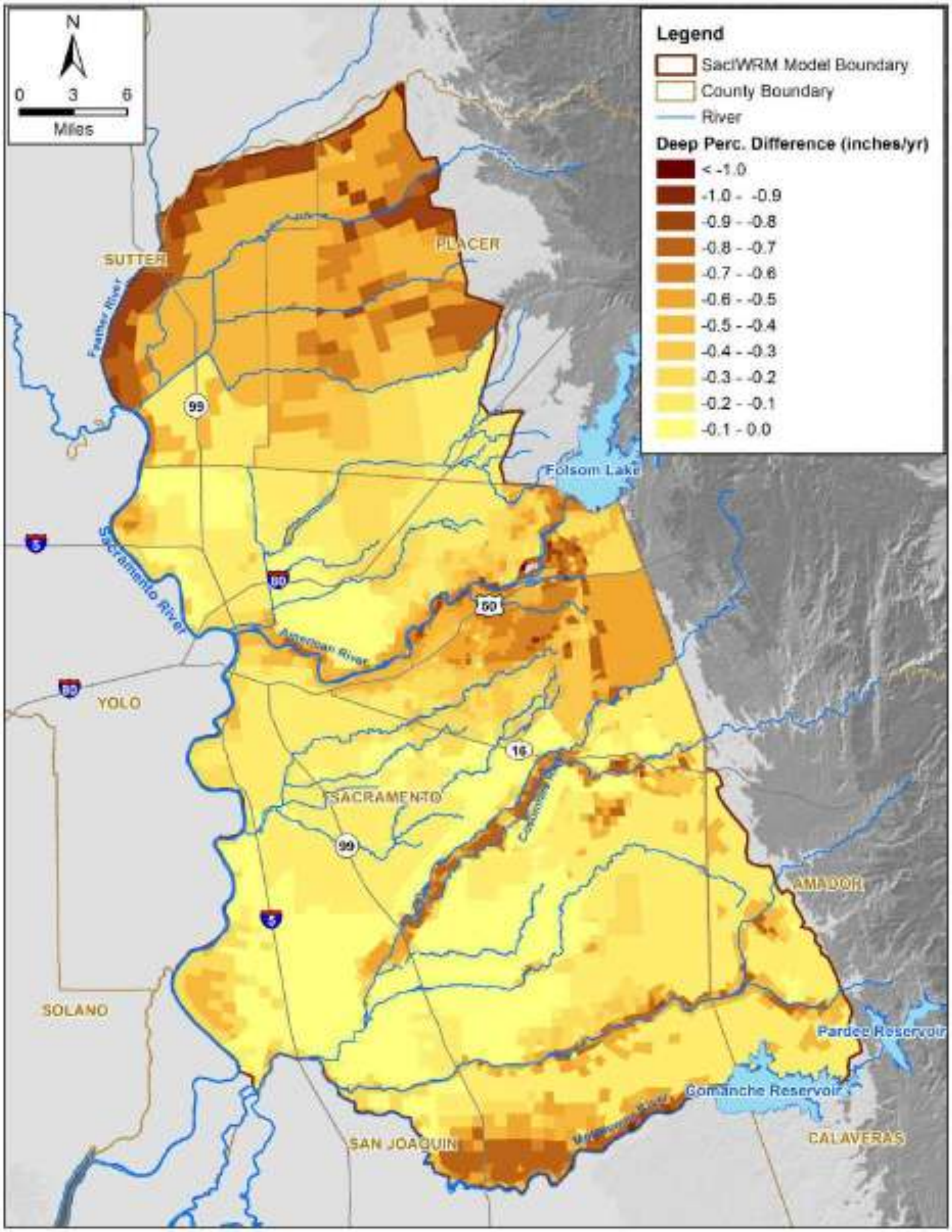


Figure 22a – Decrease in Deep Percolation in the SacIWRM Area for Scenario 1

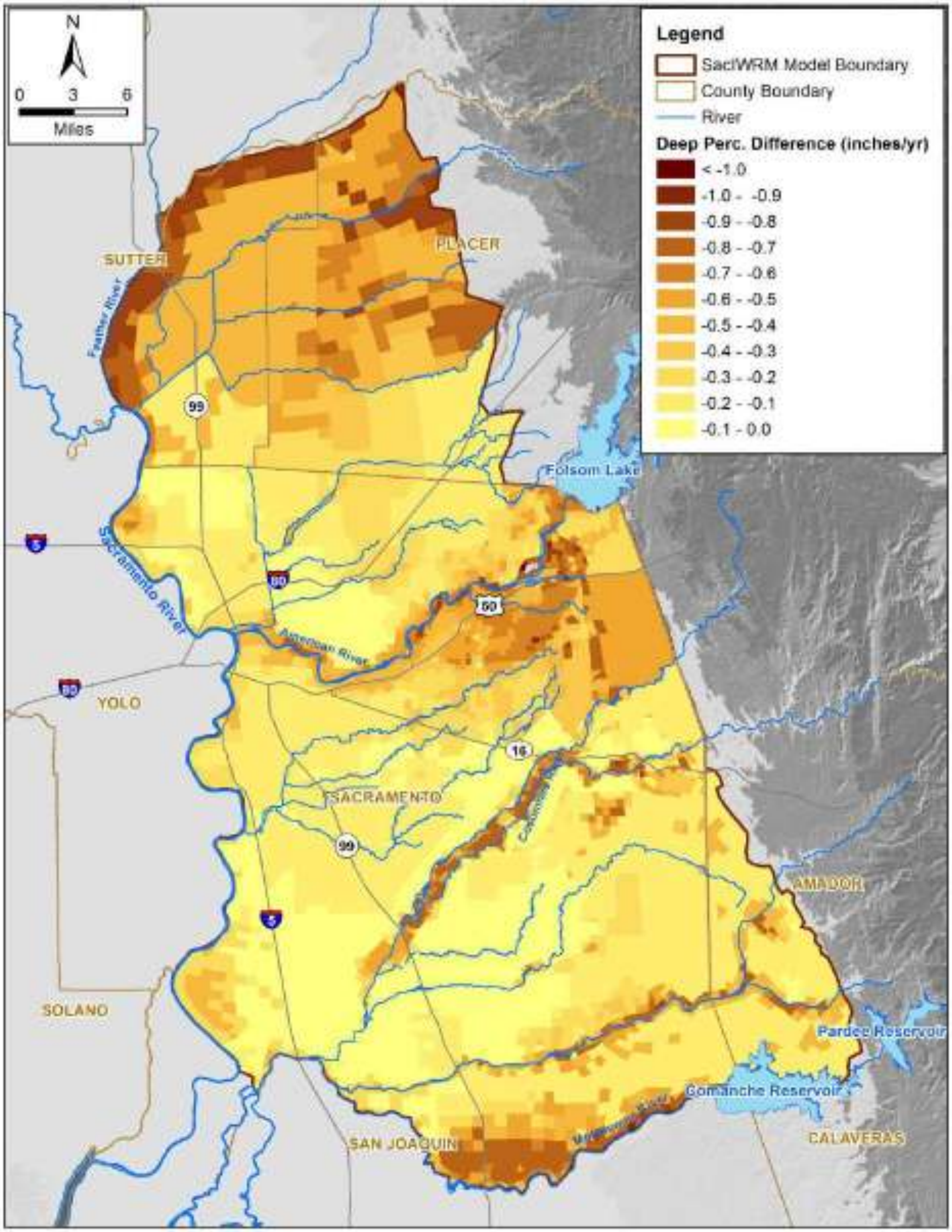


Figure 22b – Decrease in Deep Percolation in the SacIWRM Area for Scenario 2

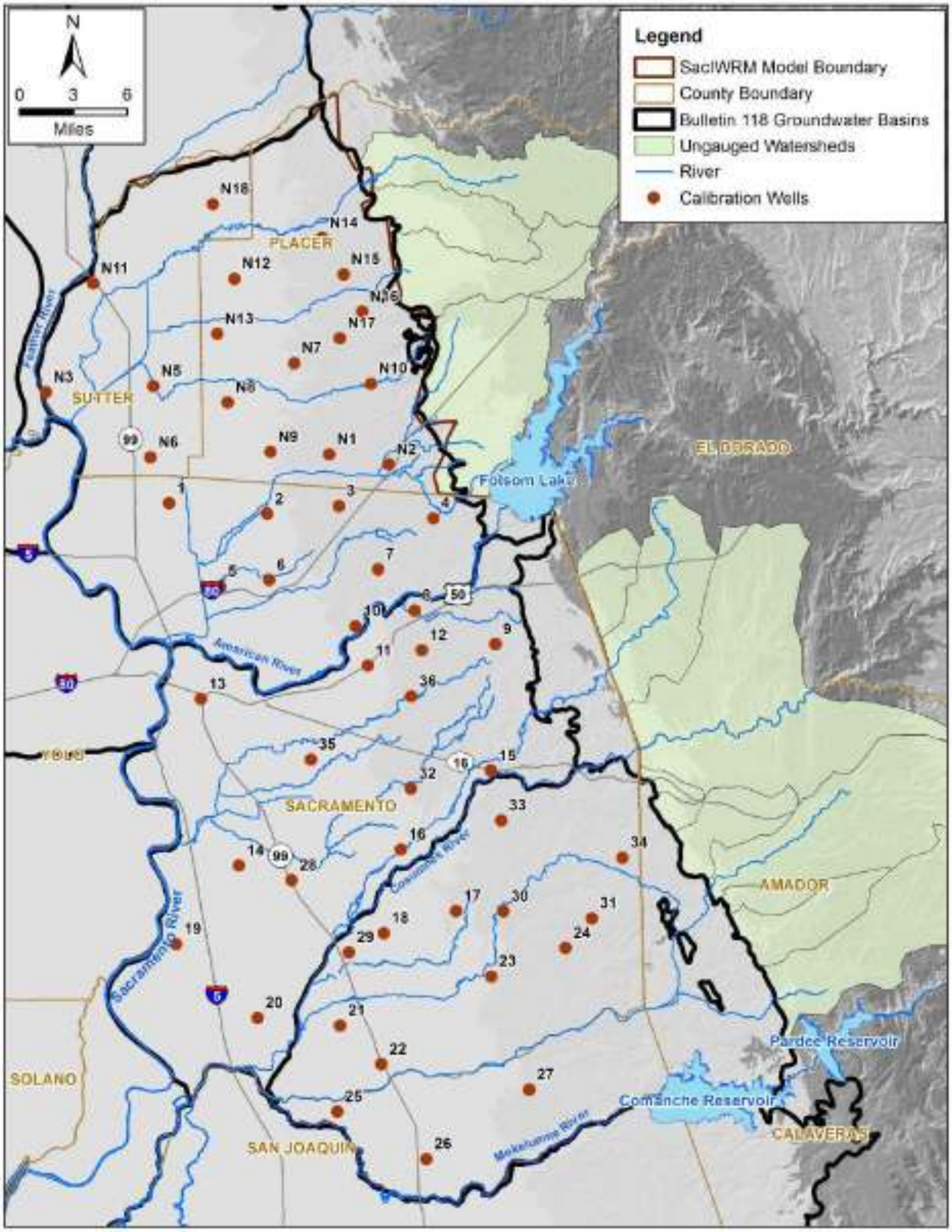


Figure 23 – Location of Representative Wells for Groundwater Hydrographs in the SacIWRM Area

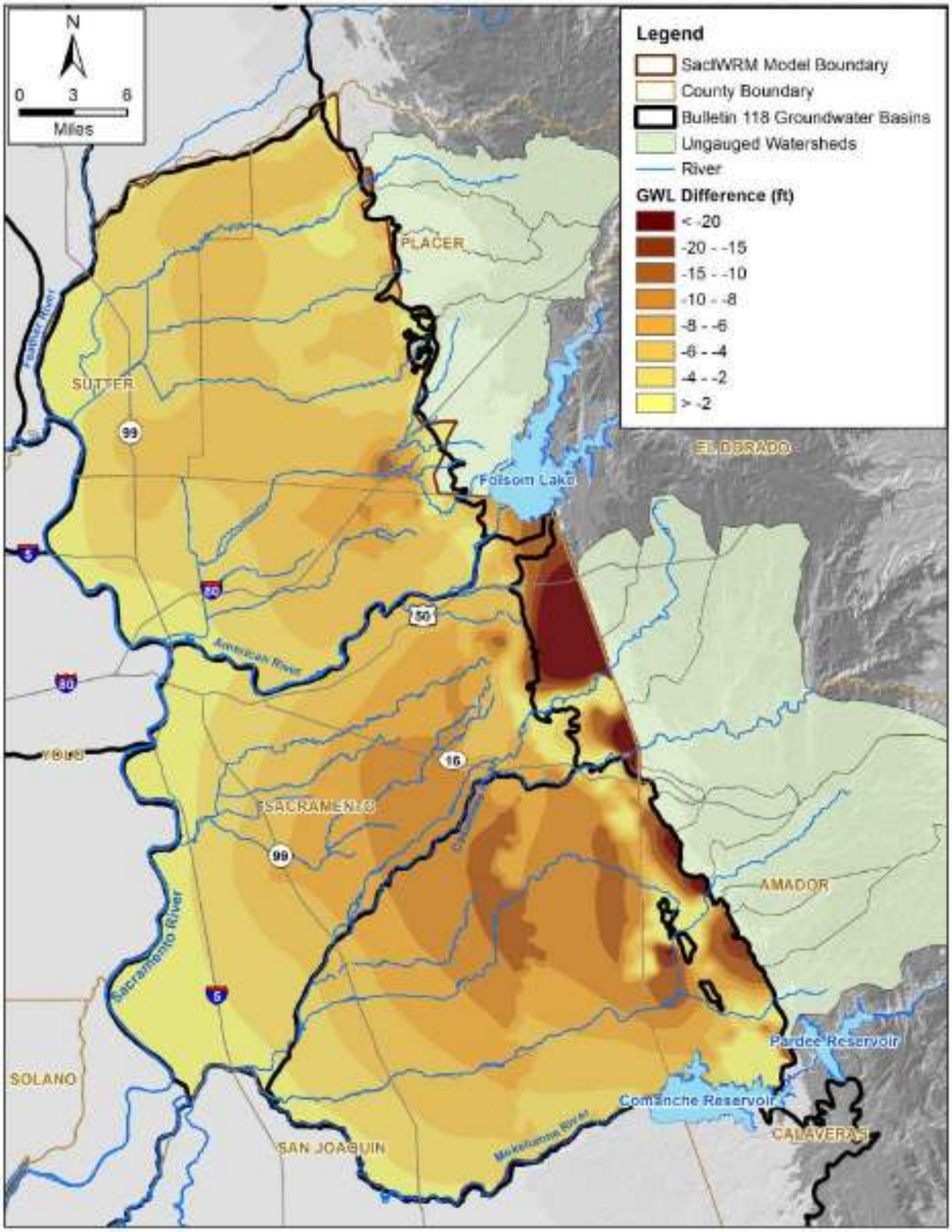


Figure 24a – Groundwater Elevation Decrease for Average Year for Scenario 1

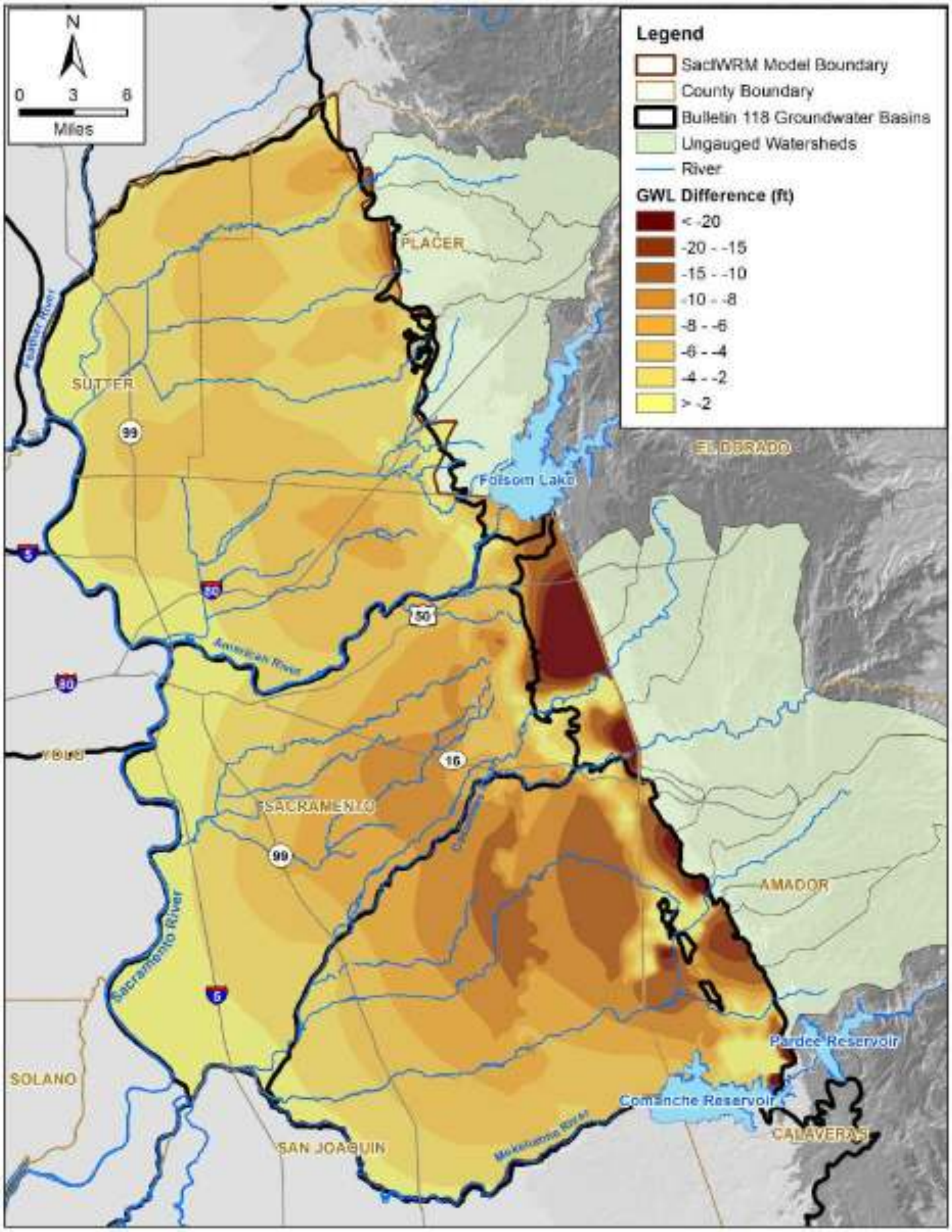


Figure 24b – Groundwater Elevation Decrease for Wet Year for Scenario 1

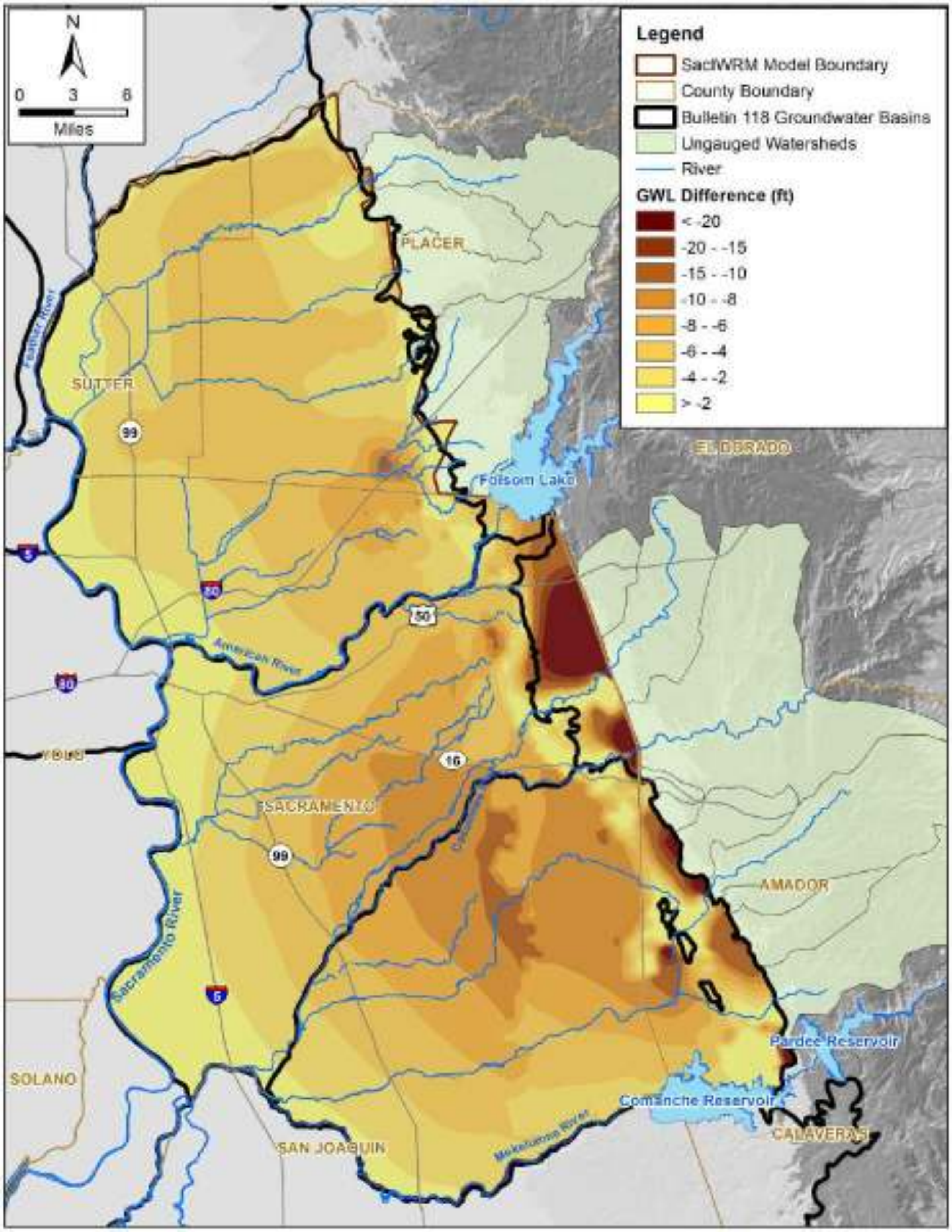


Figure 24c – Groundwater Elevation Decrease for Dry Year for Scenario 1

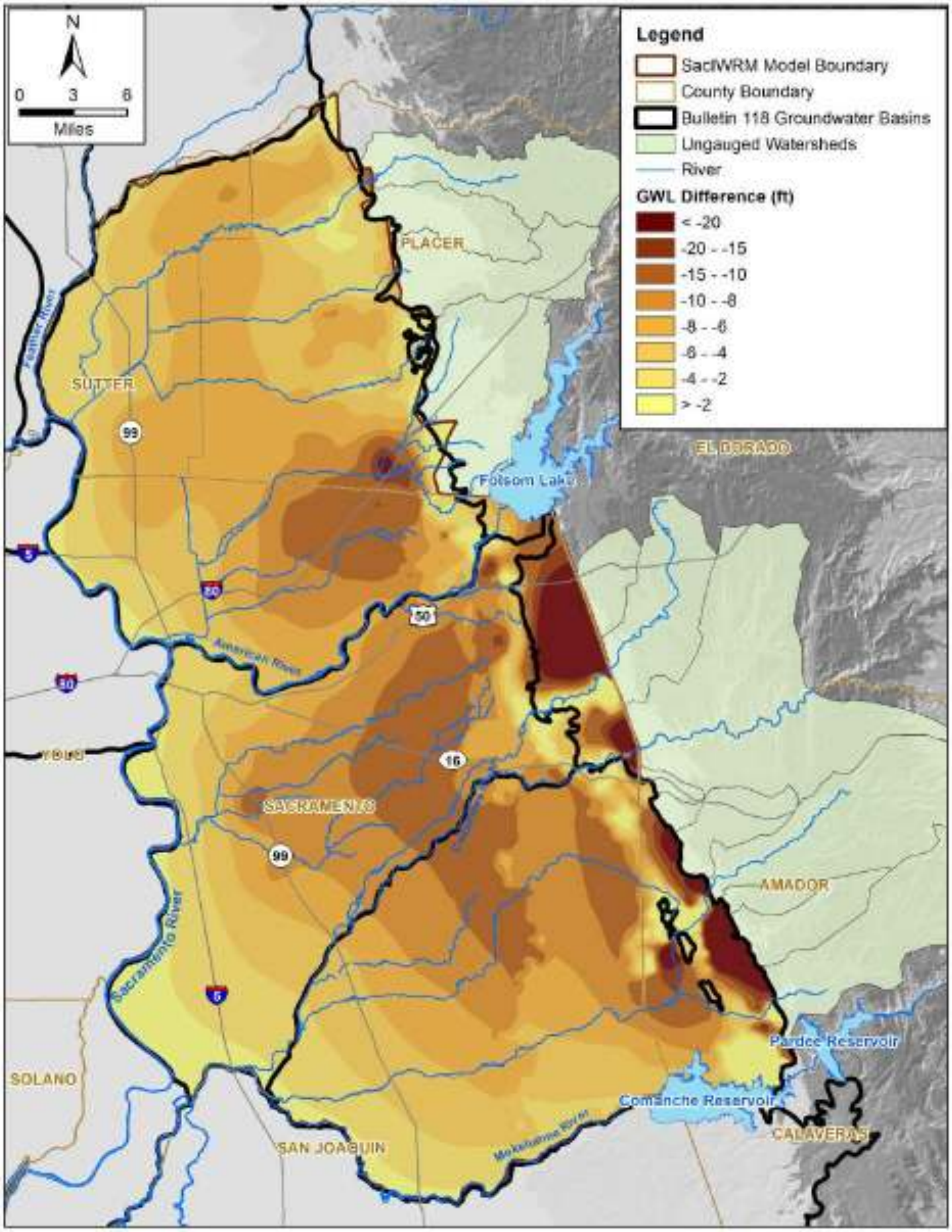


Figure 25a – Groundwater Elevation Decrease for Average Year for Scenario 2

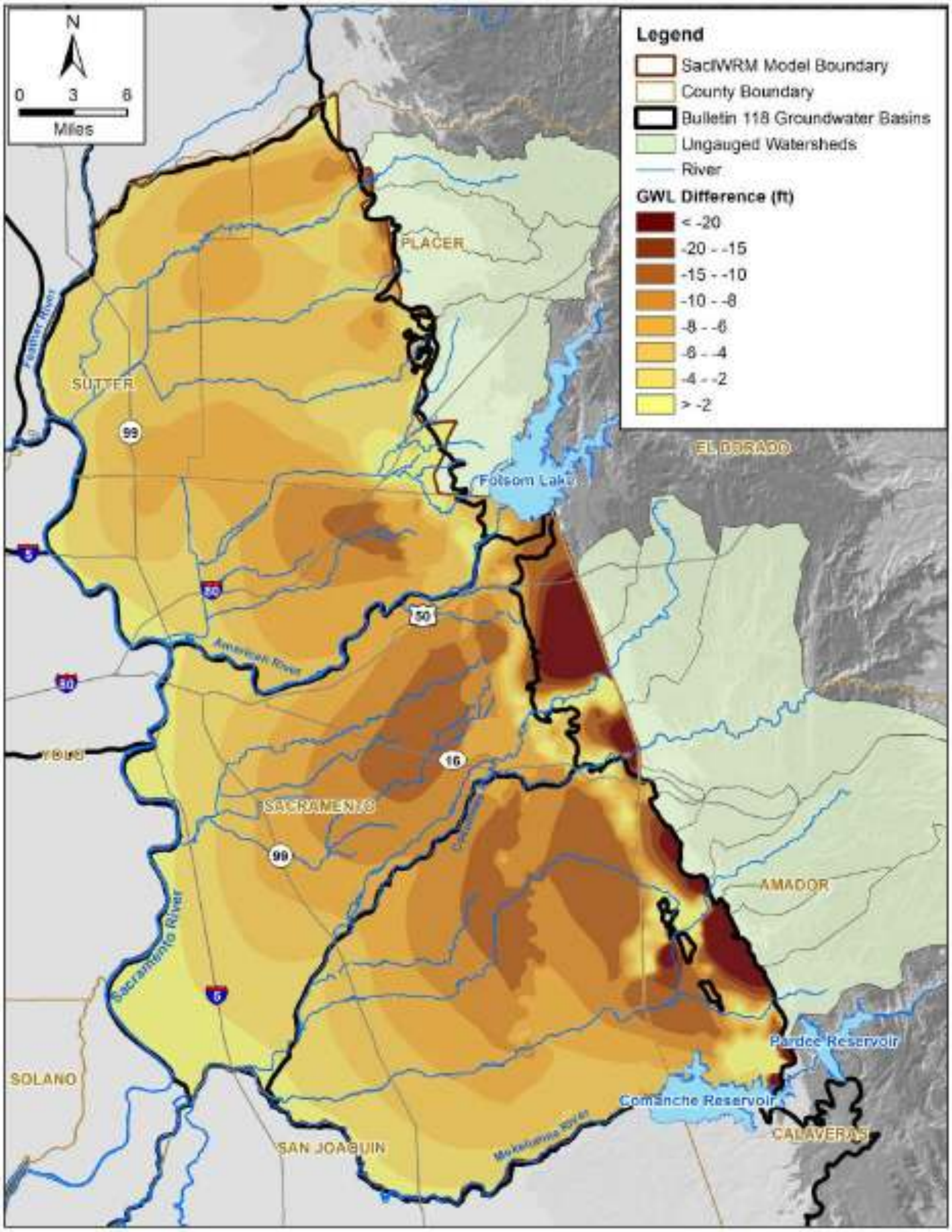


Figure 25b – Groundwater Elevation Decrease for Wet Year for Scenario 2

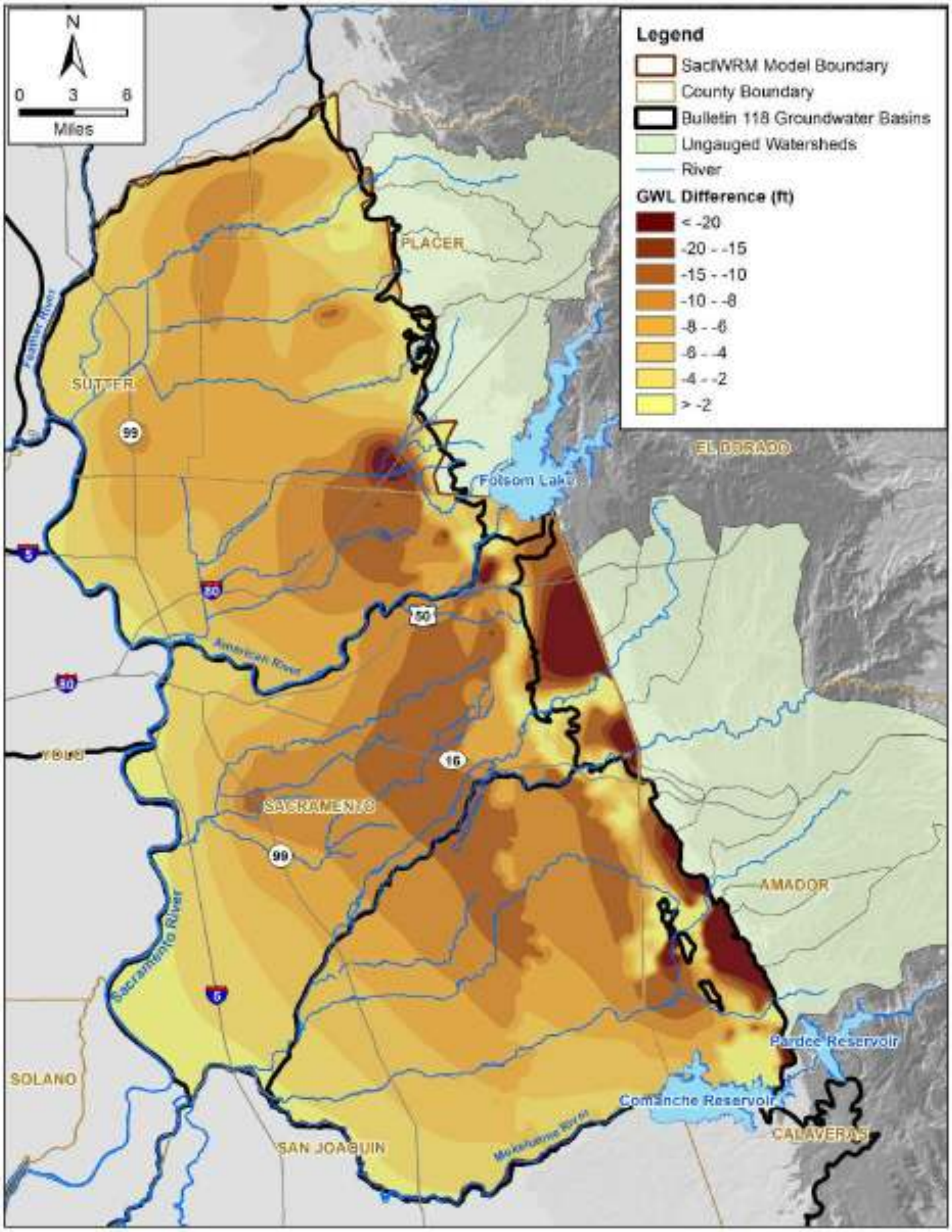


Figure 25c – Groundwater Elevation Decrease for Dry Year for Scenario 2

Appendix A Three-step Purturbation Method

Three-step Perturbation Method:

(Authors: Jianzhong Wang, Hongbing Yin, Francis Chung; Publisher: Journal of Hydrology; Volume 405, Issues 1-2, July 2011, Pages 83-92):

Step one: monthly perturbation ratio

Monthly perturbation ratio, R_i, is derived from the past mean monthly inflow from a climate model projection for each month, Qi, and the mean monthly inflow for the future from a climate model projection, P_i

$$\frac{P_i}{Q_i} \quad i = 1,2,\dots,12$$

The historical monthly inflow in each year (T_{ij}, i = 1, . . ., 12 for each month and j = 1, . . ., 35 for each water year from 1970 to 2004) is multiplied by the perturbation ratio.
So the perturbed monthly inflow becomes

$$A_{ij} = R_i \times T_{ij} \quad i = 1,2,\dots,12, \;\; j = 1,2,\dots,35$$

Step two: annual inflow adjustment

The annual inflow after perturbation $\sum_{i=1}^{i=12} A_{ij}$ is probably not equal to the original annual inflow, which is$\sum_{i=1}^{i=12} T_{ij}$. Annual inflow adjustment keeps the annual inflow unchanged through multiplying the perturbed monthly inflow A_{ij} by the ratio $\frac{\sum_{i=1}^{i=12} T_{ij}}{\sum_{i=1}^{i=12} A_{ij}}$ for each historical year. Thus, the perturbed and annual inflow adjusted monthly inflow, B_{ij}, becomes:

$$B_{ij} = A_{ij} \times \frac{\sum_{i=1}^{i=12} T_{ij}}{\sum_{i=1}^{i=12} A_{ij}} \quad i = 1,2,\dots,12, \;\; j = 1,2,\dots,35$$

After doing this, only shifting of inflow seasonal pattern due to early snow-melting and other factors is kept in the perturbed and annual inflow adjusted inflow

Step three: trend adjustment

Although different climate models have predicted different precipitation trends, keeping individual annual inflow trends is desirable to account for the uncertainty of climate models in predicting annual inflow. To address this, we introduce the trend adjustment procedure. The trend ratio T_r can be estimated by

$$T_r = \frac{\sum_{i=1}^{i=12} P_i}{\sum_{i=1}^{i=12} Q_i}$$

Through multiplying the perturbed and annual inflow adjusted monthly inflow by the trend ratio, we have the perturbed, annual inflow adjusted, and trend adjusted monthly flow, $\hat{T}_{ij}$, i = 1,..,12, as follows

$$\hat{T}_{ij} = B_{ij} \times T_r \quad i = 1,2,\dots,12, \;\; j = 1,2,\dots,35$$

Appendix B1 Representative Groundwater Elevation Hydrographs in NAR Area (north of Sacramento County Line)

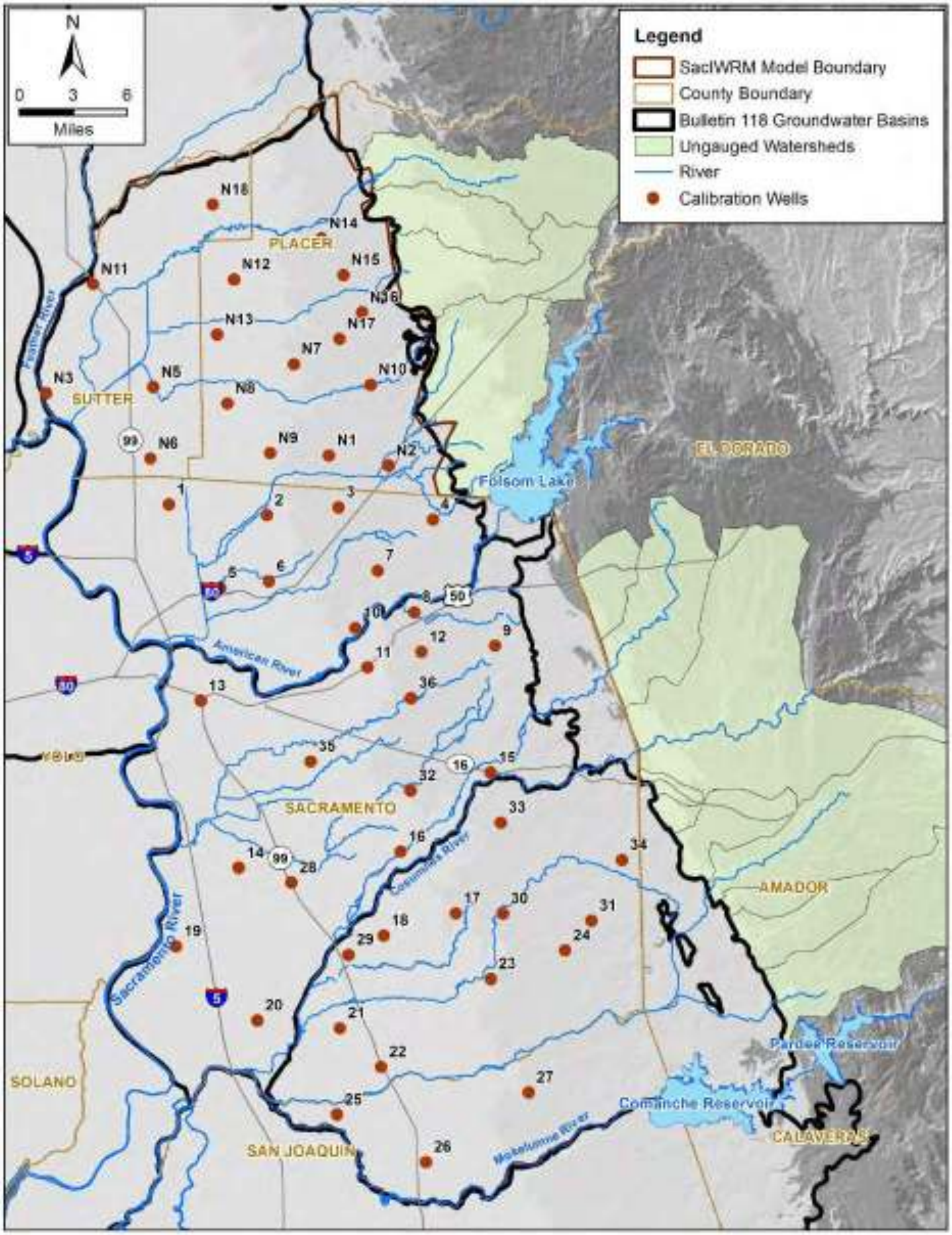
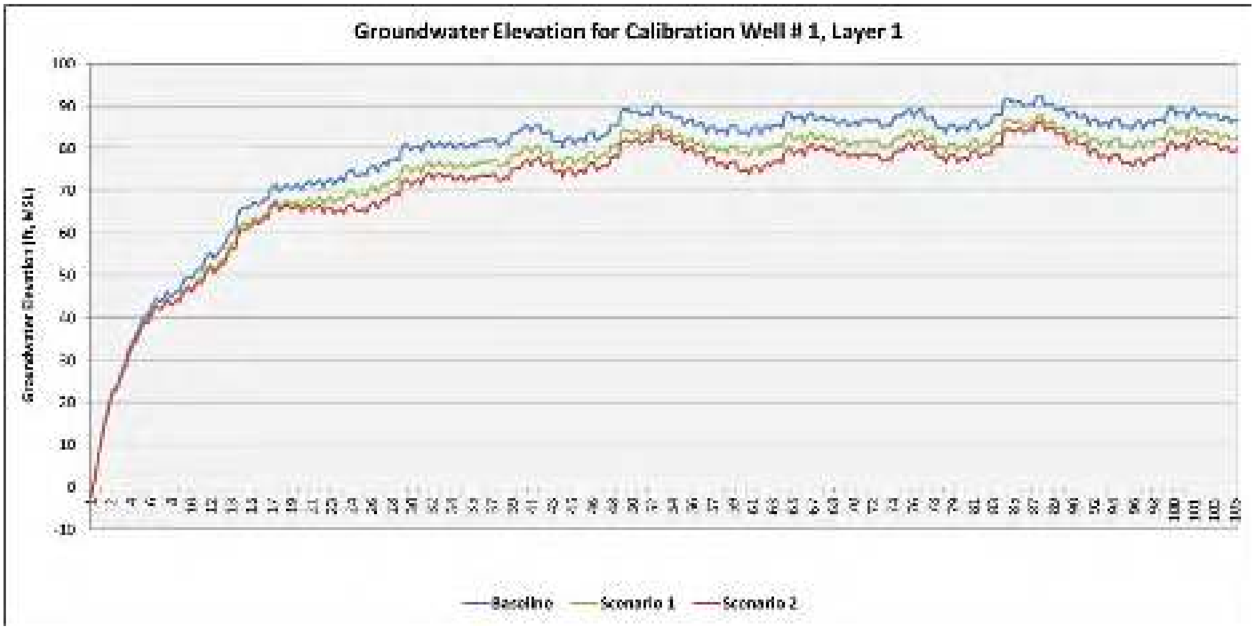
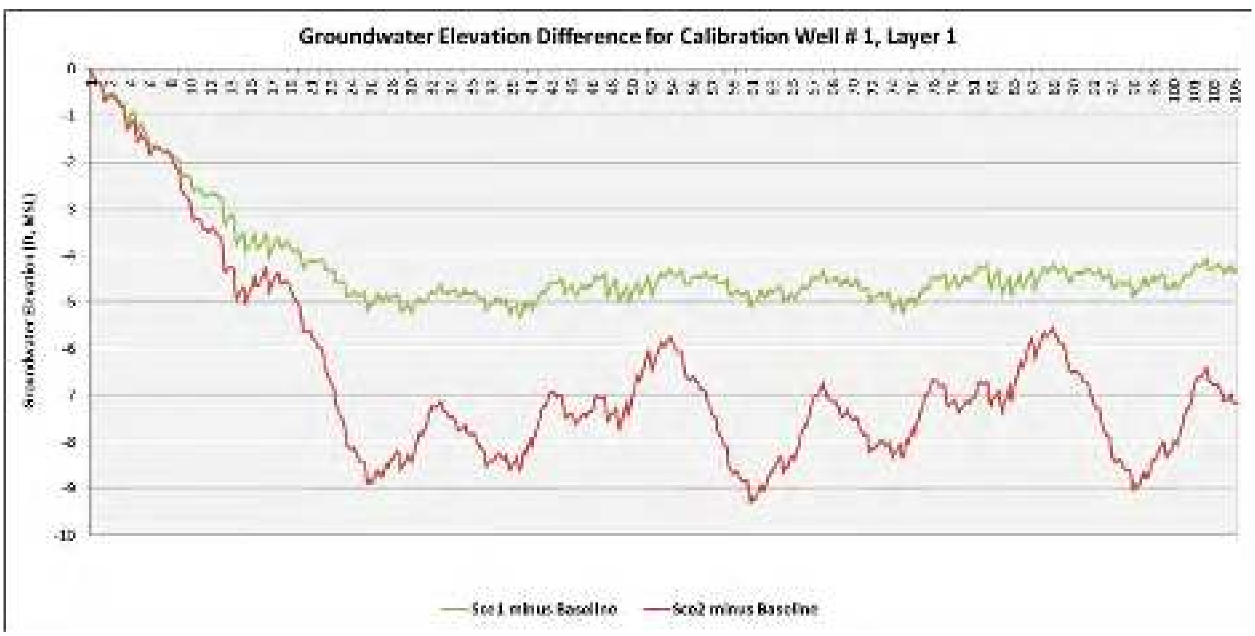
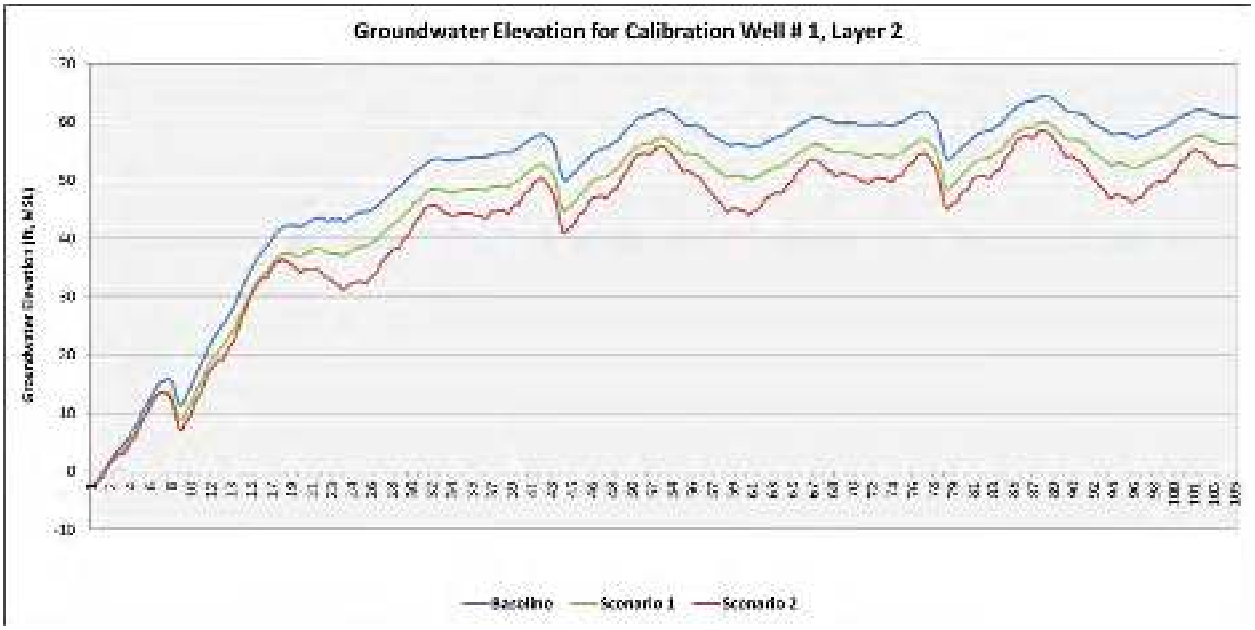
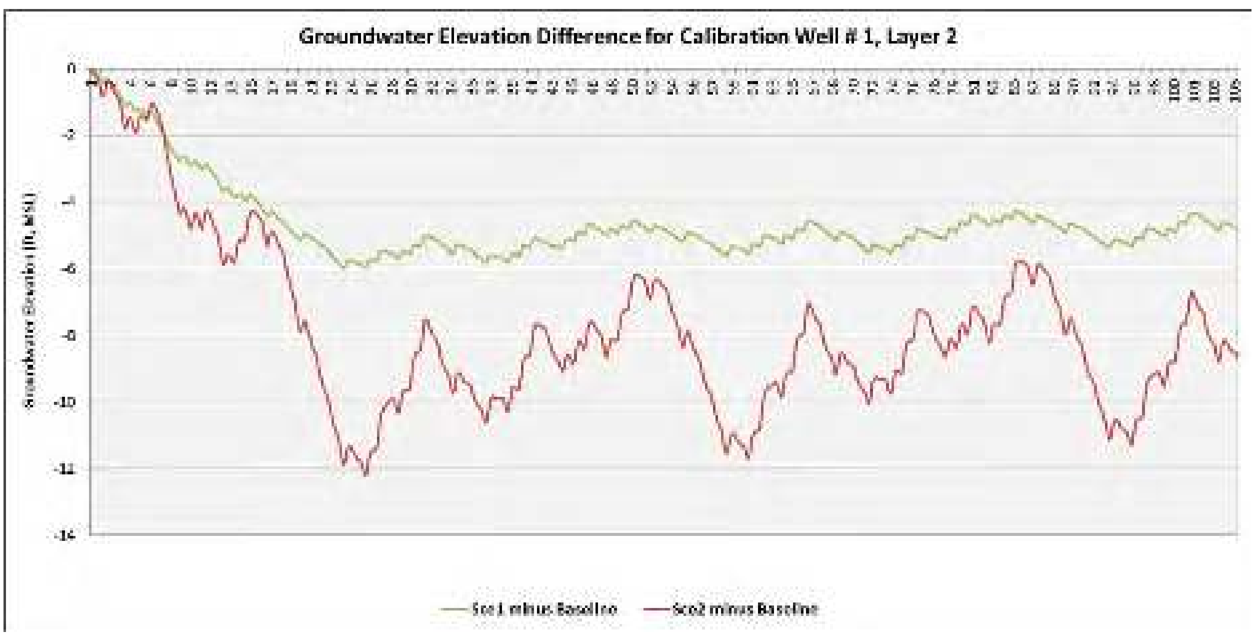


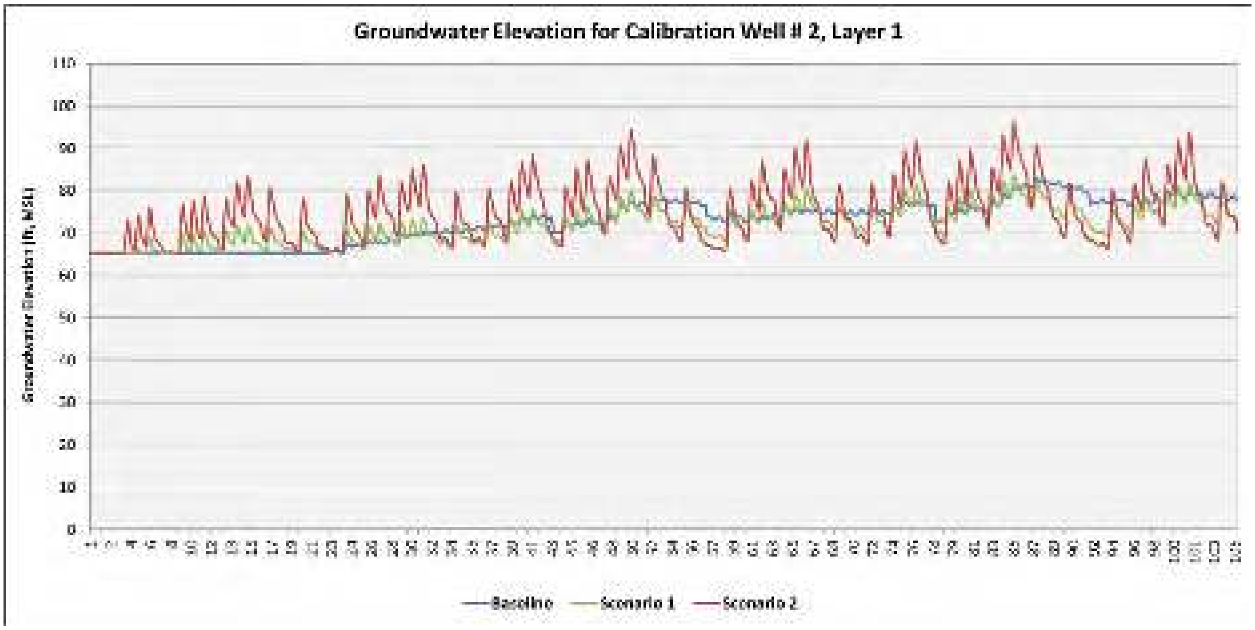
Figure B1 – Representative calibration wells in NAR area

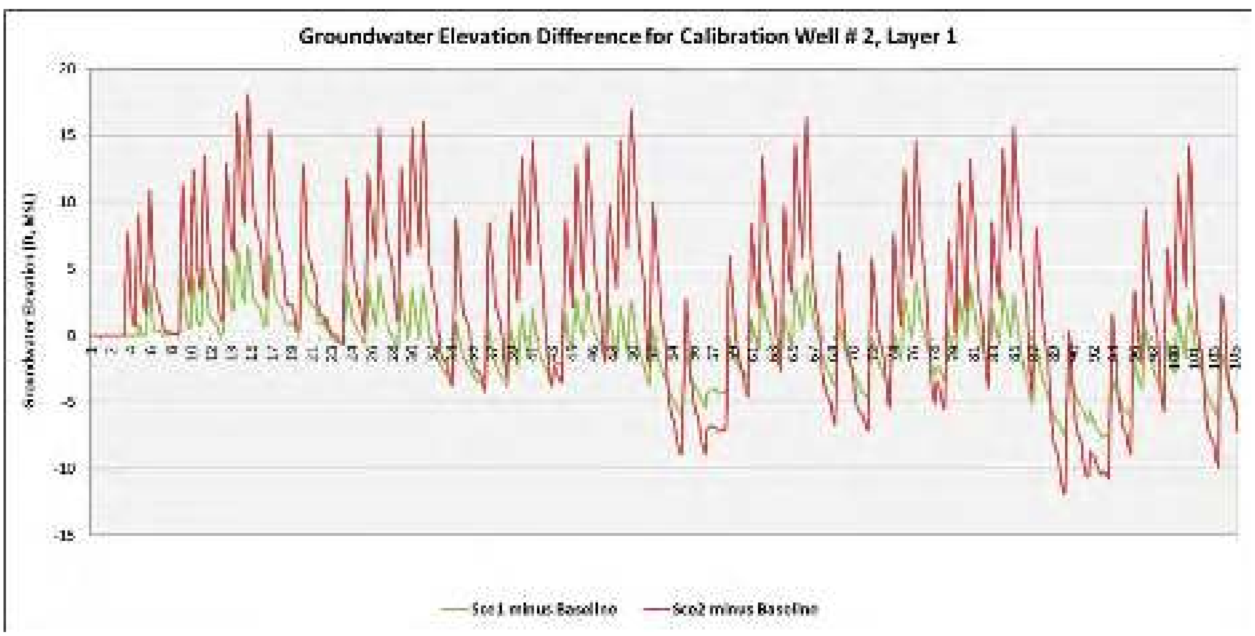

Groundwater Elevation for Calibration Well # 1, Layer 1
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

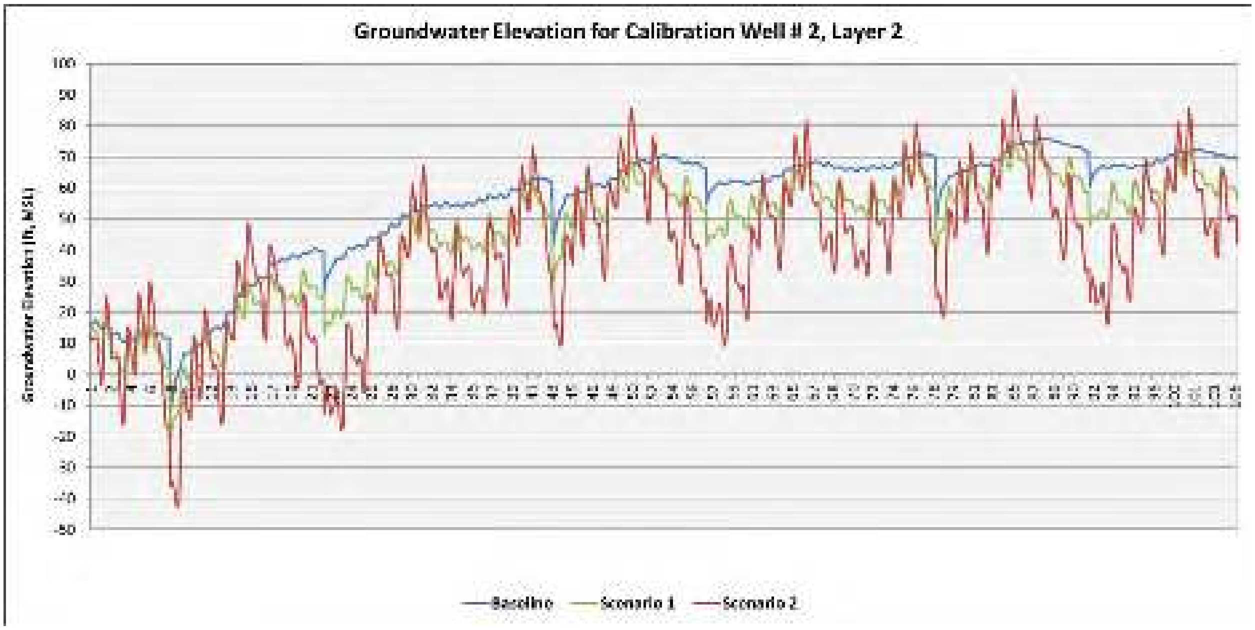

Groundwater Elevation Difference for Calibration Well # 1, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 1, Layer 2
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

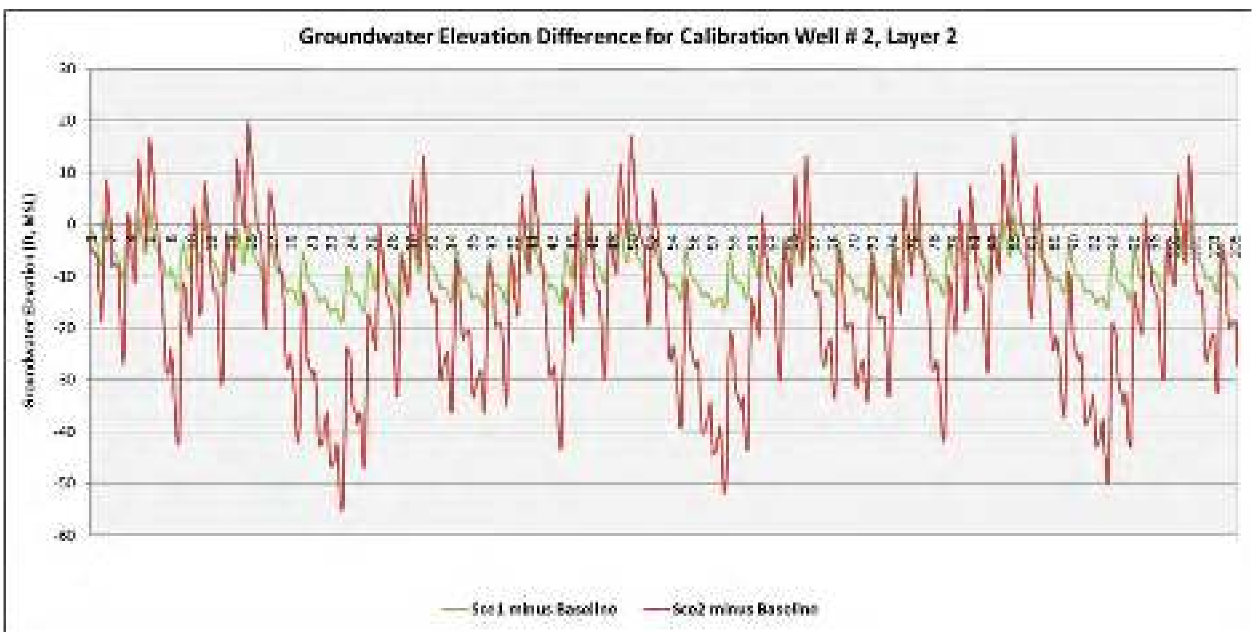

Groundwater Elevation Difference for Calibration Well # 1, Layer 2
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 2, Layer 1
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

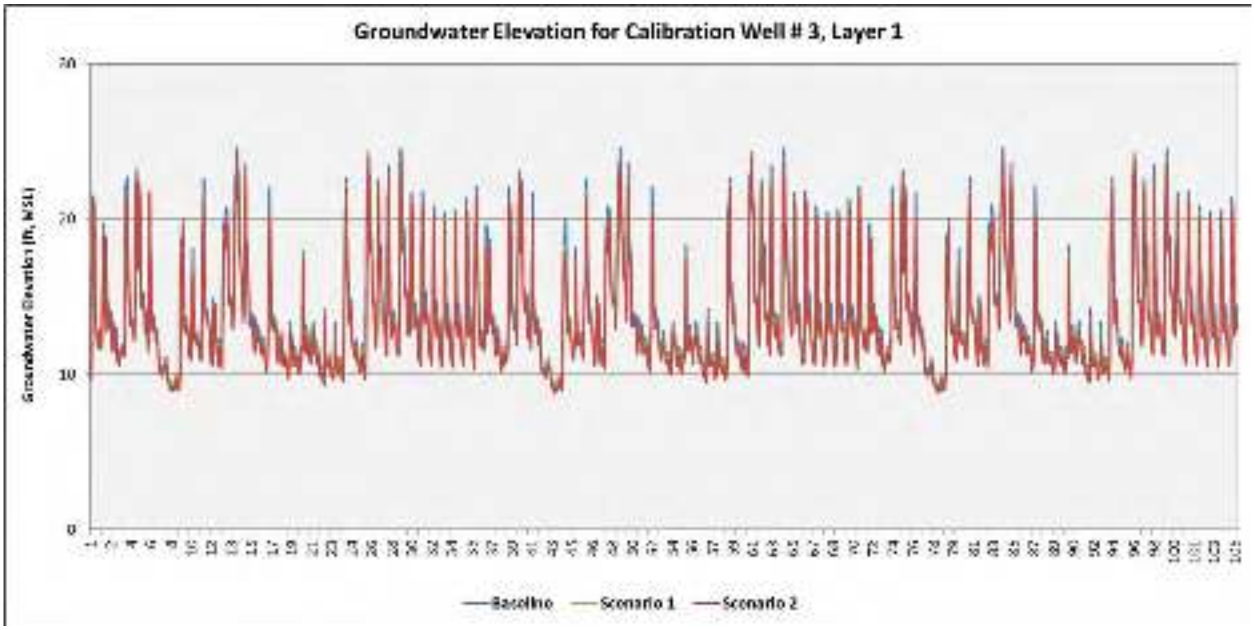

Groundwater Elevation Difference for Calibration Well # 2, Layer 1
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline

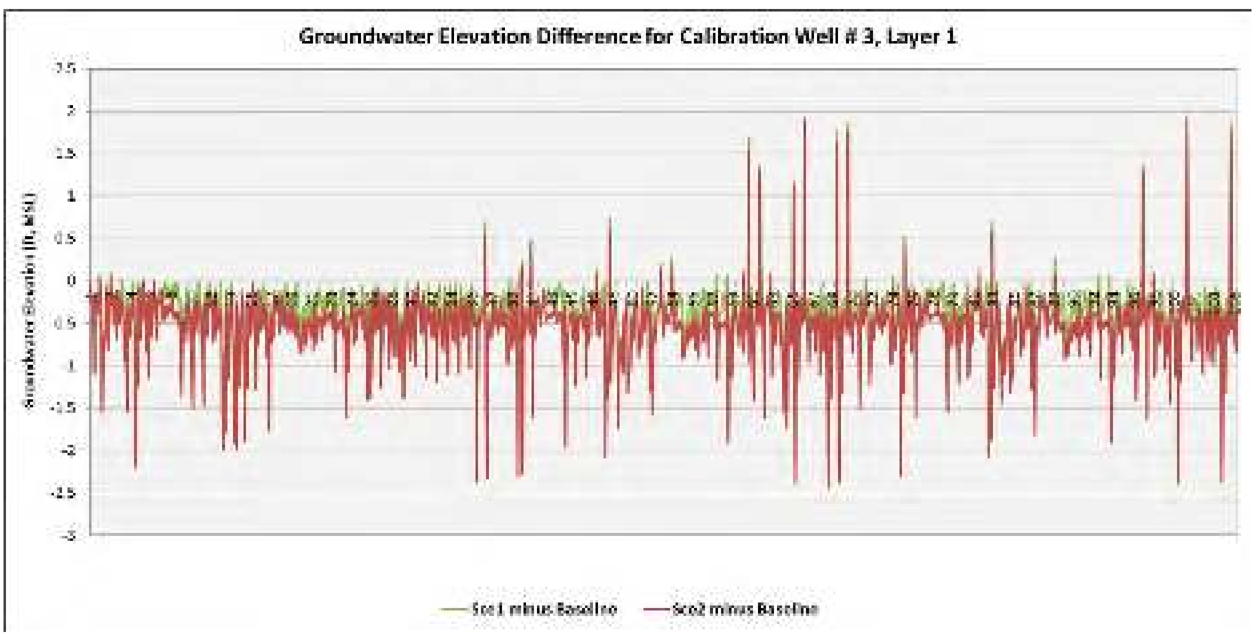


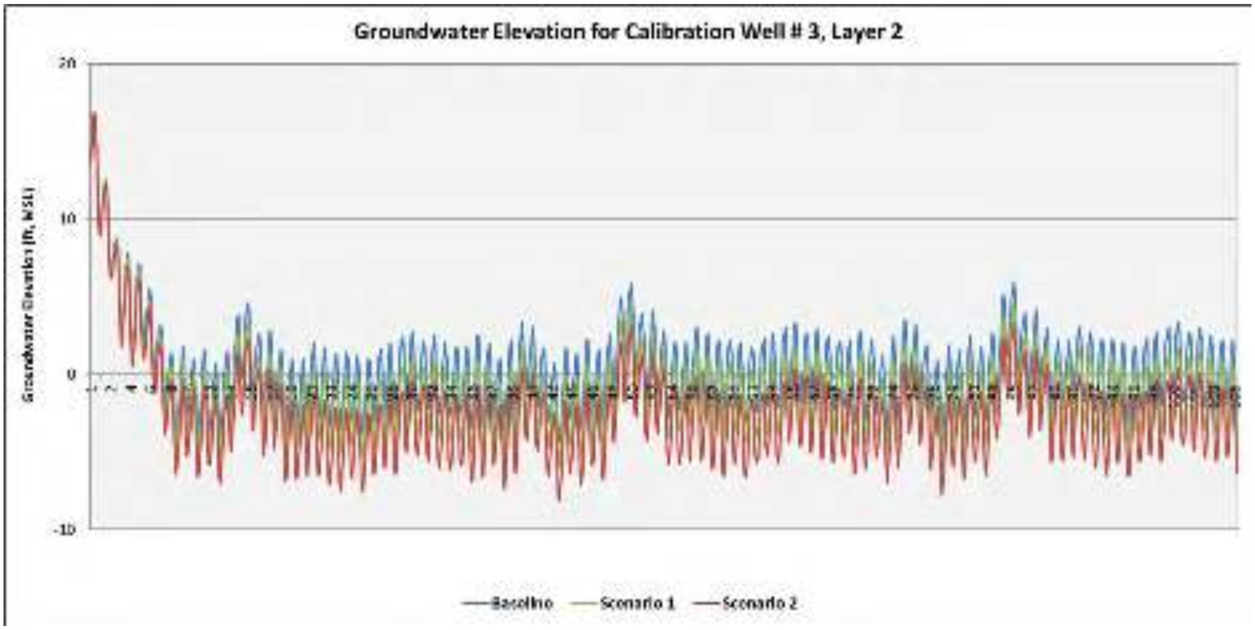
Groundwater Elevation for Calibration Well # 2, Layer 2
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

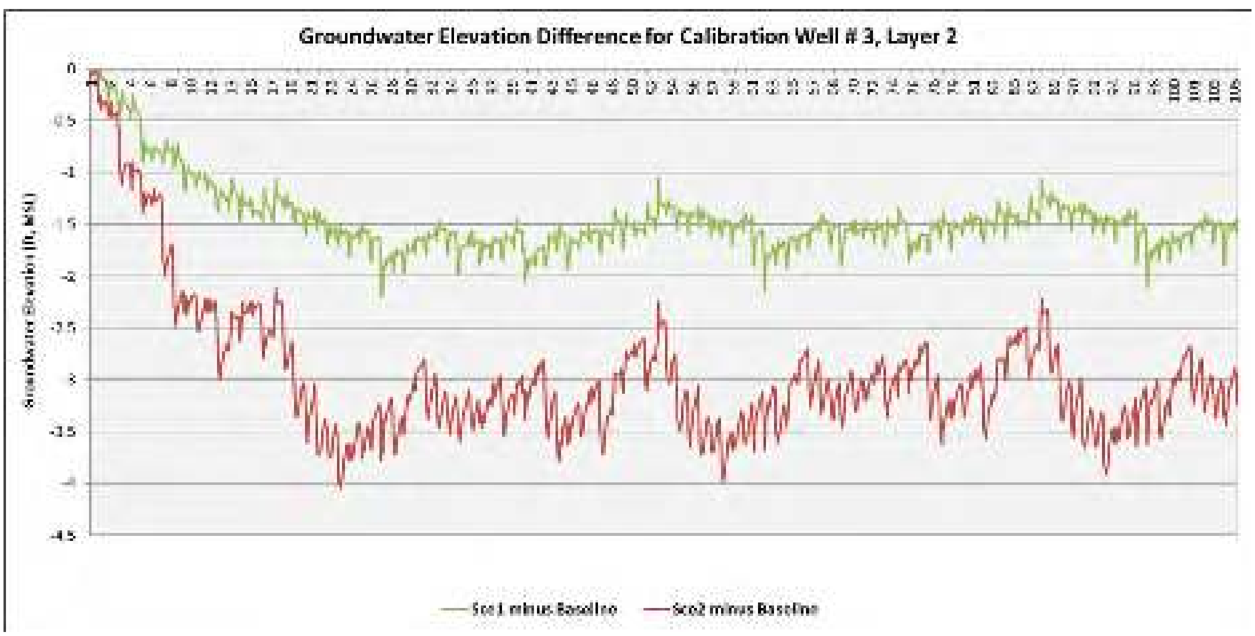


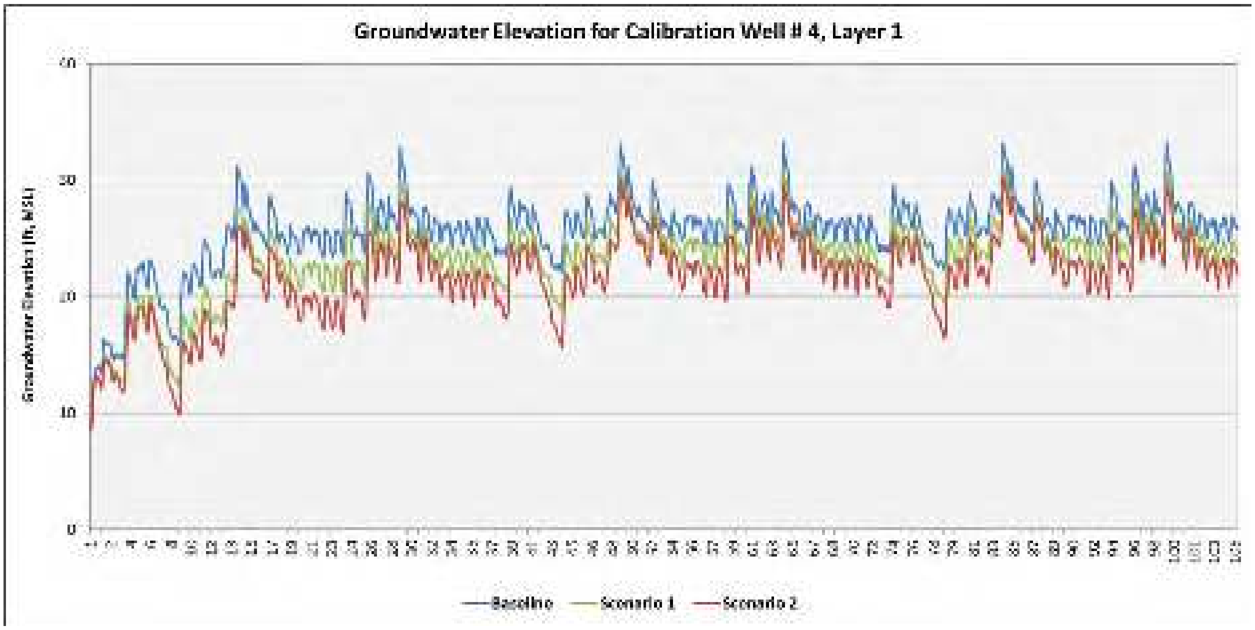
Groundwater Elevation Difference for Calibration Well # 2, Layer 2
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline

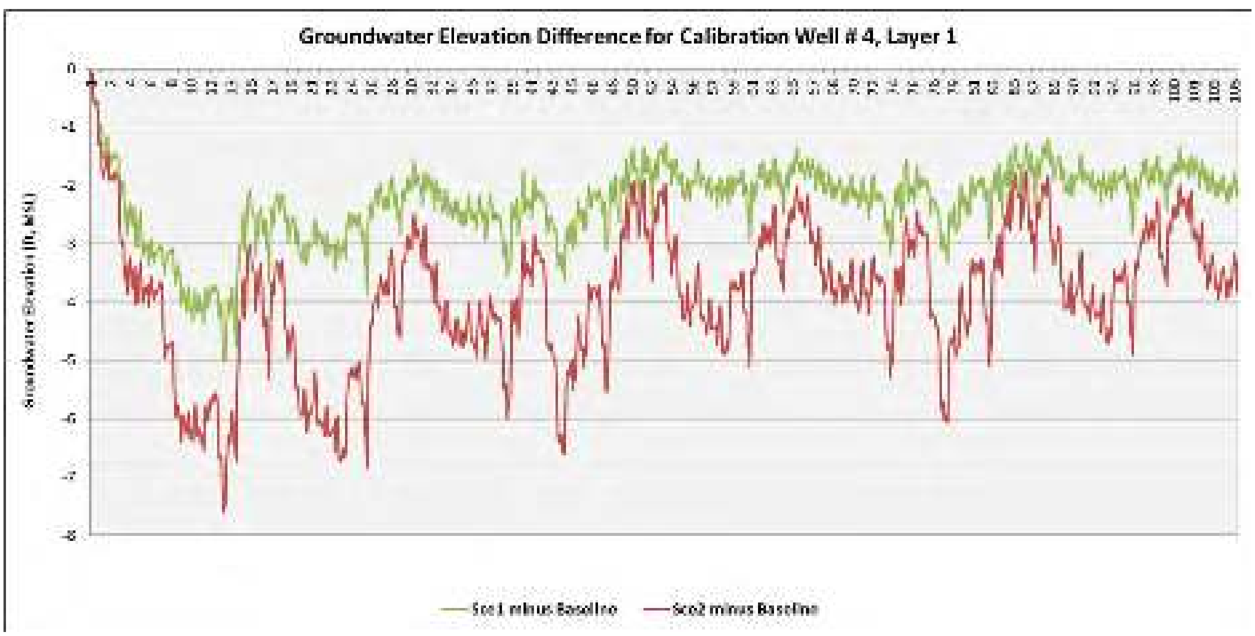

Groundwater Elevation for Calibration Well # 3, Layer 1
Baseline
Scenario 1
Scenario 2

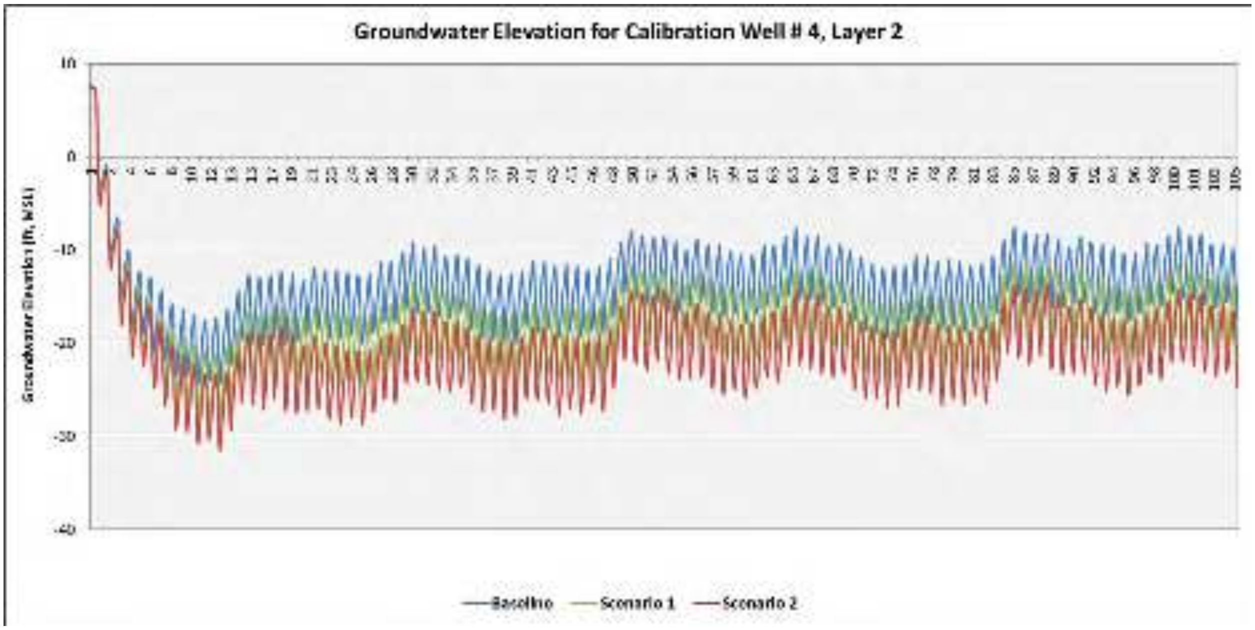

Groundwater Elevation Difference for Calibration Well # 3, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline

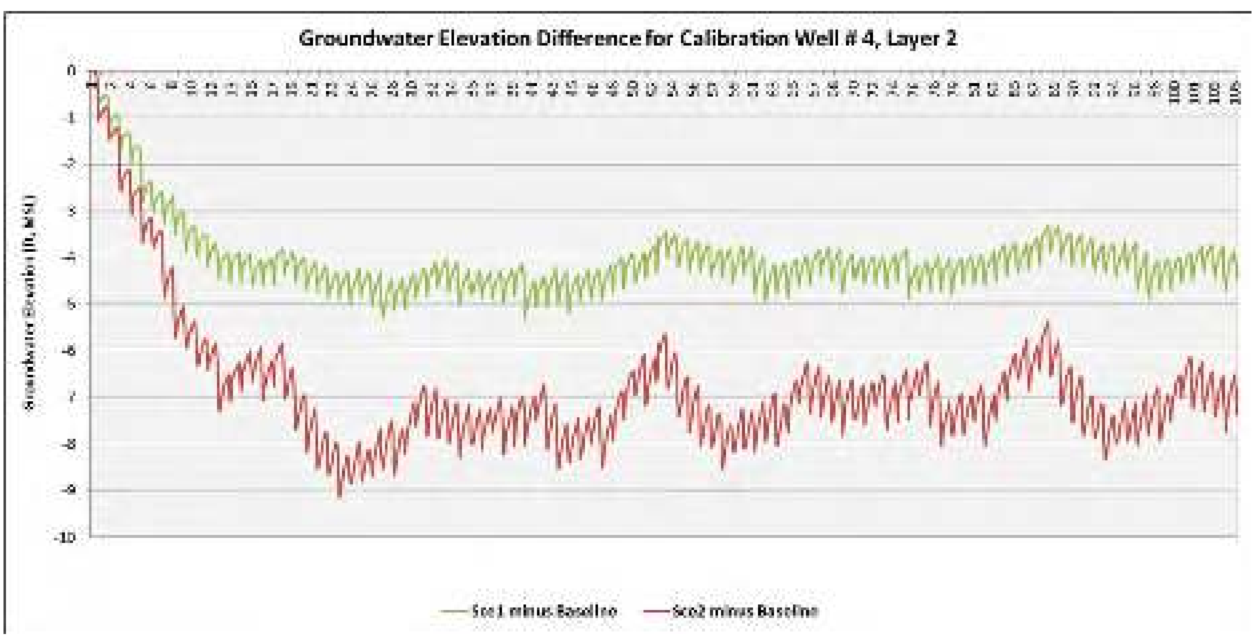

Groundwater Elevation for Calibration Well # 3, Layer 2
Baseline
Scenario 1
Scenario 2

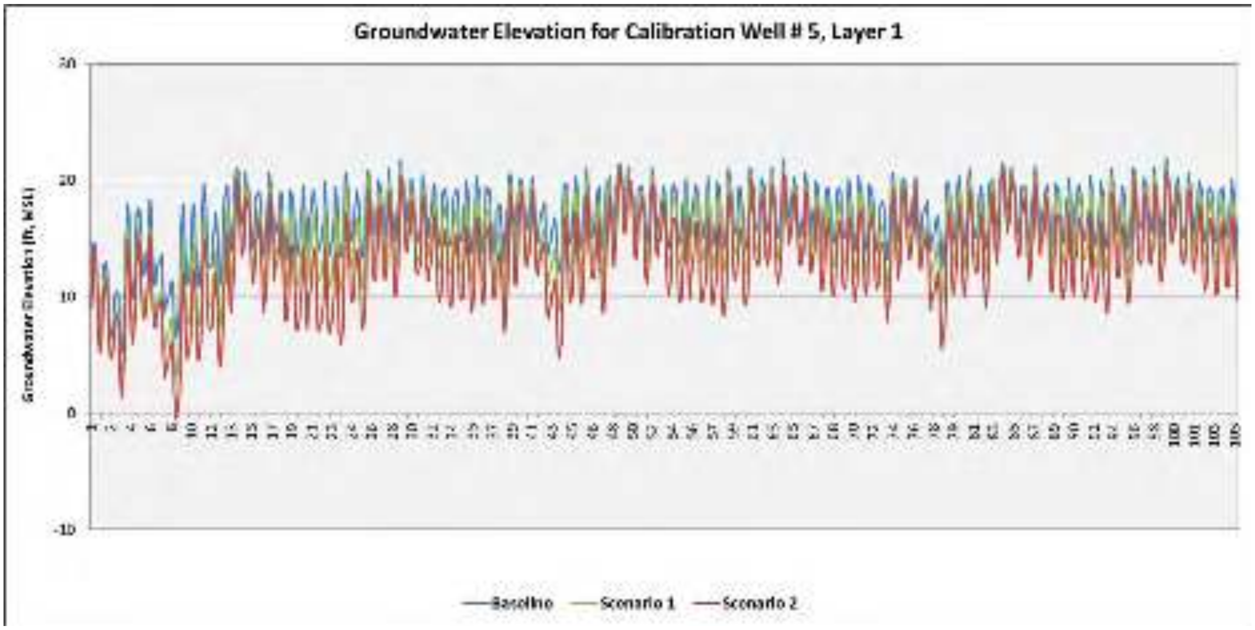

Groundwater Elevation Difference for Calibration Well # 3, Layer 2
Sce1 minus Baseline
Sce2 minus Baseline

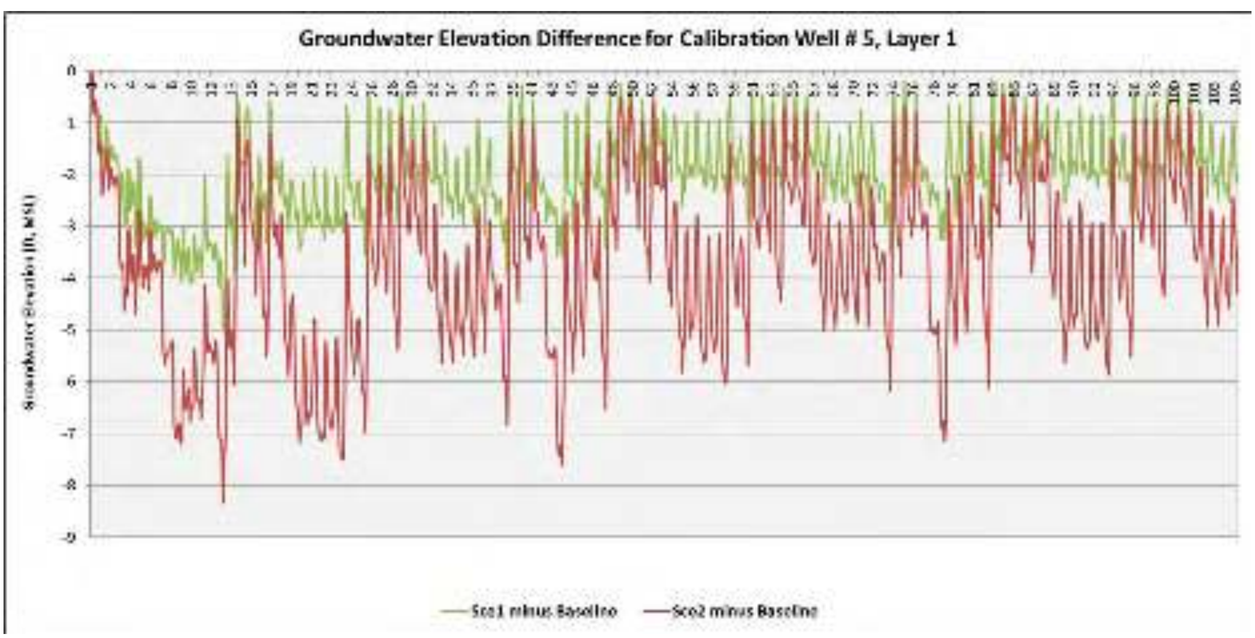

Groundwater Elevation for Calibration Well # 4, Layer 1
Baseline
Scenario 1
Scenario 2

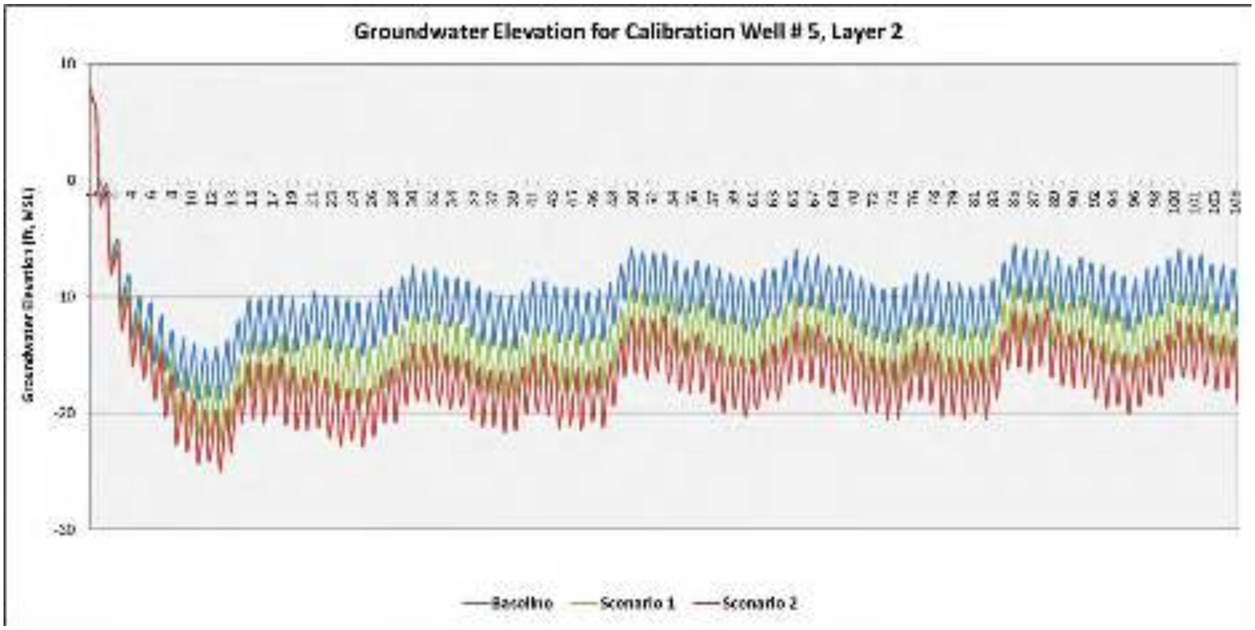

Groundwater Elevation Difference for Calibration Well # 4, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline

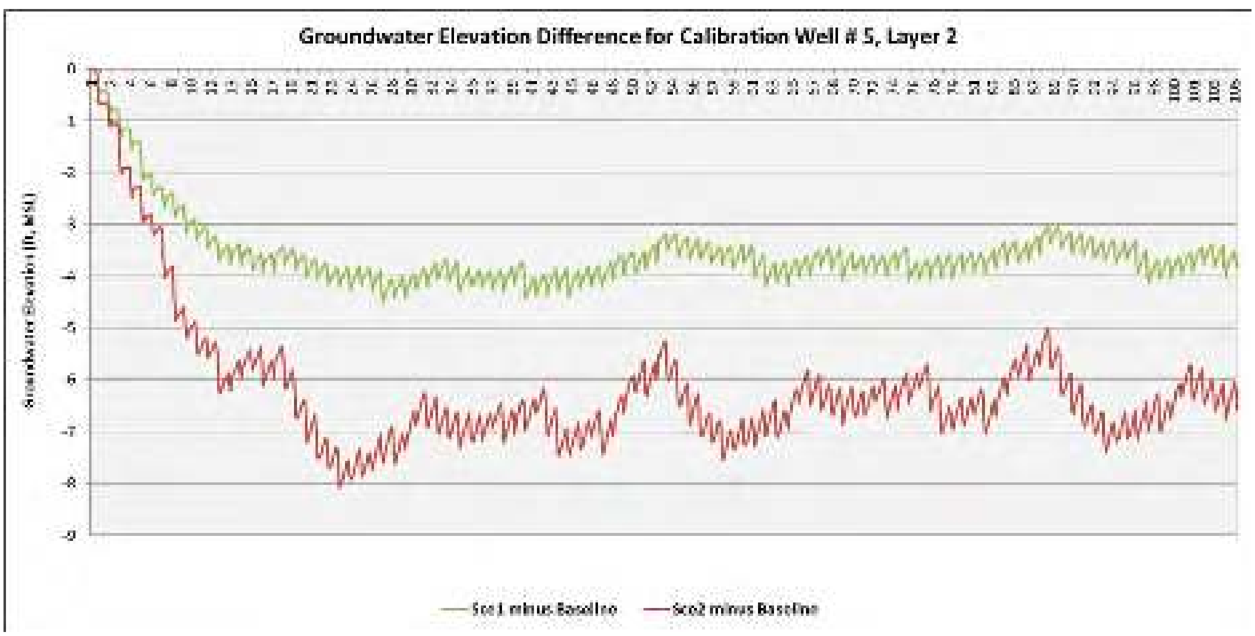

Groundwater Elevation for Calibration Well # 4, Layer 2
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

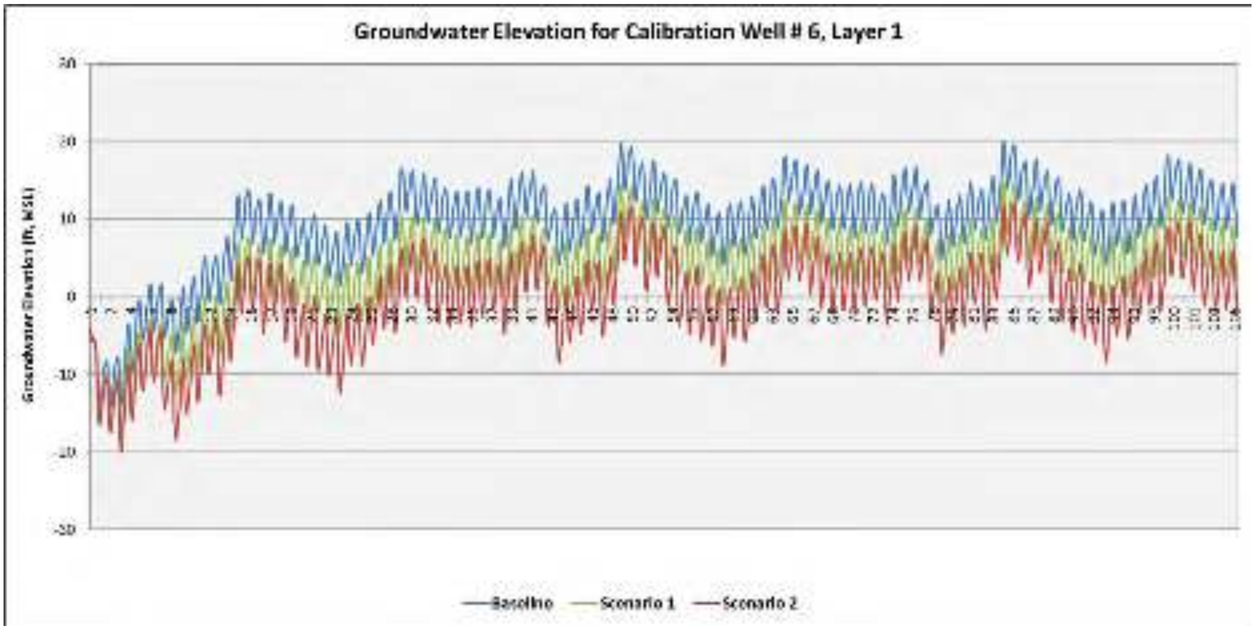

Groundwater Elevation Difference for Calibration Well # 4, Layer 2
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline

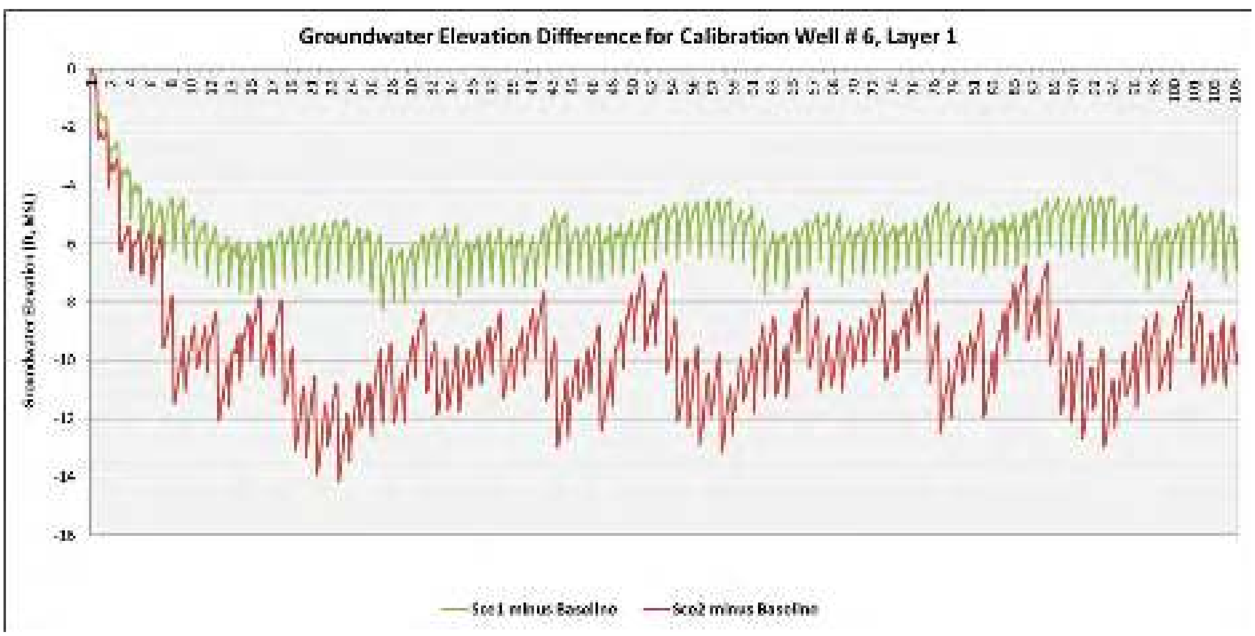

Groundwater Elevation for Calibration Well # 5, Layer 1
Baseline
Scenario 1
Scenario 2

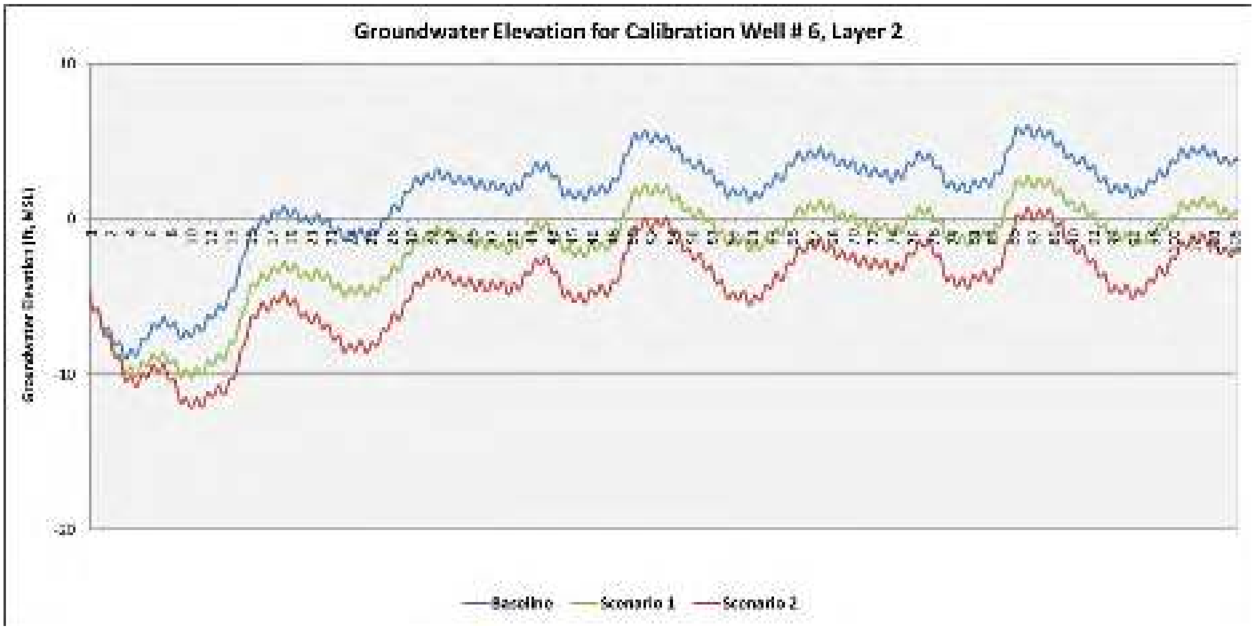

Groundwater Elevation Difference for Calibration Well # 5, Layer 1
Sco1 minus Baseline
Sco2 minus Baseline


Groundwater Elevation for Calibration Well # 5, Layer 2
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

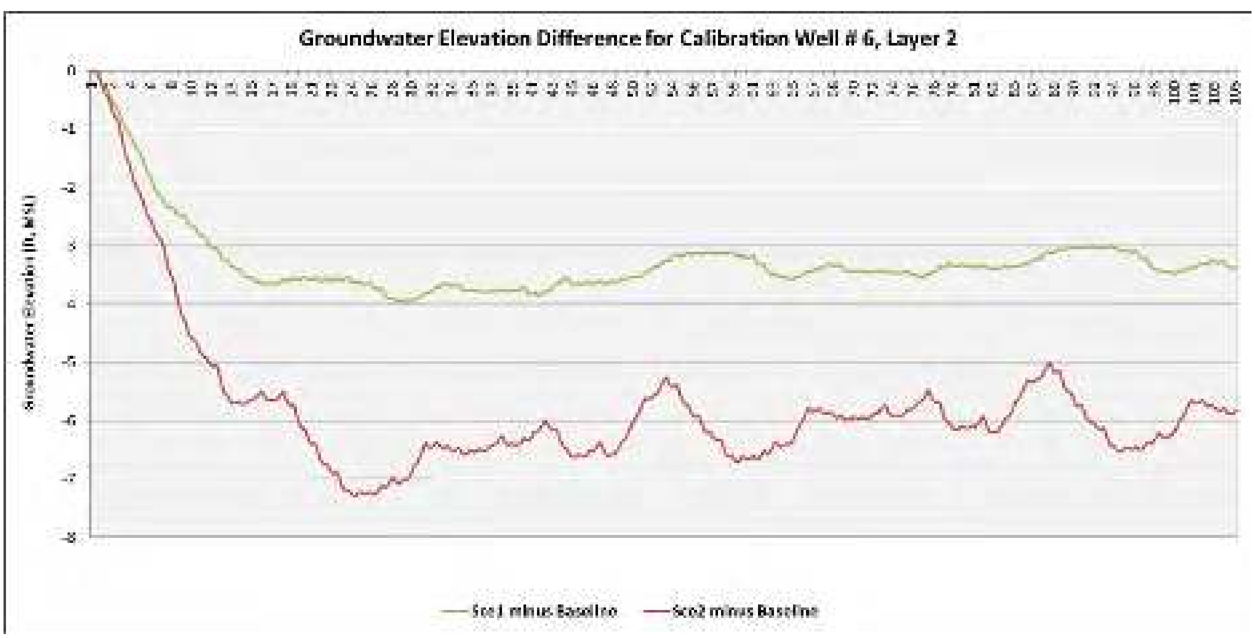

Groundwater Elevation Difference for Calibration Well # 5, Layer 2
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 6, Layer 1
Baseline
Scenario 1
Scenario 2

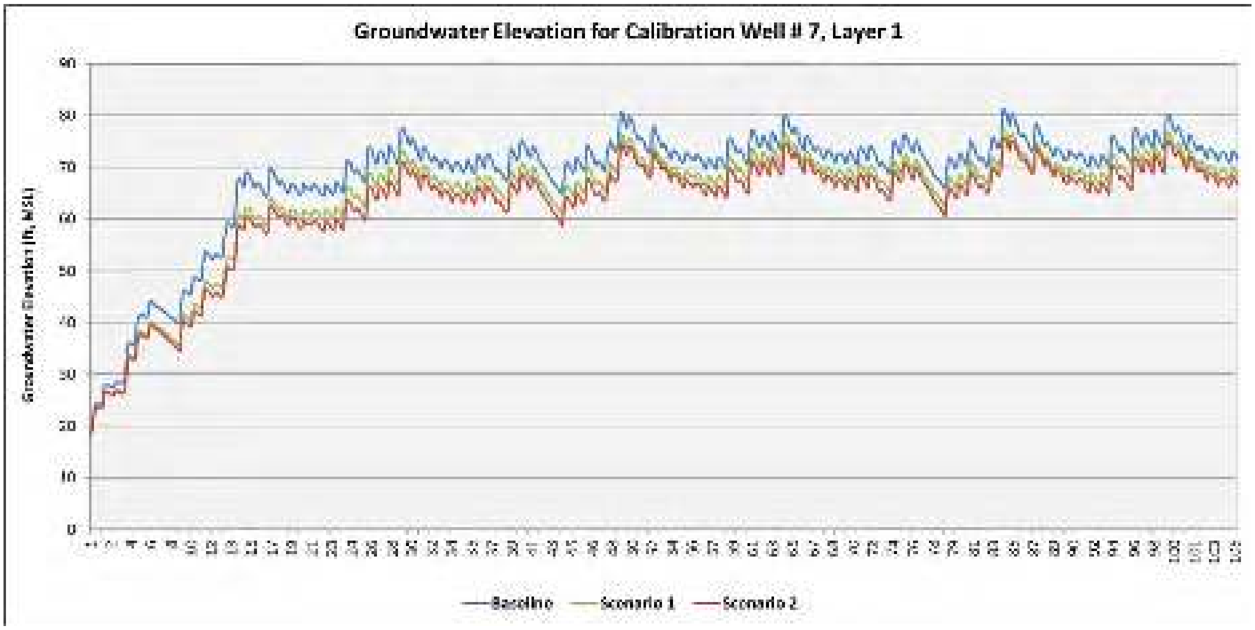

Groundwater Elevation Difference for Calibration Well # 6, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline

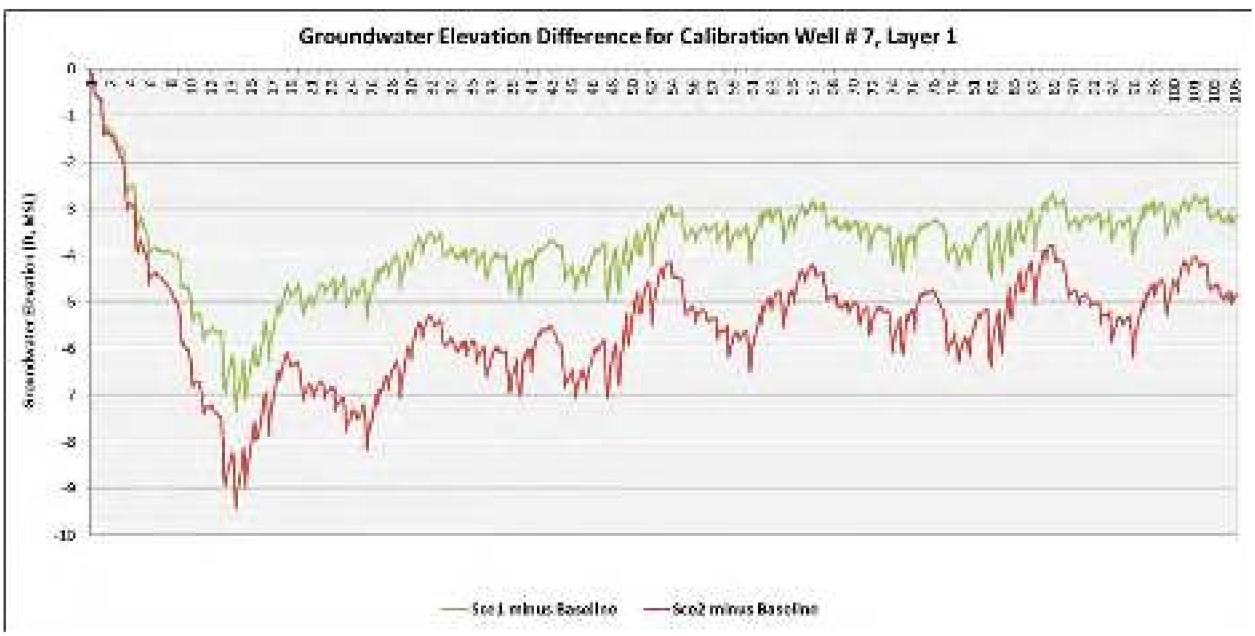


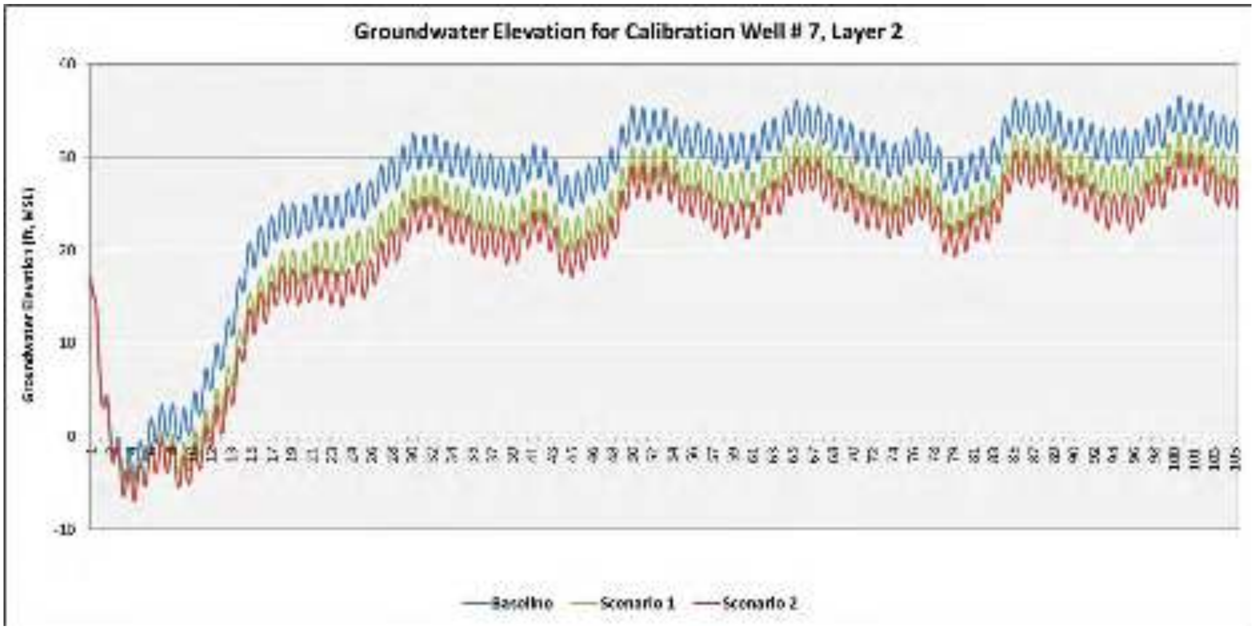
Groundwater Elevation for Calibration Well # 6, Layer 2
Baseline
Scenario 1
Scenario 2

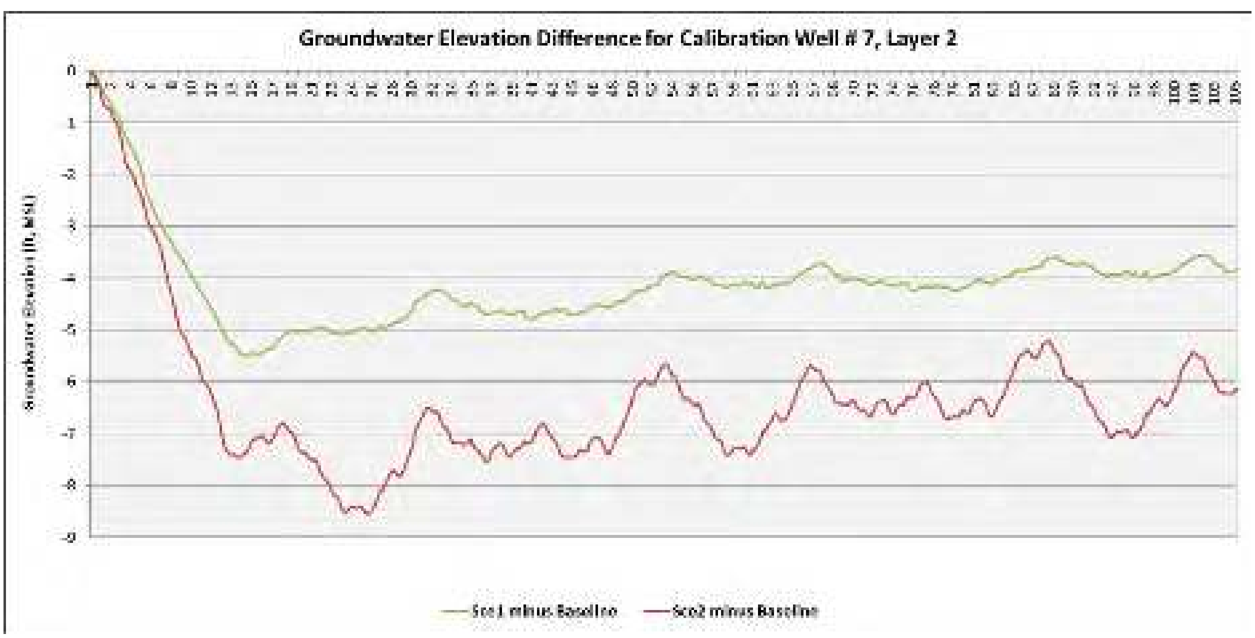


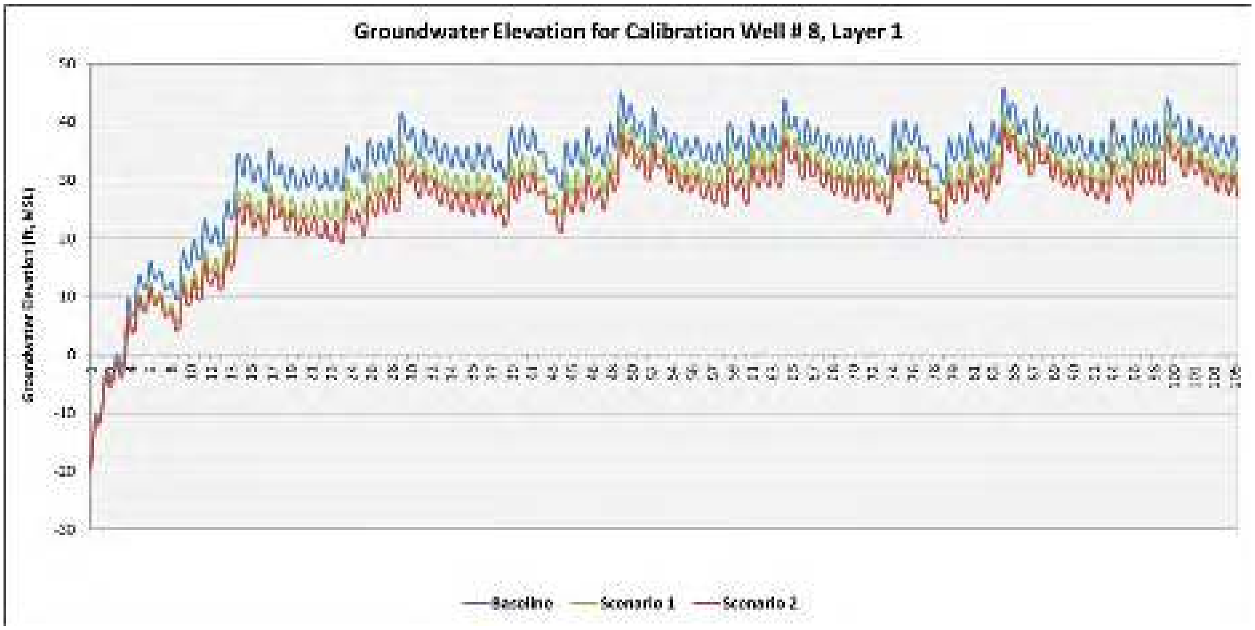
Groundwater Elevation Difference for Calibration Well # 6, Layer 2
Sce1 minus Baseline
Sce2 minus Baseline

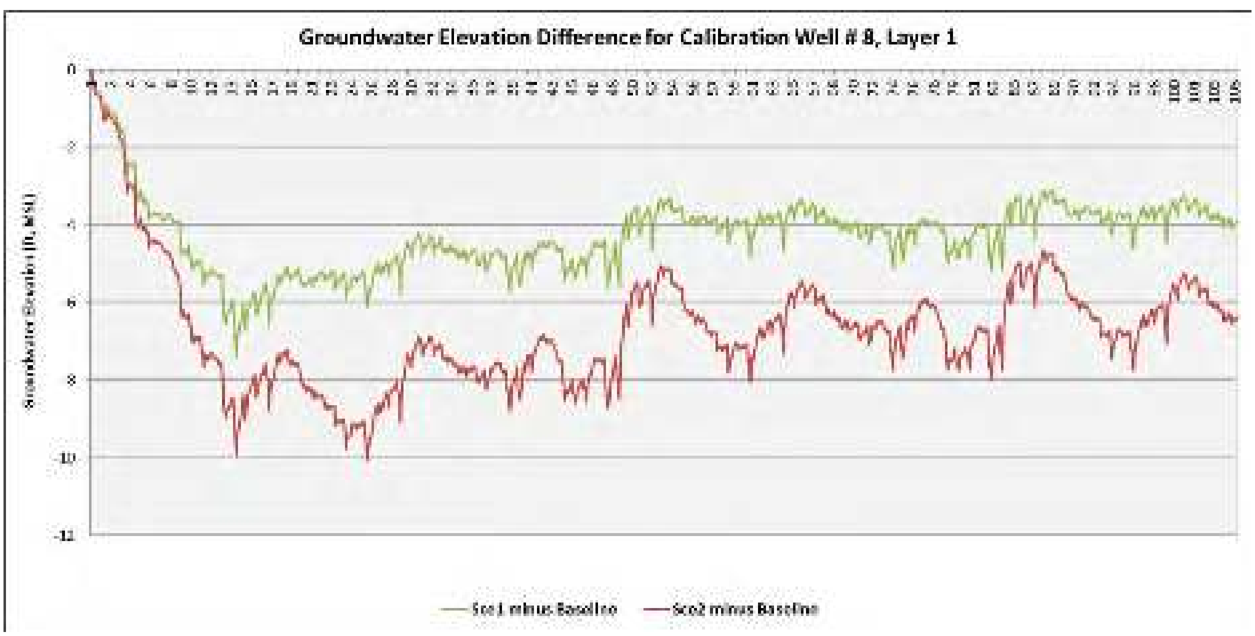

Groundwater Elevation for Calibration Well # 7, Layer 1
Baseline
Scenario 1
Scenario 2

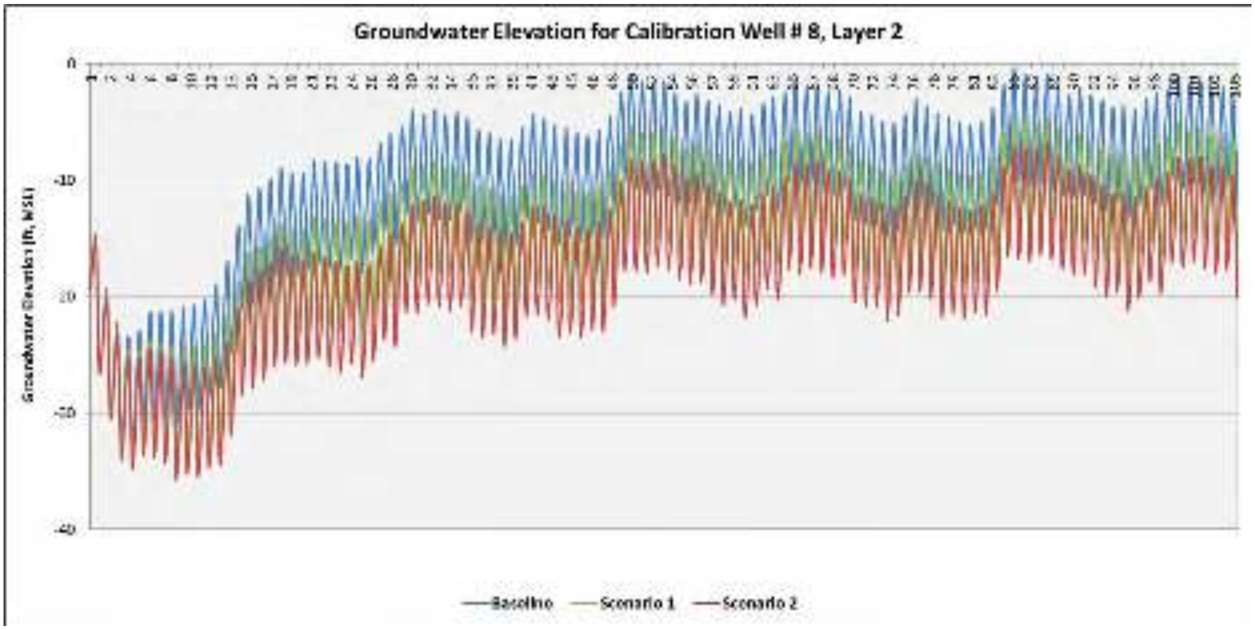

Groundwater Elevation Difference for Calibration Well # 7, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 7, Layer 2
Baseline
Scenario 1
Scenario 2

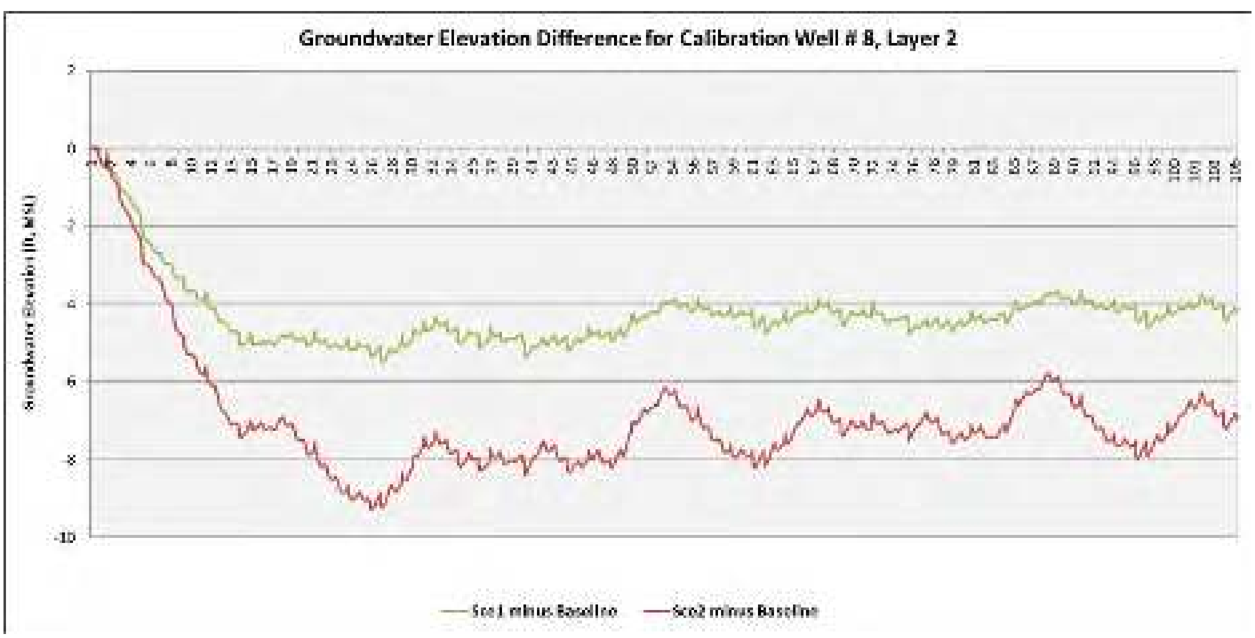

Groundwater Elevation Difference for Calibration Well # 7, Layer 2
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 8, Layer 1
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

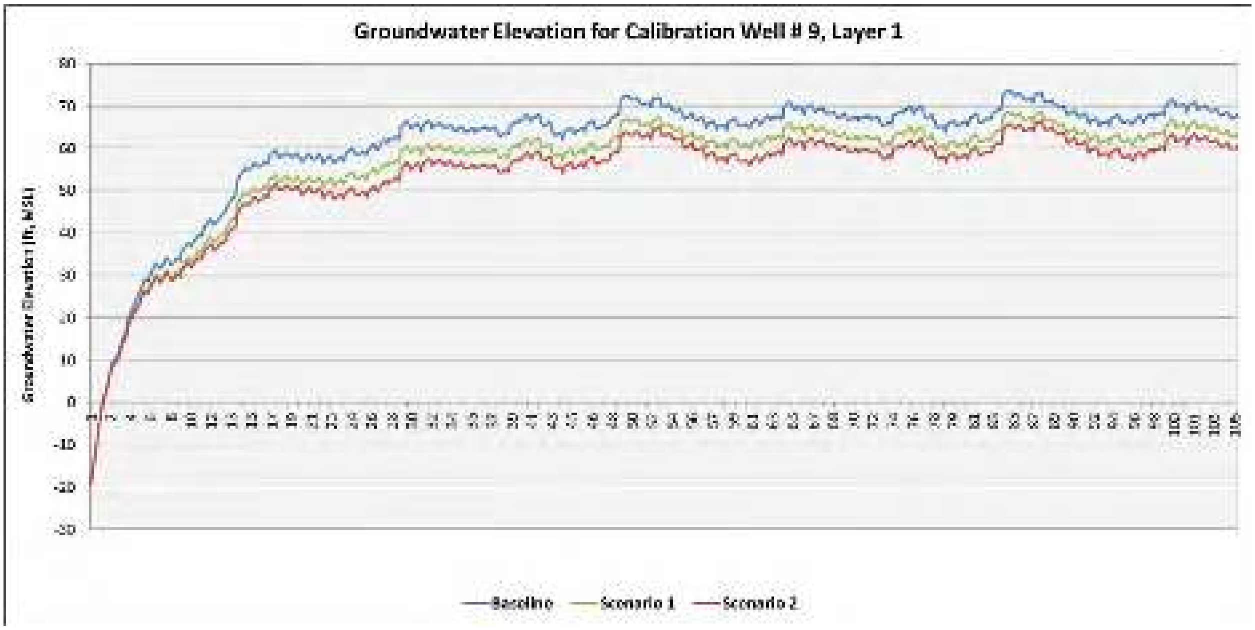

Groundwater Elevation Difference for Calibration Well # 8, Layer 1
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline



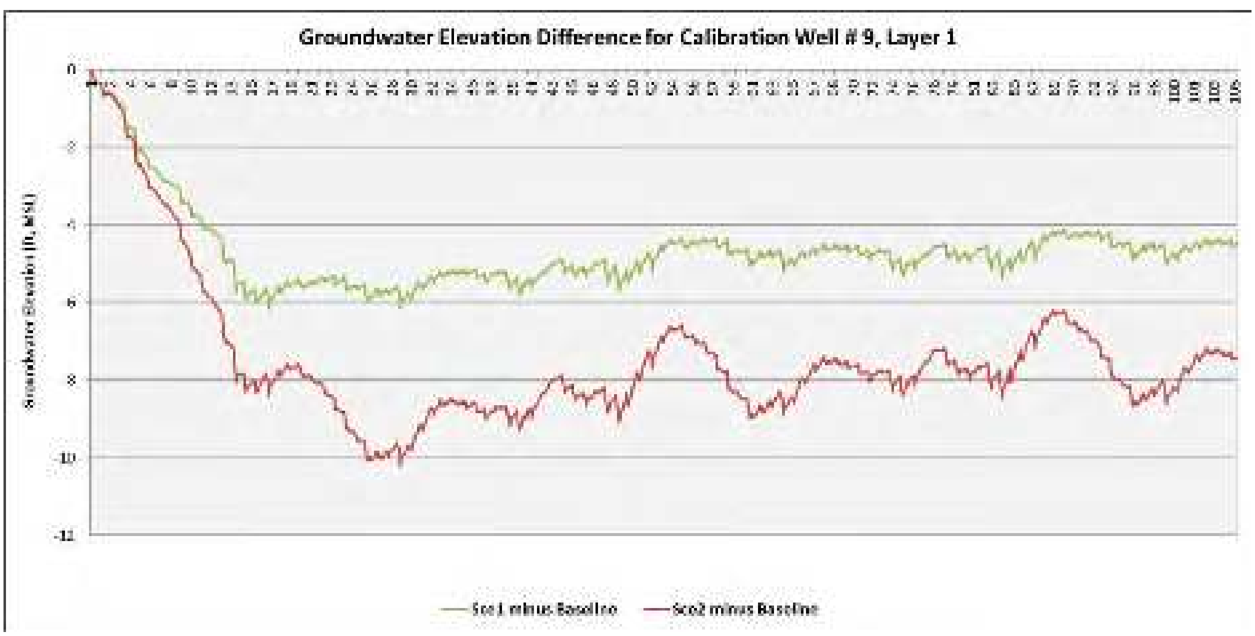
Groundwater Elevation for Calibration Well # 8, Layer 2
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2



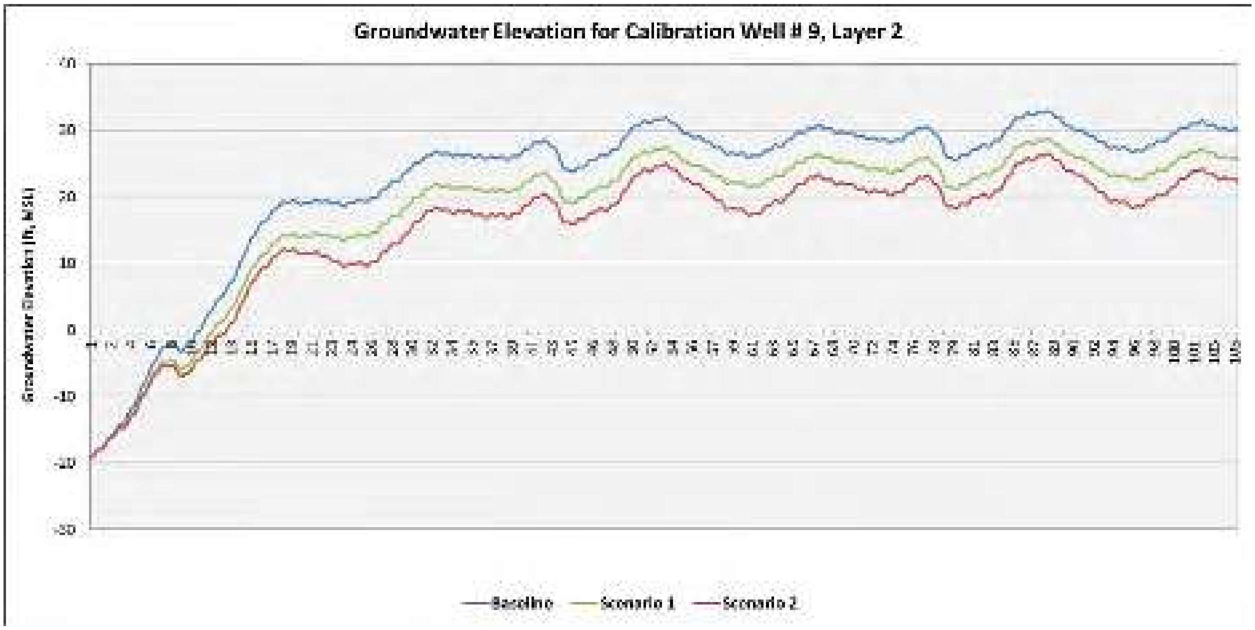
Groundwater Elevation Difference for Calibration Well # 8, Layer 2
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline

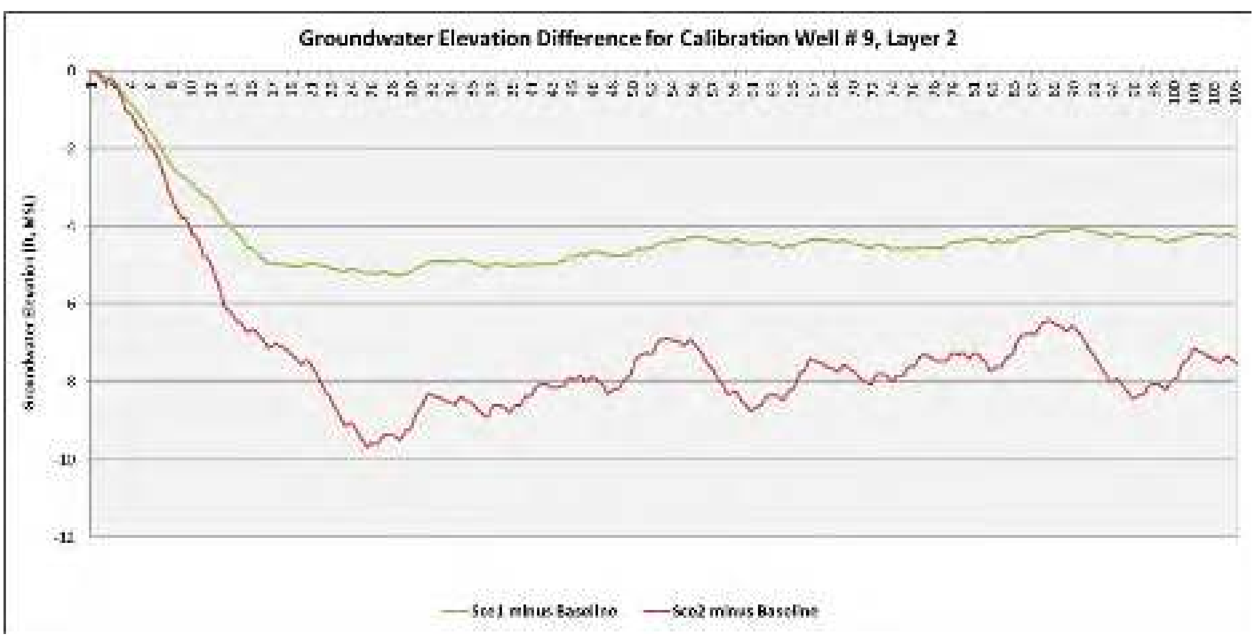


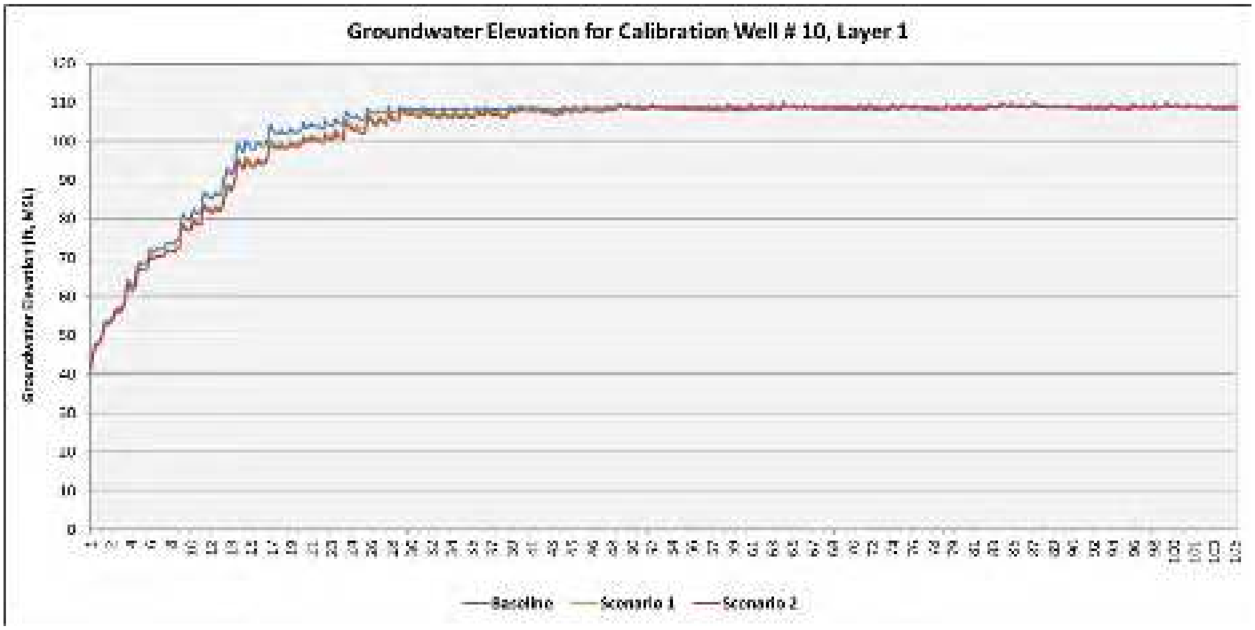
Groundwater Elevation for Calibration Well # 9, Layer 1
Baseline
Scenario 1
Scenario 2

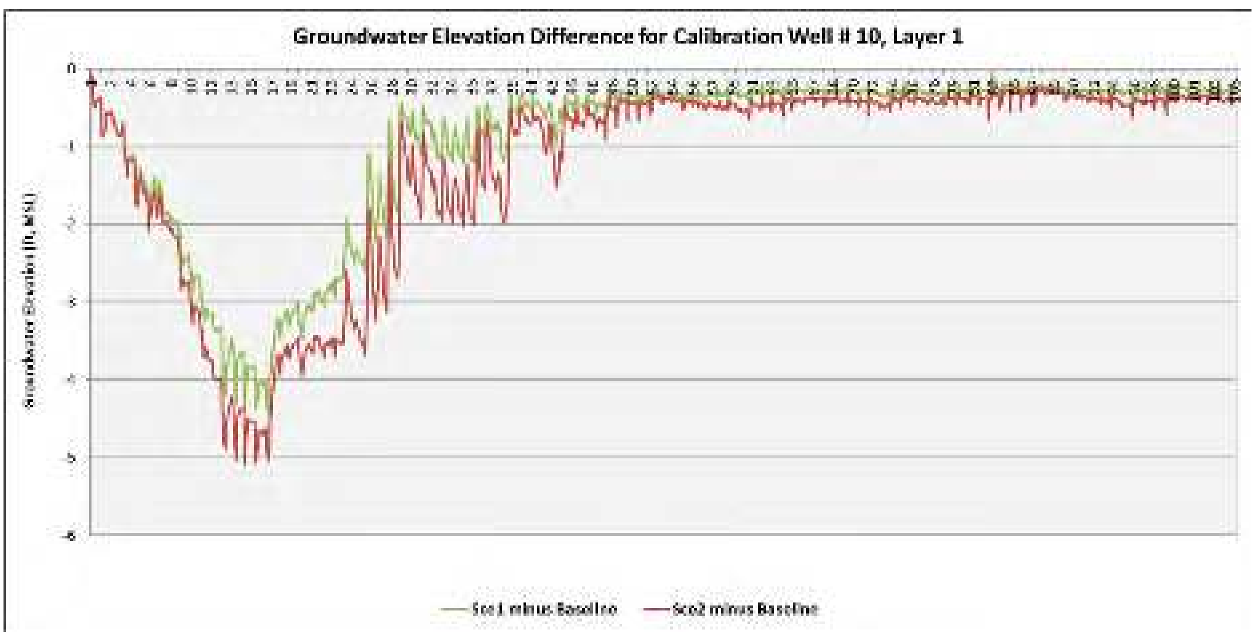


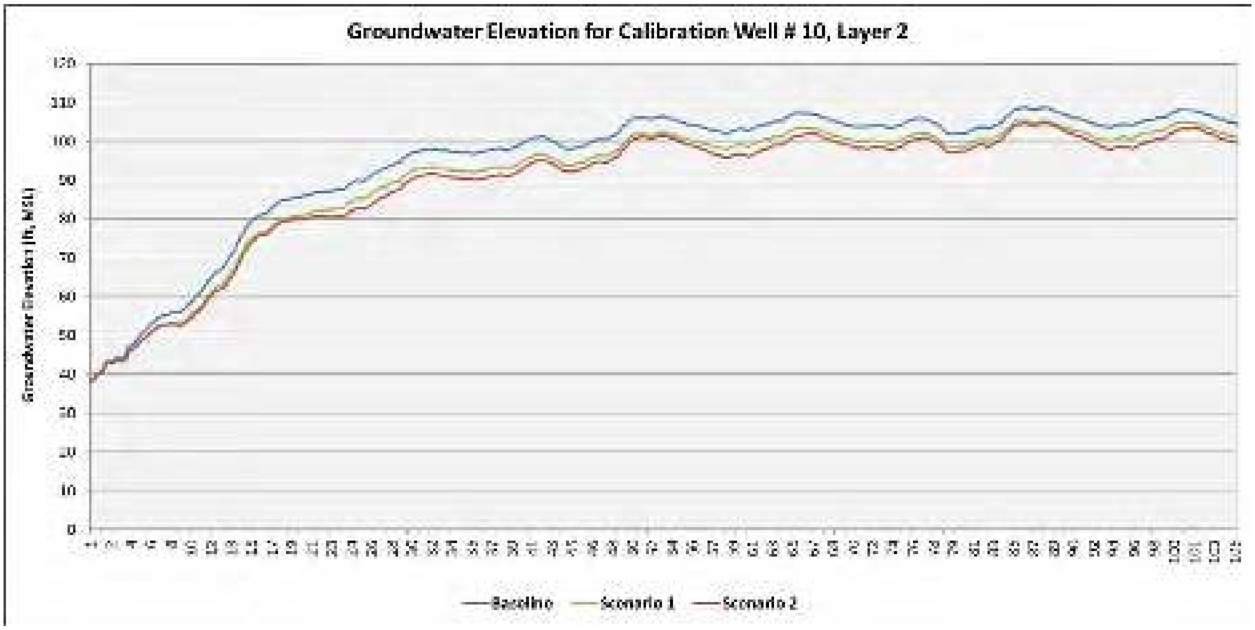
Groundwater Elevation Difference for Calibration Well # 9, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 9, Layer 2
Groundwater Elevation (ft, MSL)
30
20
10
0
-10
-20
-30
Baseline
Scenario 1
Scenario 2

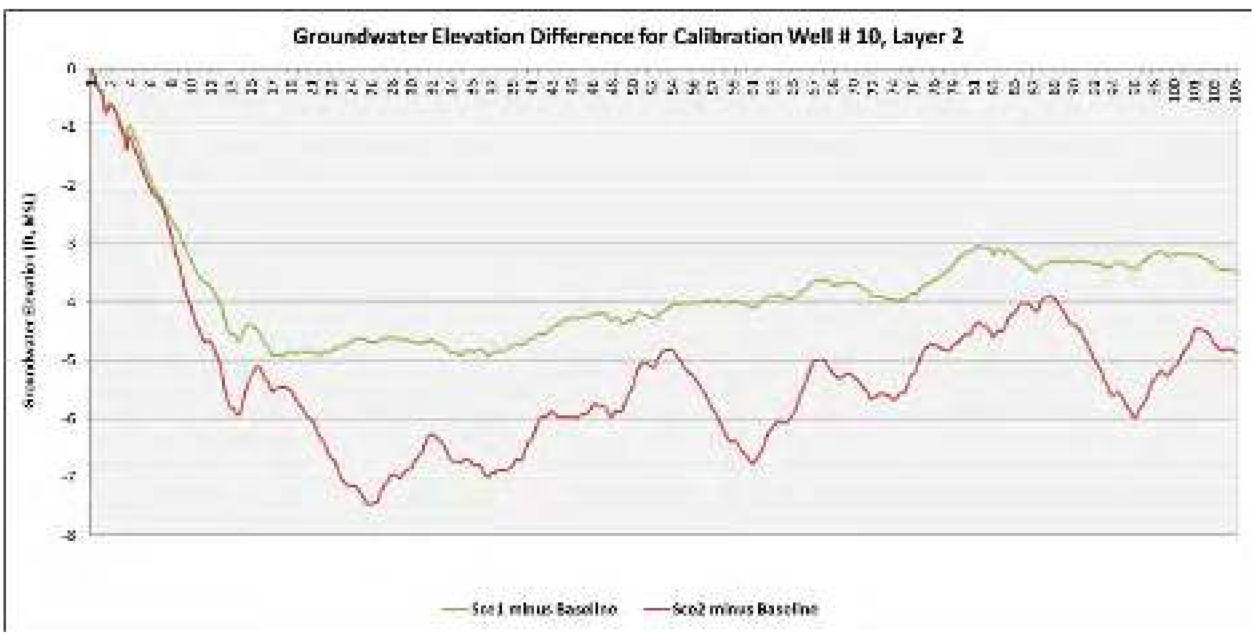

Groundwater Elevation Difference for Calibration Well # 9, Layer 2
Groundwater Elevation (ft, MSL)
0
-2
-4
-6
-8
-10
-12
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 10, Layer 1
Baseline
Scenario 1
Scenario 2

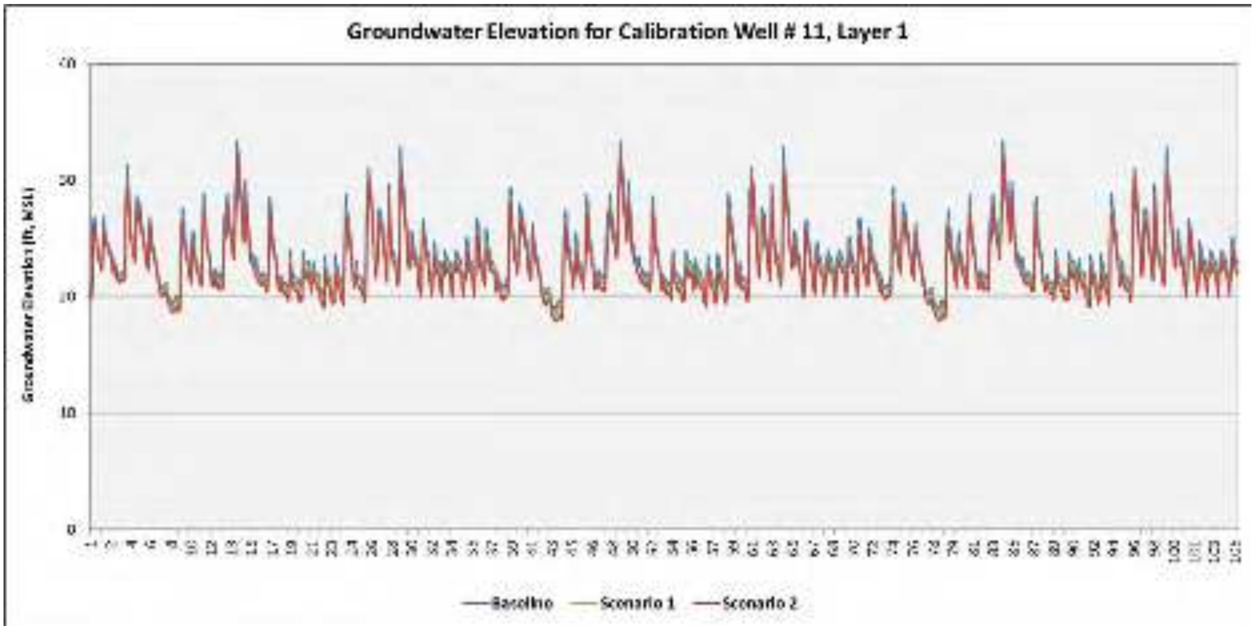

Groundwater Elevation Difference for Calibration Well # 10, Layer 1
Sce1 minus Baseline
Sce2 minus Baseline

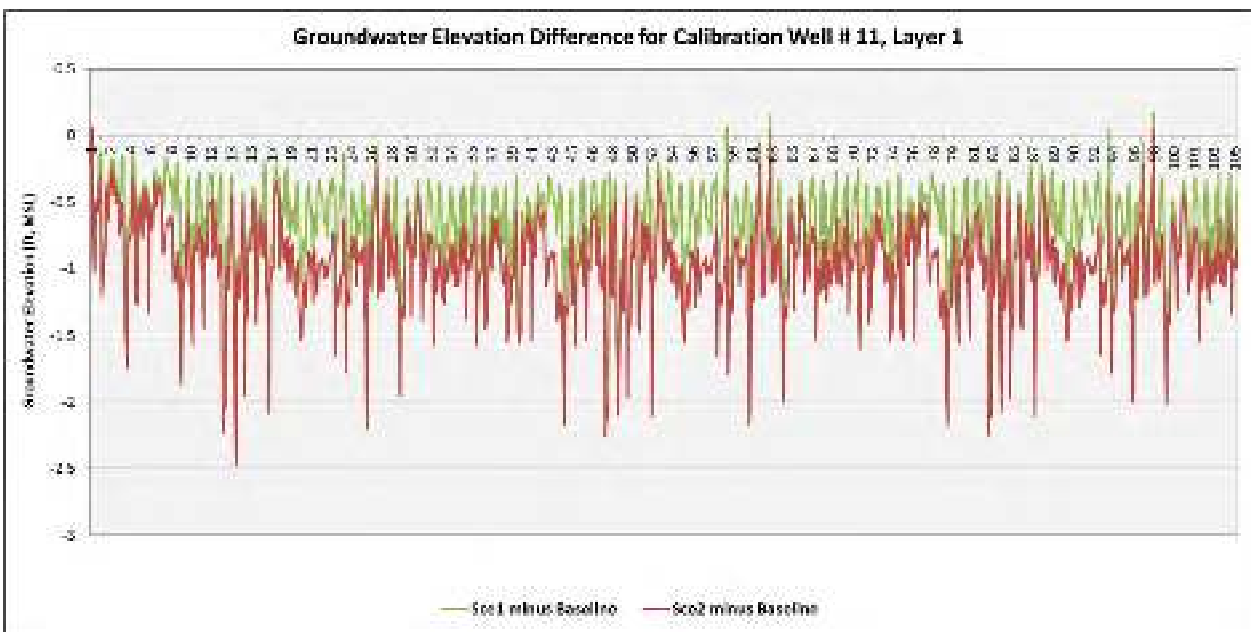


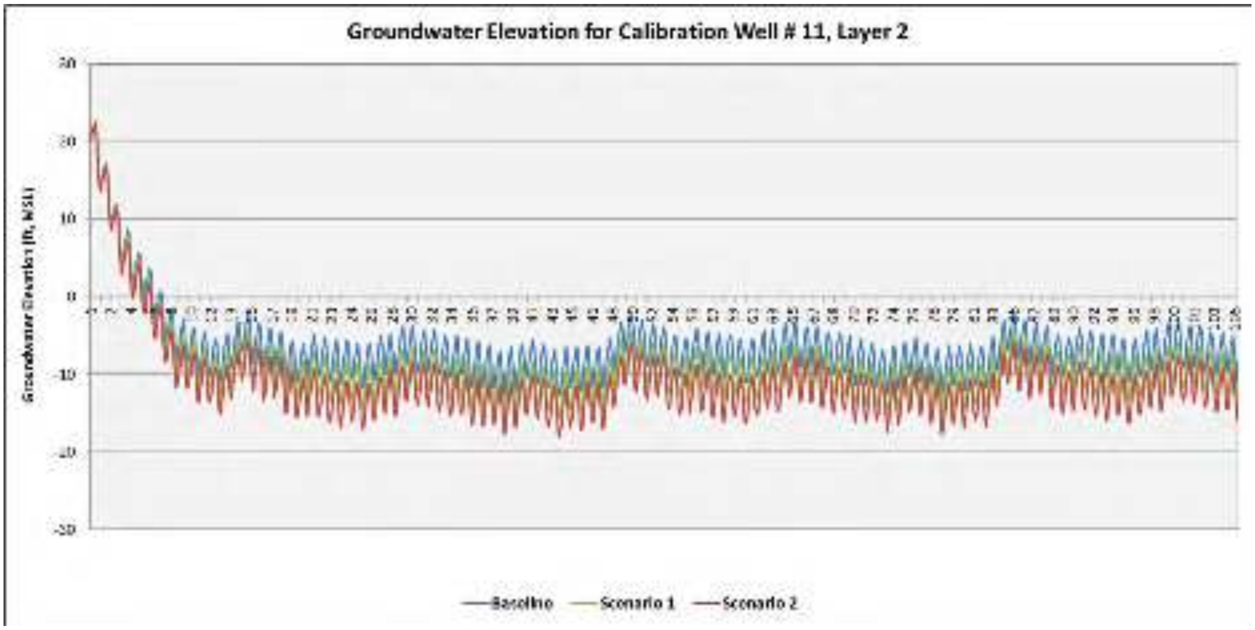
Groundwater Elevation for Calibration Well # 10, Layer 2
Baseline
Scenario 1
Scenario 2

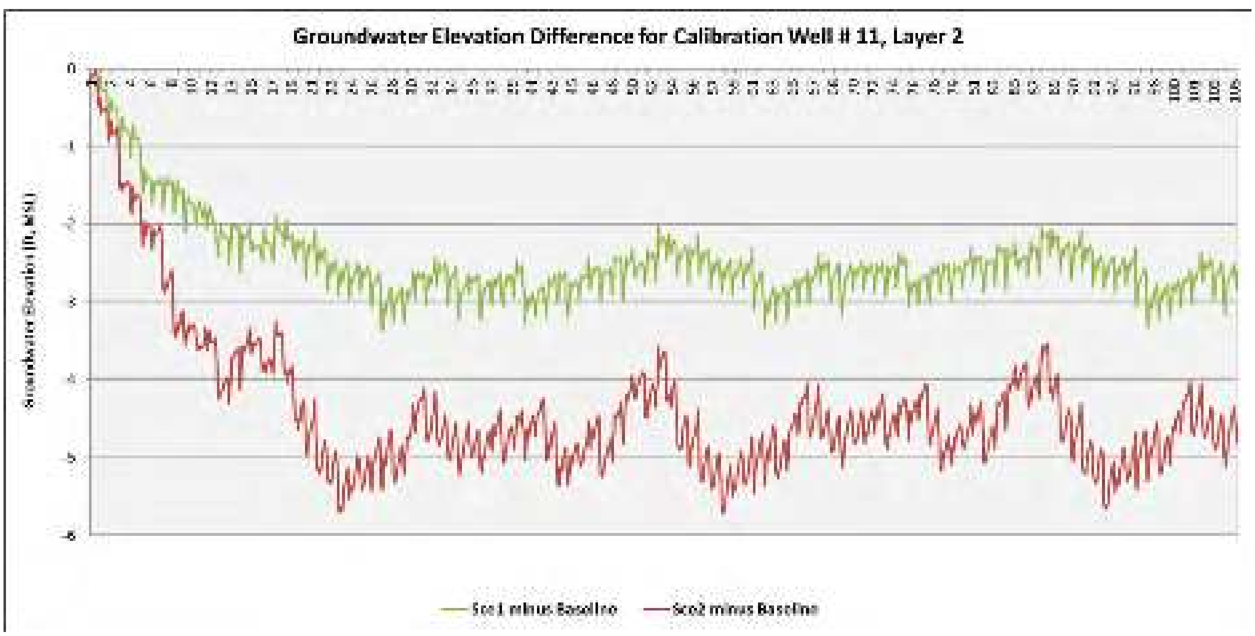


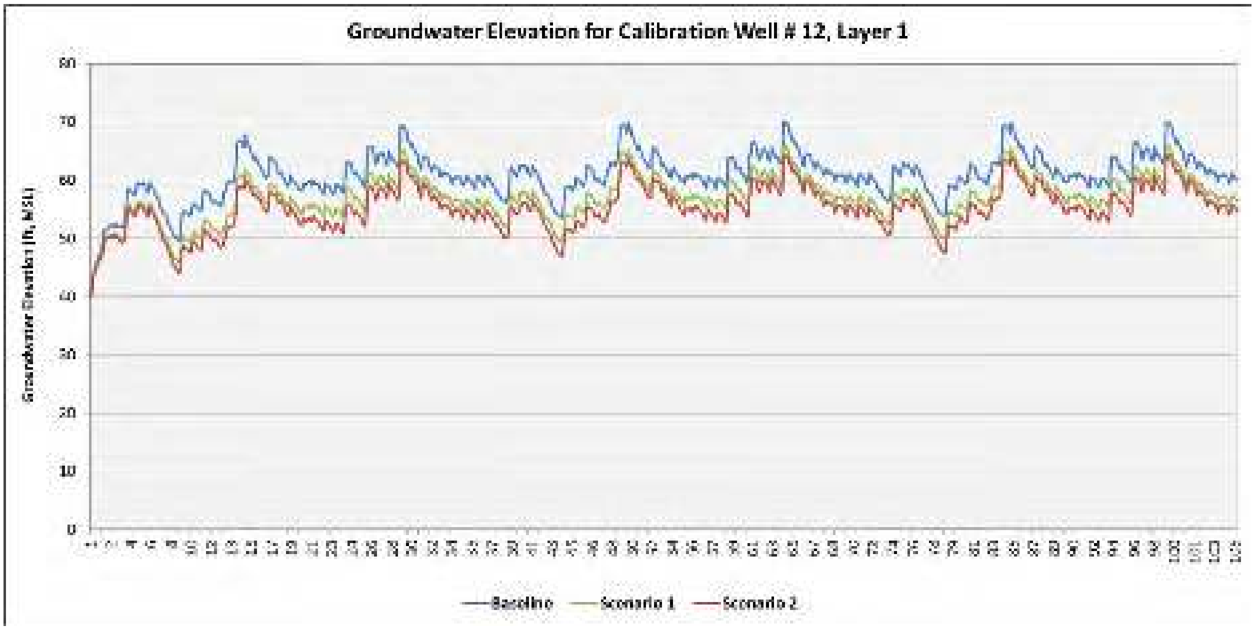
Groundwater Elevation Difference for Calibration Well # 10, Layer 2
Sce1 minus Baseline
Sce2 minus Baseline

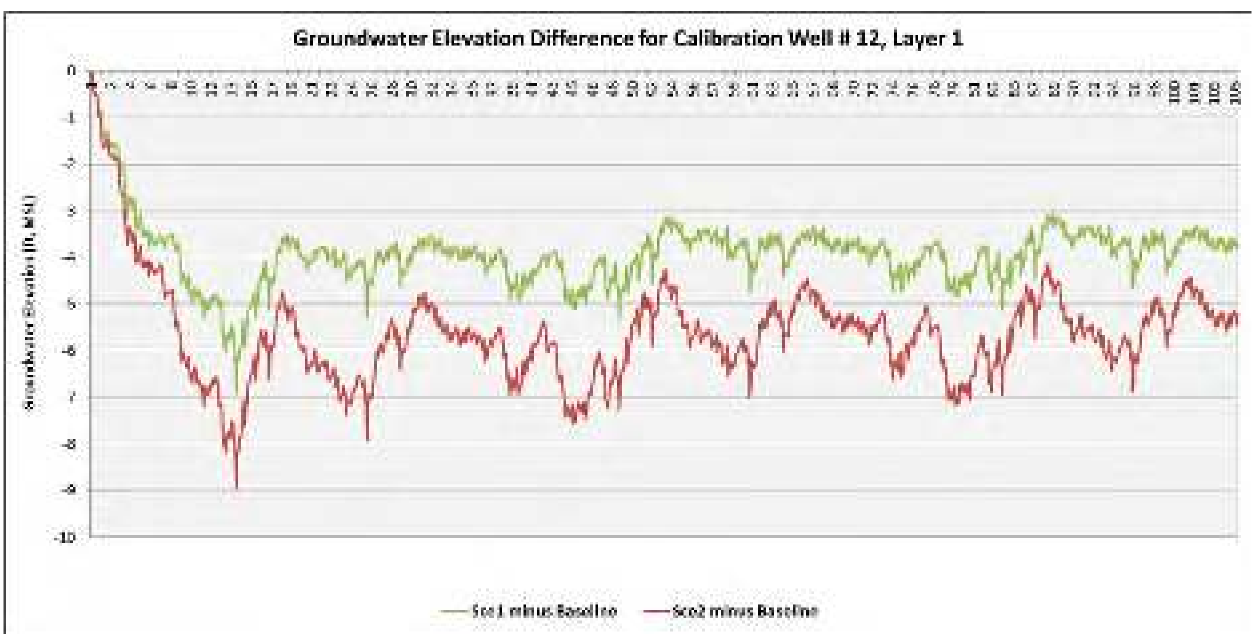

Groundwater Elevation for Calibration Well # 11, Layer 1
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

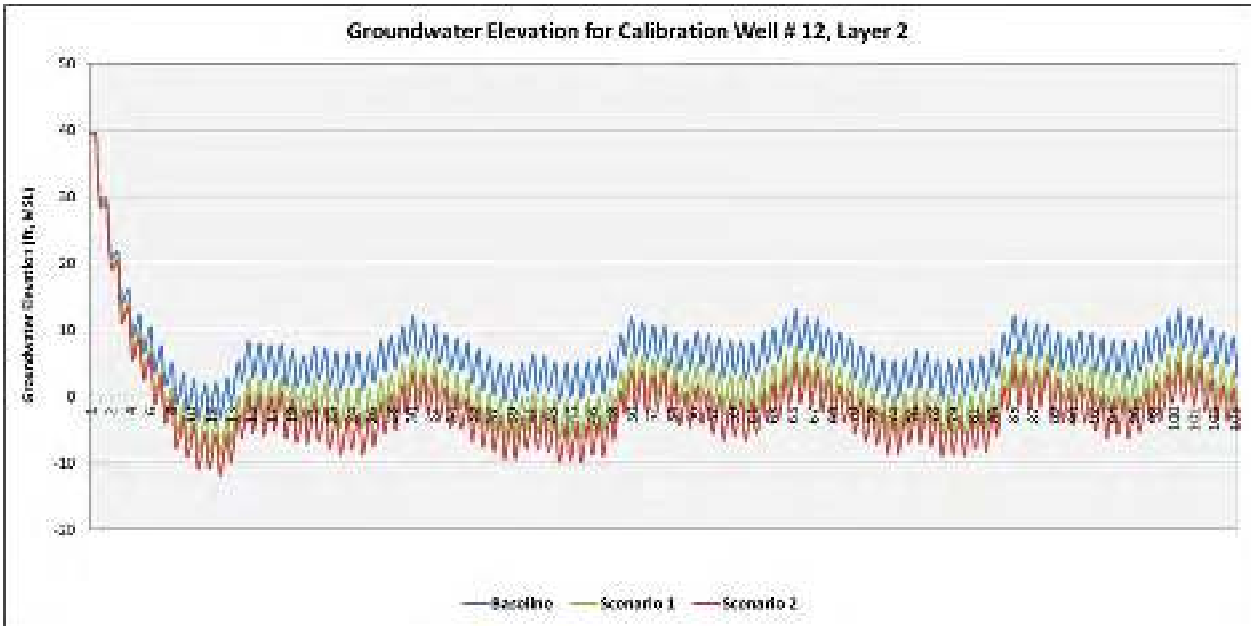

Groundwater Elevation Difference for Calibration Well # 11, Layer 1
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline

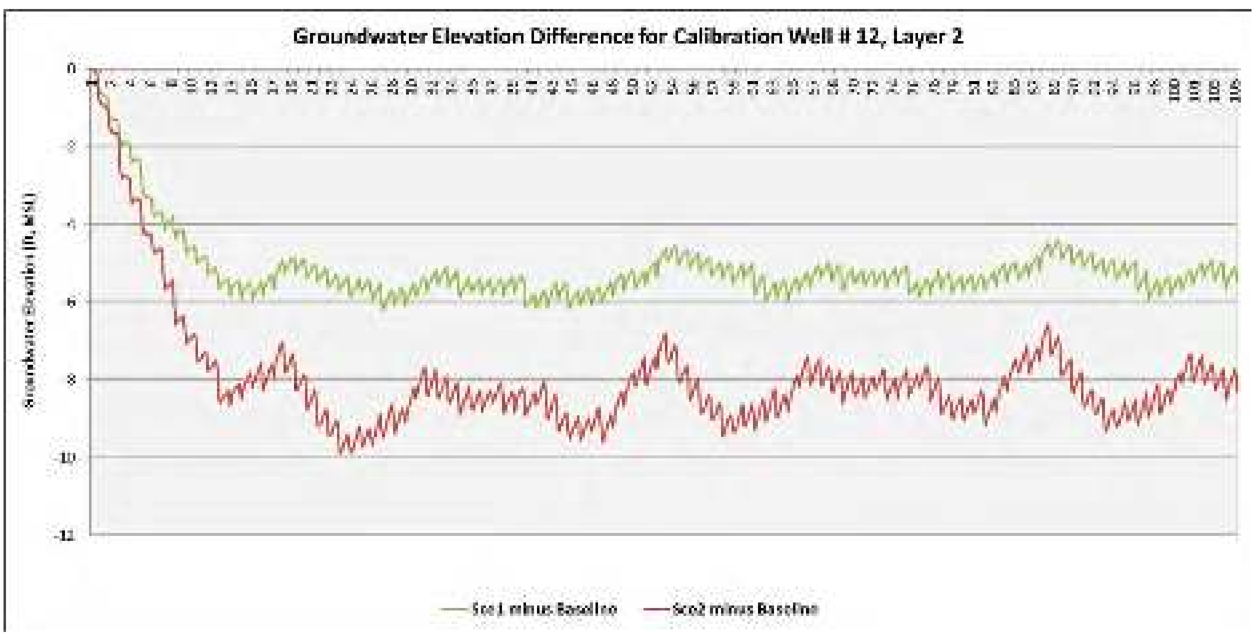

Groundwater Elevation for Calibration Well # 11, Layer 2
Baseline
Scenario 1
Scenario 2

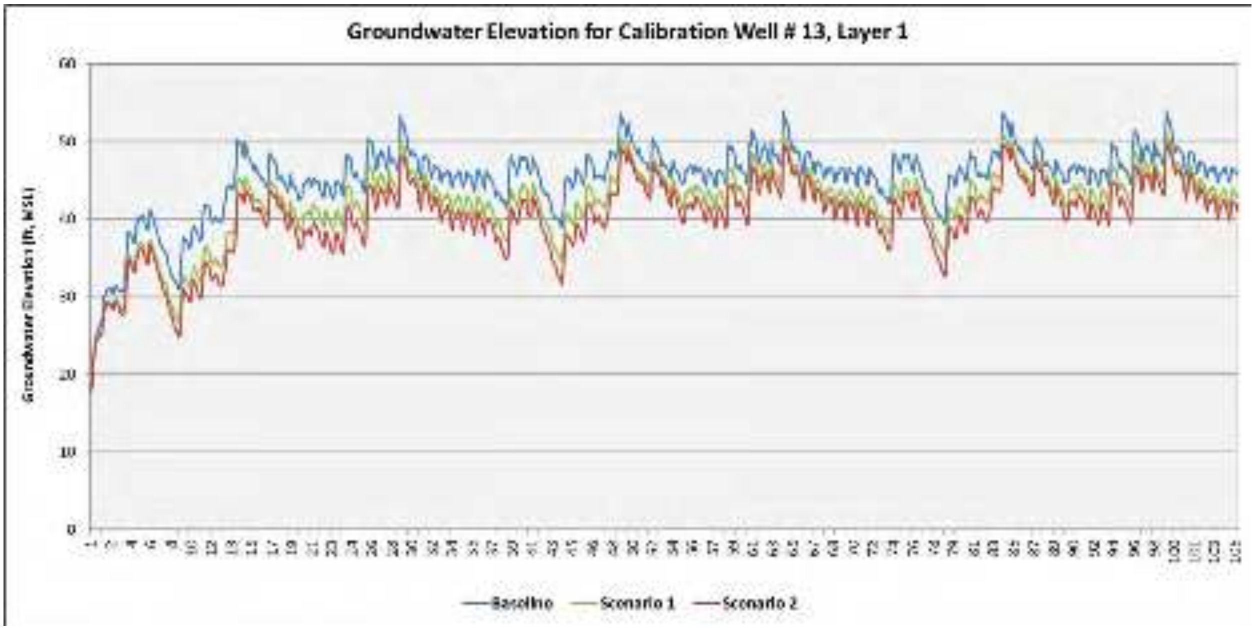

Groundwater Elevation Difference for Calibration Well # 11, Layer 2
Sce1 minus Baseline
Sce2 minus Baseline

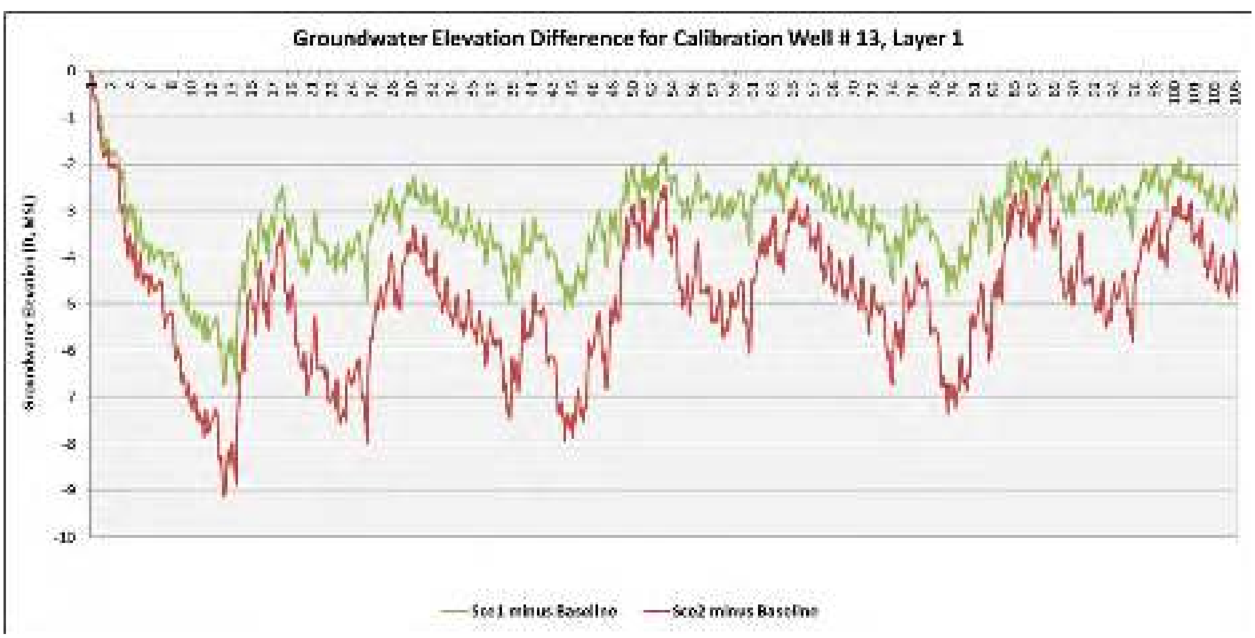

Groundwater Elevation for Calibration Well # 12, Layer 1
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

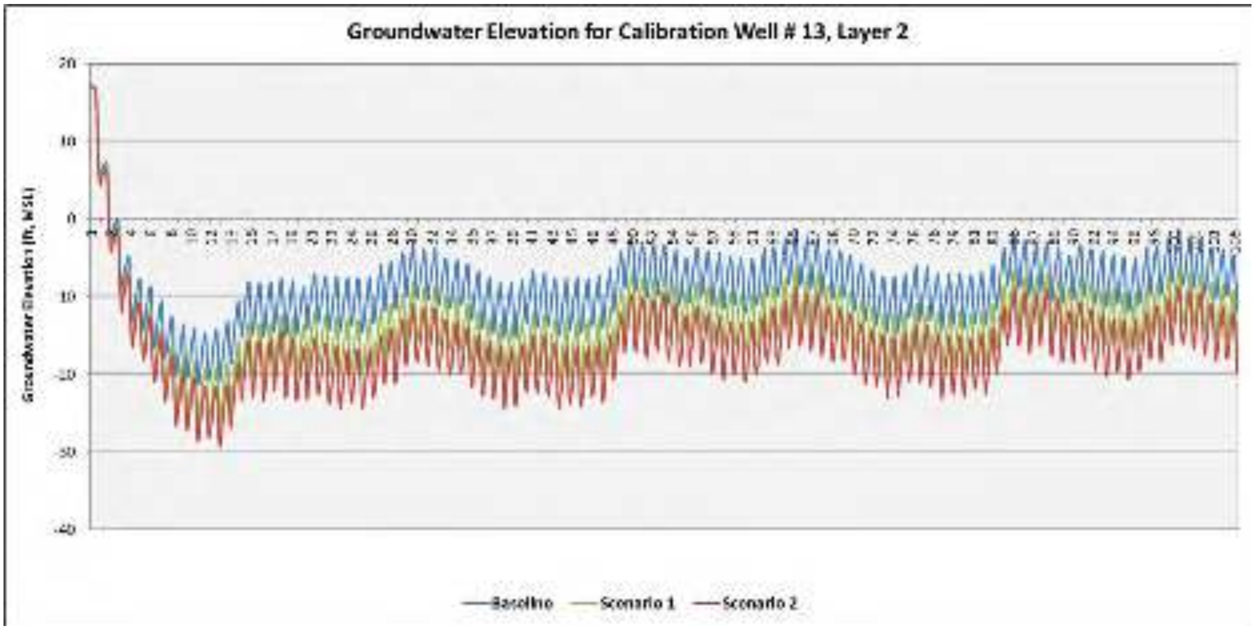

Groundwater Elevation Difference for Calibration Well # 12, Layer 1
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline

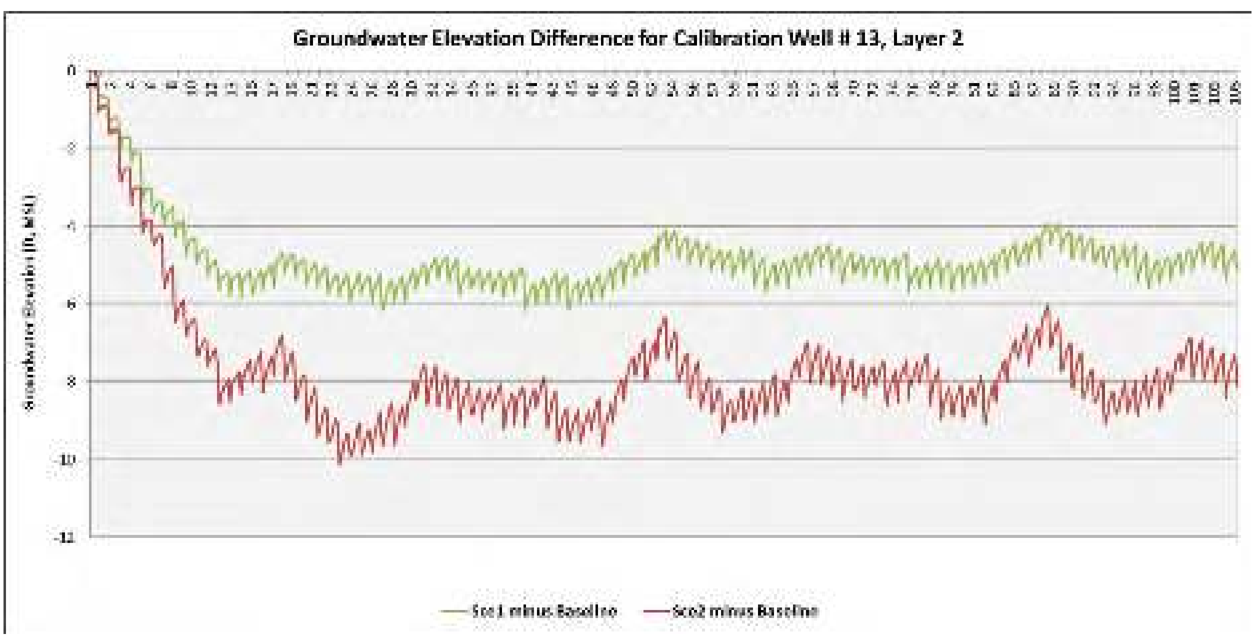

Groundwater Elevation for Calibration Well # 12, Layer 2
Groundwater Elevation (ft, MSL)
50
40
30
20
10
0
-10
-20
Baseline
Scenario 1
Scenario 2


Groundwater Elevation Difference for Calibration Well # 12, Layer 2
Groundwater Elevation (ft, MSL)
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 13, Layer 1
Baseline
Scenario 1
Scenario 2


Groundwater Elevation Difference for Calibration Well # 13, Layer 1


Groundwater Elevation for Calibration Well # 13, Layer 2
Baseline
Scenario 1
Scenario 2


Groundwater Elevation Difference for Calibration Well # 13, Layer 2
Sce1 minus Baseline
Sce2 minus Baseline

Appendix B2 Representative Groundwater Elevation Hydrographs in Sacramento County

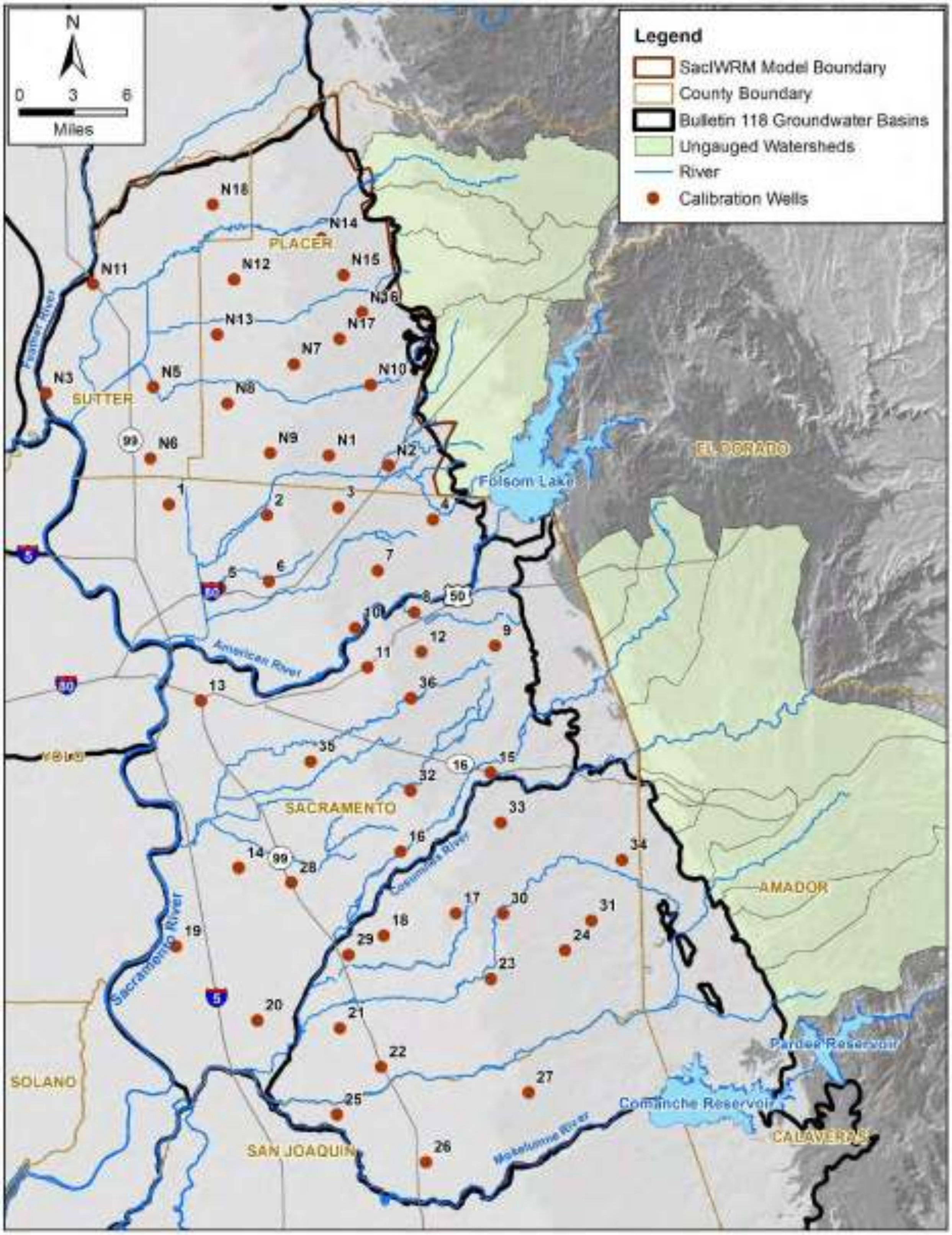
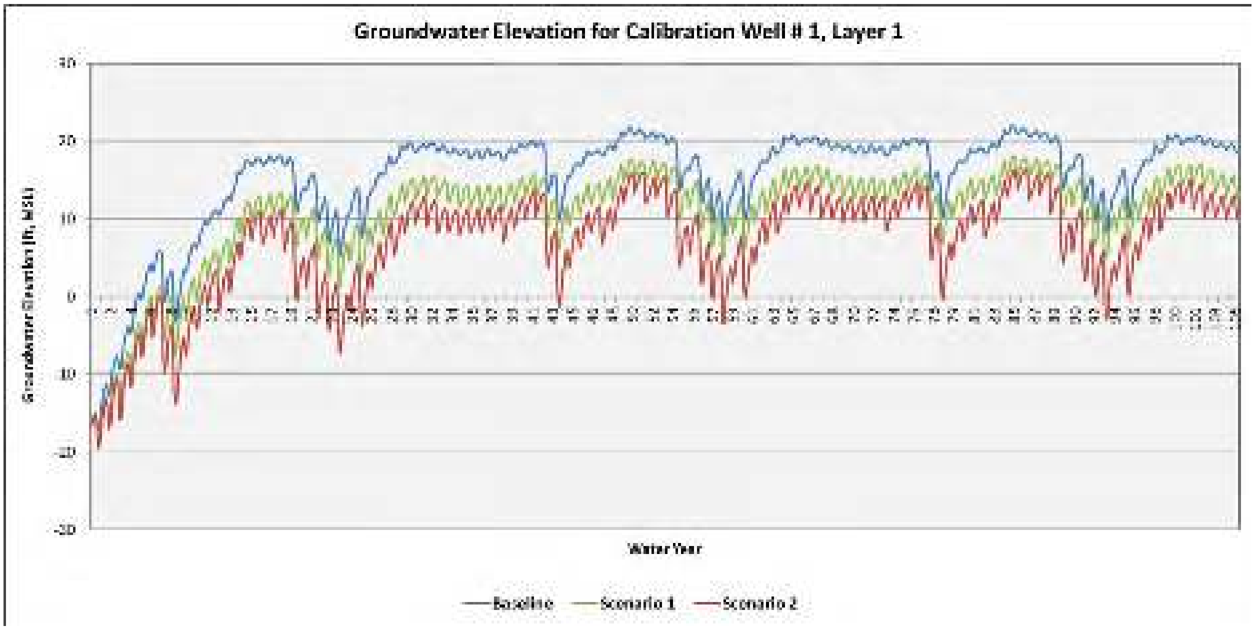
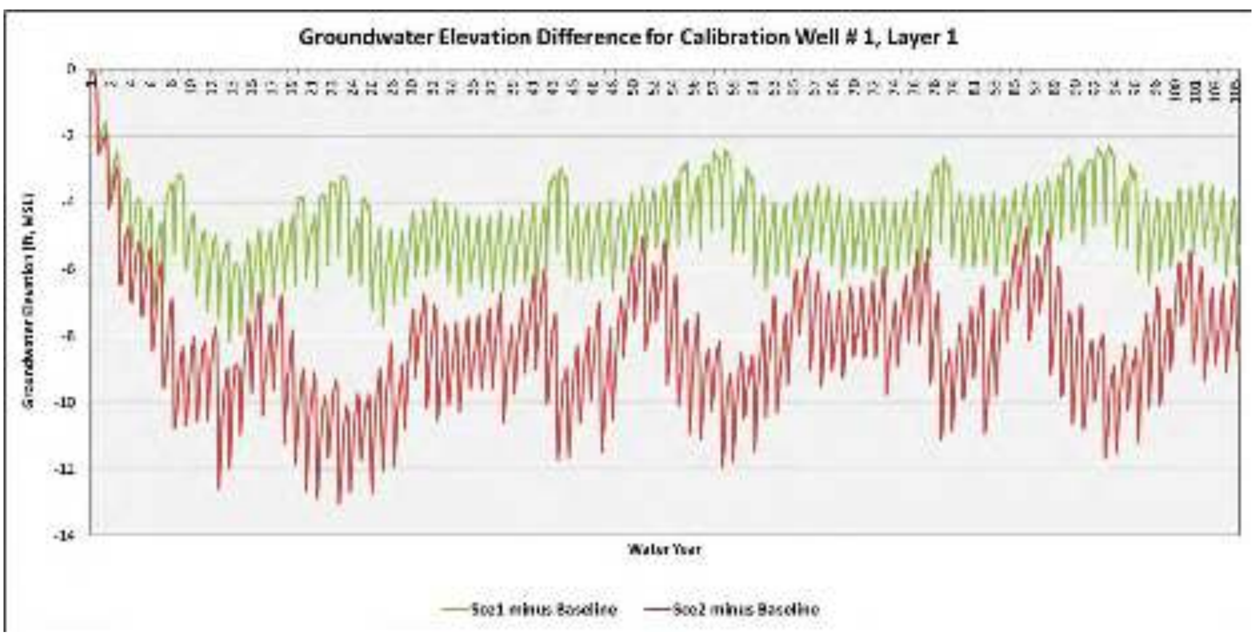


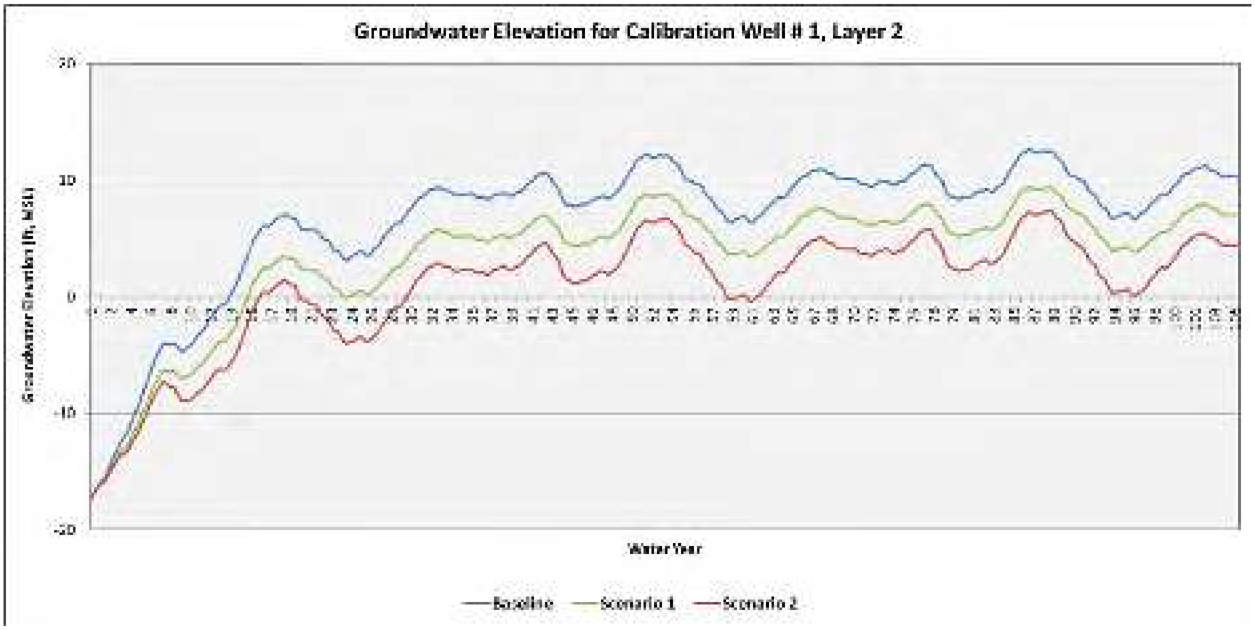
Figure B2 – Representative calibration wells in Sacramento County

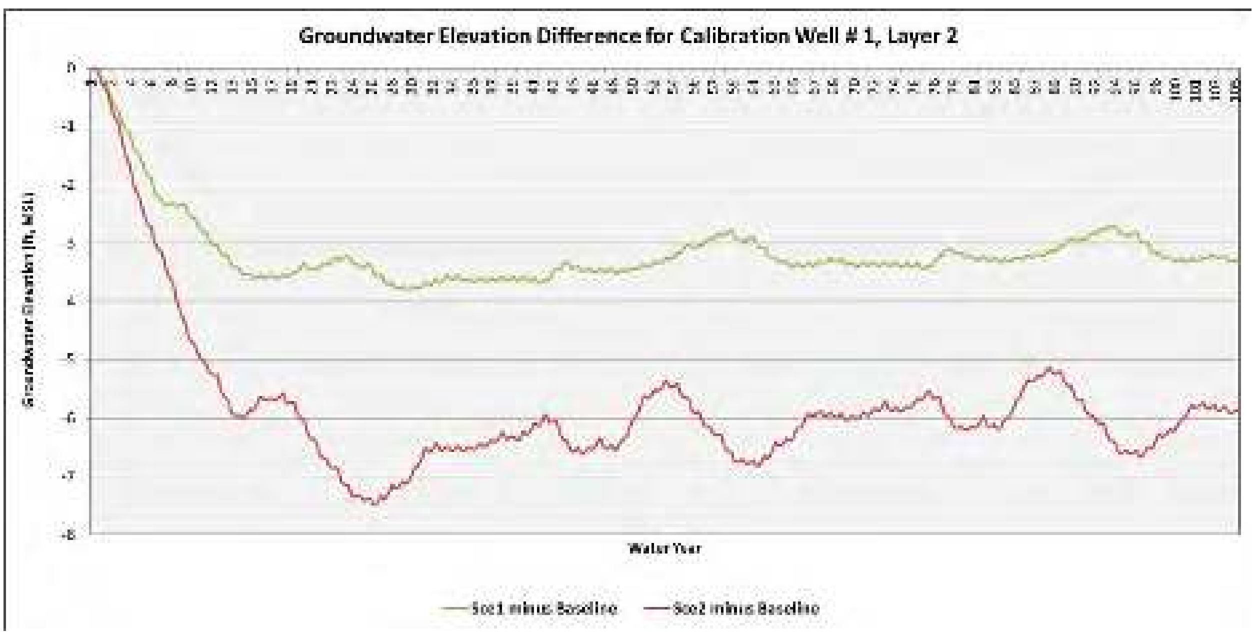


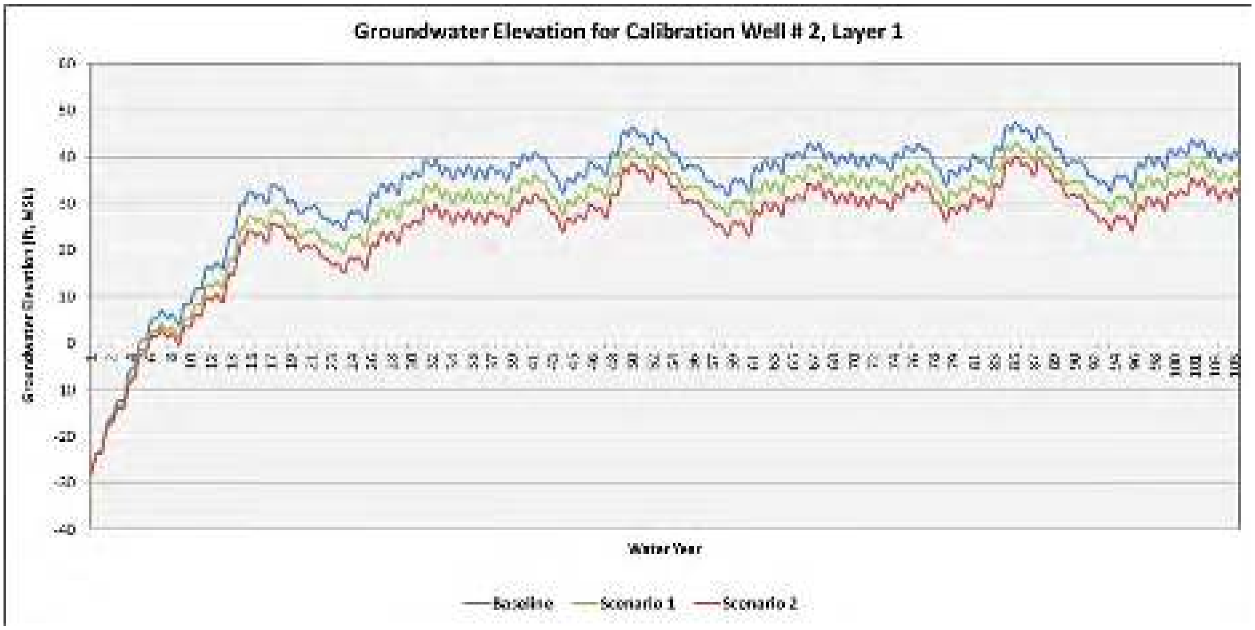
Groundwater Elevation for Calibration Well # 1, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

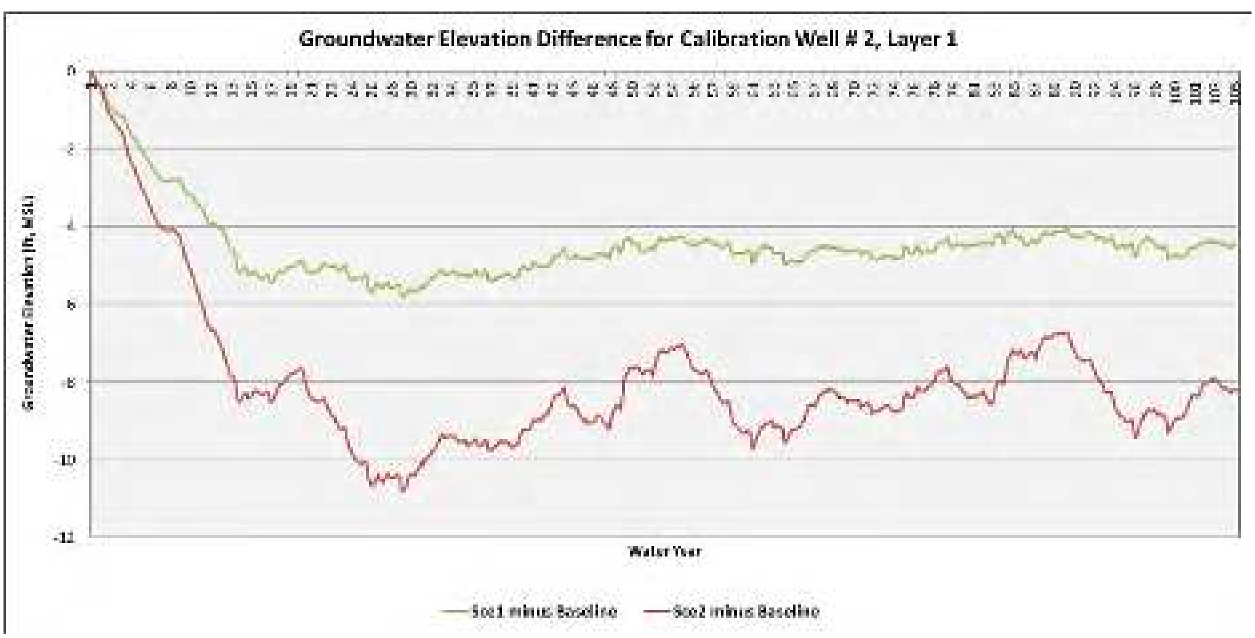


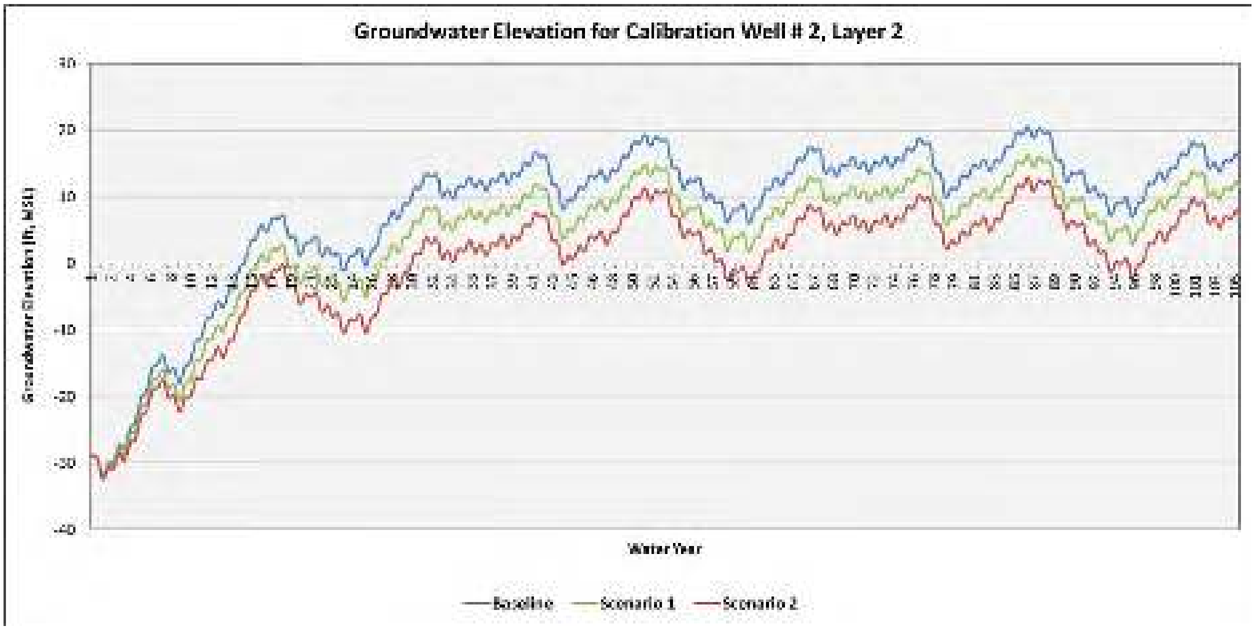
Groundwater Elevation Difference for Calibration Well # 1, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

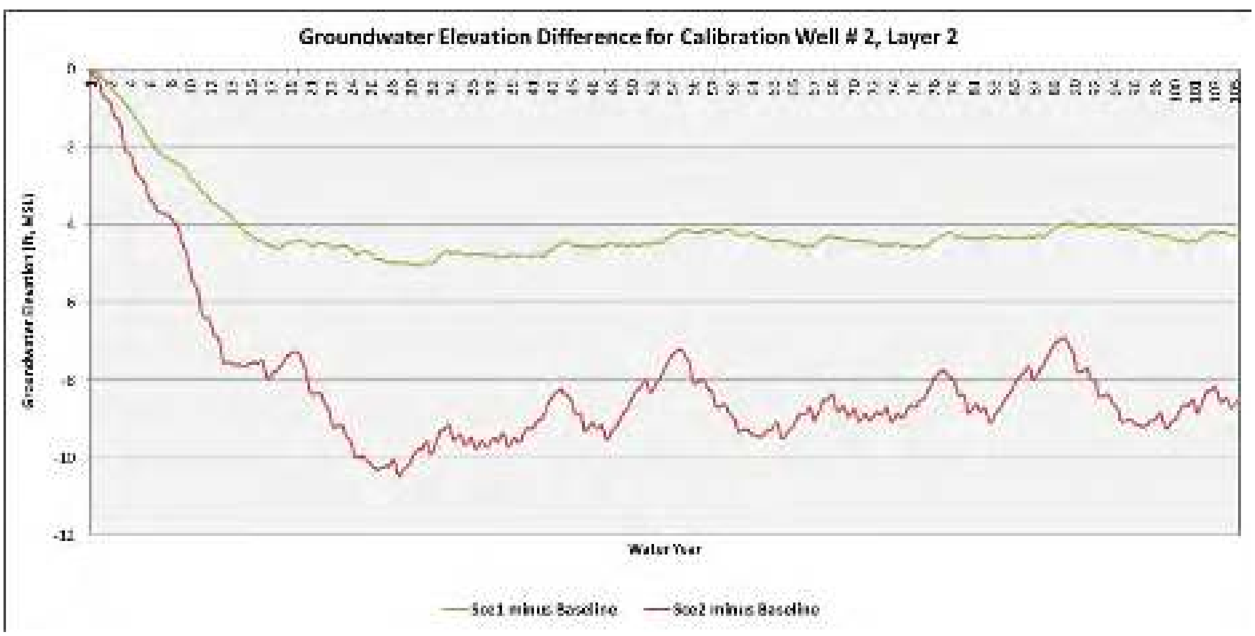

Groundwater Elevation for Calibration Well # 1, Layer 2
20
10
0
-10
-20
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

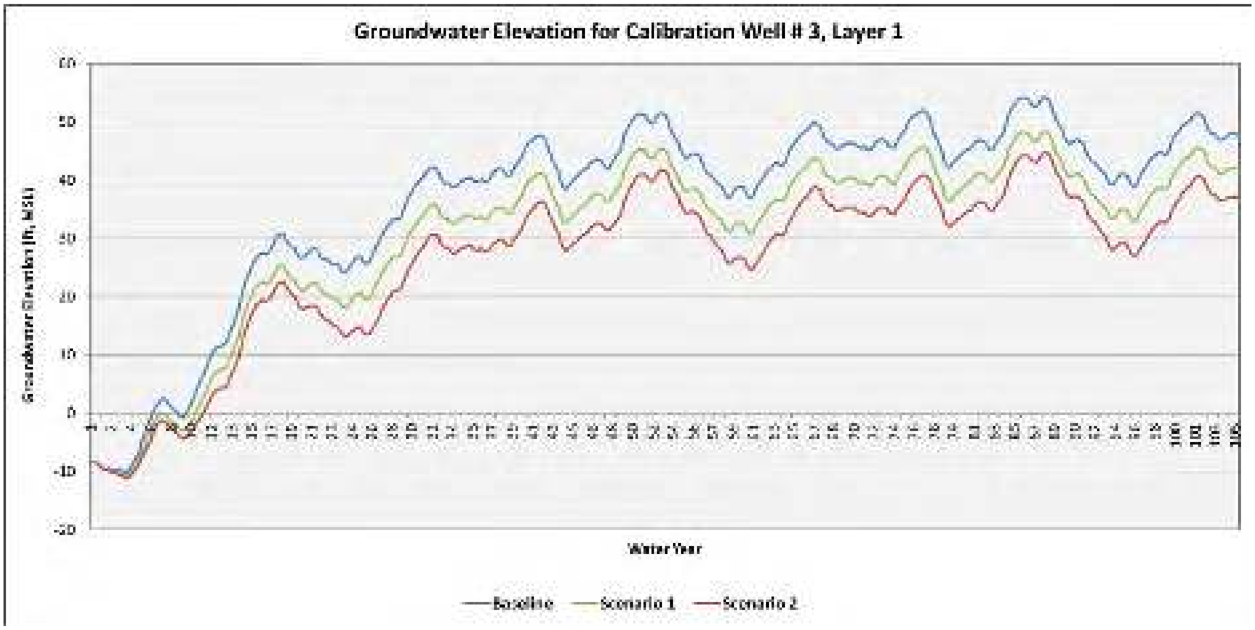

Groundwater Elevation Difference for Calibration Well # 1, Layer 2
0
-1
-2
-3
-4
-5
-6
-7
-8
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

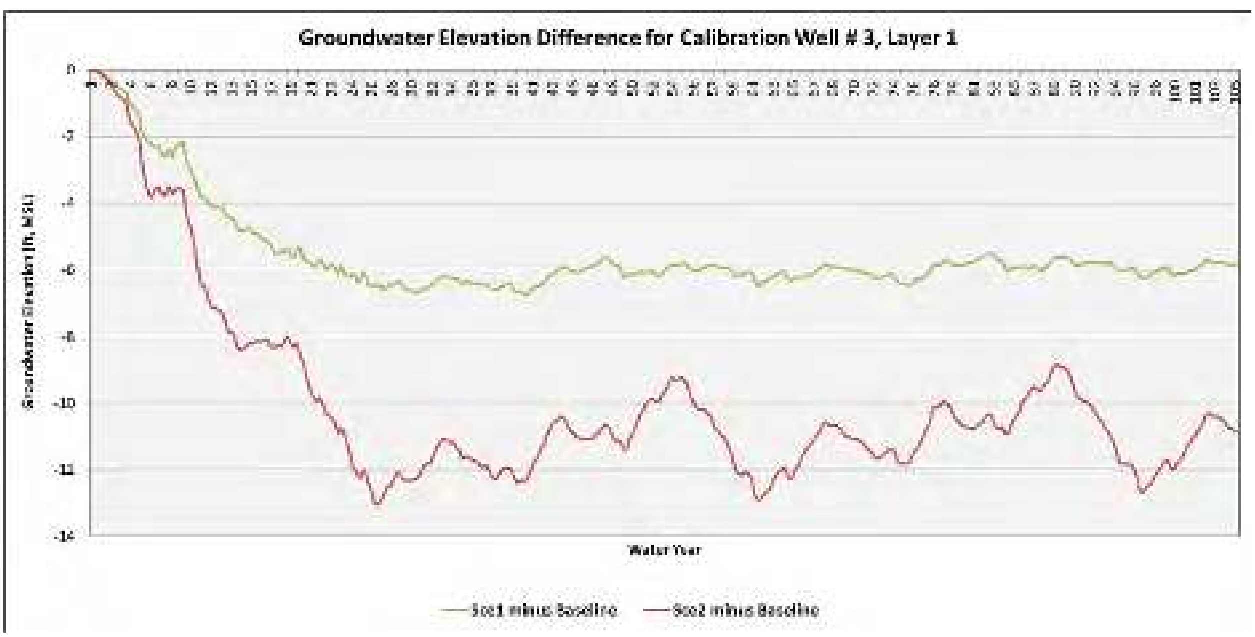

Groundwater Elevation for Calibration Well # 2, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

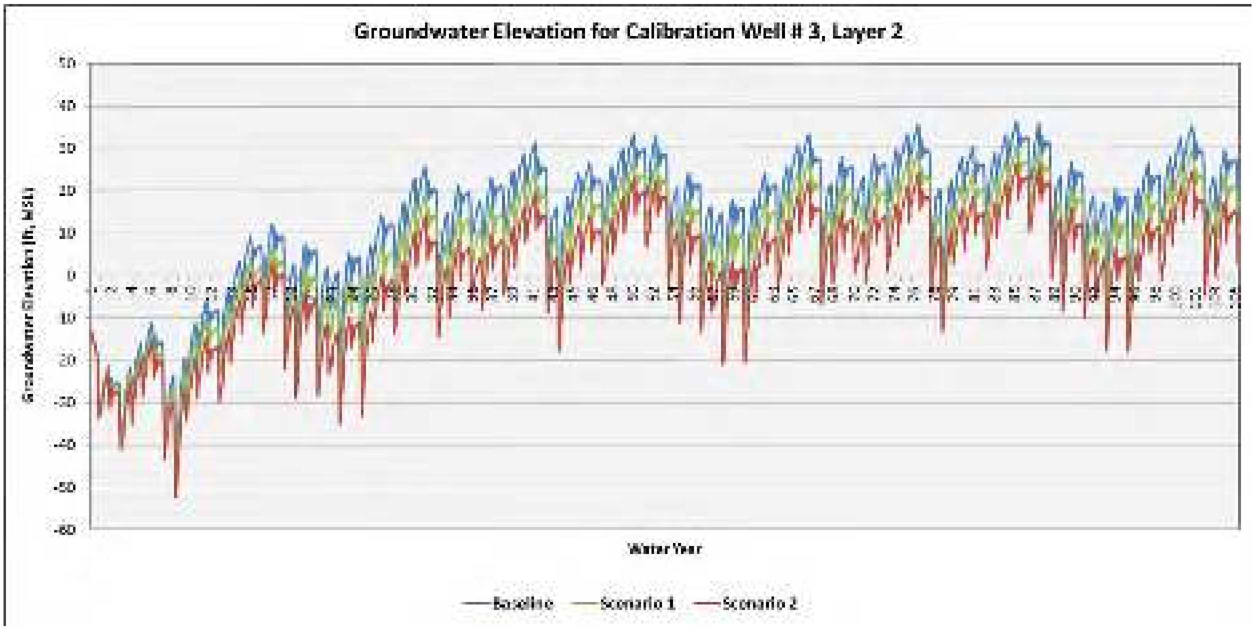

Groundwater Elevation Difference for Calibration Well # 2, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

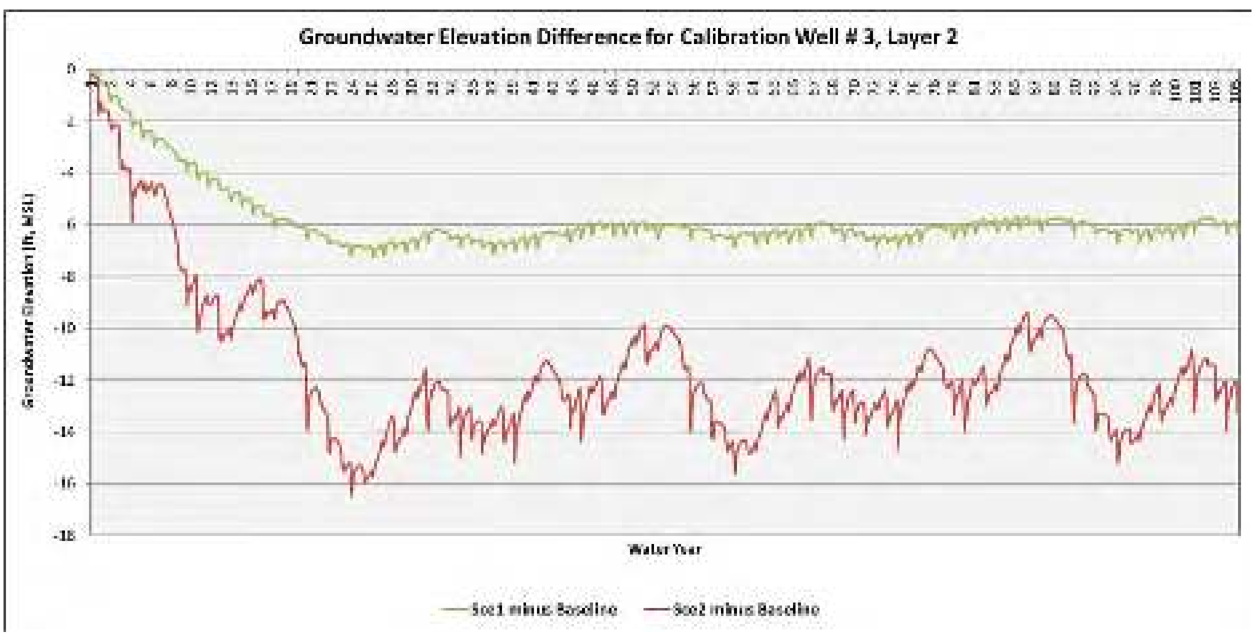

Groundwater Elevation for Calibration Well # 2, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

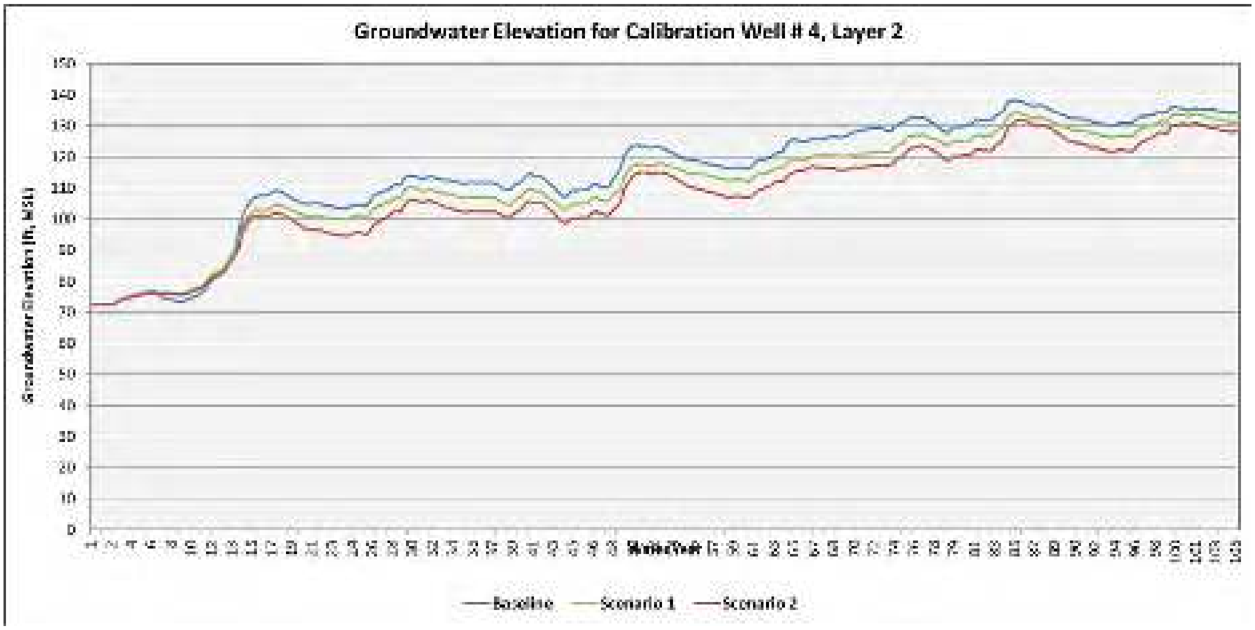

Groundwater Elevation Difference for Calibration Well # 2, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 3, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

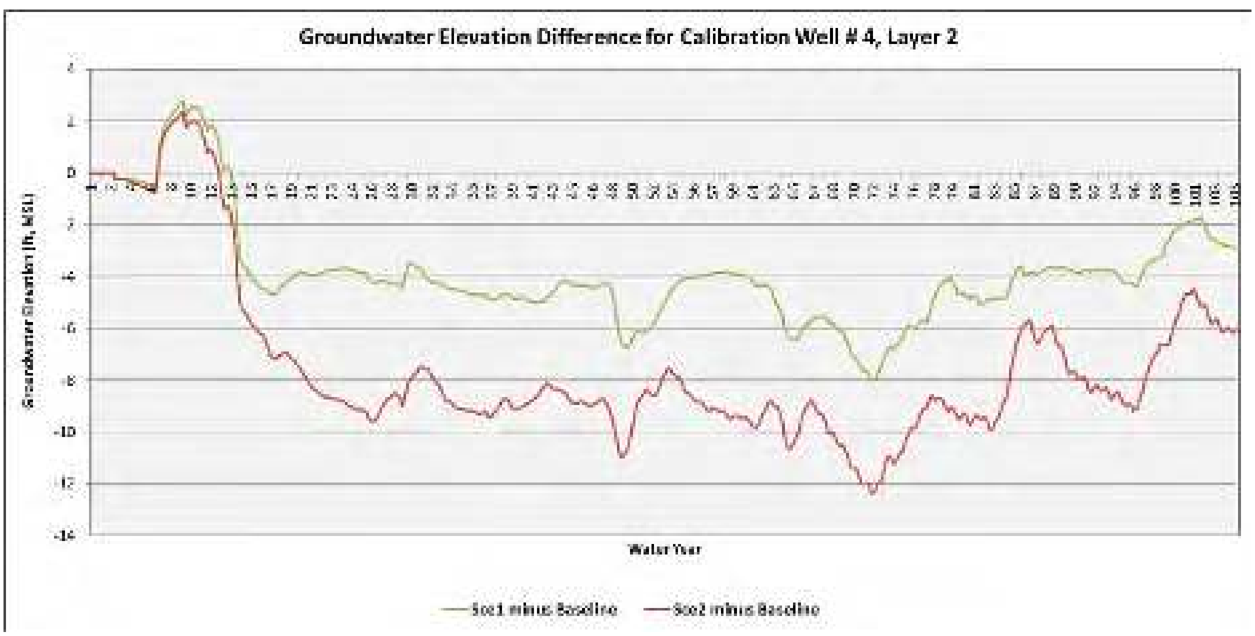

Groundwater Elevation Difference for Calibration Well # 3, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 3, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

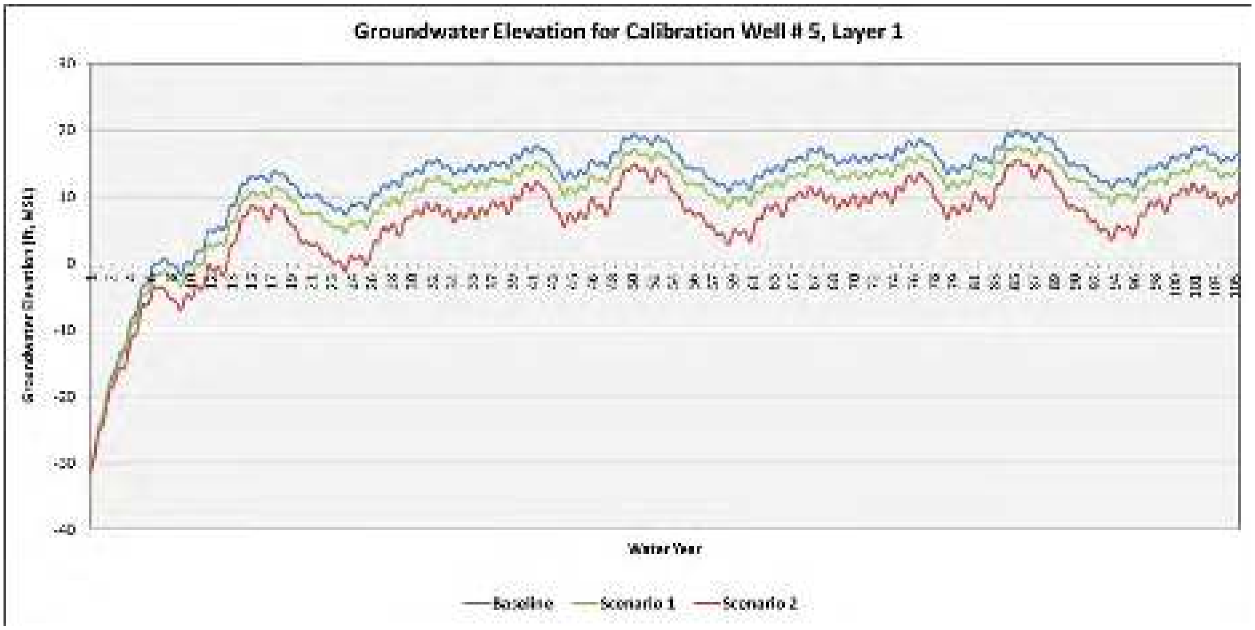

Groundwater Elevation Difference for Calibration Well # 3, Layer 2
Water Year
Scn1 minus Baseline
Scn2 minus Baseline



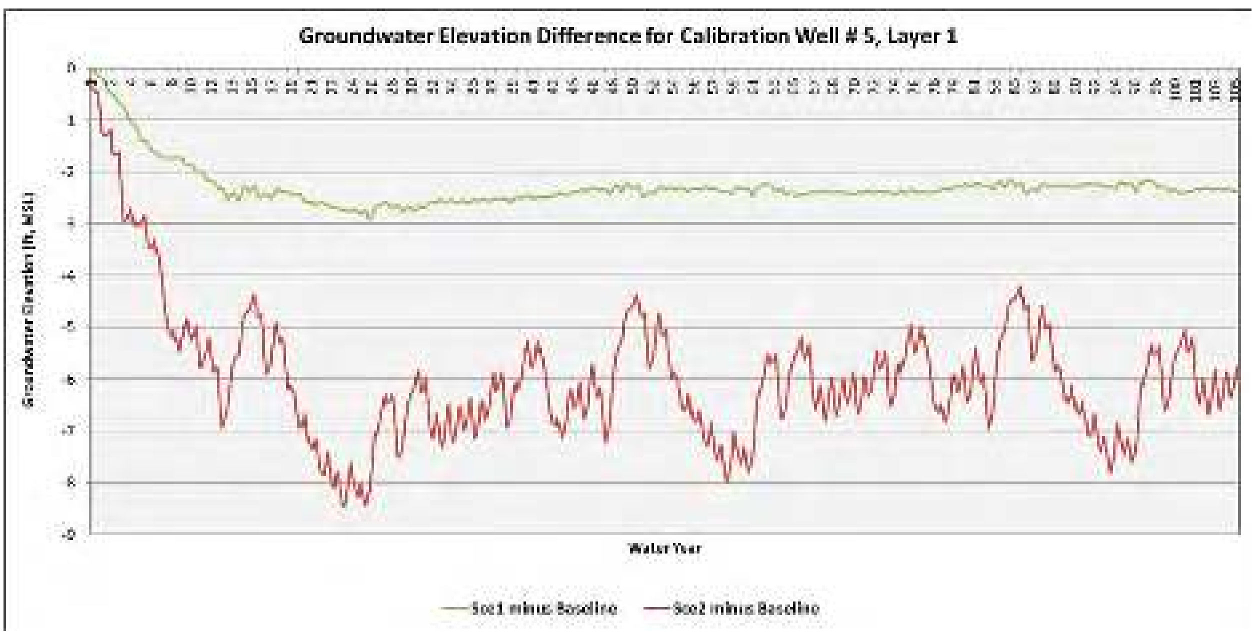
Groundwater Elevation for Calibration Well # 4, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2



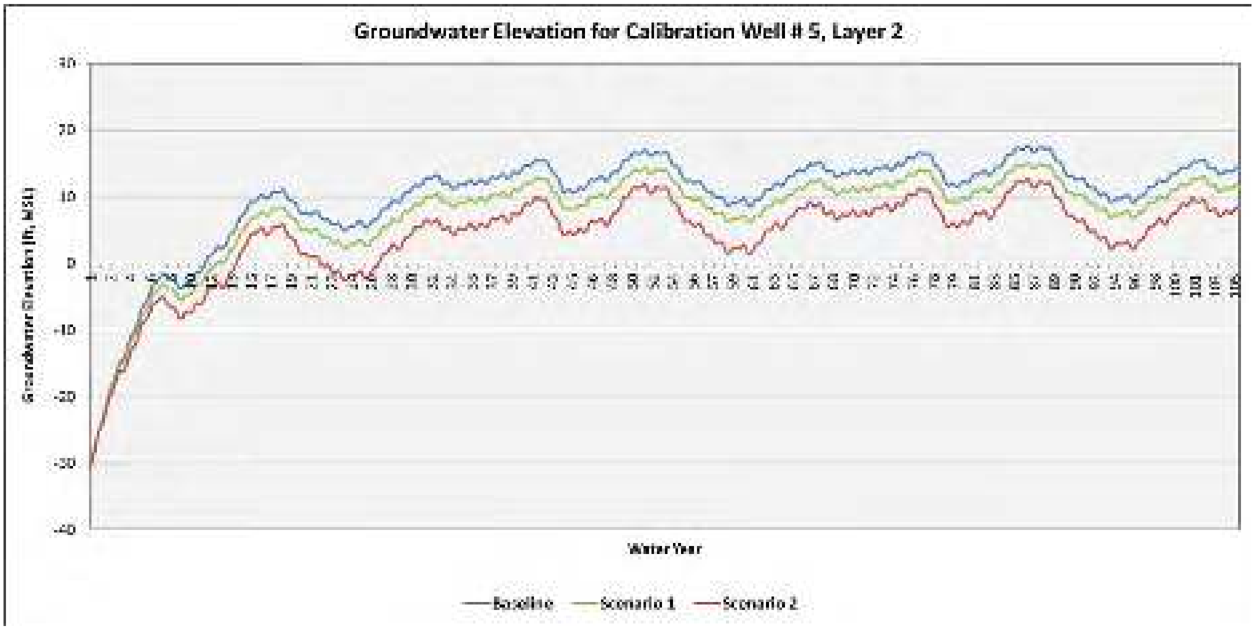
Groundwater Elevation Difference for Calibration Well # 4, Layer 2
Water Year
Scn1 minus Baseline
Scn2 minus Baseline



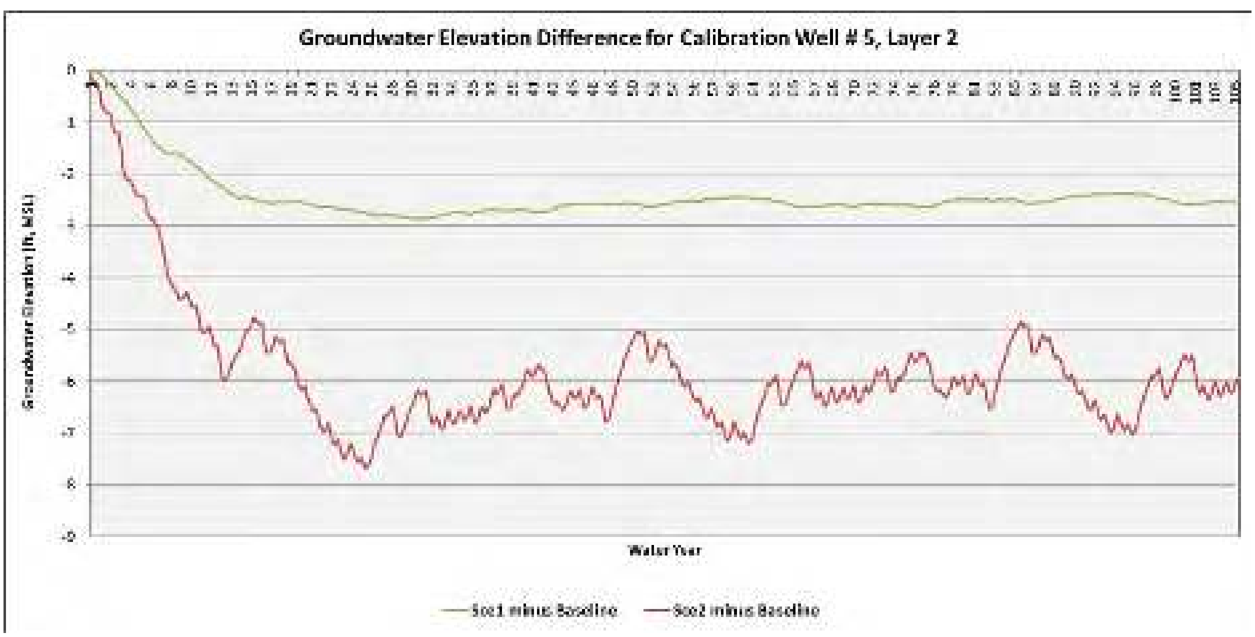
Groundwater Elevation for Calibration Well # 5, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2



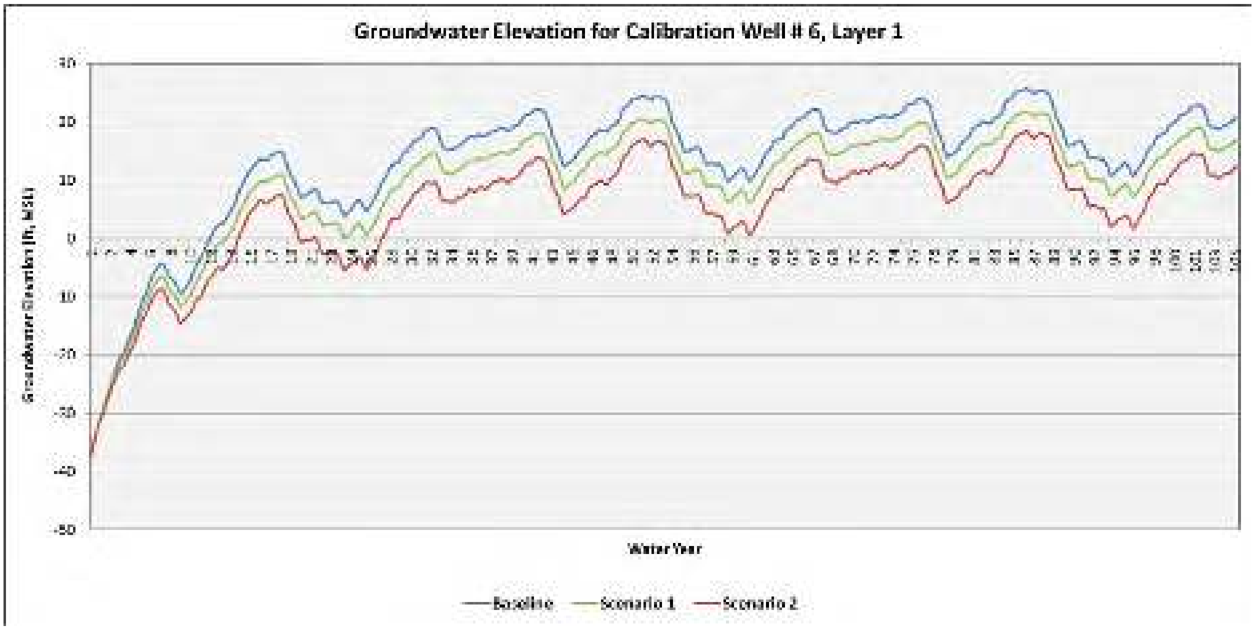
Groundwater Elevation Difference for Calibration Well # 5, Layer 1
Water Year
Scn1 minus Baseline
Scn2 minus Baseline

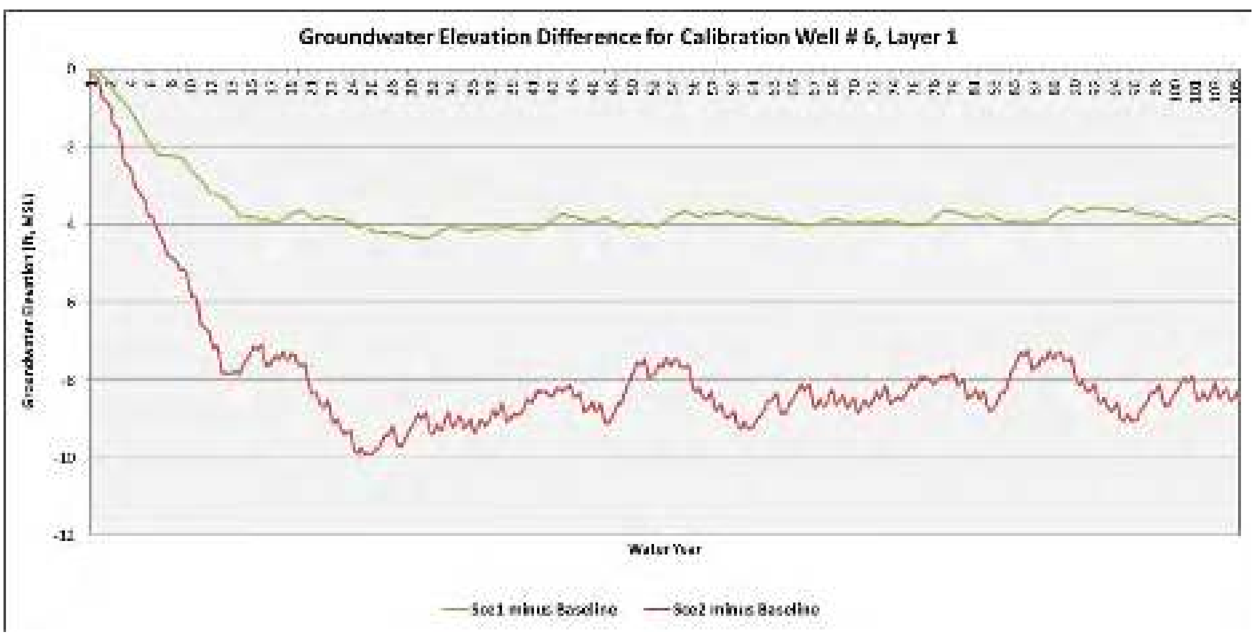


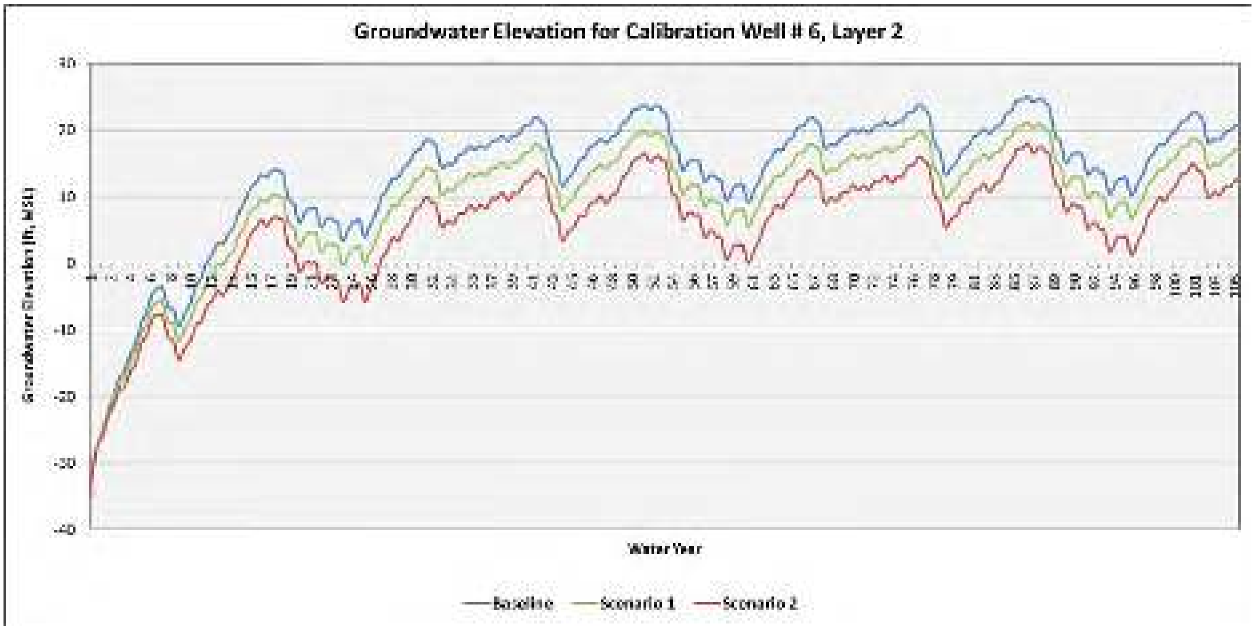
Groundwater Elevation for Calibration Well # 5, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

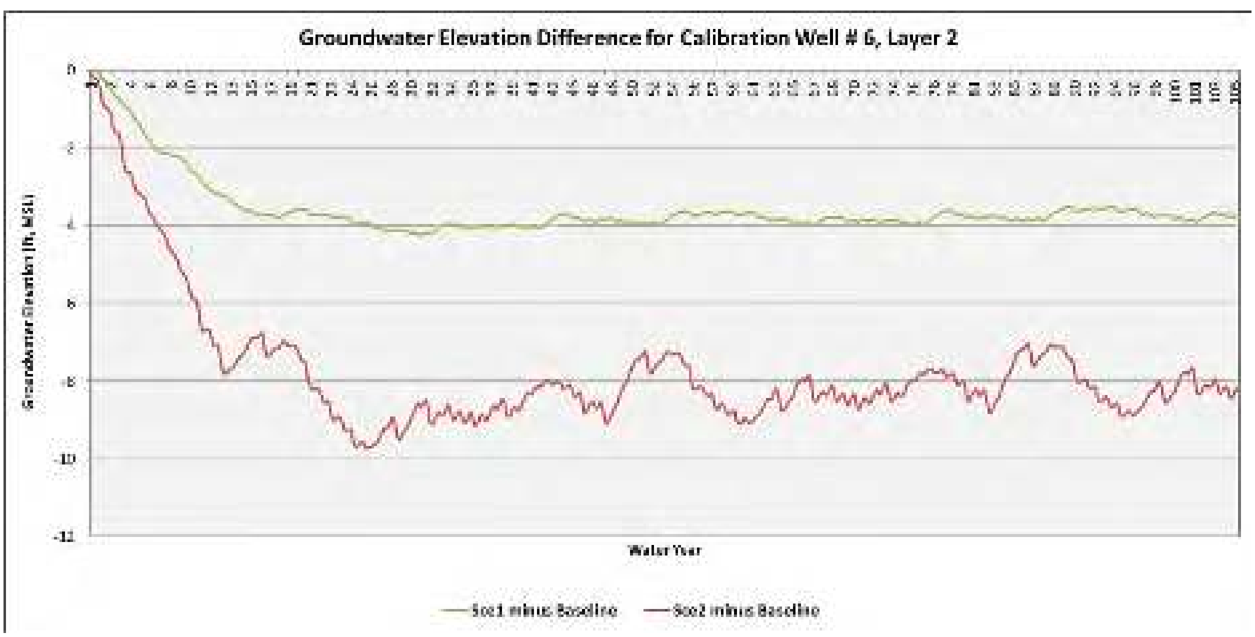


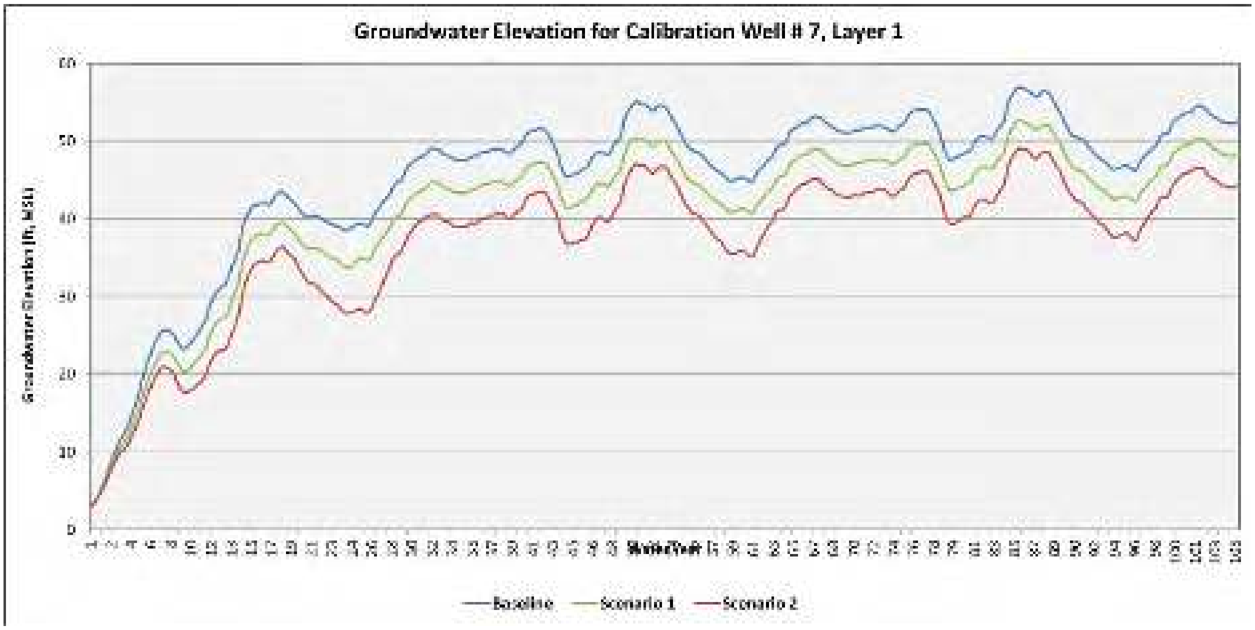
Groundwater Elevation Difference for Calibration Well # 5, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 6, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

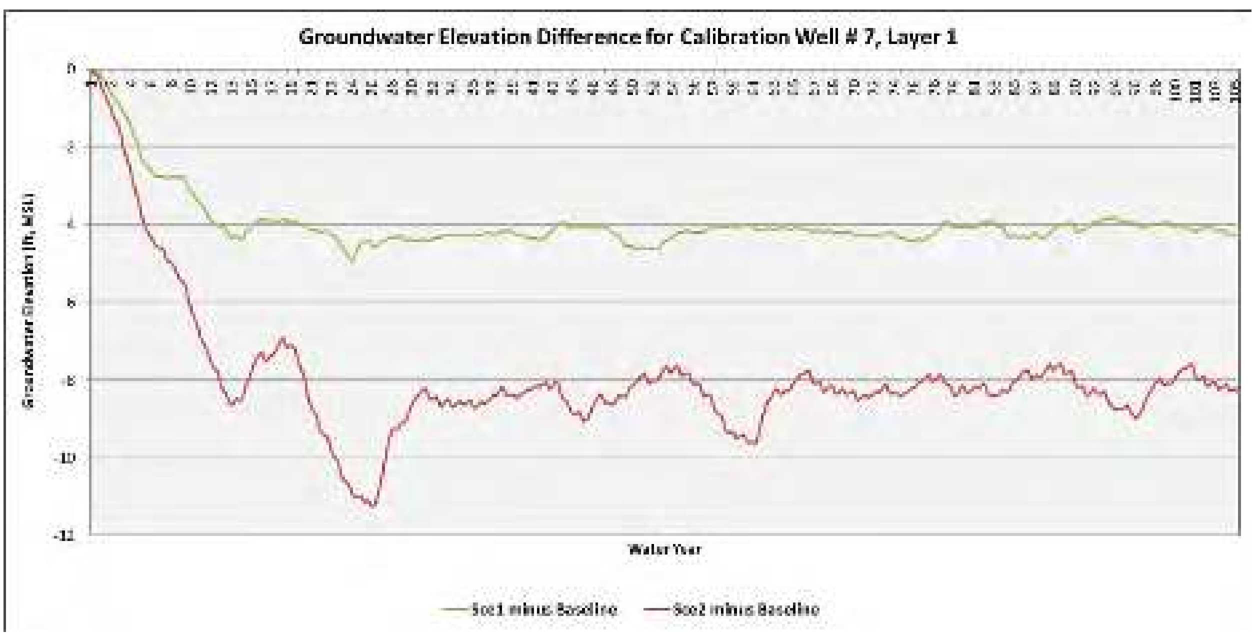

Groundwater Elevation Difference for Calibration Well # 6, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Scn1 minus Baseline
Scn2 minus Baseline


Groundwater Elevation for Calibration Well # 6, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

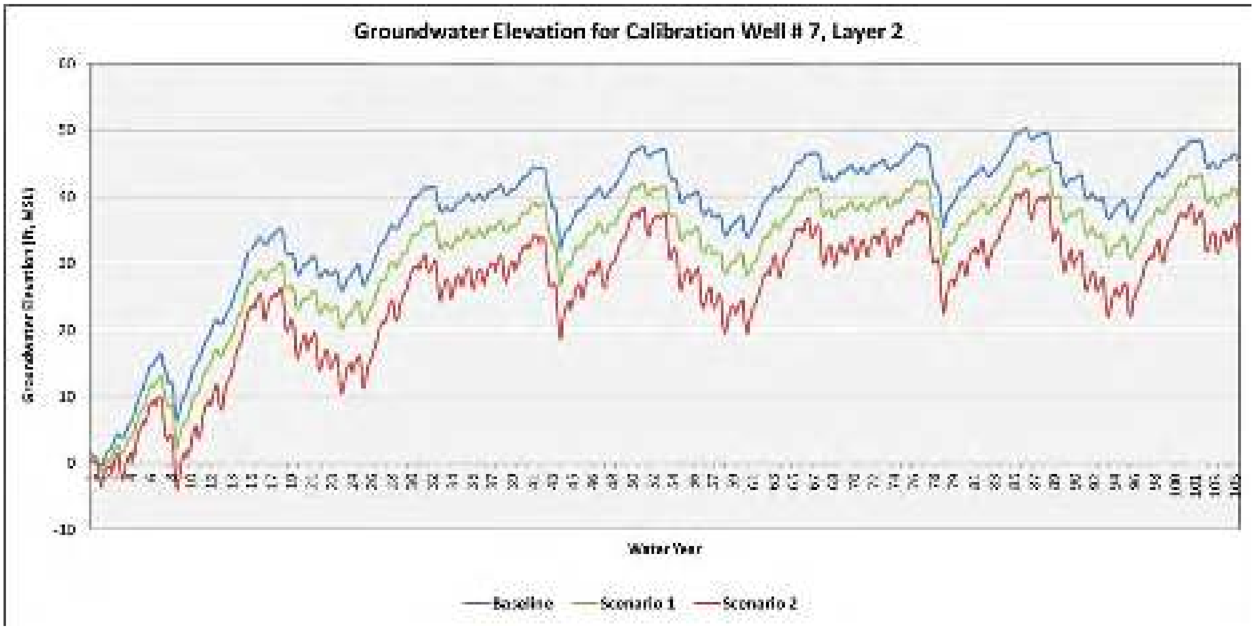

Groundwater Elevation Difference for Calibration Well # 6, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

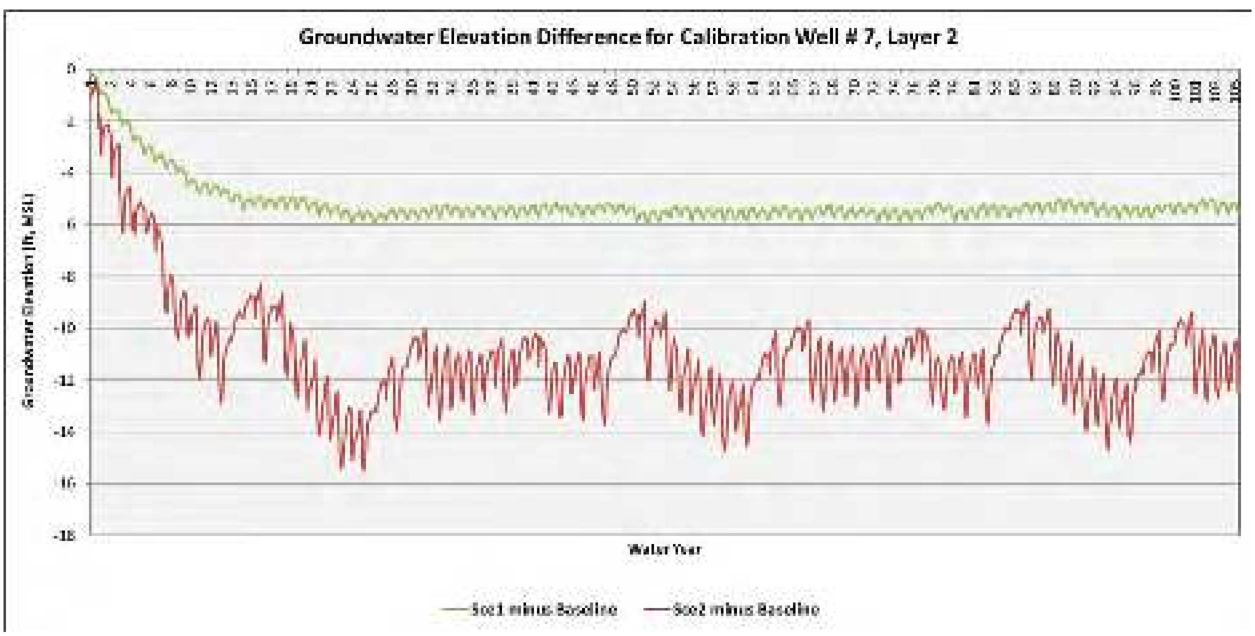


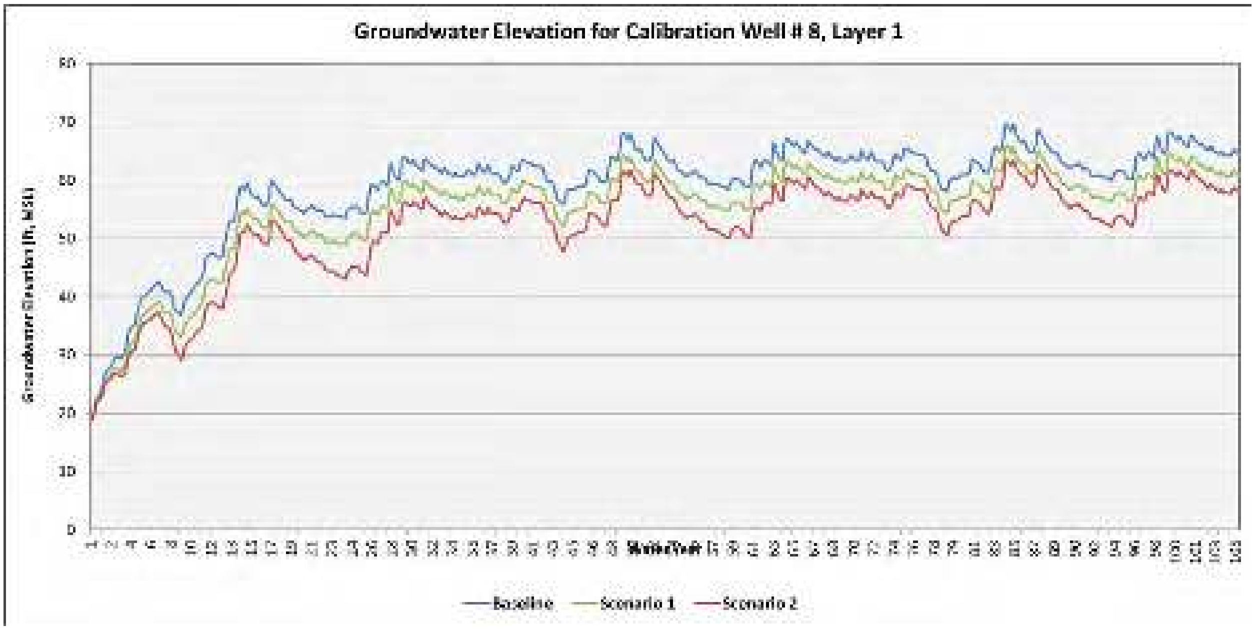
Groundwater Elevation for Calibration Well # 7, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

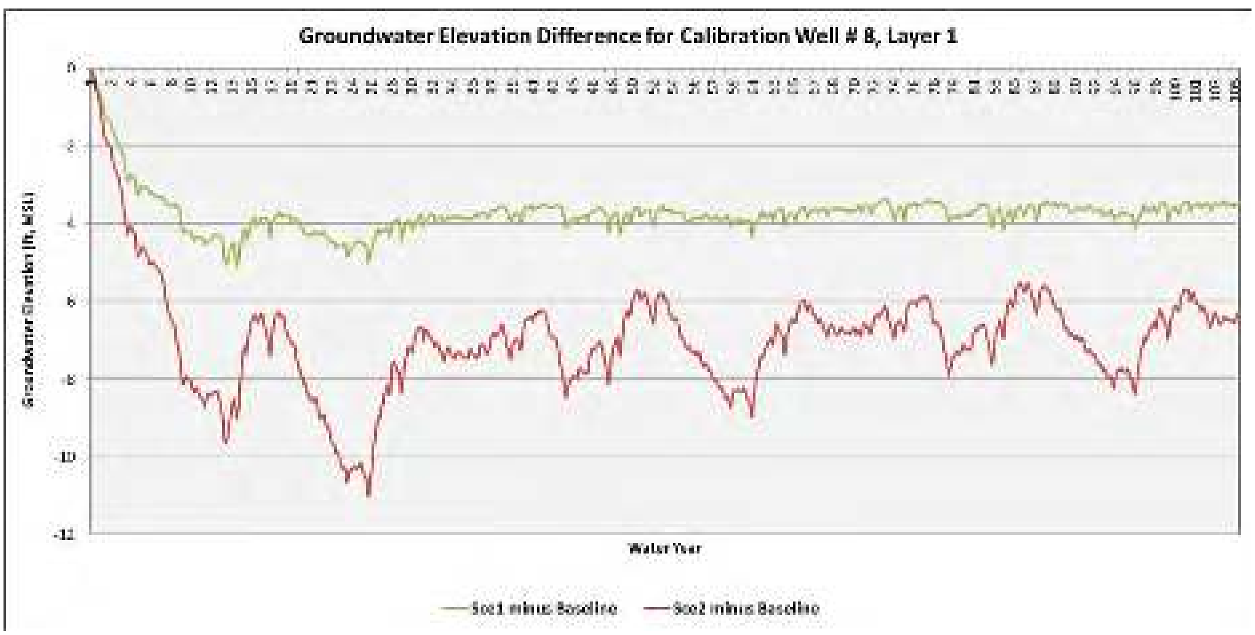


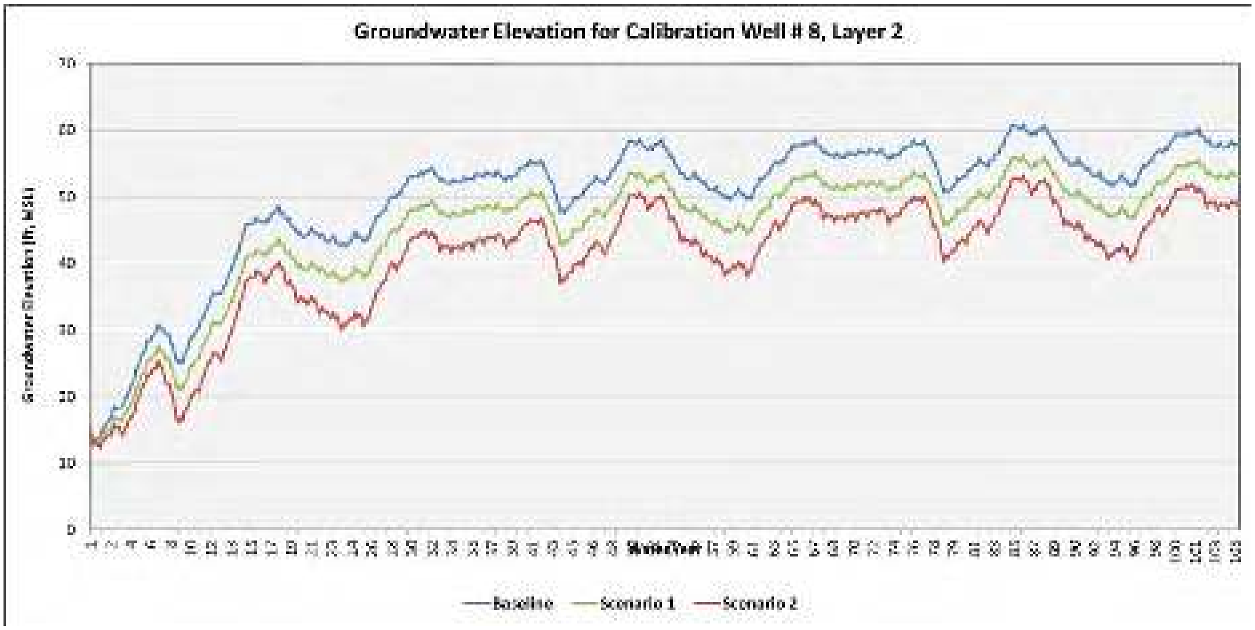
Groundwater Elevation Difference for Calibration Well # 7, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

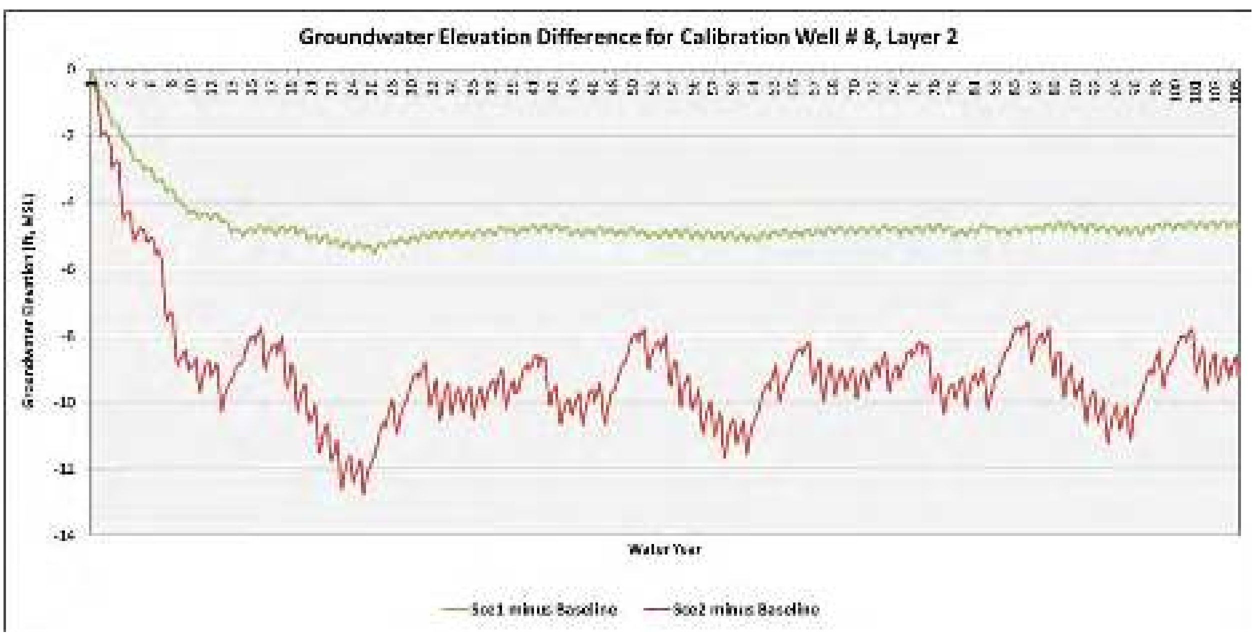

Groundwater Elevation for Calibration Well # 7, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

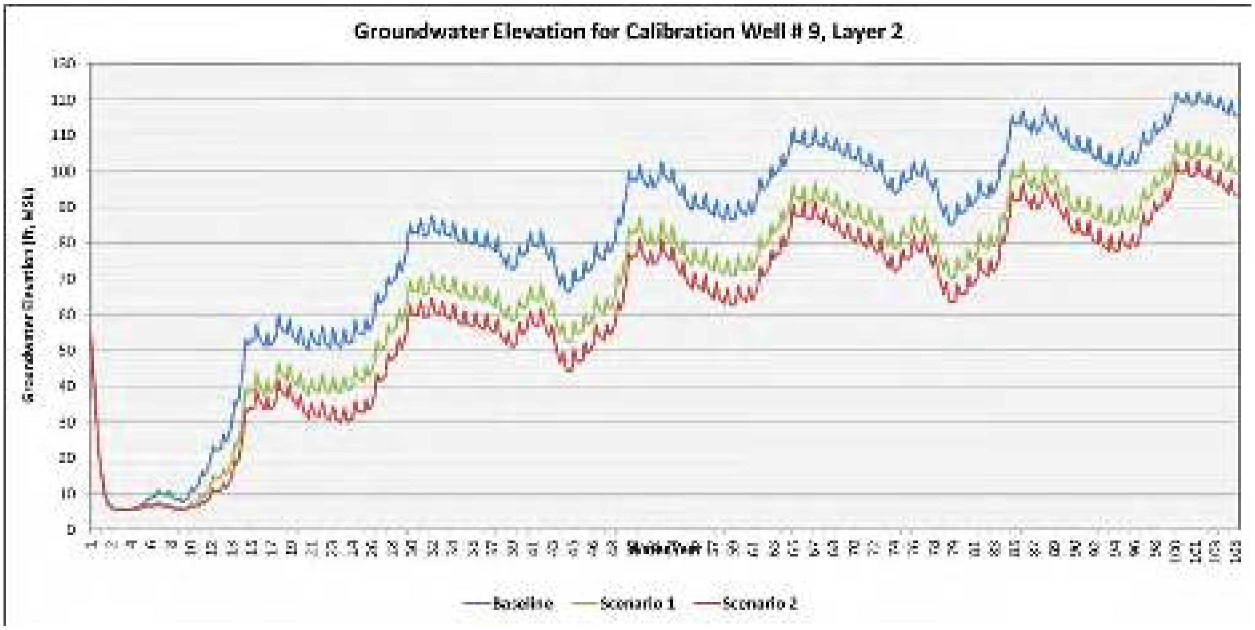

Groundwater Elevation Difference for Calibration Well # 7, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

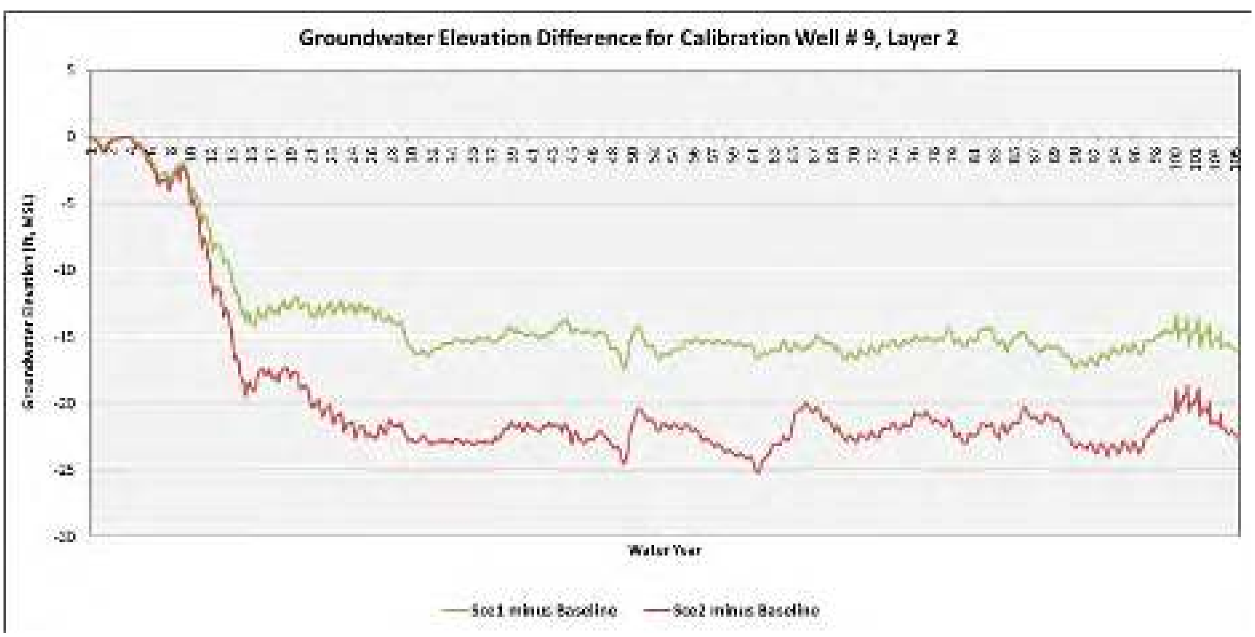

Groundwater Elevation for Calibration Well # 8, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

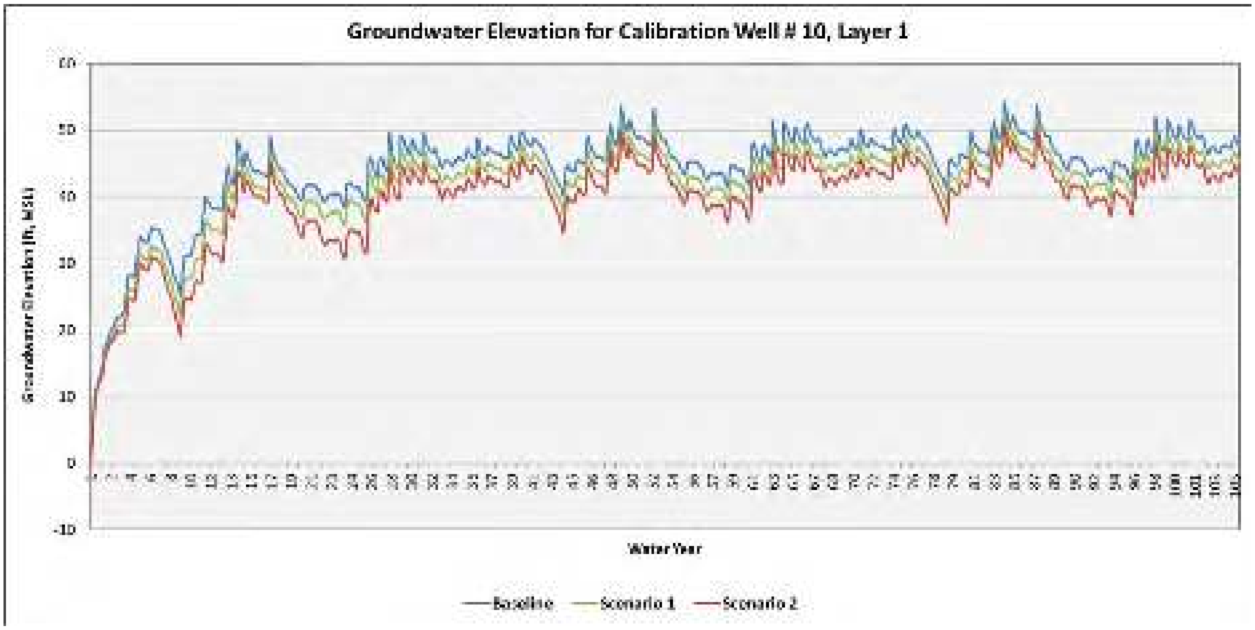

Groundwater Elevation Difference for Calibration Well # 8, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Scn1 minus Baseline
Scn2 minus Baseline


Groundwater Elevation for Calibration Well # 8, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

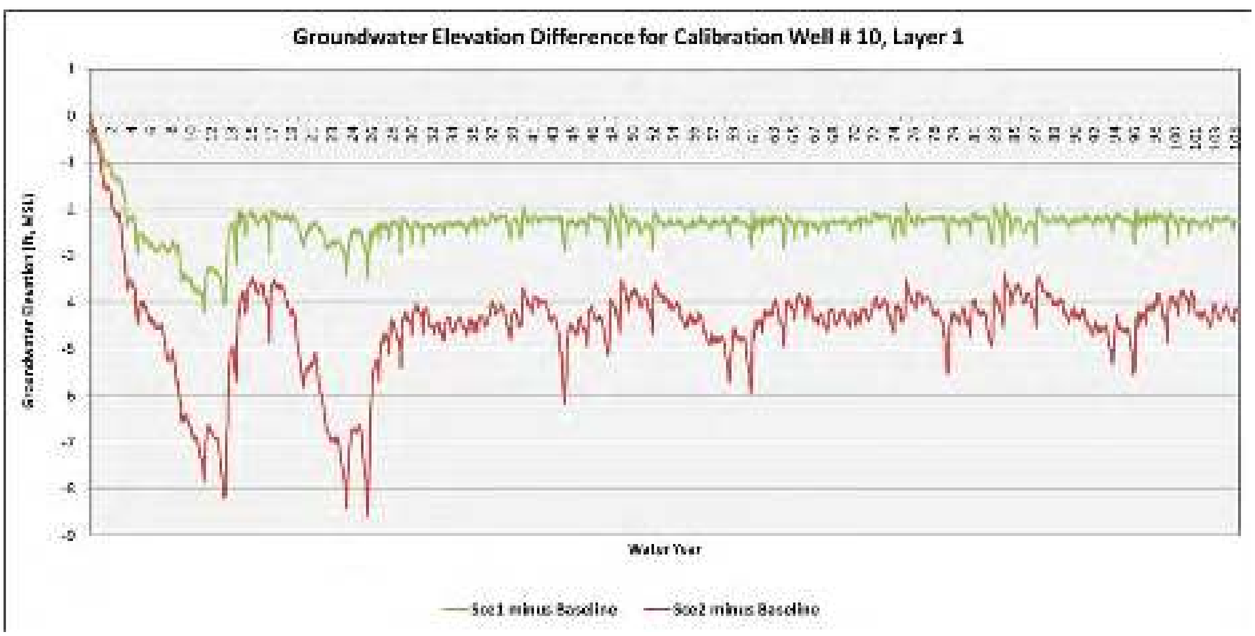

Groundwater Elevation Difference for Calibration Well # 8, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 9, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

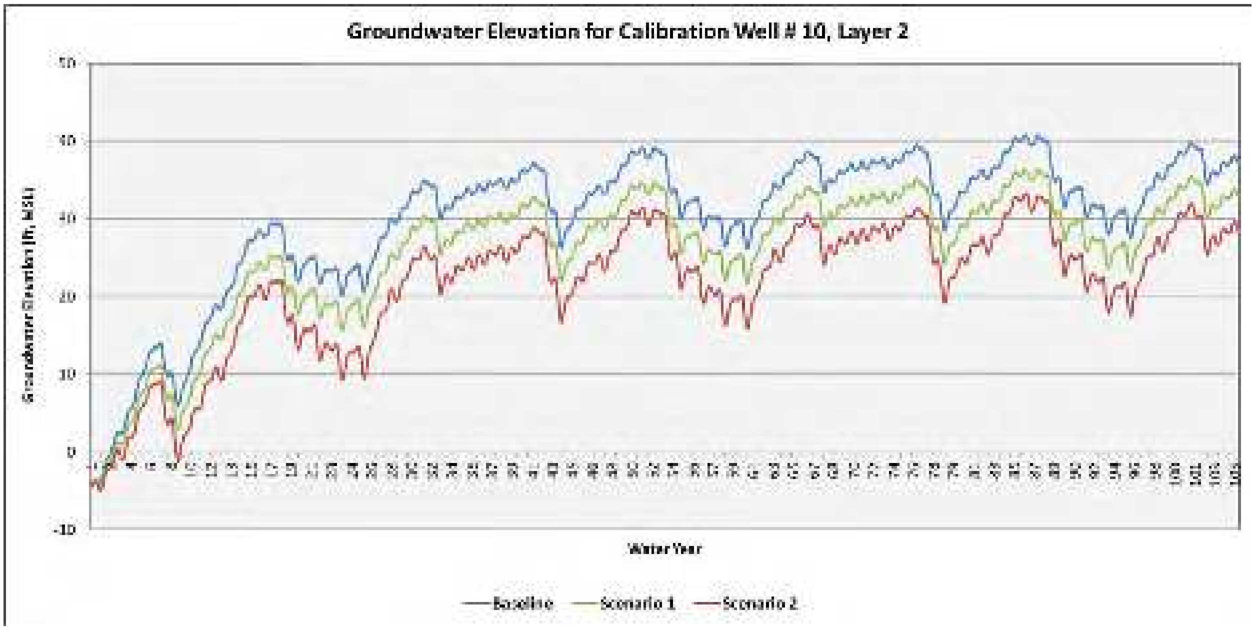

Groundwater Elevation Difference for Calibration Well # 9, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

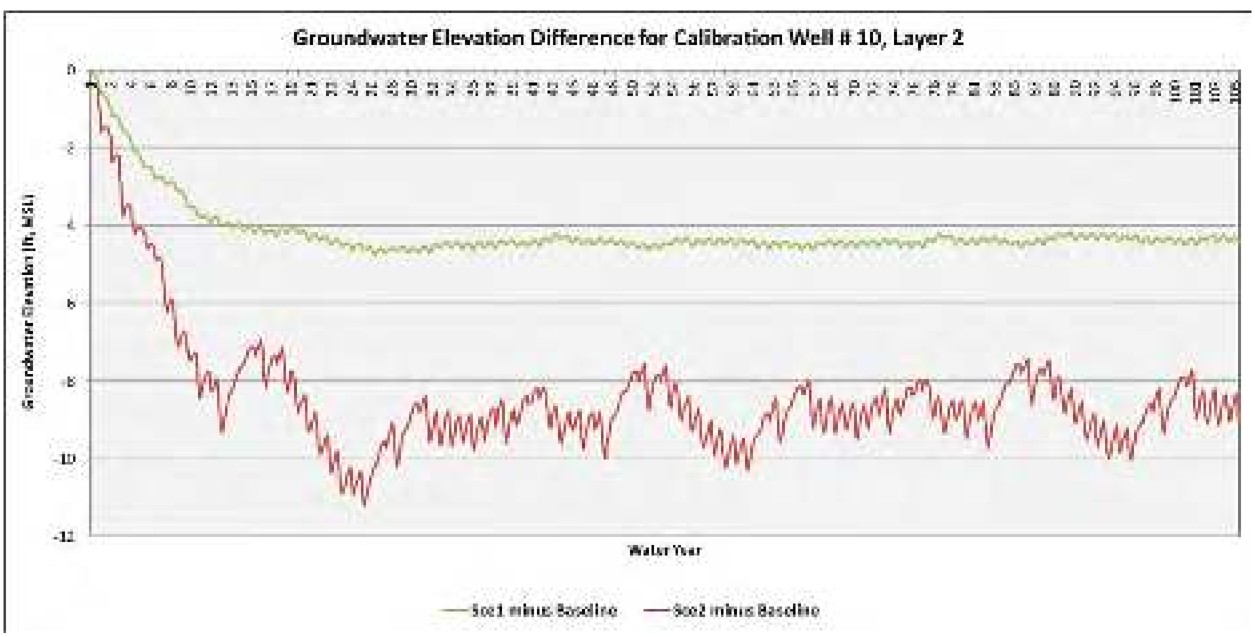


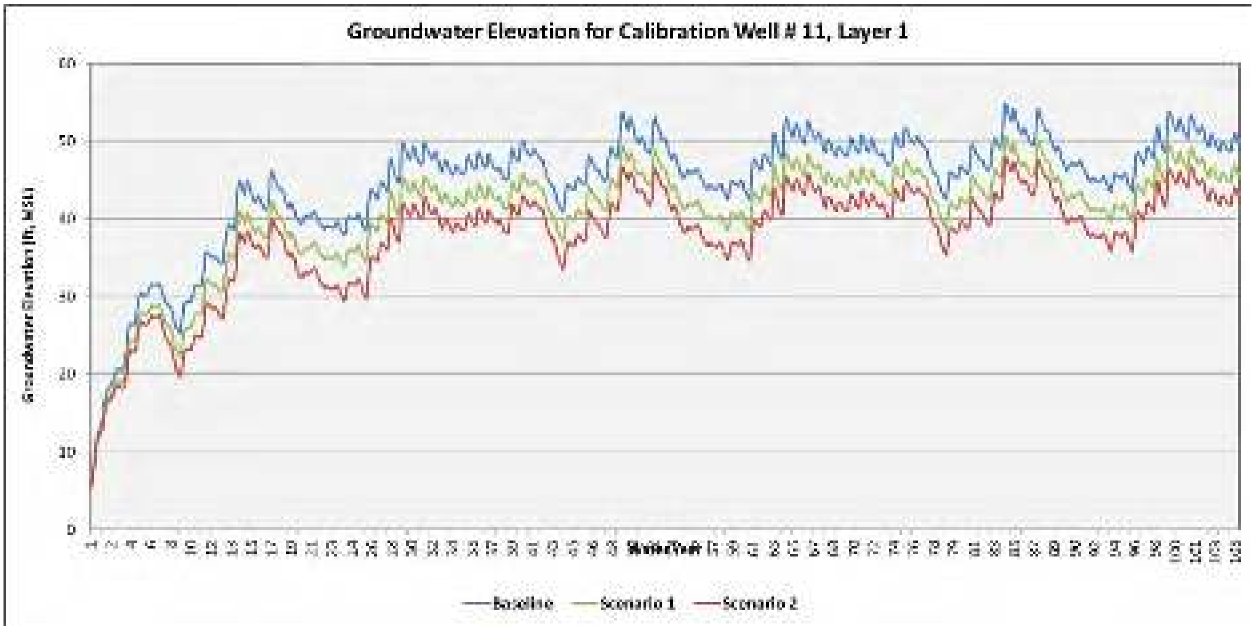
Groundwater Elevation for Calibration Well # 10, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

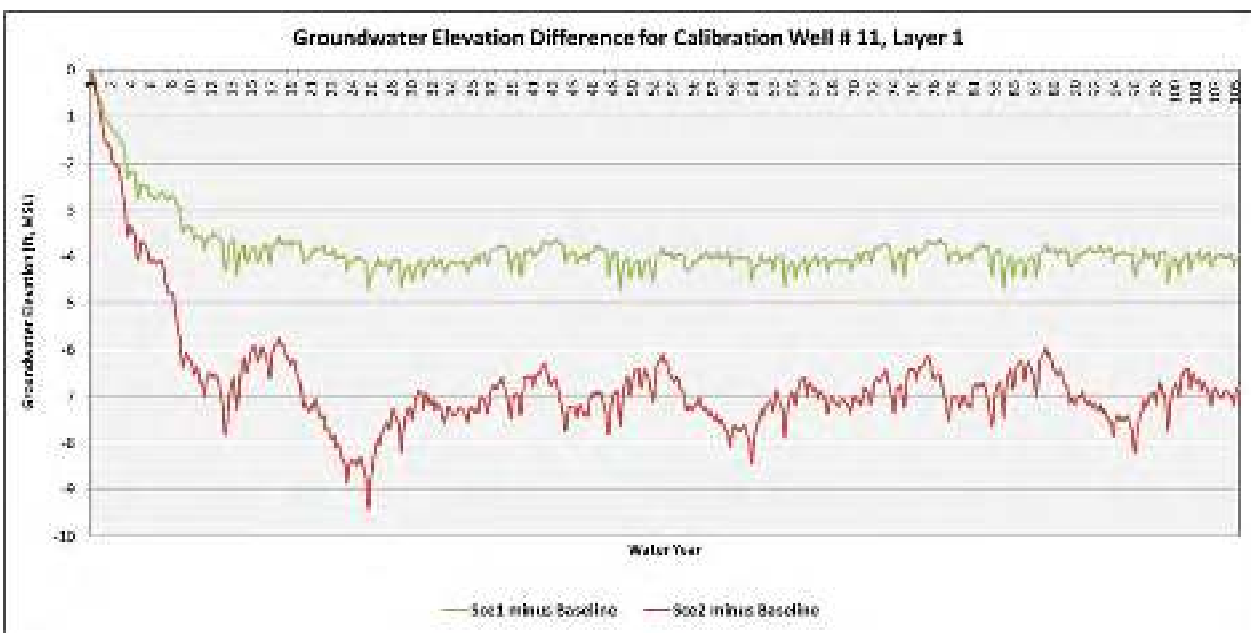


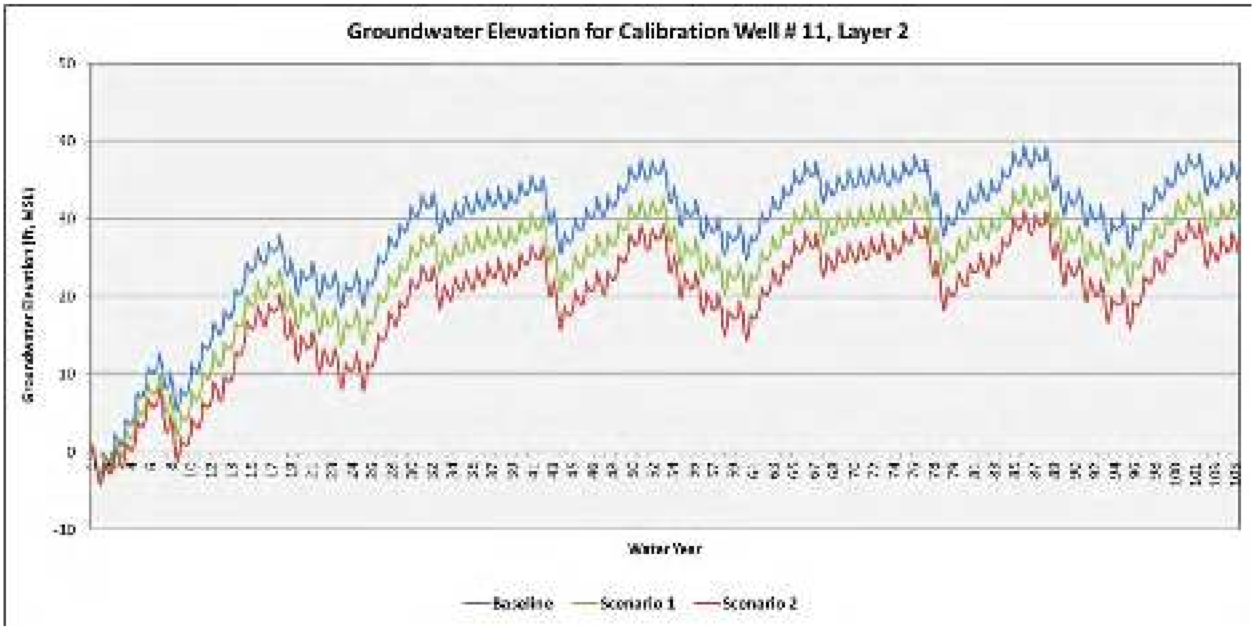
Groundwater Elevation Difference for Calibration Well # 10, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

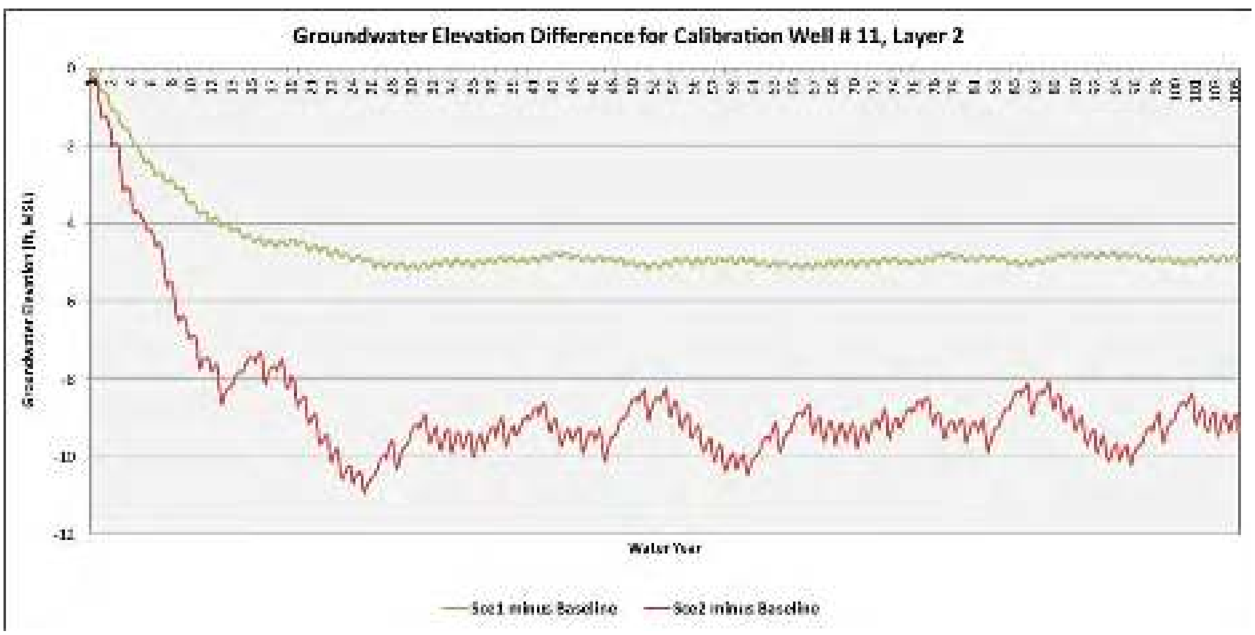

Groundwater Elevation for Calibration Well # 10, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

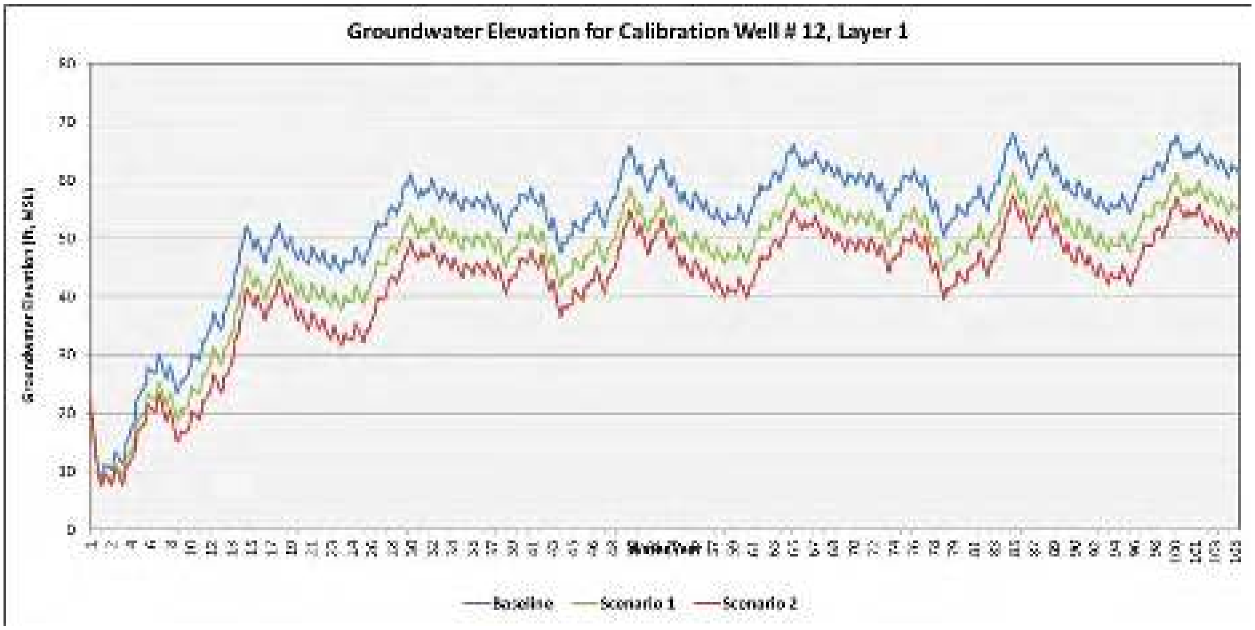

Groundwater Elevation Difference for Calibration Well # 10, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

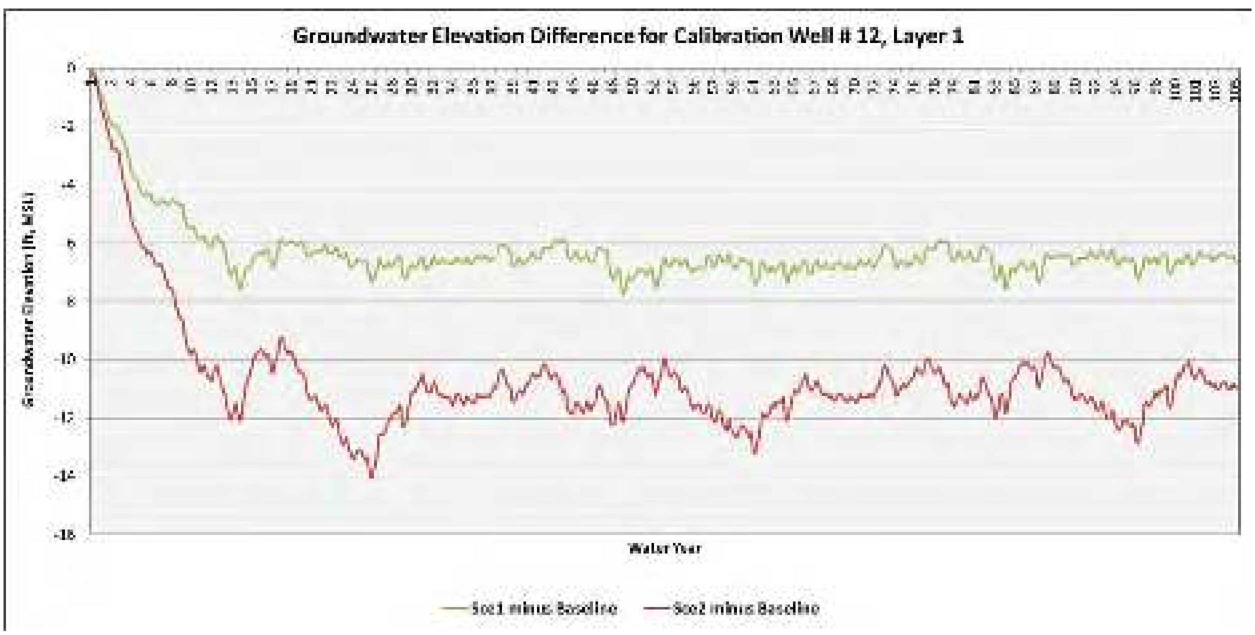

Groundwater Elevation for Calibration Well # 11, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

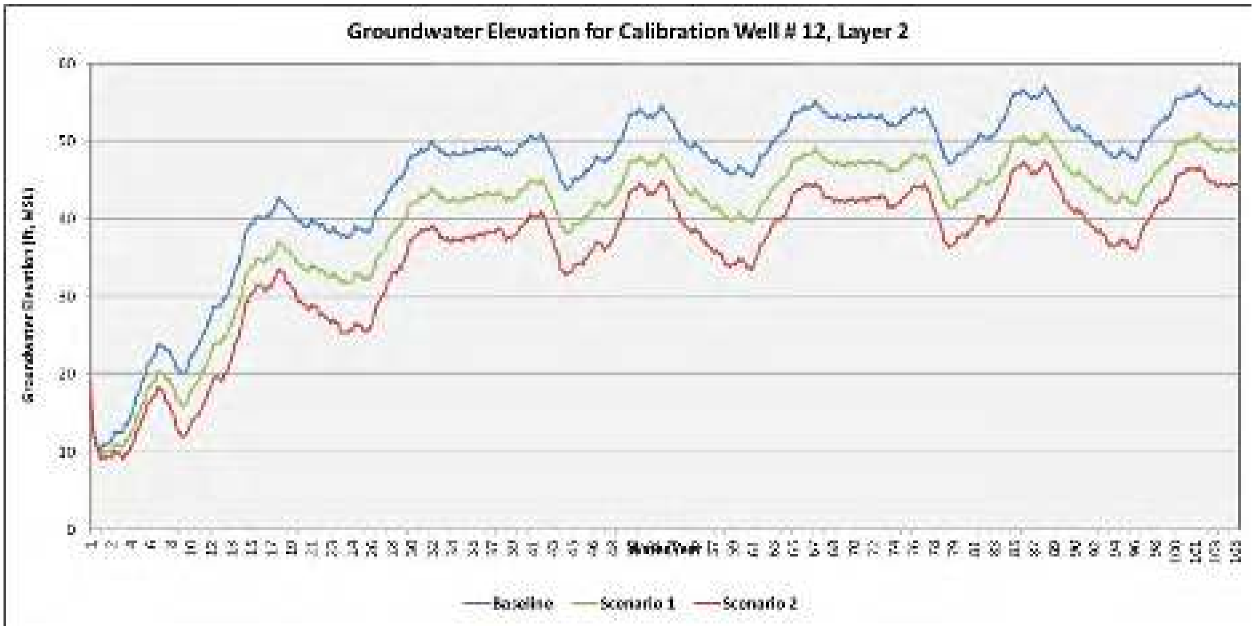

Groundwater Elevation Difference for Calibration Well # 11, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

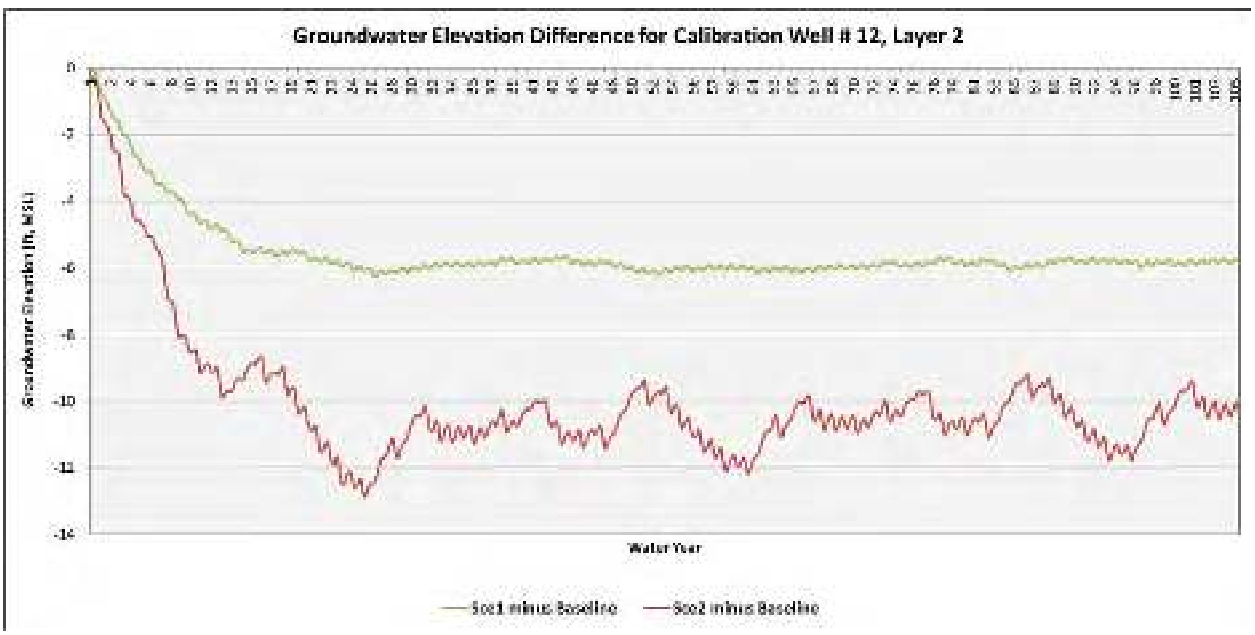

Groundwater Elevation for Calibration Well # 11, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

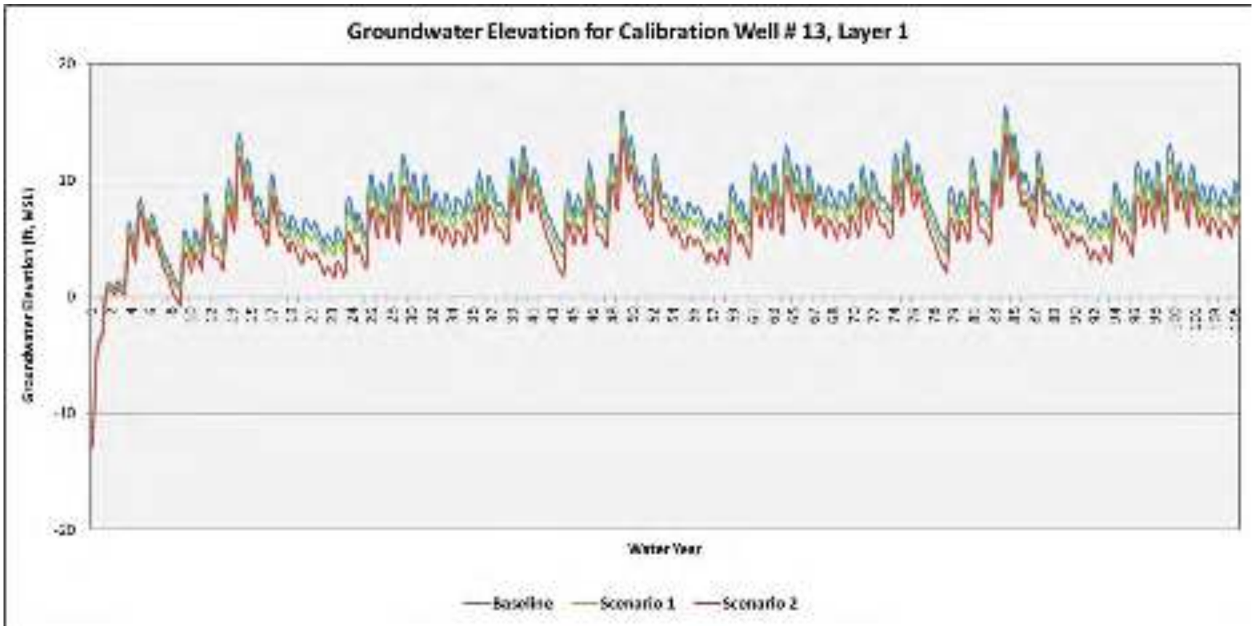

Groundwater Elevation Difference for Calibration Well # 11, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 12, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

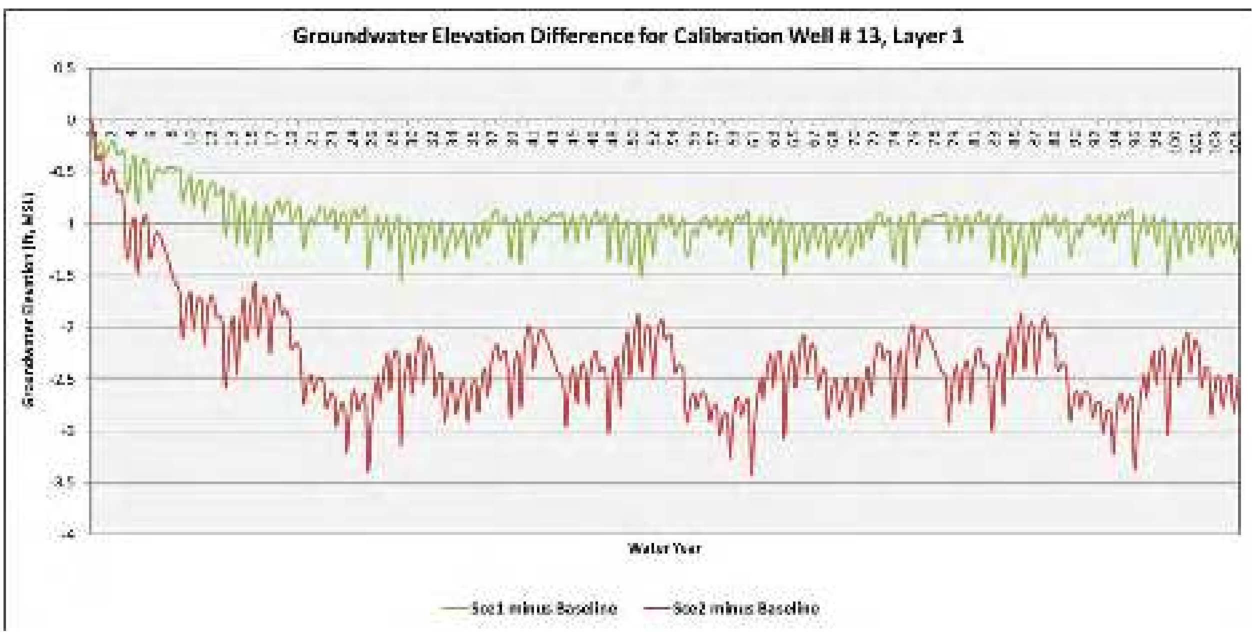

Groundwater Elevation Difference for Calibration Well # 12, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Scn1 minus Baseline
Scn2 minus Baseline


Groundwater Elevation for Calibration Well # 12, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

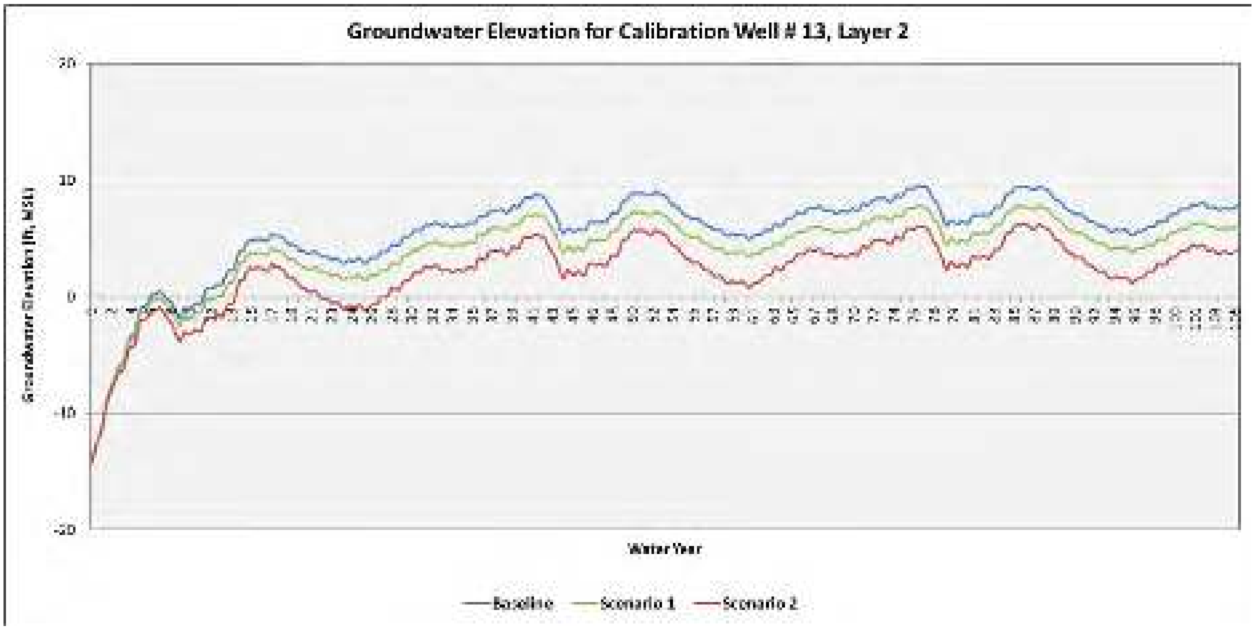

Groundwater Elevation Difference for Calibration Well # 12, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

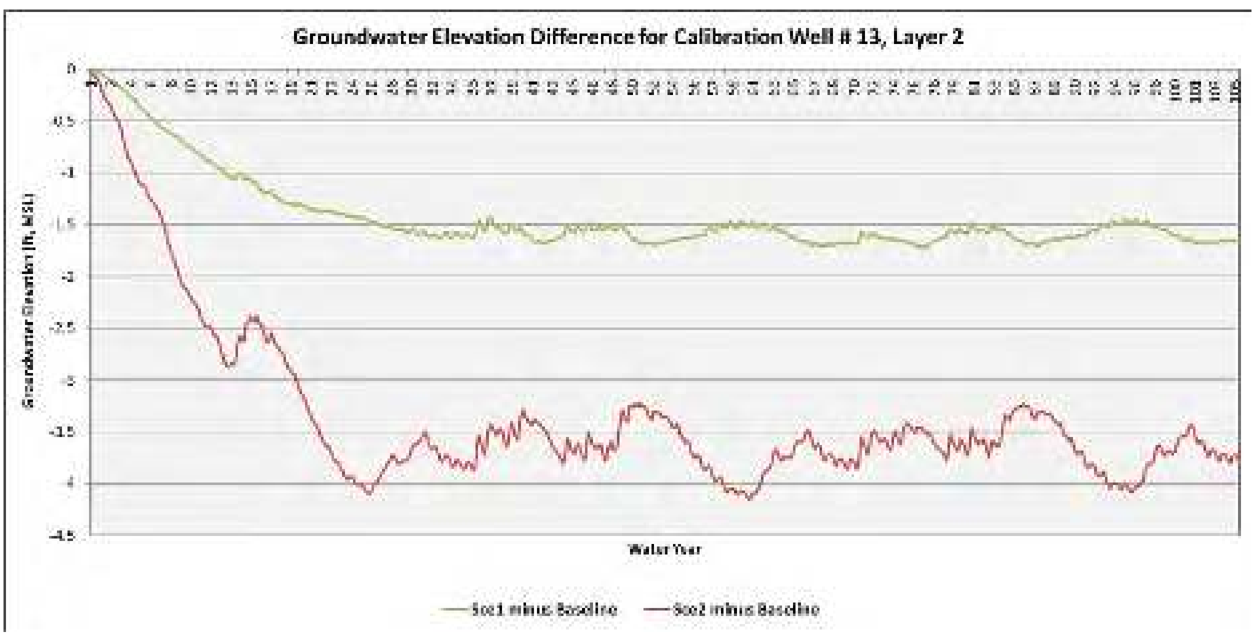


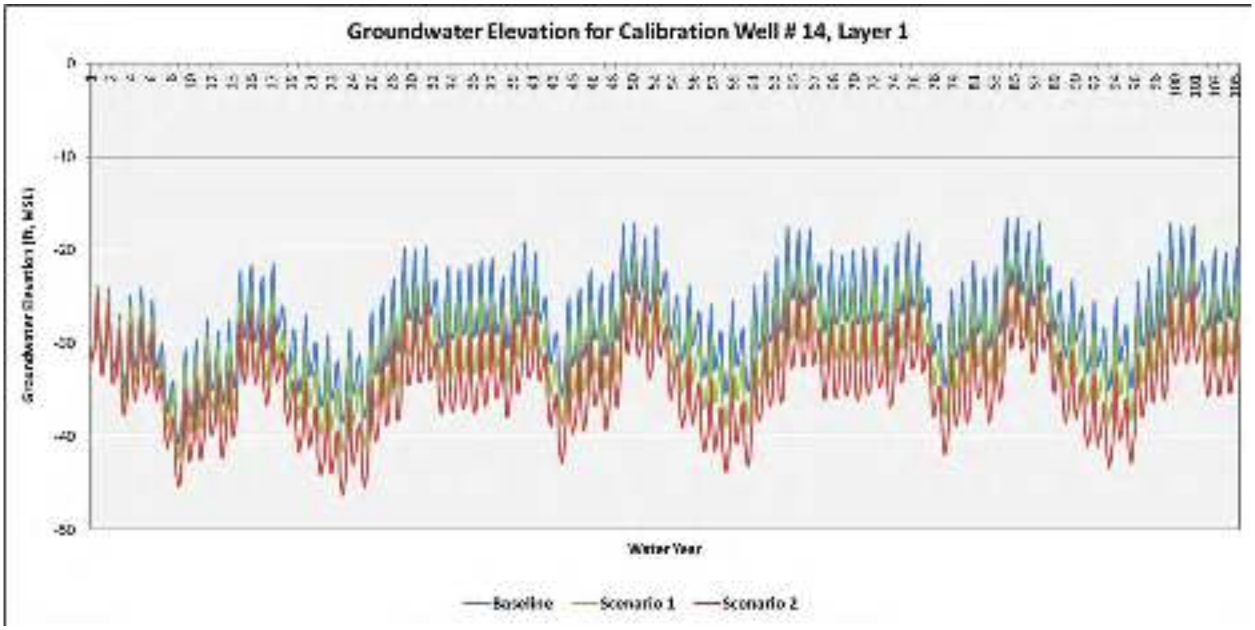
Groundwater Elevation for Calibration Well # 13, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

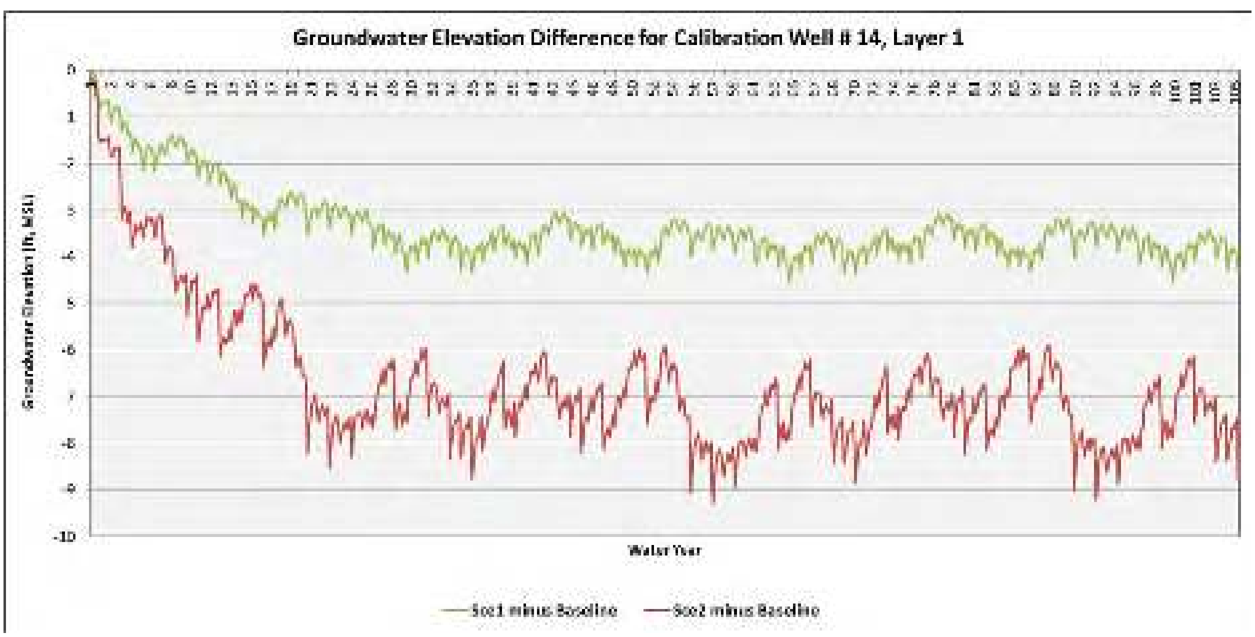


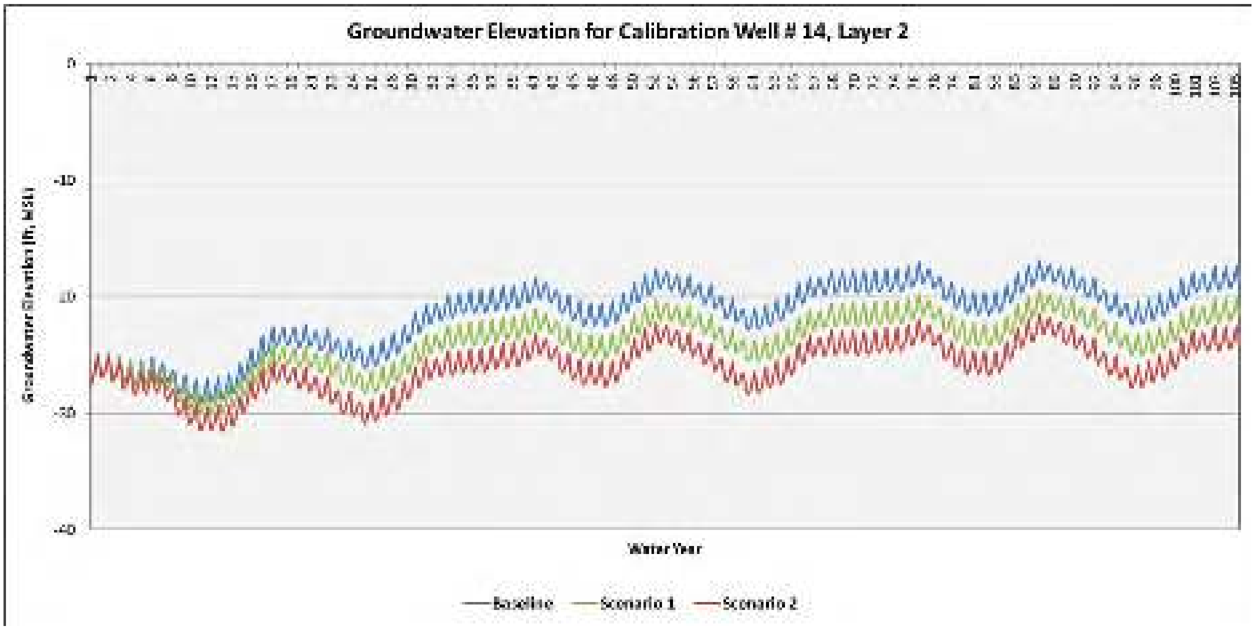
Groundwater Elevation Difference for Calibration Well # 13, Layer 1
Water Year
Scn1 minus Baseline
Scn2 minus Baseline

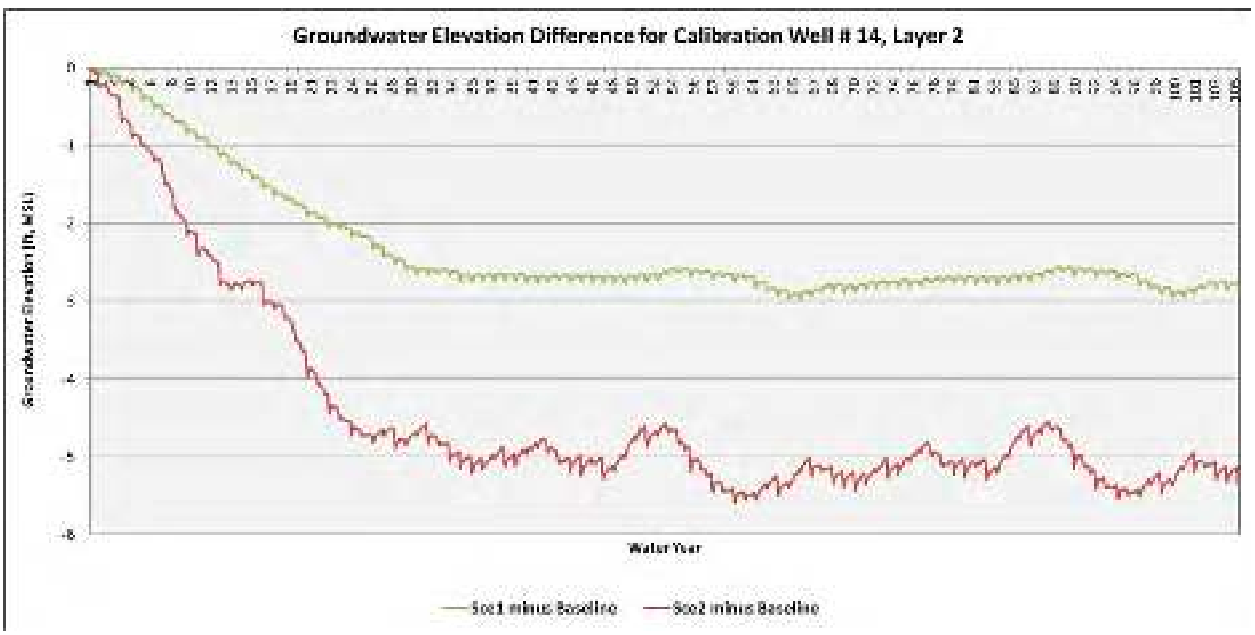

Groundwater Elevation for Calibration Well # 13, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

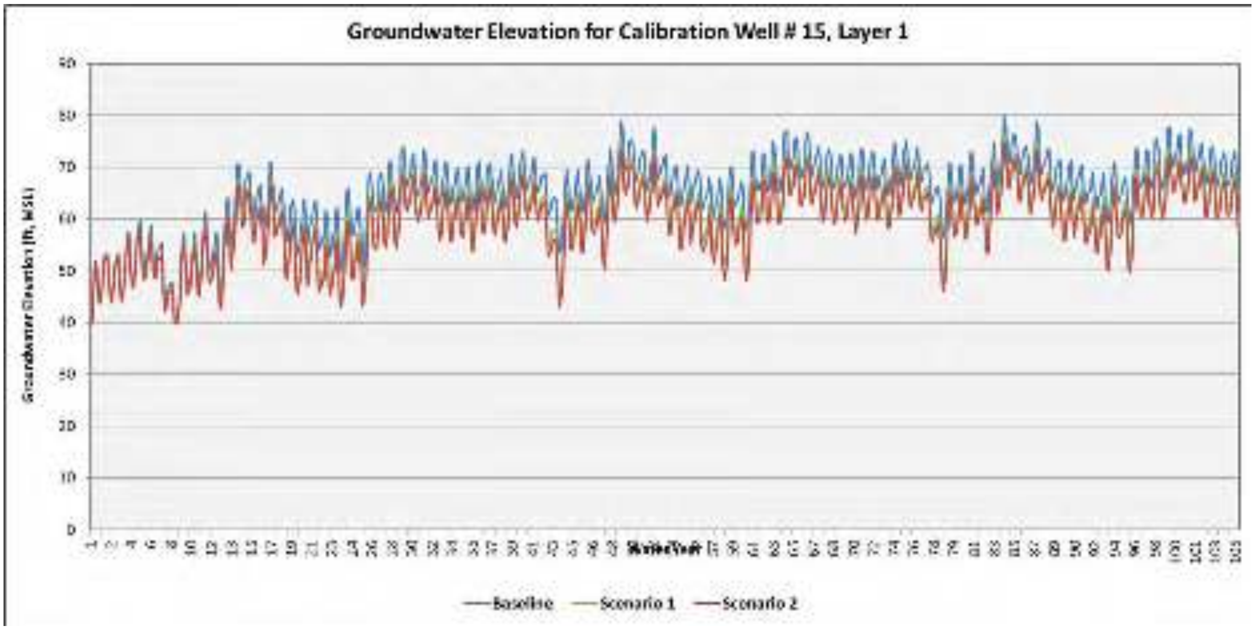

Groundwater Elevation Difference for Calibration Well # 13, Layer 2
Water Year
Scn1 minus Baseline
Scn2 minus Baseline


Groundwater Elevation for Calibration Well # 14, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

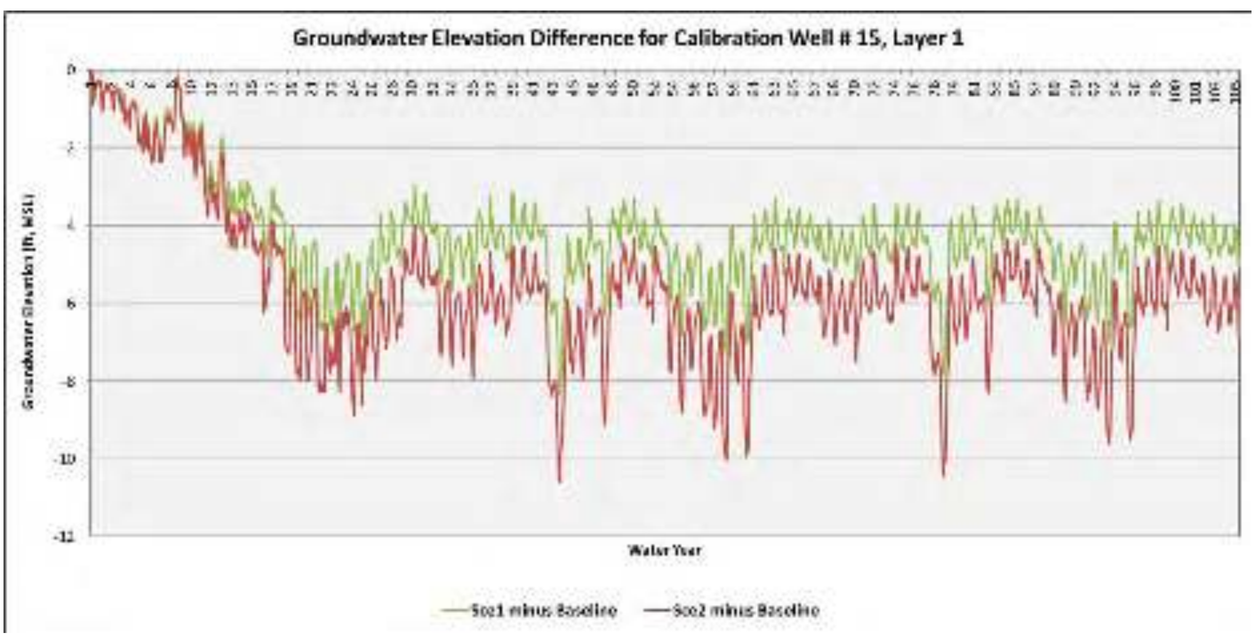

Groundwater Elevation Difference for Calibration Well # 14, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 14, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

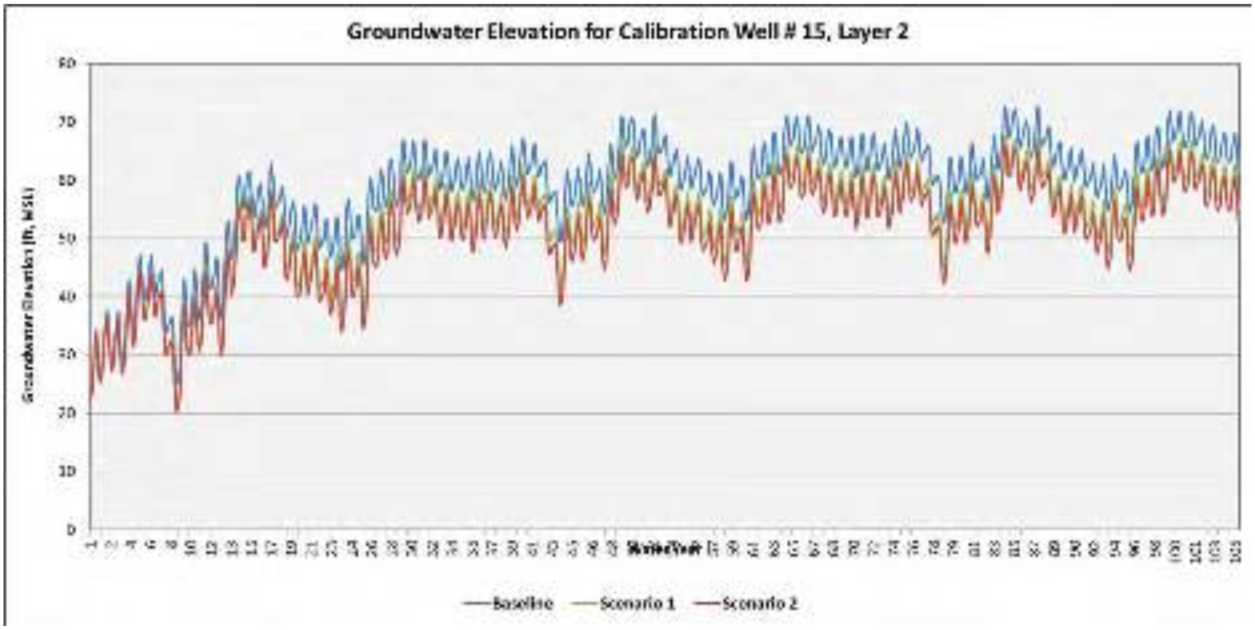

Groundwater Elevation Difference for Calibration Well # 14, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

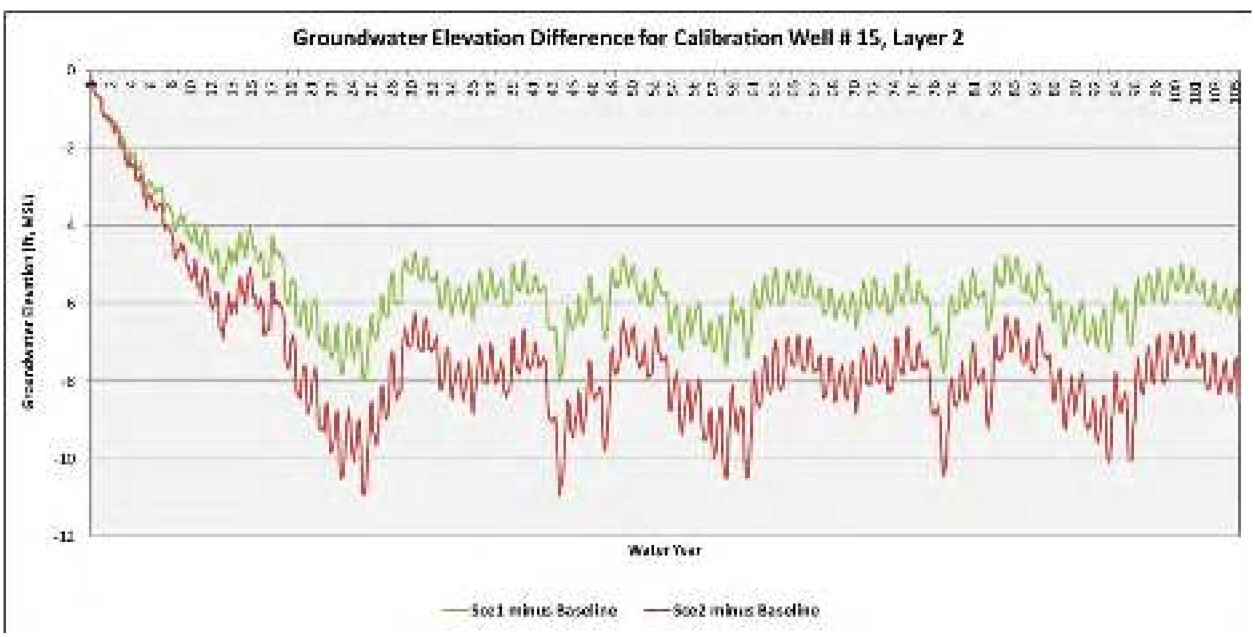


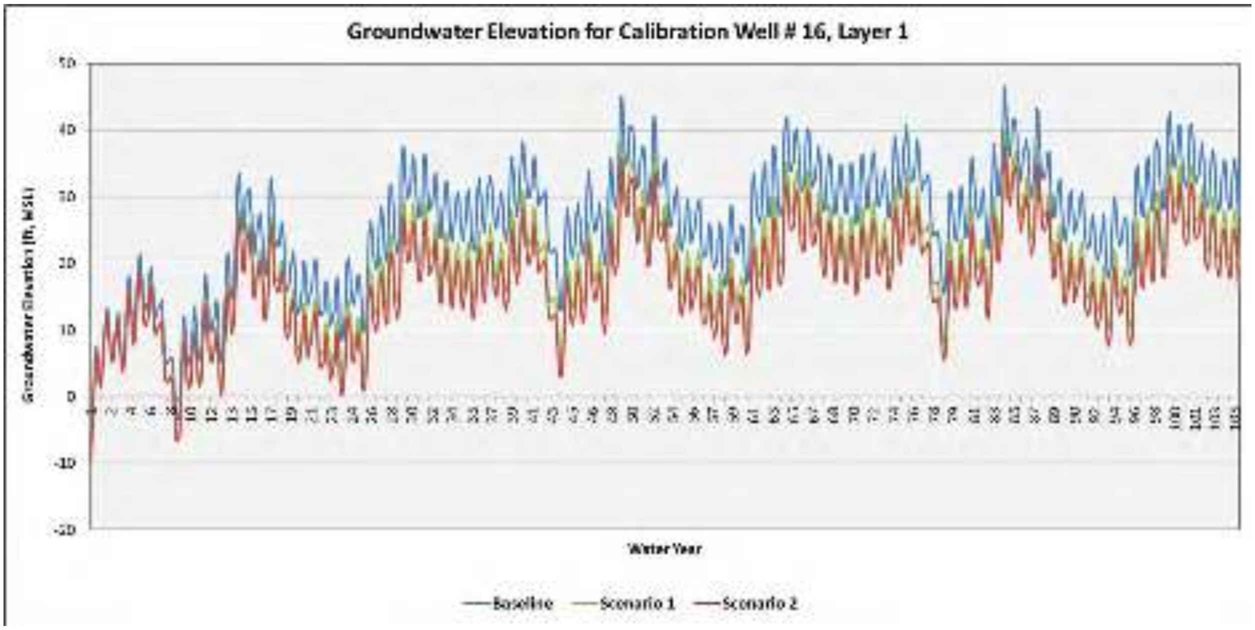
Groundwater Elevation for Calibration Well # 15, Layer 1
Baseline
Scenario 1
Scenario 2



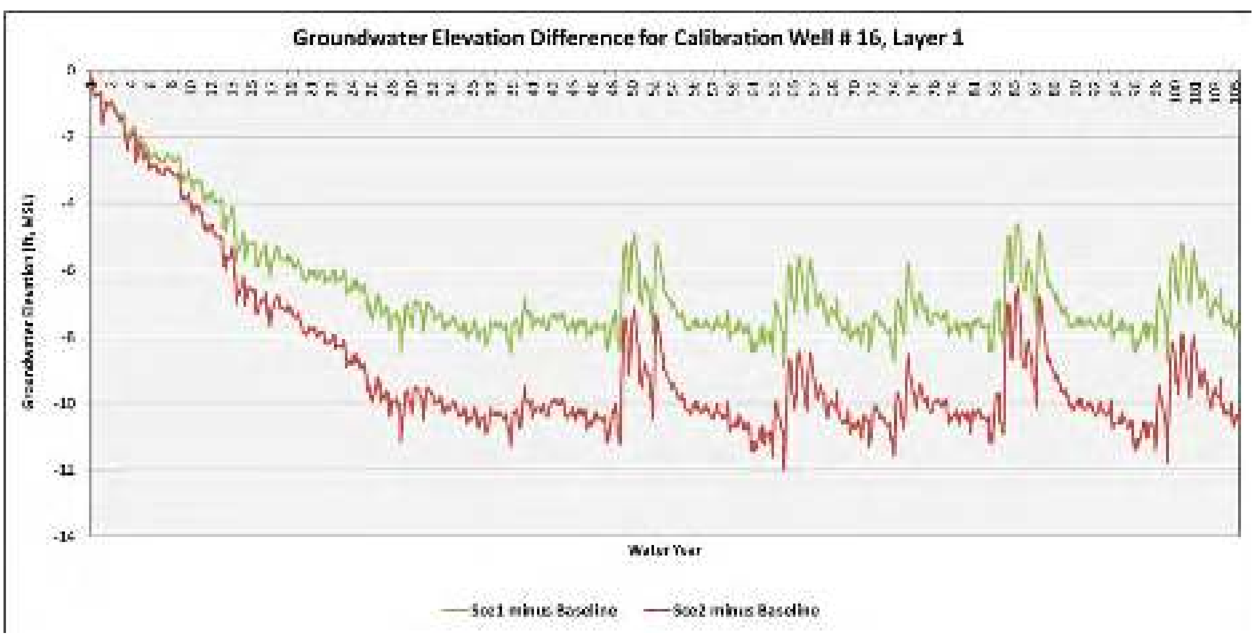
Groundwater Elevation Difference for Calibration Well # 15, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 15, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

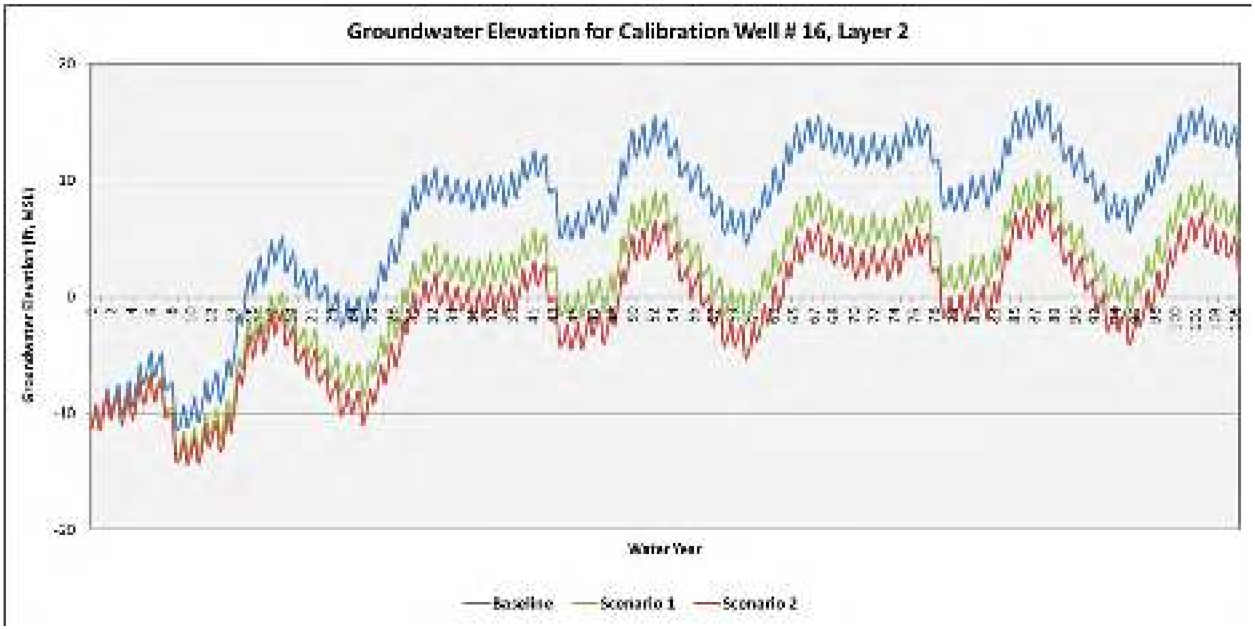

Groundwater Elevation Difference for Calibration Well # 15, Layer 2
Water Year
Scn1 minus Baseline
Scn2 minus Baseline

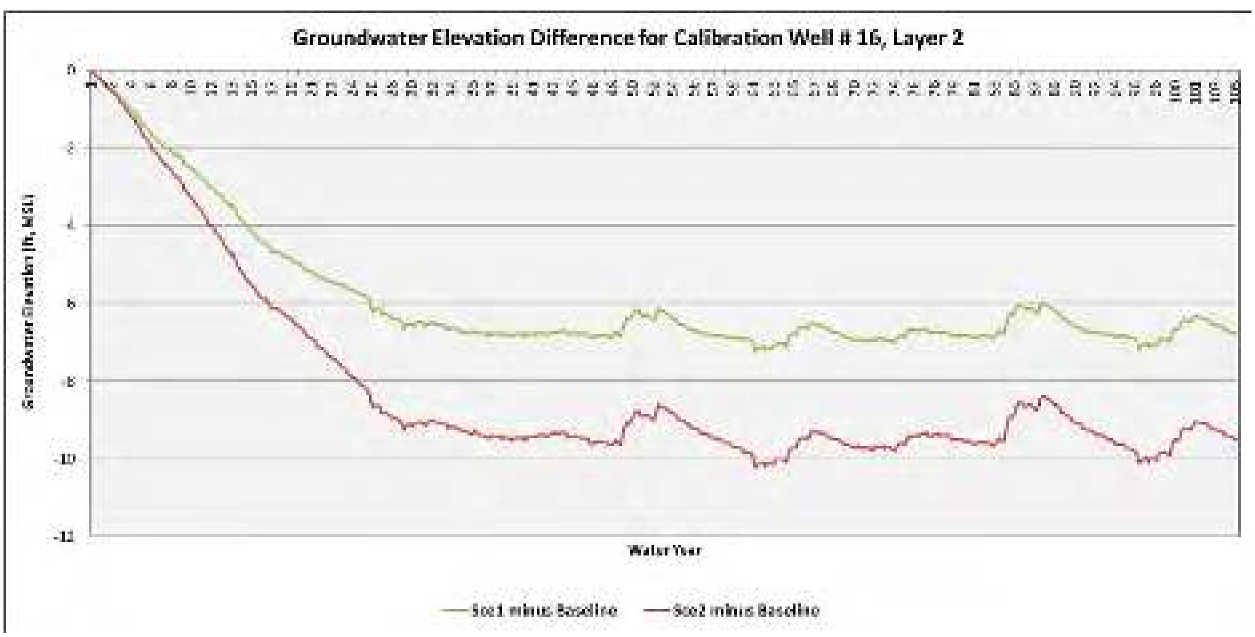


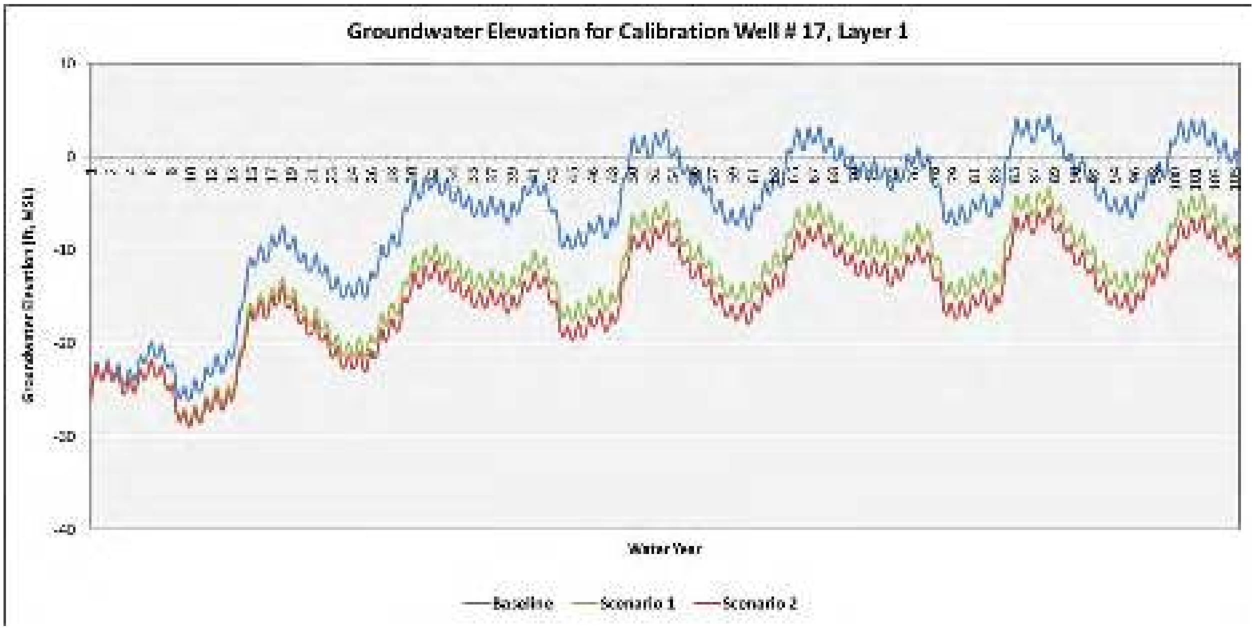
Groundwater Elevation for Calibration Well # 16, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

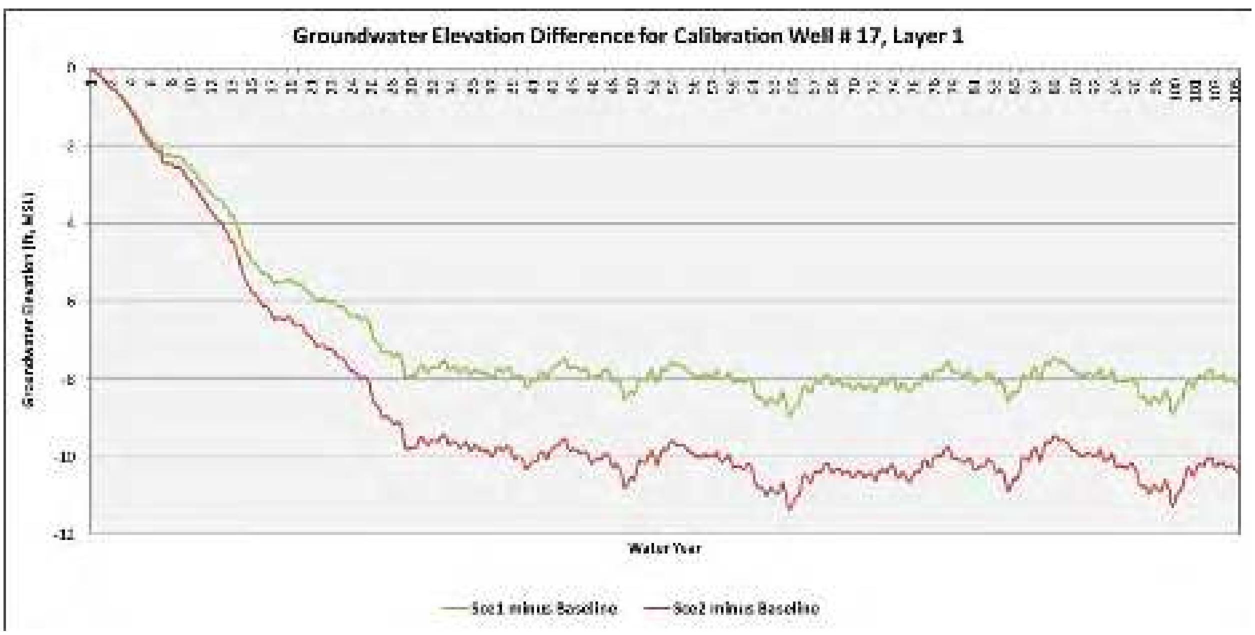


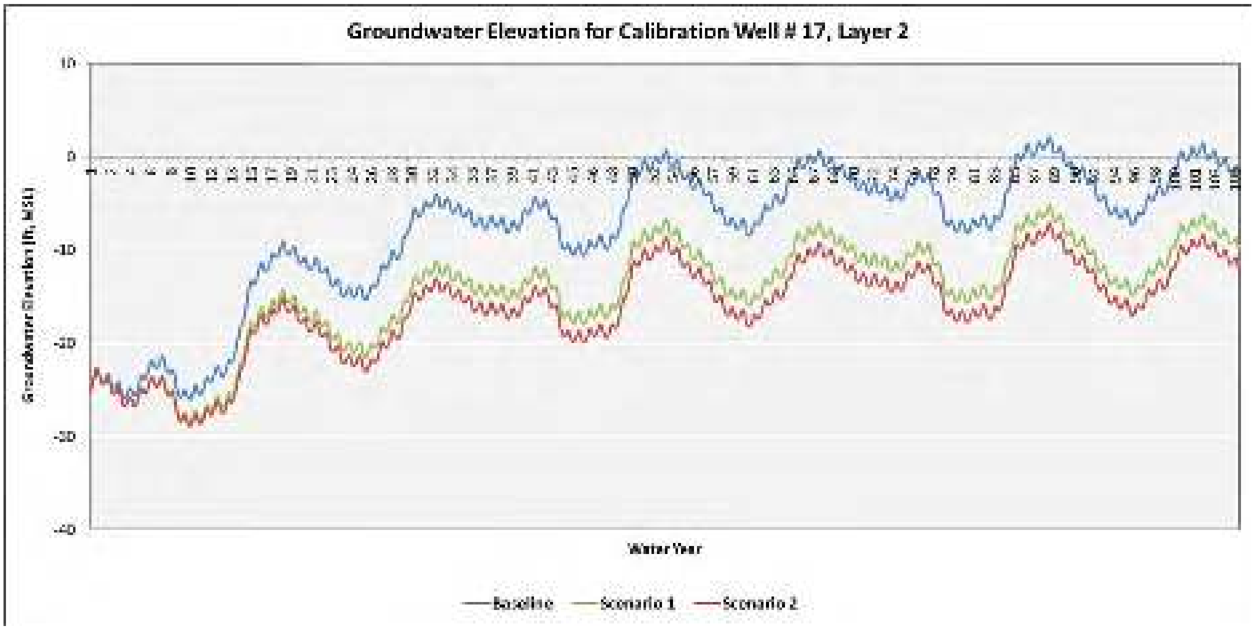
Groundwater Elevation Difference for Calibration Well # 16, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

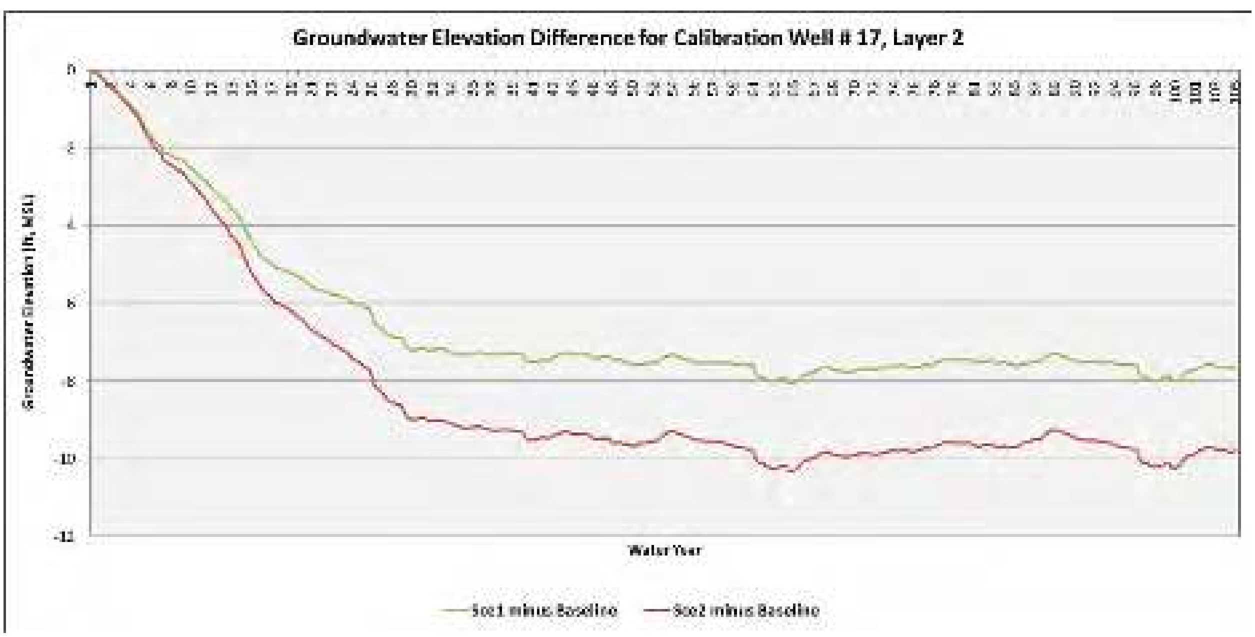

Groundwater Elevation for Calibration Well # 16, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

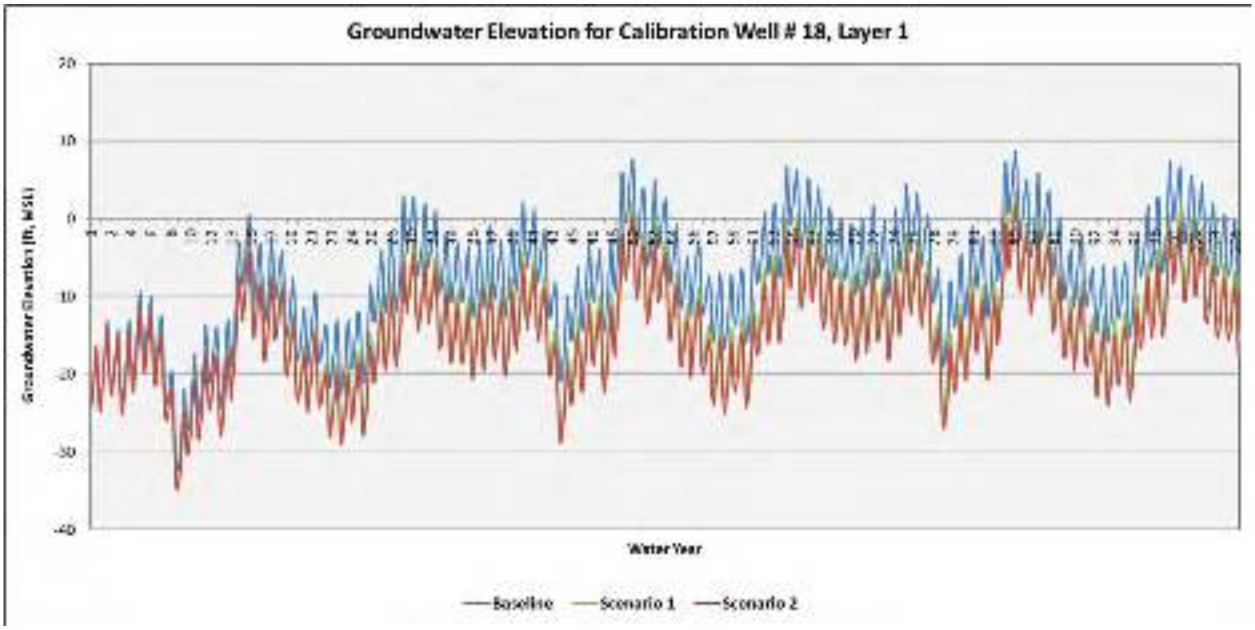

Groundwater Elevation Difference for Calibration Well # 16, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

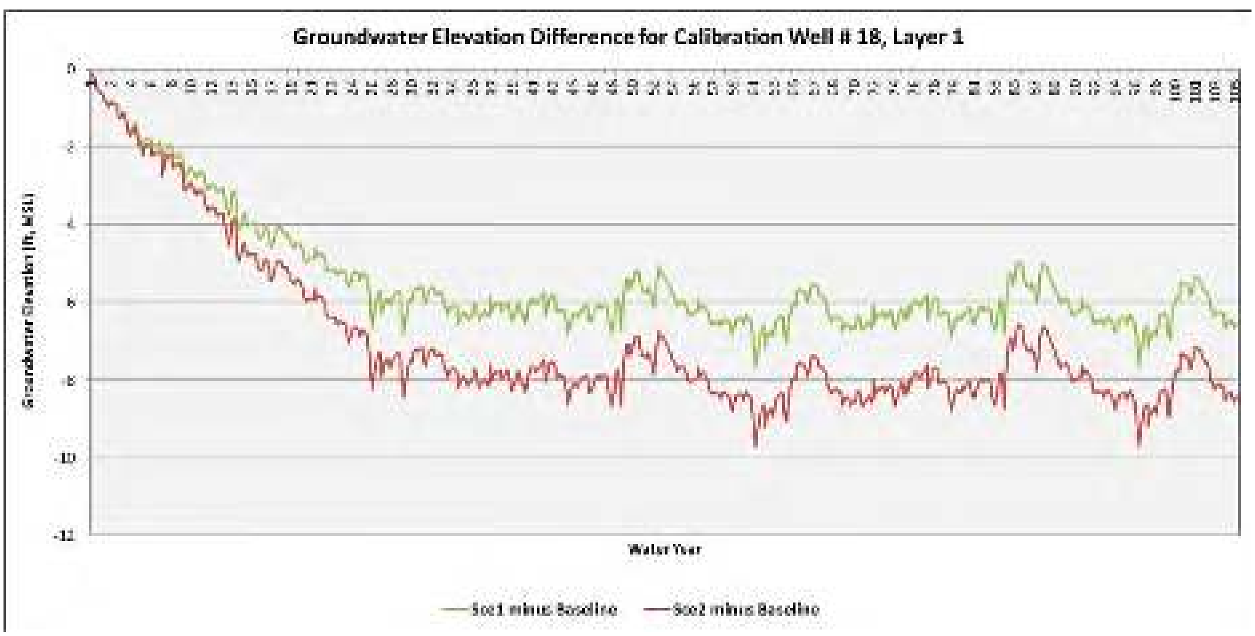

Groundwater Elevation for Calibration Well # 17, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

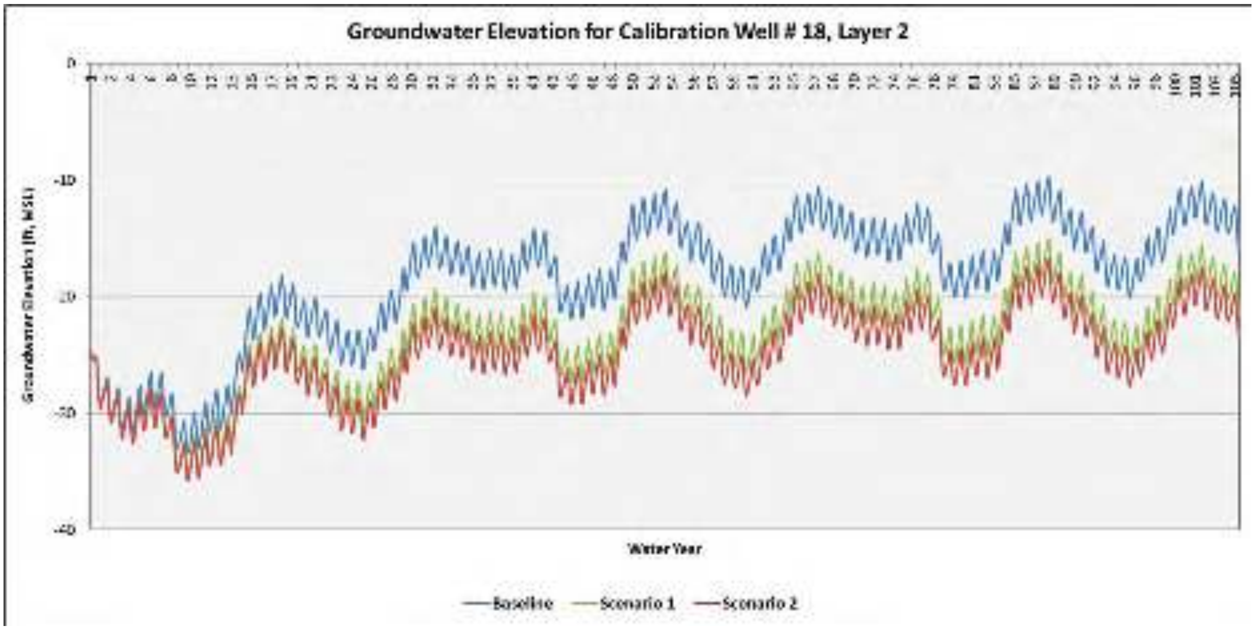

Groundwater Elevation Difference for Calibration Well # 17, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

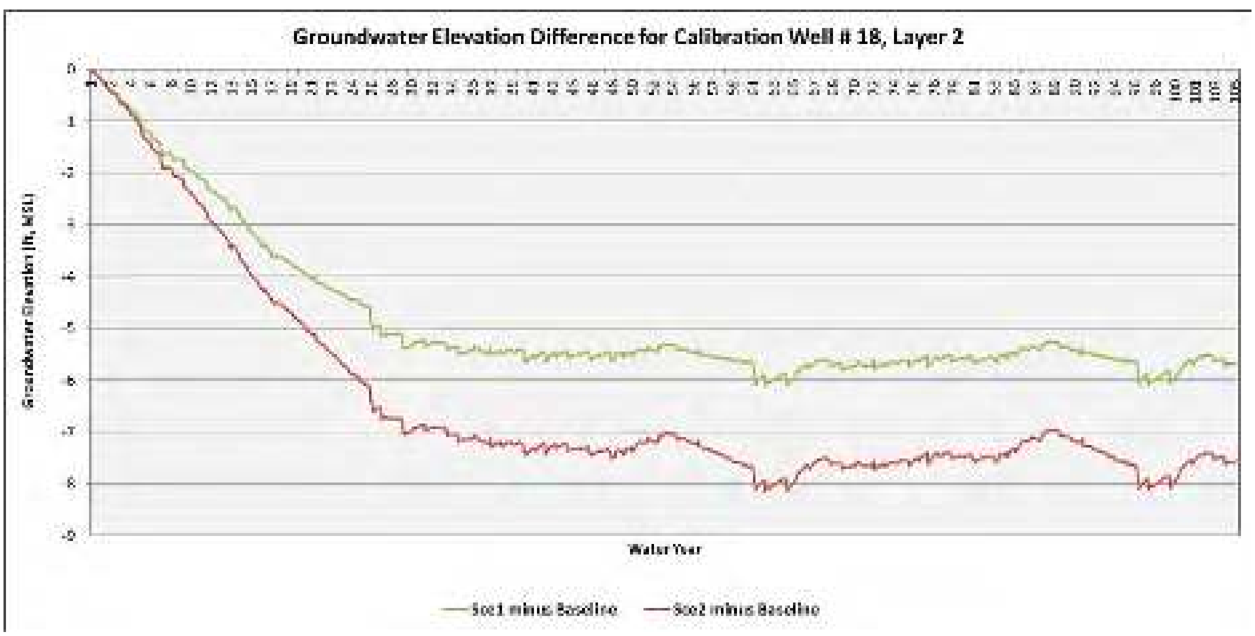

Groundwater Elevation for Calibration Well # 17, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

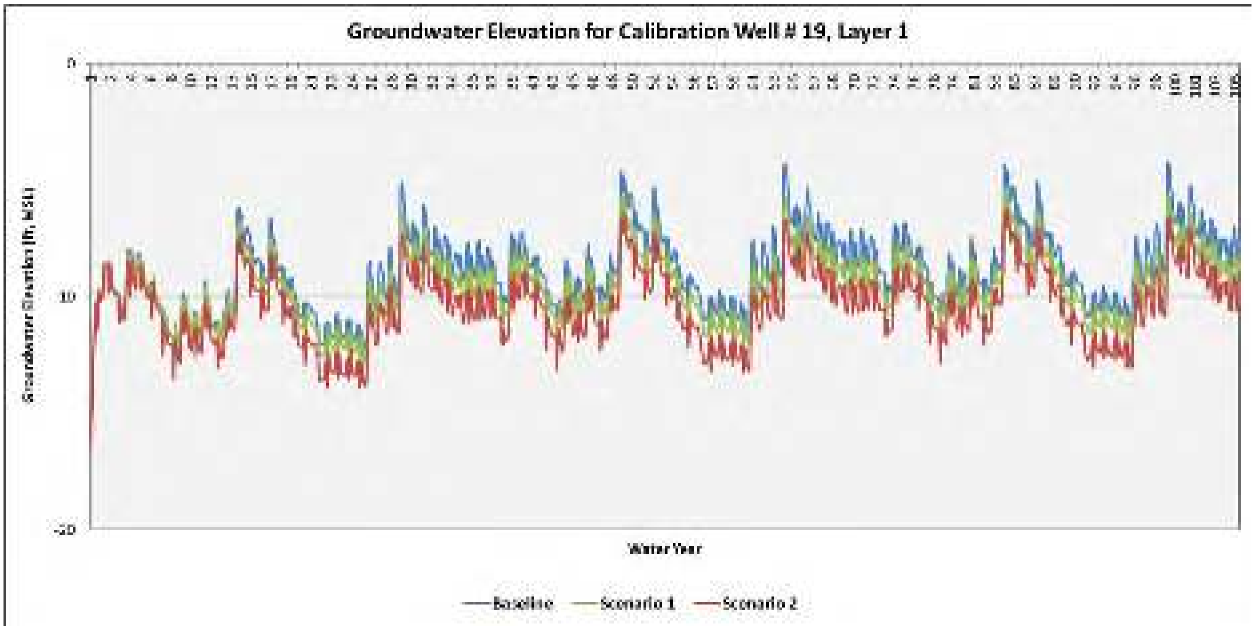

Groundwater Elevation Difference for Calibration Well # 17, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

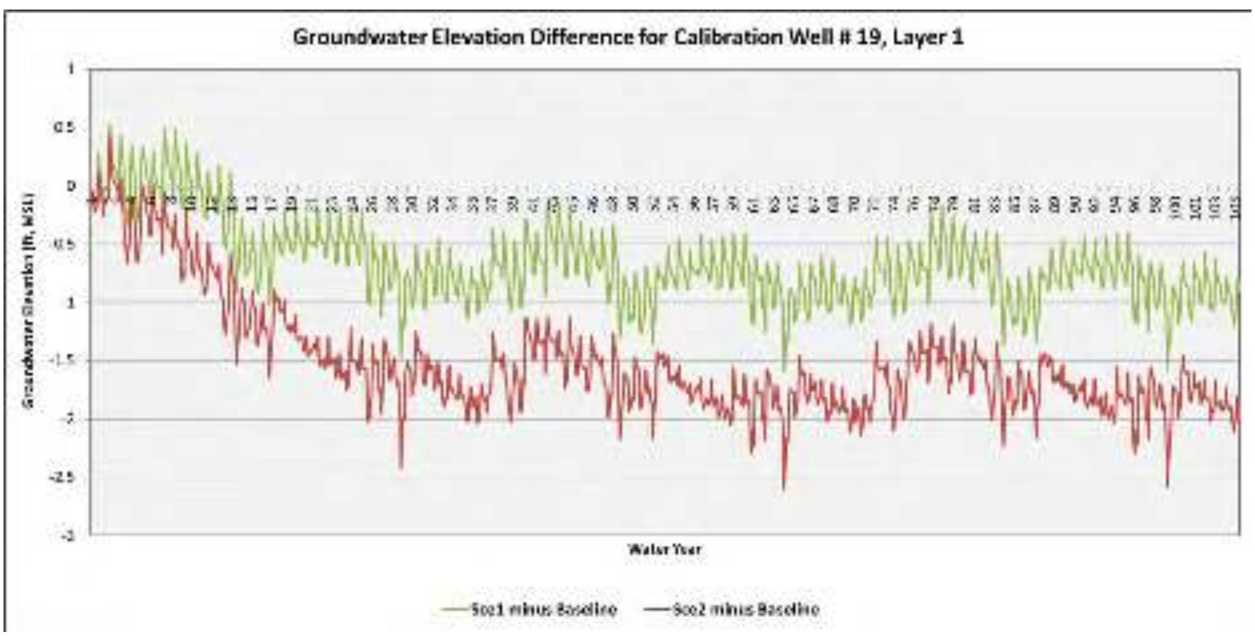

Groundwater Elevation for Calibration Well # 18, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

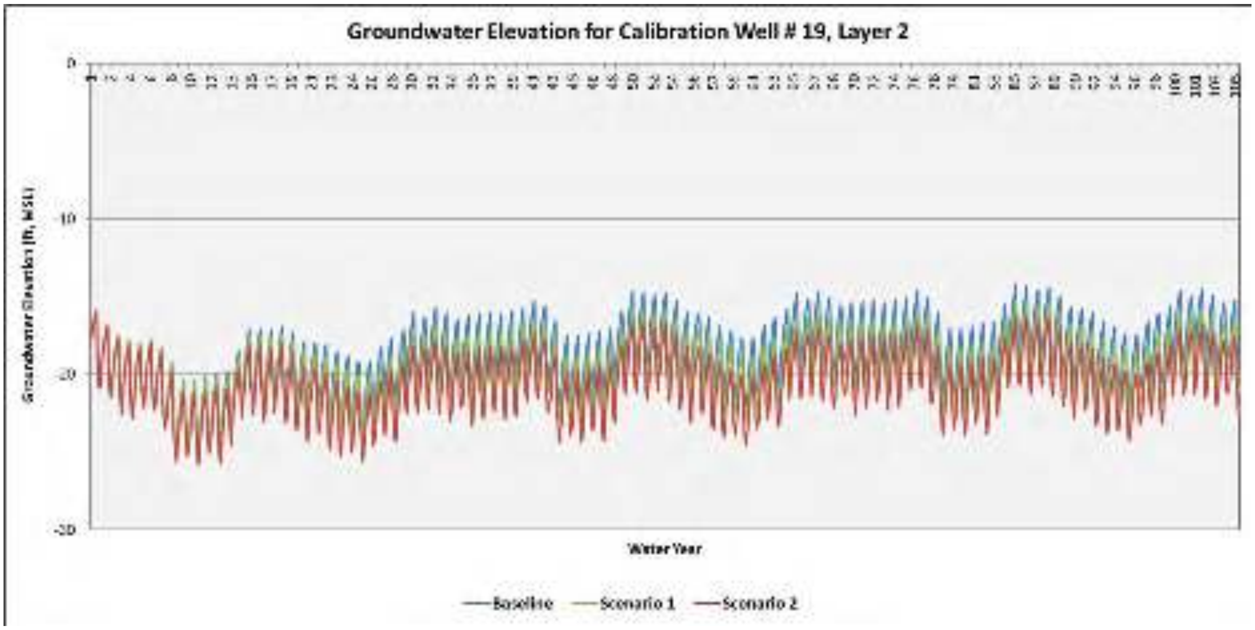

Groundwater Elevation Difference for Calibration Well # 18, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

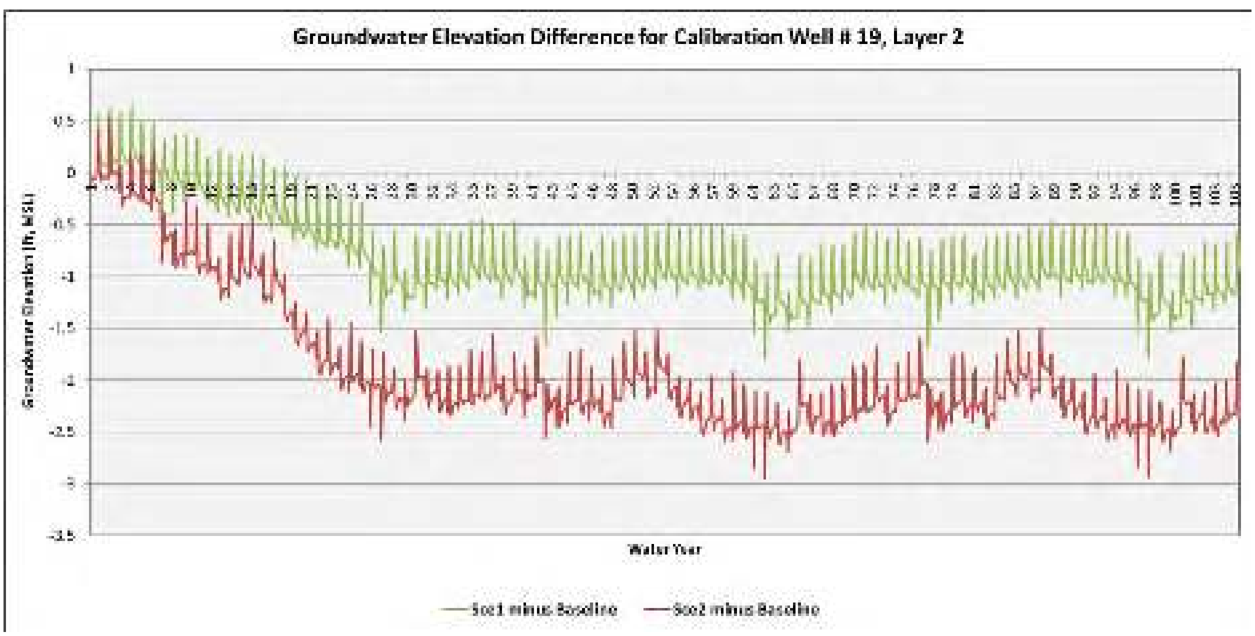

Groundwater Elevation for Calibration Well # 18, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

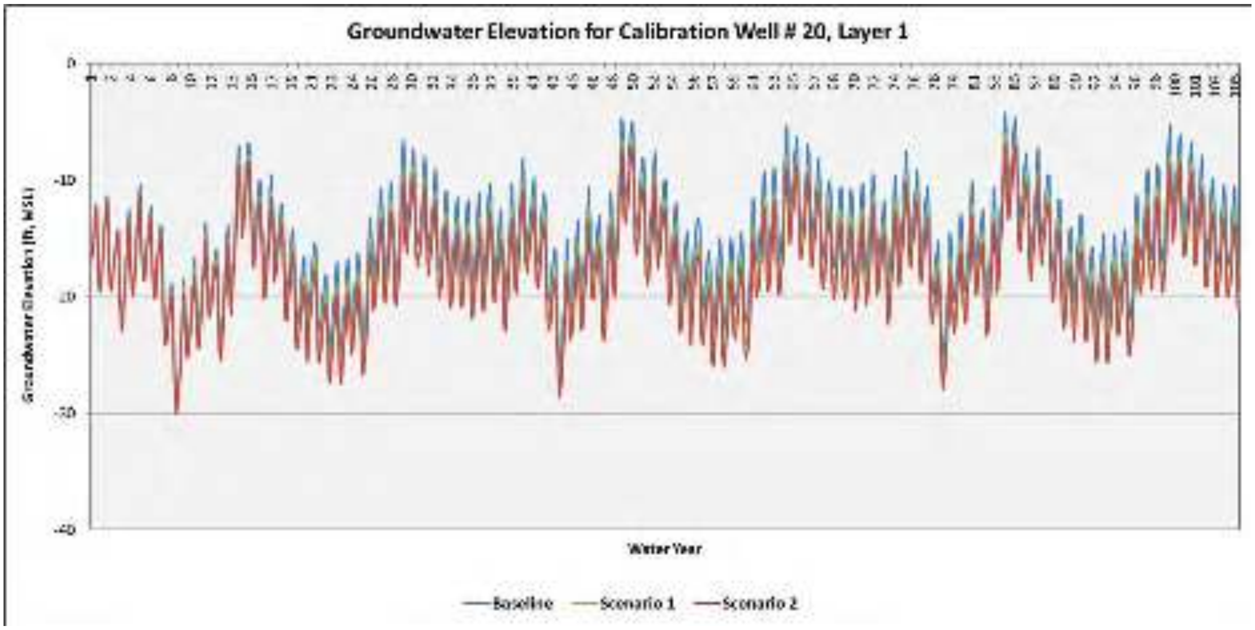

Groundwater Elevation Difference for Calibration Well # 18, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

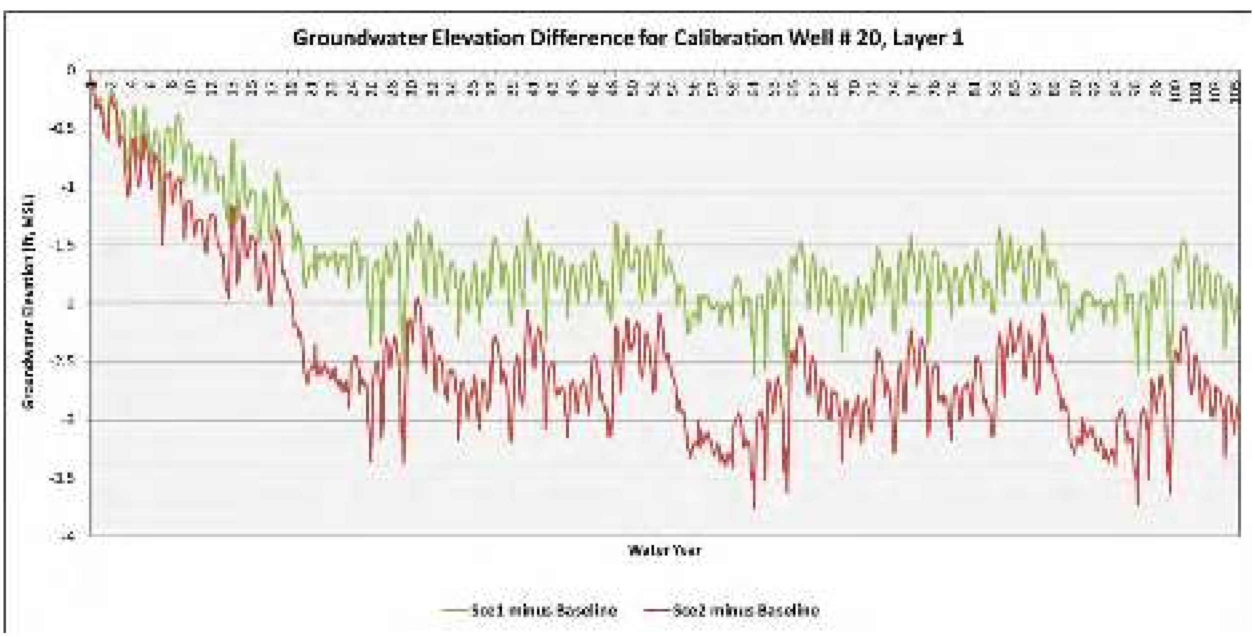

Groundwater Elevation for Calibration Well # 19, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

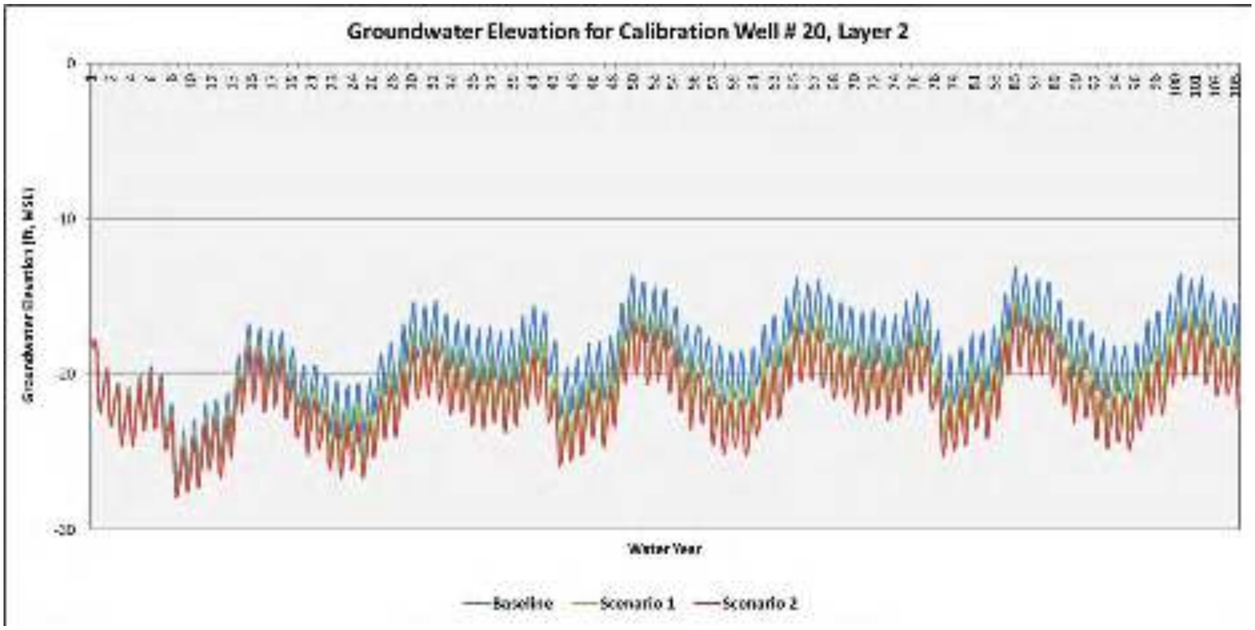

Groundwater Elevation Difference for Calibration Well # 19, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

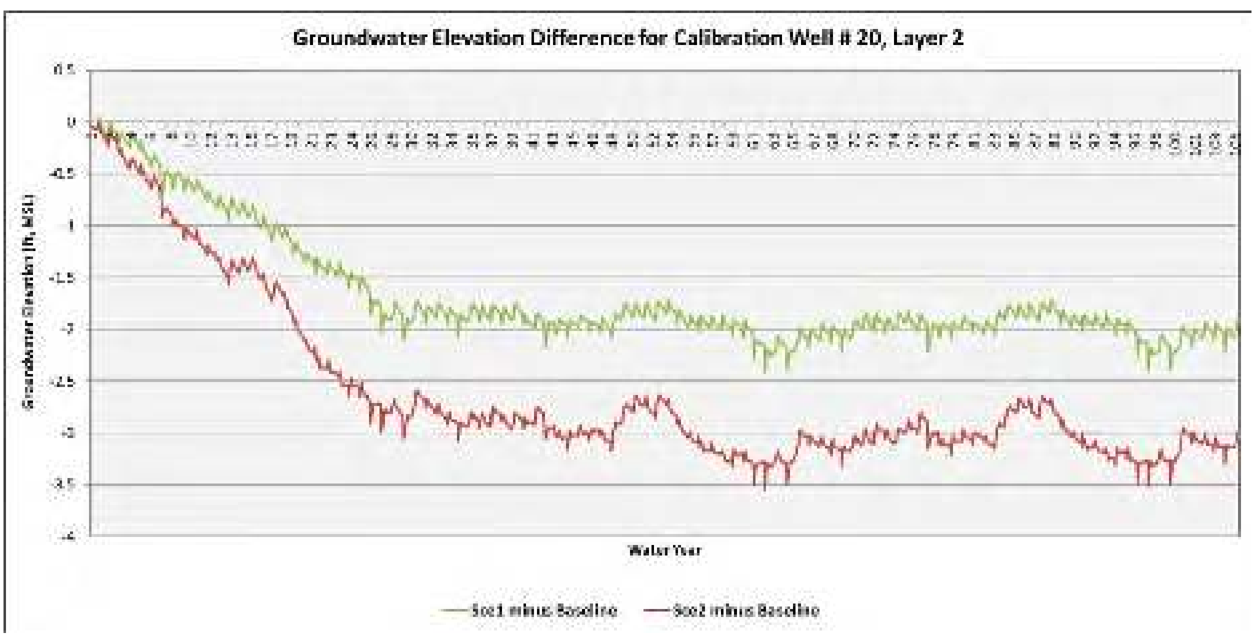

Groundwater Elevation for Calibration Well # 19, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

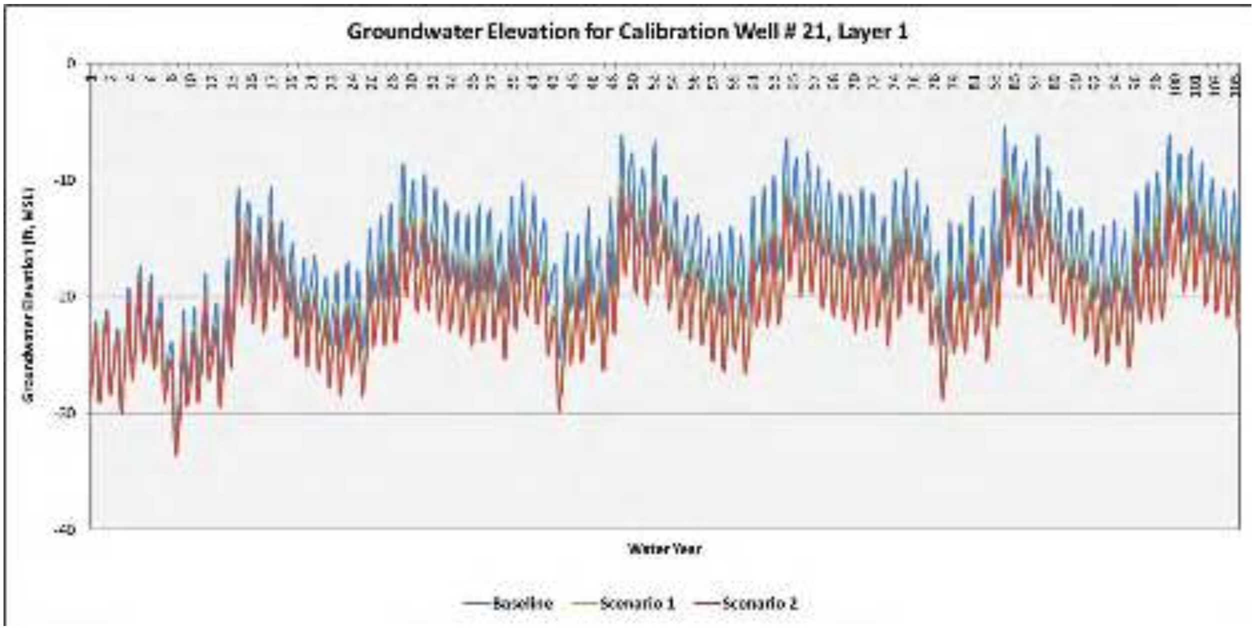

Groundwater Elevation Difference for Calibration Well # 19, Layer 2
Water Year
Scn1 minus Baseline
Scn2 minus Baseline

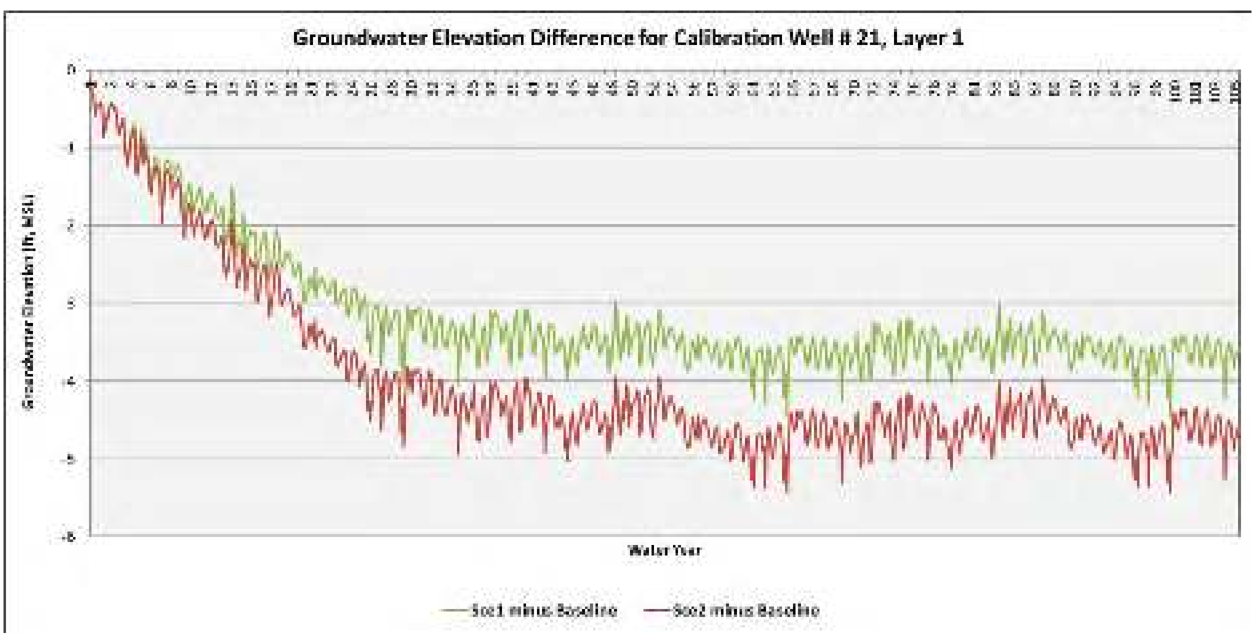

Groundwater Elevation for Calibration Well # 20, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

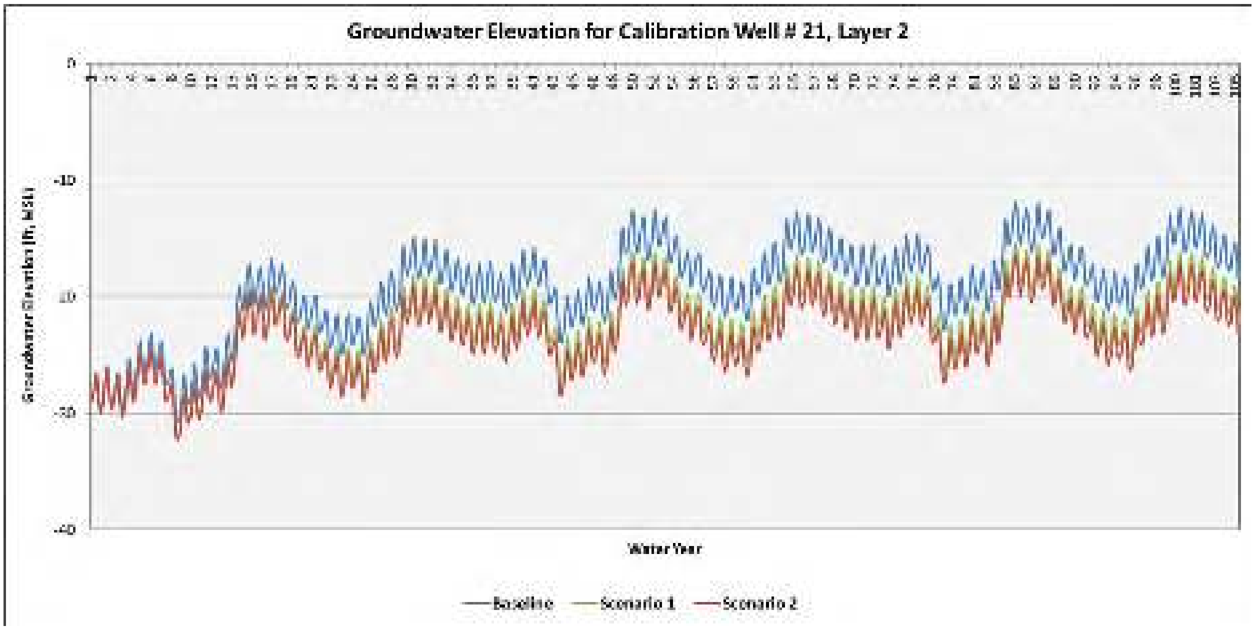

Groundwater Elevation Difference for Calibration Well # 20, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 20, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

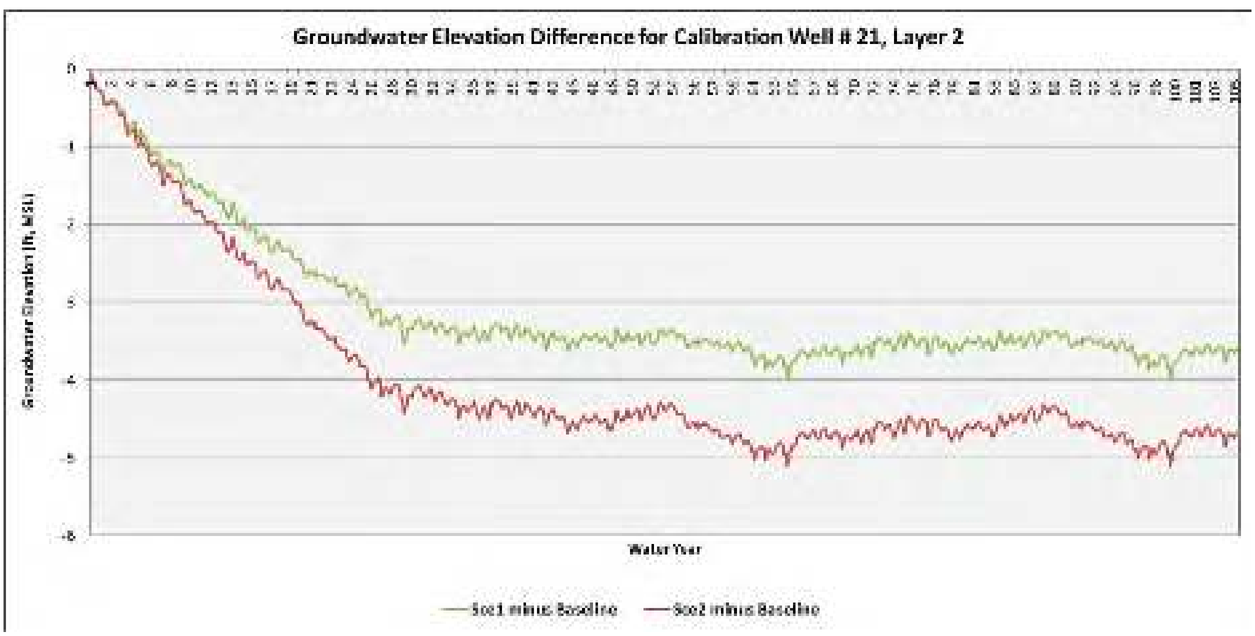

Groundwater Elevation Difference for Calibration Well # 20, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Scn1 minus Baseline
Scn2 minus Baseline


Groundwater Elevation for Calibration Well # 21, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

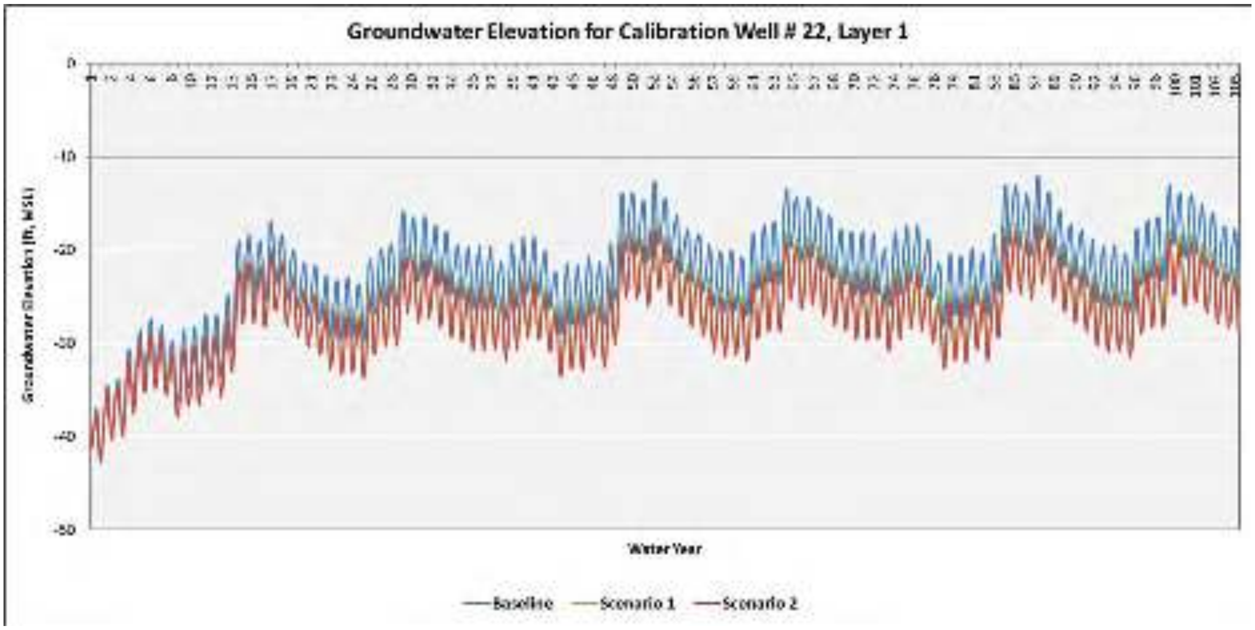

Groundwater Elevation Difference for Calibration Well # 21, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

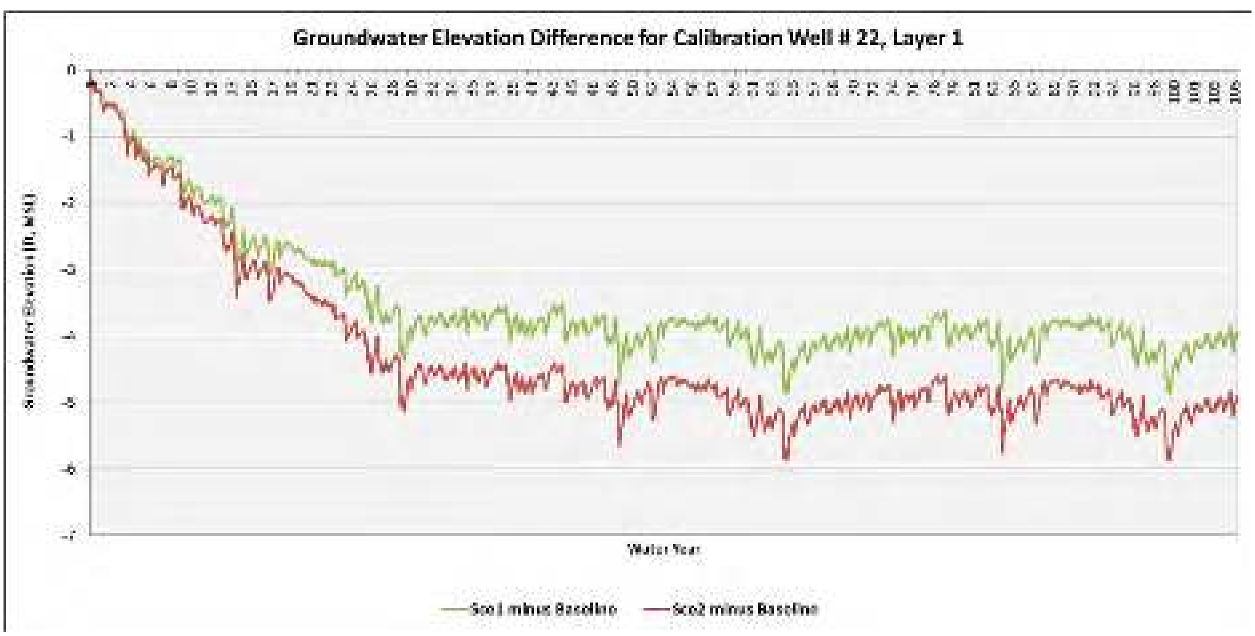


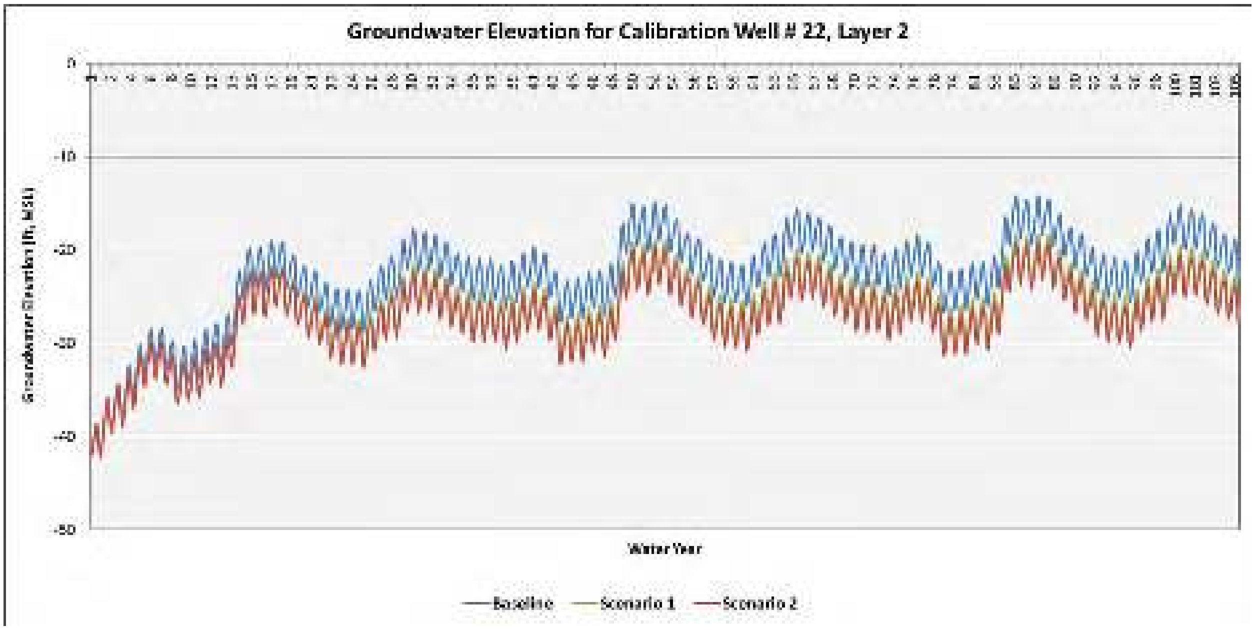
Groundwater Elevation for Calibration Well # 21, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

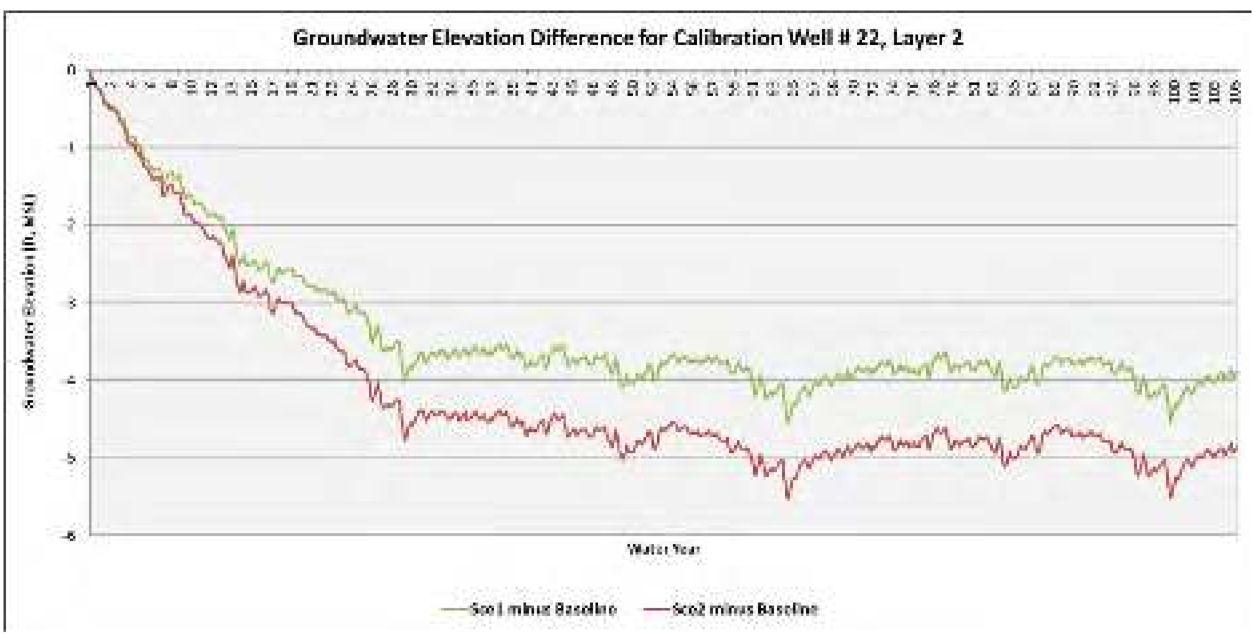


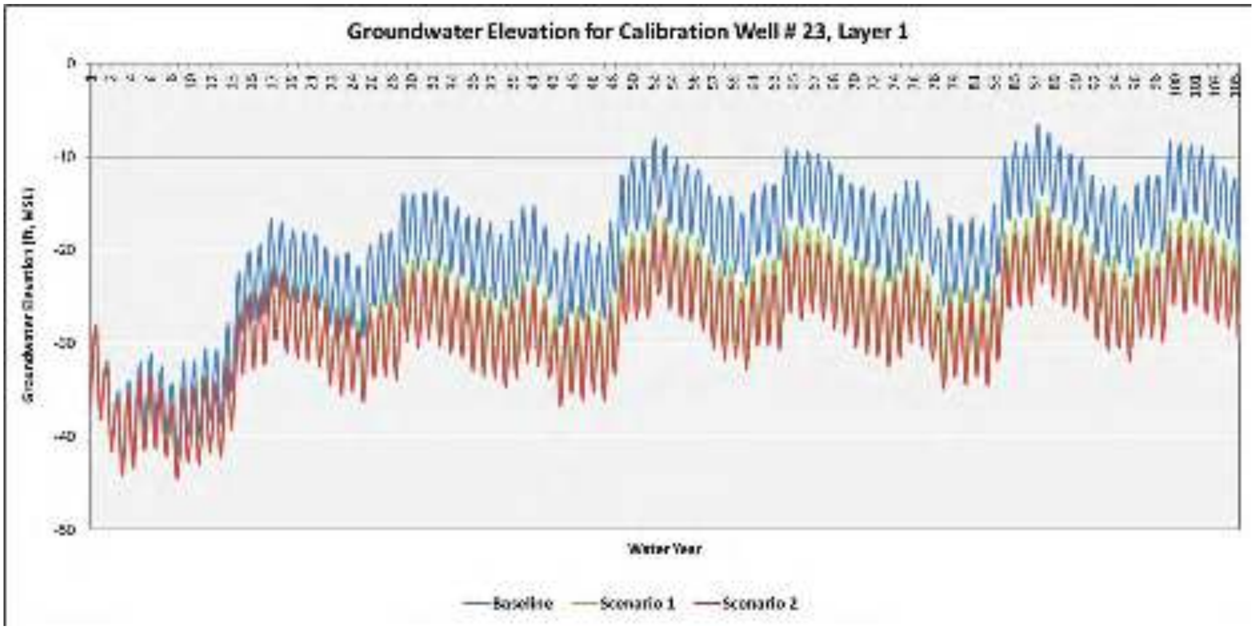
Groundwater Elevation Difference for Calibration Well # 21, Layer 2
Water Year
Scn1 minus Baseline
Scn2 minus Baseline


Groundwater Elevation for Calibration Well # 22, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

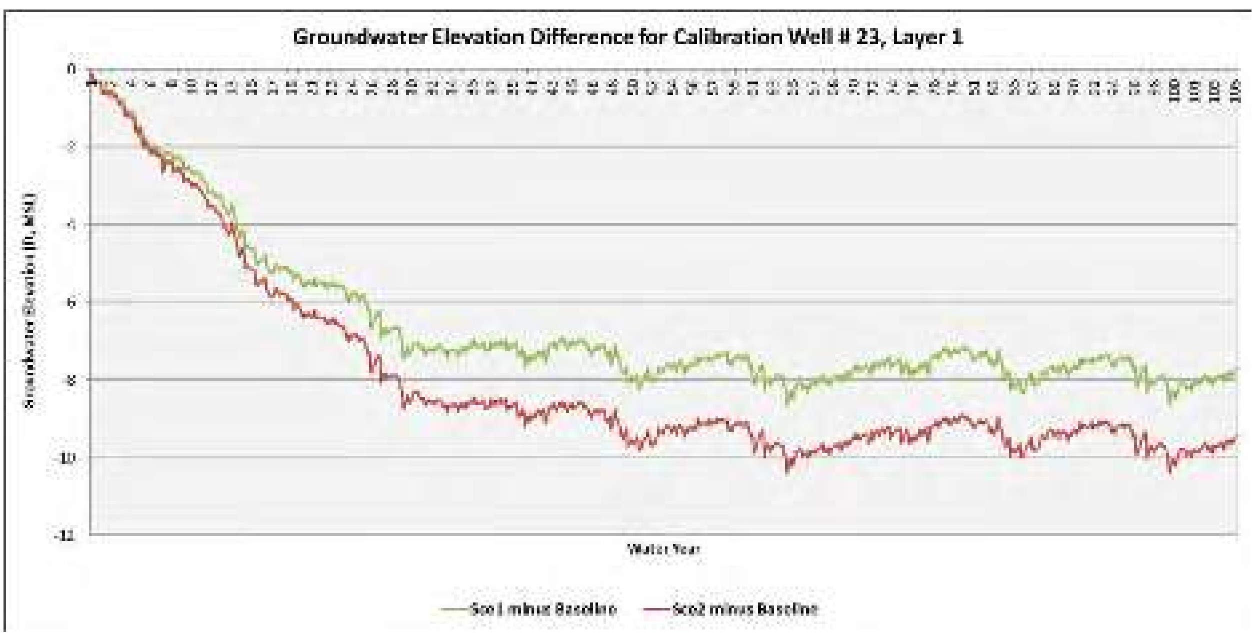

Groundwater Elevation Difference for Calibration Well # 22, Layer 1
Water Year
Sco1 minus Baseline
Sco2 minus Baseline


Groundwater Elevation for Calibration Well # 22, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

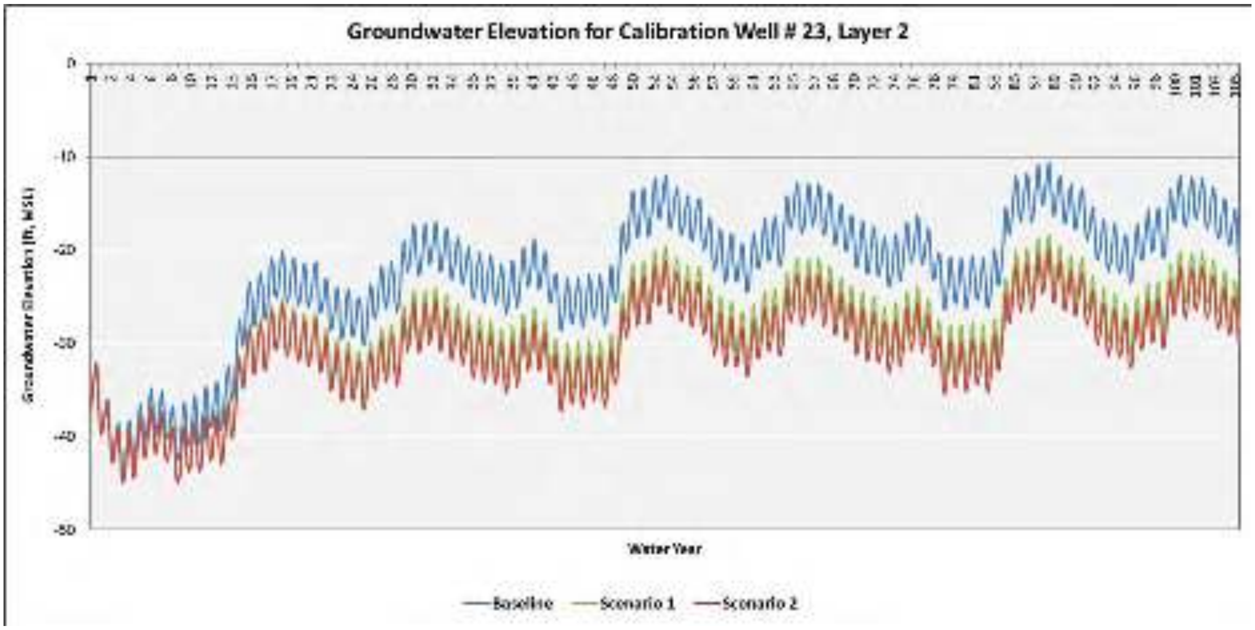

Groundwater Elevation Difference for Calibration Well # 22, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

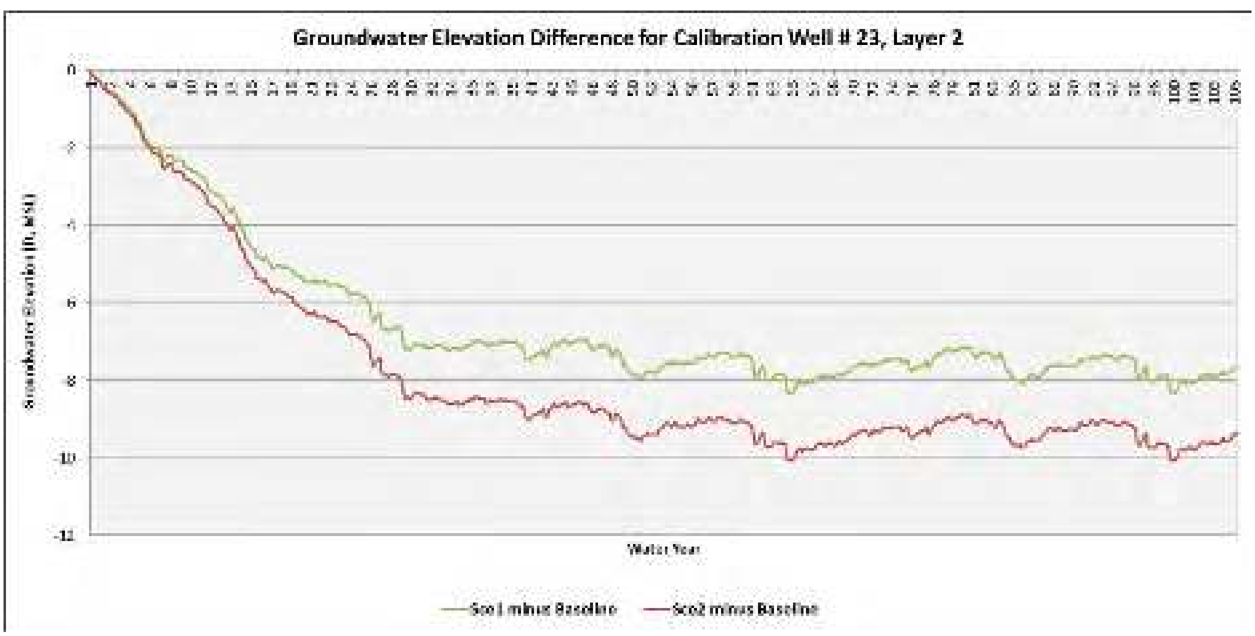


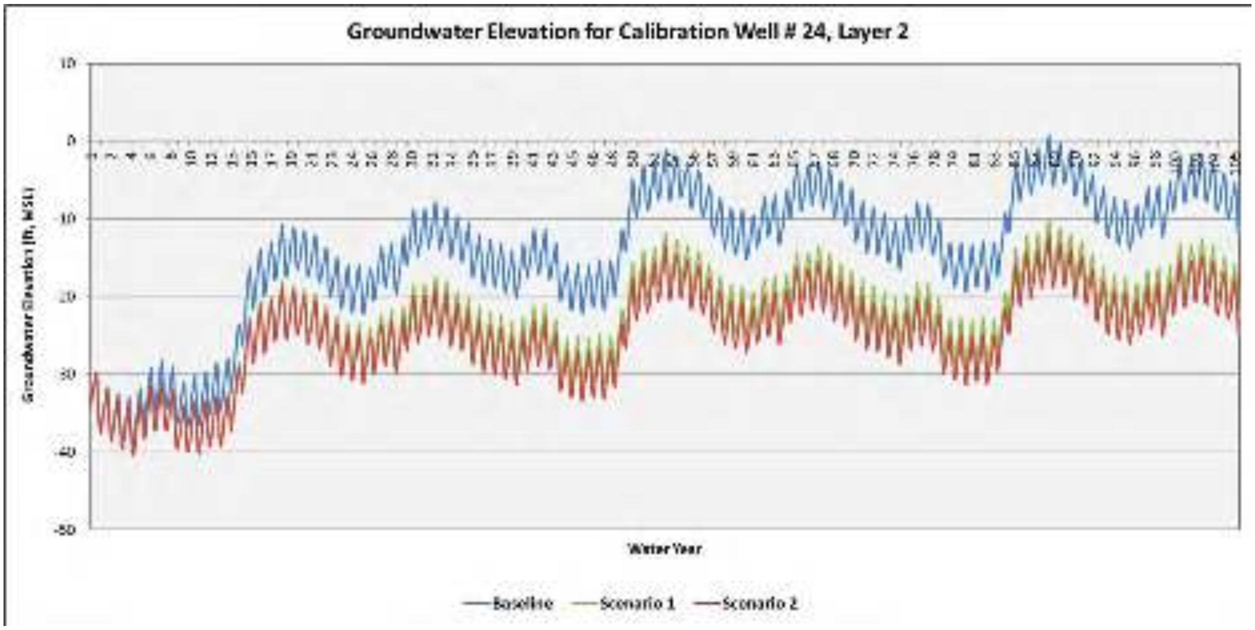
Groundwater Elevation for Calibration Well # 23, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2



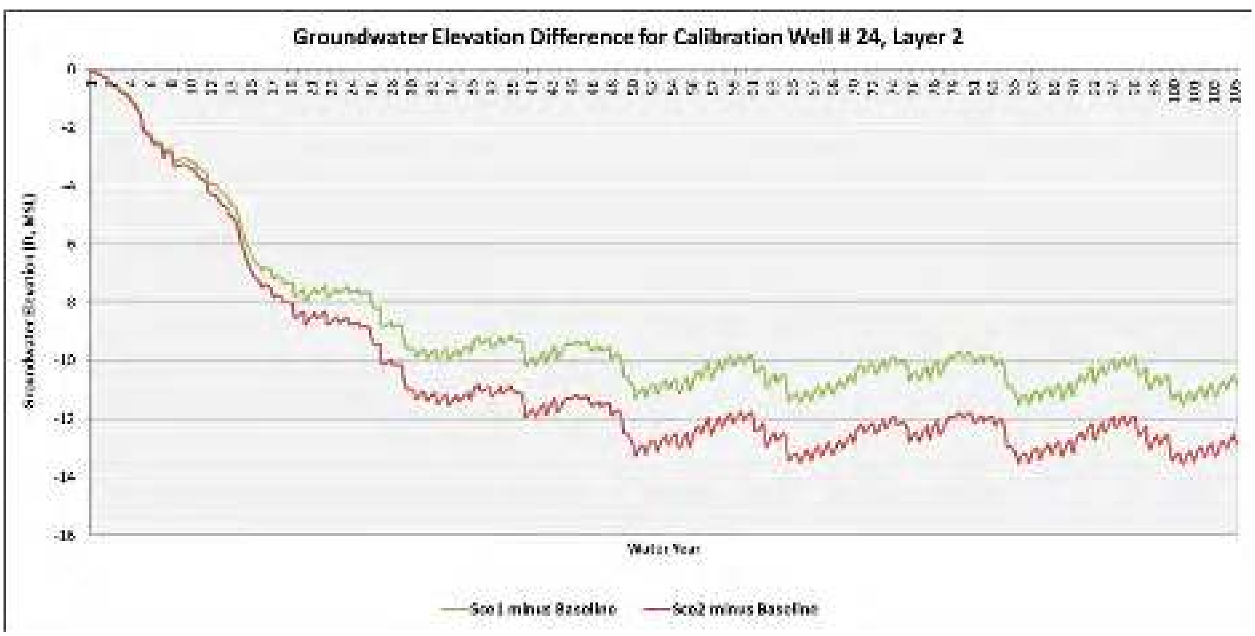
Groundwater Elevation Difference for Calibration Well # 23, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 23, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

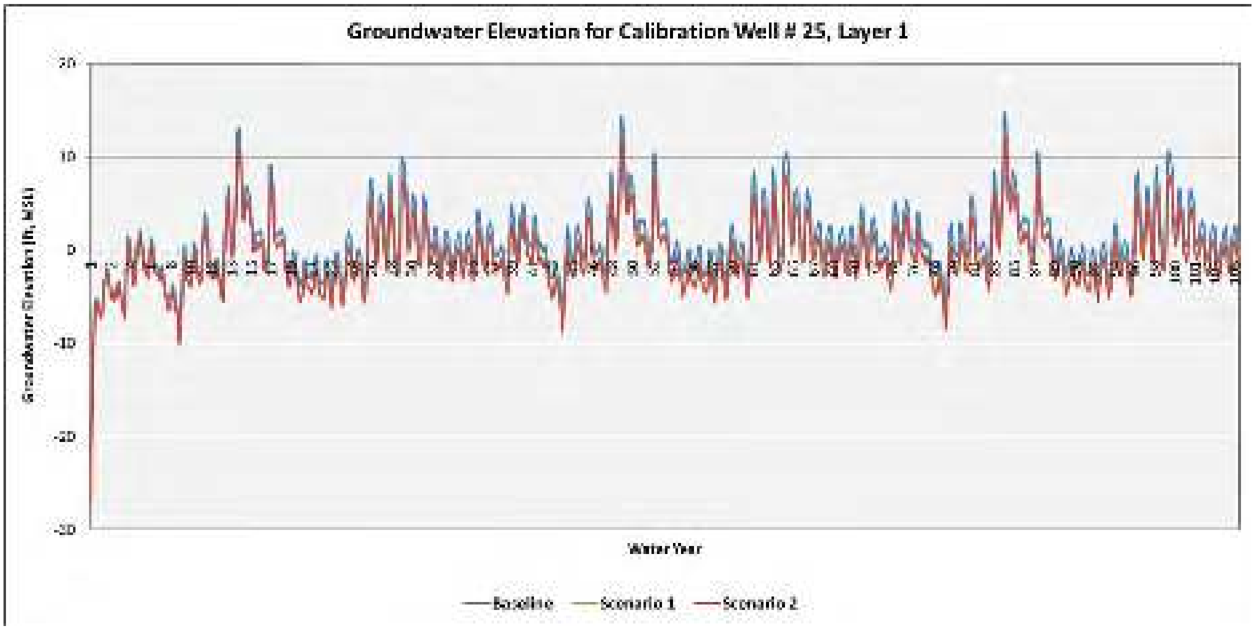

Groundwater Elevation Difference for Calibration Well # 23, Layer 2
Water Year
Sco1 minus Baseline
Sco2 minus Baseline



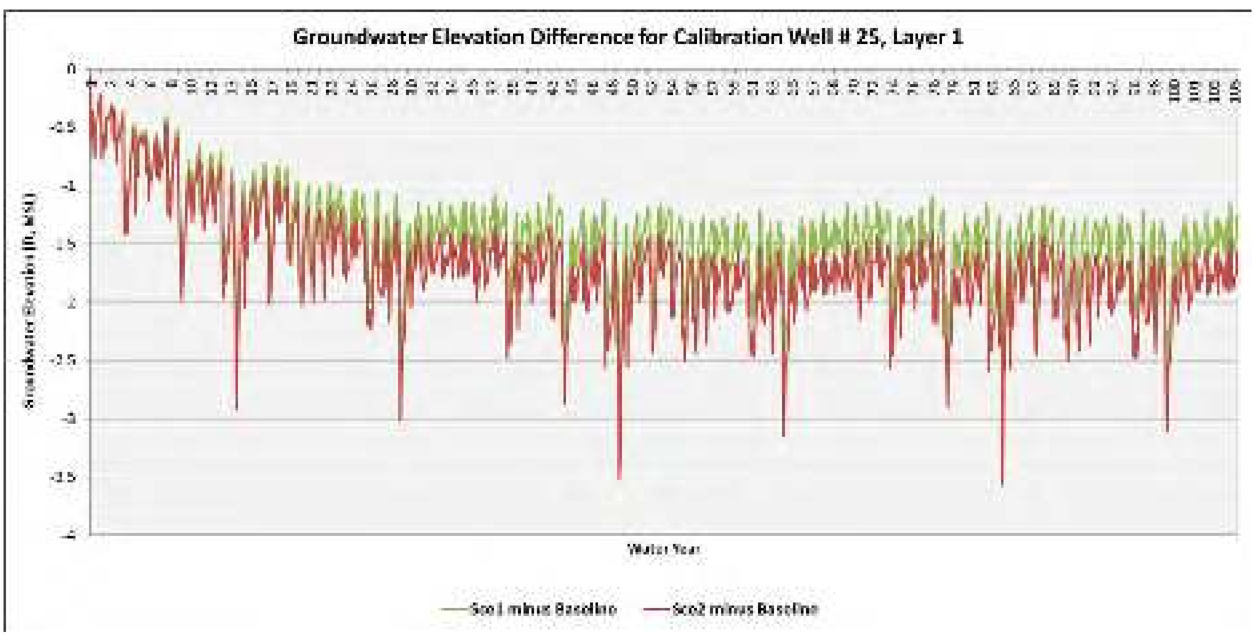
Groundwater Elevation for Calibration Well # 24, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2



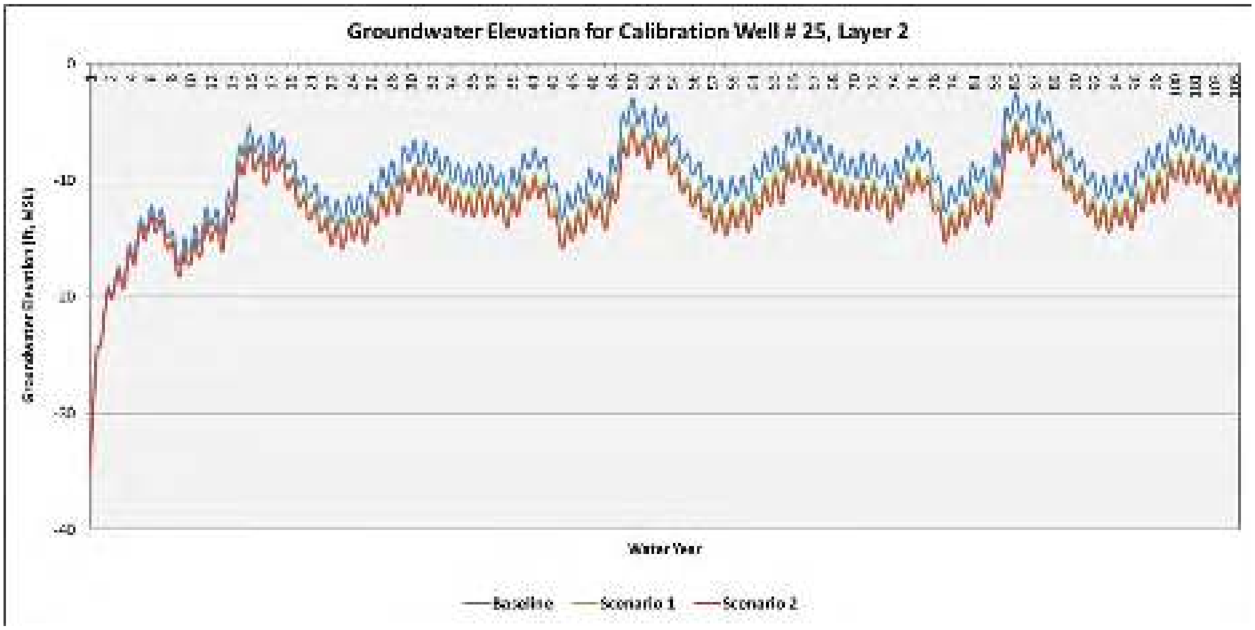
Groundwater Elevation Difference for Calibration Well # 24, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline



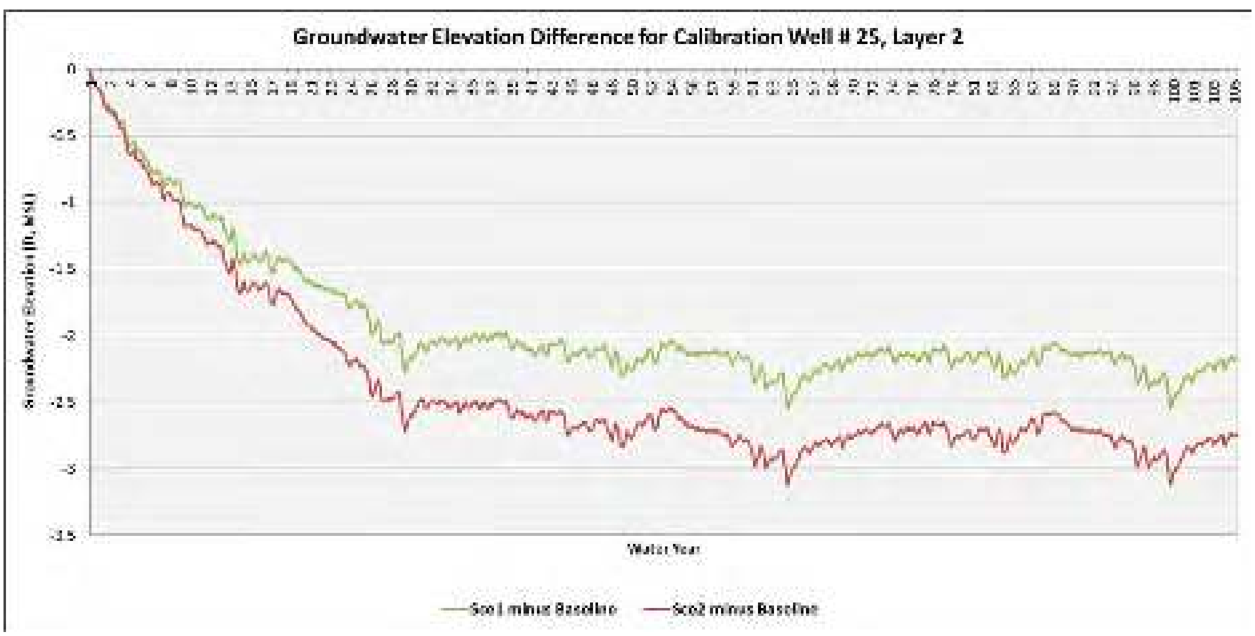
Groundwater Elevation for Calibration Well # 25, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2



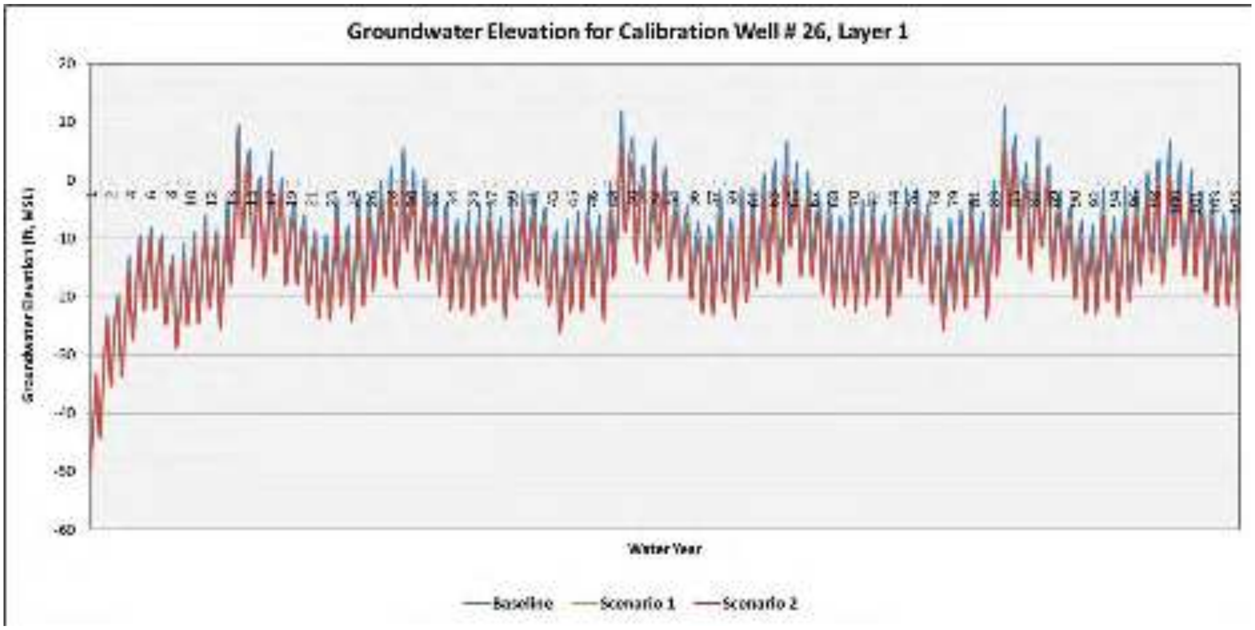
Groundwater Elevation Difference for Calibration Well # 25, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

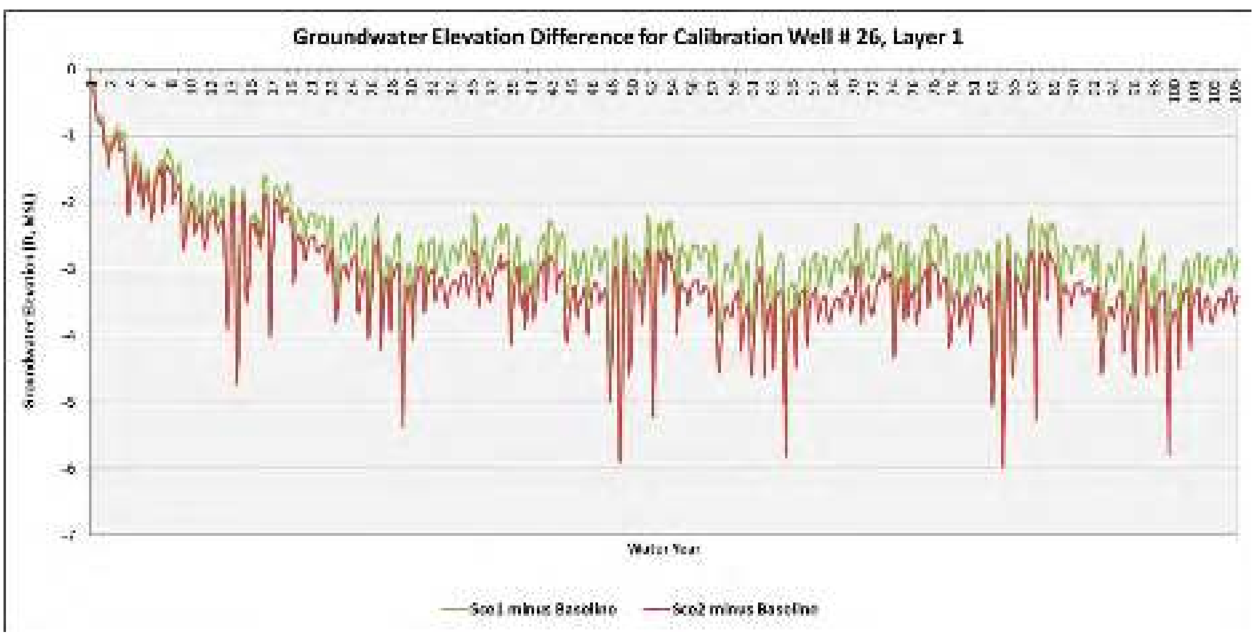


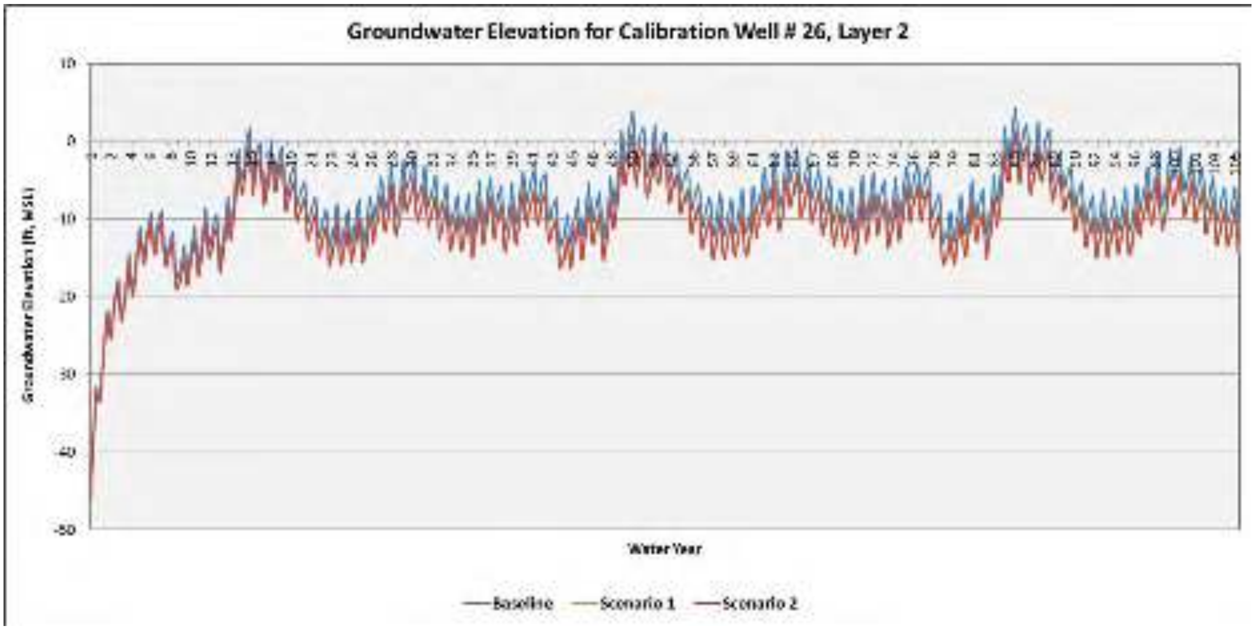
Groundwater Elevation for Calibration Well # 25, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

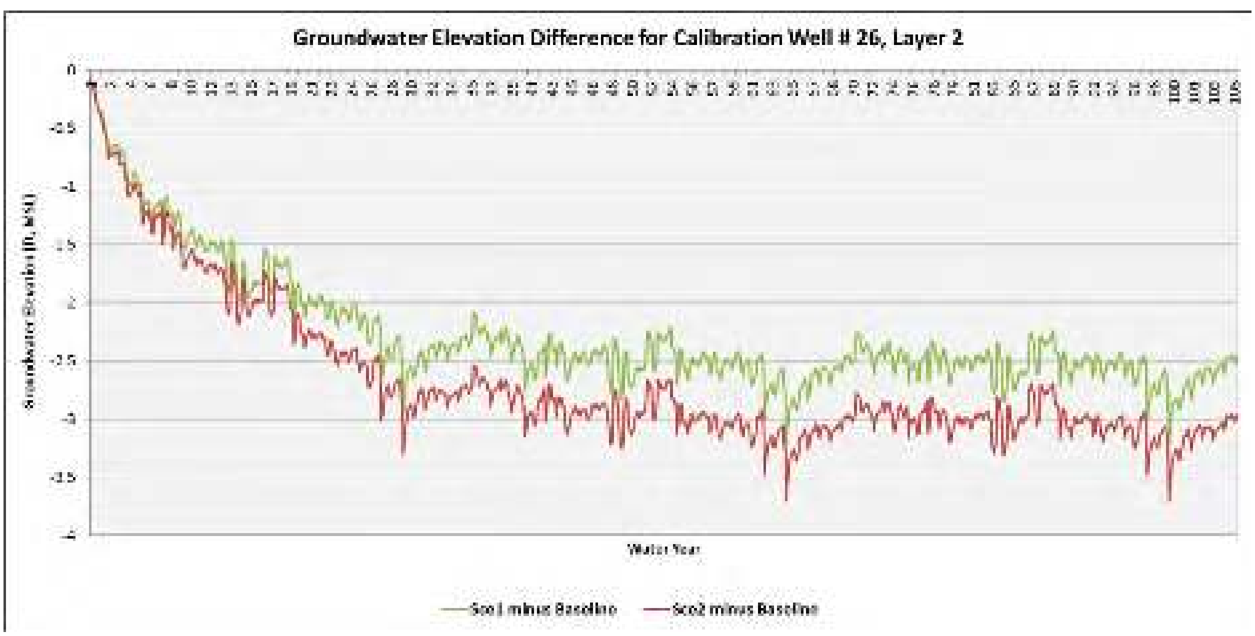


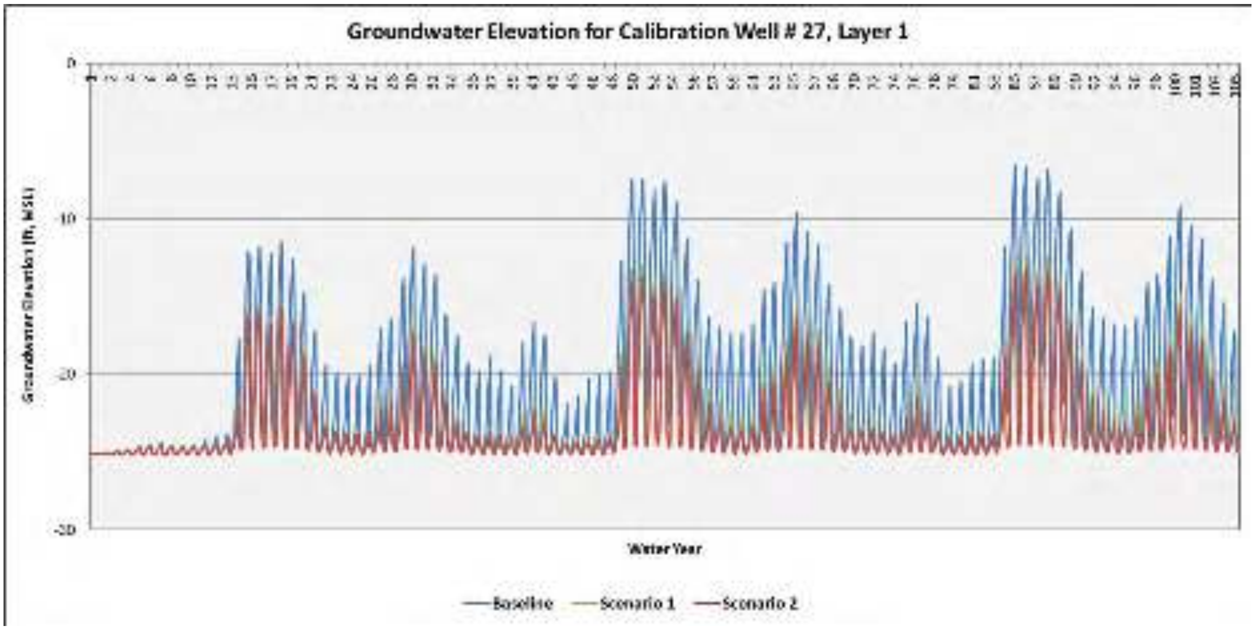
Groundwater Elevation Difference for Calibration Well # 25, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

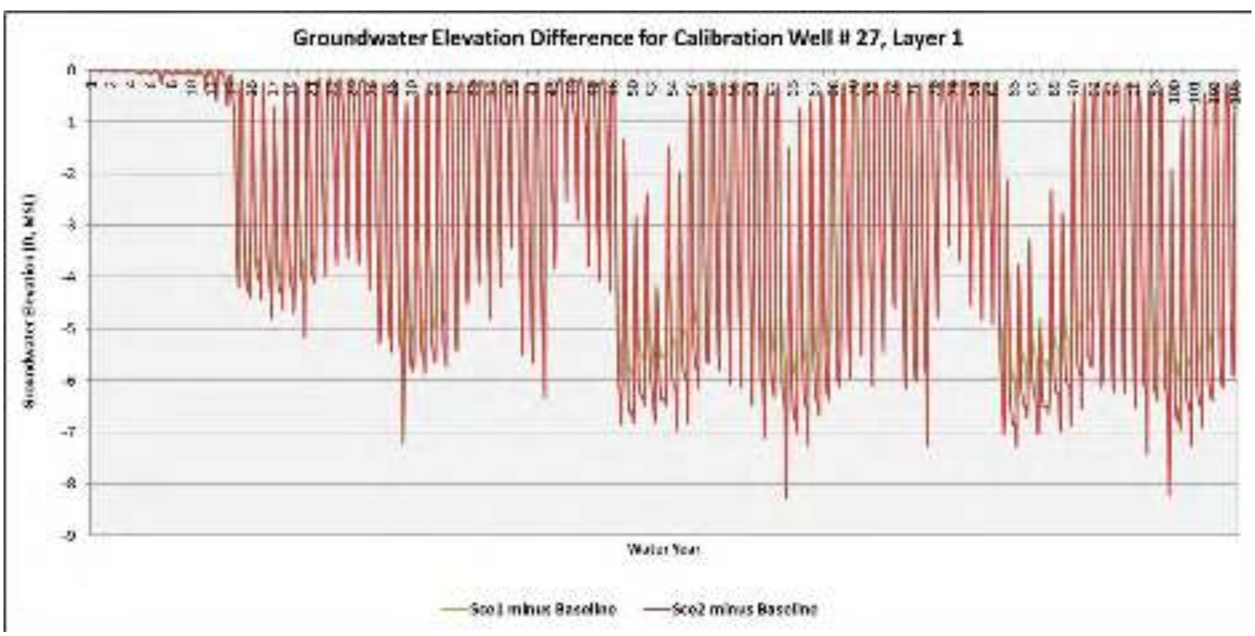

Groundwater Elevation for Calibration Well # 26, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

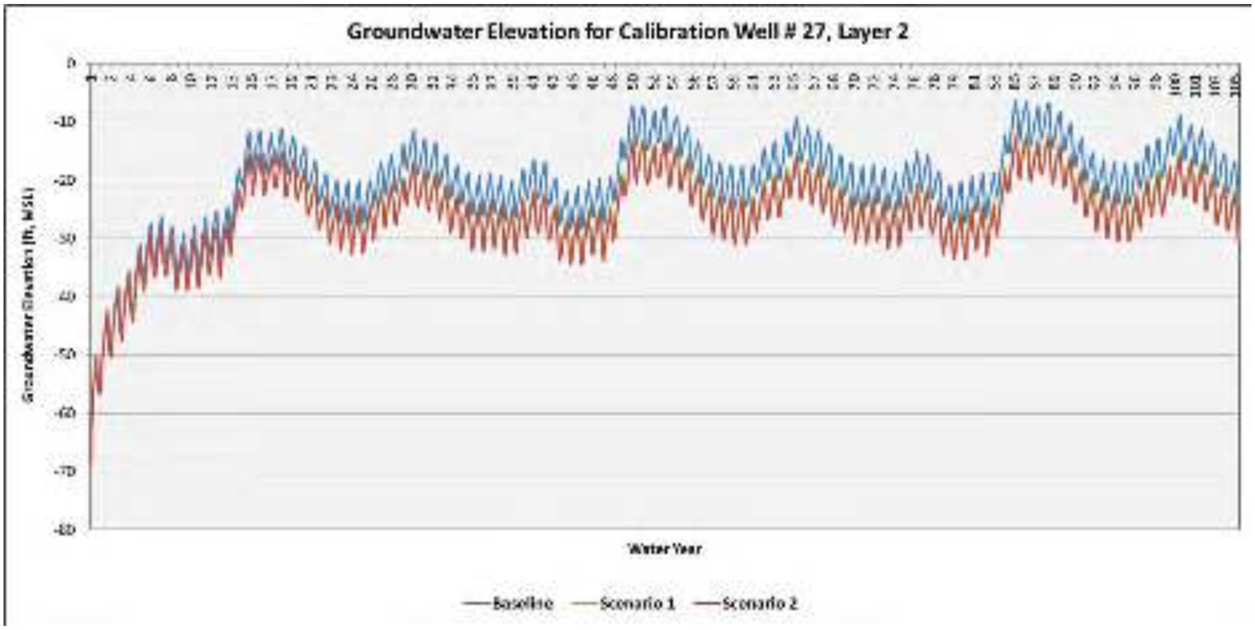

Groundwater Elevation Difference for Calibration Well # 26, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

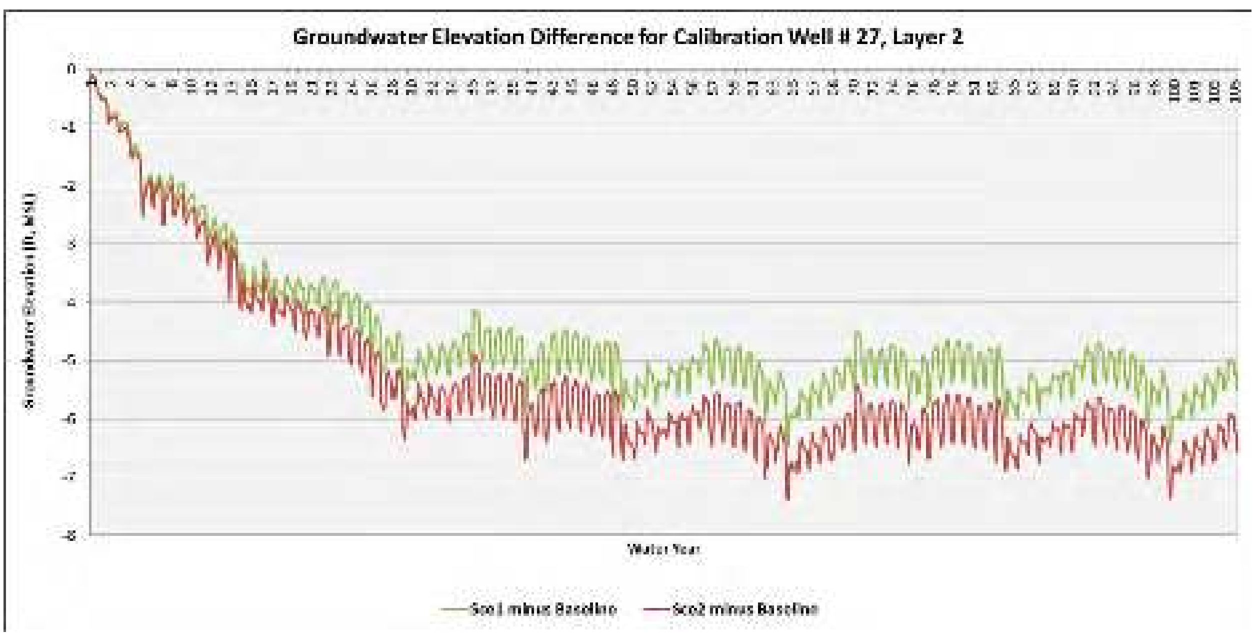

Groundwater Elevation for Calibration Well # 26, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

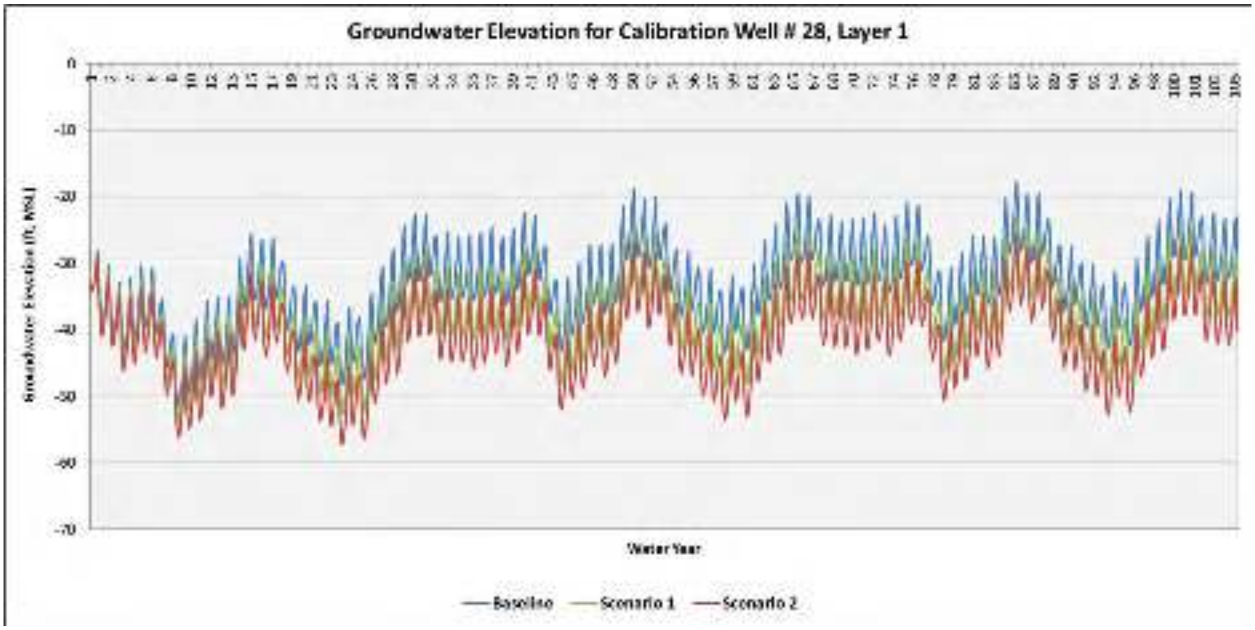

Groundwater Elevation Difference for Calibration Well # 26, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 27, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

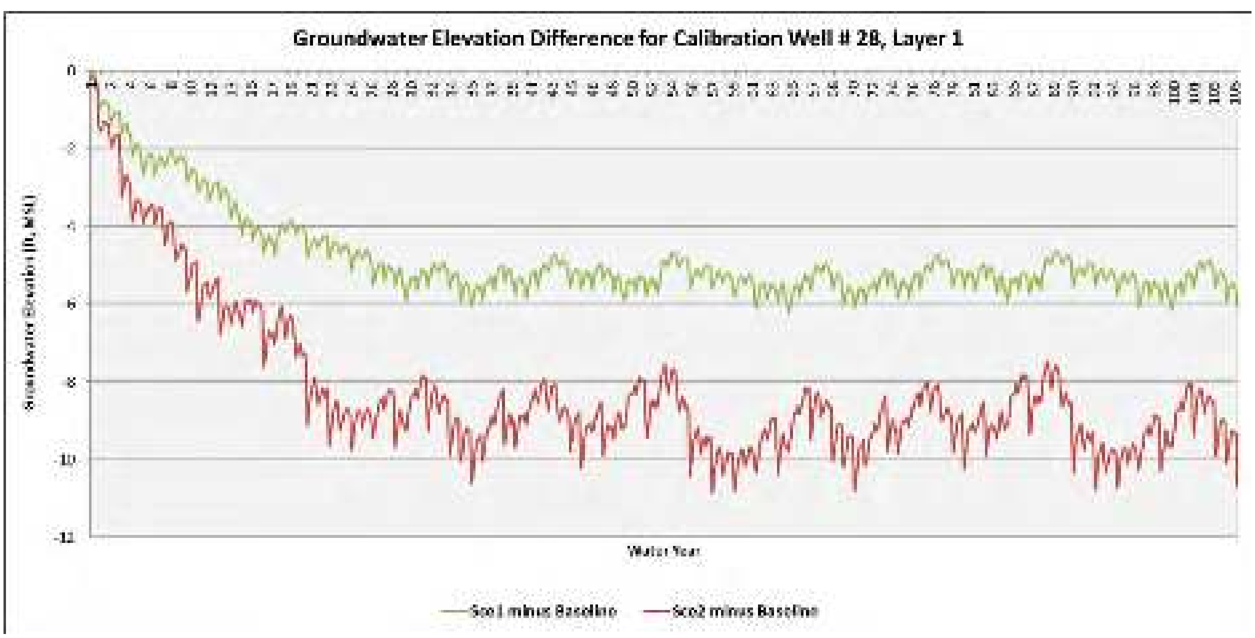

Groundwater Elevation Difference for Calibration Well # 27, Layer 1
Water Year
Sco1 minus Baseline
Sco2 minus Baseline


Groundwater Elevation for Calibration Well # 27, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

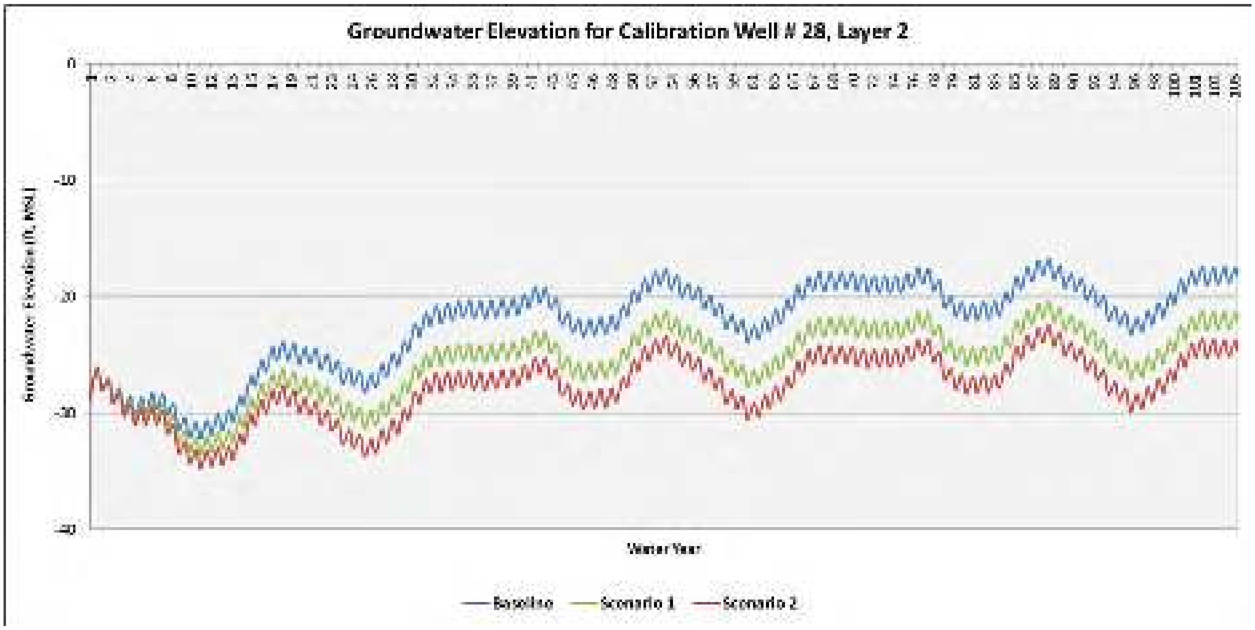

Groundwater Elevation Difference for Calibration Well # 27, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sco1 minus Baseline
Sco2 minus Baseline



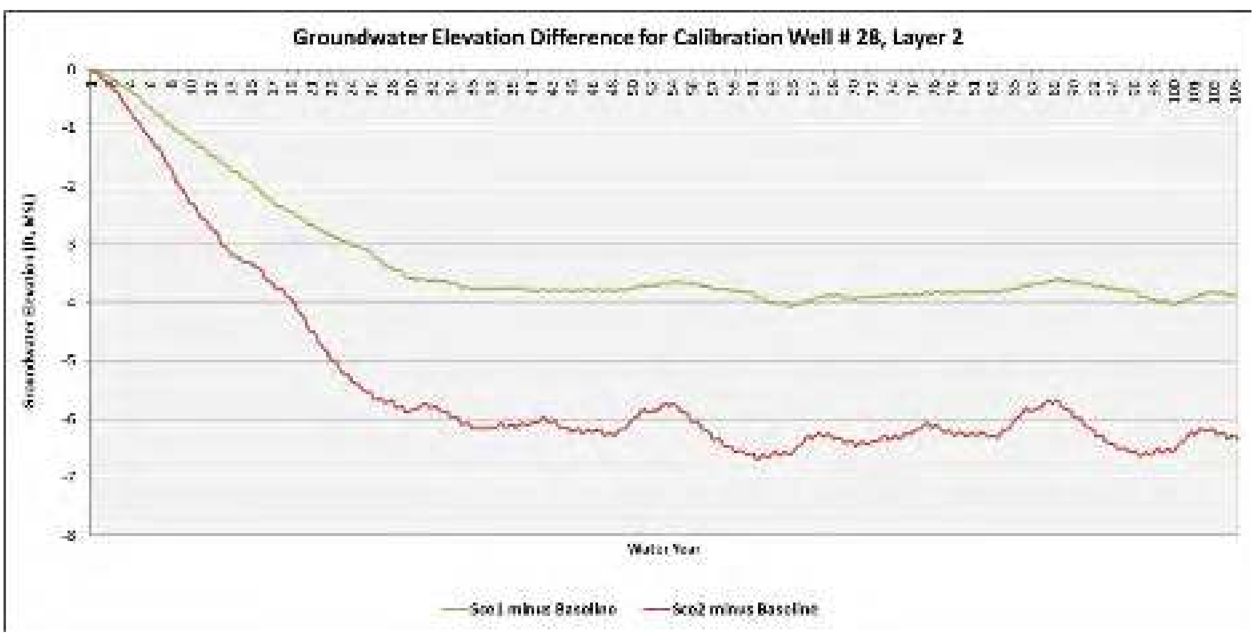
Groundwater Elevation for Calibration Well # 28, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2



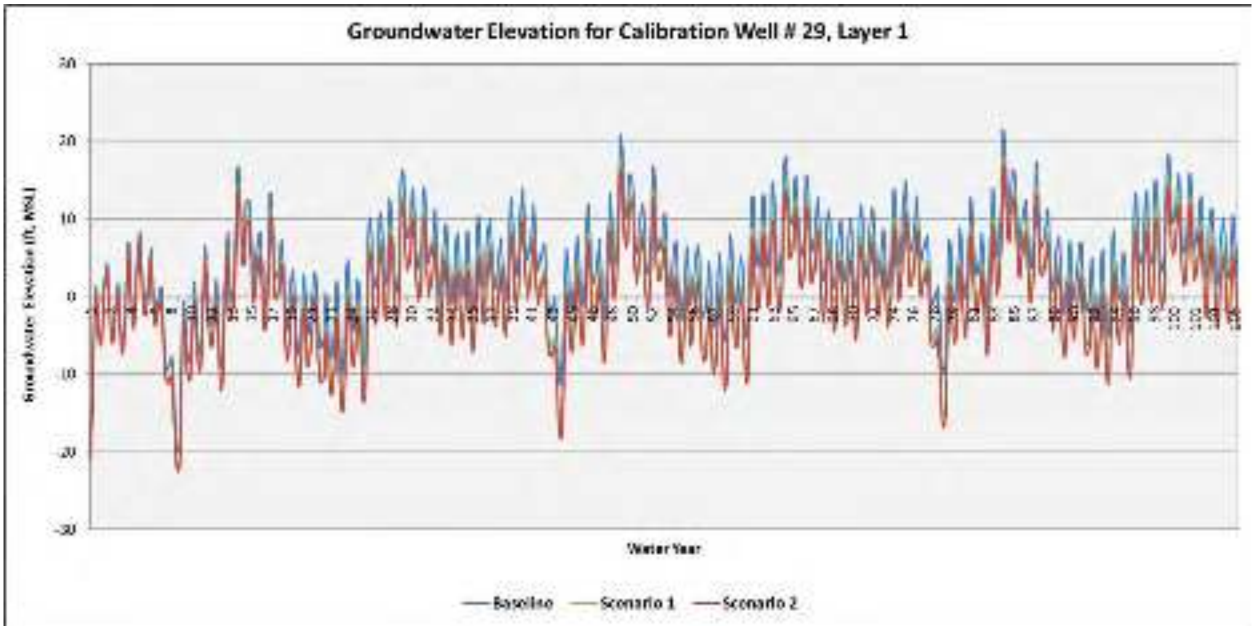
Groundwater Elevation Difference for Calibration Well # 28, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

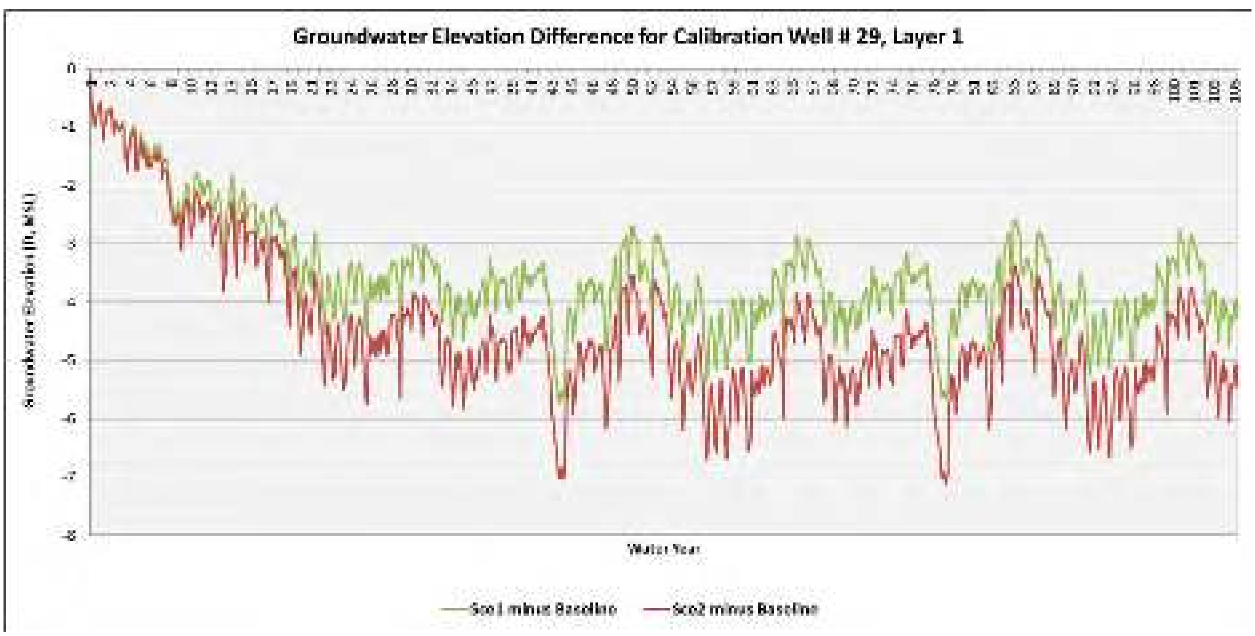


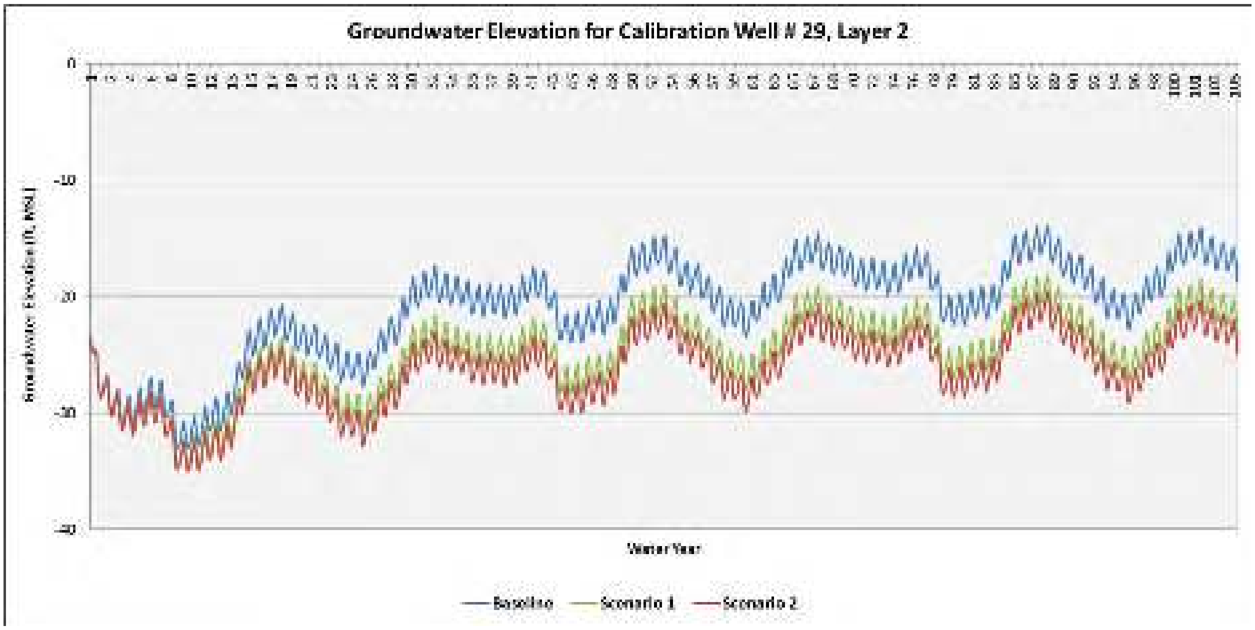
Groundwater Elevation for Calibration Well # 28, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

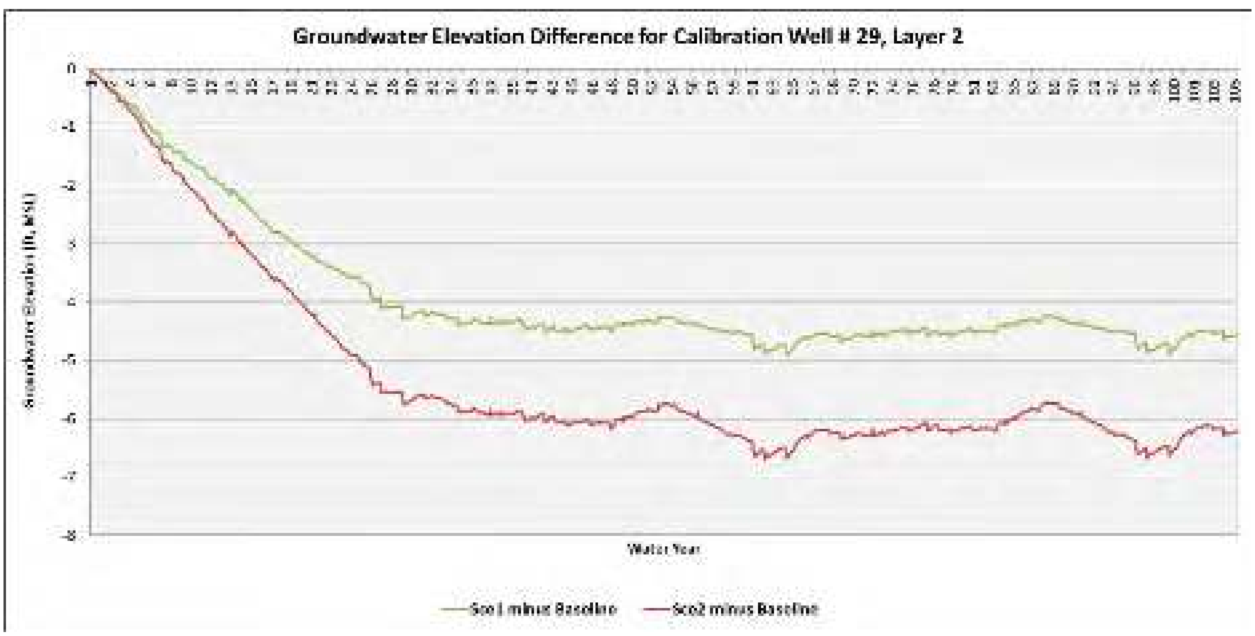


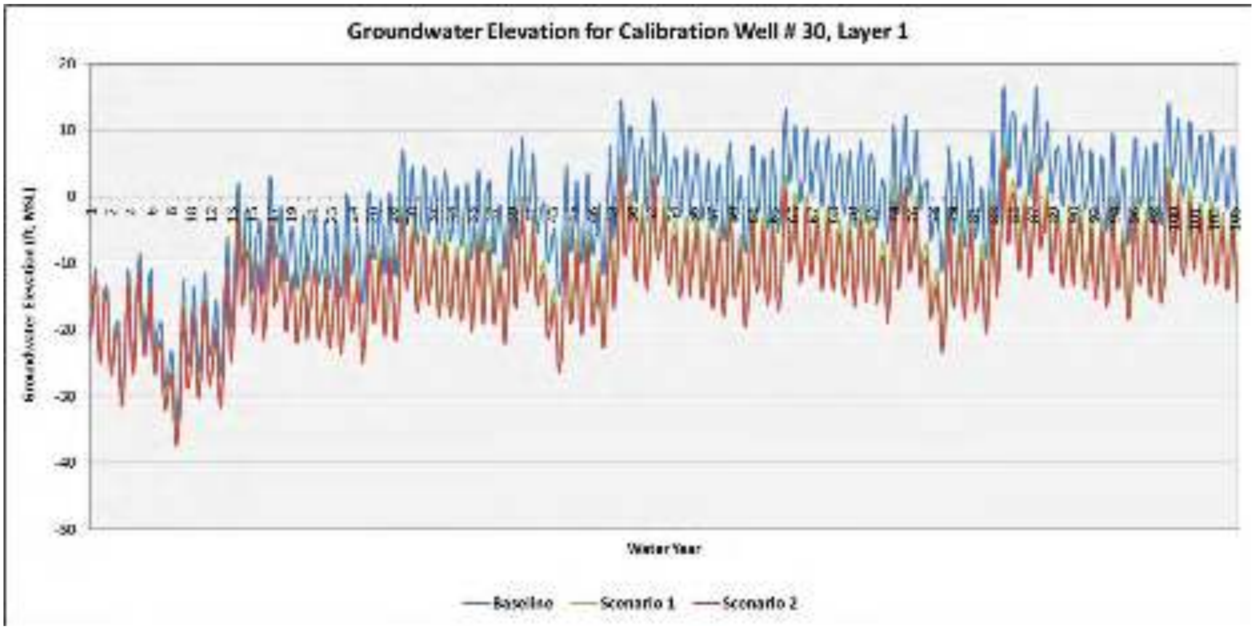
Groundwater Elevation Difference for Calibration Well # 28, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

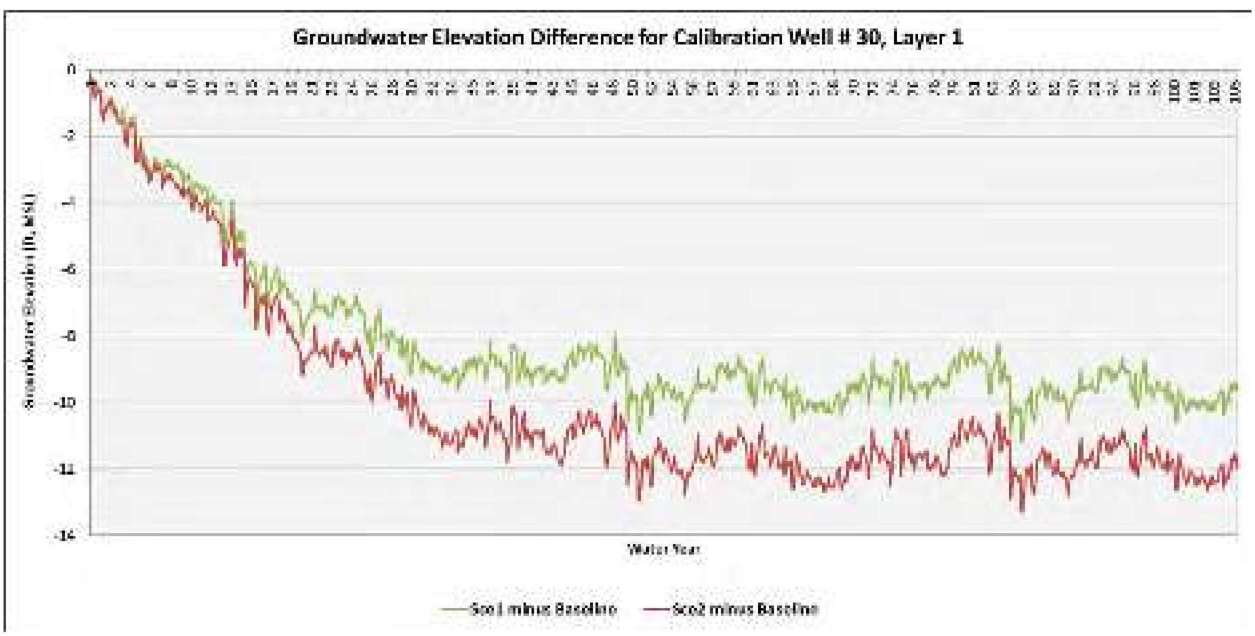

Groundwater Elevation for Calibration Well # 29, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

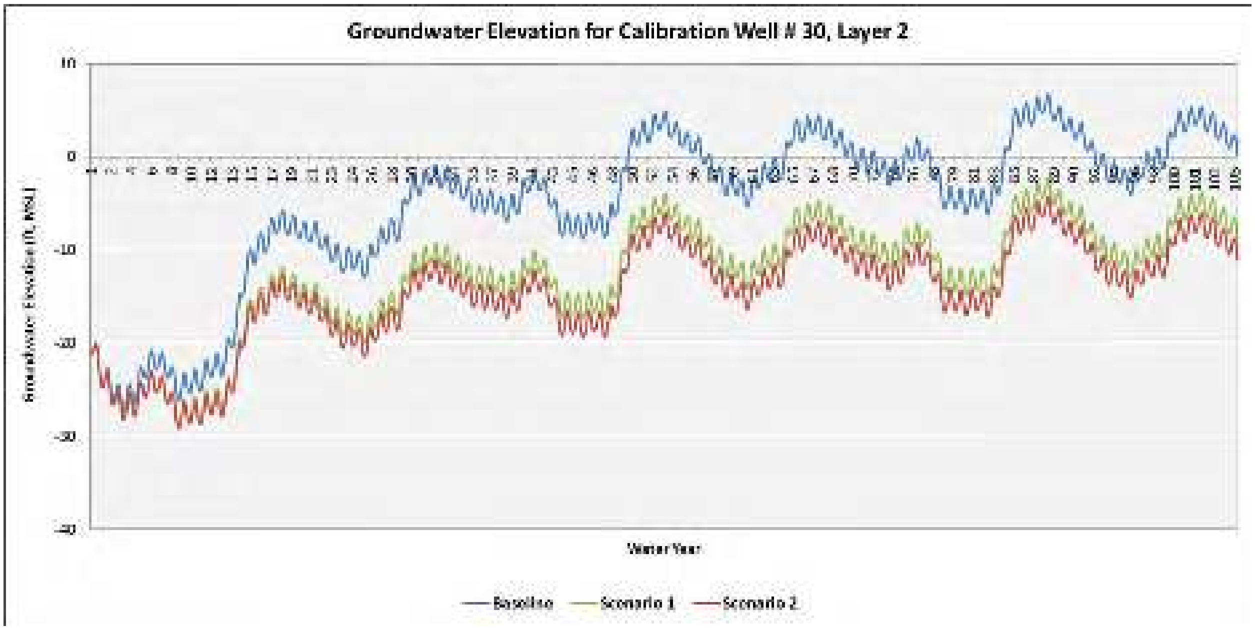

Groundwater Elevation Difference for Calibration Well # 29, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 29, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

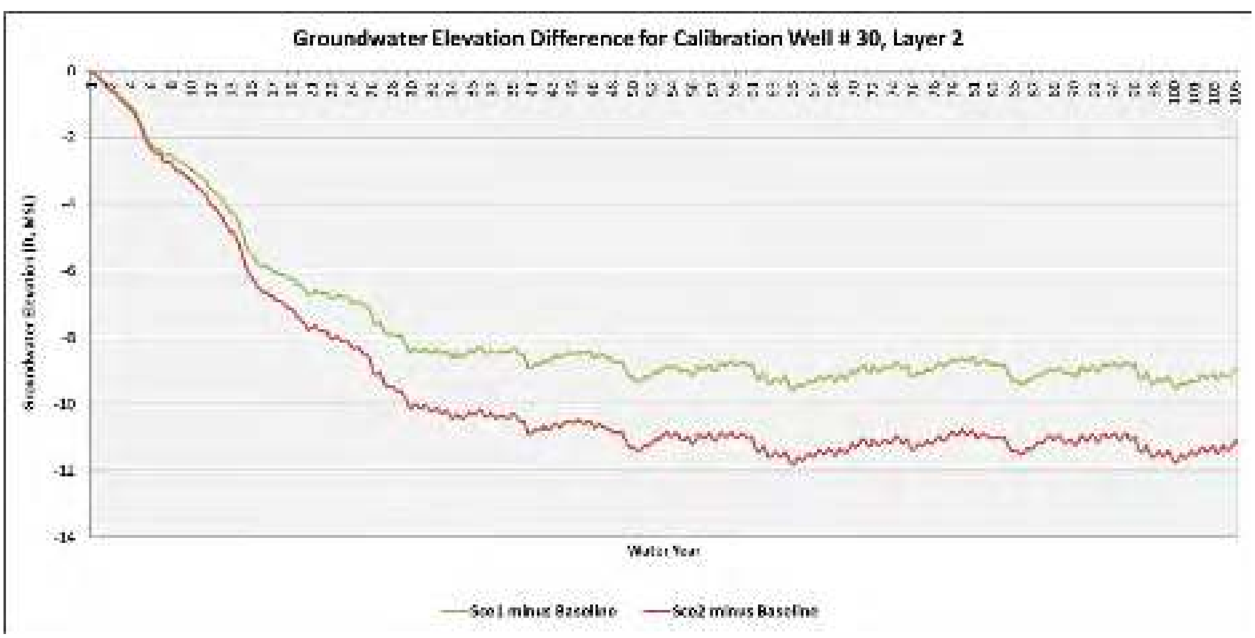

Groundwater Elevation Difference for Calibration Well # 29, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 30, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2

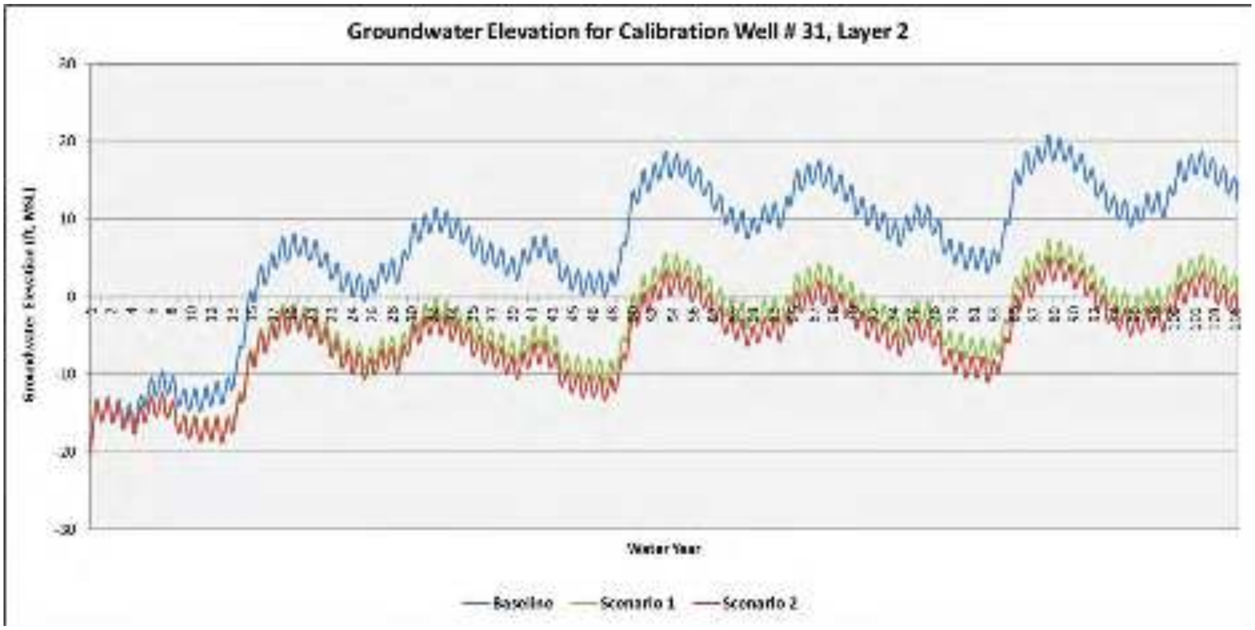

Groundwater Elevation Difference for Calibration Well # 30, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline



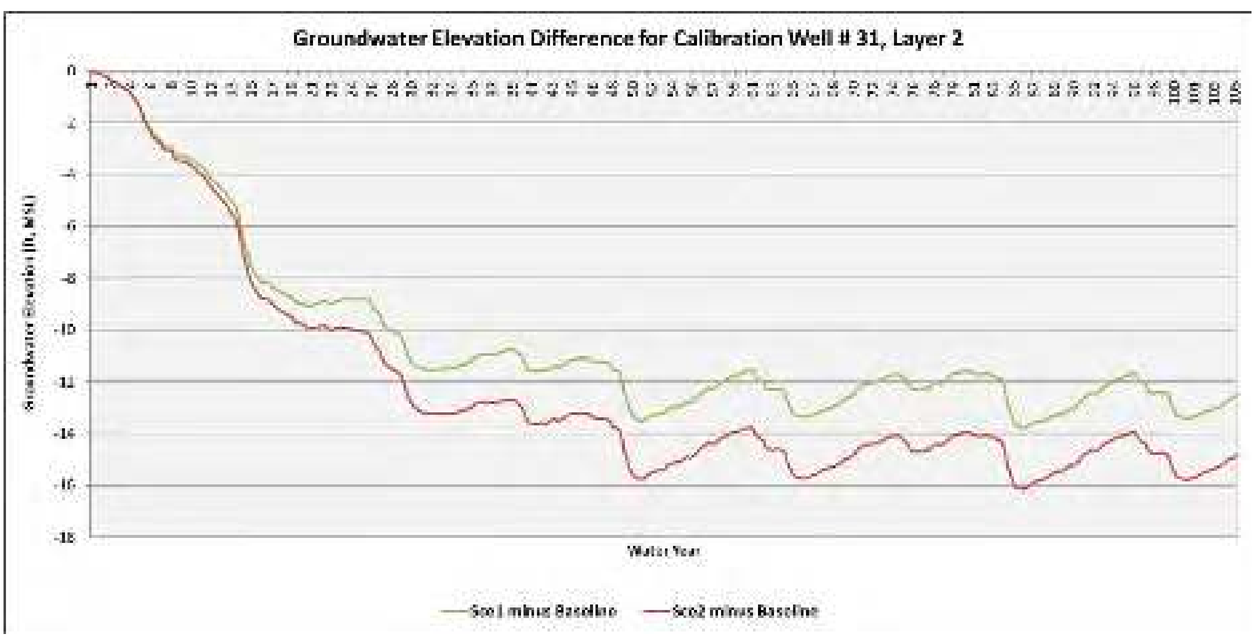
Groundwater Elevation for Calibration Well # 30, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2



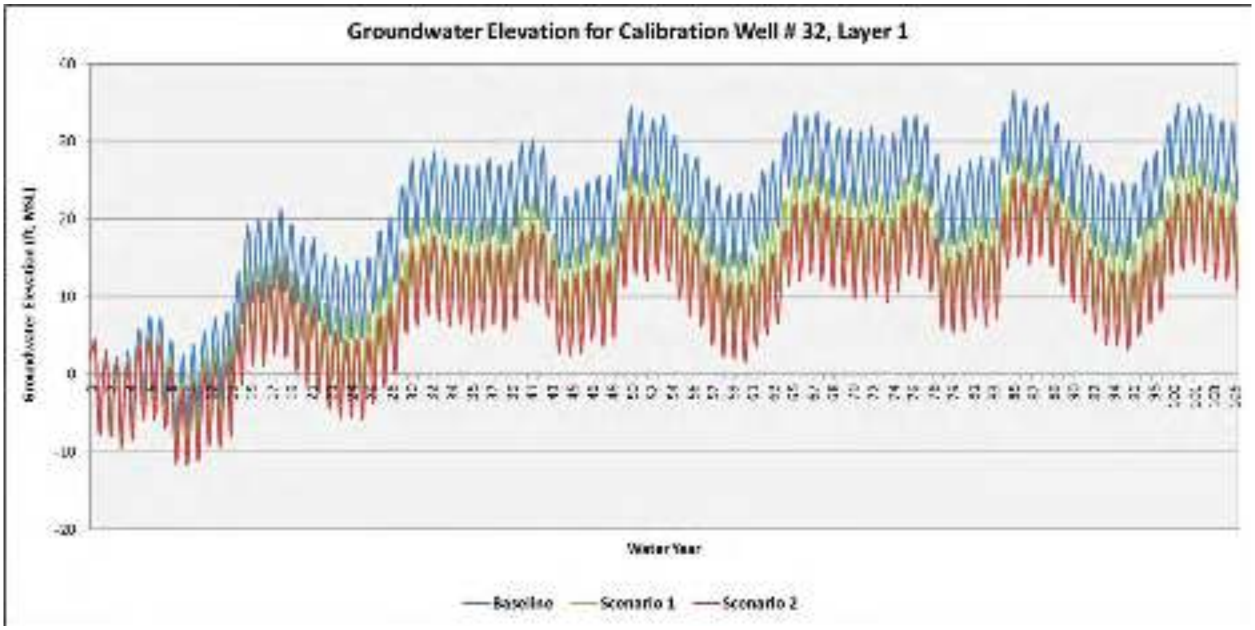
Groundwater Elevation Difference for Calibration Well # 30, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

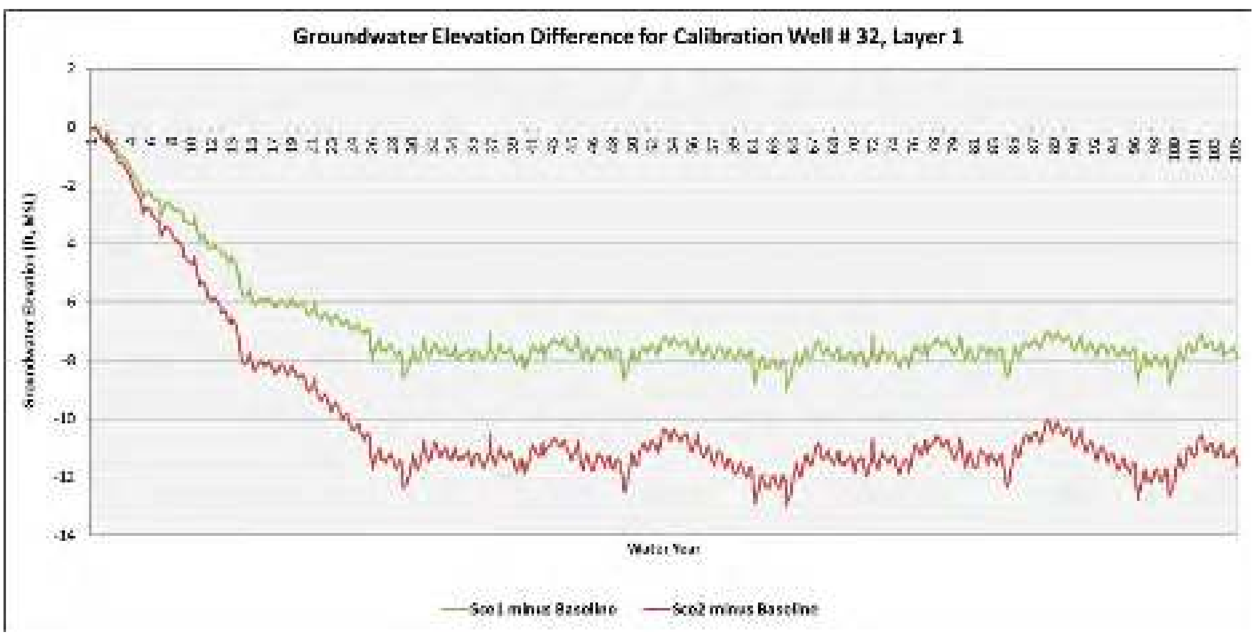


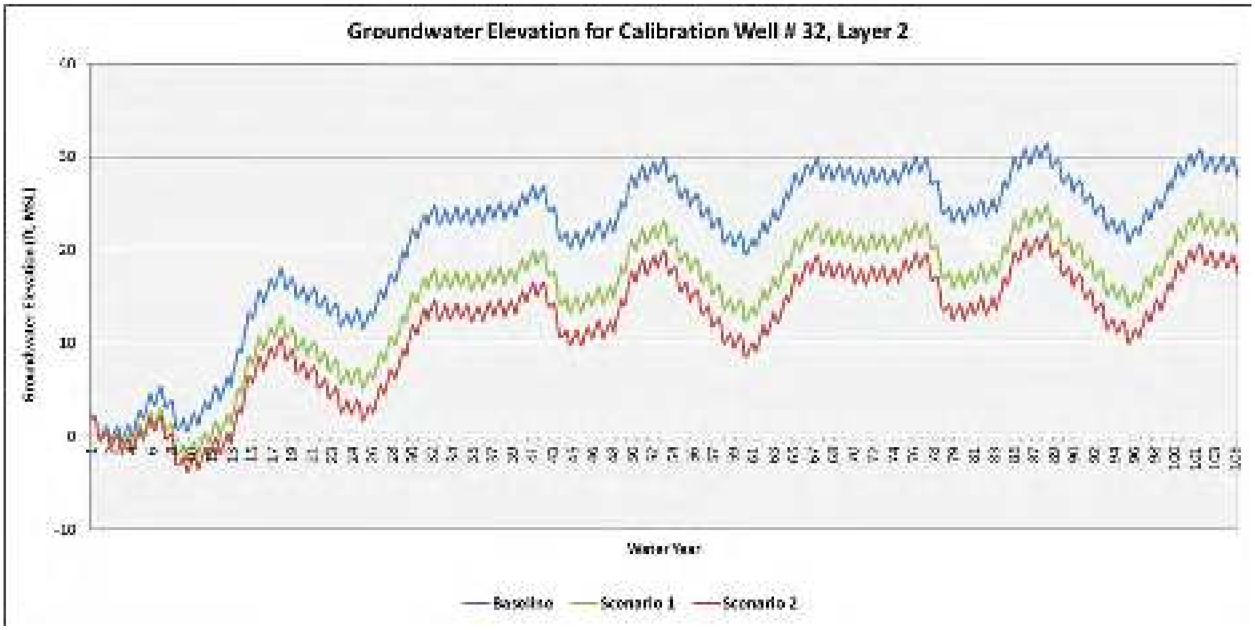
Groundwater Elevation for Calibration Well # 31, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

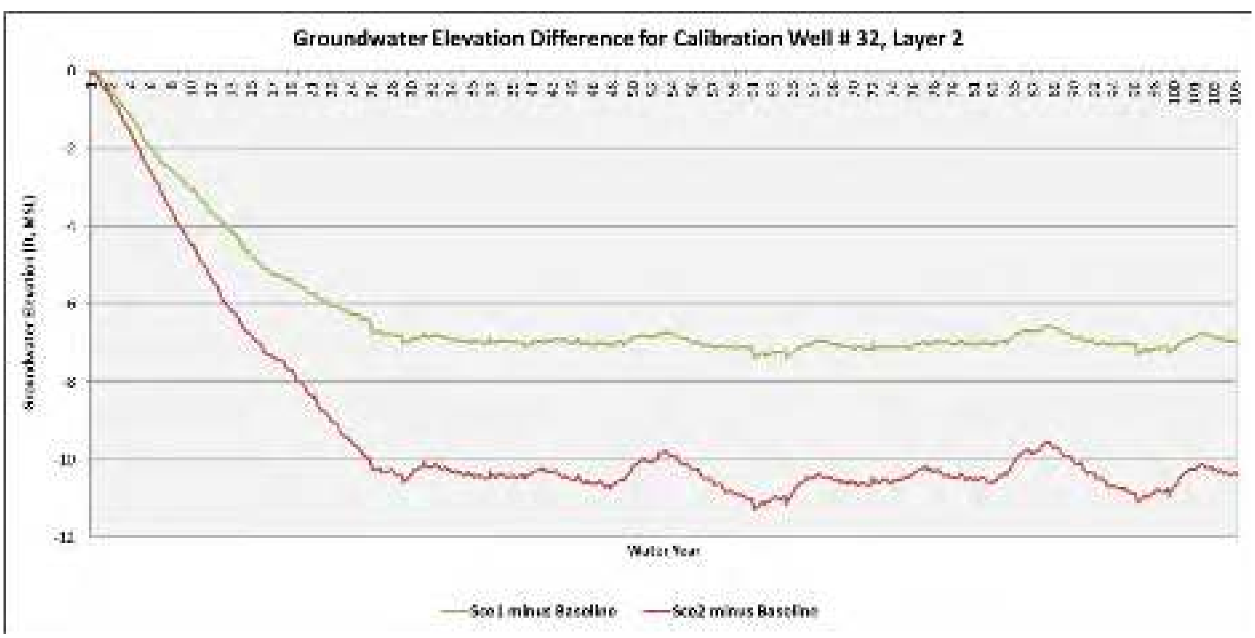


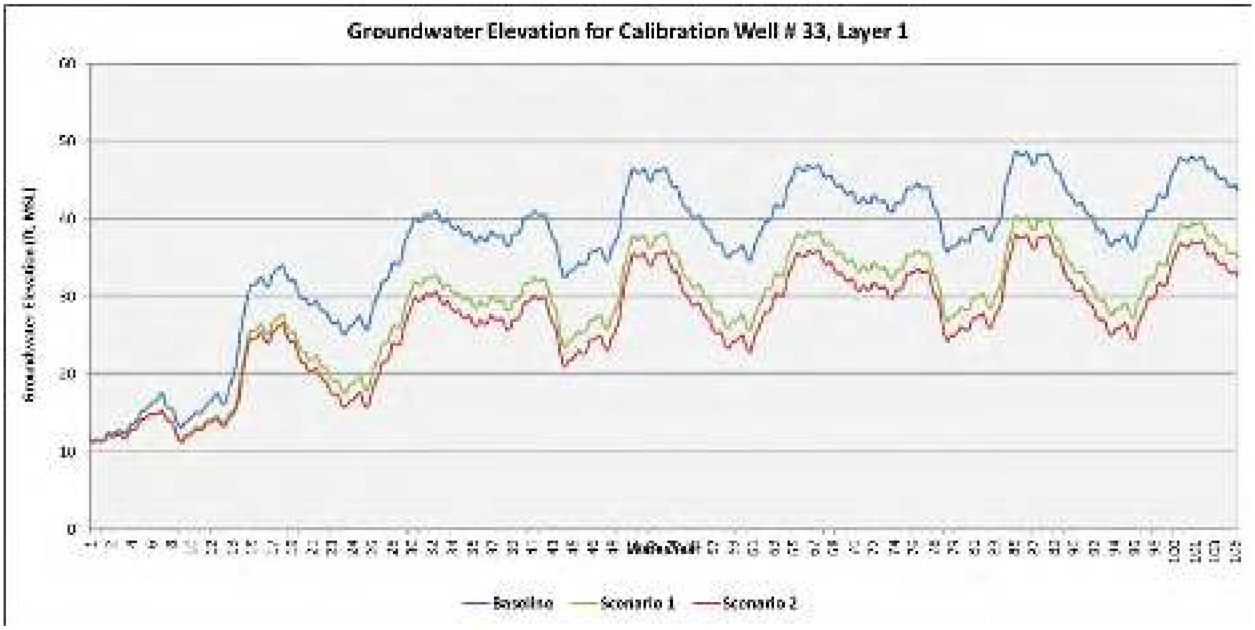
Groundwater Elevation Difference for Calibration Well # 31, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

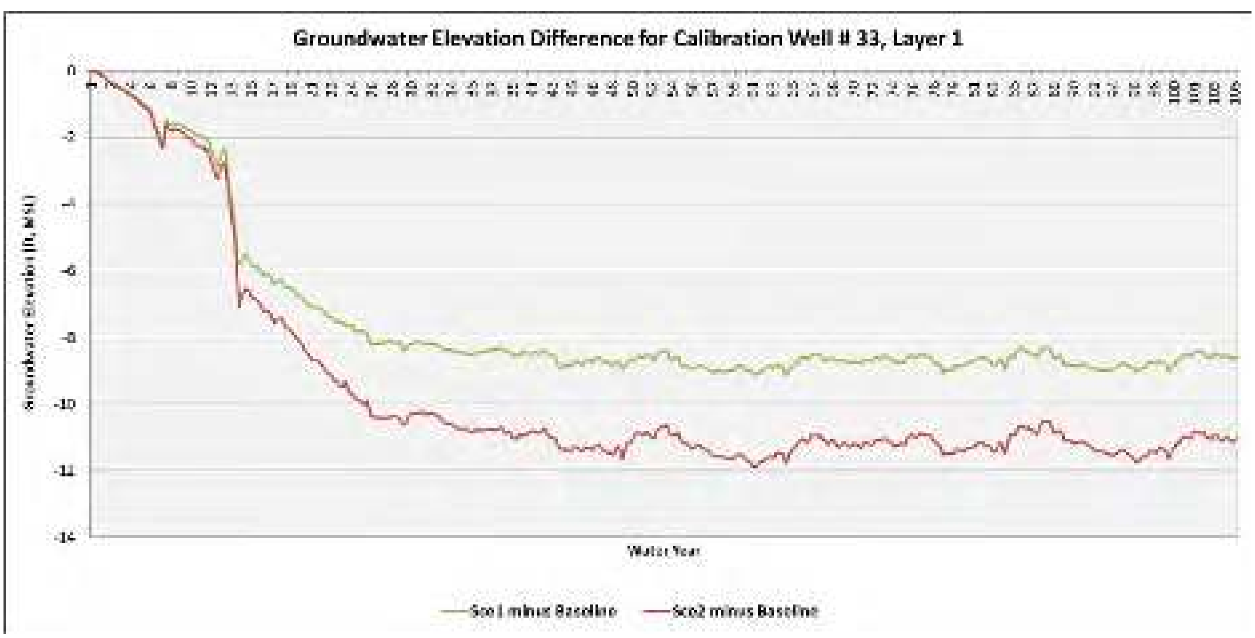

Groundwater Elevation for Calibration Well # 32, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

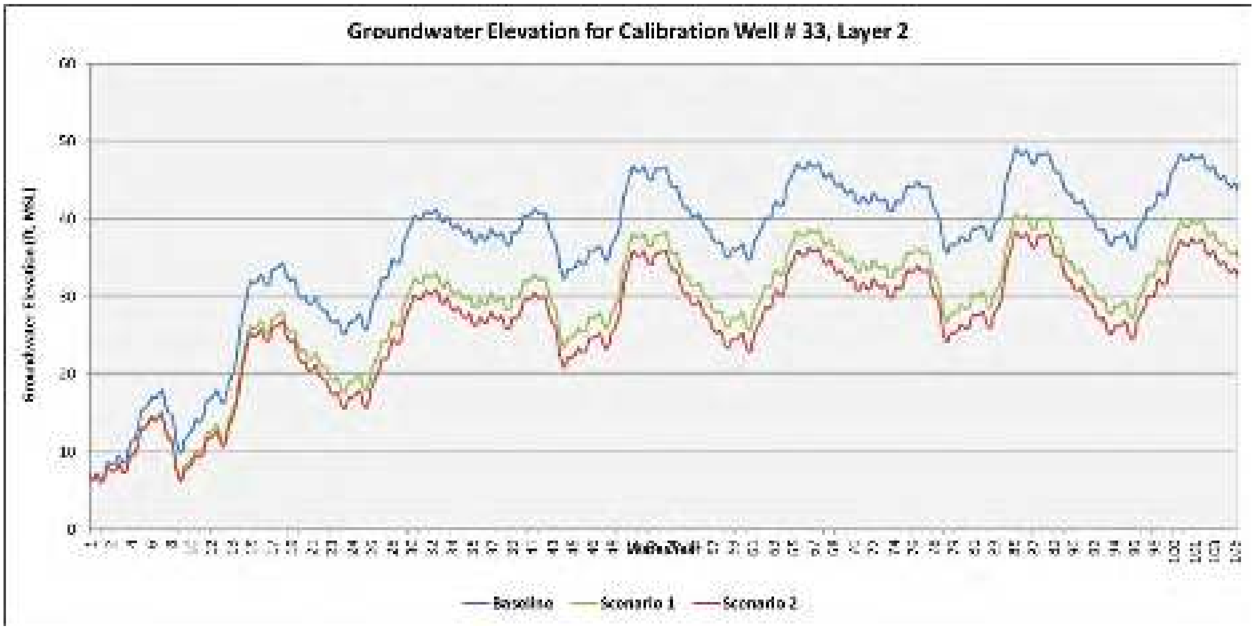

Groundwater Elevation Difference for Calibration Well # 32, Layer 1
Water Year
Sco1 minus Baseline
Sco2 minus Baseline

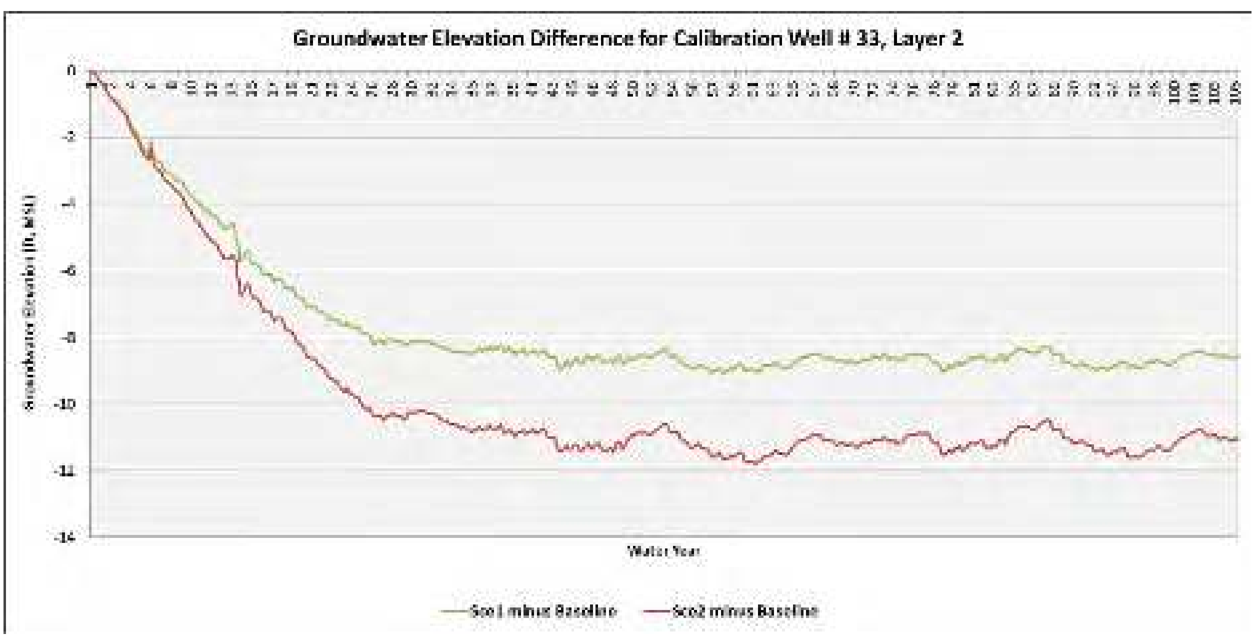

Groundwater Elevation for Calibration Well # 32, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

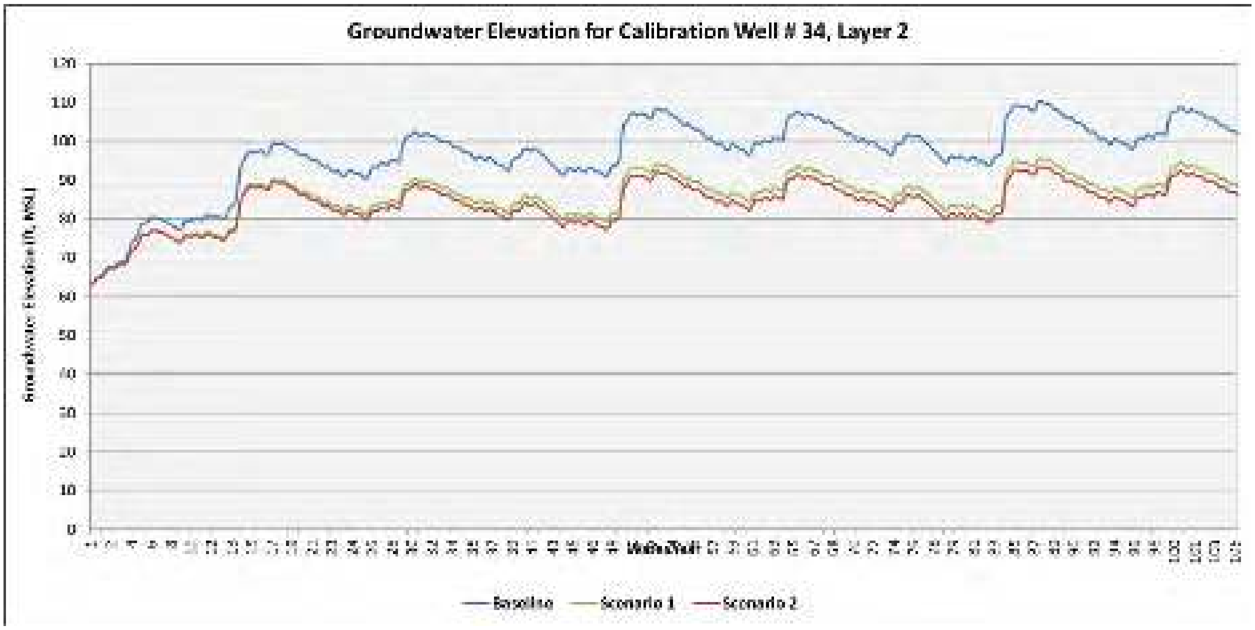

Groundwater Elevation Difference for Calibration Well # 32, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 33, Layer 1
Baseline
Scenario 1
Scenario 2

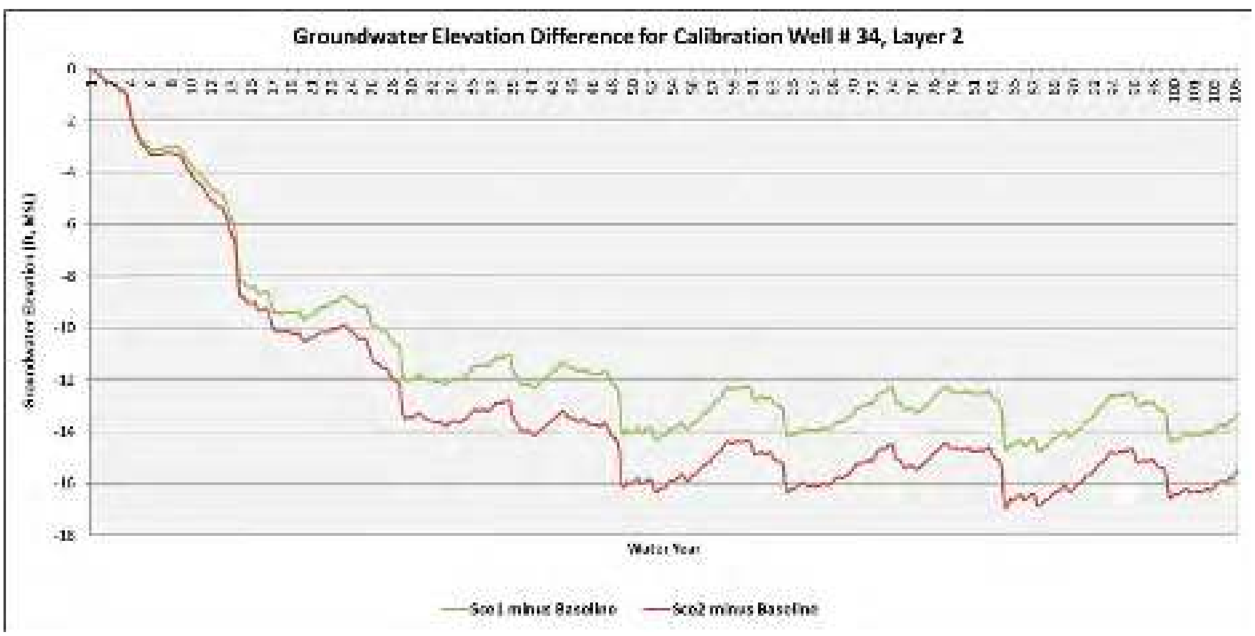

Groundwater Elevation Difference for Calibration Well # 33, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 33, Layer 2
Groundwater Elevation (ft, MSL)
Baseline
Scenario 1
Scenario 2

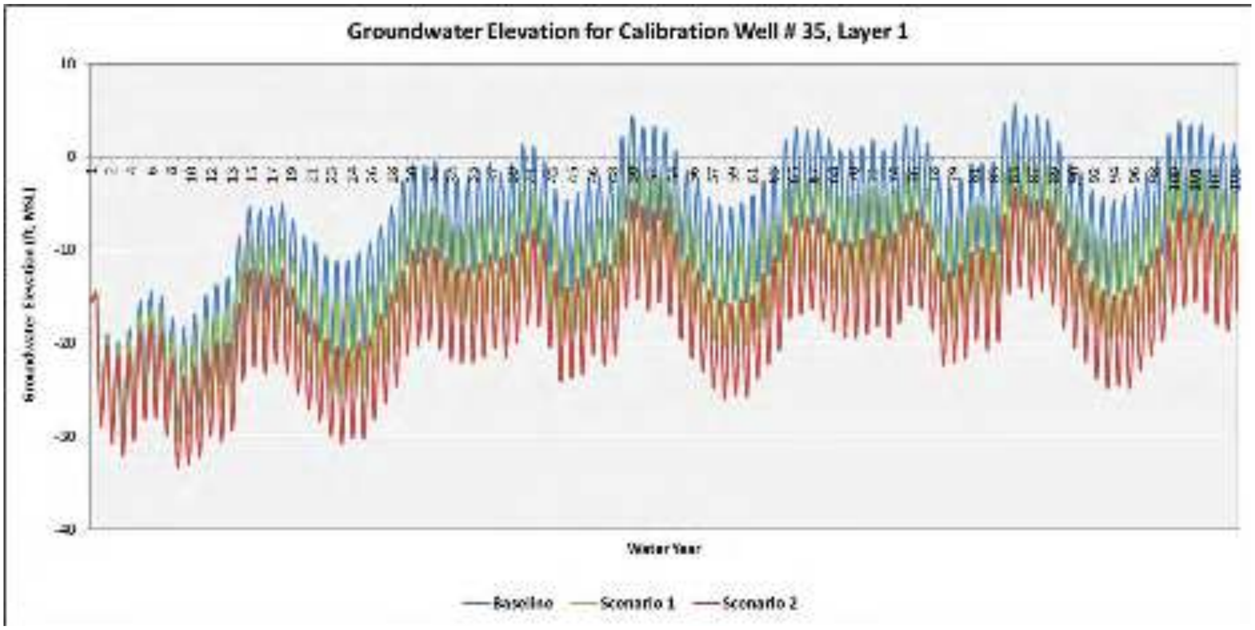

Groundwater Elevation Difference for Calibration Well # 33, Layer 2
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

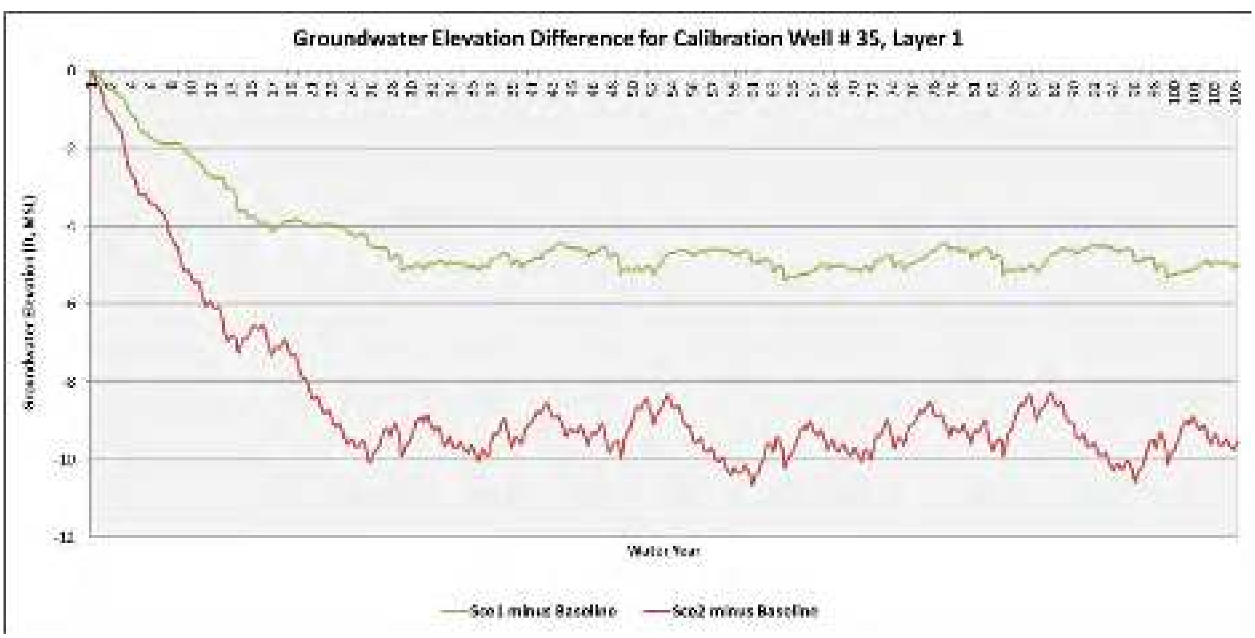


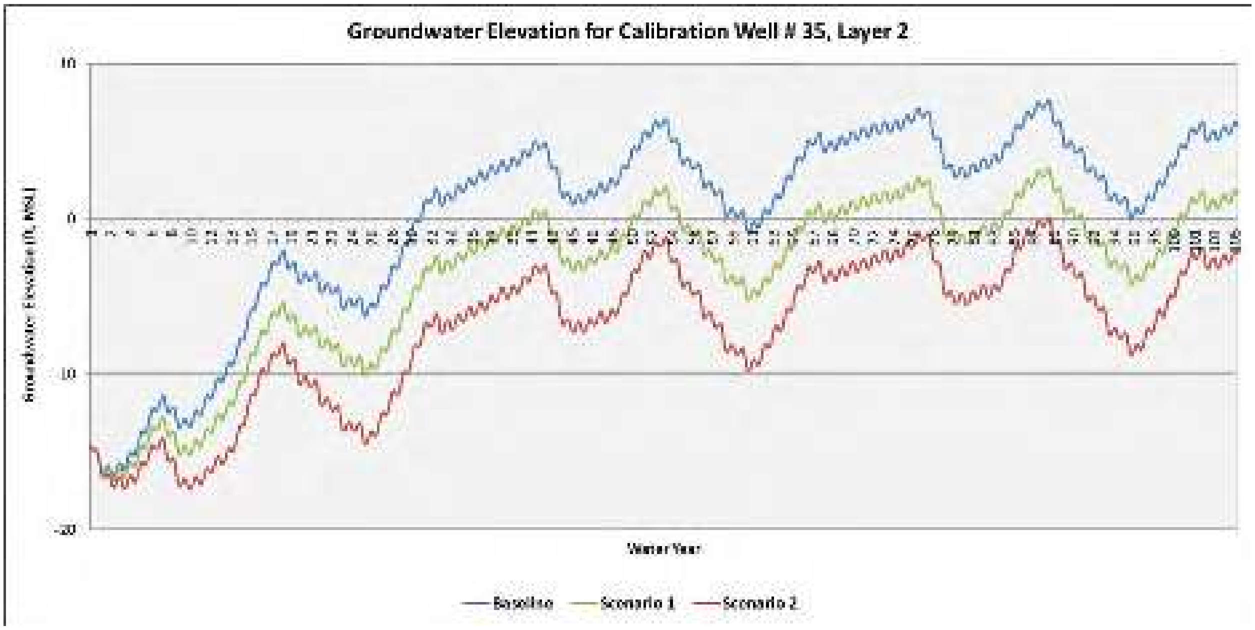
Groundwater Elevation for Calibration Well # 34, Layer 2
Baseline
Scenario 1
Scenario 2

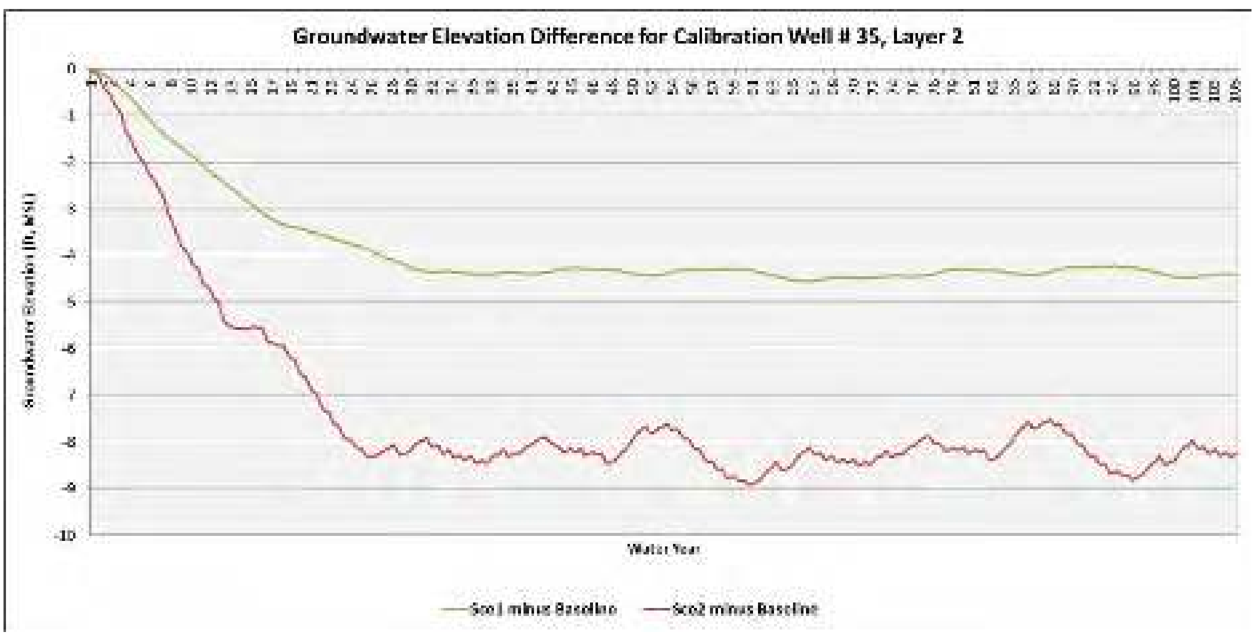


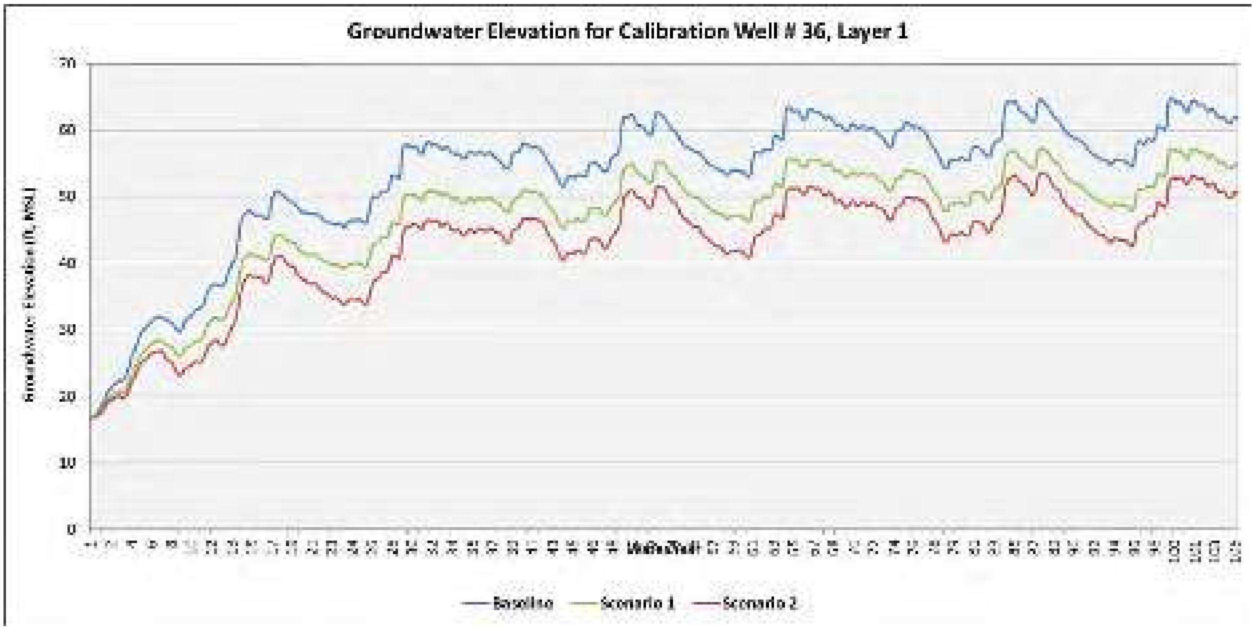
Groundwater Elevation Difference for Calibration Well # 34, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline

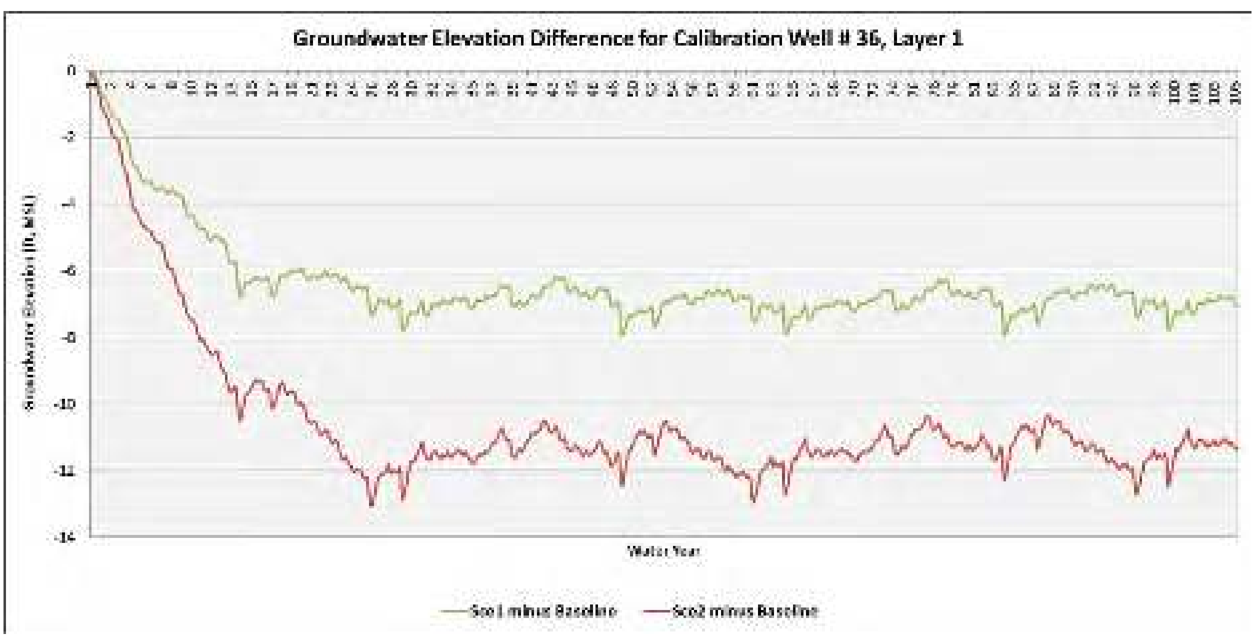

Groundwater Elevation for Calibration Well # 35, Layer 1
Water Year
Baseline
Scenario 1
Scenario 2

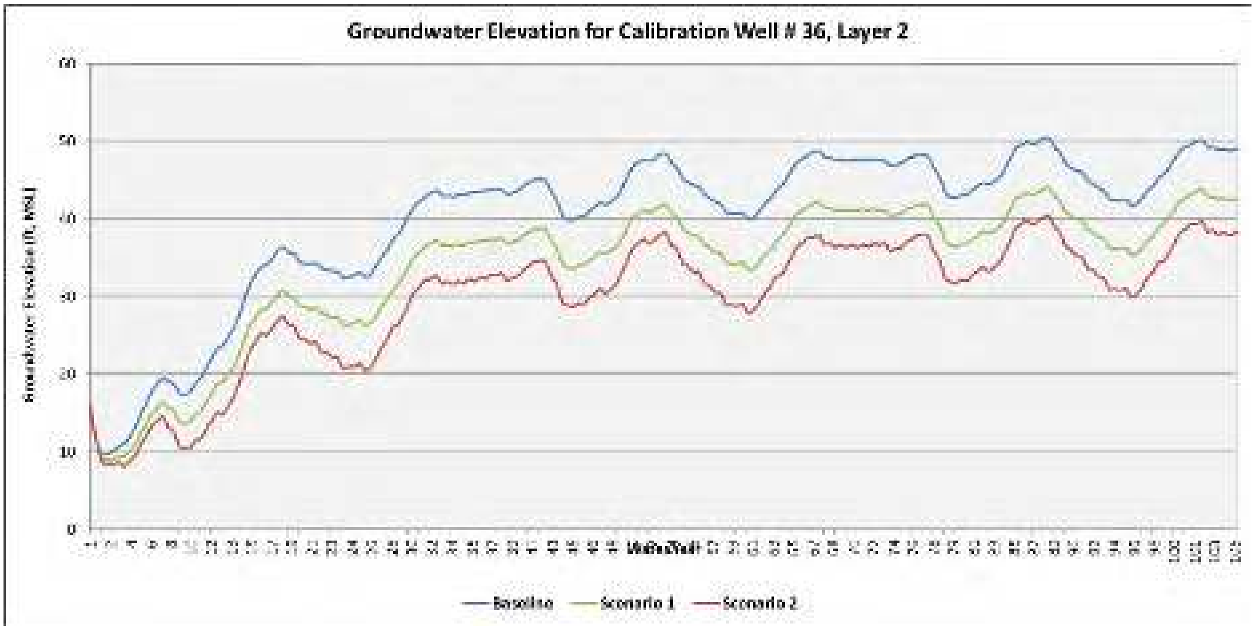

Groundwater Elevation Difference for Calibration Well # 35, Layer 1
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 35, Layer 2
Water Year
Baseline
Scenario 1
Scenario 2

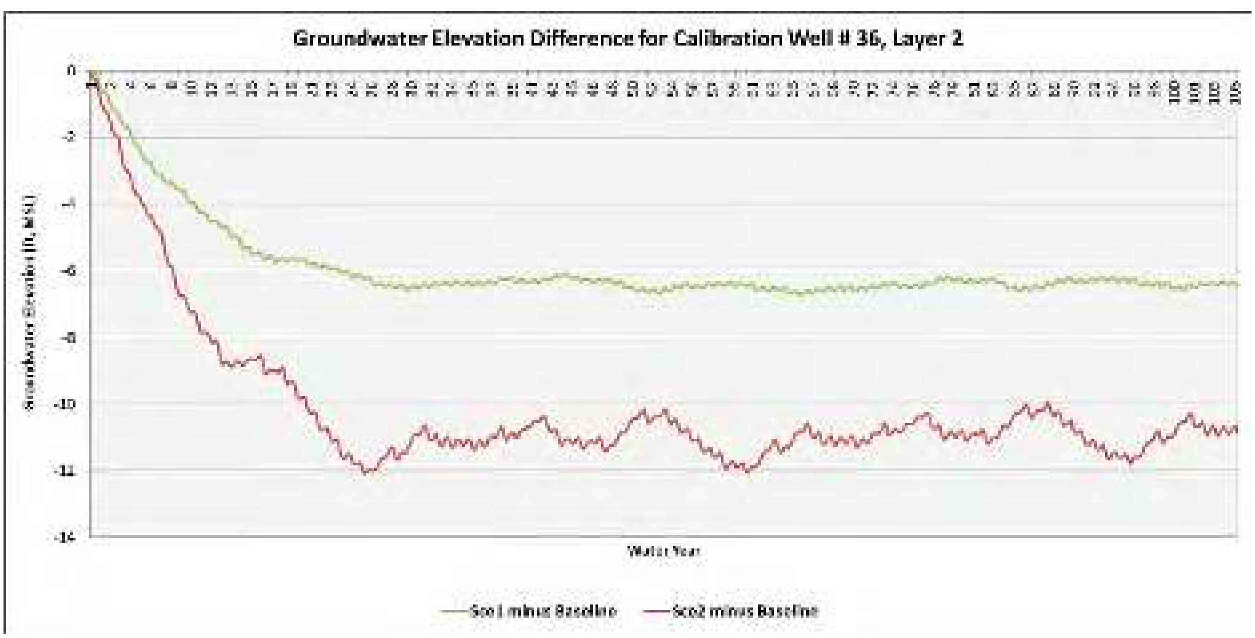

Groundwater Elevation Difference for Calibration Well # 35, Layer 2
Water Year
Sce1 minus Baseline
Sce2 minus Baseline


Groundwater Elevation for Calibration Well # 36, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Baseline
Scenario 1
Scenario 2


Groundwater Elevation Difference for Calibration Well # 36, Layer 1
Groundwater Elevation (ft, MSL)
Water Year
Sce1 minus Baseline
Sce2 minus Baseline



Groundwater Elevation for Calibration Well # 36, Layer 2
Groundwater Elevation (ft, MSL)
60
50
40
30
20
10
0
Water Year
Baseline
Scenario 1
Scenario 2



Groundwater Elevation Difference for Calibration Well # 36, Layer 2
Groundwater Elevation (ft, MSL)
0
-2
-6
-8
-10
-14
Water Year
Sce1 minus Baseline
Sce2 minus Baseline