

## **Attachment 2**

### **Projected Baseline Simulation**

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## INTRODUCTION

To help evaluate and design projects and management actions that address seawater intrusion, Montgomery & Associates (M&A) developed a predictive version of the updated Salinas Valley Seawater Intrusion Model (SWIM) that projects future groundwater conditions if no new projects and management actions are implemented. This simulation is referred to as the Baseline Scenario, and it simulates projected seawater intrusion from Water Year (WY) 2023 through WY 2072. Results from modeling various projects and management actions will be compared to the Baseline Scenario model results.

The Baseline Scenario was initially developed in 2023. It was updated in 2024 and referred to as the SWIM version 2 No Project Scenario (M&A 2023, 2024). The Baseline Scenario presented here is based on the most recent SWIM version 3, which was updated to ensure consistency with the regional Salinas Valley Integrated Hydrologic Model (SVIHM). Additionally, the Baseline Scenario reflects improvements in the predictive version of the SVIHM, known as the Salinas Valley Operations Model (SVOM), which was completed in 2026 (M&A, 2026). The 2026 SVOM updates include the latest land-use information, municipal pumping projections, and revised climate assumptions, which were all incorporated into the Baseline Scenario.

This document describes the assumptions used to develop the SWIM version 3 Baseline Scenario and summarizes the updated model results. The Baseline Scenario will continue to be updated as future model improvements are implemented.

## BASELINE SCENARIO MODEL DEVELOPMENT

The Baseline Scenario projects seawater intrusion in the Salinas Valley if there are no changes to the Valley's current land use, reservoir operations, and climate conditions. The scenario includes increases in urban pumping reflecting anticipated population growth. Baseline Scenario assumptions and inputs were updated to achieve closer alignment with the most recent SVOM. The Baseline Scenario simulates 50 years of monthly stress periods from October 2022 through September 2072.

M&A developed a 50-year climate sequence intended to represent average historical climate conditions. The simulated climate consists of a 25-year sequence of historical climate inputs that are repeated twice. Each 25-year climate sequence first starts with the climate of WY 1993, 2019, and then 1975; these years were selected as proxy years that closely match observed annual precipitation at the King City and Salinas Airport weather stations in WY 2023, 2024, and 2025. The simulated climate from these initial 3 years is followed by the simulated climate of the 22 years of WY 1999 through 2020, for a total of 25 years of climate data.

This climate sequence is not intended to accurately predict any specific future year. Therefore, year-to-year results should be interpreted with caution and multi-year average should be used to evaluate how basin water budgets may respond to future climate conditions. The *Salinas Valley Operational Model Update and Projected Baseline Simulation* Technical Memorandum includes details on the climate sequence selection (M&A, 2026).

Table 1 summarizes the assumptions and approaches for simulating boundary conditions in the Baseline Scenario. Details for each assumption and boundary condition are summarized in the sections following Table 1.

Table 1. Summary of Project Baseline Scenario Boundary Conditions Approach

Assumption or Model Boundary Condition	Approach	Comparison to SVOM
Initial Conditions	Extracted from the final historical SWIM stress period	Extracted from final SVIHM stress period
Land Use	Assumed to be the same as final SVIHM stress period	Same as SVOM
Groundwater Pumping	Extracted from SVOM simulated pumping rates at individual agricultural wells; municipal pumping based on estimated population growth	Municipal pumping same as SVOM input; agricultural pumping derived from SVOM output
Groundwater Recharge	Extracted from SVOM groundwater recharge rates, averaged by Water Balance Subregion	Derived from SVOM output
Riparian Evapotranspiration (ET)	Average by month historical model potential ET rates from WY 2022	Modeled differently from SVOM
Ocean Boundary	Based on published estimates	Same as SVOM input
Pajaro Valley Boundary	Continuation of historical, simulated SVIHM WY 2022 values	Same as SVOM input
Southeastern Boundary	Extracted from SVOM simulated groundwater heads at model boundary, averaged by reach	Derived from SVOM output
Surface Water Flow	Salinas Valley Watershed Model (SVWM) stream inflows matching 25-year historical sequence. Salinas River at Chualar inflows from SVOM corrected for SVIHM/SVOM bias; SRDF diversions from SVOM	Stream inflows same as SVOM input; Salinas River inflows at Chualar derived from SVOM output; SRDF diversions derived from SVOM output

## Initial Conditions

Groundwater elevations and chloride concentrations from the last stress period of the historical SWIM version 3 (the end of September 2022) are imported as initial conditions for the Baseline Scenario.

## Land Use

Land use remains constant, reflecting 2022 patterns. Although it is not simulated directly in the SWIM, land use implemented in the SVOM affects agricultural pumping and recharge, which are transferred to SWIM as discussed below.

## Groundwater Pumping

Well-by-well agricultural groundwater pumping for the Baseline Scenario was extracted from the SVOM output and transferred to SWIM input files. The well locations were updated to add wells that started pumping after WY 2022 and remove wells decommissioned based on available records in Monterey County's Groundwater Extraction Management System (GEMS).

Some amount of groundwater pumping is simulated in the Baseline Scenario to support agriculture in the Castroville Seawater Intrusion Project (CSIP) area. CSIP area pumping comes from 9 CSIP supplemental wells and other private wells. The total groundwater pumping in the CSIP area varied in the Baseline Scenario from 200 to 11,000 acre-feet per water year (AF/WY), depending on the simulated surface water and recycled water deliveries. The simulated average CSIP groundwater pumping in the Baseline Scenario was approximately 4,500 AF/WY.

The non-agricultural groundwater pumping assumptions for the Baseline Scenario are the same as the SVOM. Non-agricultural groundwater pumping for the Baseline Scenario was developed according to the following:

- Future urban pumping rates were developed based on growth estimates from the 2026 Regional Growth Forecast prepared by the Association of Monterey Bay Area Governments (AMBAG) and the average 2020-2023 per capita water use (AMBAG, 2024). For wells designated as urban or industrial in GEMS in locations that have no AMBAG projections, 2020-2023 average monthly extraction rates were applied.
- Rural domestic pumping was carried forward at 2022 rates and locations.
- Injection rates for injection wells in the Seaside Subbasin were developed in coordination with the Seaside Watermaster.

The simulated pumping in the Baseline Scenario does not account for changes in pumping practices in response to continued seawater intrusion. It is possible that pumping might be reduced or moved in response to seawater intrusion. Table 2 shows the average annual pumping rates for WY 2040-2064 of the Baseline Scenario to show a complete 25-year water budget cycle. Figure 5 shows the annual total agricultural and non-agricultural pumping rates for WY 2023-2072.

Table 2. Average Pumping Rates for the Baseline Scenario

	<b>Total Pumping (AF/WY)<sup>1</sup></b>					
	<b>180 400<sup>2</sup></b>	<b>Eastside<sup>2</sup></b>	<b>Langley</b>	<b>Monterey</b>	<b>Seaside<sup>3</sup></b>	<b>Subbasins Total</b>
<i>Average WY 2040-2064 Pumping Rates</i>	78,400	60,600	2,100	10,000	1,500	152,500
<i>Agriculture</i>	69,200	48,500	1,400	400	0	119,300
<i>Water Systems, Industrial Users, and Domestic</i>	9,200	12,200	700	9,600	1,500	33,100

<sup>1</sup> Values are rounded to the nearest hundred.

<sup>2</sup> Portion of these subbasins within the SWIM boundaries

<sup>3</sup> Net pumping including ASR injection

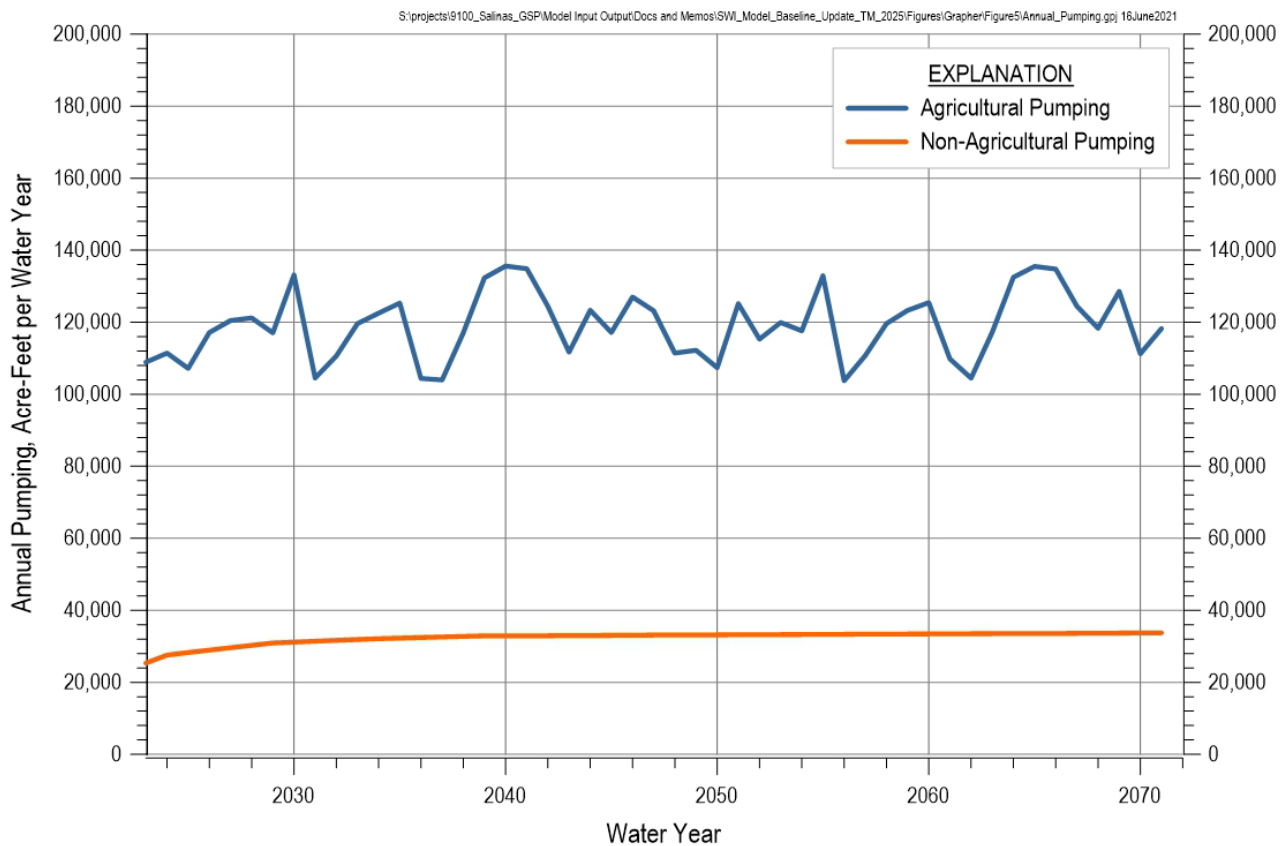


Figure 1. Simulated Annual Pumping

## Groundwater Recharge

Simulated recharge includes recharge from precipitation and recharge from agricultural irrigation return flows. These 2 recharge sources are combined into a single recharge value in SWIM. Monthly recharge rates were extracted from the SVOM output for WY 2023 through 2072 and transferred to SWIM input files. The recharge rates were spatially averaged by SVOM Water

Balance Subregion. Table 3 compares the average annual recharge for WY 2040-2064 in the Baseline Scenario to the historical model to show a complete 25-year water budget cycle. The historical model recharge estimates shown in Table 3 reflect recharge after 1985 and exclude recharge from WY 1998 because it was an anomalously wet year. Figure 2 shows the annual recharge for both the historical and projected model periods.

The recharge rate in the projected baseline is on average 94% of the recharge in the historical model. The projected recharge is similar but not the same as the historical comparison for several reasons. First, the climate sequence was selected based on total precipitation in the entire Salinas Valley, whereas the SWIM only simulates the coastal northern portion of the valley. Second, a slightly drier period was selected as a conservative measure for projected modeling, since an exact match was not possible with a discrete selection of proxy years. Finally, the irrigation return flow component of recharge is slightly lower in the projected baseline because irrigation efficiency increased in the projected model period relative to earlier periods of the historical model. This is a minor component in wet years but more obvious during dry years.

Table 3. Average Recharge by Subbasin

	<i>Total Recharge (AF/WY)<sup>1</sup></i>					
	<b>180 400<sup>2</sup></b>	<b>Eastside<sup>2</sup></b>	<b>Langley</b>	<b>Monterey</b>	<b>Seaside</b>	<b>Subbasins Total</b>
<i>Baseline Scenario (WY 2040-2064 average)</i>	36,800	16,700	6,000	12,600	4,700	76,800
<i>Historical Model (WY 1985-2022 average, excluding WY 1998)</i>	43,500	17,000	5,300	11,800	4,400	82,000

<sup>1</sup> Values are rounded to the nearest hundred.

<sup>2</sup> Portion of these subbasins within the SWIM boundaries

<sup>3</sup> Net pumping including ASR injection

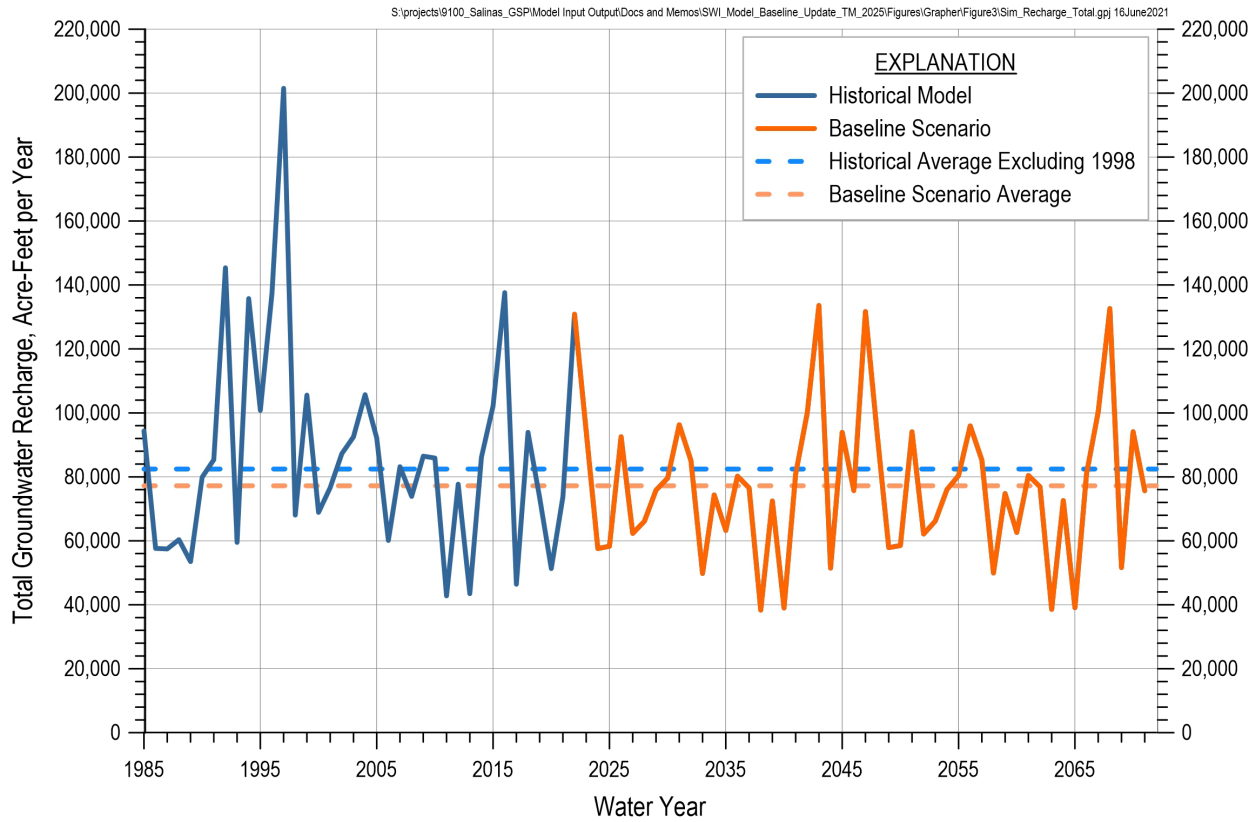


Figure 2. Simulated Annual Recharge

## Riparian Groundwater Evapotranspiration

Evapotranspiration (ET) from riparian areas with a shallow water table is simulated using the MODFLOW evapotranspiration (EVT) package. Actual ET is calculated by the EVT package using potential ET rates that diminish with lower groundwater levels. Generally, only a fraction of the potential ET becomes actual ET. WY 2022 monthly riparian potential ET rates were used as inputs for each year of the Baseline Scenario.

## Ocean Boundary Conditions

The ocean is modeled as a general head boundary (GHB) and is present in cells that represent the aquifer/ocean interface. The GHB reference groundwater levels are calculated as the monthly median sea level from the last 10 years of the historical model period (2013 through 2022) plus projected sea level rise. Sea level was estimated to rise 1.2 feet between 2022 and 2072, based on the intermediate scenario in the *State of California Sea Level Rise Guidance* (California Ocean Protection Council, *et al.*, 2024). The California Ocean Protection Council report estimates sea level rise in decadal increments, relative to a year 2000 baseline, as shown in Table 4. Projected sea level rise was linearly interpolated between decadal increments to get monthly rise and then adjusted by subtracting the approximately 0.2 feet of sea level rise which already occurred by

2022. The resulting projected sea level rise was added to the monthly median sea level, resulting in 1.2 feet of sea level rise between 2022 and 2072. The historical and projected sea level elevations are shown on Figure 3.

Table 4. Adjusted California Ocean Protection Council Intermediate Scenario Sea Level Rise

Year	Simulated Sea Level Rise (feet)
2022	0
2030	+0.1
2040	+0.3
2050	+0.5
2060	+0.8
2070	+1.1
2072	+1.2

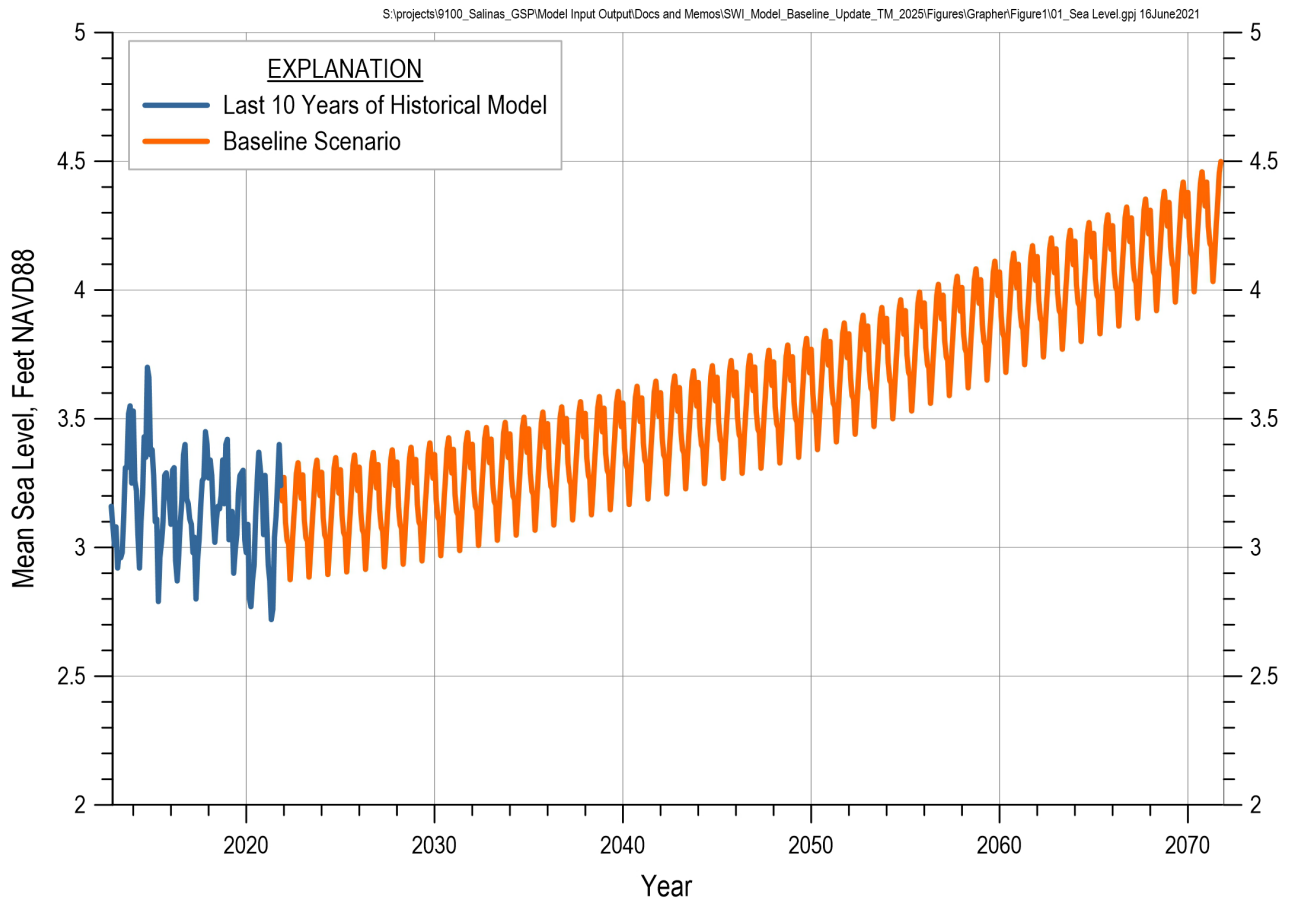


Figure 3. Sea Level for Ocean Boundary Condition

## **Pajaro Valley Boundary Condition**

A portion of the northern model edge represents the boundary with Pajaro Valley near Elkhorn Slough. This boundary is modeled as a GHB. The GHB reference groundwater levels were held constant at 2022 values.

## **Southeastern Boundary Condition**

The southeastern boundary of the model, near the confluence of Chualar Creek and the Salinas River, is modeled with a time dependent constant head (CHD) boundary. The specified heads are assigned in 4 reaches:

1. Pressure Area model layers 2-7
2. Eastside Subbasin model layers 2-6
3. Eastside Subbasin model layer 7
4. Both Pressure Area and Eastside Subbasin model layers 8-10

Transient heads were specified by extracting average simulated groundwater levels from the corresponding model cells of the SVOM and transferring these simulated groundwater levels to SWIM input files. Figure 4 shows the southeastern boundary heads for the Baseline Scenario.

The SVOM simulated heads corresponding to the Eastside Shallow Zone and the Deep Aquifers are higher than heads recently observed in corresponding wells. However, this boundary is far-field and has minimal impact on projected seawater intrusion.

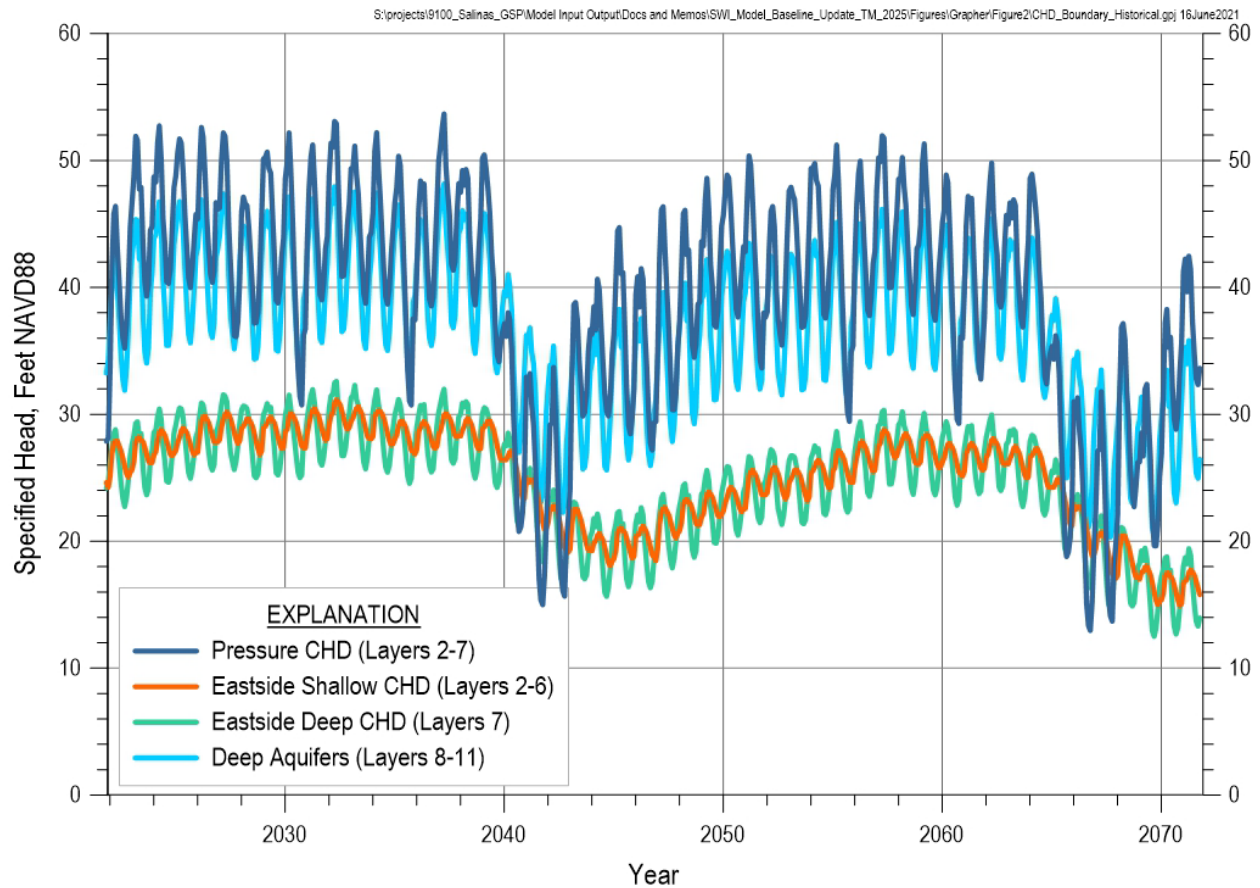


Figure 4. Specified Heads in CHD Along Southeastern Model Boundary Near Chualar

## Surface Water Flows and Diversions

The Salinas River flows at Chualar and the SRDF diversions are extracted from SVOM output and are transferred to SWIM input files for the Baseline Scenario. The Salinas River at Chualar flows are adjusted prior to input into SWIM. In the SVIHM, low flows at the Salinas River at Chualar are somewhat overestimated relative to observations. Exceedance probability analysis was used to adjust the simulated SVOM flows in the Salinas River at Chualar to better match trends in the observed data. Figure 5 shows the monthly simulated Salinas River flows at Chualar for the Baseline Scenario as well as the measured historical monthly flows after 1997.

Extracting Salinas River flows and SRDF diversions from the SVOM is essential because the Salinas River flows at Chualar and SRDF diversions are strongly influenced by reservoir operations. The Surface Water Operations package in the SVOM regulates releases from San Antonio and Nacimiento reservoirs based on MCWRA's existing operating policies and simulates when conditions will be met to operate the SRDF. SRDF diversions are made throughout the duration of the SVOM whenever reservoir storage and streamflow conditions allow from April through October, at a rate up to 36 cubic feet per second.

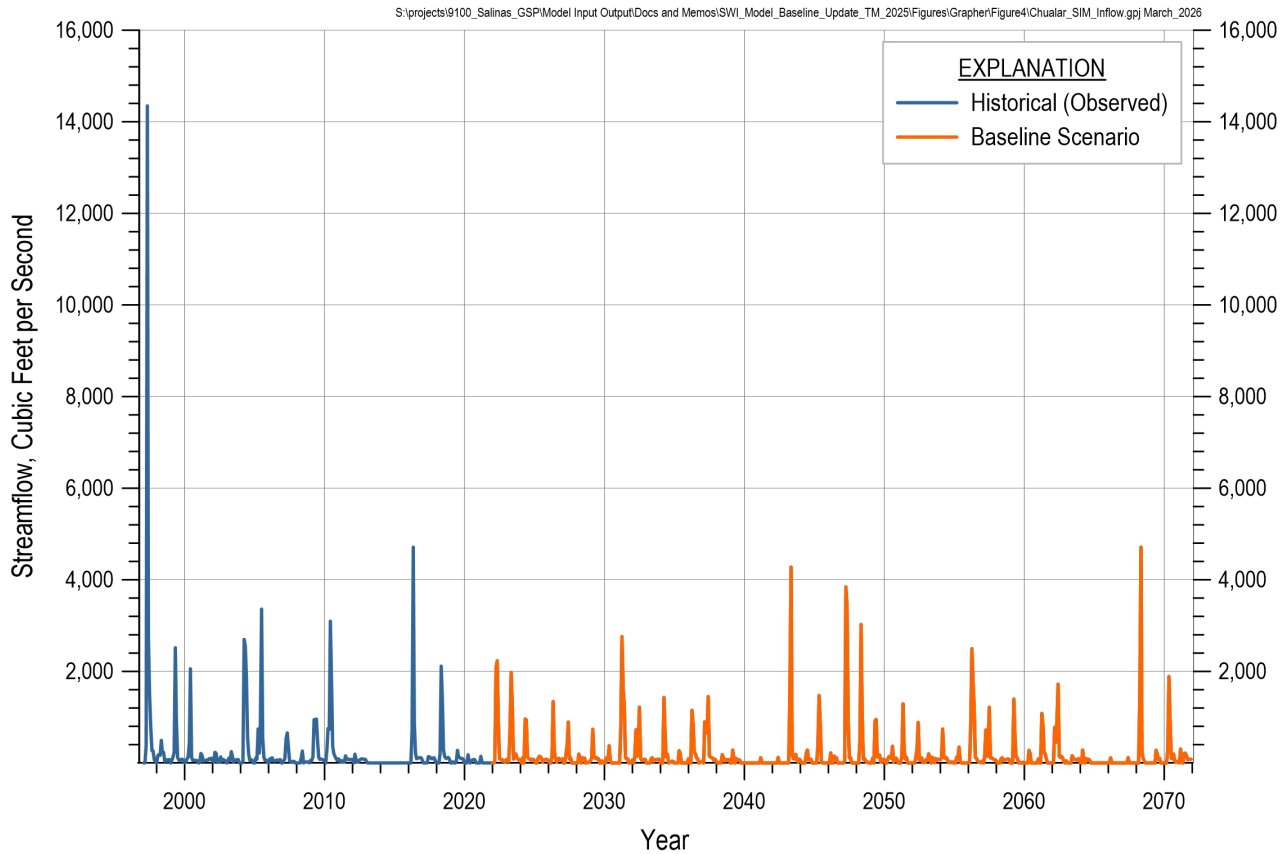


Figure 5. Measured Historical and Simulated Predicted Monthly Salinas River Flow at Chualar

Monthly inflows for streams other than the Salinas River are extracted from water years in the SVOM inputs that correspond to the simulated climate sequence and were originally derived from the Salinas Valley Watershed Model (Hevesi *et al.*, 2025).

## MODEL RESULTS

Model results are assessed by comparing projected groundwater conditions at the end of the 50-year Baseline Scenario simulation to the conditions at the start of the Baseline Scenario simulation. Results are analyzed either at the end of the simulation period (2072) or in 2070, which is the Sustainable Groundwater Management Act’s planning horizon. Results are summarized by model layer, which include the stratigraphic equivalents of the named aquifers in the same model layer.

### Groundwater Levels

Figure 6 and Figure 7 show groundwater level changes between WY 2023 and WY 2072. This represents the groundwater level changes during the 50-year simulation period. Positive values shown in green correspond to water level increases, and negative values shown in red correspond

to water level decreases. The figures show groundwater level changes in the 180-Foot Aquifer (Figure 6) and 400-Foot Aquifer (Figure 7). The 180-Foot Aquifer is represented by the model layer 3 through 5 average head difference. The 400-Foot Aquifer is represented by the head difference in model layer 7.

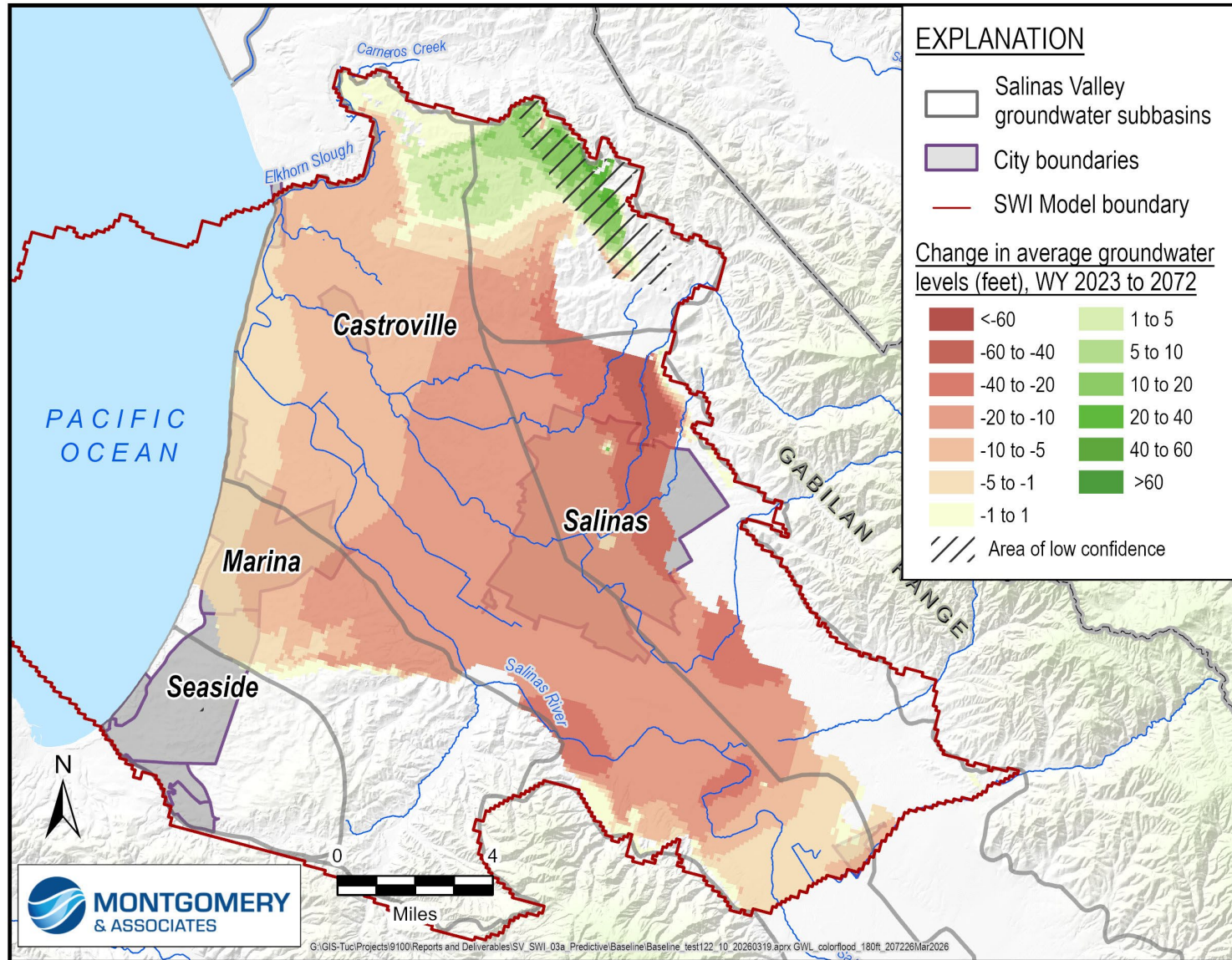


Figure 6. Projected Groundwater Elevation Change Between WY 2023 and 2072 for the 180-Foot and Equivalent Aquifers (Model Layers 3-5)

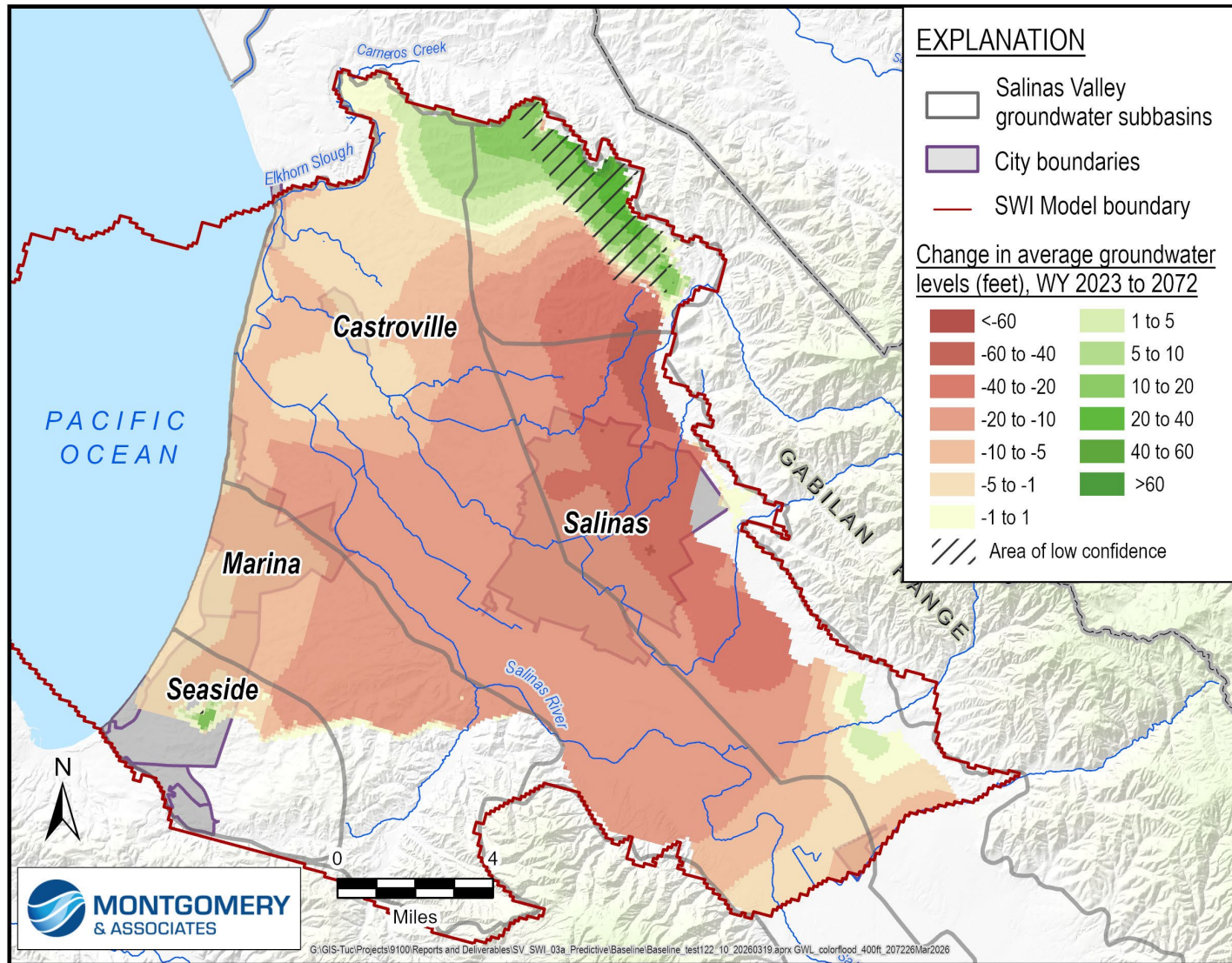


Figure 7. Projected Groundwater Elevation Change Between WY 2023 and 2072 for the 400-Foot and Equivalent Aquifers (Model Layer 7)

The SWIM estimates that over the 50-year simulation, groundwater levels will generally decrease in the Salinas Valley between 5 and 20 feet in the 180-Foot and 400-Foot Aquifers under the Baseline Scenario. In the Eastside Subbasin groundwater levels are projected to decrease by 10 to 60 feet. There is an area with increasing groundwater levels predicted in Granite Ridge area in eastern Langley; however, it is poorly calibrated in the model and the predicted results are likely unreliable in this area.

Figure 8 and Figure 9 show groundwater levels in the 180-Foot and 400-Foot Aquifers in 2070, respectively. The groundwater levels along the coast in both the 180-Foot and 400-Foot Aquifers are more than 5 feet below sea level. Sea level is approximately 3 feet NAVD88, increasing to 4 feet NAVD88 during the simulation period. As observed in current trends, the groundwater gradient is inland toward the depression north and east of the City of Salinas in the Eastside Subbasin. In 2070 the groundwater levels in the inland groundwater depression are up to 100 feet below sea level.

Groundwater levels in the Deep Aquifers are projected to follow similar trends to the 180-Foot and 400-Foot Aquifers. Groundwater levels are projected to decline by 5 to 20 feet over the 50-year period, with greater declines up to 60 feet in the Eastside Subbasin. The groundwater gradient in the Deep Aquifers is also projected to remain directed inland toward the regional depression in the Eastside Subbasin through 2070. The groundwater levels along the coastline in the Deep Aquifers are projected to be approximately 5 to 10 feet below sea level in 2070.

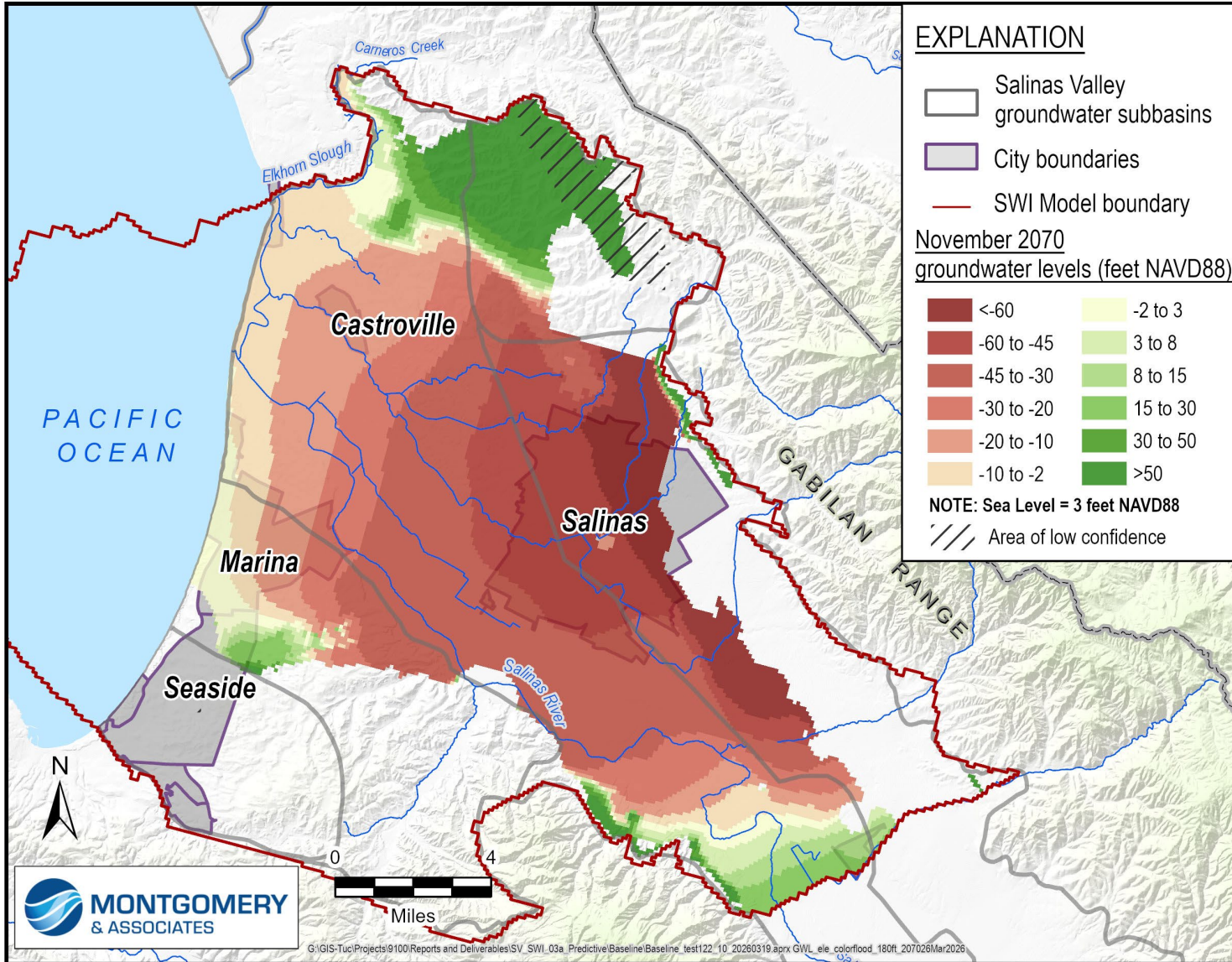


Figure 8. Projected Groundwater Levels November 2070 for the 180-Foot and Equivalent Aquifers (Model Layers 3-5)

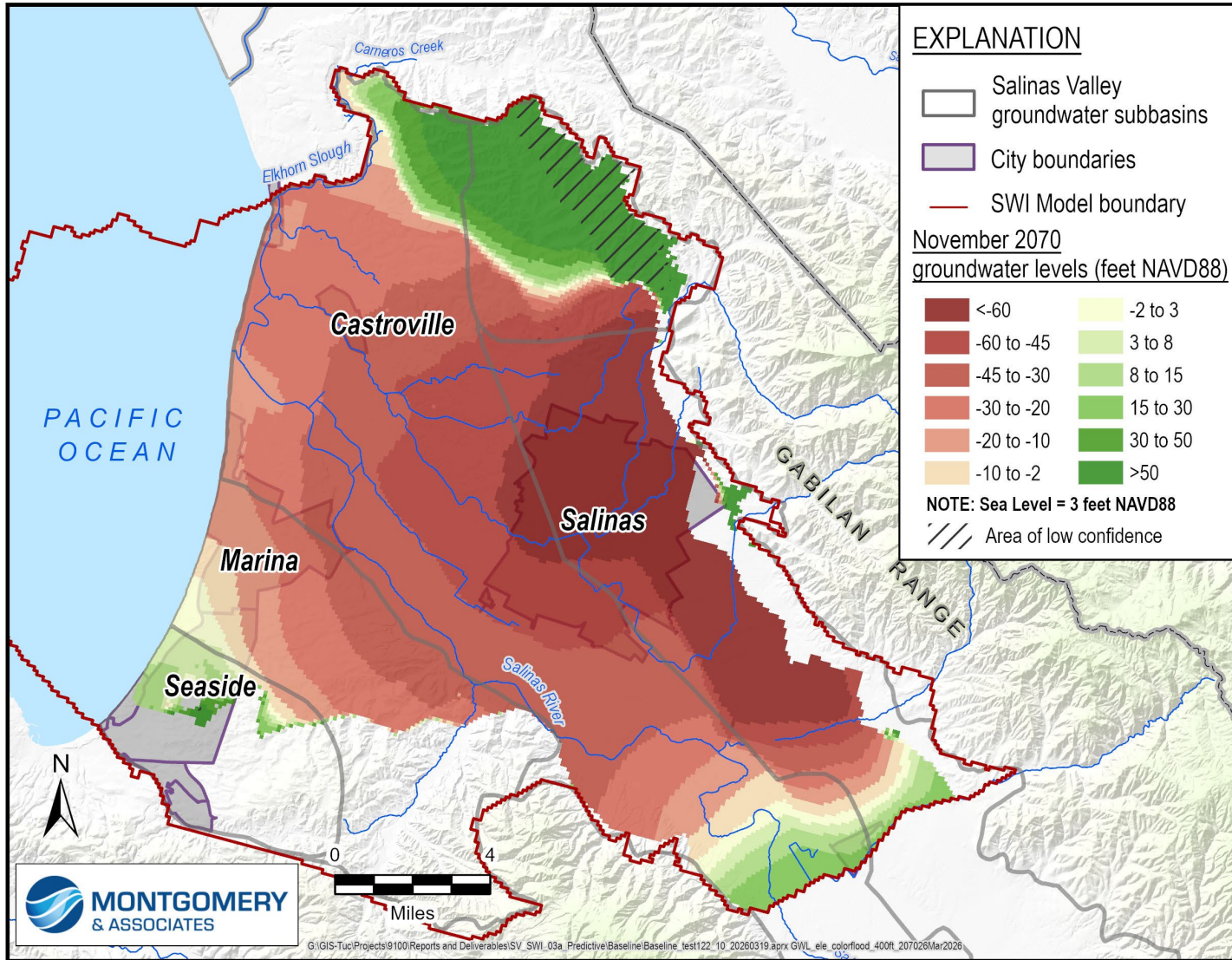


Figure 9. Projected Groundwater Levels November 2070 for the 400-Foot and Equivalent Aquifers (Model Layer 7)

## Chloride Concentrations

The model projects that seawater intrusion in the 180-Foot and 400-Foot Aquifers will steadily advance inland from 2022 through 2072. Seawater intrusion is defined by simulated 500 mg/L chloride contour. The simulated progression of the 500 mg/L contours in the 180-Foot Aquifer for 2030, 2040, 2050, 2060, and 2070 is presented on Figure 10. A map of the chloride concentrations above 100 mg/L in the 180-Foot Aquifer in 2070 is shown on Figure 11. Chloride concentrations in model layer 5 are selected to represent the 180-Foot Aquifer because the lower portion of the aquifer generally exhibits more advanced seawater intrusion. Though the location of the simulated 500 mg/L chloride contour and rate of movement only approximate future groundwater conditions, additional seawater intrusion into the Salinas Valley would be expected under the conditions simulated in the Baseline Scenario.

In the 180-Foot Aquifer, the main lobe of seawater reaches the outskirts of Salinas between 2050 and 2060 and continues advancing in the direction of the observed groundwater depression in the northern portion of Salinas. On the northern side of the 180-Foot Aquifer seawater intrusion front, in the vicinity of Castroville, seawater intrusion is also projected to continue inland. On the southern side of the seawater intrusion front, some additional seawater intrusion is projected east of the City of Marina toward a municipal well partially screened in the lower 180-Foot Aquifer. Little additional seawater intrusion is projected in the southern direction near the City of Marina.

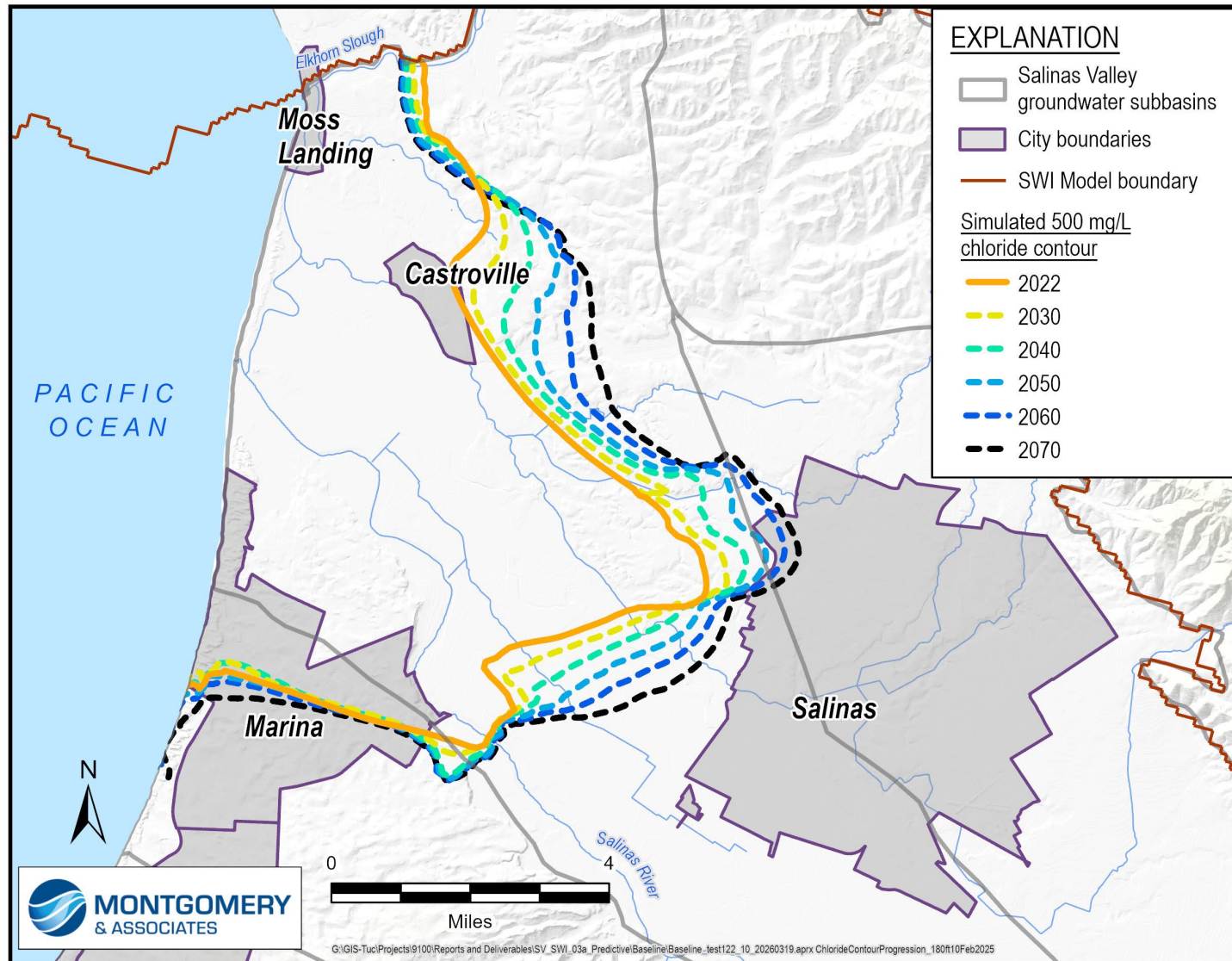


Figure 10. Lower 180-Foot Aquifer (Model Layer 5) Baseline Scenario Simulated 500 mg/L Chloride Concentration Contours in 2022, 2030, 2040, 2050, 2060, and 2070

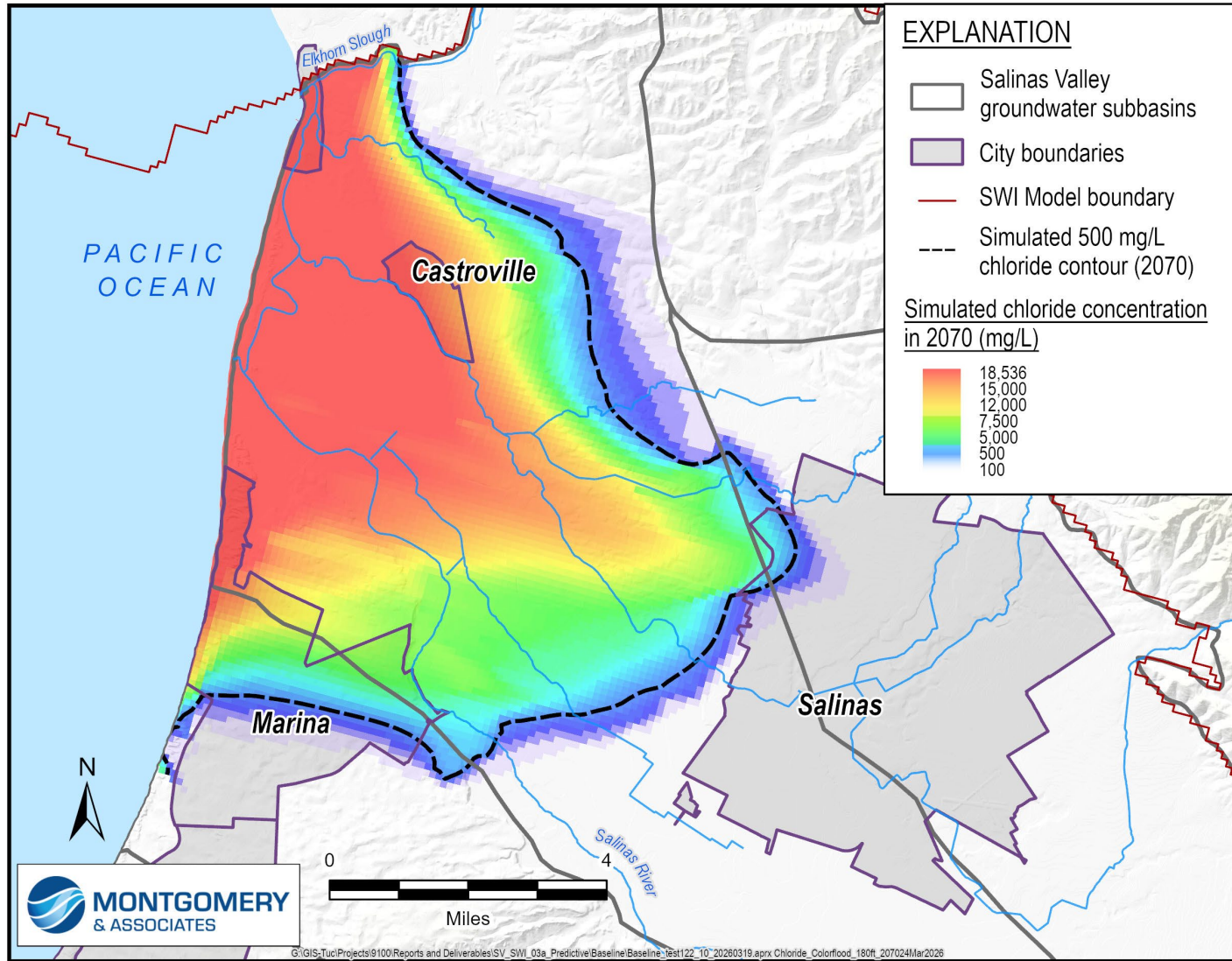


Figure 11. Lower 180-Foot Aquifer (Model Layer 5) Baseline Scenario Simulated Chloride Concentrations in 2070

The progression of the 500 mg/L contour in the 400-Foot Aquifer is presented on Figure 12. A map of the chloride concentrations above 100 mg/L in the 400-Foot Aquifer in 2070 is shown on Figure 13. Chloride concentrations in model layer 7 are shown to represent seawater intrusion in the 400-Foot Aquifer.

In the 400-Foot Aquifer, seawater intrusion advances toward the northern portion of the City of Salinas. The main lobe of seawater advances as far as where the isolated island of seawater was in 2022. Additional seawater islands appear between the advancing front of seawater in the 400-Foot Aquifer and the City of Salinas, and east of the City of Castroville. These islands migrate toward the observed groundwater depression in the northern portion of Salinas over time. The appearance of these seawater islands in the 400-Foot Aquifer is facilitated by downward flow from the 180-Foot Aquifer through groundwater wells screened across both aquifers. These model results demonstrate that seawater could flow from the 180-Foot Aquifer into the 400-Foot Aquifer in the future through cross-screened wells. However, locations of wells screened in multiple aquifers is only estimated in the model. These model results should not be interpreted as an accurate prediction of where new seawater intrusion islands may appear. They highlight the importance of identifying wells screened in multiple aquifers to prevent this as a potential migration pathway in the future.

Seawater intrusion is projected to continue on the northern side of the seawater intrusion front in the 400-Foot Aquifer in the vicinity of Castroville. On the southern side of the seawater intrusion front, additional seawater intrusion is projected east of the City of Marina. Some additional seawater intrusion is projected in the southern direction near the City of Marina. Seawater intrusion in the southern direction near the City of Marina may be hindered by a slight rise in the elevation of the Deep Aquitard; however, the geometry of the 400-Foot Aquifer suggests that there would be little obstruction for up to an additional 1 mile of seawater intrusion in the 400-Foot Aquifer in the southern direction.

The Baseline Scenario does not project additional seawater intrusion into the Deep Aquifers, nor is any intrusion currently observed. Both the historical model and Baseline Scenario simulate concentrations of chloride greater than 500 mg/L in the Deep Aquifers in a limited area along the coast between the City of Castroville and the coastline. The simulated chloride is present from the beginning the historical model and will be addressed in future model updates.

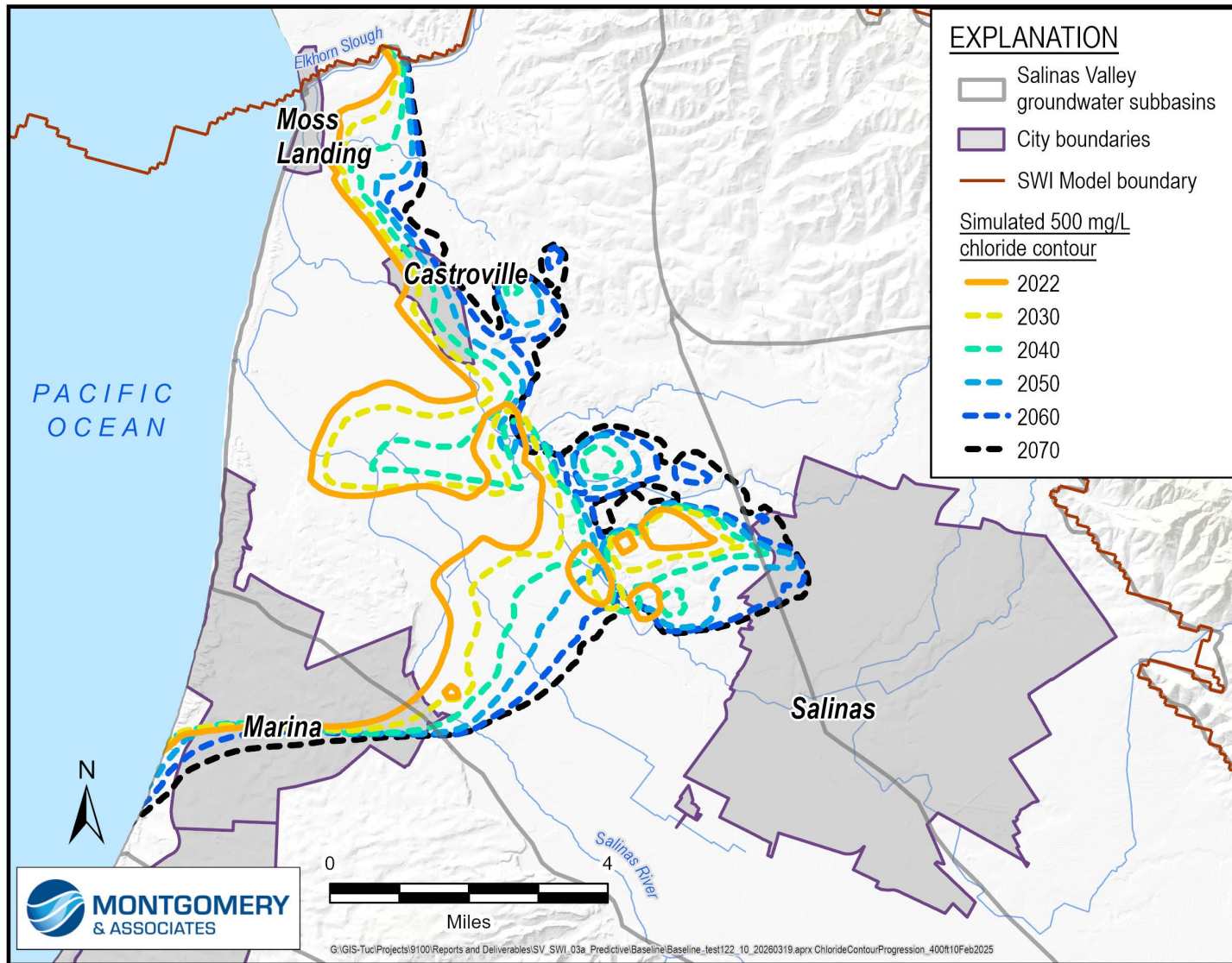


Figure 12. 400-Foot Aquifer (Model Layer 7) Baseline Scenario Simulated 500 mg/L Chloride Concentration Contours in 2022, 2030, 2040, 2050, 2060, and 2070

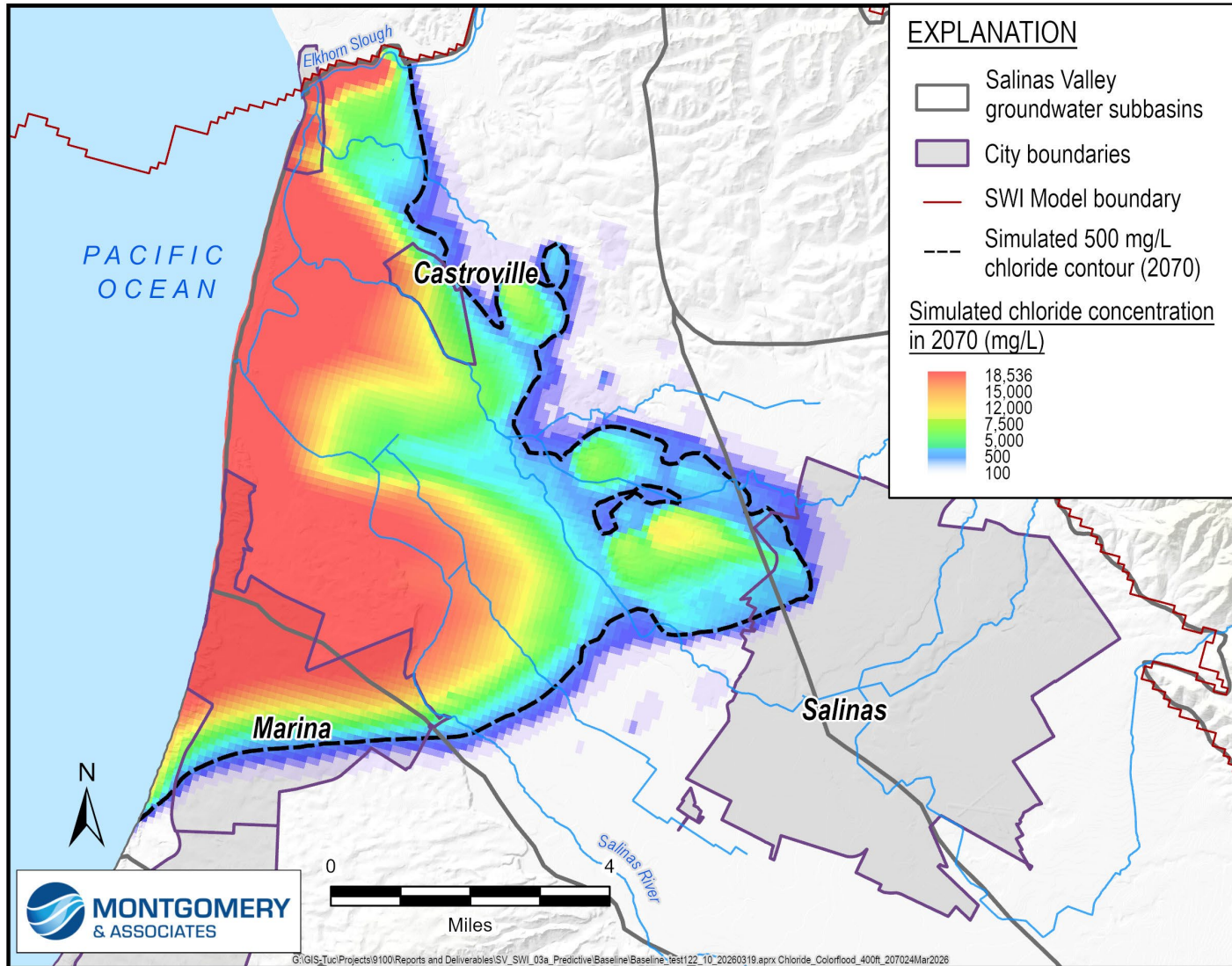


Figure 13. 400-Foot Aquifer (Model Layer 7) Baseline Scenario Simulated Chloride Concentrations in 2070

## Simulated Pumping from Impacted Wells

The Baseline Scenario predicts that by 2070 the seawater intrusion front will advance through an area of mainly agricultural groundwater users and into the City of Salinas. In the Baseline Scenario model, wells impacted by seawater intrusion continue to pump throughout the simulation. No assumptions were made to cease pumping from impacted wells because stopping pumping at these wells would require providing an alternative water supply or changing land use. Future projects simulations could include such scenarios.

Groundwater extracted from agricultural wells was assessed for chloride concentrations exceeding 100 mg/L and 500 mg/L. Figure 14 shows the predicted annual amount of water pumped by wells impacted by seawater intrusion from 2022 to 2072. Figure 15 is a map of the annual extraction of wells impacted by chloride concentrations above 500 mg/L by 2072. By 2072, wells pumping approximately 11,000 AF/yr are projected to be impacted by chloride concentrations exceeding 500 mg/L. Wells pumping approximately 21,000 AF/yr will be impacted by chloride concentrations above 100 mg/L in the Baseline Scenario. The majority of the impacted wells are in the 400-Foot Aquifer.

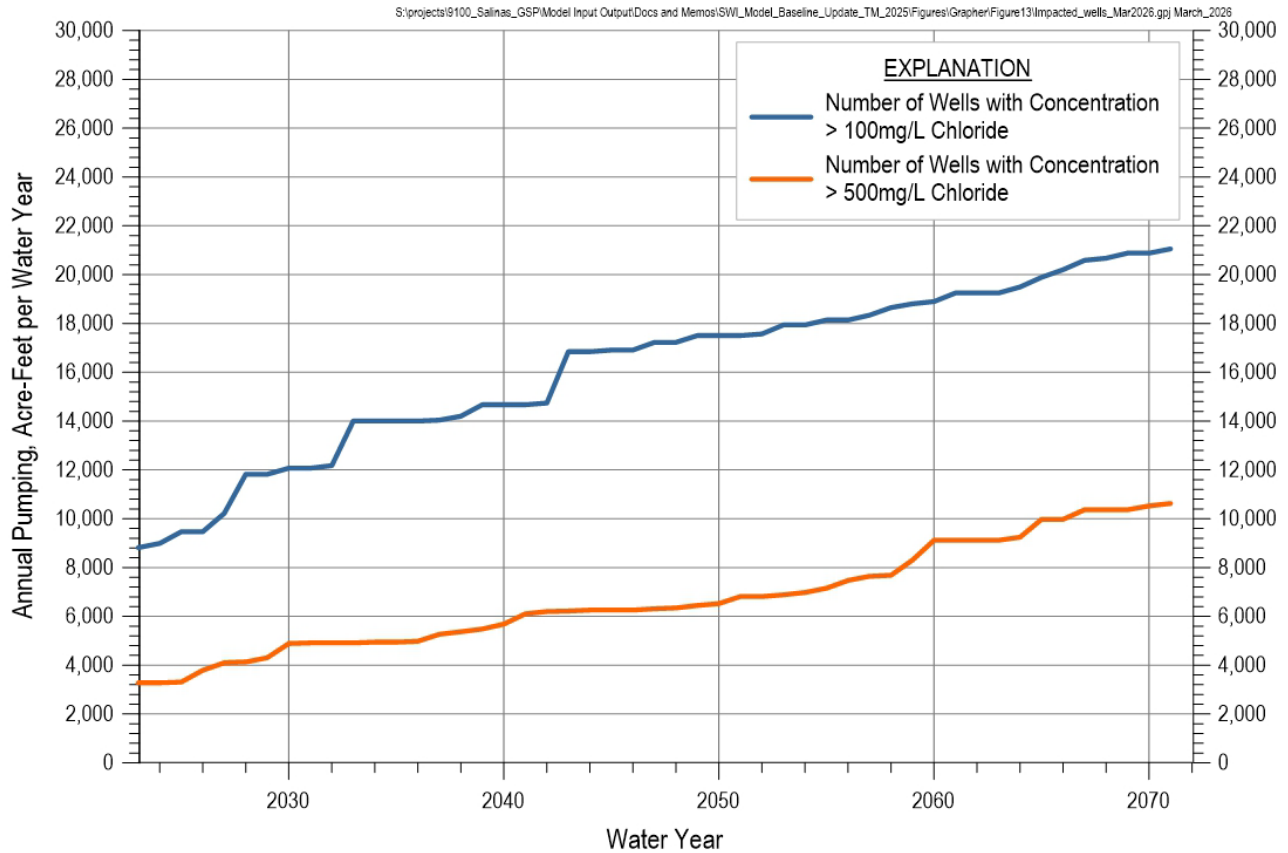


Figure 14. Simulated Groundwater Demand Impacted by Seawater Intruded Wells

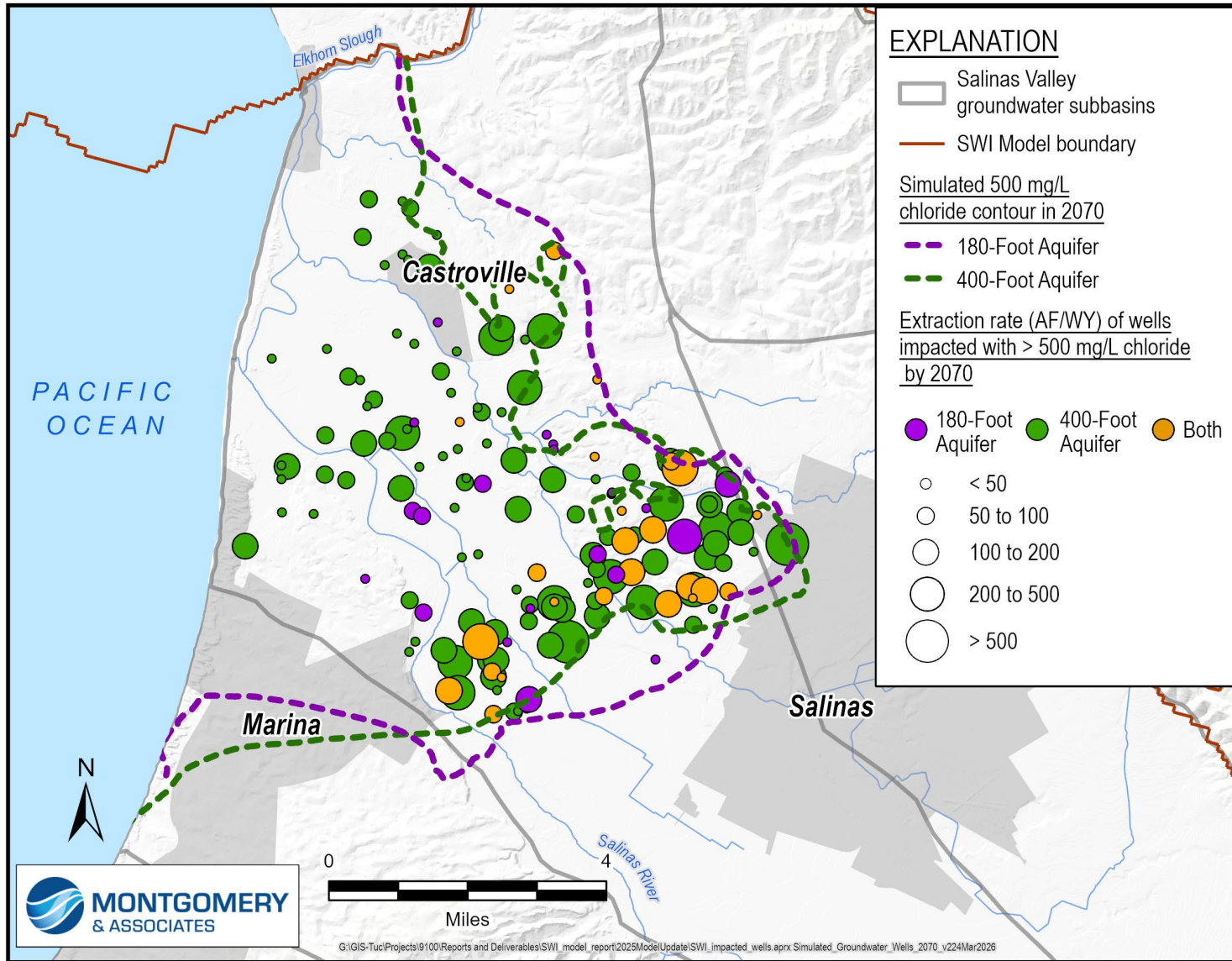


Figure 15. Simulated Groundwater Wells Impacted by Chloride Concentrations Exceeding 500 mg/L by 2072

## CONCLUSION

M&A developed a predictive version of the SWIM that projects 50 years of groundwater conditions in the coastal portion of the Salinas Valley. Future groundwater conditions were simulated with the Baseline Scenario model to serve as a comparative reference for other projects and management actions.

The SWIM Baseline Scenario simulates groundwater conditions that may occur in the Salinas Valley with current land use, reservoir operations, and climate conditions, and increases in urban pumping reflecting anticipated population growth. Climate change was not included in this update; model results represent the impacts of continued groundwater extraction on groundwater conditions independent of potential impacts associated with climate change. Groundwater extraction in the Baseline Scenario reflects likely agricultural pumping needed to meet current cropping patterns and increases to municipal pumping based on AMBAG estimates. Sea level rise was based on published estimates by the California Ocean Protection Council. Other hydrologic conditions such as recharge and streamflows are extracted from SVOM output and transferred to the SWIM input.

The Baseline Scenario projects that groundwater levels will decrease by 5 to 10 feet near the coast and up to 20 feet near the City of Salinas in both the 180-Foot and 400-Foot Aquifers and their stratigraphic equivalents. Groundwater levels are projected to decrease by 10 to 40 feet, up to 60 feet in the Eastside Subbasin north and east of the City of Salinas. Seawater intrusion in the 180-Foot and 400-Foot Aquifers is projected to continue if current groundwater management practices remain in place. Movement of chloride between the aquifers through wells in the results indicate the importance of identifying wells in the path of seawater intrusion that may be screened in both the 180-Foot and 400-Foot Aquifers if they do exist.

The Baseline Scenario will be updated alongside future model improvements. These results demonstrate a baseline against which potential projects and management actions may be compared. The Baseline Scenario may be used for assessing, comparing, and designing projects and management actions that reach groundwater sustainability goals.

## LIMITATIONS

The model simulations reflect professional judgment and represent the best available estimates of potential groundwater conditions. The model's accuracy is affected by simplifying assumptions and data limitations that underpin the model. Given the nature of this initial preliminary feasibility analysis these simplifying assumptions were a necessary step.

In addition to the Baseline Scenario modeling assumptions stated previously, the same assumptions and limitations apply as for the SVIHM and SVOM (M&A, 2025; M&A 2026).

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