Appendix 3E

Subsidence Analysis

DWR's InSAR data is used to monitor land subsidence at monthly intervals in the 180/400-Foot Aquifer Subbasin (Subbasin).

An annual land subsidence map is included in each Annual Report. Since each year could contain measurement error, cumulative land subsidence is evaluated relative to the SMC for the Periodic Evaluation. Cumulative land subsidence for just the evaluation period is not available; however, cumulative land subsidence from June 2015 to October 2023 is available, which represents the maximum cumulative subsidence. Since the goal is no land subsidence, this period is used to review land subsidence over the evaluation period, shown on Figure 1. The yellow areas show where land subsidence has been less than 0.1 foot, the subsidence minimum threshold. The red areas show where land subsidence has been between 0.1 and 0.2 foot, which is slightly greater than the minimum threshold. The gray areas are data gaps in the InSAR dataset. There are 3 isolated locations in the Subbasin with apparent maximum cumulative subsidence greater than the minimum threshold of 0.1 foot.

The Land Subsidence minimum threshold is only related to inelastic subsidence due to groundwater elevation decline because elastic subsidence is recoverable and does not result in permanent or long-term impacts. Assessing whether small amounts of subsidence are elastic or inelastic can be difficult, and involves some uncertainty. To assess whether the subsidence is elastic or inelastic, land subsidence and groundwater elevations in all 3 aquifers are compared for the 3 locations where cumulative subsidence was above the minimum threshold. No Deep Aquifers groundwater elevation are available for the southern-most site; however, there is very little groundwater extraction from the Deep Aquifers in this area. Subsidence and groundwater elevation time-series plots are displayed on Figure 2 through Figure 4 going from north to south. These figures plot groundwater levels and subsidence beyond the October 2023 end of the evaluation period to assess whether any recovery of elastic subsidence has occurred. The groundwater elevation monitoring well locations used for this comparison are shown on Figure 1.

These figures show that maximum cumulative subsidence, which ranged from 0.15 to 0.2 foot, was observed in fall 2022. This corresponds to the period when groundwater levels were at their lowest in most wells after 3 consecutive dry water years from 2020 to 2022. After fall 2022, groundwater levels and the land surface rebounded partially, likely due to groundwater level recovery in the wet water year 2023. This suggests that at least part of, if not all of, the subsidence minimum threshold exceedances are due to elastic subsidence, not inelastic subsidence. None of the three locations currently display cumulative subsidence more than the minimum threshold value of 0.1 foot. Since subsidence between 2015 and 2023 is predominantly elastic in all 3 locations, the apparent minimum threshold exceedances in 2022 do not constitute an undesirable result.

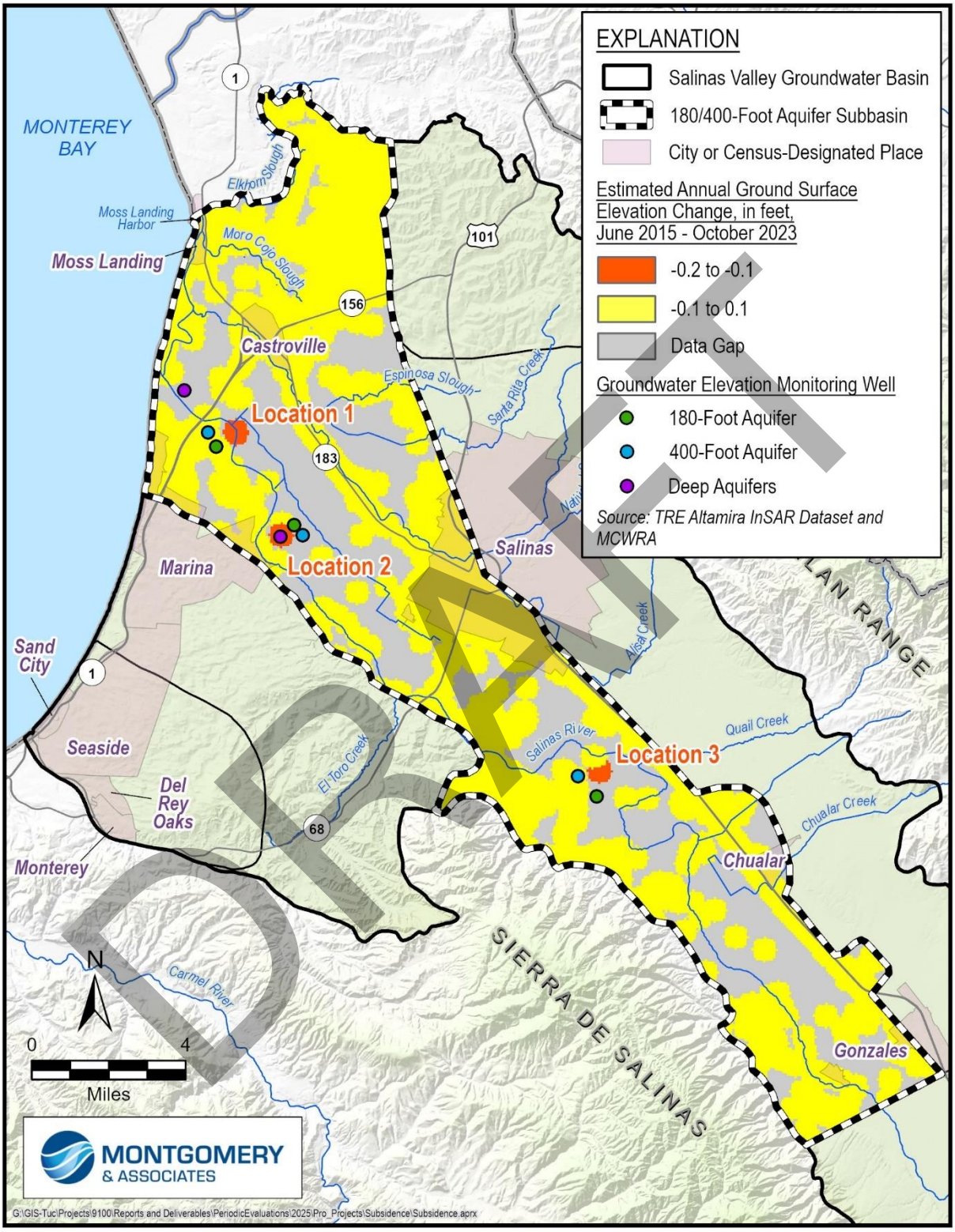

Figure 1. Locations with Cumulative Land Subsidence Greater than 0.1 ft from June 2015 to October 2023 and Nearby Groundwater Elevation Monitoring Wells

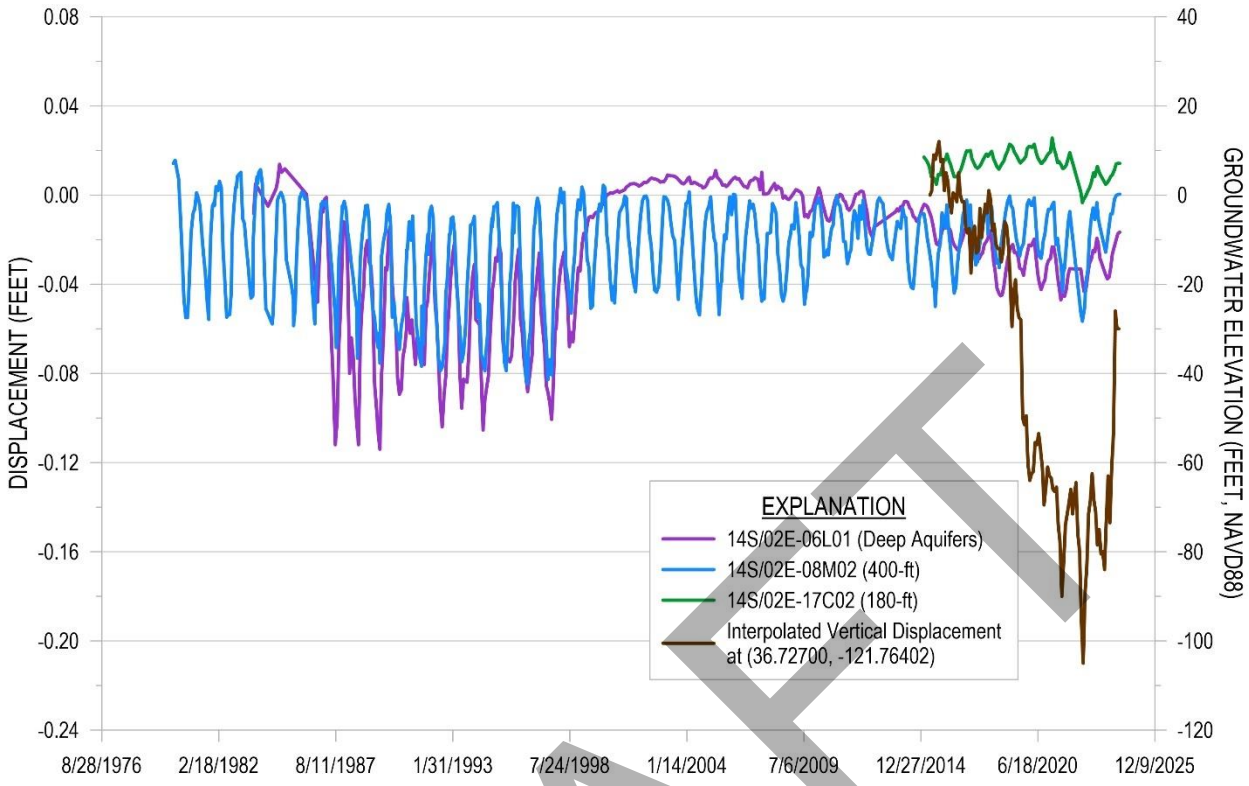

Figure 2. Interpolated Vertical Displacement Compared to Groundwater Elevations in the 180-Foot, 400-Foot, and Deep Aquifers at Location 1

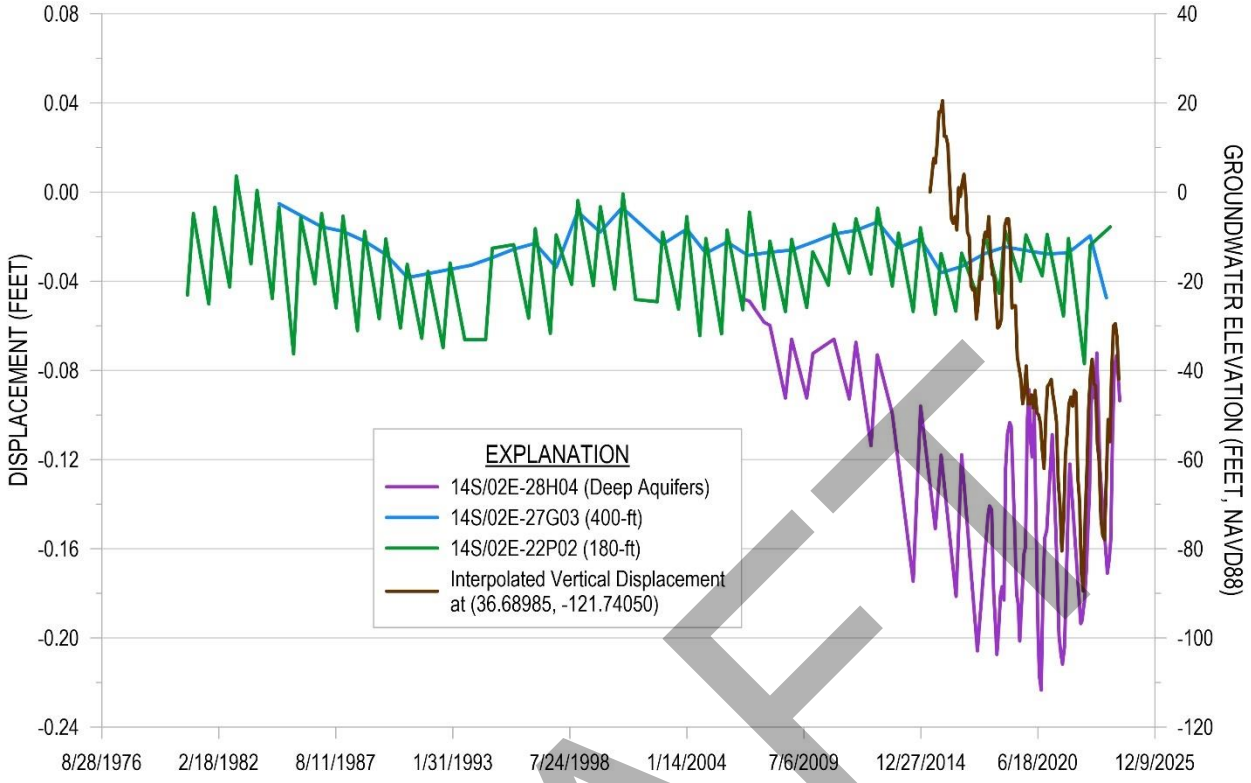

Figure 3. Interpolated Vertical Displacement Compared to Groundwater Elevations in the 180-Foot, 400-Foot, and Deep Aquifers at Location 2

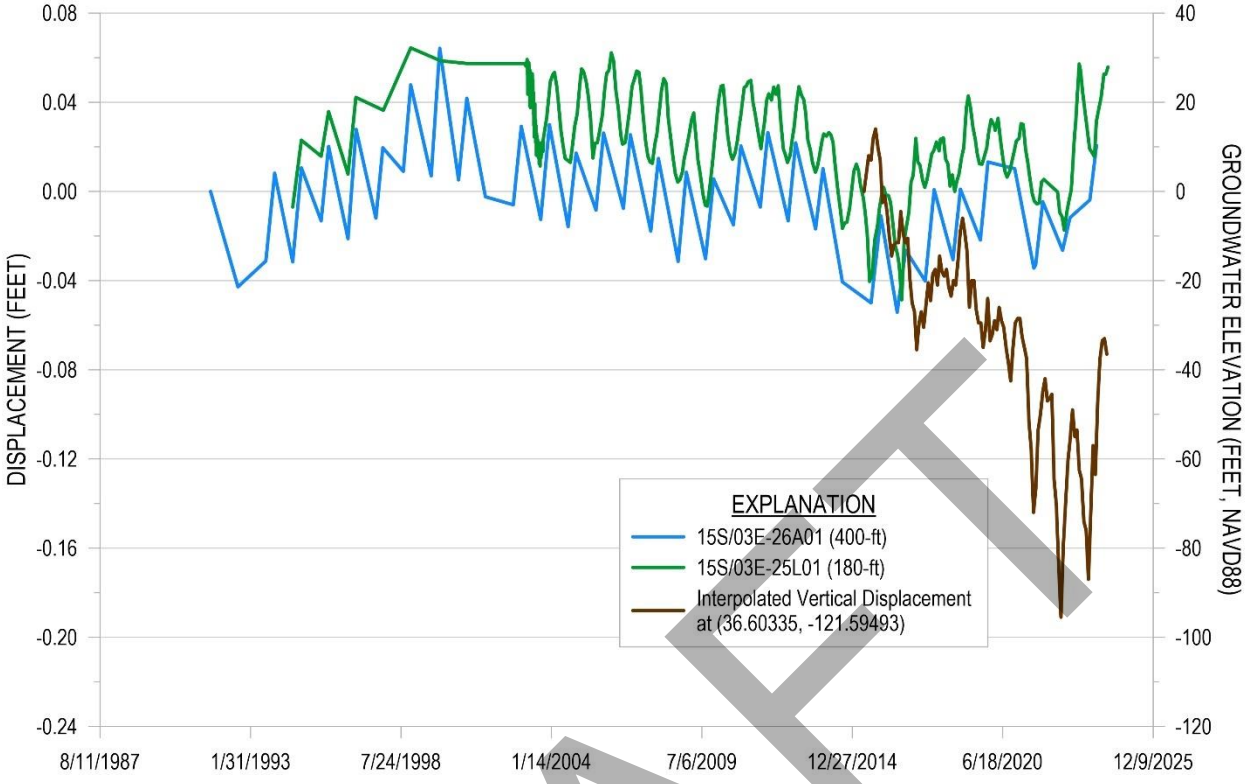

Figure 4. Interpolated Vertical Displacement Compared to Groundwater Elevations in the 180-Foot and 400-Foot Aquifers at Location 3