



TECHNICAL MEMORANDUM

DATE: March 23, 2026 **PROJECT #:** 9100.94

TO: Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA)

FROM: Hanni Blair

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PROJECT: Salinas Valley Brackish Groundwater Restoration Project

SUBJECT: Seawater Intrusion Modeling Reassessment and Refinement of Preferred Scenario

INTRODUCTION

The Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) is working with Montgomery & Associates (M&A) and Carollo Engineers to evaluate the Salinas Valley Brackish Groundwater Restoration Project (BGRP). The BGRP is designed to achieve the goal of the 180/400-Foot Aquifer Subbasin (180/400 Subbasin) Groundwater Sustainability Plan (GSP) of preventing further seawater intrusion into the 180-Foot and 400-Foot Aquifers and drawing existing seawater intrusion back toward the coast. Previous groundwater modeling results selected a preferred BGRP scenario designed to meet the seawater intrusion minimum threshold requirement. The minimum threshold in the 180/400 Subbasin is the 2017 extent of the 500 mg/L chloride concentration contours as mapped by Monterey County Water Resources Agency (MCWRA) in both the 180-Foot and 400-Foot Aquifers (SVBGSA, 2022).

Montgomery & Associates (M&A) conducted groundwater modeling of the preferred BGRP scenario using the updated Salinas Valley Seawater Intrusion Model (SWIM) version 3 (M&A, 2026a). Previous groundwater modeling of the BGRP scenarios used SWIM version 2. The current modeling reassessed and refined the BGRP preferred scenario's ability to meet the 180/400 Subbasin's seawater intrusion sustainability goals.

MODEL SETUP

The SWIM is a variable density regional groundwater flow and solute transport model that includes the ability to simulate chloride concentration changes (M&A, 2023, 2024, 2025a). It is calibrated to historical groundwater levels and the historical rate and direction of seawater intrusion, based largely on the 500 milligrams per liter (mg/L) chloride contours developed by

MCWRA. The SWIM simulates groundwater conditions on a regional scale and may not reflect specific conditions in any specific location.

The predictive version of the SWIM estimates future groundwater conditions if no new projects and management actions are implemented (M&A, 2026a). This simulation is referred to as the Baseline Scenario. It simulates potential seawater intrusion from water year (WY) 2023 through WY 2072. The effectiveness of the preferred BGRP scenario was assessed by comparing the projected 500 mg/L chloride contour in 2040 to the results from the Baseline Scenario and to the seawater intrusion minimum threshold.

The preferred BGRP scenario was formerly referred to as the Injection Only project scenario. M&A simulated the preferred BGRP scenario by modifying the predictive version of the SWIM, version 3. The project scenario simulation modified the Baseline Scenario by adding extraction and injection wells in the 180-Foot and 400-Foot Aquifers.

Baseline Scenario Assumptions

The Baseline Scenario included the following assumptions:

- Water inflows and outflows such as precipitation, potential evapotranspiration, and stream inflows along the valley margins were derived from a historical 25-year climate cycle. This 25-year climate cycle was selected to be representative of recent historical climate.
- Land use remained constant. The land use in the Salinas Valley Operations Model (SVOM) is identical to the 2022 land use used in the SVIHM.
- Agricultural pumping rates and irrigation return flows to groundwater were estimated by the SVOM and copied into the SWIM.
- Groundwater recharge from precipitation was estimated by the SVOM and copied into the SWIM.
- Salinas River inflows at Chualar were estimated by the SVOM and copied into the SWIM. These river inflows include projected reservoir operations.
- Municipal pumping was based on Association of Monterey Bay Area Governments (AMBAG) population estimates and growth projections.
- 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).

For a detailed summary of the SWIM Baseline Scenario, see Attachment 2 of the 2025 Seawater Intrusion Model Updates (Addendum 3 to the Salinas Valley Seawater Intrusion Model Report)

(M&A, 2026a). For a detailed summary of the SVOM Baseline, see the Salinas Valley Operational Model Update and Projected Baseline Simulation Technical Memorandum (M&A, 2026b).

Preferred BGRP Scenario Assumptions

M&A assumed the project extraction barrier and injection wells are installed by October 2035 and operate continuously from WY 2036 through WY 2072. The other modeling assumptions for the preferred BGRP scenario are the same as the Injection Only project scenario presented in the *Brackish Groundwater Restoration Project Scenario Modeling Results Technical Memorandum* (M&A, 2025b), with minor modifications noted in the following sections.

Extraction Barrier Wells

The simulated extraction barrier consists of a line of wells that extract at rates sufficient to create a continuous groundwater depression along or near the coast, thereby preventing the advance of seawater inland past the wells. The number, location, and pumping rates of the extraction barrier wells were not modified. The extraction barrier wells are assumed to operate at a constant rate. Pumping rates for the 10 extraction barrier wells in the 180-Foot Aquifer range from 1,700 gallons per minute (gpm) to 2,100 gpm. Pumping rates for the 10 extraction barrier wells in the in the 400-Foot Aquifer range from 1,200 gpm to 2,100 gpm. The total annual extraction rate is 67,000 acre-feet per year (AF/yr). Table 1 summarizes the extraction barrier well assumptions. The extraction barrier well locations in the 180-Foot Aquifer are shown on Figure 1. The extraction barrier well locations in the 400-Foot Aquifer are shown on Figure 2.

Table 1. Brackish Groundwater Restoration Project Extraction Summary

Scenario Name	No. Extraction Barrier Wells			Total Extraction (AF/yr)		
	180-Foot Aquifer	400-Foot Aquifer	Total	180-Foot Aquifer	400-Foot Aquifer	Total
Preferred BGRP Scenario	10	10	20	36,300	30,700	67,000

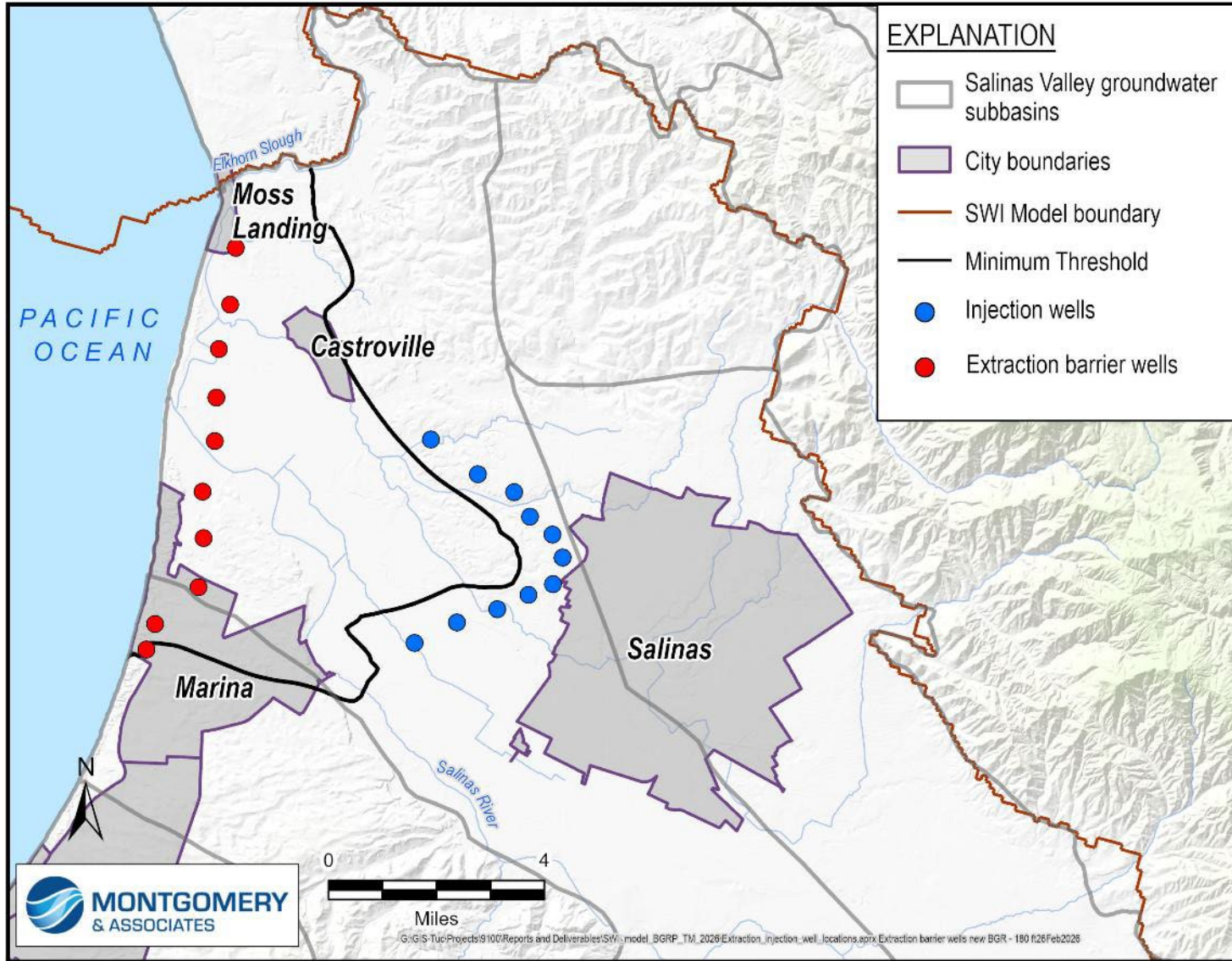


Figure 1. Extraction Barrier and Injection Well Locations in the 180-Foot Aquifer

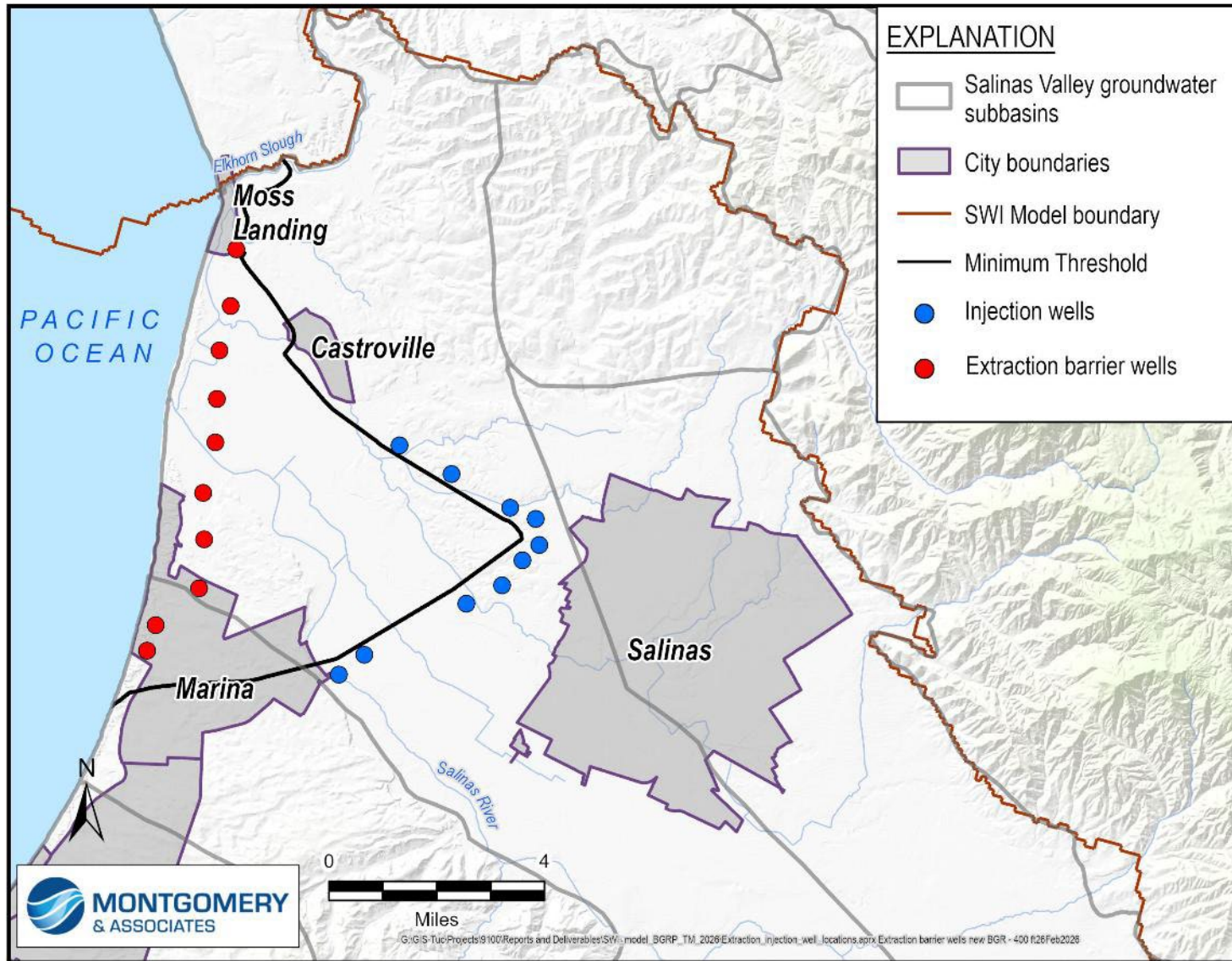


Figure 2. Extraction Barrier and Injection Well Locations in the 400-Foot Aquifer

Injection Wells

Injection wells help reverse progress of the existing seawater intrusion and make use of treated water from the extraction barrier wells. Injection wells are placed to aid in halting and reversing the 500 mg/L contour by building a groundwater mound. Injection wells are placed near the projected 2035 500 mg/L chloride contour to increase their impact on the seawater intrusion front when the project comes online in 2035. The injection well locations were updated from the previous Injection Only scenario to account for the project starting in 2035 instead of 2030, and to account for slight differences in the shape of the projected 500 mg/L contour in the SWIM v3. Injection well locations in the 180-Foot Aquifer are shown on Figure 1 and injection well locations in the 400-Foot Aquifer are shown on Figure 2. The number of injection wells was modified to better contain the seawater intrusion plume in the 400-Foot Aquifer. There are 10 injection wells in the 400-Foot Aquifer and 11 injection wells in the 180-Foot Aquifer.

Assuming a 70% recovery rate from the reverse osmosis (RO) treatment plant, the total injection volume is 46,900 AF/yr. The total injection volume is divided among the 21 individual injection wells. More water is injected into the 180-Foot Aquifer than in the 400-Foot Aquifer because of the higher aquifer transmissivity in the 180-Foot Aquifer. In this model update, the proportion of water injected into the 400-Foot Aquifer was increased slightly to gain more control over the seawater intrusion in the 400-Foot Aquifer. The injection rates in the 180-Foot Aquifer injection wells were a constant 1,300 gpm; the injection rates in the 400-Foot Aquifer injection wells were a constant 1,000 gpm. The number of injection wells and annual rates of injection are summarized in Table 2.

Table 2. Brackish Groundwater Restoration Project Injection Summary

Scenario Name	Treated Water Available Assuming 70% RO (AF/yr)	No. Injection Wells			Total Injection (AF/yr)			Water Delivered to Groundwater Users/ Pumping Offset (AF/yr)
		180-Foot Aquifer	400-Foot Aquifer	Total	180-Foot Aquifer	400-Foot Aquifer	Total	
Preferred BGRP Scenario	46,900	11	10	21	27,300	19,600	46,900	0

MODEL RESULTS

The following sections summarize the updated modeling results of the preferred BGRP scenario. BGRP scenario models are evaluated based on the following criteria:

1. Location of the 500 mg/L chloride contour in 2040 and 2070 compared to:

- a. The 2017 simulated 500 mg/L chloride contour (GSP seawater intrusion minimum threshold)
 - b. The Baseline Scenario simulated 500 mg/L chloride contour
2. Change in the spatial distribution of chloride within the seawater intruded area, showing the extent and location of the high salinity areas
 3. Change in average groundwater levels from the beginning of the simulation to 2040
 4. Change in the area impacted by chloride concentrations greater than 500 mg/L to the east of the extraction barrier
 5. Change in the mass of chloride within the seawater intruded area east of the extraction barrier

Model layers 3 through 5 represent the 180-Foot Aquifer in the 180/400 Subbasin and the Eastside Shallow Zone in the Eastside Subbasin. Figures showing results in the 180-Foot Aquifer include the Eastside Shallow Zone in the Eastside Subbasin. For the above criteria 1 and 2, the chloride concentrations in model layer 5 are evaluated as representative of the 180-Foot Aquifer because the lower portion of the aquifer generally exhibits more advanced seawater intrusion. Criteria 4 and 5 are evaluated across layers 3-5 for the 180-Foot Aquifer.

Model layer 7 represents the 400-Foot Aquifer in the 180/400 Subbasin and the Eastside Deep Zone in the Eastside Subbasin. Figures showing results in the 400-Foot Aquifer include the Eastside Deep Zone in the Eastside Subbasin. The 5 criteria above are evaluated in only layer 7 for the 400-Foot Aquifer.

Simulated change in groundwater level (criteria 3 above) is calculated by comparing the average groundwater levels during the first simulated water year starting October 2022 against the average water levels during the year starting October 2040. The calculations are performed for the 180-Foot Aquifer, 400-Foot Aquifer, and Eastside equivalent alluvial aquifers. 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.

The BGRP scenarios were not evaluated based on impacts to the Deep Aquifers. Seawater intrusion has not been observed in the Deep Aquifers in the 180/400 or Monterey Subbasins and are not the target aquifers addressed by this project.

Table 3 summarizes the results for criteria 4 and 5—the increasing mass of chloride and area of seawater intrusion. Table 3 demonstrates how the preferred BGRP scenario is effective at reducing chloride mass and the seawater intruded area in both the 180-Foot and 400-Foot Aquifer.

Table 3. BGRP Modeling Results Summary Calculations

Scenario	180-Foot Aquifer		400-Foot Aquifer	
	2035-2070 Change in chloride mass (kg)	2035-2070 Change in seawater intruded area (ac)	2035-2070 Change in chloride mass (kg)	2035-2070 Change in seawater intruded area (ac)
Baseline Scenario	+870,000	+5,800	+3,400,000	+10,000
Preferred BGRP Scenario	-1,500,000	-13,000	-610,000	-6,300

kg = kilogram
 ac = acres

Figure 3 shows maps of the 500 mg/L contour by the SWIM for the preferred BGRP scenario; between 2022 and 2030, the 500 mg/L contour intrudes farther inland in both the 180-Foot and 400-Foot Aquifers toward the City of Salinas. Figure 3 also shows that between 2030 and 2040, the 500 mg/L chloride contour retreats in the 180-Foot and 400-Foot Aquifers as the project comes online in 2035. Through 2070, the 500 mg/L contour continues to steadily retreat toward the coast in both aquifers. Less movement of the 500 mg/L chloride contour occurs toward the coast to the east of the City of Marina where Marina Coast Water District municipal wells are located.

Figure 3 shows seawater intrusion increasing in the 400-Foot Aquifer, south of the extraction barrier. While some additional seawater intrusion is predicted to occur in this area in the Baseline Scenario, the extent is slightly greater in the preferred BGRP scenario. This difference is caused by the influence of the southern extraction barrier wells on the local groundwater gradient. A lower extraction rate in the southern extraction barrier wells may reduce this effect while maintaining a hydraulic gradient barrier to the north.

Figure 4 through Figure 7 show how the preferred BGRP Scenario improves groundwater conditions by 2040, which is the date by which the Subbasin must achieve sustainability. Figure 4 compares the simulated 2040 intrusion extent (blue dashed line) with the 2040 Baseline Scenario intrusion extent (red dashed line) and the seawater intrusion minimum threshold (black line). The preferred BGRP scenario generally meets the seawater intrusion minimum threshold criterion in both the 180-Foot and 400-Foot Aquifers. The 500 mg/L chloride contour slightly exceeds the minimum threshold near the community of Castroville, and also to the east of the City of Marina near the Marina Coast Water District municipal wells that continue to pump.

Figure 5 shows the chloride concentrations in the 180-Foot and 400-Foot Aquifers in 2040 for the preferred BGRP scenario. Chloride concentrations are reduced inland of the extraction barrier. The purple area on Figure 5 shows concentrations less than 500 mg/L but greater than background. There are areas in both the 180-Foot and 400-Foot Aquifers on the inland side of

the minimum threshold, near the injection wells, where chloride concentrations are greater than background, but less than 500 mg/L.

Figure 6 shows the simulated average groundwater level changes between 2022 and 2040 in the preferred BGRP scenario. Average groundwater levels decrease near the extraction wells and increase near the injection wells. The areas of increasing groundwater levels are focused around the injection wells in the 180-Foot and 400-Foot Aquifers. Average groundwater levels near the injection wells increase about 20 to 40 feet in both the 180-Foot and 400-Foot Aquifers. Groundwater levels are not projected to significantly increase in the Eastside alluvial fans in response to the injection in the 180/400 Subbasin due to the SWIM v3's refined interpretation of the hydrologic connection between the alluvial fans and the fluvial deposits in the 180/400 Subbasin. Average groundwater levels around the extraction barrier decrease by approximately 20 to 40 feet in the 180-Foot Aquifer and 40 to 60 feet in the 400-Foot Aquifer.

Figure 7 shows the simulated average fall groundwater level levels for November 2040 and 2041 for the preferred BGRP scenario. The groundwater levels in the 180-Foot and 400-Foot Aquifers are projected to remain below sea level even in areas where average groundwater levels would increase.

Figure 8 shows the difference between the preferred BGRP and the Baseline scenarios' simulated fall 2040-2041 groundwater levels. Red areas indicate where the preferred BGRP scenario lowers groundwater levels compared to the Baseline scenario; green areas indicate where the preferred BGRP scenario raises groundwater levels compared to the Baseline scenario. The preferred BGRP scenario lowers groundwater levels in the 180-Foot and 400-Foot Aquifers near the extraction barrier, as expected. This area of lowered groundwater levels extends south into the Seaside Subbasin. Groundwater levels are 10 to 40 feet lower than the Baseline scenario in the 180-Foot Aquifer. Groundwater levels are 20 to 40 feet lower than the Baseline scenario in the 400-Foot Aquifer, and up to 60 feet lower near the northern end of the extraction barrier.

Compared to the Baseline scenario, the BGRP scenario generally raises groundwater levels throughout the most of the 180/400 Subbasin, as well as portions of the Monterey, Langlely, and Eastside subbasins. Groundwater levels are 20 to 60 feet higher than the Baseline scenario in the region near the injection wells in both the 180- and 400-Foot Aquifers. The groundwater level benefits extend south and east of the City of Salinas and into the Eastside Subbasin to a lesser extent, with benefits 1 to 10 feet increase relative to the Baseline scenario.

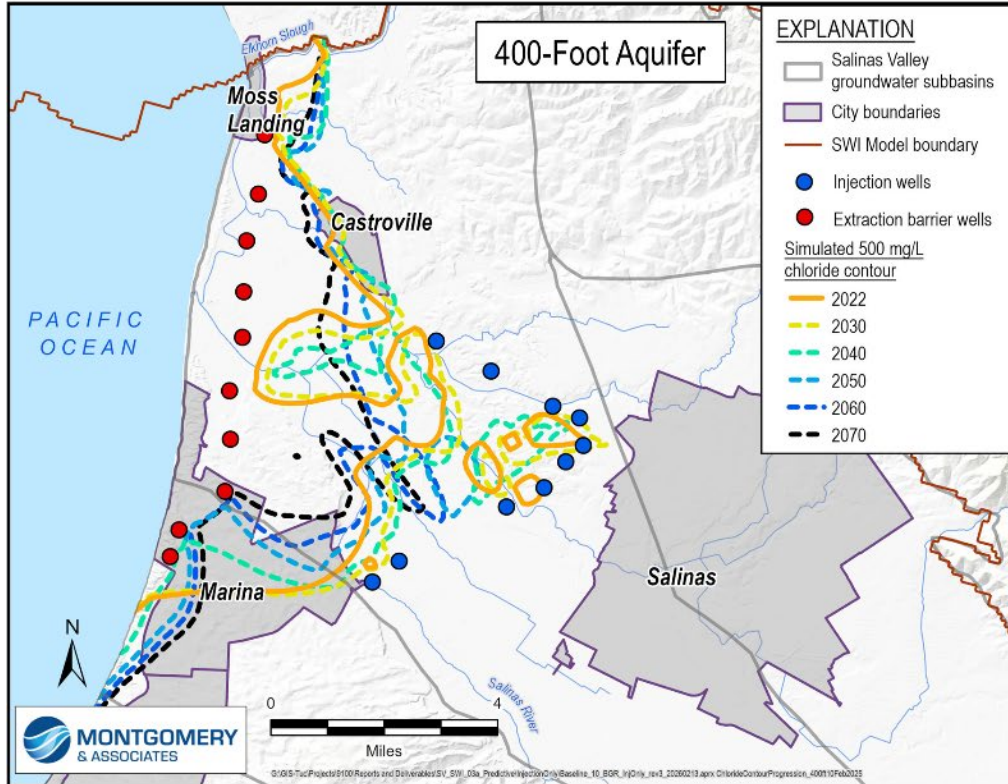
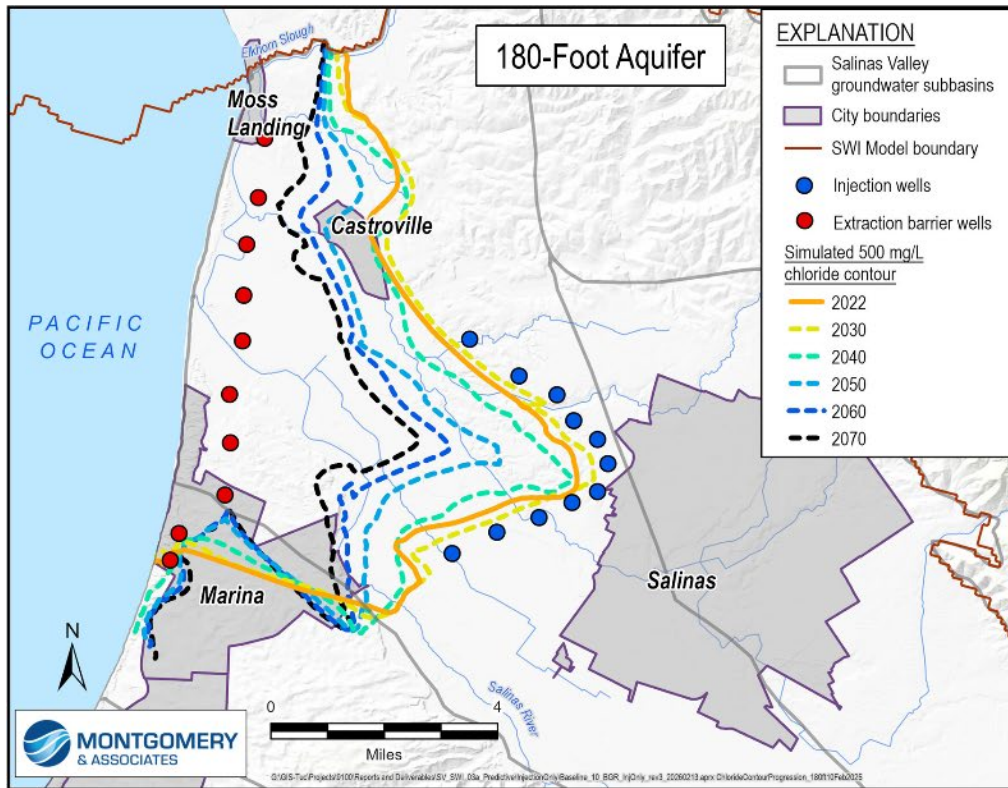


Figure 3. Progression of Simulated Chloride Contours

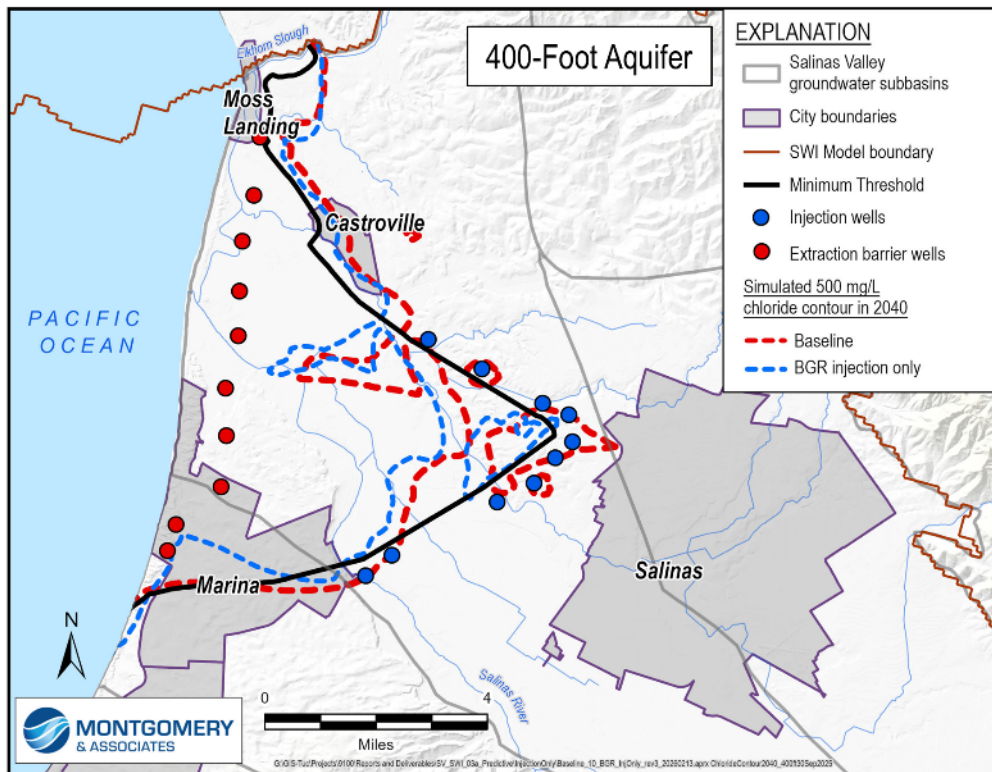
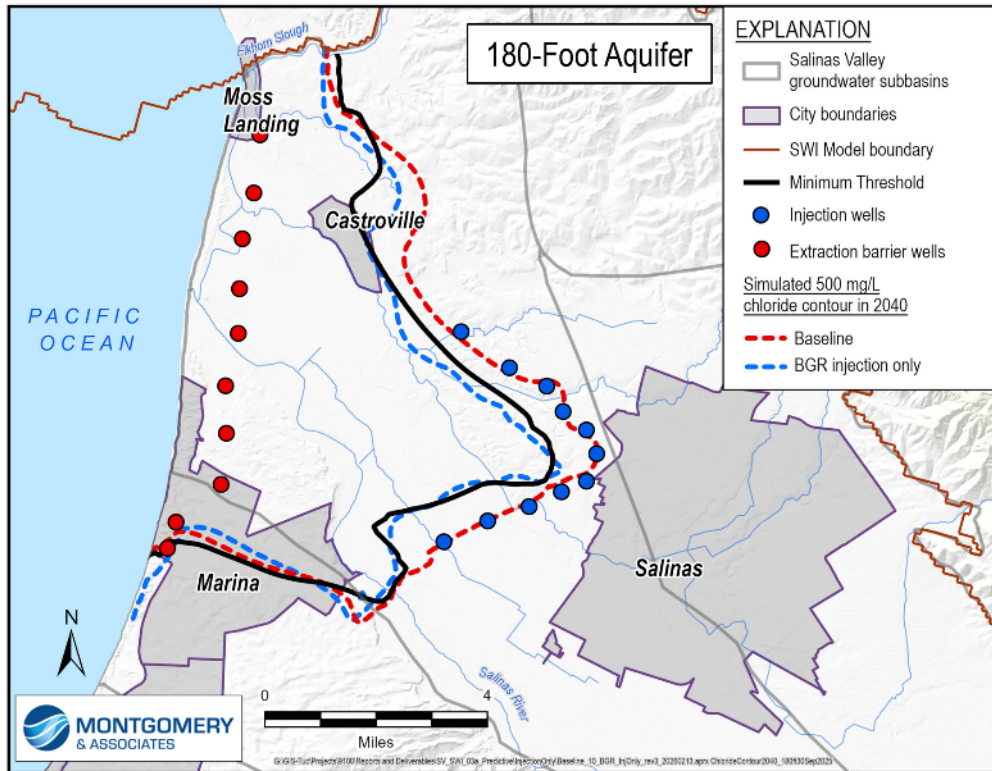


Figure 4. 2040 500 mg/L Chloride Contours Compared to Baseline Scenario and Minimum Threshold

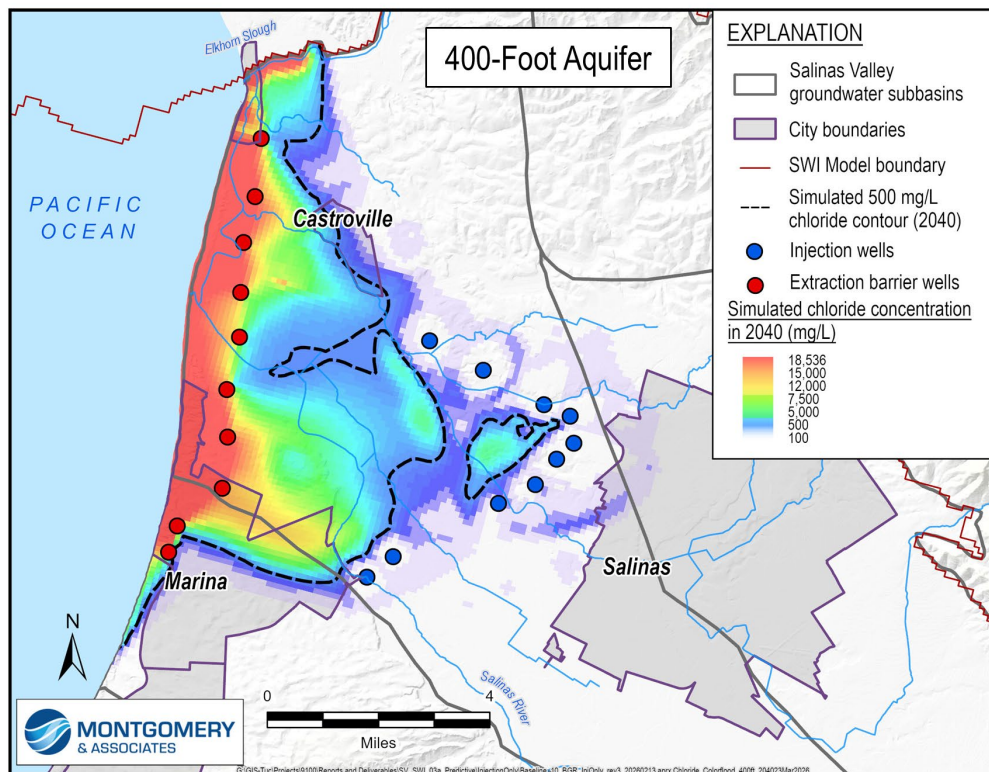
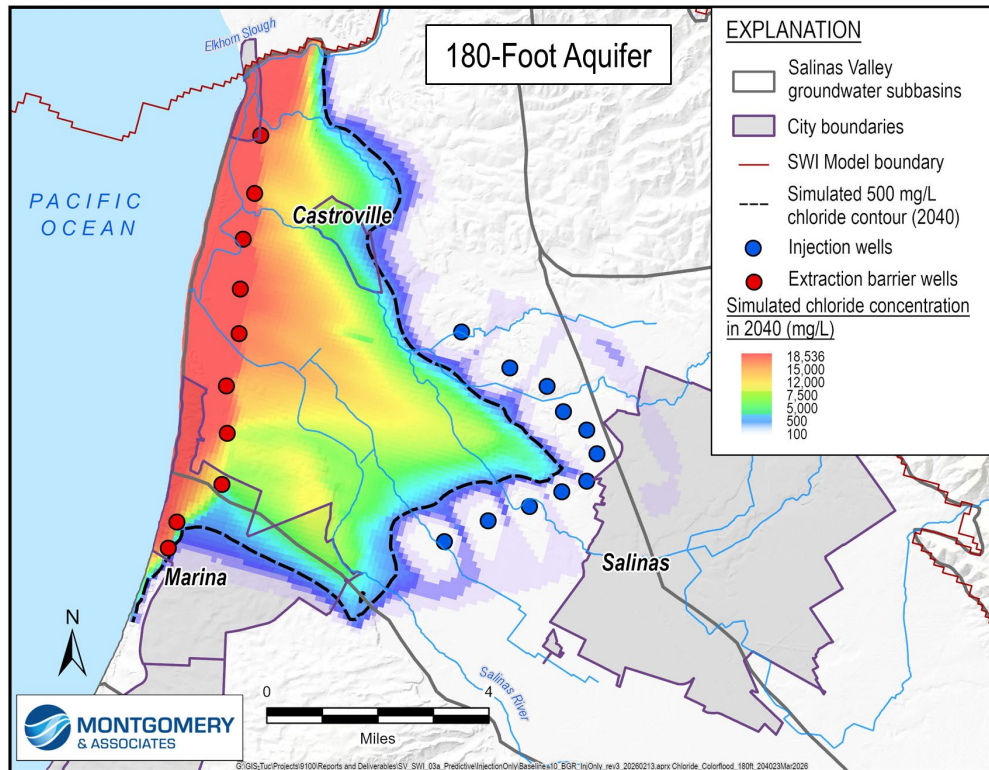


Figure 5. Simulated Chloride Concentrations in 2040

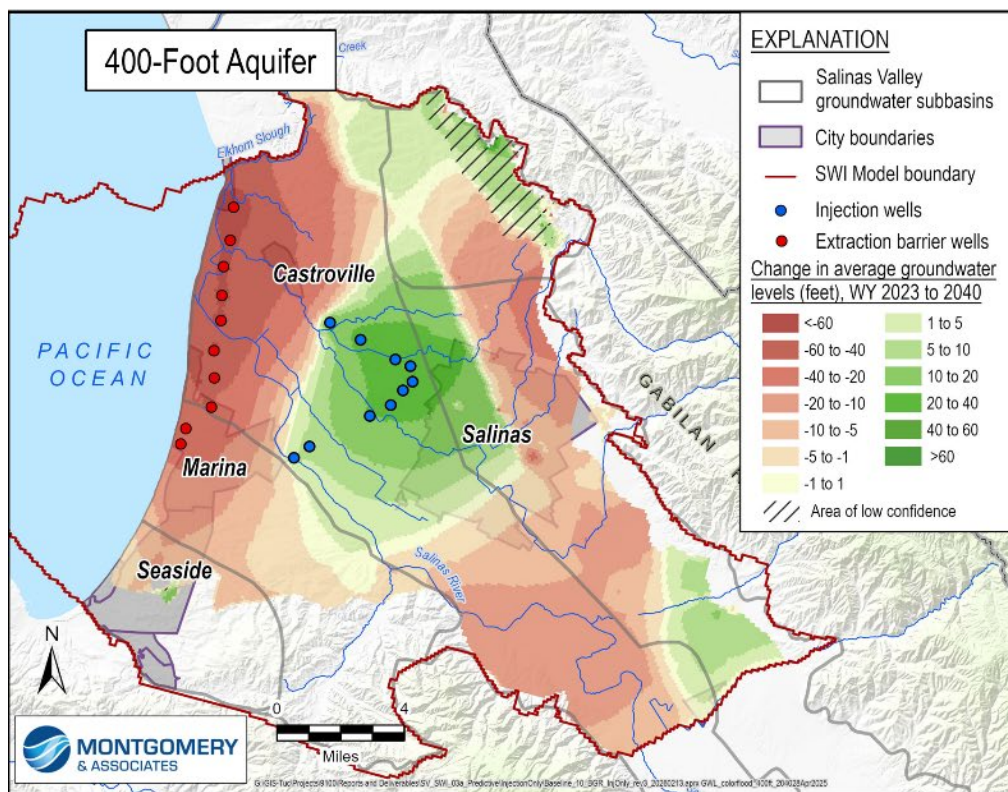
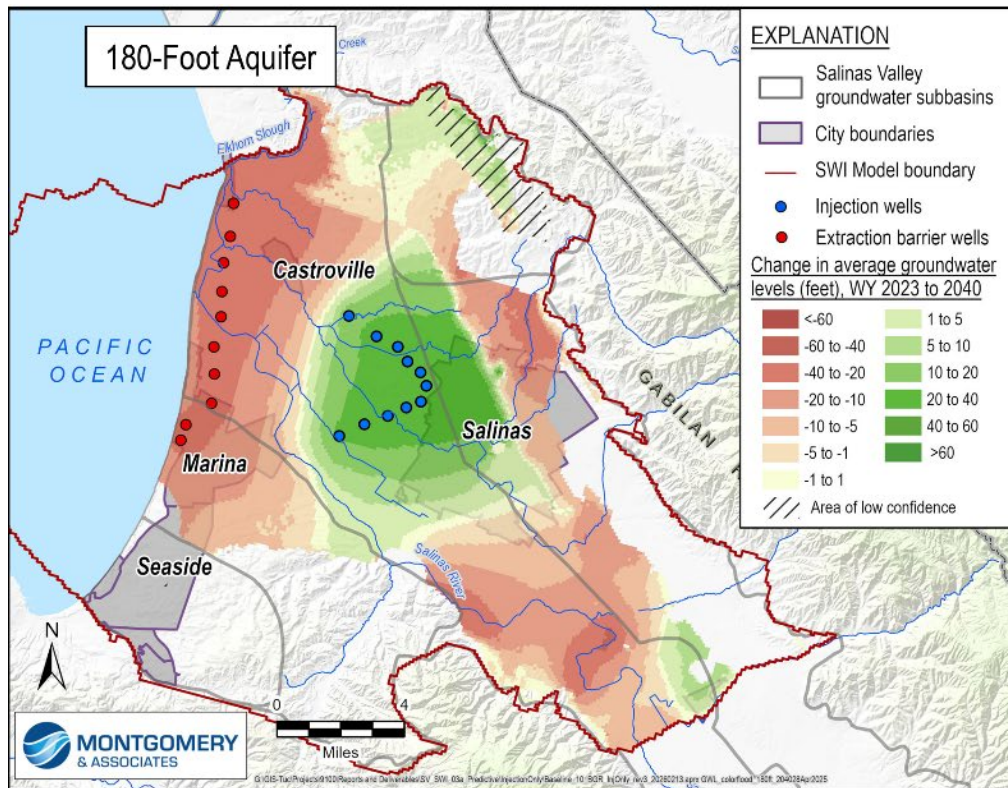


Figure 6. Simulated Change in Groundwater Levels Between 2023 and 2040

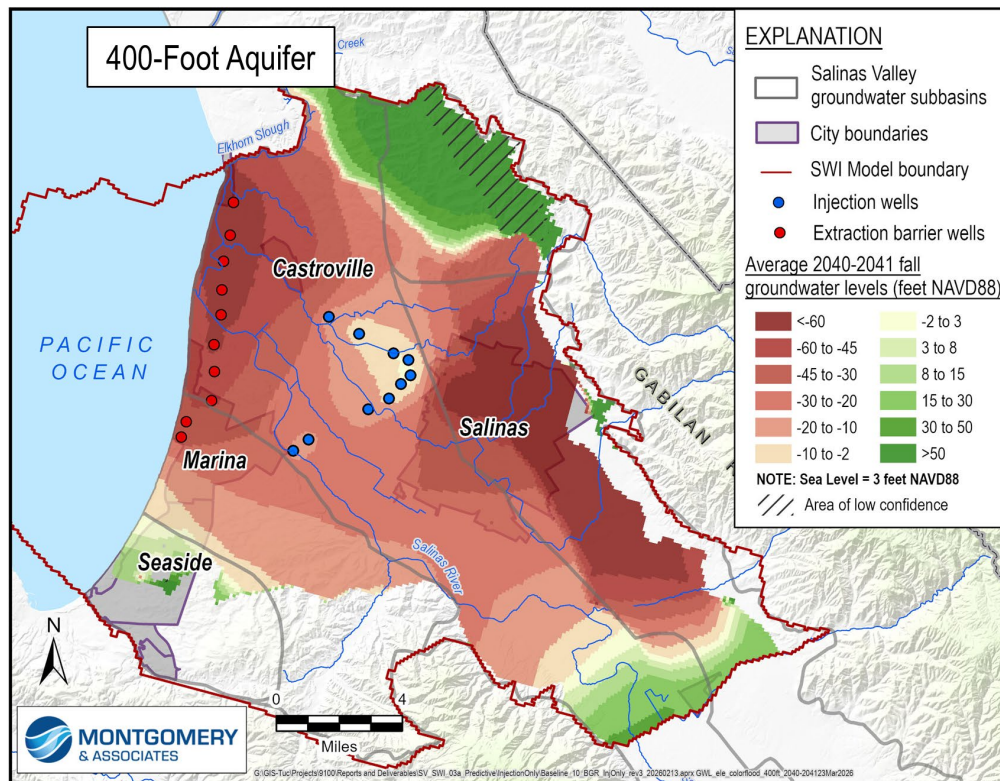
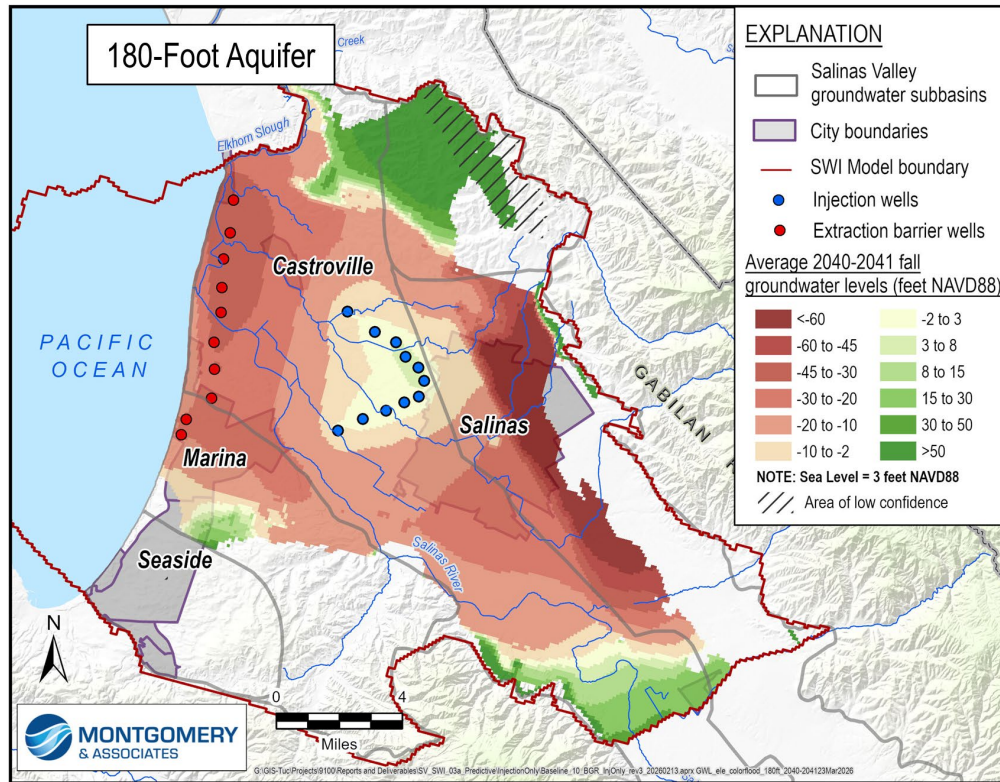


Figure 7. Simulated 2040 Groundwater Levels

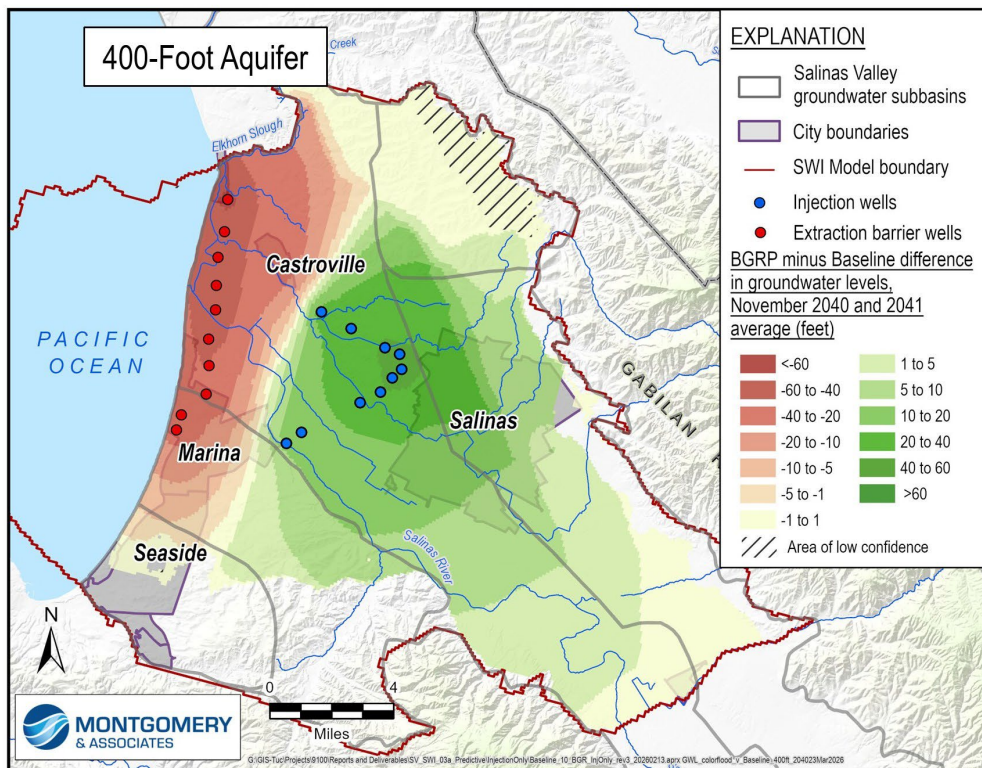
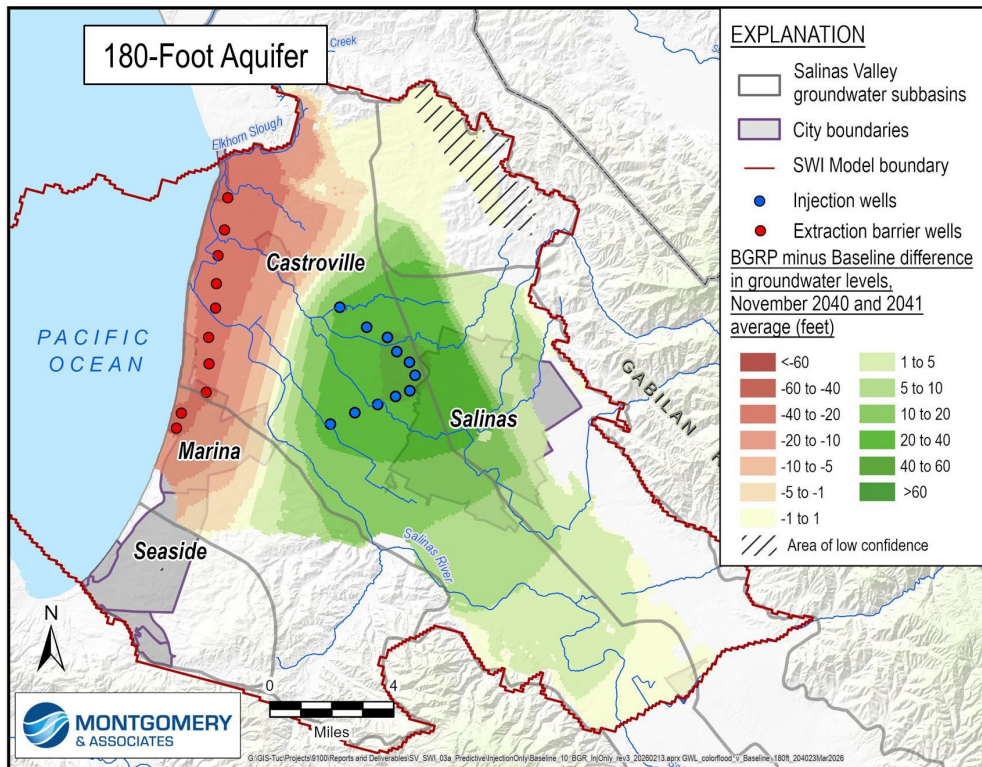


Figure 8. Difference Between Preferred BGRP Scenario and Baseline Scenario Groundwater Levels, November 2040 and 2041 Average

Figure 9 through Figure 12 show how the preferred BGRP scenario continues to improve groundwater conditions past 2040 and through the Sustainable Groundwater Management Act's planning horizon of 2070. Figure 9 compares the simulated 2070 500 mg/L chloride isocontour (blue dashed line) with the 2040 Baseline Scenario 500 mg/L chloride isocontour (red dashed line) and the seawater intrusion minimum threshold (black line). The extent of seawater intrusion in the majority of both the 180-Foot and 400-Foot Aquifers has retreated well beyond the minimum threshold line by 2070. The 500 mg/L chloride contour slightly exceeds the minimum threshold in the 180-Foot Aquifer near the Marina Coast Water District municipal wells that continue to pump, and in the southern portion of the City of Marina beyond the southern extent of the extraction barrier.

Figure 10 shows the 2070 chloride concentrations in the 180-Foot and 400-Foot Aquifers. The extraction barrier establishes an effective divide between high chloride areas west of the barrier and low chloride areas east of the barrier. Chloride concentrations east of the extraction barrier have diminished significantly by 2070.

Figure 11 shows the simulated change in average groundwater levels between WY 2023 and WY 2070 in the preferred BGRP scenario. Average groundwater levels decrease near the extraction wells and increase near the injection wells. The magnitude and extent of the areas with increasing or decreasing groundwater levels is generally similar to what is shown on Figure 6. Unlike the chloride concentrations shown on Figure 10, most of the groundwater level response to BGRP occurs by 2040 with only minor change between 2040 and 2070.

Figure 12 shows the simulated November 2070 groundwater levels for the preferred BGRP scenario. Except for an area adjacent to the injection wells in the 180-Foot Aquifer, the groundwater levels in the 180-Foot and 400-Foot Aquifers are projected to remain below sea level, even in areas where average groundwater levels would increase.

Figure 13 shows the difference between the preferred BGRP and the Baseline scenarios' simulated fall 2070 groundwater levels. Red areas indicate where the preferred BGRP scenario lowers groundwater levels compared to the Baseline scenario; green areas indicate where the preferred BGRP scenario raises groundwater levels compared to the Baseline scenario. This figure is similar to the 2040 groundwater level differences shown on Figure 8, except by 2070 the preferred BGRP scenario raises groundwater levels over a larger area and to a greater magnitude. The area of relatively lower groundwater levels is approximately the same extent and magnitude as in 2040. Groundwater levels near the injection wells and the City of Salinas increase by 20 to 60 feet, and the benefits extend farther into Eastside Subbasin.

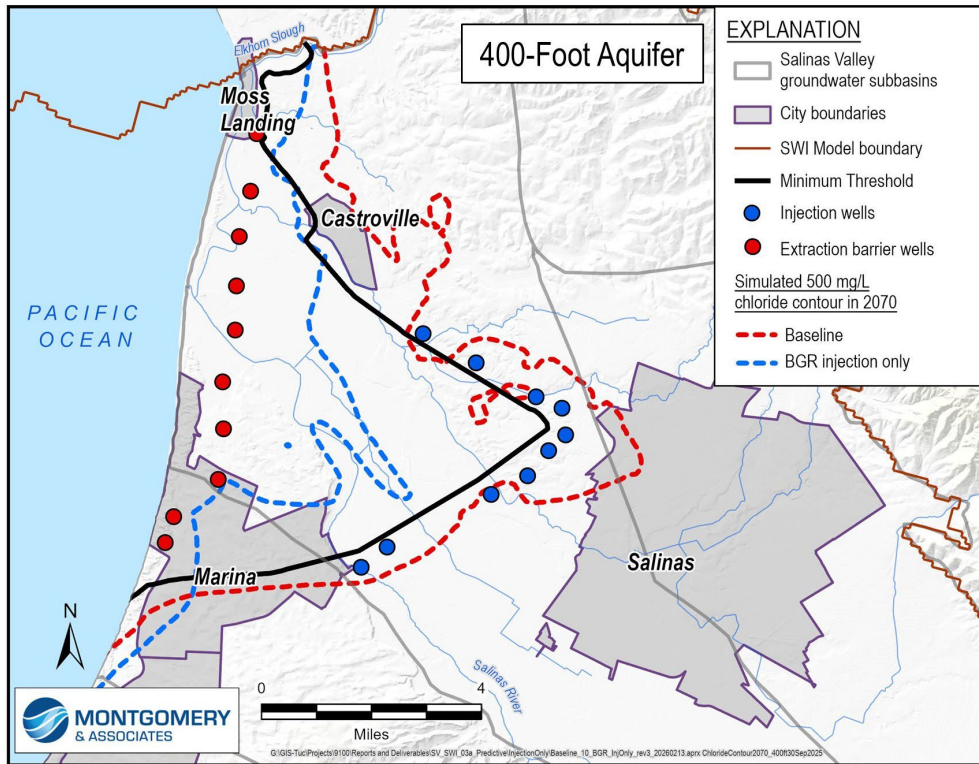
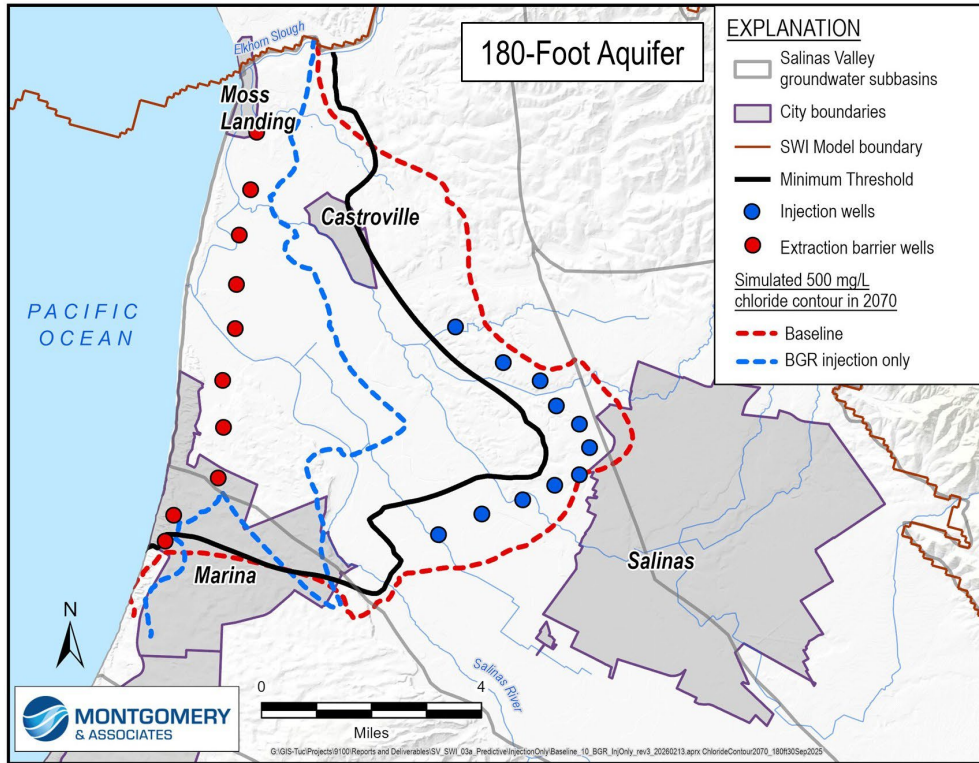


Figure 9. 2070 500 mg/L Chloride Contours Compared to Baseline Scenario and Minimum Threshold

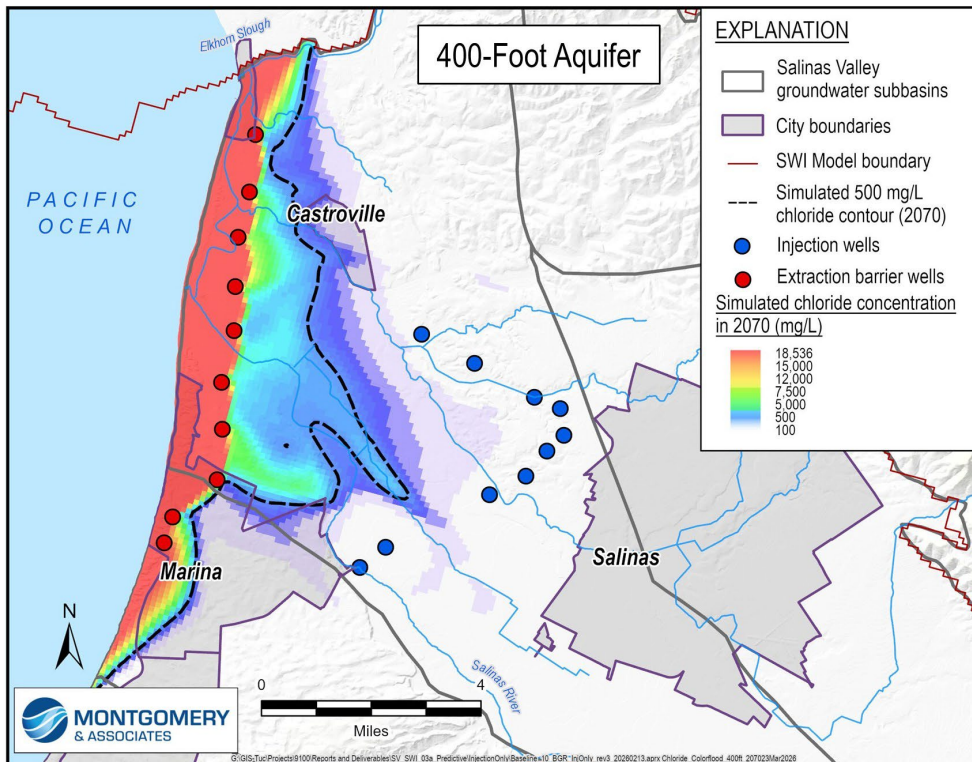
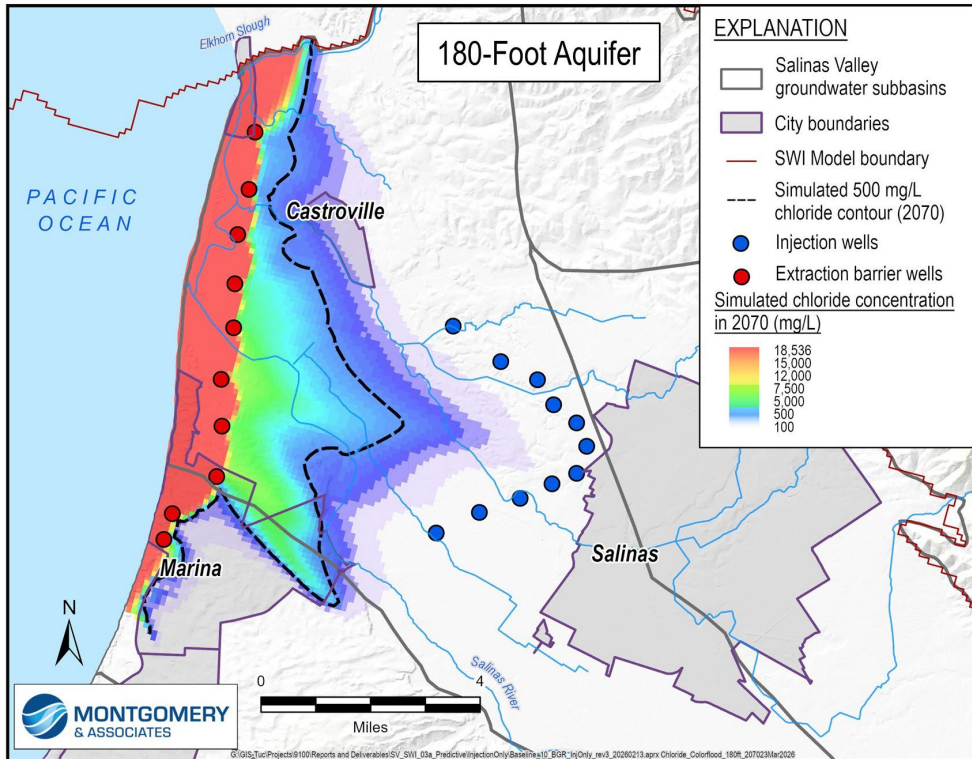


Figure 10. Simulated Chloride Concentration in 2070

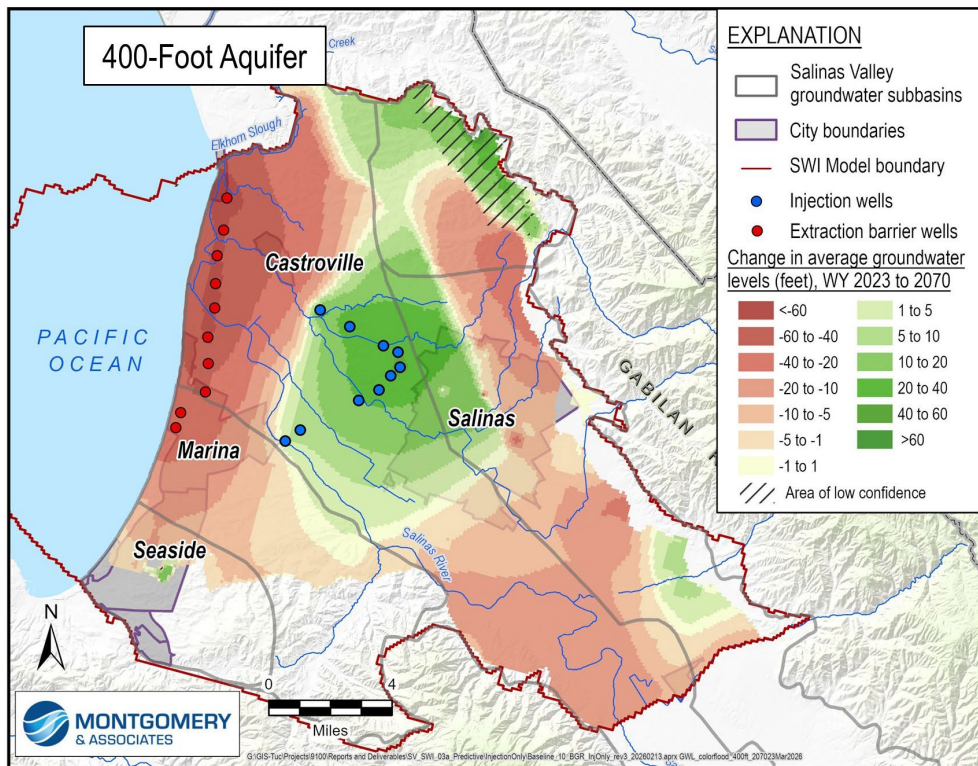
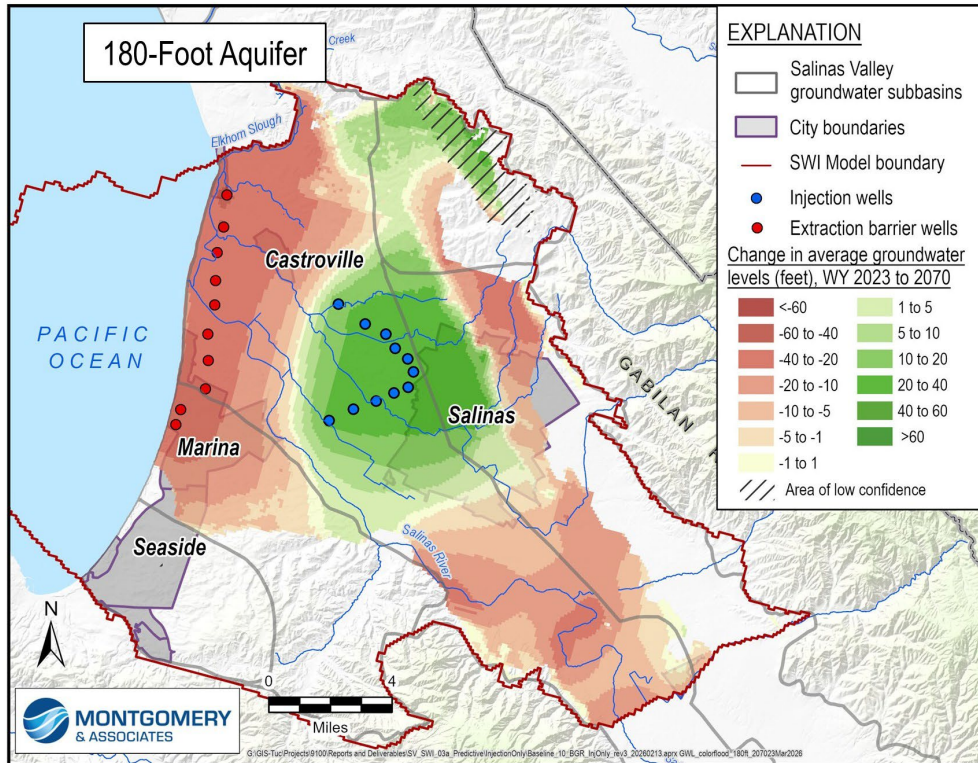


Figure 11. Simulated Change in Groundwater Levels Between 2023 and 2072

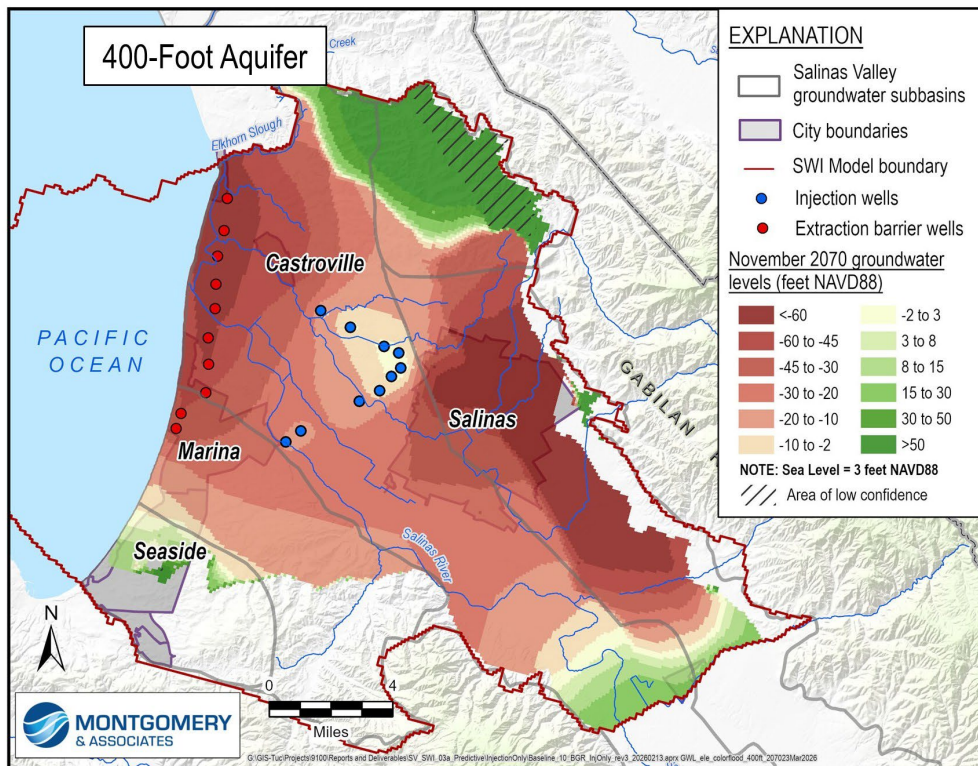
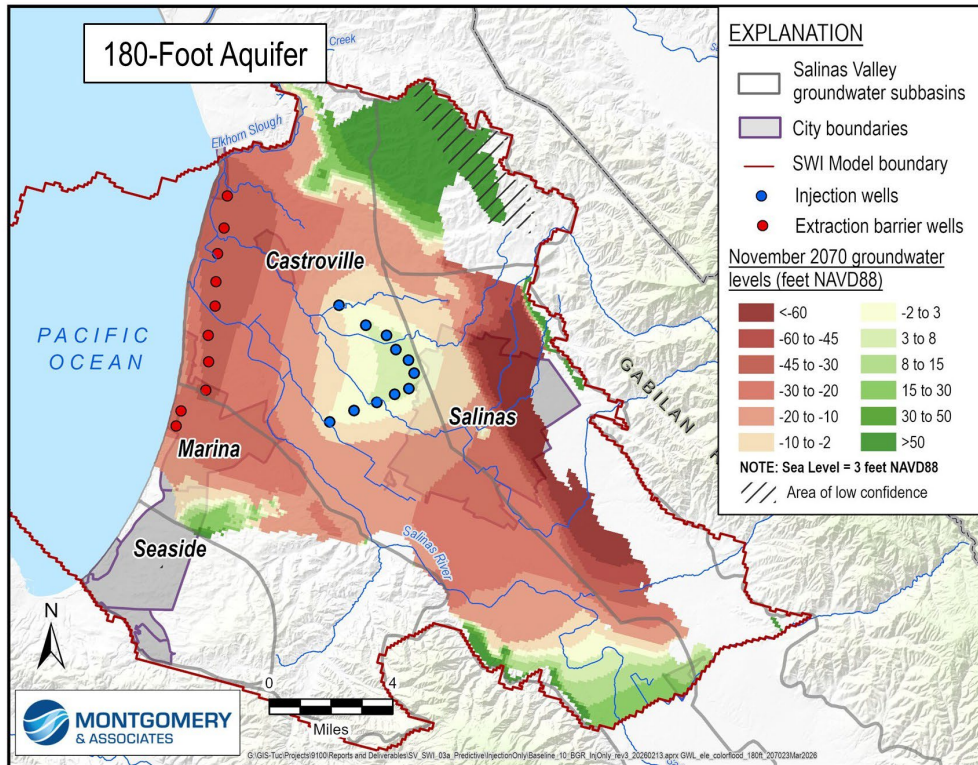


Figure 12. Simulated 2070 Groundwater Levels

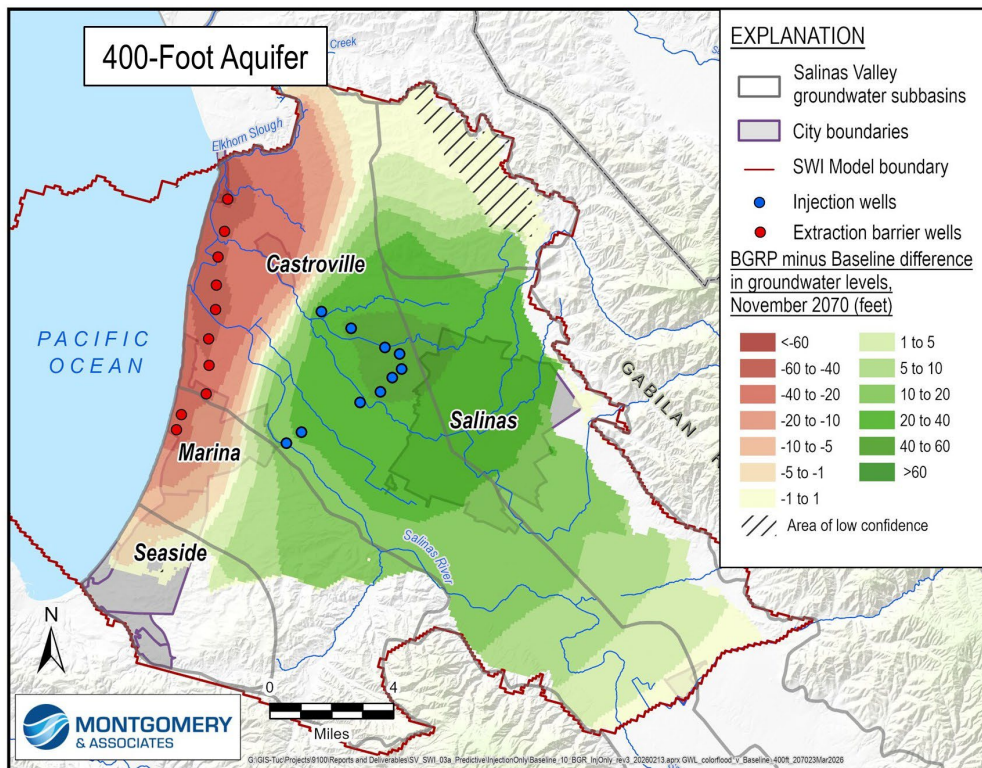
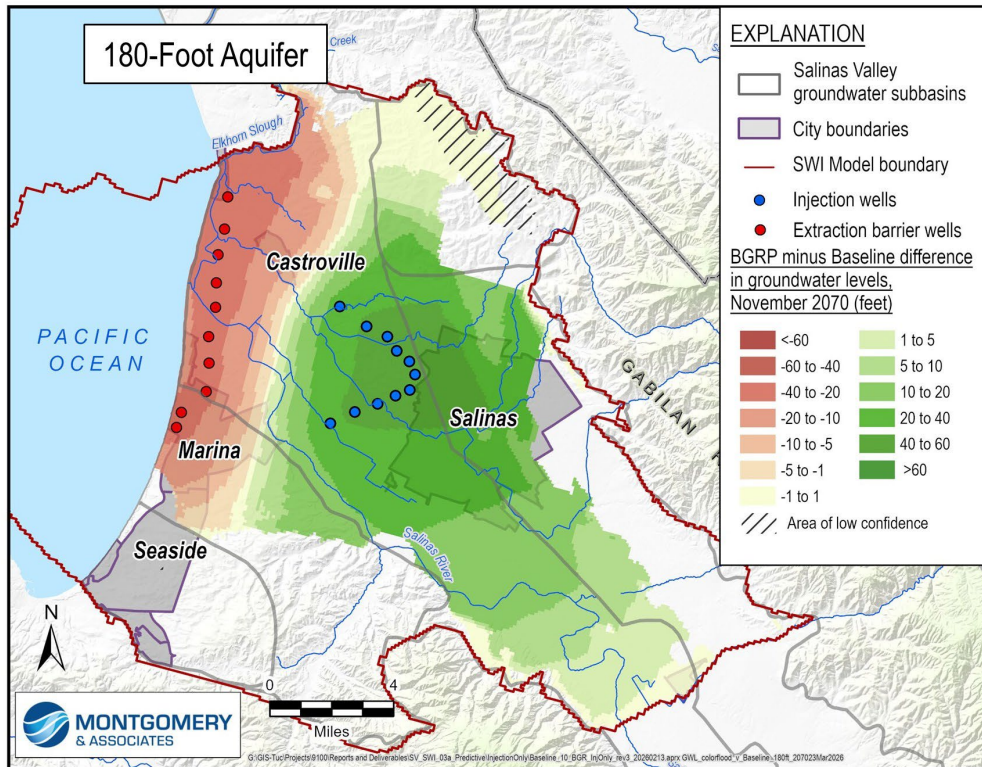


Figure 13. Difference Between Preferred BGRP Scenario and Baseline Scenario Groundwater Levels, November 2070

CONCLUSION

Groundwater modeling reevaluated the potential effectiveness of the preferred BGRP scenario using the predictive version of SWIM v3. The impact of the preferred BGRP scenario on seawater intrusion is generally consistent with the previous modeling of the Injection Only project scenario with some local differences. Quantitative measures of project effectiveness (Table 3) support conclusions about relative effectiveness.

The preferred BGRP scenario is projected to halt the intrusion of new seawater into the 180-Foot and 400-Foot Aquifers at the coast where the extraction barrier exists. The project reduces inland migration of previously intruded seawater and generally meets the 180/400 Subbasin seawater intrusion minimum threshold by 2040 in both the 180-Foot and 400-Foot Aquifers. Future studies will refine the project location and extraction and injection rates in association with further feasibility work.

DISCLAIMERS AND NEXT STEPS

A series of model simulations helped compare and contrast relative effects of the preferred BGRP scenario with the Baseline Scenario. 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 following are examples of simplifying assumptions for the current model simulations:

- Future modeling will include refined information and details related to extraction barrier and injection well construction as they become available.
- We assumed that 70% of the monthly extracted water is treated and available for delivery to end users or injection and that this water would be conveyed, stored, treated, delivered, and injected within the same month.
- Groundwater extraction was not modified in response to groundwater quality. Some wells are likely to stop pumping when chloride levels in the well exceed 500 mg/L. Further analyses could turn off pumping in response to extracted groundwater quality to see if that significantly affects results.
- The model does not simulate impacts of climate change. Future studies should evaluate whether there could be significant implications for the project.

As the feasibility study progresses and more specific design assumptions are made, model inputs will be modified, which may alter model results. Additionally, project impacts to the Deep Aquifers should be evaluated in future feasibility studies.

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