Salinas Valley Basin
Groundwater Sustainability Agency

Brackish Groundwater Restoration Project

TECHNICAL MEMORANDUM

Scenarios Analysis

October 2025 / FINAL

carollo®

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Abbreviations

180/400 Subbasin	180/400-Foot Aquifer Subbasin
AF	acre-feet
AFY	acre-feet per year
Alco	Alisal Water Service Company
BGRP	Brackish Groundwater Restoration Project
Cal Am	California American Water Company
Cal Water	California Water Service
CCSD	Castroville Community Services District
CSIP	Castroville Seawater Intrusion Project
DWR	Department of Water Resources
Eastside	Eastside Aquifer
Forebay	Forebay Aquifer
ft^2	square feet
GEMS	Groundwater Extraction Management System
gfd	gallons per square foot per day
gpm	gallons per minute
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
Langley	Langley Area
M	million
M&A	Montgomery and Associates
M1W	Monterey One Water
MCL	maximum contaminant level
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
mg/L	milligrams per liter
mgd	million gallons per day
MO	measurable objective
MT	minimum threshold
Normco	Normco Water Company
O&M	operations and maintenance
psi	pounds per square inch
RO	reverse osmosis
ROC	reverse osmosis concentrate
SGMA	Sustainable Groundwater Management Act
SMC	Sustainability Management Criteria
SRDF	Salinas River Diversion Facility

SRF	State Revolving Fund
SVBGSA	Salinas Valley Basin Groundwater Sustainability Agency
SWI Model	Seawater Intrusion Model
TM	technical memorandum
USBR	United States Bureau of Reclamation
USBR Report	United States Bureau of Reclamation Title XVI Feasibility Study Report
WIFIA	Water Infrastructure Finance and Innovation Act
WY	water year

SECTION 1 INTRODUCTION

1.1 Background

The Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) was formed in 2017 with jurisdiction over six out of nine subbasins in the Salinas Valley Groundwater Basin to ensure groundwater management pursuant to the Sustainable Groundwater Management Act (SGMA). SVBGSA has prepared Groundwater Sustainability Plans (GSPs) for its six subbasins that the California Department of Water Resources (DWR) has approved to meet the requirements of the SGMA. The GSPs establish quantifiable criteria with minimum thresholds (MTs) and measurable objectives (MOs) to address groundwater challenges facing the Salinas Valley such as seawater intrusion, chronic declines in groundwater levels, and loss of groundwater in storage. GSPs include projects and management actions to achieve sustainability within 20 years of the initial GSP.

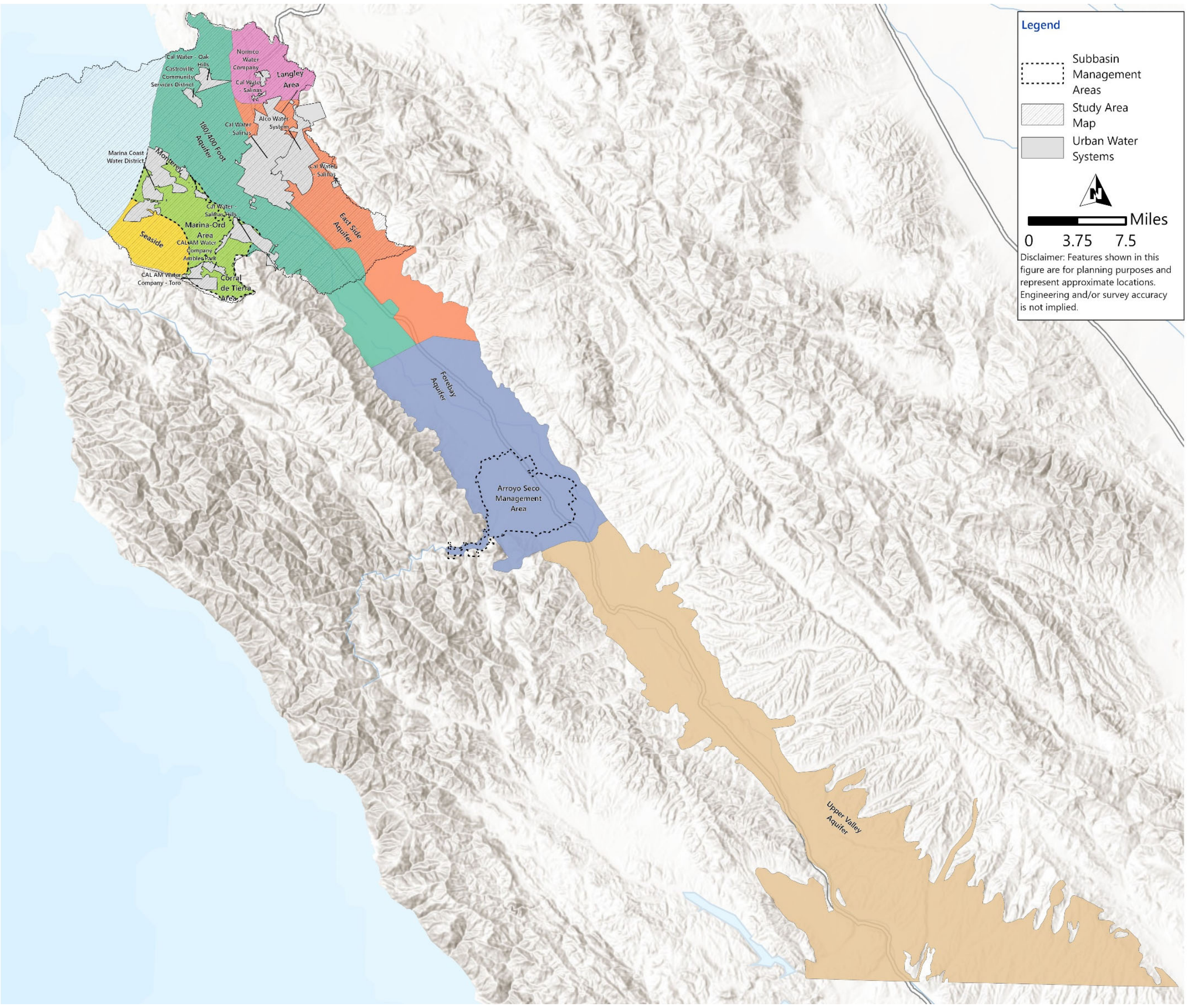
Seawater intrusion has significantly deteriorated groundwater supplies in the 180/400-Foot Aquifer Subbasin (180/400 Subbasin) as well as in portions of the Monterey Subbasin, which provide for agricultural, urban, and environmental uses in the northern coastal area of the Salinas Valley. Seawater intrusion is measured by the inland movement of the 500 milligrams per liter (mg/L) chloride concentration isocontour lines in the 180-Foot and 400-Foot Aquifers, with the MT set at the 500 mg/L isocontour line in 2017. The 180/400 Subbasin, the Monterey Subbasin, and the Eastside Aquifer (Eastside) Subbasin have groundwater levels well below sea level, resulting in extensive intrusion of seawater into the previously freshwater aquifers. Seawater intrusion has been occurring for more than 90 years and is a contributing factor for the 180/400 Subbasin’s classification by the California DWR as high priority and critically overdrafted.

This report evaluates scenarios for two combined projects identified in several SVBGSA GSPs, referred to as a Seawater Intrusion Extraction Barrier and a Regional Municipal Supply Project. SVBGSA decided to evaluate the feasibility of these two projects as a single project referred to as the Brackish Groundwater Restoration Project (BGRP). With grant funding from DWR, SVBGSA brought on a consultant team with Carollo Engineers and Montgomery and Associates (M&A) to evaluate how well the BGRP could achieve and maintain the GSP MT for seawater intrusion, set at the 2017 500 mg/L chloride concentration isocontour line, while also providing a new treated water supply to both agricultural and urban end users.

Following the analysis of BGRP scenarios presented in this technical memorandum (TM), SVBGSA will continue investigating the BGRP through preparation of a United States Bureau of Reclamation (USBR) Title XVI Feasibility Study Report (USBR Report) for large, recycled water or desalination projects. SVBGSA is also evaluating other projects, including demand management, new surface water diversions, and aquifer storage and recovery, as other means to reduce the impact of seawater intrusion and meet the required MT. The USBR Report will further evaluate a BGRP scenario selected as the preferred approach, as well as at least one alternative project that can meet the seawater intrusion MT.

1.2 Project Study Area

The project study area is generally on the Pacific coast in the northern subbasins of the Salinas Valley. Figure 1 shows the project study area that is referenced hereon throughout the TM. The study area covers the same area as a groundwater model for seawater intrusion, SVBGSA's Salinas Valley Seawater Intrusion Model (SWI Model), which extends up-valley far enough to minimize any potential boundary effects on groundwater modeling results.



Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 1 Project Study Area and Seawater Intrusion Model Area

1.2.1 Salinas Valley Groundwater Basin

The Salinas Valley Groundwater Basin is situated on the central coast of California in Monterey and San Luis Obispo counties, serving as one of the most vital agricultural regions in the state and the nation. The Salinas Valley Groundwater Basin includes nine subbasins, six of which fall partially or entirely within the jurisdiction of the SVBGSA and are referred to here as the Salinas Valley or Valley (Figure 1):

- 180/400 Subbasin (3-004.01).

- Eastside Subbasin (3-004.02).
- Forebay Aquifer (Forebay) Subbasin (3-004.04).
- Upper Valley Aquifer Subbasin (3-004.05).
- Langley Area (Langley) Subbasin (3-004.09).
- Monterey Subbasin (3-004.10).

Two of the subbasins are co-managed with other Groundwater Sustainability Agencies (GSAs): Monterey with the Marina Coast Water District (MCWD) GSA and Forebay with the Arroyo Seco GSA. The adjudicated Seaside Subbasin, while outside of SVBGSA's jurisdiction and under management by the Seaside Groundwater Basin Watermaster, is at risk of seawater intrusion and therefore is included in the study area.

The Salinas Valley covers an area of approximately 1,000 square miles with over 250,000 acres of irrigated crops including lettuce, strawberries, broccoli, artichokes, and wine grapes—supporting a $3.9 billion agricultural economy. Groundwater is currently the sole source of drinking water for more than 300,000 people in urban and rural communities. The sources of groundwater recharge include precipitation, return flows from applied irrigation water, and streambed percolation from the Salinas River. Groundwater makes up over 95 percent of the water used within the Salinas Valley, supporting domestic, agricultural, and other beneficial uses. Agriculture heavily relies on groundwater, attributing to about 90 percent of the extractions in the Salinas Valley. Agriculture also provides one in five jobs in Monterey County and has national importance as the sixth largest producer of vegetable crops in the country in 2024.[1]

The Salinas Valley faces multiple groundwater issues related to overdraft conditions in some areas: seawater intrusion near the coast, lowering groundwater levels, and loss of groundwater in storage. The principal aquifers by the coast, the 180-Foot and 400-Foot Aquifers, have direct connectivity with the Pacific Ocean, providing a pathway for seawater intrusion as pumping caused groundwater levels to drop below sea level. Seawater intrusion is present in the 180/400 Subbasin and Monterey Subbasin, also threatening the Langley Subbasin and Eastside Subbasin. However, all subbasins are hydrogeologically connected, therefore seawater intrusion is considered a regional challenge. Groundwater elevations east of the seawater intrusion front remain below sea level and have continued to decline, and during recent periods of droughts, new islands of seawater intrusion were detected in the 400-Foot Aquifer.

1.3 Groundwater Management Prior to Sustainable Groundwater Management Act

Groundwater has been the primary source of water for the Salinas Valley for over 100 years. In the late 1800s, farmers in the Salinas Valley began extracting groundwater as a source of water for irrigation and other uses. Near the coast, seawater intrusion was first detected in the 1930s. By 1946, seawater intrusion was noted to extend approximately 1 mile inland in the 180-Foot Aquifer and underlay approximately 4,200 acres of land.

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[1] https://montereycfb.com/annual-crop-report/.

Monterey County Water Resources Agency (MCWRA) constructed the Nacimiento and San Antonio Dams in the 1950s and 1960s. Reservoir releases contribute to groundwater recharge; however, they must meet many objectives for various beneficial uses, including but not limited to flood control, downstream surface water diversions, and maintaining environmental flows. While these reservoir projects significantly improved water resources management throughout the Salinas Valley, seawater intrusion continued to advance inland, with the 400-Foot Aquifer becoming impacted by seawater beginning by the late 1960s.

MCWRA continued to address seawater intrusion with additional projects. The Monterey County Water Recycling Projects, a combination of the Salinas Valley Reclamation Plant and Castroville Seawater Intrusion Project (CSIP), began construction in 1995 and started delivering recycled water in lieu of groundwater pumping to fields near Castroville in 1998. MCWRA and Monterey One Water (M1W) have since jointly implemented these projects for agricultural irrigation on about 12,000 acres in the seawater intruded area near Castroville. In 2010, MCWRA implemented the Salinas Valley Water Project Phase 1, which added a surface water source of supply to CSIP at the Salinas River Diversion Facility (SRDF). Nacimiento and San Antonio Dams operations were modified to release stored water during the summers for diversions downstream at SRDF during the peak growing season. The SRDF further reduced reliance on groundwater in the CSIP area.

1.4 Sustainable Groundwater Management Act

The SGMA was enacted in 2014 as California legislation to protect groundwater resources and achieve sustainable groundwater conditions by 2040. To facilitate implementation of the SGMA, groundwater basins, as defined in Bulletin 118,[2] were grouped by the California DWR into one of four priority categories: high, medium, low, and very low using eight criteria outlined in California Water Code Section 10933(b). Additionally, groundwater basins were evaluated and designated, where applicable, as being in a state of critical overdraft.

The SGMA mandated formation of GSAs for the medium and high priority basins. A GSA could be formed by an existing local agency or combination of local agencies overlying a groundwater basin. The GSAs were required to develop and implement GSPs considering the interests of all beneficial uses and users of groundwater in the basin. A GSP is a plan that outlines how a basin can be brought into sustainability in 20 years.

The SGMA defines sustainability as “the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results”. The six sustainability indicators defined by the SGMA comprise:

1. Chronic lowering of groundwater levels.
2. Reduction of groundwater in storage.
3. Seawater intrusion.
4. Land subsidence.
5. Water quality degradation.
6. Depletion of interconnected surface water.

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[2] https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118.

A GSP identifies and defines undesirable results, MTs, MOs, and interim milestones for each of the six sustainability indicators. GSPs include projects and management actions that should be considered to achieve and/or maintain groundwater sustainability within the 20-year planning horizon established by the SGMA. DWR reviews and approves GSPs, and GSPs are to be reevaluated every five years. GSPs for critically overdrafted basins, including the 180/400 Subbasin, were required to be submitted to DWR by January 31, 2020, and GSPs for medium and high priority basins, including the five other Salinas Valley subbasins, were required to be submitted by January 31, 2022. DWR has approved the GSPs for all six subbasin managed by SVBGSA.

As noted previously, the BGRP was identified as two individual projects in the 180/400 Subbasin GSP: 1) Seawater Intrusion Extraction Barrier, and 2) Regional Municipal Supply Project. The Regional Municipal Supply Project is also included in the Eastside, Monterey, and Langley GSPs. SVBGSA decided to proceed with a feasibility study for a single combined project, renamed as BGRP.

1.5 Purpose of Technical Memorandum

The purpose of this TM is to present the BGRP scenarios that have been evaluated. The analysis was an iterative process to model the effects of implementing the BGRP facilities required for extracting brackish groundwater within the seawater intruded zone to create a barrier along the coast, creating a supplemental water supply with brackish desalination treatment, delivering treated water to potential end users to reduce groundwater pumping, and/or injecting treated water inland of the seawater intrusion front to push it beyond the MT towards the MO. Each scenario's production capacity (groundwater offset), hydrogeologic characteristics, conveyance and treatment infrastructure components, overall cost, and implementation strategies are developed and used to compare scenarios for effectiveness in meeting the GSP requirements.

This TM is organized into the following sections:

- **Section 1:** Introduction.
- **Section 2:** Problem and Need.
- **Section 3:** Description of Project Scenarios.
- **Section 4:** Summary of Scenarios.

SECTION 2 PROBLEM AND NEED

2.1 Summary of Problem and Need

Local groundwater is the primary water source for the Salinas Valley's communities, farms, and environment, but it is being used faster than it is being replenished. In parts of the valley, groundwater levels are declining, seawater is moving further inland, and more wells are at risk of failure. In the face of these warning signs, management efforts have historically been fragmented, infrastructure is aging, and opportunities to capture and store water are limited. Climate extremes, data uncertainty, and the high cost of new projects add to the challenge.

SVBGSA is working to protect and restore the region’s groundwater by balancing use with recharge, considering supplemental supply projects, improving coordination, and guiding local solutions through inclusive, science-based planning.

In much of the study area, pumping exceeds the natural rate of recharge. Groundwater levels in the northern Salinas Valley remain stressed and declining, with the sharpest drops occurring during drought years. Groundwater levels east of the seawater intrusion front are below sea level, creating conditions that allow saltwater to advance further inland. The 180/400 Subbasin has been designated by DWR as critically overdrafted due to ongoing seawater intrusion. As seawater continues to migrate inland, brackish groundwater increasingly impacts wells across the region.

Within the CSIP service area, continued groundwater pumping contributes to overdraft conditions, leaving wells vulnerable to rising salinity. Some of the MCWRA’s CSIP supplemental wells have already been intruded upon and are no longer suitable for irrigation. This growing problem also affects local communities. Castroville, Salinas, and Marina—recognized as underrepresented communities—face heightened risks to their water supplies. In fact, some of Castroville Community Services District’s (CCSD) water supply wells have already been taken offline due to salinity contamination. At the same time, improved water use efficiency in urban areas has reduced the amount of wastewater available for recycling, limiting an important supplemental source.

In recent years, many new wells have been drilled into the Deep Aquifers[3] in the areas where intrusion has expanded in the 400-Foot Aquifer and where CSIP in-lieu supplies are not available. Confined aquifers recharge slowly, and inflows to the Deep Aquifers occur on a timescale too long for management purposes. As a result, reliance on the Deep Aquifers is not a sustainable replacement supply for areas that have become impaired by seawater intrusion. The Deep Aquifers are also at risk of overdraft and seawater intrusion, as well as subsidence, making them an unreliable long-term water source.

Figure 2 shows the historical extents of seawater intrusion in the 180/400 Subbasin within the study area.

SVBGSA is working to identify solutions and supplemental supplies to address these issues in the study area. The BGRP has been identified as a potential project to mitigate seawater intrusion and improve groundwater quality, raise groundwater levels, and provide a new source of water for the region.

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[3] The Deep Aquifers Study (M&A 2024) defines the Deep Aquifers as the water-bearing sediments that are below a relatively continuous aquitard or area of higher clay content encountered between approximately 500 feet and 900 feet below land surface within the portions of the Salinas Valley Groundwater Basin within Monterey County. The relatively continuous high-clay aquitard, or 400/Deep Aquitard, must be below the identified 400-Foot Aquifer or its stratigraphic equivalent, and the sediments must be within the Paso Robles Formation, Purisima Formation, and/or Santa Margarita Sandstone.

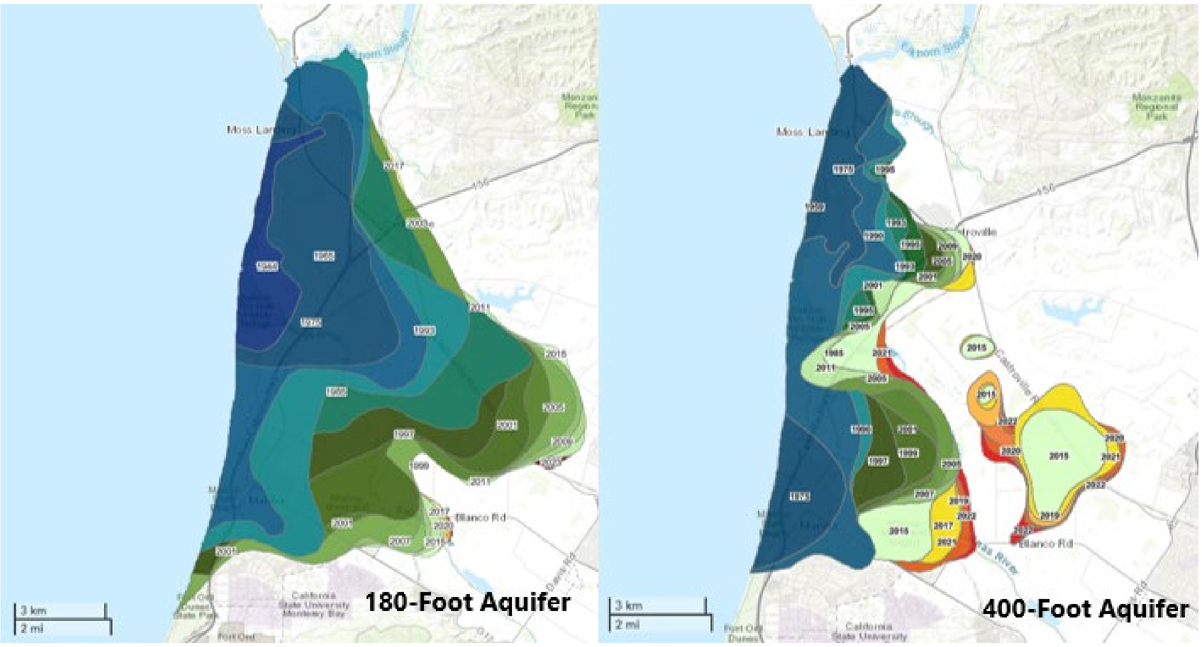


Figure 2 Historical Seawater Intrusion by Year

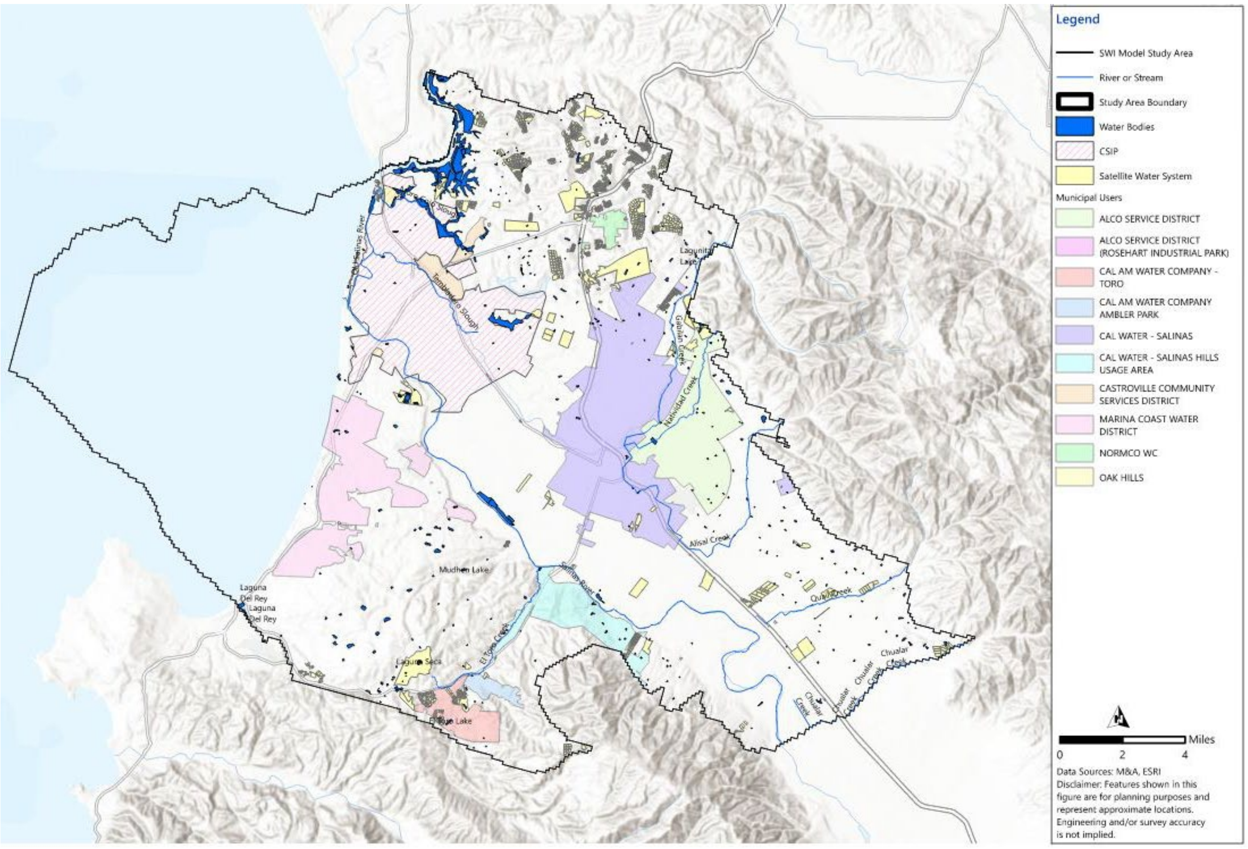
2.2 Overview of Water Supplies and Demands

The study area for the project includes five northern subbasins of the Salinas Valley (northernmost areas of the 180/400 Subbasin and Eastside Subbasin, as well as the Monterey, Langley, and adjudicated Seaside Subbasins), covering an area of approximately 372 square miles. Within the study area there are multiple water, wastewater, and recycled water systems that provide water supply for urban, agricultural, commercial, and industrial users.

The larger urban water systems in the study area comprise the CCSD, Alisal Water Service Company (Alco), California Water Service (Cal Water) – Salinas, and MCWD. The urban water systems and agricultural water users in the study area rely on groundwater produced from the 180-Foot and 400-Foot Aquifers, the alluvial fan aquifer system in the Eastside Subbasin, and the Deep Aquifers.

Agriculture relies heavily on groundwater. Within the 12,000 acres of the CSIP distribution area, recycled water and surface water diverted through the SRDF provide supplemental supplies for agricultural irrigation. CSIP also relies on supplemental groundwater wells to meet system demands and to maintain pressure in the distribution system. M1W also operates the Advanced Water Purification Facility for groundwater injection and indirect potable reuse in the Seaside Basin to serve the Monterey Peninsula.

Figure 3 below provides a map of the water, wastewater, and recycled water systems in the study area. The following sections describe the urban and agricultural water use within the study area.



Data Sources: M&A, ESRI
Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 3 Overview of Water Systems in Study Area

2.2.1 Agricultural Water Users

Agricultural demand makes up approximately 77 percent of the total water usage in the study area. Figure 4 shows all the agricultural land use within the study area. Agricultural users in the Salinas Valley rely heavily on groundwater sources for irrigation supply. On average in the study area, agriculture irrigation uses approximately 115,400 acre-feet (AF) of groundwater, 3,600 AF of surface water diverted at the SRDF, and 11,900 AF of recycled water. Typical growing seasons are spring, summer, and fall. Figure 5 shows the seasonality of the agricultural water use in the study area. Typical demand in the summer months is almost 20 times higher than in the winter season. Notably, in comparison to Figures 5 and 7 the seasonal fluctuation in agricultural water use is much more significant than urban water use.

Water quality in the study area continues to be an issue for agricultural irrigation use given that poor quality groundwater can potentially impact crop yields negatively. The treatment design assumptions in Section 3 were mainly governed by the Basin Plan boron limit of 0.2 mg/L for groundwater in the 400-Foot Aquifer, where injection of reverse osmosis (RO) permeate water is expected to occur. In order to reach this boron limit with a sufficient factor of safety, specific treatment processes are required and accounted for in the treatment design assumptions included in the project scenarios.

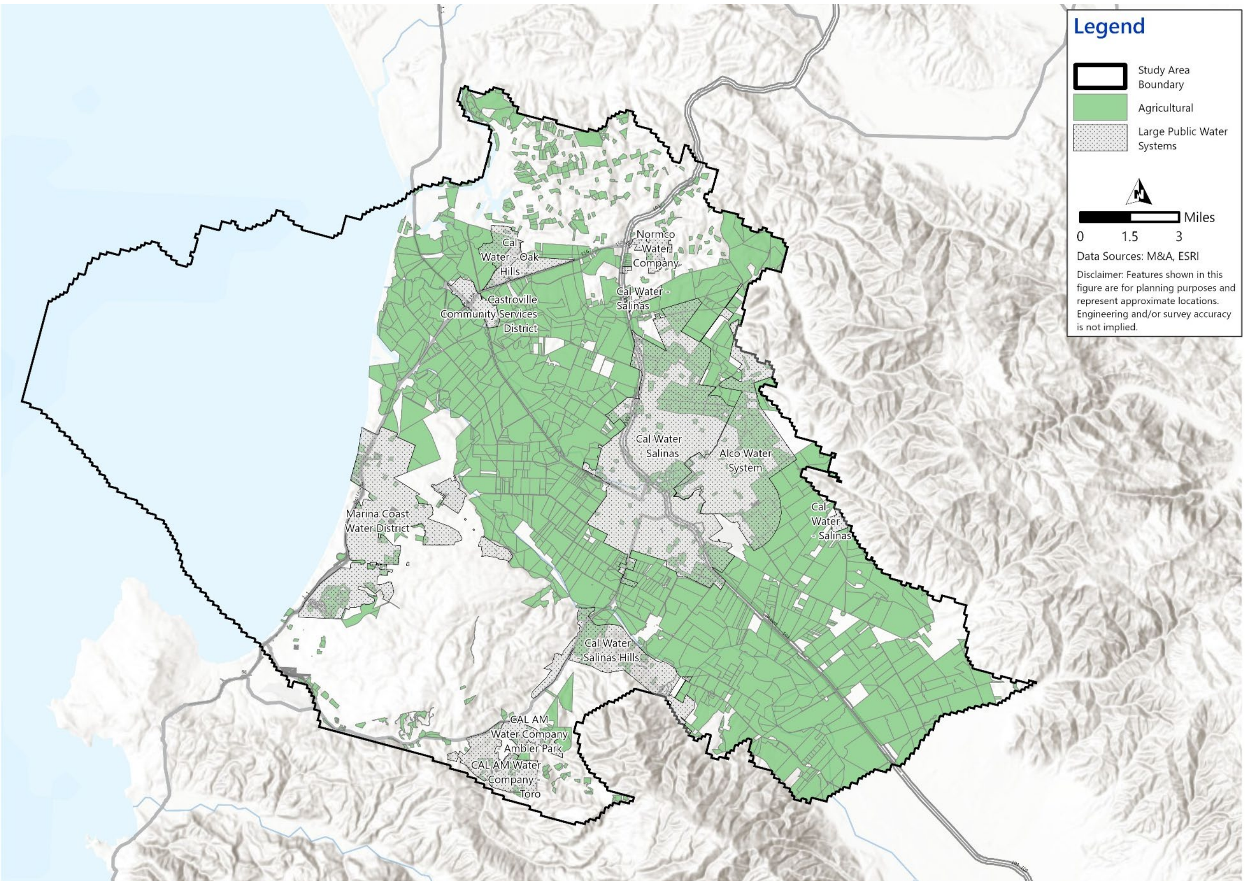


Figure 4 Agricultural Water Users in Study Area

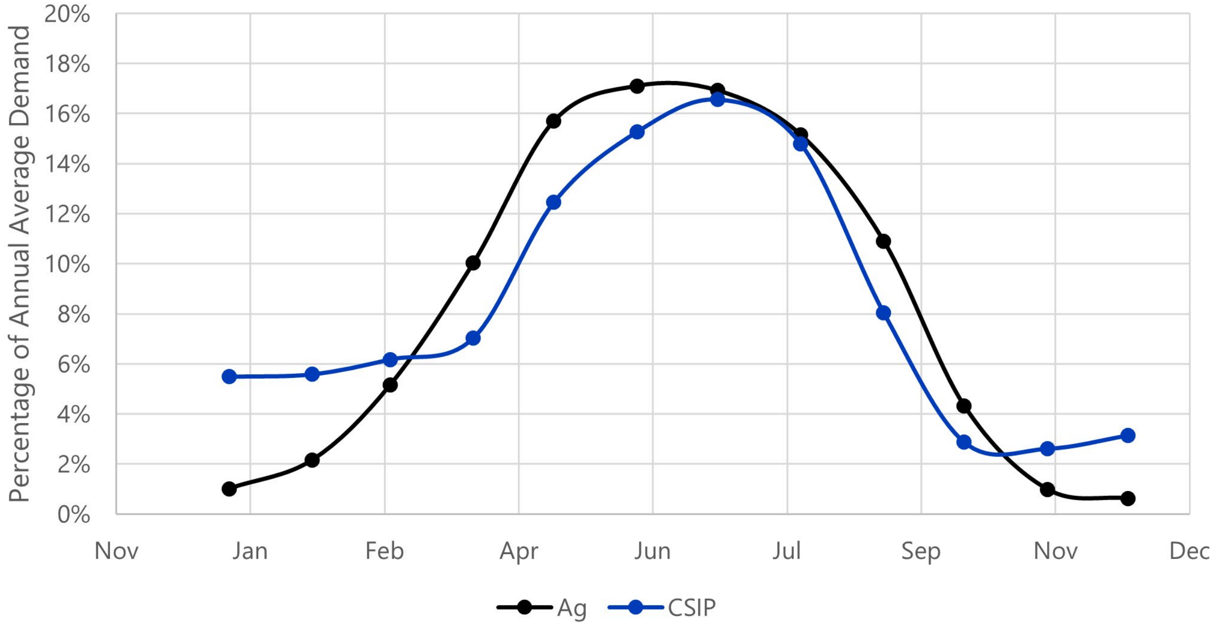


Figure 5 Agricultural Water Use Seasonality

2.2.2 Urban Water Users

The demand volumes for urban users were calculated from raw Groundwater Extraction Management System (GEMS) data tracked by MCWRA and organized into monthly averages for the last 10 years (water years [WYs] 2013 through 2022). Urban water user demand fluctuates based on seasonality. For urban end users in the study area, water usage increases in the summer months with a 56 percent increase over winter demands during the summer peak. The data used in calculating seasonality factors and end user demand volumes was from GEMS and the California State Water Resources Control Board databases. Figure 6 shows the urban water users within the study area while Figure 7 shows the seasonality of the urban demands and how they vary over time.

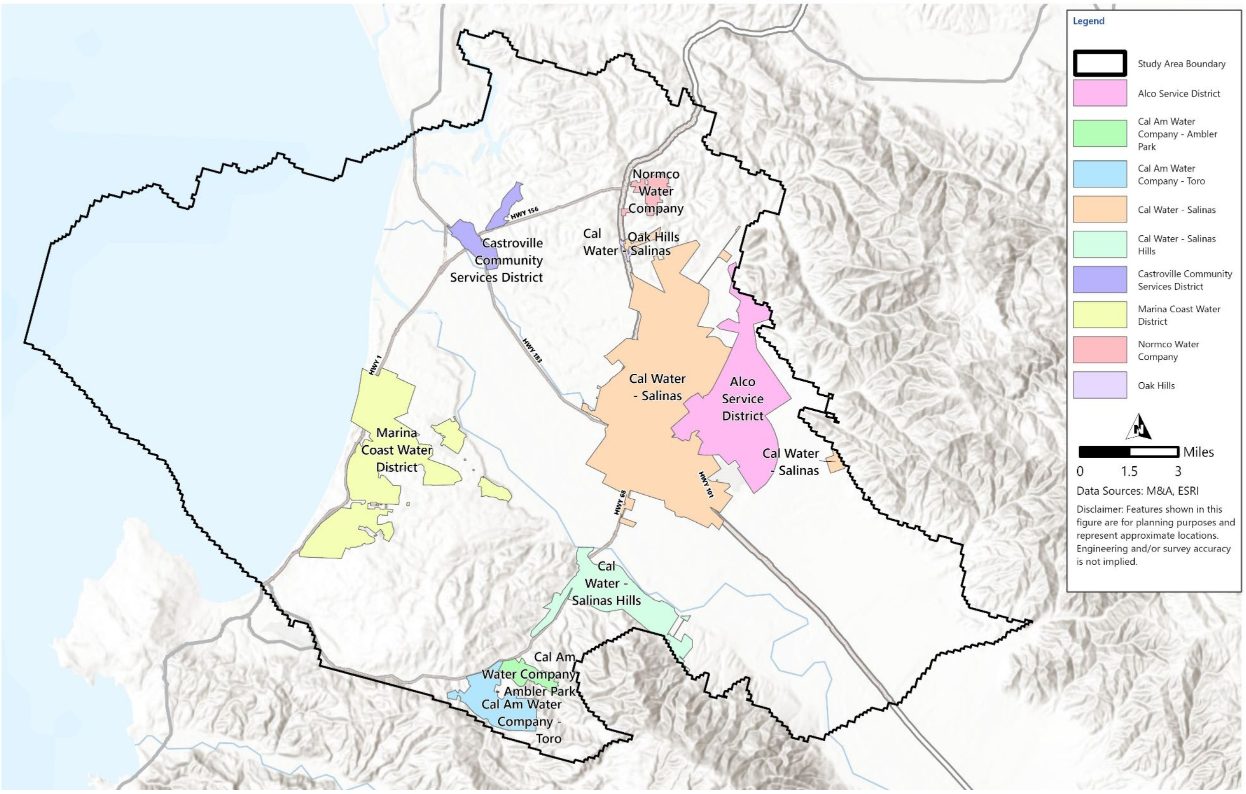


Figure 6 Urban Water Users

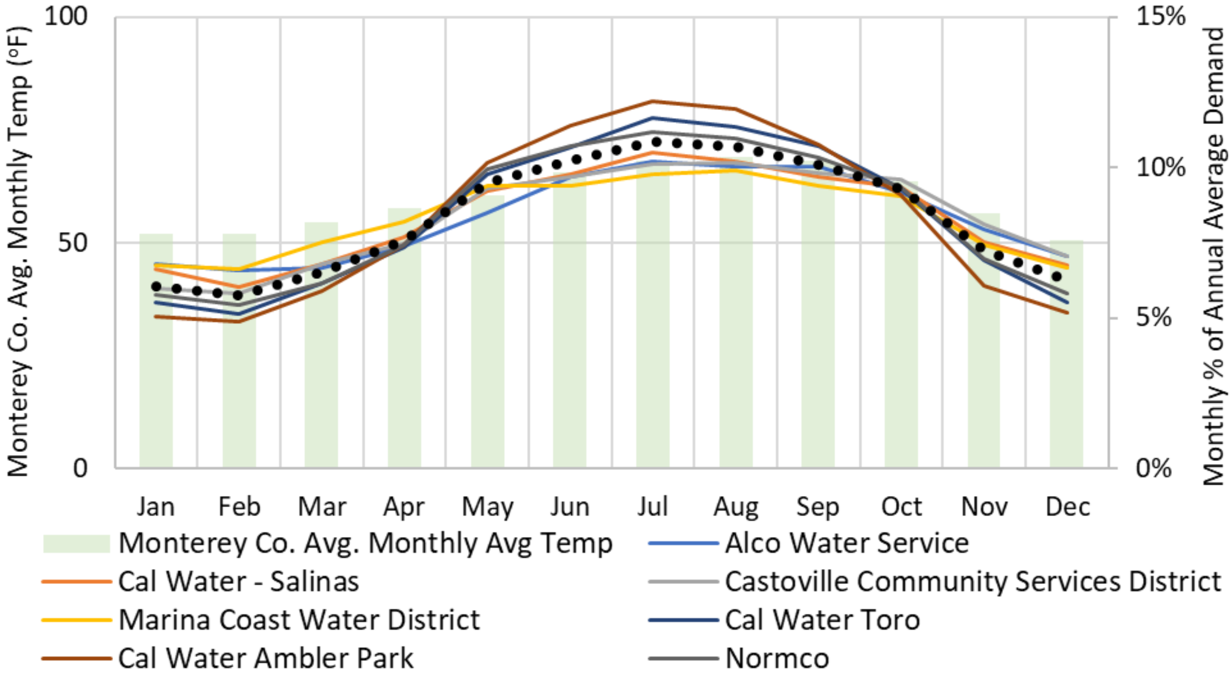


Figure 7 Urban Water Users Seasonality of Demands

The following sections provide further details about each of the potential urban water end users identified for the project scenarios with direct delivery of treated water supplies: Alco, Cal Water – Salinas, MCWD, CCSD, Cal Water – Salinas Hills, California American Water Company (Cal Am) – Toro, Cal Am – Ambler Park, Cal Water – Oak Hills, and Normco Water Company (Normco). Figure 8 shows the 10-year (2014 to 2023) monthly average use.

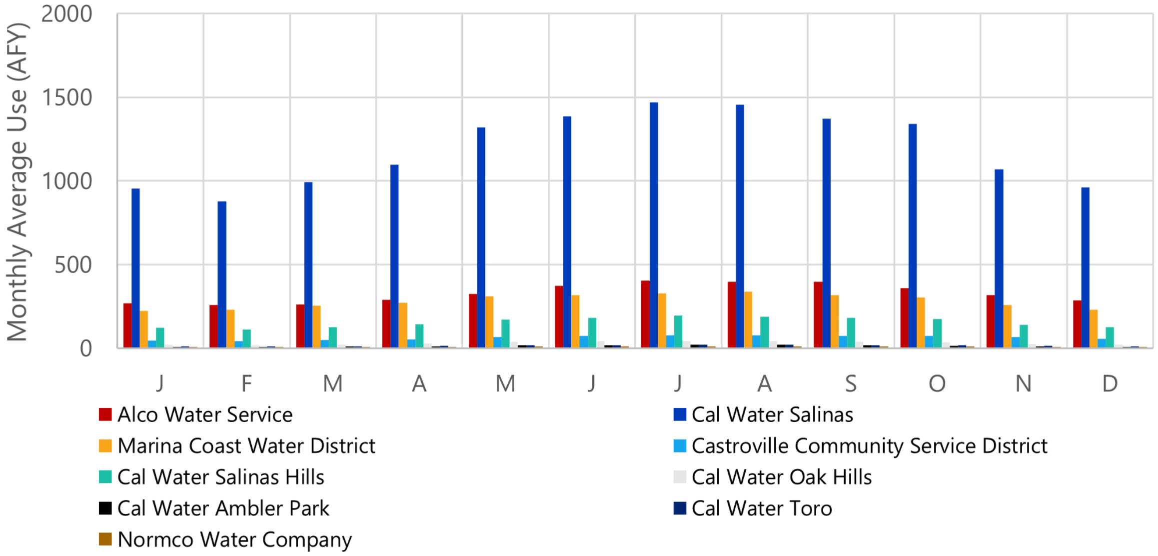


Figure 8 10-Year Monthly Averages for Urban End Users

2.2.2.1 Alisal Water Service Company

Alco is one of two California Public Utilities Commission regulated private water utilities in the City of Salinas that serves the east side of the city and adjacent unincorporated areas. Alco's 10-year average demand is 4,027 acre-feet per year (AFY) with peak usage in July and lowest usage in January. While Alco implemented conservation efforts during the last major drought period, 2015 to 2020, demand increased between 2020 through 2022. This system is supplied by local groundwater.

2.2.2.2 California Water Service – Salinas

Cal Water – Salinas main system serves most of the City of Salinas. Cal Water's 10-year average demand is 13,572 AFY with peak usage in July and lowest usage in February. This system is supplied by local groundwater.

2.2.2.3 Marina Coast Water District

MCWD serves the City of Marina and is directly north of the City of Seaside. MCWD's 10-year average demand is 3,214 AFY with peak usage in July and lowest usage in February. This system is supplied by local groundwater. Marina coast also receives recycled water from M1W for non-potable irrigation uses.

2.2.2.4 Castroville Community Services District

CCSD serves the unincorporated community of Castroville. CCSD's 10-year average annual demand for is 738 AFY with peak usage in July and lowest usage in February. Historical average demands were around 800 AFY prior to the 2012 to 2016 drought, and through conservation efforts, CCSD has seen a reduction in demands. This system is supplied by local groundwater.

2.2.2.5 California Water Service – Salinas Hills

Cal Water – Salinas Hills provides water service to residential areas in the Monterey Subbasin/Corral de Tierra Management Area. Cal Water – Salinas Hills has 10-year average demand of 1,863 AFY. This system is supplied by local groundwater. Salinas Hills also uses recycled water for non-potable irrigation use.

2.2.2.6 California Water Service – Oak Hills

Cal Water – Oak Hills provides water service to a subdivision east of Castroville. It has a 10-year average demand of 123 AFY. This system is supplied by local groundwater.

2.2.2.7 California American Water Company – Toro and Ambler Park

Cal Am's Ambler Park and Toro satellite systems serve residential subdivisions in the Monterey Subbasin/Corral de Tierra Management Area and have a 10-year annual average demand of 189 and 163 AFY, respectively, with the maximum usage in July and lowest usage in January/February. These systems are supplied by local groundwater.

2.2.2.8 Normco Water Company

Normco provides water service to a small community located directly north of the City of Salinas adjacent to Highway 101, operated by the Pajaro Sunny Mesa Community Services District. This water system serves a portion of the unincorporated community of Prunedale. It is surrounded by several smaller water companies serving the remainder of the area along with domestic wells. Normco relies solely on local groundwater and does not receive water from outside of the area. The 10-year annual average demand for Normco is 106 AFY.

SECTION 3 DESCRIPTION OF PROJECT SCENARIOS

3.1 Introduction to the Brackish Groundwater Restoration Project

The elements of the BRGP include constructing a series of extraction wells to form a hydraulic barrier by continuously extracting brackish groundwater and capturing seawater where the Monterey Bay interfaces with the freshwater aquifers along the coastline of the 180/400 and Monterey Subbasins. The extraction wells generate significant volumes of brackish water (a mixture of freshwater and seawater) that will be desalted and used as a new potable water supply, as identified in the GSP's regional municipal supply project. The treated water is also available for injection into the 180-Foot and 400-Foot Aquifers, further enhancing the barrier against seawater intrusion on the inland side. Figure 9 shows a conceptual diagram outlining how the BGRP would work.

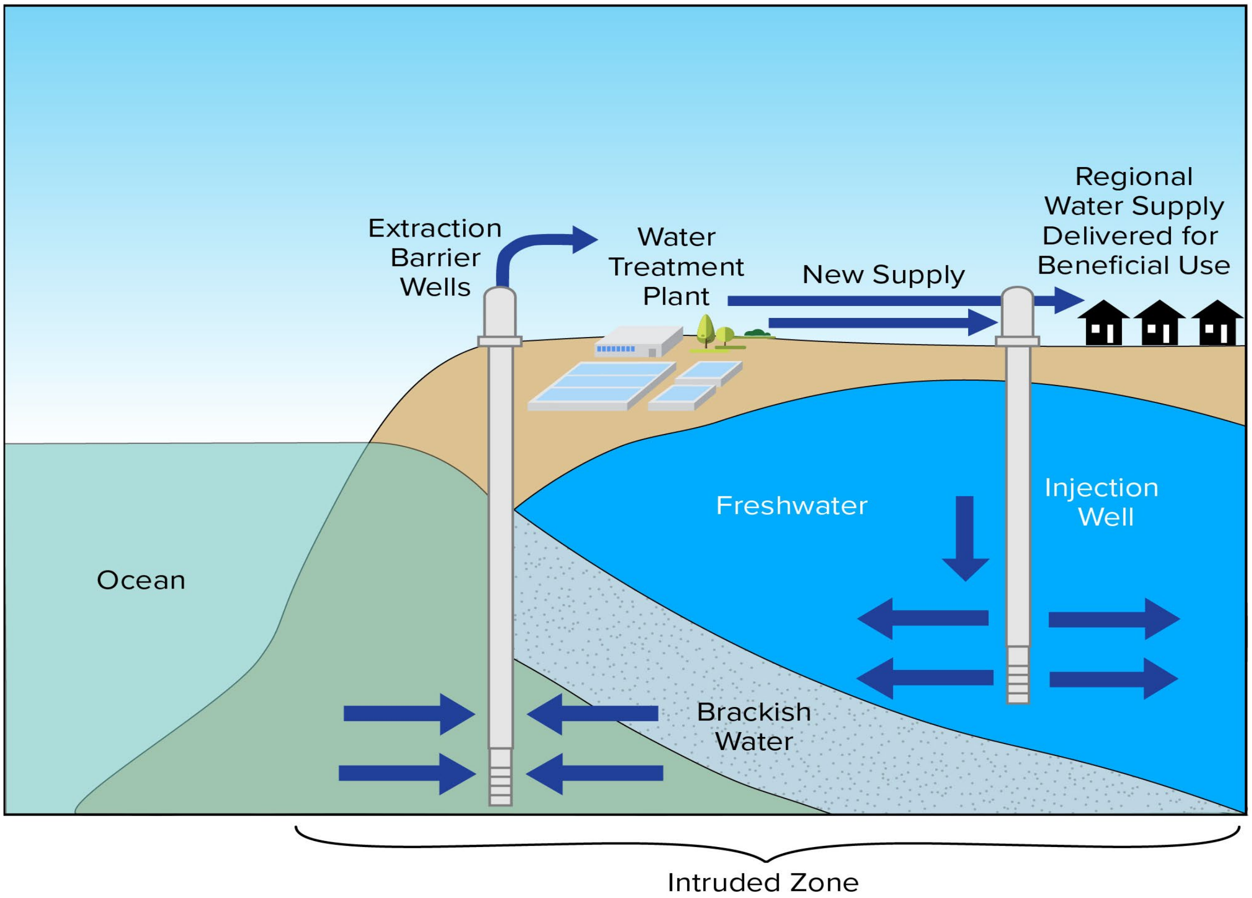


Figure 9 Brackish Groundwater Restoration Project Concept

The BGRP is intended to both protect against further seawater intrusion and improve existing groundwater quality. A landward hydraulic gradient has been created from the ocean towards supply wells due to historical and ongoing groundwater extractions that have chronically lowered groundwater levels below sea level, allowing seawater to migrate inland. The project reverses this gradient, using the extraction barrier to draw existing intruded (brackish) water back towards the coastline and improve groundwater quality over time. Additionally, the extracted brackish water will be treated and used to augment or offset groundwater uses inland. Both direct delivery of an in-lieu water supply to reduce groundwater pumping or injection of treated water raises groundwater levels, helping to reverse the inland migration of seawater intrusion.

Brackish water treatment technology can be performed by multiple different methods. The technology selected for this study was RO due to its typical use in brackish and ocean water treatment applications. RO utilizes cartridge membranes under pressure with extremely small openings to filter out constituents. RO has two products as result of this process—permeate which is the potable product water that is filtered and RO concentrate (ROC) which is the reject or waste from the RO process that has a concentrated level of constituents that were removed through the membrane filtration. ROC is typically sent to a disposal point, such as an ocean outfall pipeline. In this case the ROC would be sent to the M1W ocean outfall. Initial investigations into outfall mixing indicated that the outfall could be adequately configured to meet regulatory requirements, although diffuser modifications may be required.

The RO treatment facility would receive the extracted water from the seawater intrusion extraction barrier wells. Feed water would be treated through a two-pass, multiple-stage RO system to ensure compliance with permeate water quality targets. The RO configuration was determined based on several parameters: desired recovery, influent flow rate, feed and concentrate pressures, membrane fluxes, and required permeate water quality. The RO permeate water quality goal was preliminarily set to ensure compliance with the State of California's established drinking water maximum contaminant levels (MCLs), secondary MCLs, notification levels, and the Central Coast Basin Plan water quality objectives. The RO design is mainly governed by the Basin Plan boron limit of 0.2 mg/L for groundwater in the 400-Foot Aquifer, where injection of RO permeate water might potentially occur. To reach this boron limit with a sufficient factor of safety, a two-pass system is likely required, based on the limited data available for this feasibility analysis. The effective recovery of the entire RO system is estimated to be 70 percent.

3.2 Development of Project Scenarios

This section describes the approach for developing project scenarios and the modeling results by M&A. While initial project scenarios focused on direct deliveries with the treated water, the seasonal nature of water demands in the study area (as discussed in Section 2) did not allow for efficient and effective operation of either the extraction wells or the treatment, both of which require relatively consistent volumes to maintain efficacy. Injection wells were added to the scenarios to accommodate the winter season excess treated water flows (due to low irrigation and drinking water demands). An injection-only scenario with no direct deliveries was added to determine if it would be as effective at mitigating seawater intrusion and a way to potentially reduce delivery pipeline lengths and associated costs. The cumulative investigation has led to the development of seven project scenarios that vary in their volumes produced, type of delivery, and location. The seven scenarios represent a range of possible solutions to meet the subbasin's MTs. The seven BGRP scenarios considered are:

1. Extraction, Treatment, and Direct Deliveries Plus Injection – Small.
2. Extraction, Treatment, and Direct Deliveries Plus Injection – Medium.
3. Extraction, Treatment, and Direct Deliveries Plus Injection – Large.
4. Extraction, Treatment, and Injection Only.
5. Extraction, Treatment, and Eastside Injection.
6. Extraction North of the Salinas River, Treatment, and Direct Deliveries Plus Injection.
7. Extraction From the 180-Foot Aquifer, Treatment, and Injection in the 400-Foot Aquifer.

3.2.1 Groundwater Sustainability Plan Sustainable Management Criteria

The GSP established specific sustainability indicators (shown in Table 1) that are used for this project's evaluation criteria. An MO in the GSP, defined as bringing the 500 mg/L chloride isocontour back to Highway 1, reflects the subbasin's long term goals for sustainable groundwater conditions. An MT is the quantitative value that represents the groundwater conditions that, when exceeded, may cause an undesirable result in the basin. At the minimum, the selected project needs to meet the MT for seawater intrusion, which is defined as the 2017 location of the 500 mg/L chloride concentration contour.

3.2.2 Modeling Background

The SWI Model is a regional groundwater flow and transport model developed by M&A to simulate seawater intrusion in the Salinas Valley Groundwater Basin (M&A 2023 and 2024). The SWI Model is a regional variable-density groundwater flow and solute transport model that is capable of simulating changes in chloride concentration over time (M&A 2023 and 2024). It is calibrated to historical groundwater elevations and the historical rate and direction of seawater intrusion, based largely on the 500 mg/L chloride isocontours developed by MCWRA. The SWI Model simulates groundwater conditions on a regional scale and may not reflect specific conditions in any specific location.

The predictive version of the SWI Model was first used to estimate future groundwater conditions if no new projects and management actions are implemented (M&A 2024). This baseline scenario is a status quo scenario referred to as the No Project scenario. It continues current or recent conditions into the future: recent pumping (WY 2016 to WY 2020 average), an average hydrologic period, and no climate change or sea level rise.

The predictive version of the SWI Model simulates potential seawater intrusion from WY 2021 through WY 2070. Project scenarios are developed by modifying the No Project scenario to evaluate the effectiveness of various management strategies. For the BGRP, these modifications include the addition of extraction and injection wells, as well as the elimination or offset of groundwater pumping by selected users who receive treated water from the project. Each scenario varies the well locations, the numbers of wells, extraction and injection rates, and pumping offsets for existing groundwater users. Project scenarios are then assessed by comparing model outputs to the No Project scenario model outputs and the MT for seawater intrusion at 2040 and 2070. This report focuses on the model outputs at 2040; the date at which seawater intrusion must meet the MTs. However, seawater intrusion must be controlled through the full SGMA implementation timeframe to at least 2070, so Appendix A includes a TM about the BGRP modeling that shows model results through 2070. Key outputs from groundwater modeling, such as chloride concentration of extracted water, are used to inform the design and sizing of the treatment plant, ensuring alignment between engineering design and groundwater objectives.

3.2.3 Modeling Assumption

The SWI Model No Project scenario includes the following assumptions:

- Land use remains constant throughout the simulation. The average groundwater demands from the last five years of the historical SWI Model (WYs 2016 to 2020 monthly average) are carried forward.
- Boundary conditions are a continuation of recent hydrologic conditions (WYs 1996 to 2018) in the Salinas Valley.
- Climate change and sea level rise are not simulated.

BGRP scenarios include the same base assumptions as the No Project scenario in addition to the following:

- **Project Timing:** The model assumes that projects will be implemented by WY 2031 and operate continuously through WY 2070.
- **Extraction Volume:** Volume of extracted water is dependent upon the scenario modeled.
- **End Users:** Groundwater users that are provided with treated water in some of the BGRP modeling simulations include a group of public water systems and agricultural groundwater users within the study area that are a reasonable distance for water deliveries. The group of end users and volume of water received varies by the scenario modeled. The end users included in the scenarios do not represent any commitment to receiving treated water in the BGRP feasibility study or at this point in the project evaluation. Water that is extracted will stay within the Salinas Valley area (e.g., no water exports).
- **Injection Well Locations:** Injection well locations were selected at the inland edge of the seawater intrusion front, so injected water would help push the brackish intruded water back towards the ocean.

Table 1 180/400 Subbasin GSP Sustainable Management Criteria Selected for Project Evaluation Criteria

GSP SMC	MO(1)	MT	Basis for Selection or Removal
Chronic Lowering of Groundwater Levels	Achieve 2003 groundwater elevations.	Achieve groundwater elevations 1 foot above 2015 groundwater elevations.	**Selected.** A new extraction barrier will impact groundwater levels in the vicinity of the extraction wells, which will need to be mitigated. Groundwater levels outside of the zone of influence of the new wells will be evaluated to assess benefit of project.
Reduction in Groundwater Storage	Zero reduction in storage when groundwater elevations held at MO (2003 elevations) and are at the seawater intrusion MO.	626,000 AF below MO. Based on MOs and MTs for groundwater elevations (1 foot above 2015 groundwater elevations) and seawater intrusion.	**Removed from consideration.** Tied to chronic lowering of groundwater level SMC and seawater intrusion SMC which will be evaluated as a fatal flaw criterion. Can be evaluated by proxy.
Seawater Intrusion	Reduce seawater intrusion extent to the Highway 1 line for all aquifers.	Reduce seawater intrusion to the 2017 extent of the 500 mg/L chloride isocontour for the 180-Foot and 400-Foot Aquifers and the Highway 1 line for the Deep Aquifers.	**Selected.** Used as the basis for alternative development and selection. Note that the MT and MO for the Deep Aquifers were not included in this study.
Degraded Groundwater Quality	Set to a target number of wells above the regulatory exceedance standard or agricultural limits for each constituent of concern. MO is dependent on water quality parameter and dependent on end use of the water (urban or agricultural).	Set to a target number of wells known to exist above the regulatory exceedance standard or agricultural limits for each constituent of concern. MT is dependent on water quality parameter and dependent on end use of the water (urban or agricultural).	**Removed from consideration.** Groundwater model tracks water quality related to seawater intrusion. Additional water quality data will not be used as an evaluation criterion for this project.
Land Subsidence	Zero net long-term subsidence.	Zero net long-term subsidence.	**Removed from consideration.** Land subsidence is not a concern in the 180/400 Subbasin.
Depletion of Interconnected Surface Water	Established by proxy to the MO for chronic lowering of groundwater levels (2003 elevations).	Established by proxy to the MT for chronic lowering of groundwater levels (1 foot above 2015 groundwater elevations).	**Selected.** Use area with some interconnection in northern area of the subbasin (no aquitard in that area) where groundwater levels are higher. Suggested to use this metric as a fatal flaw since depletion of interconnected surface water is limited to one area.

Notes:
SMC - Sustainability Management Criteria.
(1) MO may be subject to change depending on feasibility of meeting MT and MO.

3.2.4 Measuring Modeled Scenario Effectiveness

The model scenarios are evaluated based on the following criteria:

- Location of the simulated 500 mg/L chloride isocontour in 2040 compared to the 2017 simulated 500 mg/L chloride isocontour (represents MT) and the No Project scenario 2040 simulated 500 mg/L chloride isocontour.
- Change in the simulated spatial distribution of chloride within the seawater intruded area, showing the extent and location of the high salinity areas.
- Change in average groundwater levels from the beginning of the simulation to the end of the simulation.

Two additional criteria used to evaluate model scenarios are included in Appendix A, but not detailed here.

- Change in the simulated area impacted by chloride concentrations greater than 500 mg/L to the east of the extraction barrier (BGRP scenarios only).
- Change in the simulated mass of chloride within the seawater intruded area east of the extraction barrier (BGRP scenarios only).

3.3 Brackish Groundwater Restoration Project Scenarios

The section provides more detail about each scenario analyzed in this study. The description of each project scenario includes: 1) the supply and demand volumes of extracted groundwater and treated water delivered, 2) the treatment process and outfall analysis, 3) a planning level cost estimate separated by major infrastructure component, and 4) the modeled results of the scenario's effect on seawater intrusion. For each scenario costs are presented for the estimated capital construction and soft costs as well as operations and maintenance (O&M) costs. It is assumed that the RO treatment recovery for the scenarios is set at 70 percent, which means that the product water available is approximately 70 percent of the total water volume from the extraction wells. The remaining 30 percent is sent to the M1W ocean outfall as the ROC waste product.

3.3.1 No Project Scenario

The No Project scenario simulates seawater intrusion if current groundwater extraction practices continue uninterrupted at the same rate with no new projects or management actions. In the No Project scenario, seawater intrusion in the 180-Foot and 400-Foot Aquifers continues advancing inland from 2020 through 2040 as shown in Figure 10. Seawater advances inland because inland groundwater elevations remain below sea level and the resulting hydraulic gradient draws seawater inland. Seawater intrusion progresses inland toward the City of Salinas in both the 180-Foot and 400-Foot Aquifers. Figures 10 and 11 show the seawater intrusion under the No Project scenario for the 180-Foot and 400-Foot Aquifers, respectively, and will exceed the MTs, likely resulting in the subbasin being placed on probation. Figures 12 and 13 show the chloride concentrations for the 180-Foot and 400-Foot Aquifers, respectively. The 180-Foot and 400-Foot Aquifers do not exist in the Eastside Subbasin; the chloride concentrations shown on Figures 12 and 13 extend into Eastside Subbasin sediments at equivalent depths to the 180-Foot and 400-Foot Aquifers. These are referred to as the 180-Foot Equivalent and 400-Foot Equivalent aquifers in this report.

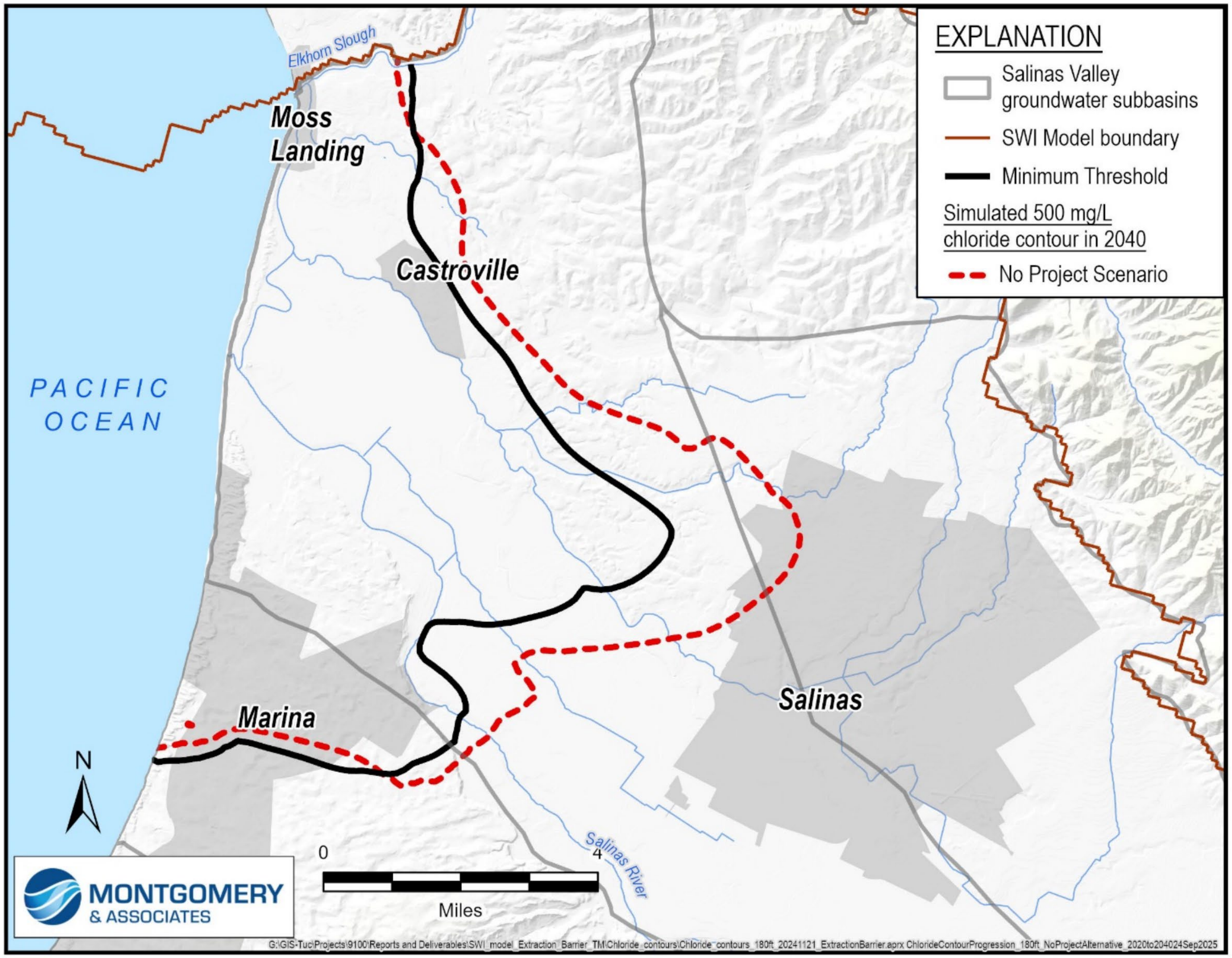


Figure 10 No Project Scenario 180-Foot Aquifers

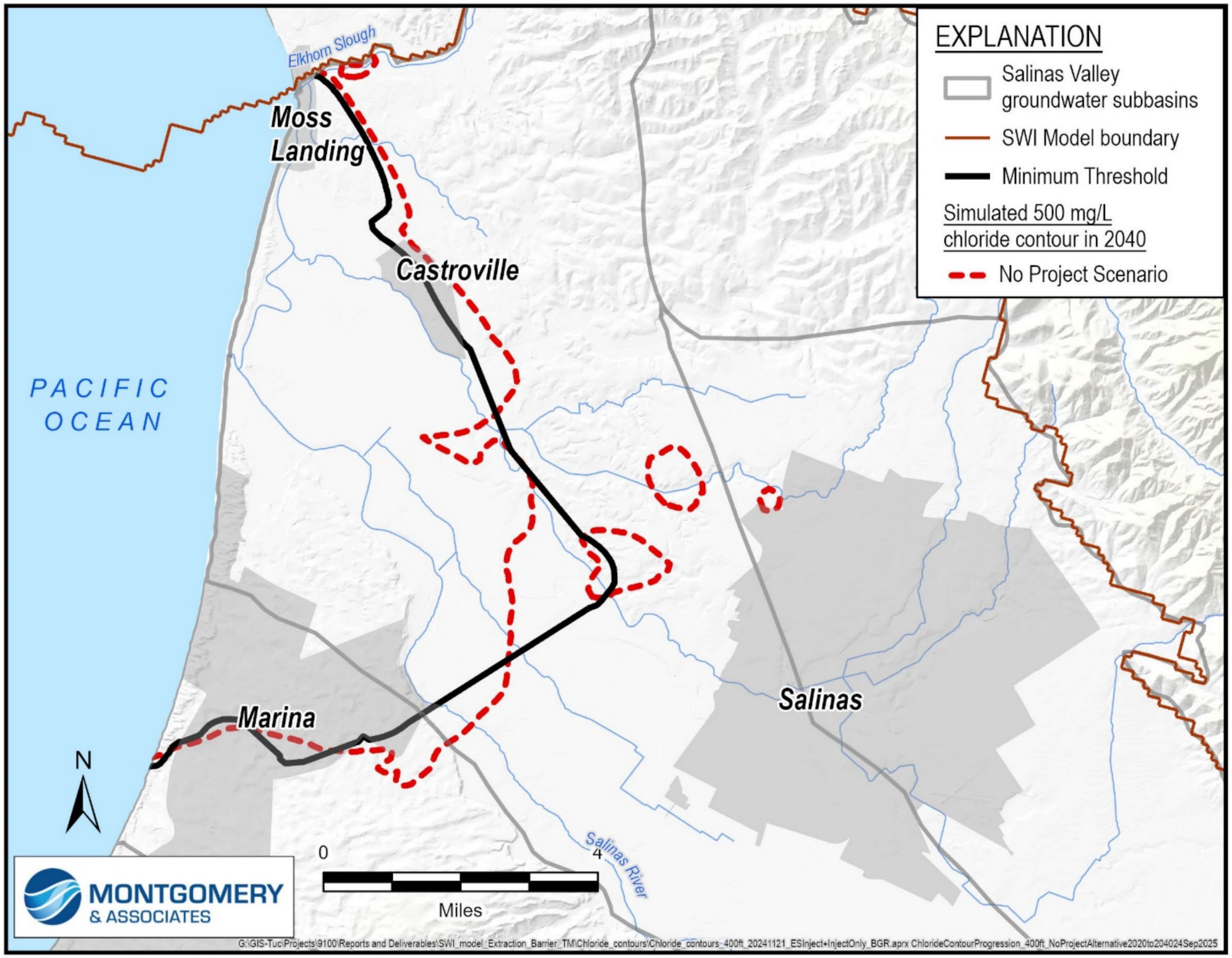


Figure 11 No Project Scenario 400-Foot Aquifer

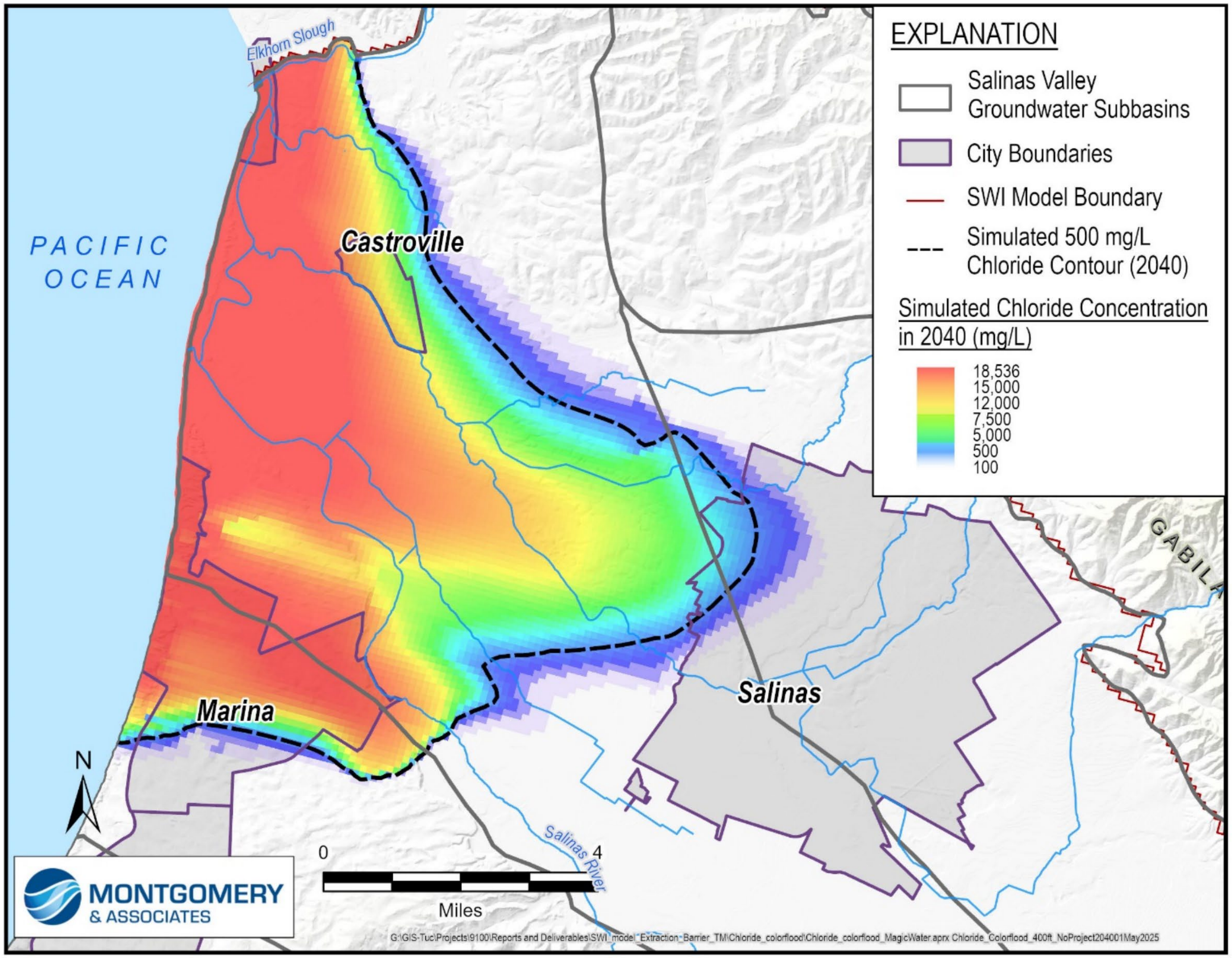


Figure 12 No Project Scenario Chloride Concentration Map 180-Foot Aquifer

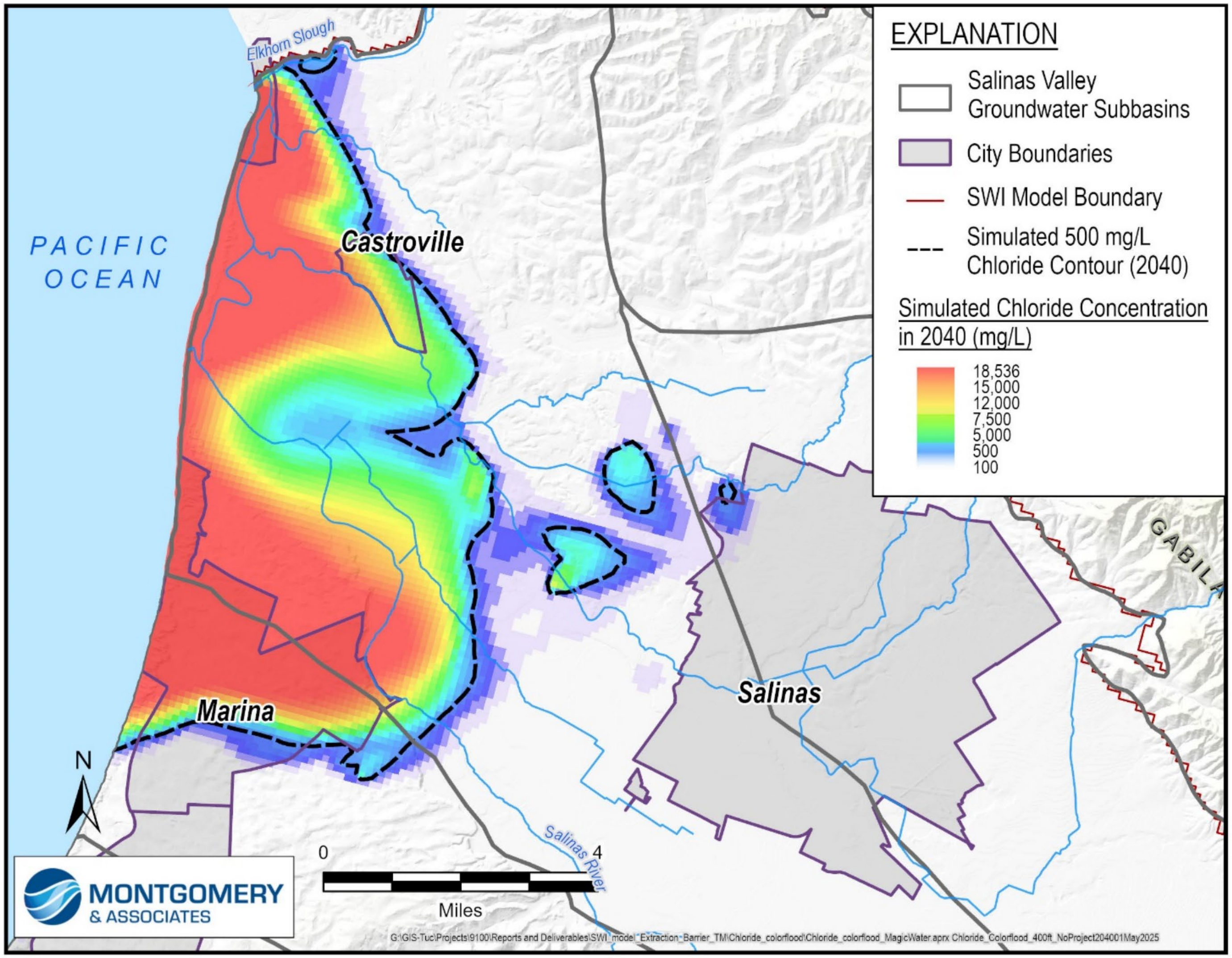


Figure 13 No Project Scenario Chloride Concentration Map 400-Foot Aquifer

3.3.2 Small Project Scenario

The Small Project scenario is designed around the minimal amount of groundwater extraction that would enable the extraction and injection wells to effectively inhibit the progression of seawater intrusion inland. The Small Project scenario includes 12 groundwater extraction wells with 6 in each of the 180-Foot and the 400-Foot Aquifers. The Small Project scenario includes nine potable water inland injection wells with five in the 180-Foot Aquifer and four in the 400-Foot Aquifer.

End users served in the Small Project scenario include urban users (CCSD, MCWD, Cal Water – Salinas, and Alco) and CSIP (to offset their supplemental well usage). However, the treated water deliveries to each end user would not offset their peak demands. While 100 percent of CCSD and CSIP supplemental well pumping is supplied, only a portion of Alco (72 percent), Cal Water – Salinas (62 percent), and MCWD (47 percent) demand is offset. CSIP's demand increased to approximately 146 percent of their current groundwater capacity, recognizing that the CSIP system has lost well capacity. The pumping rate of the CSIP supplemental wells for WYs 2016 to 2020 and simulated in the No Project scenario is 3,600 AFY. Based on the WYs 2014 to 2023 GEMS pumping data, Carollo Engineers estimated that future demand for the CSIP supplemental wells is 5,300 AFY. For this reason, a 100 percent offset of CSIP supplemental well pumping is represented as 5,300 AFY of delivered treated water.

The following sections provide the Small Project scenario details. Figure 14 shows the Small Project infrastructure layout. Pipe diameters for the potable distribution system were sized based on the average day demand during the maximum demand month, which was typically July. Note that the seasonality factors for agricultural end use are much higher than urban users, therefore requiring larger pipes for deliveries to CSIP and other common transmission mains that share demands with agricultural users. It is assumed that all end users would utilize groundwater as the source of supply to meet peak demands above the delivered amount. The supply provided is assumed to cover the average day demand, however existing wells would remain operational to be able to cover peak day and peak hour demands as needed on a day-to-day basis, as well as a backup source of supply should in-lieu delivery from the BGRP be interrupted under emergency conditions.

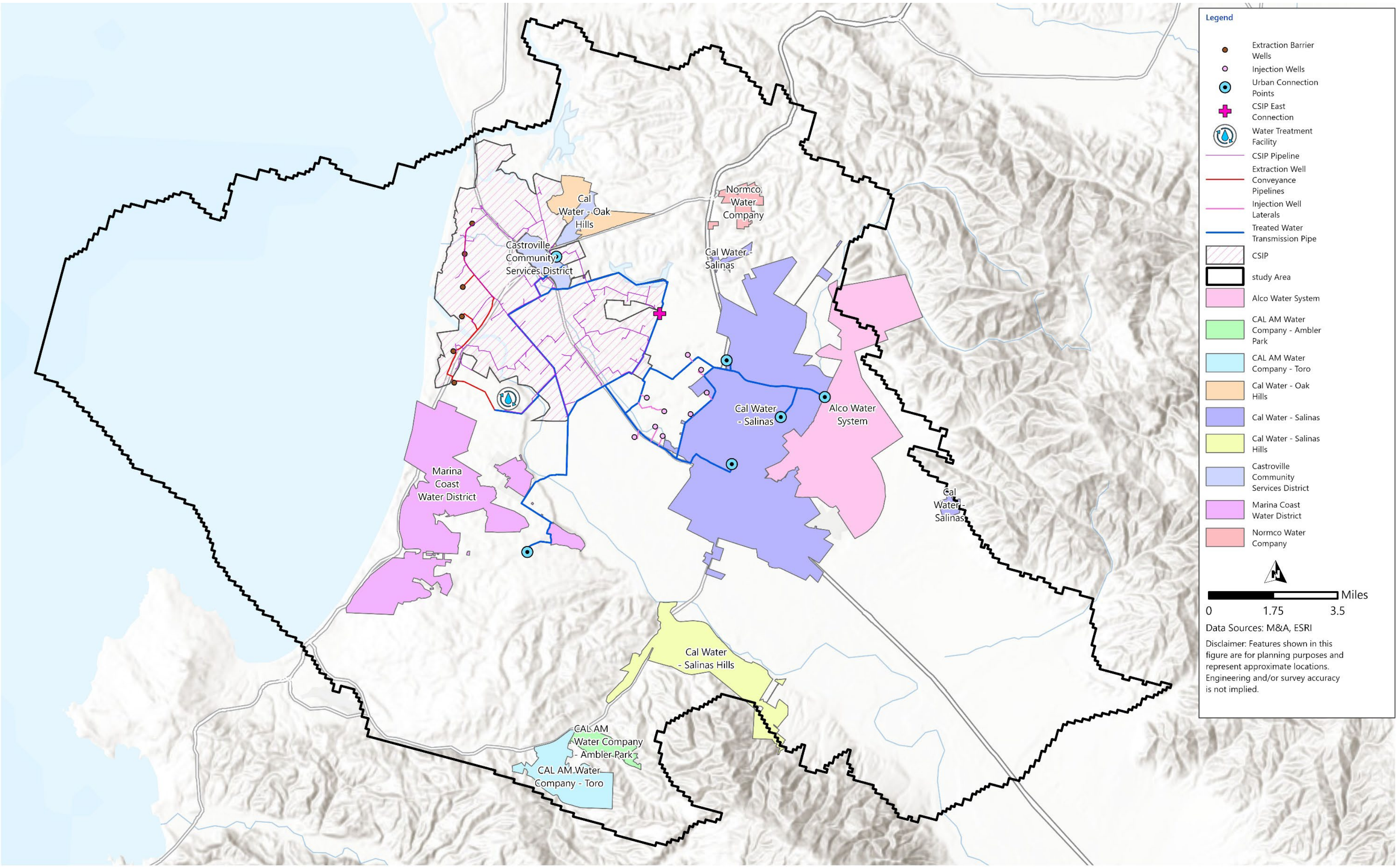


Figure 14 Small Project Scenario

3.3.2.1 Supply and Demand Volumes

Table 2 lists the extraction volume of the 12 extraction wells and the corresponding set of end users. The total volume extracted would be 24,600 gallons per minute (gpm) or about 39,700 AFY. Assuming a 70 percent RO recovery for product water development at the water treatment facility, the total available water volume for distribution would be approximately 28,000 AFY. Figure 15 shows the monthly demand of the end users listed in Table 2 using the seasonality factors discussed in Section 2 with respect to the available monthly potable supply available for distribution. Note in Figure 15, the total production supply is shown as an average monthly supply since the extraction volumes are assumed to be constant throughout the year. Excess monthly supply would be used for inland injection wells. The volume injected is calculated as the difference between the average monthly supply and the total monthly end user demand for the Small Project.

Table 2 Small Project Supply and Demand Volumes

Supply Volume(1)	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	14,500
Total Extraction Capacity in 400-Foot Aquifer (gpm)	10,100
Total (gpm)	24,600
Total Extracted Volume (AFY)	39,700
Total Treated Potable Volume (AFY) at 70% Recovery(2)	28,000
Demand (AFY)	
Alco	2,900
Cal Water – Salinas	9,000
CCSD	700
MCWD	1,500
CSIP	5,300
Small Project End User Demand Subtotal	19,400
Modeled Injection Volume (AFY)	8,600
Small Project Demand Total (AFY)	**28,000**
Total Demand % of Total Supply	**70%**

Notes:

(1) Extraction well volumes are in gpm, unless noted otherwise.

(2) Percent of total treated extracted water used for injection was estimated using a 70 percent treatment recovery for the total potable water supply.

(3) Rates rounded to the nearest 100.

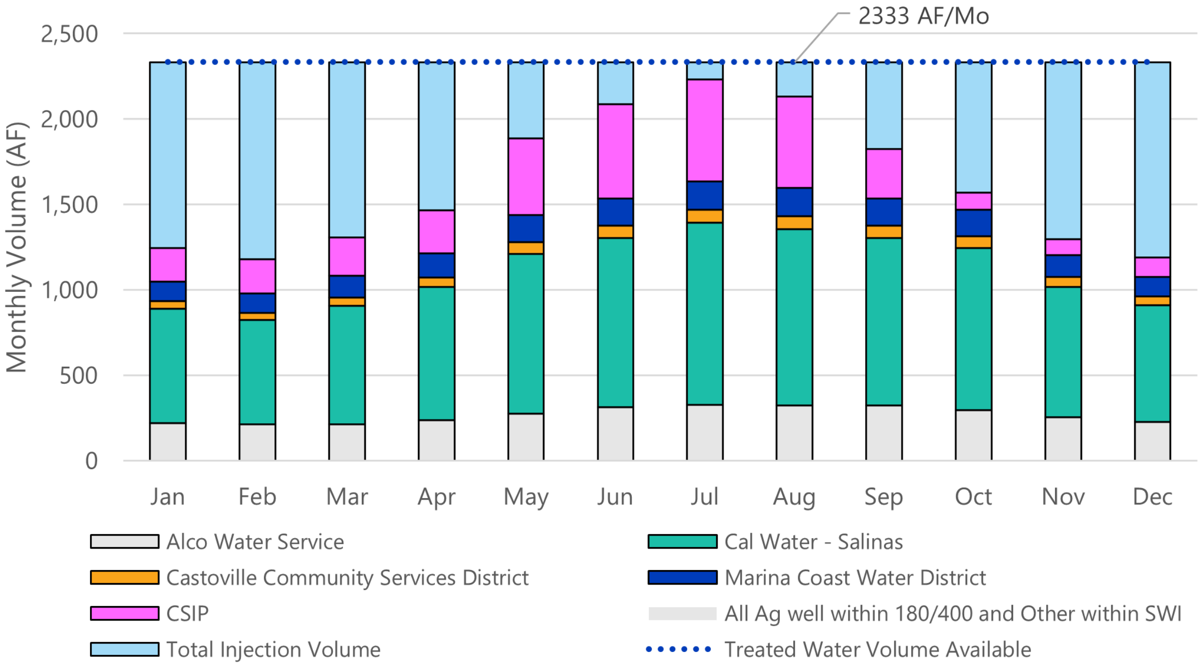


Figure 15 Small Project Monthly Demand of End Users and Injection Volume

3.3.2.2 Water Treatment and Outfall

As discussed in Section 3.1, RO treatment technology would be used for treatment due to its proven performance and efficiency with treating brackish and ocean water for potable water purposes. The Small Project includes a two-pass RO system to reduce the elevated boron concentration found in the influent water. The Small Project also includes an ROC storage pond that will be used to store one day of ROC when the outfall is offline or is unable to accept additional flows during significant wet weather events. Although the feasibility study has not yet evaluated treatment facility locations, it is assumed that it would require a 10-acre site.

To determine the number of membranes and pressure vessels needed for the RO system, it was assumed that 100 percent of the flow from the extraction wells would be processed through the RO facility. Additionally, feed and concentrate pressures were kept below 1,100 pounds per square inch (psi) to prevent membrane failure, and the fluxes through the first membrane elements of each stage for each pass were balanced by adjusting permeate and booster pressures to ensure optimal permeate water quality. The total number of membrane elements required per pass was calculated by dividing the permeate flow by the membrane flux rate and membrane area. The number of membranes required for the Small Project is outlined in Table 3.

Table 3 Small Project Membrane Configuration

Pass	Permeate Flow (mgd)	Flux (gfd)	Membrane Area per Element (ft^2)	Number of Membrane Elements
1	26.62	9.3	400	7,187
2	23.94	16.2	400	3,695

Notes:
ft^2 - square feet; gfd - gallons per square foot per day; mgd - million gallons per day.

Outfall improvements for any of the scenarios would be required consisting of a 60-degree elbow with a rubber duckbill check valve attached to each of the outfall diffusers in order to reach the minimum velocity necessary to achieve dilution.

3.3.2.3 Project Costs

The planning level cost estimate of the Small Project is shown in Table 4. Total project costs include both construction direct cost and soft costs. Soft costs represent an estimated planning, design, administrative, legal, and construction management cost based on percentages of the direct construction costs subtotal. Construction costs have a 30 percent contingency applied on each line item, an escalation to midpoint of a 0.25 percent cost increase per month (3 percent annual escalation) on present day costs to a midpoint of construction date of July 2030, and sales tax on an assumed 50 percent of the total direct costs. The total construction cost is shown for each of the major infrastructure components.

For planning purposes, this cost estimate assumes that the Project would be financed through a federal or state low interest loan program (e.g., State Revolving Fund [SRF] or Water Infrastructure Finance and Innovation Act [WIFIA]) with a 30-year repayment period. The projected lifecycle of the project was assumed to be the same as the groundwater model run, which is through the year 2070, resulting in a total lifecycle of 40 years. The O&M costs for the Small Project are estimated at approximately $69.3 million (M) with an annual financing cost of approximately $41.6M. Using a 4 percent interest and discount rate the annualized net present value of the Small Project is approximately $82.8M which results in an annualized project unit cost of $2,930 per AF. The use of $/AF per year is a useful metric when comparing cost of different water supplies and is commonly used in USBR feasibility studies. However, this metric of $/AF per year should not be construed to be the cost of water to any individual user as grant funding and financial planning to spread costs to all beneficiaries has not been completed.

Table 4 Small Project Costs

Project Component	Cost(1)
Well Sites	$ 43,500,000
Outfall Cleaning and Modification	$ 6,250,000
Extraction Distribution	$ 38,850,000
Treated Water Distribution Transmission Mains	$ 142,500,000
Treated Water Booster Pump	$ 7,000,000
Injection Well Sites	$ 37,250,000
ROC Storage	$ 2,100,000
Land Costs	$ 3,100,000
Water Treatment Facility Costs	$ 335,000,000
Construction Total	**$ 615,550,000**
Engineering Planning and Design (10%)	$ 61,560,000
Environmental Planning and Permitting (2%)	$ 12,310,000
Administrative and Legal (1%)	$ 6,160,000
Construction Management (4%)	$ 24,620,000
Soft Costs Subtotal	**$ 104,650,000**
Grand Total Project Cost	**$ 720,200,000**

Notes:

(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.2.4 Seawater Intrusion Mitigation Effectiveness

As shown in Figures 16 and 17 below, the Small Project reduces the amount of additional seawater intrusion between 2030 and 2040 relative to the No Project scenario. The black lines on Figures 16 and 17 are the simulated MT. However, the Small Project scenario's 500 mg/L chloride contour is not pulled back to the MT criterion in either the 180-Foot or 400-Foot Aquifers. Areas in the 180-Foot Aquifer, between Castroville and the City of Salinas, as well as between the cities of Marina and Salinas, extend beyond the MT line.

As shown in Figures 16 and 17, the extraction wells have a limited extent, straddling the mouth of the basin on either side of the Salinas River, but not extending completely across the entire intruded coastline. Figures 18 and 19 show the chloride concentrations resulting from the Small Project implementation for the 180-Foot and 400-Foot Aquifers, respectively. The dark blue area inland of the black dashed line represents areas that are above background chloride, but below the 500 mg/L threshold for seawater intrusion.

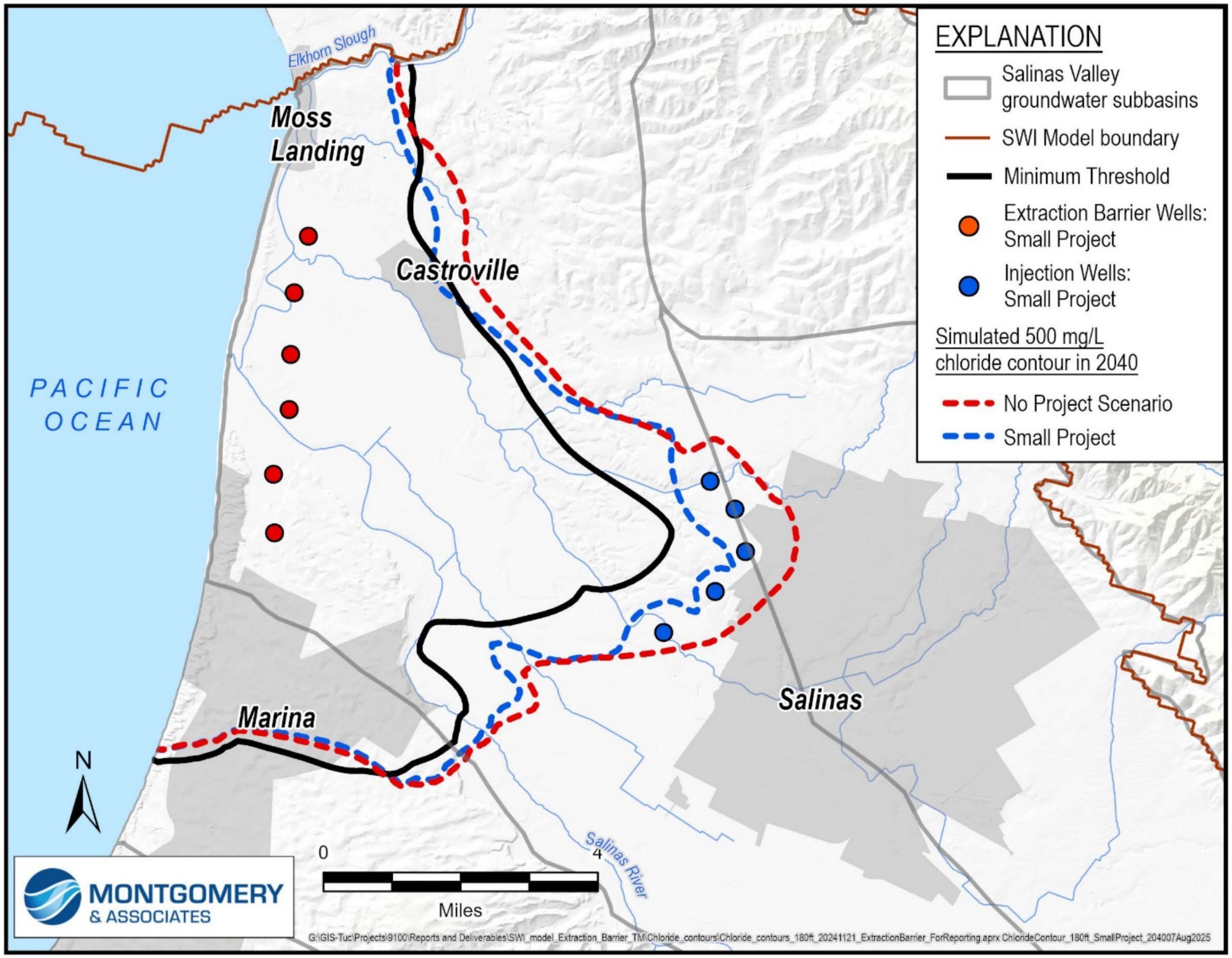


Figure 16 Small Project Modeling Results 180-Foot Aquifer

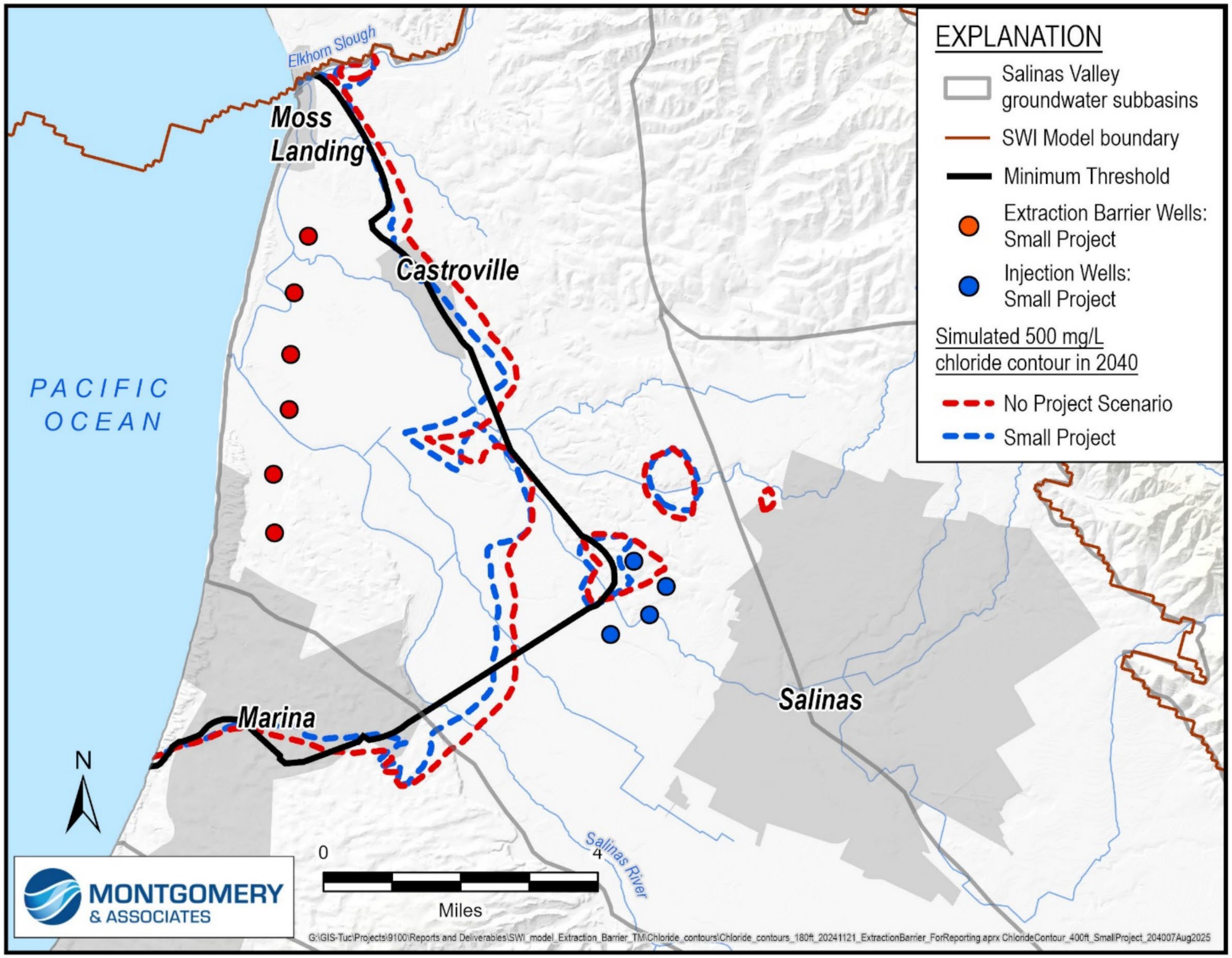


Figure 17 Small Project Modeling Results 400-Foot Aquifer

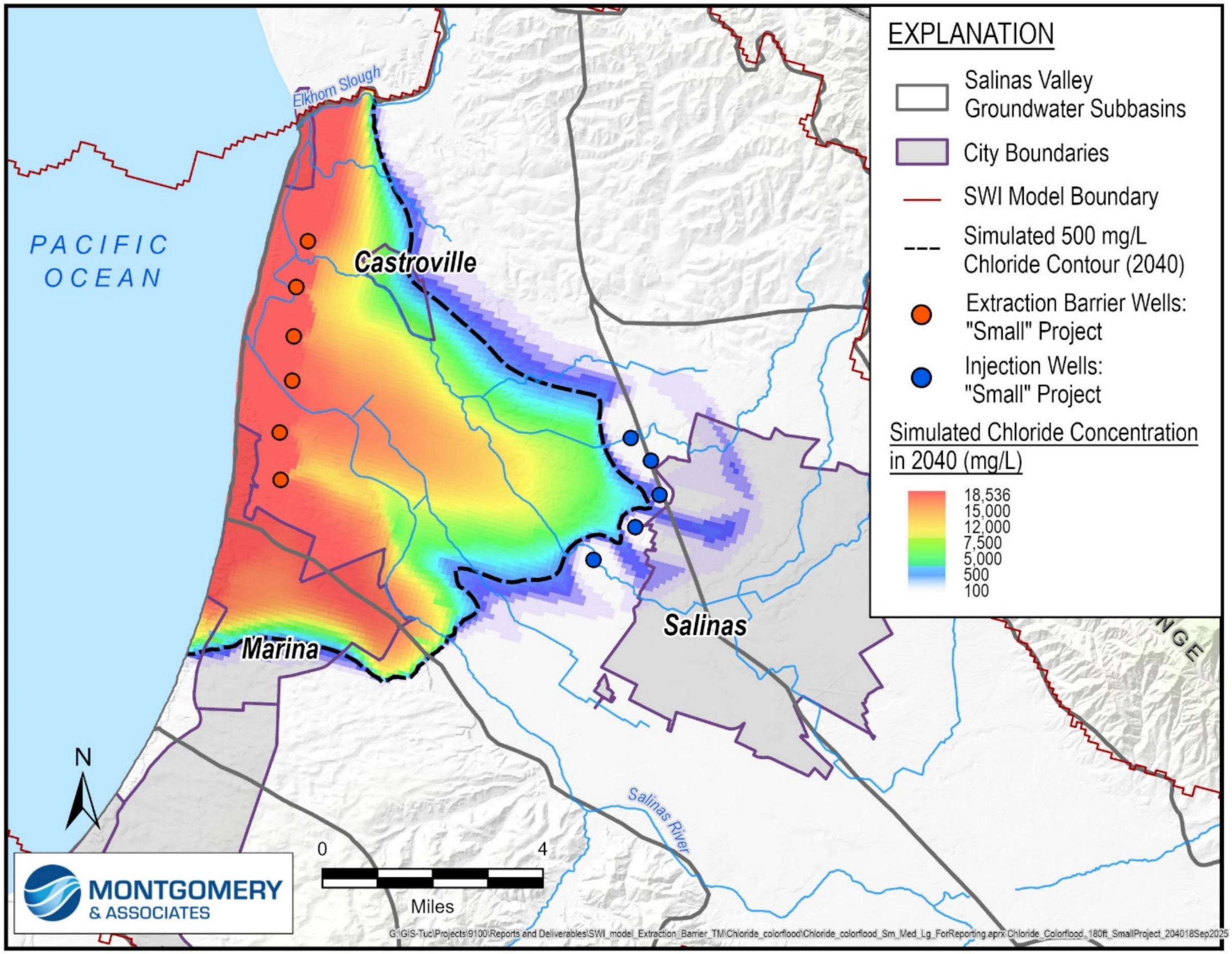


Figure 18 Small Project Chloride Concentrations Modeling Results for 180-Foot Aquifer

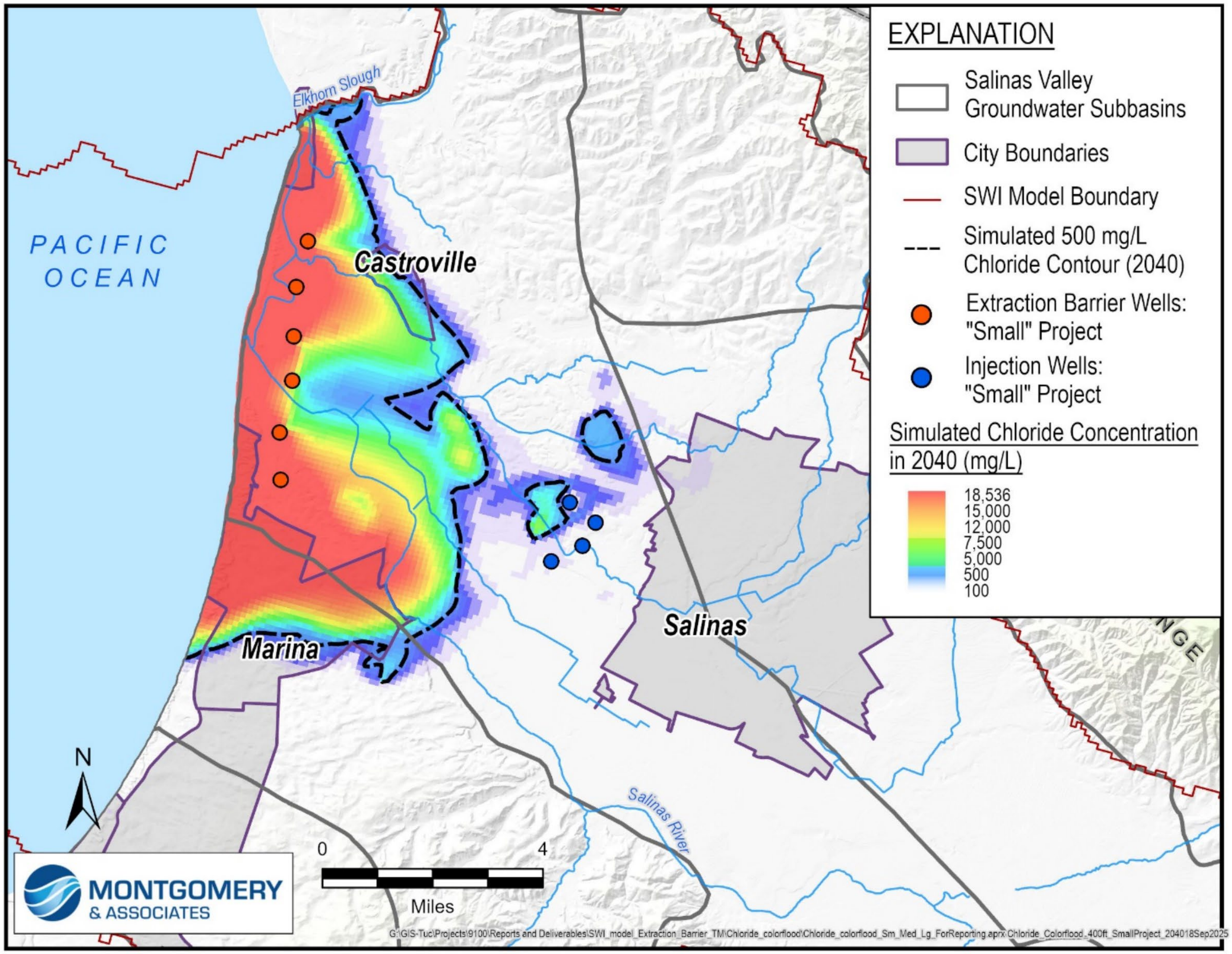


Figure 19 Small Project Chloride Concentrations Modeling Results for 400-Foot Aquifer

3.3.3 Medium Project Scenario

The Medium Project is designed to represent a middle ground between the Small and Large Project scenarios presented in this TM. For the Medium Project, groundwater extraction wells along the coast are extended an additional 1 mile north and approximately 2 miles south compared to the Small Project to try to establish a barrier along the coastline where seawater intrusion has been observed in the 180/400 Subbasin and Monterey Subbasin. The Medium Project includes a total of 20 extraction wells with 10 wells in each of the 180-Foot and the 400-Foot Aquifers. It has 12 injection wells with 8 wells in the 180-Foot Aquifer and 4 wells in the 400-Foot Aquifer. Table 5 lists the end users that would be served by the Medium Project. The end users include the major urban users and CSIP (same users as the Small Project), however the volume served is approximately 100 percent of their demand rather than only a portion of demand as compared to the Small Project. Figure 20 shows the Medium Project infrastructure layout.

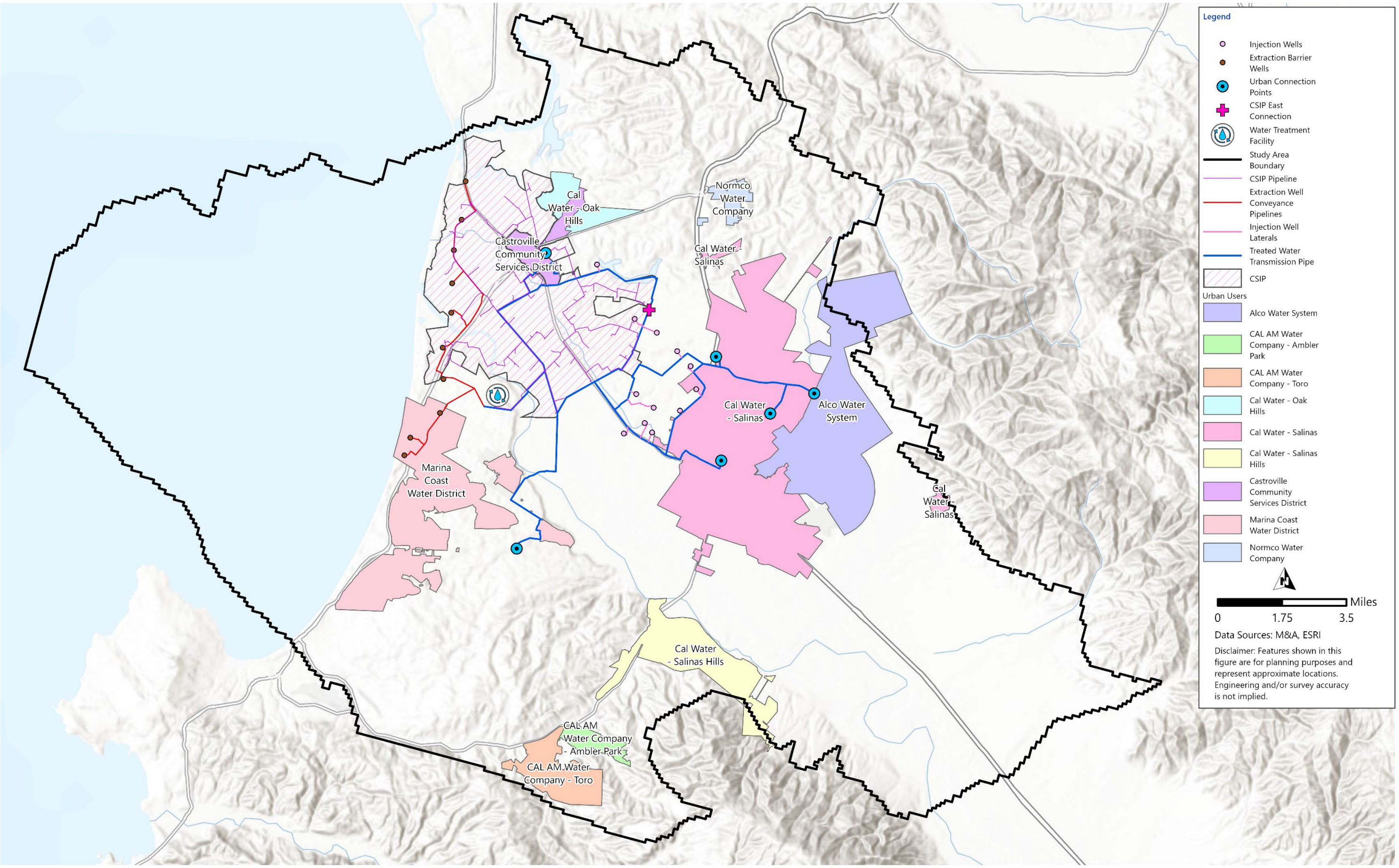


Figure 20 Medium Project Scenario

3.3.3.1 Supply and Demand Volumes

Table 5 lists the extraction volume of the 20 extraction wells and the corresponding set of end users. The total volume extracted is 41,500 gpm or 67,000 AFY. The total available water volume for distribution is approximately 46,900 AFY (assuming a 70 percent RO recovery). The monthly demand of the end users listed in Table 5 was developed using the seasonality factors discussed in Section 2 with respect to the available monthly potable supply available for distribution. The end user volume is the full maximum month demands. Additionally, CSIP's demand increased to approximately 146 percent of their current groundwater capacity, recognizing that the CSIP system has lost well capacity. 100 percent offset of CSIP supplemental well pumping is represented as 5,300 AFY of delivered treated water.

In addition, the Medium Project offsets the use of the Deep Aquifers for all users. Like the Small Project, excess supply is used for inland injection wells. This injected volume is calculated as the difference between the average monthly supply and the total monthly demand for the Medium Project. Figure 21 shows the variable monthly volumes to each user.

Table 5 Medium Project Supply and Demand Volumes

Supply	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	22,500
Total Extraction Capacity in 400-Foot Aquifer (gpm)	19,000
Total (gpm)	**41,500**
Total (AFY)	67,000
Total Potable Volume AFY at 70%	46,900
Demand (AFY)	
Alco	4,000
Cal Water – Salinas	14,500
CCSD	700
MCWD	3,200
CSIP	5,300
Medium Project End User Demand Subtotal	**27,700**
Modeled Injection Volume (AFY)	19,100
Medium Project Demand Total	46,900
Total Demand % of Total Supply	**70%**

Notes:
(1) Extraction well volumes are in gpm, unless noted otherwise.
(2) Percent of total treated extracted water used for injection was estimated using a 70 percent treatment recovery for the total potable water supply.
(3) Values rounded to nearest 100.

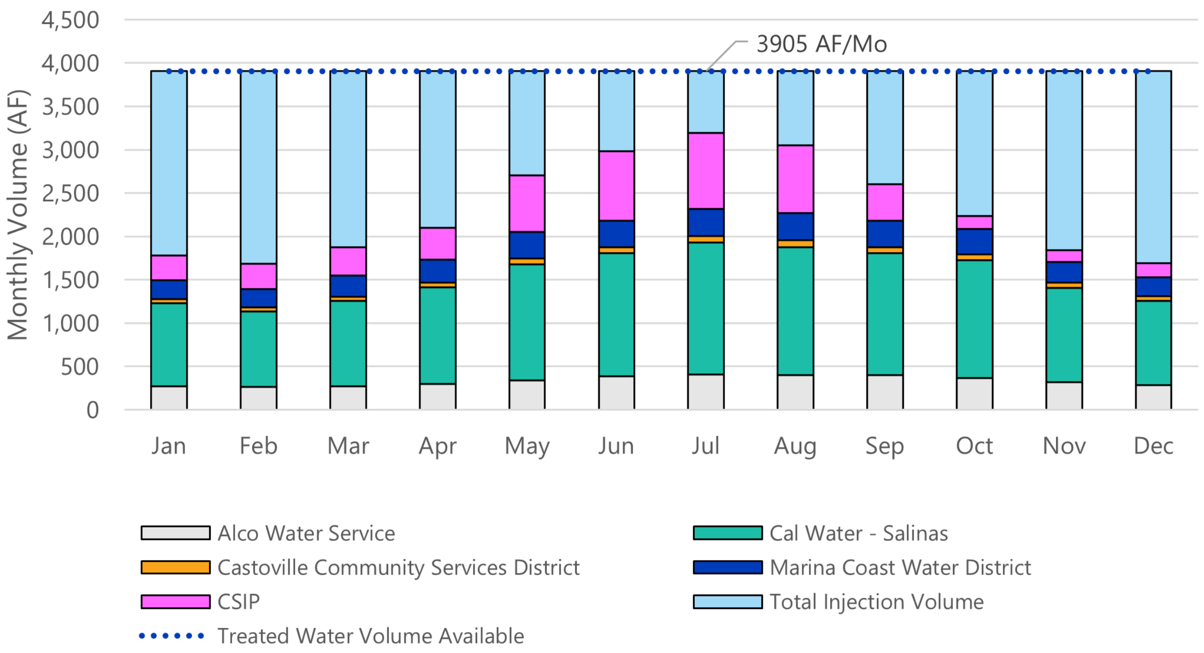


Figure 21 Medium Project Monthly Demand of End Users and Injection Volume

3.3.3.2 Water Treatment and Outfall

Like the Small Project, the Medium Project includes a two-pass system to reduce the elevated boron concentration found in the influent water. The Medium Project also includes an ROC storage pond that will be used to store one day of ROC if the outfall is offline. The volume of the ROC storage pond is assumed to hold one day of ROC production, estimated at 62 AF and has a 6-acre footprint. It is assumed that the facility will be sited on a 12-acre piece of land. The RO treatment sizing utilized the same assumptions as the Small Project. 100 percent of the flow from the extraction wells would be processed through the RO facility. Additionally, feed and concentrate pressures were kept below 1,100 psi to prevent membrane failure, and the fluxes through the first membrane elements of each stage for each pass were balanced by adjusting permeate and booster pressures to ensure optimal permeate water quality. Table 6 lists the number of membrane elements required for the Medium Project.

Table 6 Medium Project Membrane Configuration

Pass	Permeate Flow (mgd)	Flux (gfd)	Membrane Area per Element (ft^2)	Number of Membrane Elements
1	44.95	9.3	400	12,084
2	40.46	16.2	400	6,244

As discussed earlier, the outfall improvements for all projects would require a 60-degree elbow with a rubber duckbill check valve attached to the outfall diffusers to reach the minimum velocity necessary to achieve dilution.

3.3.3.3 Project Costs

The total estimated cost of the Medium Project is shown in Table 7. Similar to the Small Project, the total project costs include both direct construction cost and soft costs. The construction costs have the same cost contingencies applied as well. The Medium Project has larger groundwater extraction flows and a higher quantity of seawater barrier wells, therefore increasing the cost of the extraction and treatment components.

Similar to the Small Project, the Medium Project is assumed to be financed through a federal or state low interest loan program (e.g., SRF or WIFIA) with a 30-year repayment period. The projected lifecycle of the project was assumed to be the same, which is through the year 2070 resulting in a total lifecycle of 40 years. The O&M costs for the Medium Project are estimated at approximately $106.6M with an annual financing cost of approximately $586M. Using a 4 percent interest and discount rate, the annualized net present value of the Medium Project is approximately $124.5M which results in an annualized project unit cost of $2,635 per AF.

Table 7 Medium Project Costs

Project Component	Cost(1)
Well Sites	$ 53,400,000
Outfall Cleaning and Modification	$ 6,250,000
Extraction Distribution	$ 58,100,000
Treated Water Distribution Transmission Mains	$ 163,100,000
Treated Water Booster Pump	$ 11,000,000
Injection Well Sites	$ 37,250,000
ROC Storage	$ 3,500,000
Land Costs	$ 11,200,000
Water Treatment Plant Costs	$ 522,000,000
Construction Subtotal	**$ 865,800,000**
Engineering Planning and Design (10%)	$ 86,580,000
Environmental Planning and Permitting (2%)	$ 17,320,000
Administrative and Legal (1%)	$ 8,660,000
Construction Management (4%)	$ 34,630,000
Soft Costs Subtotal	**$ 147,190,000**
Grand Total Project Costs	**$ 1,012,990,000**

Notes:
(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, and 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.3.4 Seawater Intrusion Mitigation Effectiveness

As shown in Figures 22 and 23 below, as compared to the No Project scenario, the Medium Project successfully halts the seawater intrusion from advancing inland. The Medium Project comes close to meeting the MT in both the 180-Foot and 400-Foot Aquifers by 2040. This project will likely meet MTs with minimal revisions and modifications. Figures 24 and 25 show the chloride concentrations resulting from the Medium Project implementation.

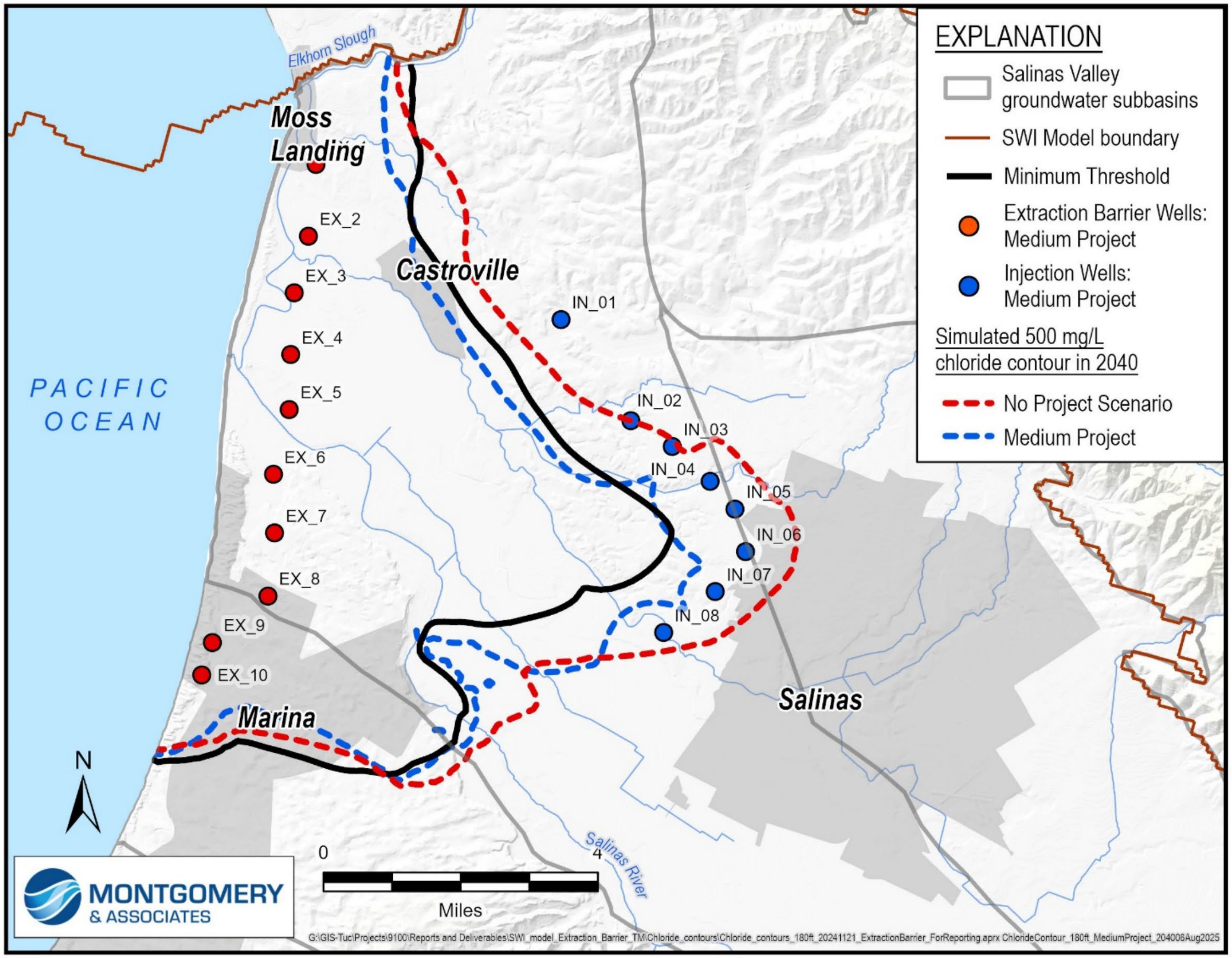


Figure 22 Medium Project Modeling Results for 180-Foot Aquifer

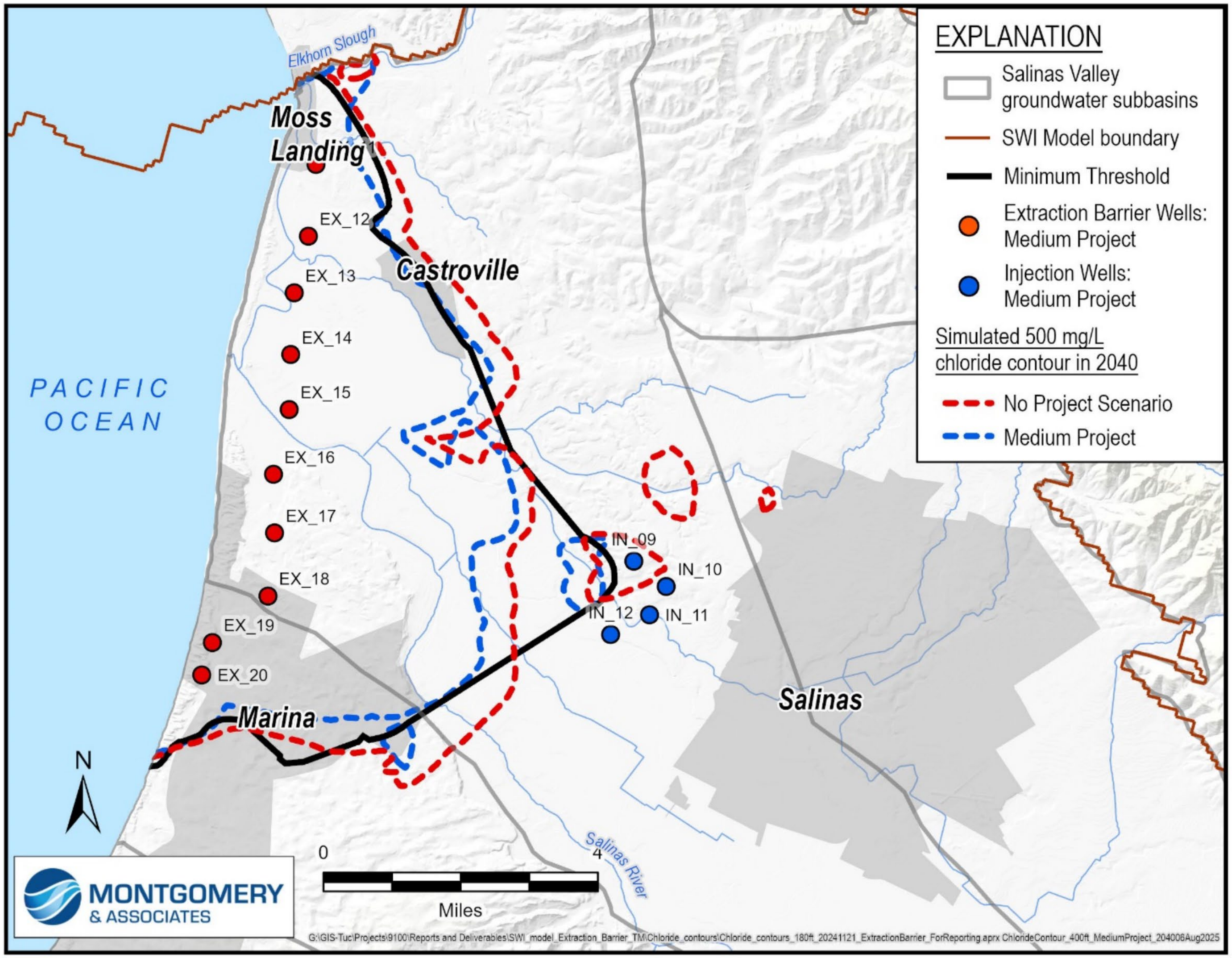


Figure 23 Medium Project Modeling Results for 400-Foot Aquifer

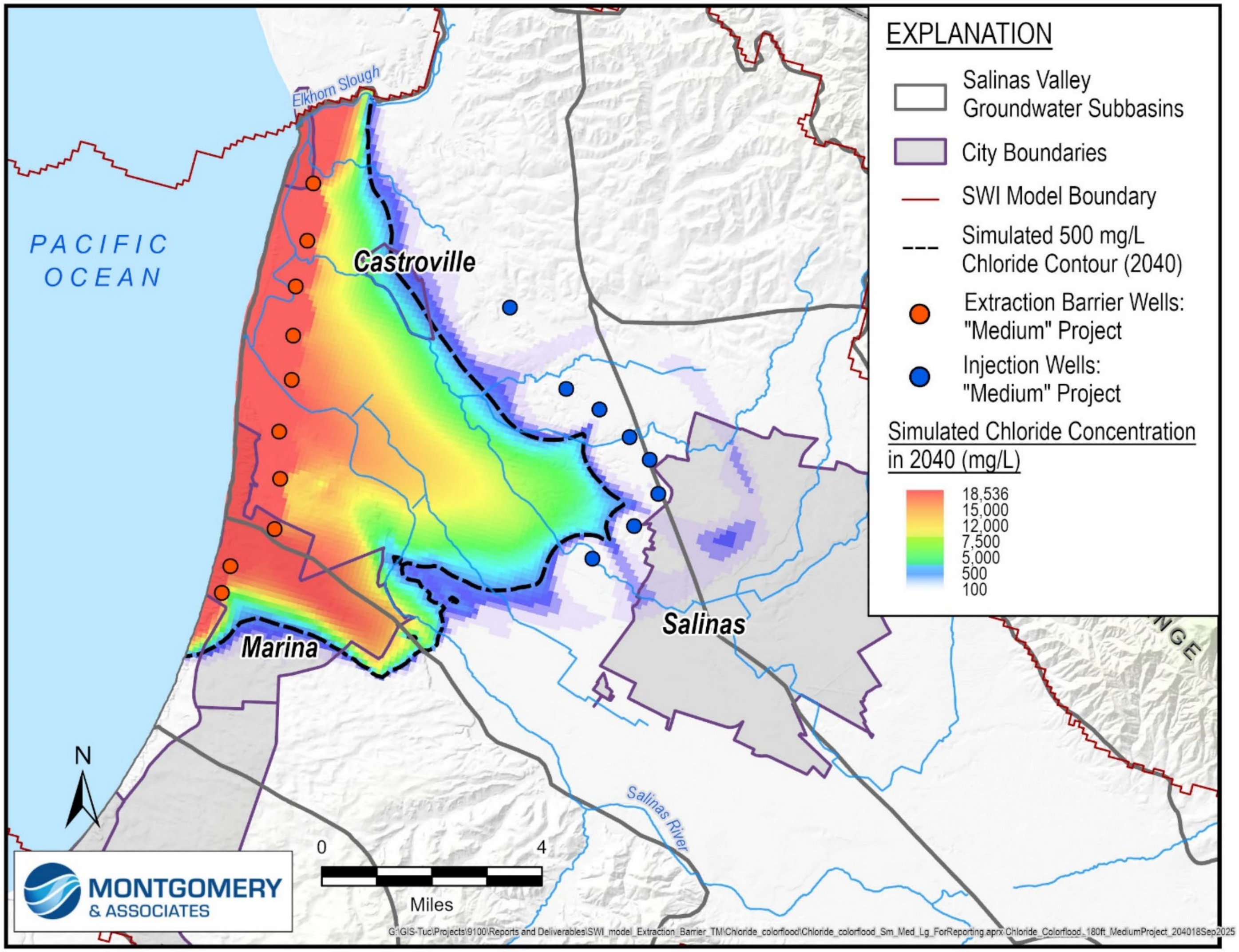


Figure 24 Medium Project Chloride Concentrations Modeling Results for 180-Foot Aquifer

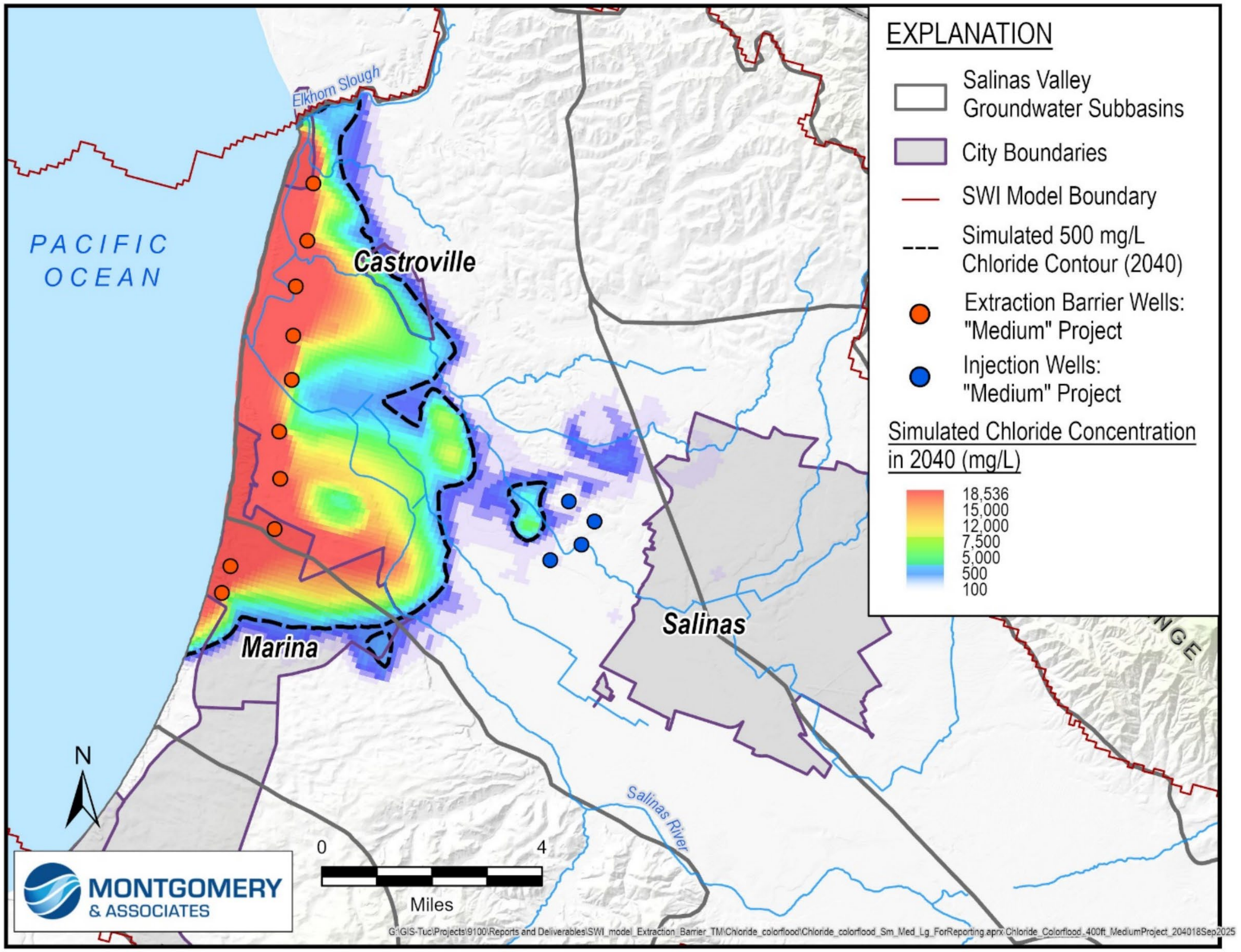


Figure 25 Medium Project Chloride Concentrations Modeling Results for 400-Foot Aquifer

3.3.4 Large Project Scenario

The Large Project scenario was designed to achieve the seawater intrusion MO (Highway 1) during the lifespan of the project. The Large Project scenario was the largest project scope considered and includes the largest volume of groundwater extracted among the project scenarios as well as the largest volume of treated water. The Large Project groundwater extraction wells along the coast are in the same location as the Medium Project, however, they have a larger extraction pumping capacity. The Large Project includes four inland cleanup wells to remediate stranded inland seawater intrusion in addition to the coastal barrier wells. The Large Project scenario includes a total of 24 extraction wells with 10 extraction barrier wells and 2 cleanup wells in both the 180-Foot and the 400-Foot Aquifers. It has 12 injection wells with 8 in the 180-Foot Aquifer and 4 in the 400-Foot Aquifer.

The end users served in the Large Project include the urban users included in the Medium and Small Projects (Alco, Cal Water – Salinas, CCSD, and MCWD), as well as adding smaller urban end users in an expanded distribution area where groundwater levels are depressed. These include the Pajaro Sunny Mesa Normco system, the Cal Water – Oak Hills and Salinas Hills systems, and the Cal Am Toro and Ambler Park systems. The Large Project also includes serving CSIP and, like the Medium Project, the volume is based on the 10-year annual average supplemental groundwater well usage.

Although the Large Project scenario adds systems in the Langley Subbasin and the Corral de Tierra Management Area of the Monterey Subbasin that are generally beyond the area of concern for continued seawater intrusion, these areas have experienced declines in groundwater levels and overdraft conditions which may need to be partially addressed with supplemental supplies. They are included only in the Large Project scenario.

Lastly, the Large Project scenario would serve select private agricultural wells that are either 1) within either the 180-Foot Aquifer or 400-Foot Aquifer and within the maximum extent of the seawater intruded area included in the 2020 MCWRA 500 mg/L chloride contour, 2) up to 1,000 feet adjacent to potable distribution lines, or 3) located between Reservation and River Road and the Salinas River. The volume served for all the end users in the Large Project is listed in Table 8. The following sections include the Large Project details. Figure 26 shows the Large Project infrastructure layout.

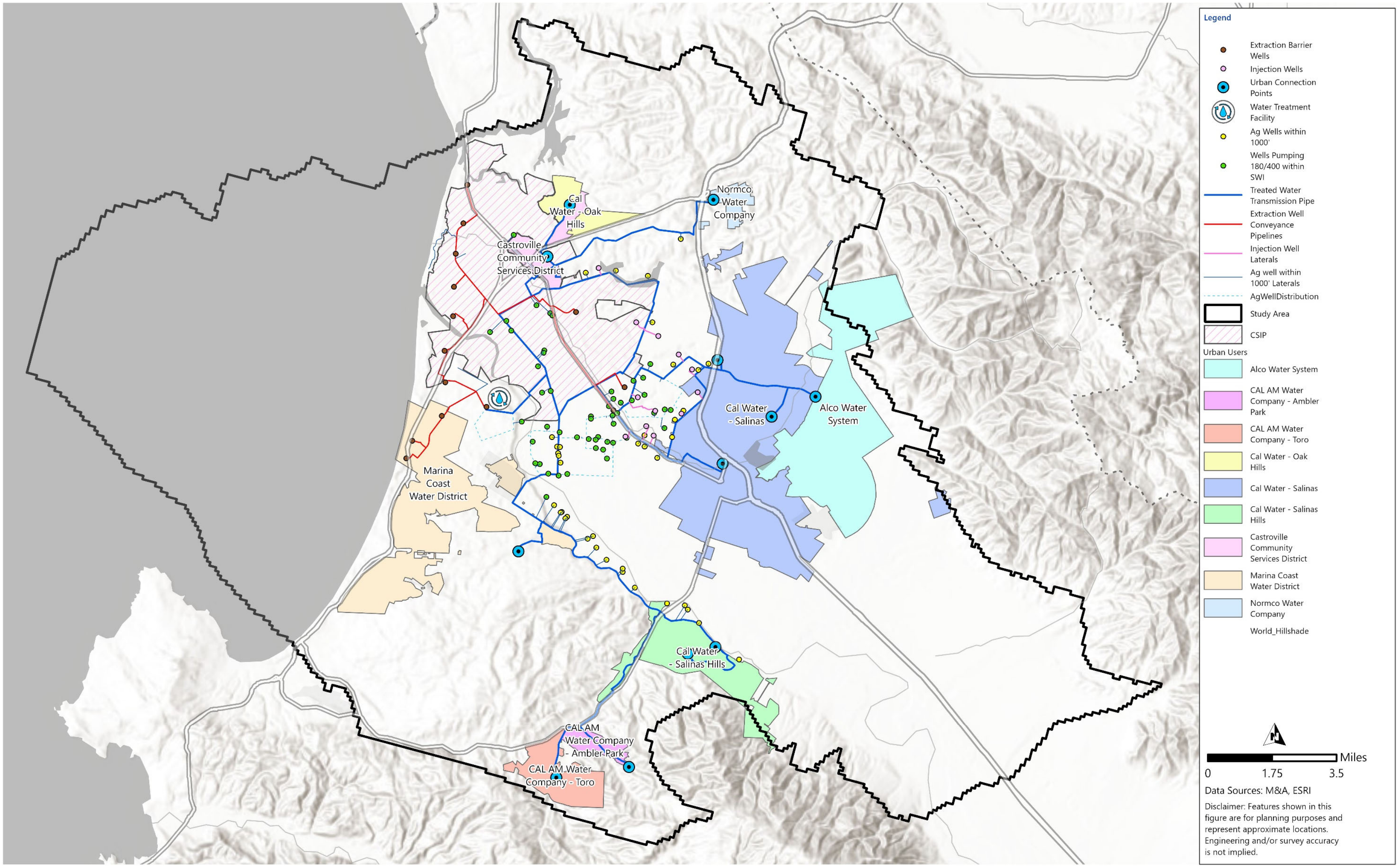


Figure 26 Large Project Scenario

3.3.4.1 Supply and Demand Volumes

Table 8 lists the extraction volume of the 24 extraction wells and the corresponding end users. The total volume extracted is 60,000 gpm or 96,800 AFY. The total available water volume for distribution is approximately 67,800 AFY (assuming a 70 percent RO recovery). Figure 27 shows the monthly demand of the end users listed in Table 8 using the seasonality factors discussed in Section 2 with respect to the available monthly potable supply available for distribution. As in the Small and Medium Project scenarios, excess supply is used for inland injection wells. This injected volume is calculated as the difference between the average monthly supply and the total monthly demand.

Table 8 Large Project Supply and Demand Volumes

Supply	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	32,000
Total Extraction Capacity in 400-Foot Aquifer (gpm)	28,000
Total (gpm)	60,000
Total (AFY)	96,800
Total Potable Volume AFY at 70%	67,800
Demand (AFY)	
Alco	4,000
Cal Water – Salinas	14,500
CCSD	700
MCWD	3,200
CSIP Supplemental Wells	5,300
Cal Water – Salinas Hills	1,800
Adjacent Agriculture Well Groups (within 1,000 feet)	5,200
Small Water Systems (Toro, Ambler, Oak Hills, Normco)	800
Agriculture Within Seawater Intrusion	6,000
Large Project End User Demand Subtotal	**41,500**
Modeled Injection Volume (AFY)	26,200
Large Project Demand Total	67,700
Total Demand % of Total Supply	**67%**

Notes:

(1) Extraction well volumes are in gpm, unless noted otherwise.

(2) Percent of total treated extracted water used for injection was estimated using a 70 percent treatment recovery for the total potable water supply.

(3) Values are rounded to the nearest 100.

(4) Offset of agriculture wells based on MCWRA GEMS data.

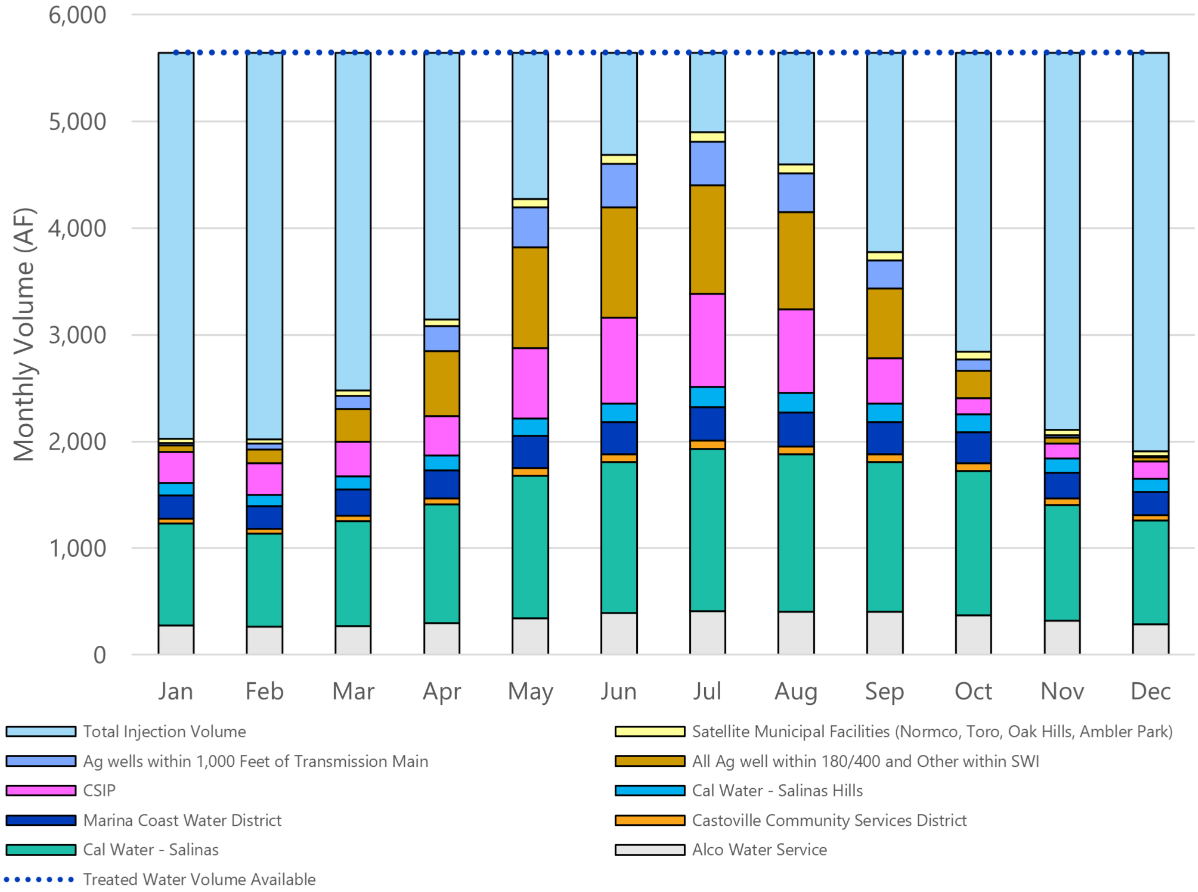


Figure 27 Large Project Monthly Demand of End Users and Injection Volume

3.3.4.2 Water Treatment and Outfall

The Large Project includes a two-pass system to reduce the elevated boron concentration found in the influent water. The Large Project also includes an ROC storage pond that would be used to store one day of ROC if the outfall is offline. The volume of the ROC storage pond would be 97 AF and would have a 7-acre footprint. It is assumed that the treatment facility would need to be sited on a 16-acre piece of land.

The RO treatment sizing utilized the same assumptions as the Small and Medium Projects. 100 percent of the flow from the extraction wells would be processed through the RO facility. Additionally, feed and concentrate pressures were kept below 1,100 psi to prevent membrane failure, and the fluxes through the first membrane elements of each stage for each pass were balanced by adjusting permeate and booster pressures to ensure optimal permeate water quality. Table 9 lists the number of membrane elements required for the Large Project.

Table 9 Large Project Membrane Configuration

Pass	Permeate Flow (mgd)	Flux (gfd)	Membrane Area per Element (ft^2)	Number of Membrane Elements
1	44.95	9.3	400	12,084
2	40.46	16.2	400	6,244

As discussed earlier, the outfall improvements for all project scenarios would require a 60-degree elbow with a rubber duckbill check valve attached to the outfall diffusers in order to reach the minimum velocity necessary to achieve the required dilution.

3.3.4.3 Project Costs

The estimated cost of the Large Project is shown in Table 10 and similar to the Small and Medium Project scenarios the total project costs include both construction cost and soft costs with the same contingency percentages applied. Like the other project scenarios, the Large Project is assumed to be financed through a federal or state low interest loan program (e.g., SRF or WIFIA) with a 30-year repayment period for planning purposes. The projected lifecycle is 40 years. The O&M costs for the Large Project are estimated at approximately $147.6M with an annual financing cost of approximately $85.7M. The annualized net present value of the Large Project is approximately $173.9M which results in an annualized project unit cost of $2,668 per AF.

Table 10 Large Project Costs

Infrastructure Component	Cost(1)
Well Sites	$ 58,650,000
Cleanup Well Sites	$ 10,300,000
Outfall Modifications and Cleaning	$ 6,250,000
Extraction Distribution	$ 97,000,000
Potable Water Distribution Transmission Mains	$ 233,400,000
Potable Water Booster Pump	$ 15,400,000
Injection Well Sites	$ 47,100,000
ROC Storage	$ 4,900,000
Land Costs	$ 11,600,000
1,000 Feet Agriculture Wells Laterals	$ 11,600,000
Offset MCWRA Wells Laterals	$ 12,050,000
Water Treatment Facility	$ 758,000,000
Construction Subtotal	**$ 1,266,250,000**
Engineering Design (10%)	$ 126,630,000
Environmental Planning and Permitting (2%)	$ 25,330,000
Administrative and Legal (1%)	$ 12,660,000
Construction Management (4%)	$ 50,650,000
Soft Costs Subtotal	**$ 215,270,000**
Grand Total Project Costs	**$ 1,481,520,000**

Notes:
(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, and 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.4.4 Seawater Intrusion Mitigation Effectiveness

As shown in Figures 28 and 29, the Large Project successfully halts seawater intrusion from advancing inland and meets the MT in the 400-Foot Aquifer and nearly meets the MT in the 180-Foot Aquifer by 2040. This project scenario would likely meet the MT by 2040 in both aquifers with minor modifications. This project scenario, along with all other project scenarios, does not meet the MO by 2040. Given the amount of time to plan and construct a project of this size and the rate at which the project would work, it is unlikely that the seawater intrusion MO will be met by 2040. Figures 30 and 31 show the simulated chloride concentration from implementing the Large Project scenario.

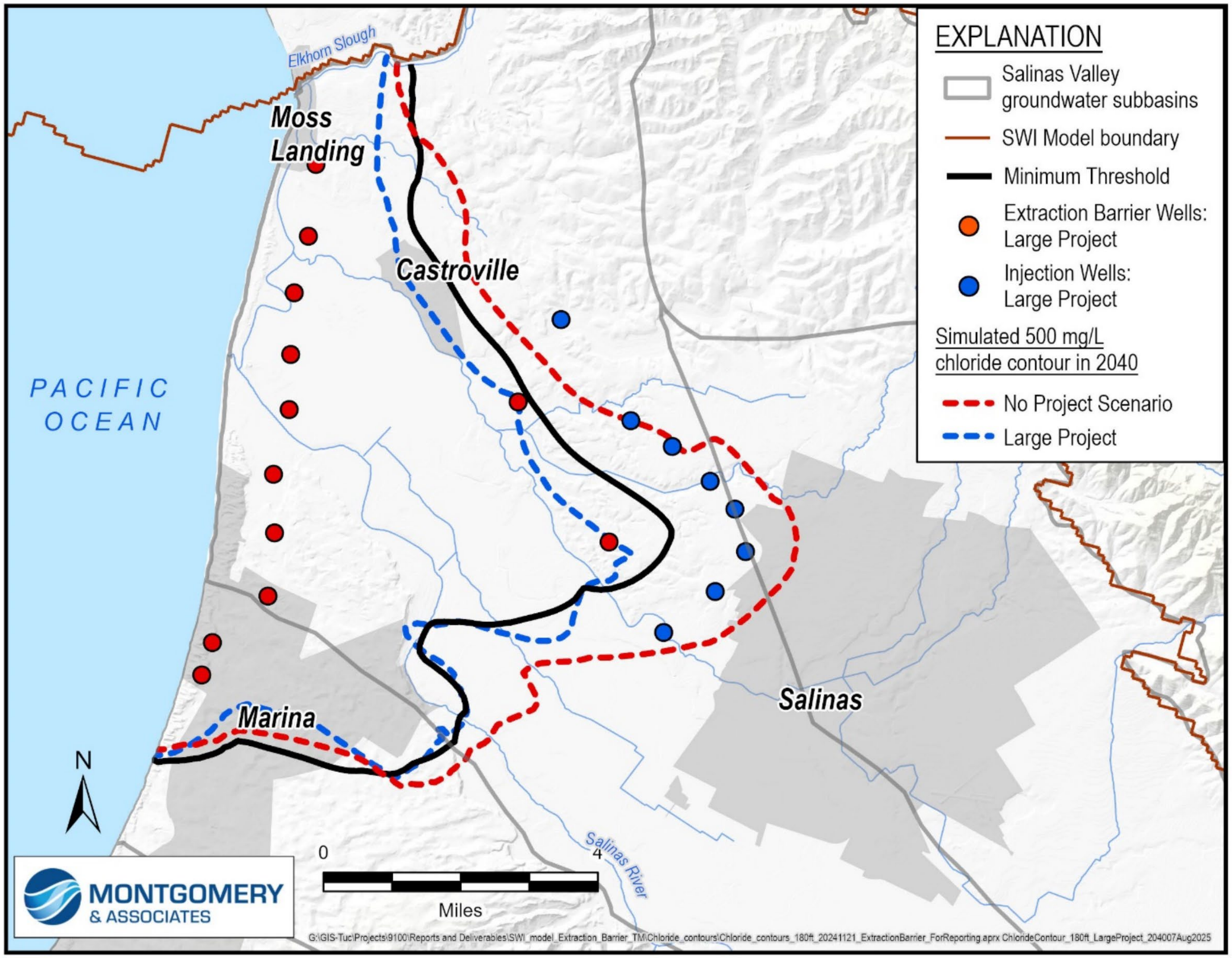


Figure 28 Large Project Modeling Results for 180-Foot Aquifer

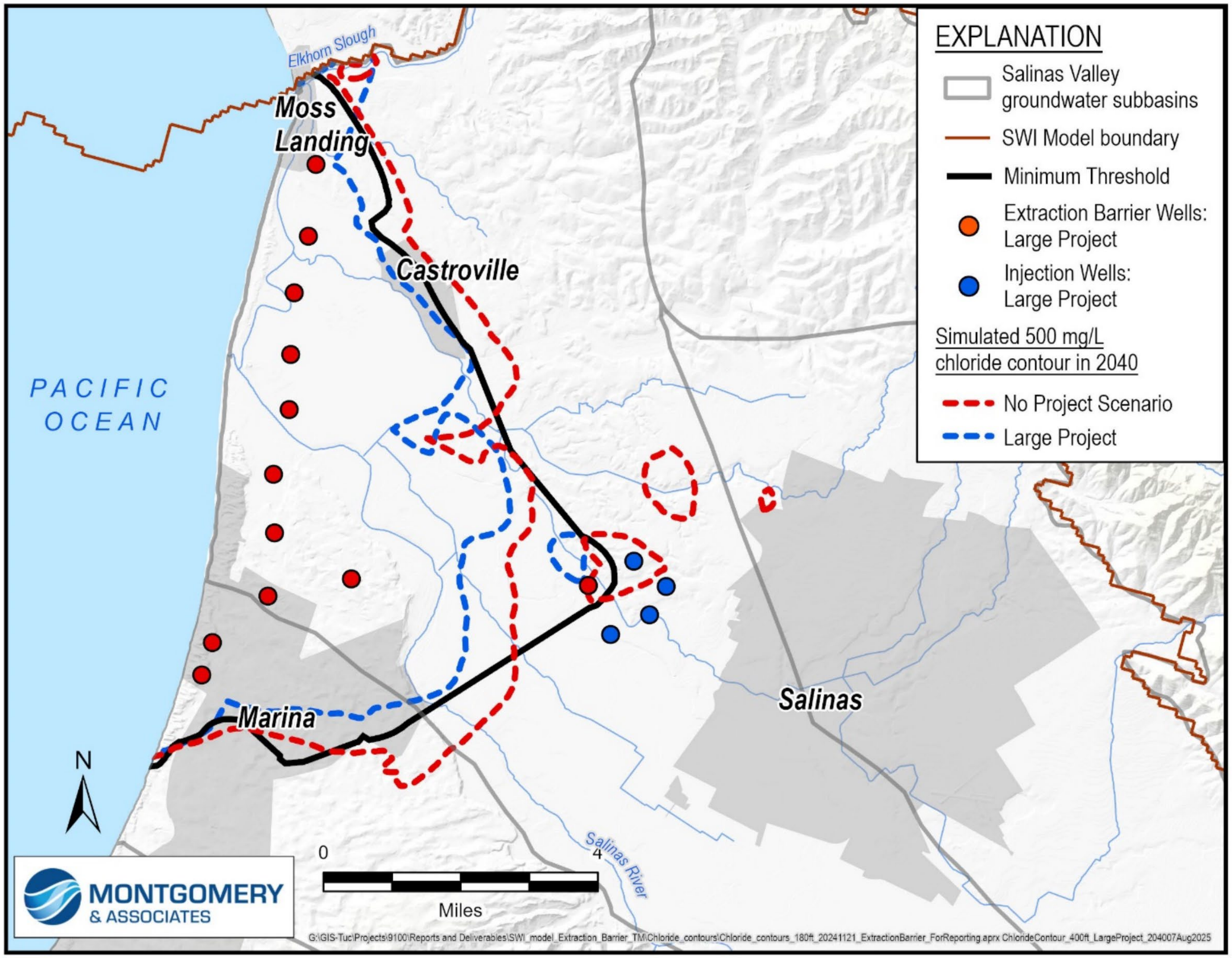


Figure 29 Large Project Modeling Results for 400-Foot Aquifer

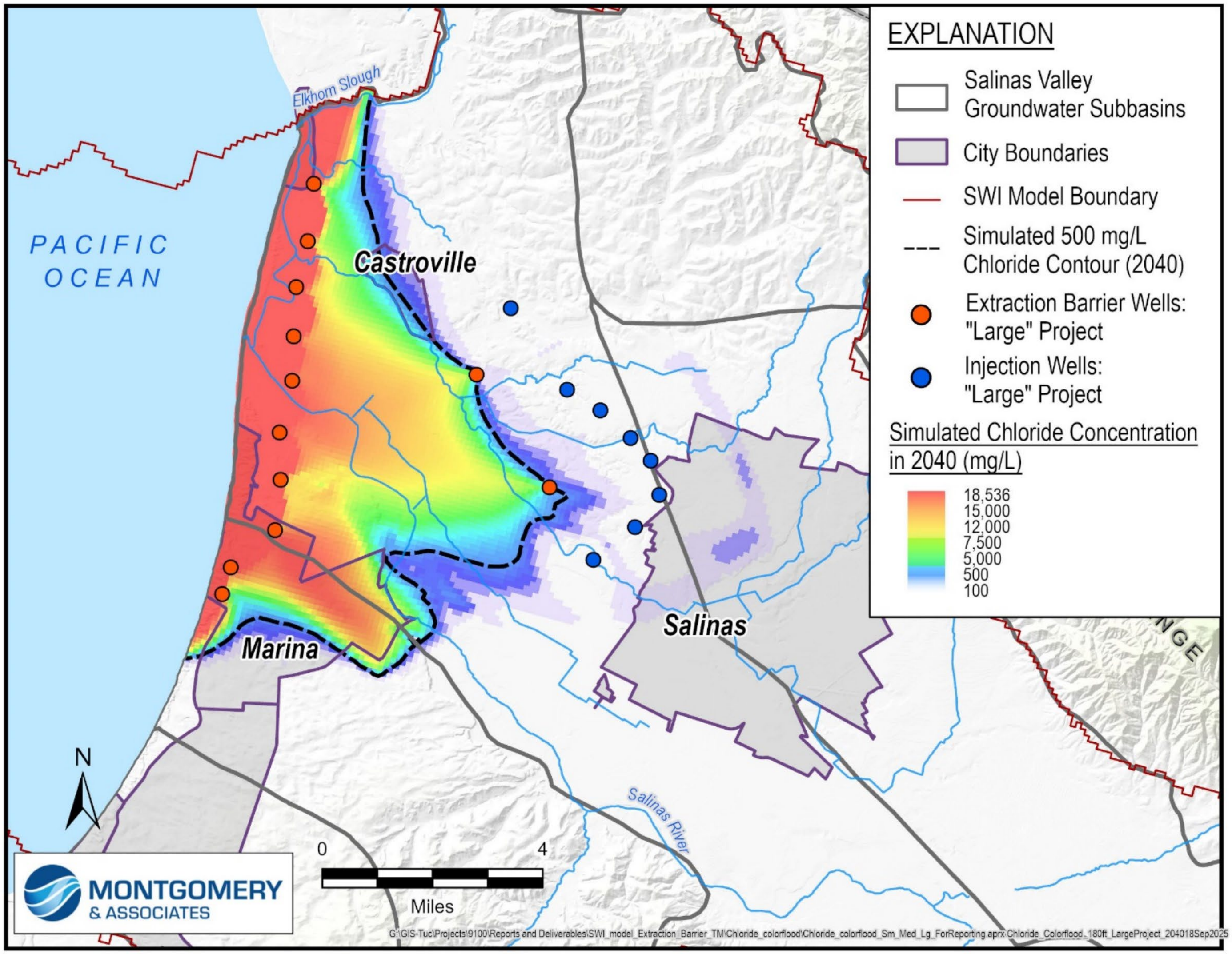


Figure 30 Large Project Chloride Concentrations Modeling Results 180-Foot Aquifer

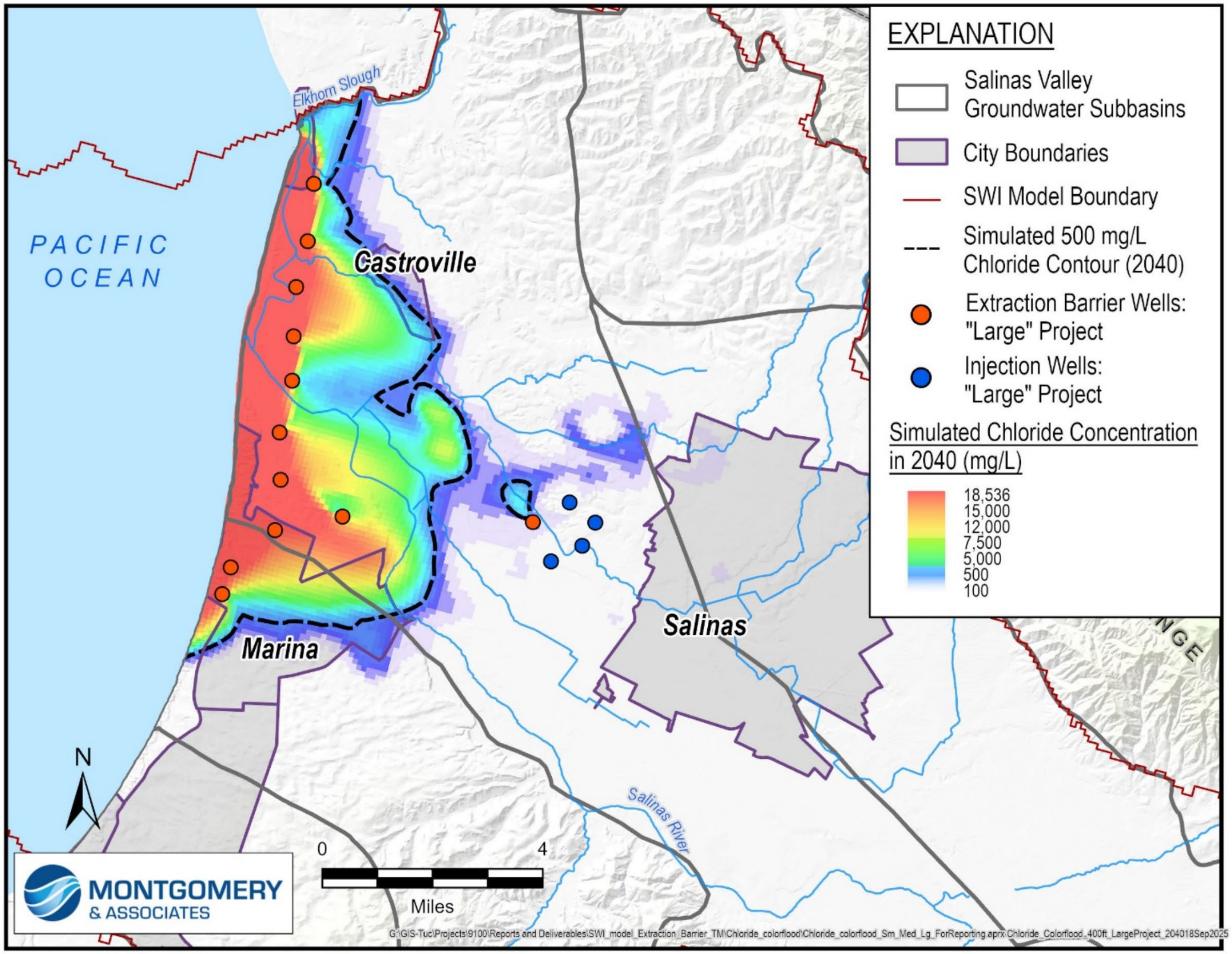


Figure 31 Large Project Chloride Concentrations Modeling Results for 400-Foot Aquifer

3.3.5 Injection-Only Project Scenario

The Injection-Only Project scenario has the same extraction concept as the Medium Project scenario with an extraction barrier on the coastal edge of the Salinas Valley. Instead of delivery to urban or agricultural end users coupled with injection, this project scenario does not include any direct deliveries and instead only injects treated brackish groundwater into the 180-Foot Aquifer and 400-Foot Aquifer. The injection-only scenario has the same treatment extraction and distribution capacity as the Medium Project seawater extraction barrier scenario. The distribution piping layout is different given the injection-only end use. It includes a total of 20 extraction barrier wells with 10 in the 180-Foot Aquifer and 10 in the 400-Foot Aquifer. Similarly, there are a total of 20 injection wells with 12 in the 180-Foot Aquifer and 8 in the 400-Foot Aquifer. Figure 32 shows the injection-only project layout.

3.3.5.1 Supply and Demand Volumes

Table 11 lists the extraction volume of the 20 extraction wells and the injection volume within the 180-Foot and 400-Foot Aquifers respectively. The total volume extracted is 41,500 gpm or about 67,000 AFY. The total available water volume for injection is approximately 46,900 AFY (assuming a 70 percent RO recovery). The total volume injected is 44,800 AFY. The slight variation between injection wells volume and treated water production is negligible at this stage of the analysis knowing that RO recovery can range between 65 and 70 percent, similar to variations in injection well volumes over time.

Table 11 Injection-Only Project Supply and Demand Volumes

Supply	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	22,500
Total Extraction Capacity in 400-Foot Aquifer (gpm)	19,000
Total (gpm)	**41,500**
Total (AFY)	67,000
Total Potable Volume AFY at 70%	46,900
Demand (AFY)	
Injection in the 180-Foot Aquifer	33,000
Injection in the 400-Foot Aquifer	11,800
Total Injection Volume (AFY)	**44,800**
Total Demand % of Total Supply	**67%**

Notes:
(1) Extraction well volumes are in gpm, unless noted otherwise.
(2) Values rounded to the nearest 100.

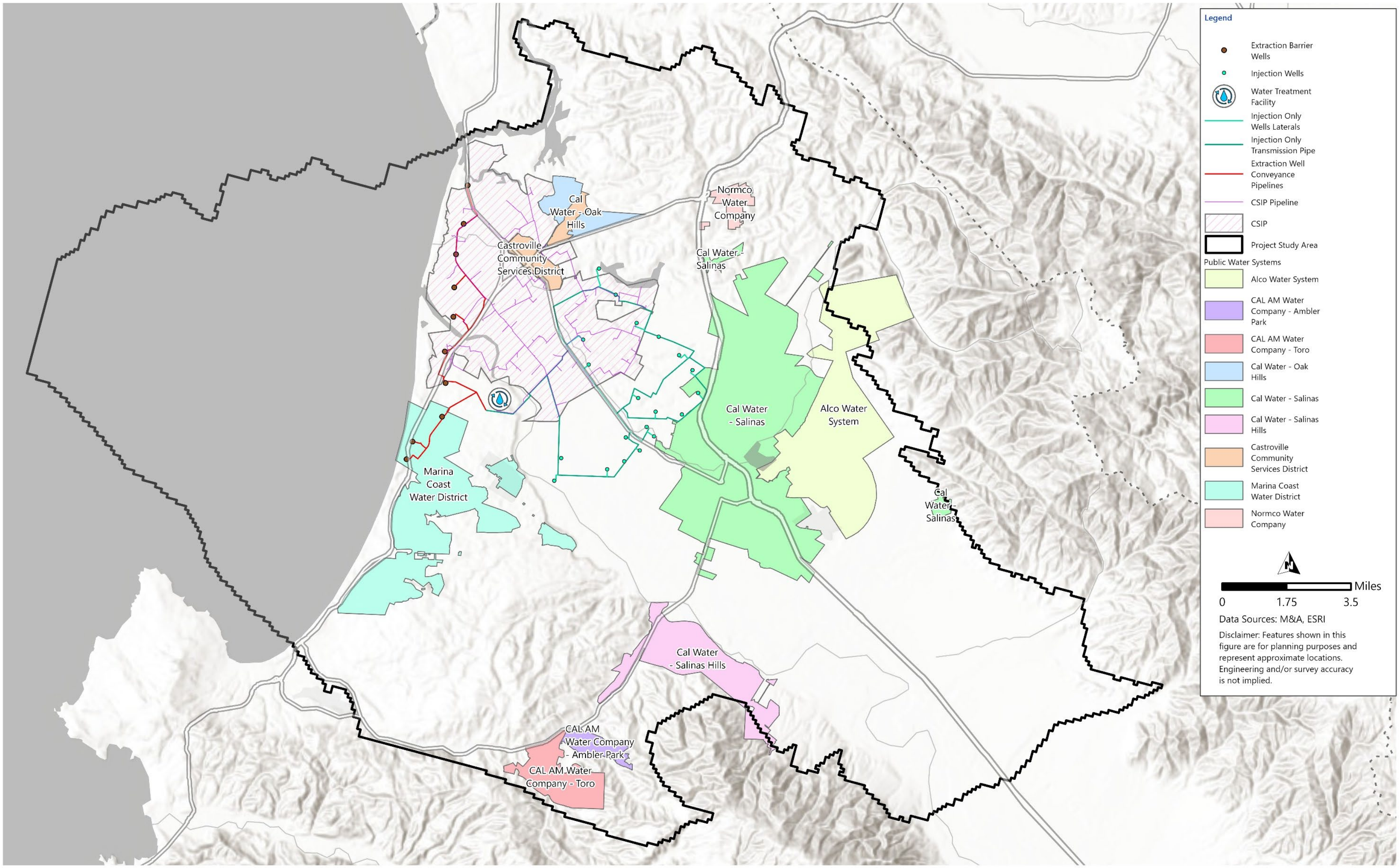


Figure 32 Injection-Only Project Scenario

3.3.5.2 Water Treatment and Outfall

Similar to the Medium Project scenario, the Injection-Only Project scenario includes a two-pass RO system to reduce the elevated boron concentration found in the influent water. All project scenarios with a treatment facility include an ROC storage pond that will be used to store one day of ROC if the outfall is offline. The volume of the ROC storage pond is assumed to hold one day of ROC production, estimated at 62 AF and has a 6-acre footprint. It is assumed that the treatment facility will be sited on a 12-acre piece of land.

3.3.5.3 Project Costs

The total cost of the Injection-Only Project scenario is shown in Table 12. The construction costs have the same cost contingencies and soft costs factors included as the Small, Medium, and Large Project scenarios. The Injection-Only Project scenario is assumed to be financed through a federal or state low interest loan program (e.g., SRF or WIFIA) with a 30-year repayment period. The projected lifecycle of the project was assumed to be the same, which is through the year 2070 resulting in a total lifecycle of 40 years. The O&M costs for the Injection-Only Project scenario are estimated at approximately $112.7M with an annual financing cost of approximately $55.5M. Using a 4 percent interest rate and a 2.75 percent discount rate, the annualized net present value of the Injection-Only Project scenario is approximately $127.1M which results in an annualized project unit cost of $2,712 per AF.

Table 12 Injection-Only Project Costs

Project Component	Cost(1)
Well Sites	$ 52,600,000
Outfall Cleaning and Modification	$ 6,250,000
Extraction Distribution	$ 57,100,000
Potable Water Distribution Transmission Mains	$ 88,500,000
Potable Water Booster Pump	$ 21,300,000
Injection Well Sites	$ 46,450,000
Injection Well Laterals	$ 7,050,000
ROC Storage	$ 3,450,000
Land Costs	$ 11,200,000
Water Treatment Plant Costs	$ 522,000,000
Construction Subtotal	**$ 815,900,000**
Engineering Planning and Design (10%)	$ 81,590,000
Environmental Planning and Permitting (2%)	$ 16,320,000
Administrative and Legal (1%)	$ 8,160,000
Construction Management (4%)	$ 32,640,000
Soft Costs Subtotal	**$ 138,710,000**
Grand Total Project Costs	**$ 954,610,000**

Notes:
(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, and 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.5.4 Seawater Intrusion Mitigation Effectiveness

The Injection-Only Project scenario into the 180/400 Subbasin is similar in size to the Medium Project scenario, however, the Injection-Only Project scenario appears to be more effective at reversing seawater intrusion and avoiding undesirable results. Figures 33 and 34 show that in both the 180-Foot and 400-Foot Aquifers, the 2040 extent of seawater intrusion is close to the MT. The exceptions are an area west of the injection wells and west of the City of Salinas in the 180-Foot Aquifer, and in the 400-Foot Aquifer an area east of the City of Marina near MCWD wells and an area east of Castroville near a CSIP supplemental well (which pumping is not offset in the Injection-Only Project scenario). This scenario controls seawater intrusion about as well as the Medium Project scenario and not quite as well as the Large Project scenario. The addition of injection wells to the southern side of the main seawater intrusion lobe in the 180-Foot Aquifer improved the Injection-Only Project scenario performance relative to the Medium Project scenario in this area. Figures 35 and Figure 36 show the simulated chloride concentrations in the 180-Foot and 400-Foot Aquifers, respectively, resulting from the Injection-Only Project scenario.

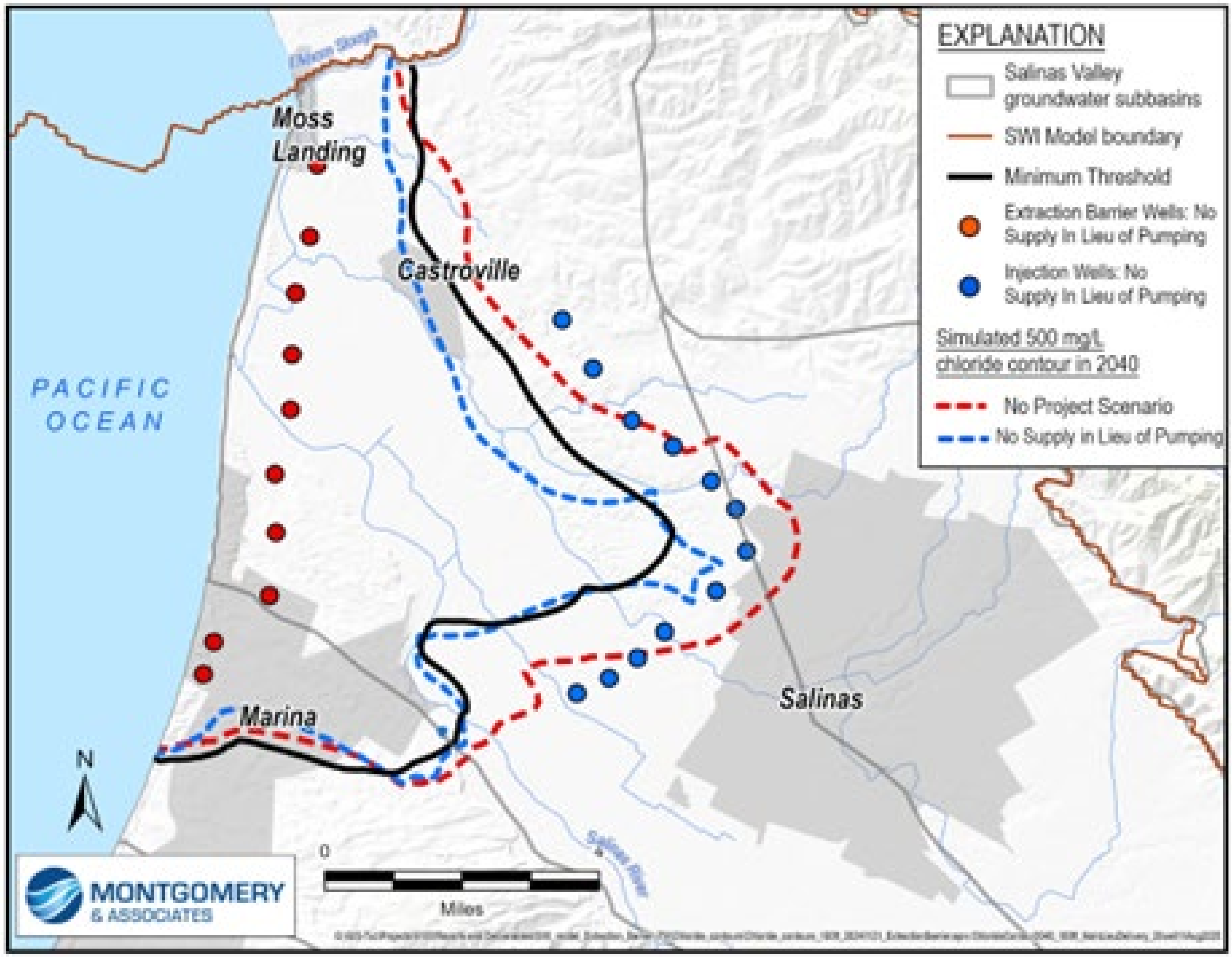


Figure 33 Injection-Only Project Scenario Modeling Results 180-Foot Aquifer

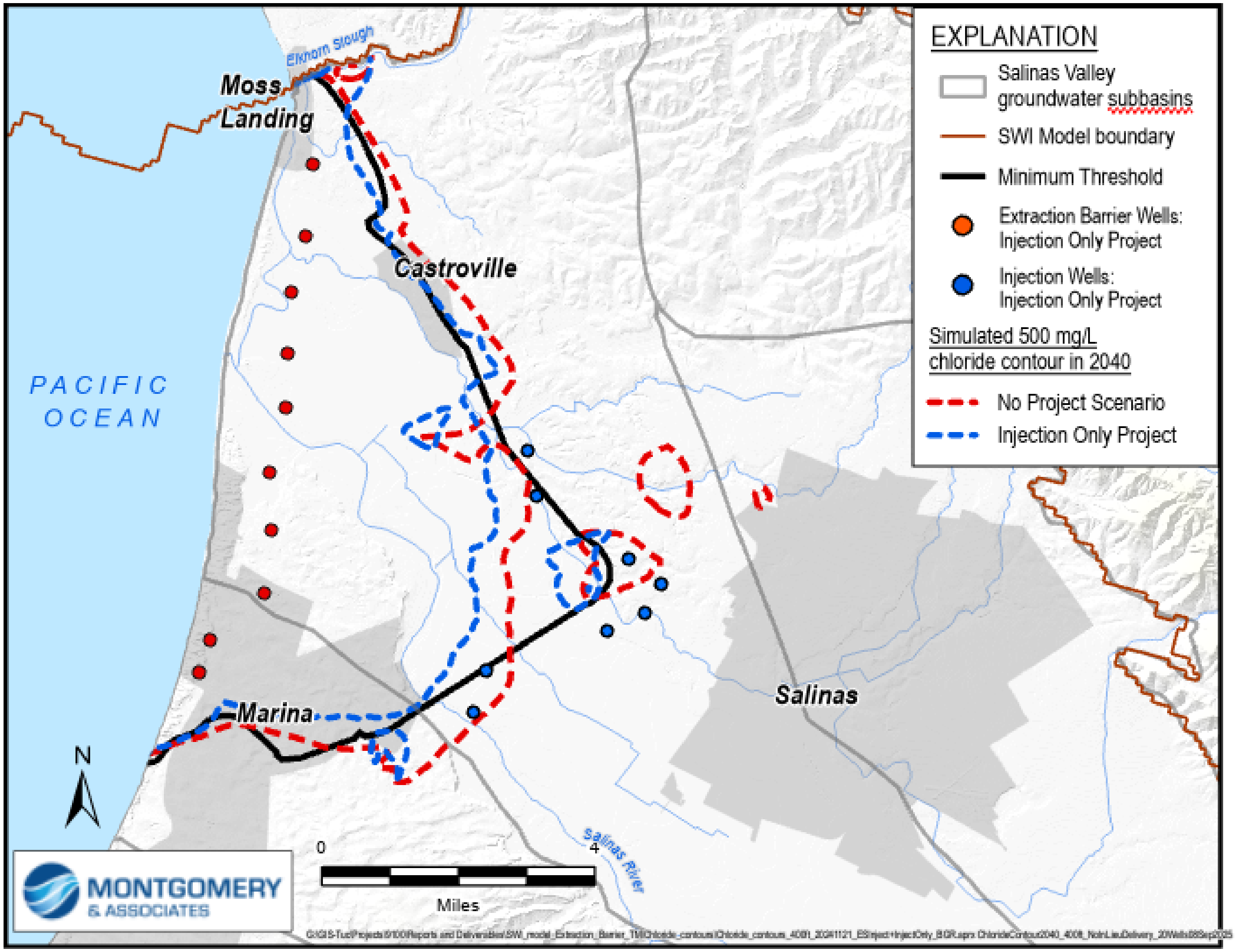


Figure 34 Injection-Only Project Scenario Modeling Results 400-Foot Aquifer

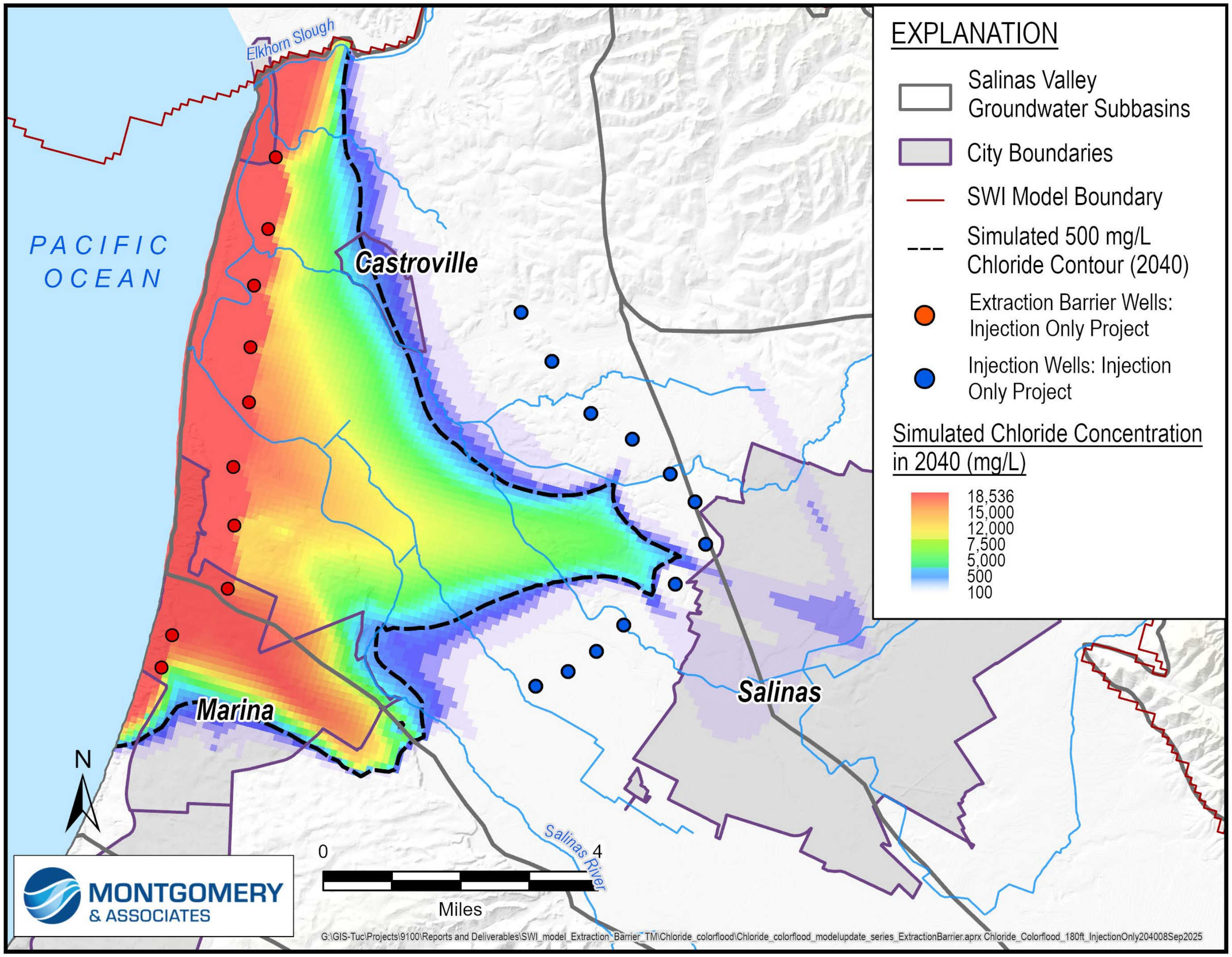


Figure 35 Injection-Only Project Scenario Chloride Concentrations Modeling Results 180-Foot Aquifer

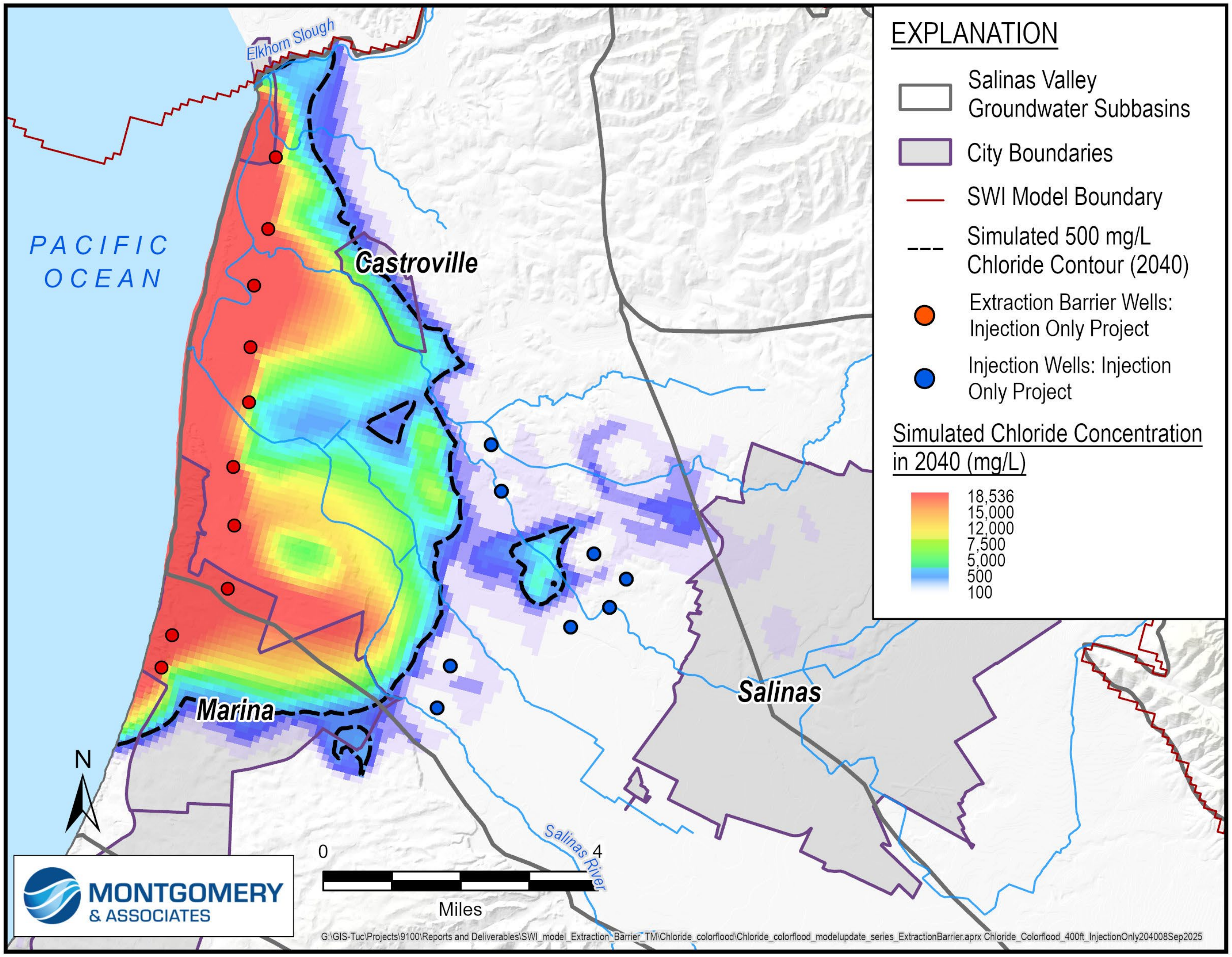


Figure 36 Injection-Only Project Scenario Chloride Concentrations Modeling Results 400-Foot Aquifers

3.3.6 Eastside Subbasin Injection Project Scenario

This scenario does not provide any direct deliveries to end users but instead injects all the treated water into the Eastside Subbasin, north of the City of Salinas, Figure 37 shows the project scenario layout. The purpose of this scenario is to assess benefits of managing seawater intrusion if the project goals were shifted to focus on raising groundwater levels in the Eastside Subbasin, and to evaluate the effectiveness of this approach to address seawater intrusion. This scenario uses an extraction barrier similar to the Medium Project scenario and Injection-Only Project scenario, but with the treated water being injected into the Eastside Subbasin and no direct delivery of in-lieu supply. Groundwater is injected in the Eastside 180-Foot Equivalent and 400-Foot Equivalent Aquifers.

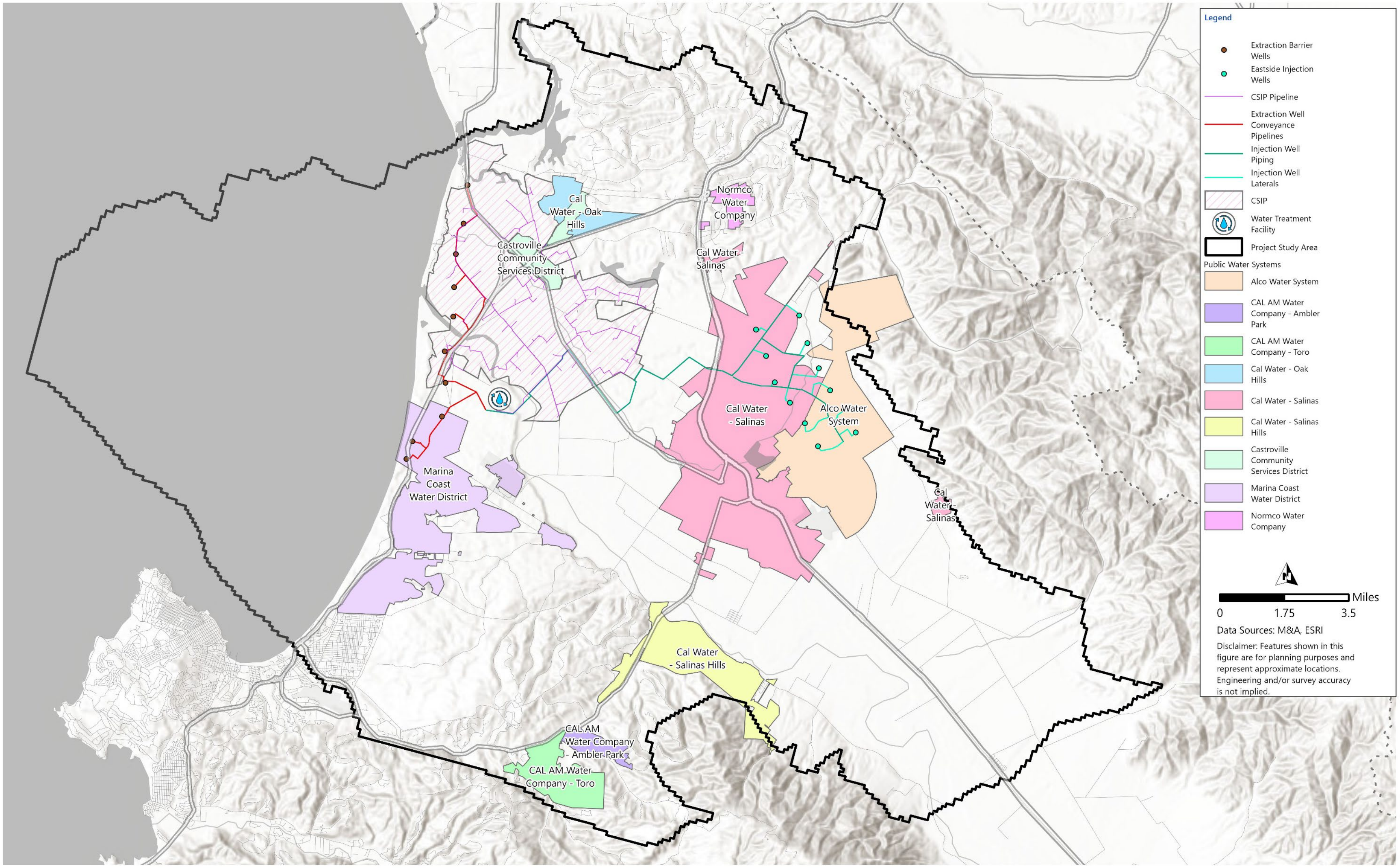


Figure 37 Eastside Subbasin Injection Project Scenario

3.3.6.1 Supply and Demand Volumes

Table 13 lists the extraction volume of the 20 extraction wells and the injection volume within the 180-Foot and 400-Foot Equivalent Aquifers, respectively. The total volume extracted is the same as the Medium Project and Injection-Only Project scenarios at 41,500 gpm or 67,000 AFY. The total available water volume for injection is approximately 46,900 AFY (assuming a 70 percent RO recovery). The total volume injected into the Eastside Subbasin is approximately 44,800 AFY through a total of 12 wells. Each well has a long screen through both aquifers in the Eastside Subbasin equivalent to the 180-Foot Aquifer and 400-Foot Aquifer.

Table 13 Eastside Subbasin Injection Project Supply and Demand Volumes

Supply	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	22,500
Total Extraction Capacity in 400-Foot Aquifer (gpm)	19,000
Total (gpm)	41,500
Total (AFY)	67,000
Total Potable Volume AFY at 70%	46,900
Demand (AFY)	
Injection in the Eastside Subbasin Alluvial Fans (Both 180-Foot and 400-Foot Aquifer Equivalents)	22,100
Total Injection Volume (AFY)	**44,800**
Total Demand % of Total Supply	**66%**

Notes:
(1) Extraction well volumes are in gpm, unless noted otherwise.
(2) Values rounded to nearest 100.

3.3.6.2 Water Treatment and Outfall

The Eastside Subbasin Injection Project scenario has the same treatment process assumptions and performance criteria as the Medium and Injection-Only Project scenarios. It is assumed the costs, layout, and all criteria outlined for the Medium Project and Injection-Only Project scenarios are carried forward for the Eastside Subbasin Injection Project scenario.

3.3.6.3 Project Costs

The total costs of the Eastside Subbasin Injection Project scenario are shown in Table 14. The construction costs have the same cost contingencies and soft costs factors included as all of the other project scenarios considered previously in this TM.

The project scenario is assumed to be financed through a federal or state low interest loan program (e.g., SRF or WIFIA) with a 30-year repayment period. The projected lifecycle of the project was assumed to be the same, which is through the year 2070 resulting in a total lifecycle for financing of 40 years. The O&M costs for the Eastside Subbasin Injection Project scenario are estimated at approximately $112.7M with an annual financing cost of approximately $54.9M. Using a 4 percent interest rate and a 2.75 percent discount rate, the annualized net present value of the Eastside Subbasin Injection Project is approximately $126.8M which results in an annualized project unit cost of $2,707 per AF.

Table 14 Eastside Subbasin Injection Project Costs

Project Component	Cost(1)
Well Sites	$ 52,550,000
Outfall Cleaning and Modification	$ 6,250,000
Extraction Distribution	$ 57,000,000
Potable Water Distribution Transmission Mains	$ 91,000,000
Potable Water Booster Pump	$ 21,200,000
Injection Well Sites	$ 34,050,000
Injection Well Laterals	$ 12,600,000
ROC Storage	$ 3,400,000
Land Costs	$ 11,200,000
Water Treatment Plant Costs	$ 522,000,000
Construction Subtotal	**$ 811,250,000**
Engineering Planning and Design (10%)	$ 81,130,000
Environmental Planning and Permitting (2%)	$ 16,230,000
Administrative and Legal (1%)	$ 8,110,000
Construction Management (4%)	$ 32,450,000
Soft Costs Subtotal	**$ 137,920,000**
Grand Total Project Costs	**$ 949,170,000**

Notes:

(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, and 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.6.4 Seawater Intrusion Mitigation Effectiveness

The Eastside Subbasin Injection Project scenario is similar in size to the Medium Project scenario. This scenario focuses on raising groundwater levels in the Eastside Subbasin. It is less effective at managing seawater intrusion than either the Medium Project or the Injection-Only Project, both of which inject only into the 180/400 Subbasin. As shown in Figures 38 and 39, this scenario provides some improvement in the seawater intrusion extent relative to the No Project scenario, however, it does not meet the MTs. The 2040 500 mg/L chloride contour is inland of the MT in the 180-Foot Aquifer. The 500 mg/L chloride contour is about the same in the 400-Foot Aquifer as in the Medium and Injection-Only Project scenarios, except that the seawater islands are more advanced inland; this scenario does not avoid undesirable results from seawater intrusion.

Figures 40 and 41 show the simulated Eastside Subbasin Injection Project scenario 2040 chloride concentrations in the 180-Foot Aquifer and 400-Foot Aquifer, respectively.

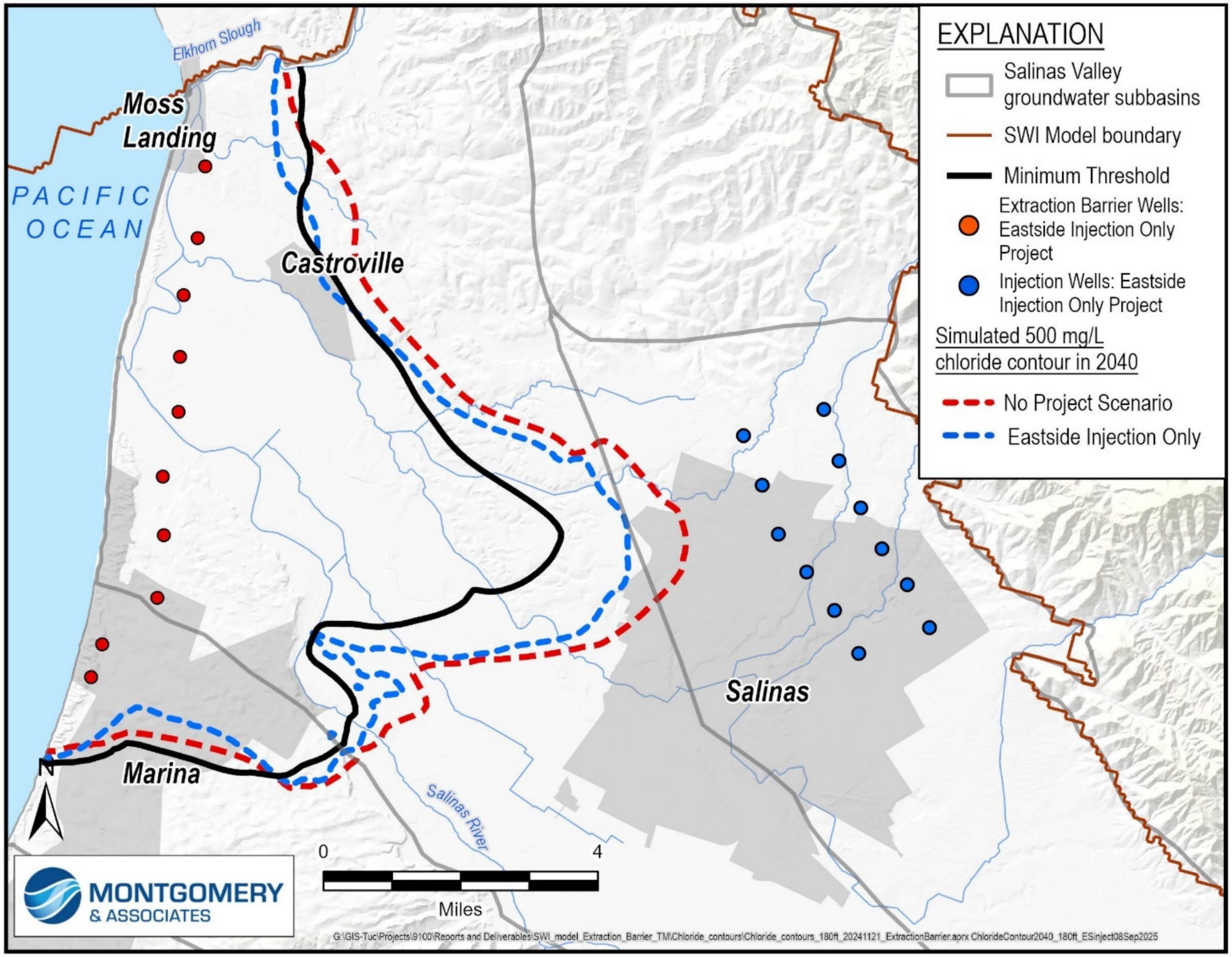


Figure 38 Eastside Subbasin Injection Project Modeling Results for 180-Foot Aquifer

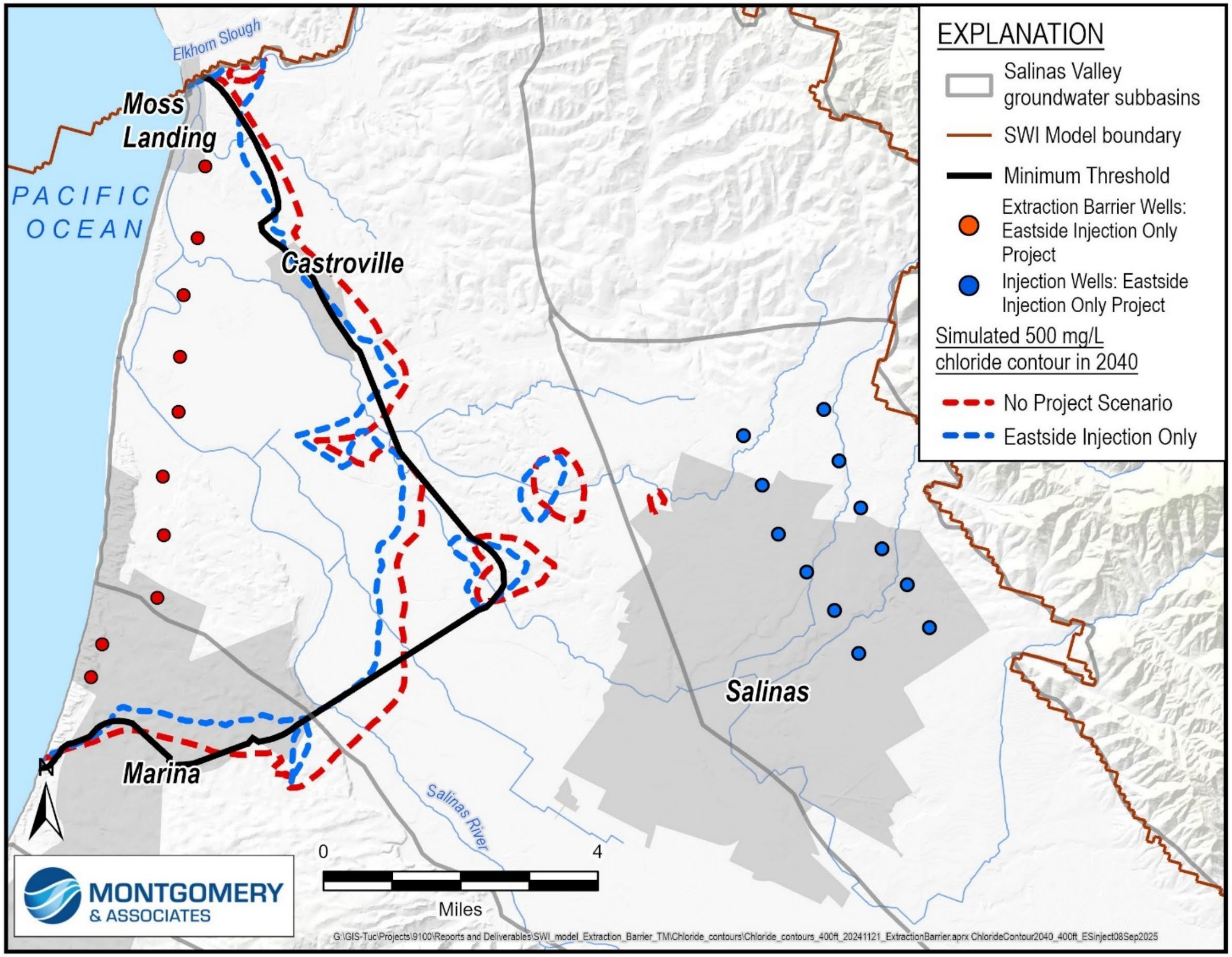


Figure 39 Eastside Subbasin Injection Project Modeling Results for 400-Foot Aquifer

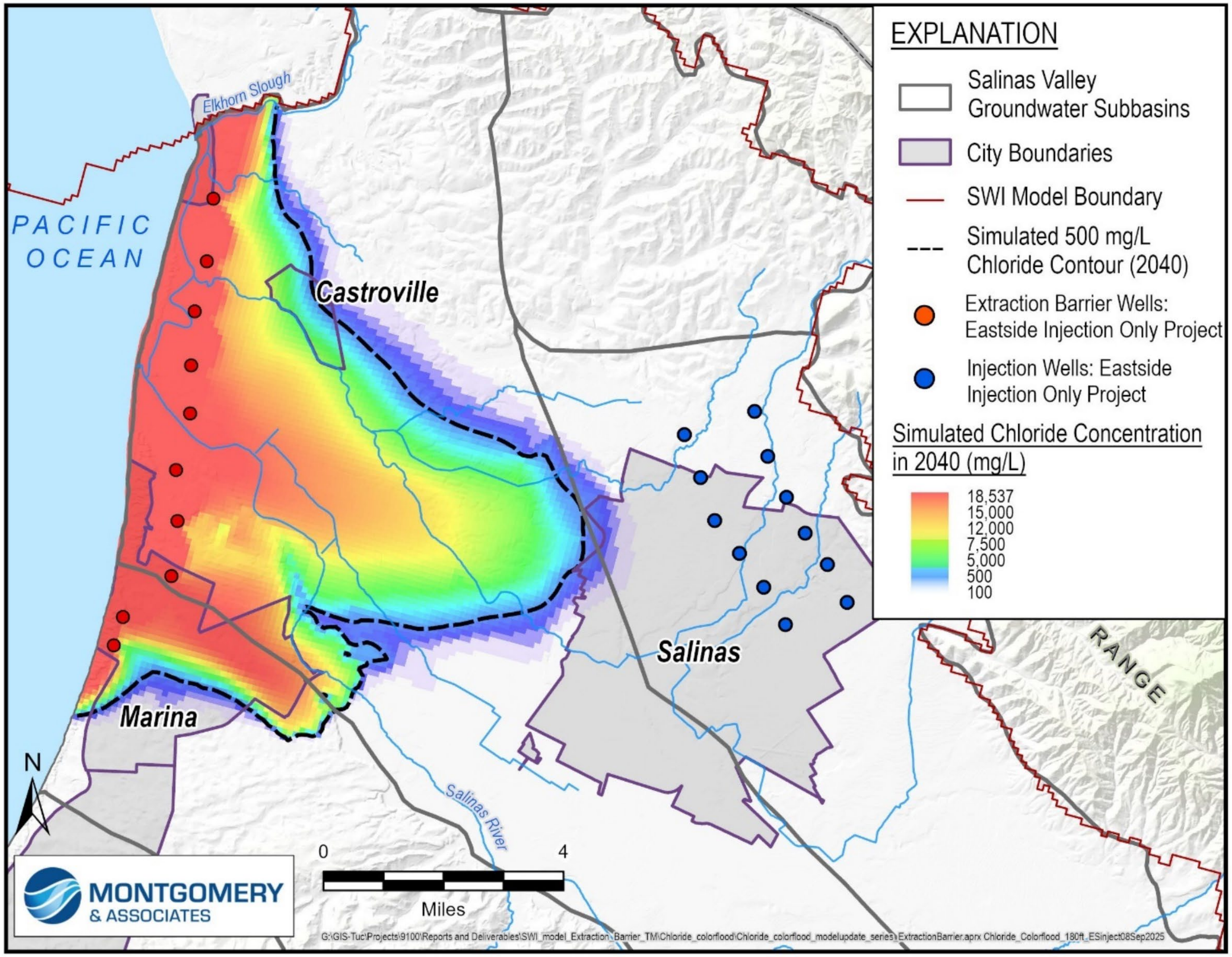


Figure 40 Eastside Subbasin Injection Project Chloride Concentrations Modeling Results for 180-Foot Aquifer

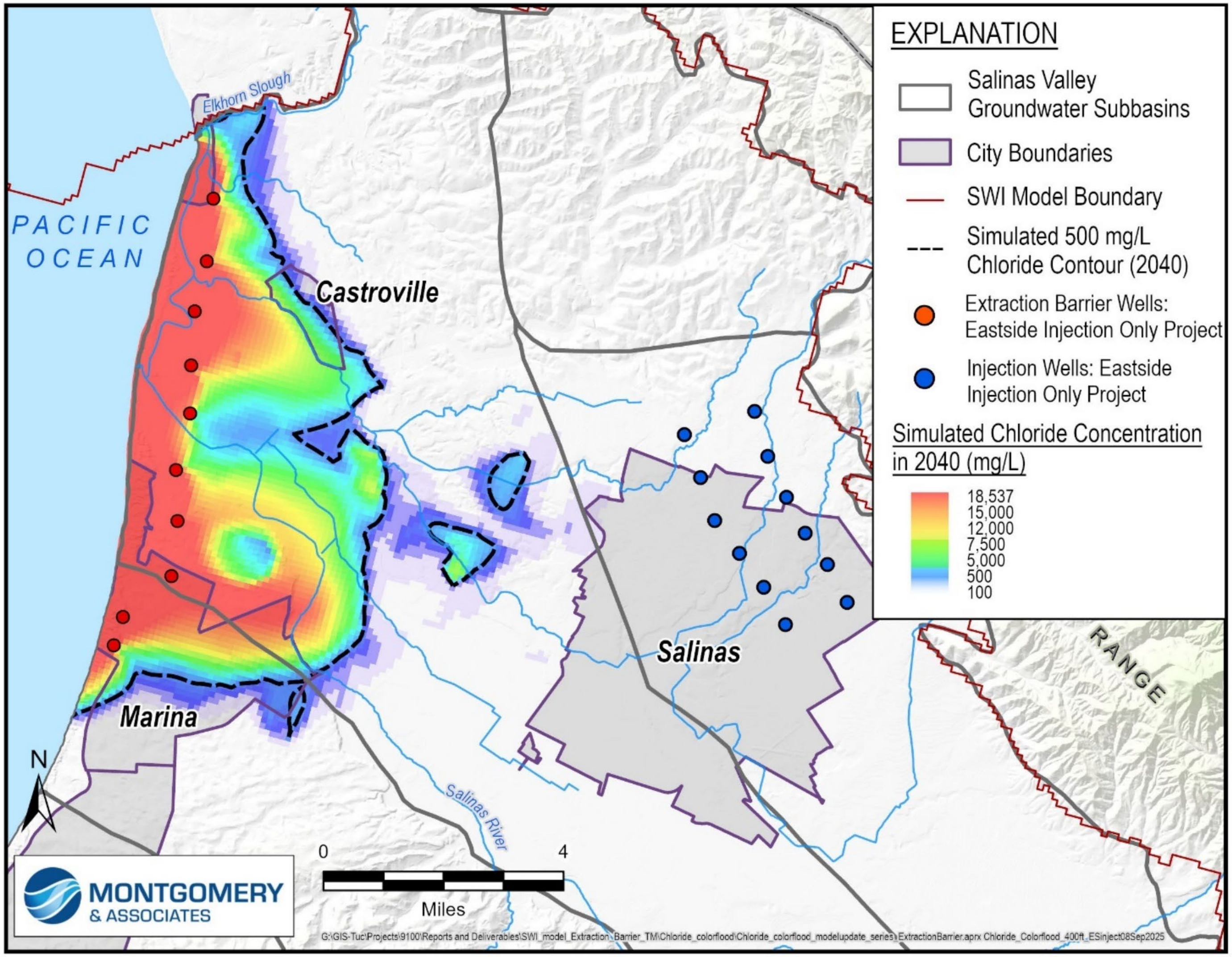


Figure 41 Eastside Subbasin Injection Project Chloride Concentrations Modeling Results for 400-Foot Aquifer

3.3.7 North of River Project Scenario

This scenario limits the extraction and injection of groundwater to areas north of the Salinas River. The purpose of the scenario is to evaluate if only having the barrier north of the river would minimize any effects from the project on MCWD wells. This scenario uses 10 coastal extraction and 14 injection wells sited north of the Salinas River. The lack of an extraction barrier south of the Salinas River leaves the City of Marina at risk of continued seawater intrusion—for this reason, two new injection wells to the east of the City of Marina but north of the Salinas River were included. Direct deliveries are provided to the community of Castroville and the CSIP system. The remainder of the treated water is used for injection to the 180-Foot Aquifer and the 400-Foot Aquifer. Except for Castroville and CSIP, all current groundwater users continue to pump water as they currently do. Figure 42 shows the layout of the North of River Project scenario.

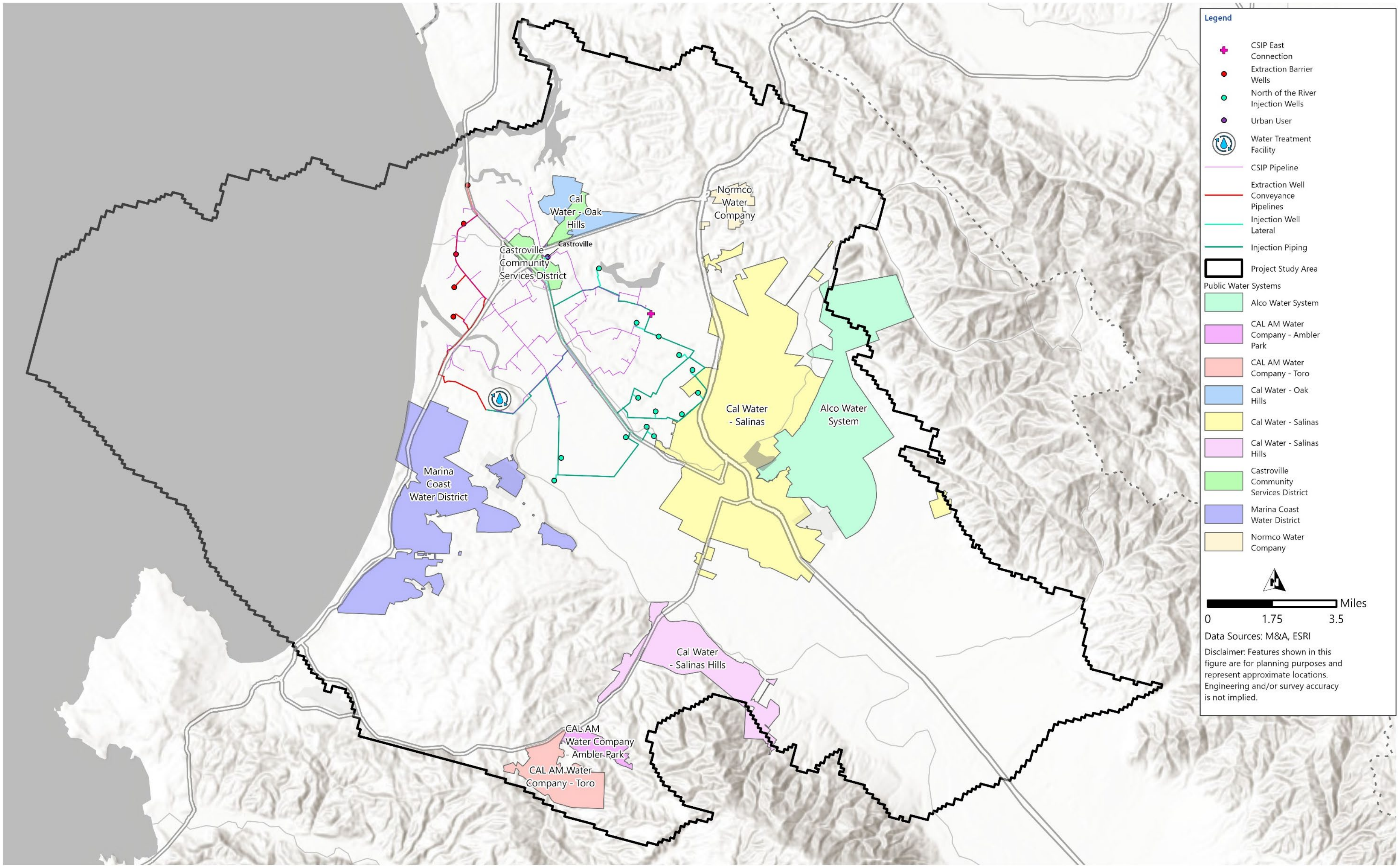


Figure 42 North of River Project Scenario

3.3.7.1 Supply and Demand Volumes

The North of River Project scenario uses 10 coastal extraction wells and 12 injection wells that are all located north of the Salinas River for a total extraction volume of 29,800 AF. Assuming the same 70 percent treatment recovery, the resulting potable water available for delivery and injection is approximately 20,900 AF. The extraction wells all discharge to a centralized treatment facility similar to the other BGRP scenarios. Additionally, this scenario provides direct deliveries to both CCSD and CSIP. The total extraction, injection, and delivery volumes are shown in Table 15.

Table 15 North of River Only Project Supply and Demand Volumes

Supply	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	11,500
Total Extraction Capacity in 400-Foot Aquifer (gpm)	7,000
Total (gpm)	18,500
Total (AFY)	29,800
Total Potable Volume AFY at 70%	20,900
Demand (AFY)	
CCSD	700
CSIP Supplemental Wells	5,300
Injection in the 180-Foot Aquifer	8,600
Injection in the 400-Foot Aquifer	6,300
Total Direct Delivery and Injection Volume (AFY)	**20,900**
Total Demand % of Total Supply	**70%**

Notes:
(1) Extraction well volumes are in gpm, unless noted otherwise.
(2) Values are rounded to the nearest 100.

3.3.7.2 Water Treatment and Outfall

Similar to the Medium and Injection-Only Project scenarios, the North of River Project scenario has the same treatment process assumptions and performance criteria. The treatment cost for the Medium Project scenario was linearly adjusted to represent a treatment facility approximately the same size as the small alternative.

3.3.7.3 Project Costs

The total cost of the North of River Project scenario is shown in Table 16. The construction costs have the same cost contingencies and soft costs factors included as all of the other project scenarios considered previously in this TM.

The North of River Project scenario is assumed to be financed through a federal or state low interest loan program (e.g., SRF or WIFIA) with a 30-year repayment period. The projected lifecycle of the project was assumed to be the same, which is through the year 2070 resulting in a total lifecycle of 40 years. The O&M costs for the North of River Project are estimated at approximately $71.5M with an annual financing cost of approximately $36.5M. Using a 4 percent interest rate and a 2.75 percent discount rate, the annualized net present value of the North of River Project scenario is approximately $81.4M which results in an annualized project unit cost of $1,763 per AF.

Table 16 North of River Project Costs

Project Component	Cost(1)
Well Sites	$ 28,050,000
Outfall Cleaning and Modification	$ 6,250,000
Extraction Distribution	$ 51,400,000
Potable Water Distribution Transmission Mains	$ 66,500,000
Potable Water Booster Pump	$ 11,100,000
Injection Well Sites	$ 31,100,000
Injection Well Laterals	$ 5,150,000
ROC Storage	$ 2,050,000
Land Costs	$ 3,100,000
Water Treatment Plant Costs	$ 335,000,000
Construction Subtotal	**$ 539,700,000**
Engineering Planning and Design (10%)	$ 53,970,000
Environmental Planning and Permitting (2%)	$ 10,790,000
Administrative and Legal (1%)	$ 5,400,000
Construction Management (4%)	$ 21,590,000
Soft Costs Subtotal	**$ 91,750,000**
Grand Total Project Costs	**$ 631,450,000**

Notes:
(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, and 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.7.4 Seawater Intrusion Mitigation Effectiveness

Figures 43 and 44 show that between 2030 and 2040 seawater intrusion is halted and reverses direction on the northern side of the seawater intruded area in the 180-Foot Aquifer; however, seawater continues to progress inland towards the City of Salinas in the rest of the 180-Foot Aquifer, even between and around the injection wells. In the 400-Foot Aquifer, the effect of the North of River Project scenario on seawater intrusion is about the same as the Small Project scenario. The two additional wells east of the City of Marina appear to have helped halt seawater intrusion slightly; however, some seawater was still able to penetrate inland south of, and between, the two injection wells.

Compared to the No Project scenario, the 2040 500 mg/L chloride contour is slightly closer to the coast, showing some benefit from the project. However, the 2040 500 mg/L contour line is still inland of the MT; this project does not avoid undesirable results. Figures 45 and 46 show the simulated chloride concentration from the North of River Project.

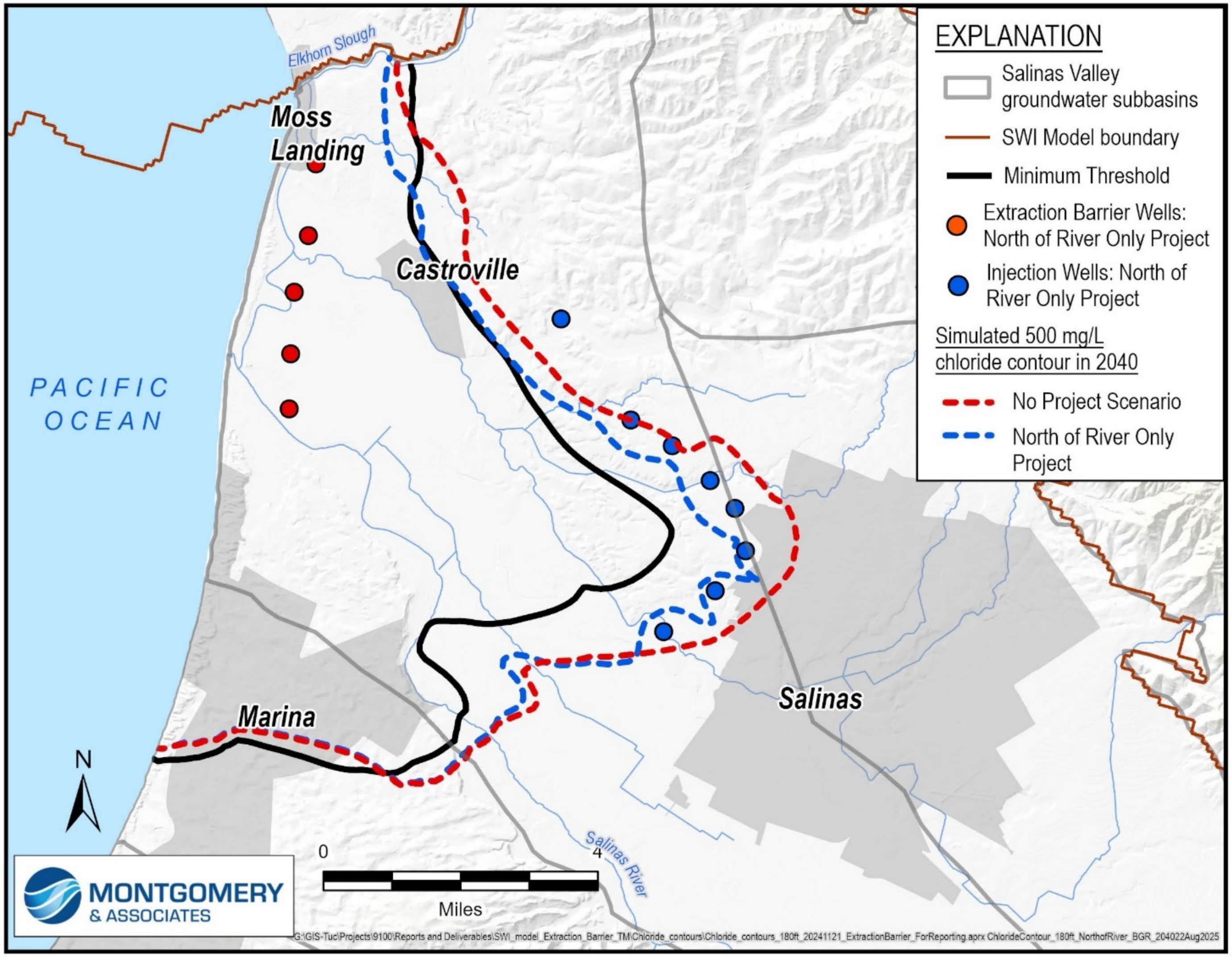


Figure 43 North of River Project Modeling Results for 180-Foot Aquifer

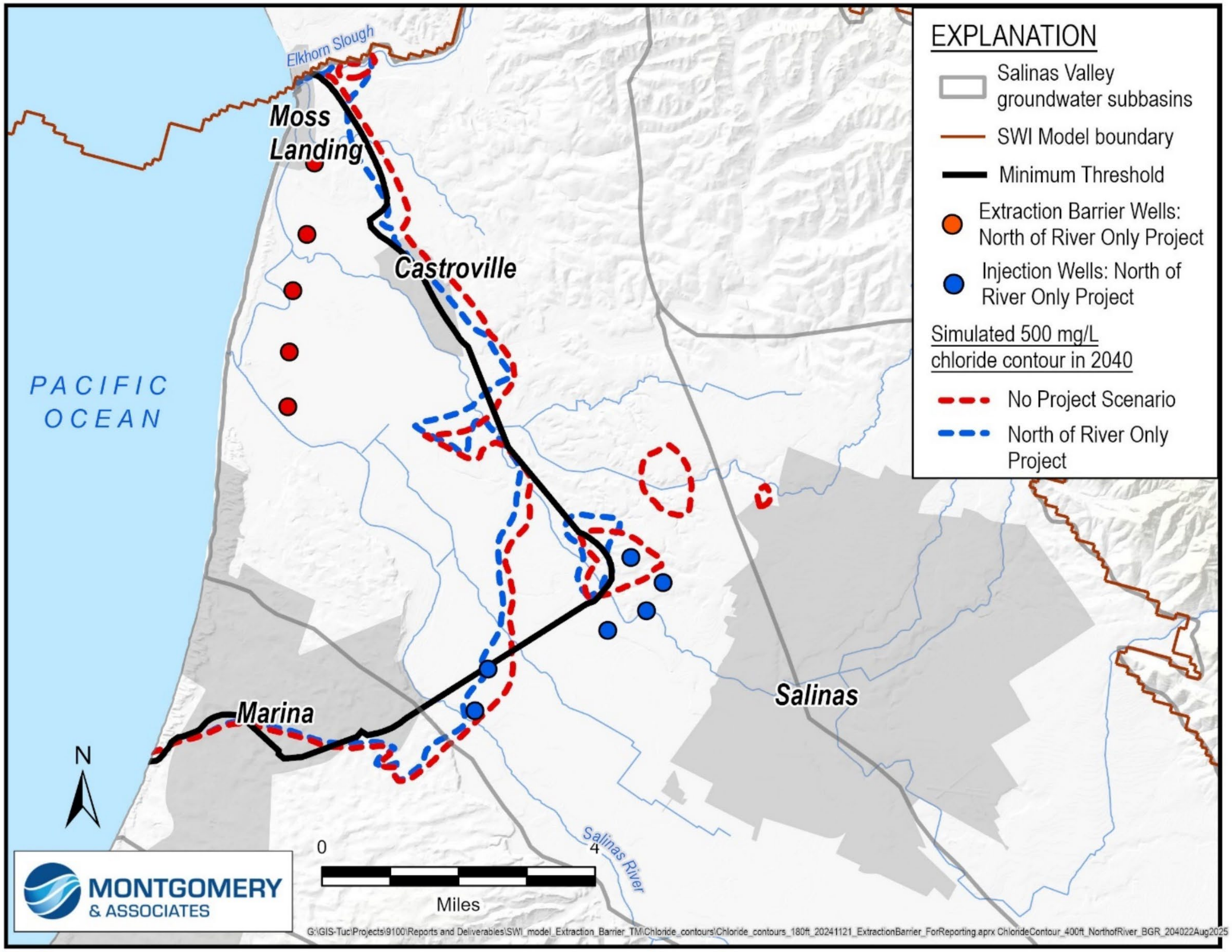


Figure 44 North of River Project Modeling Results for 400-Foot Aquifer

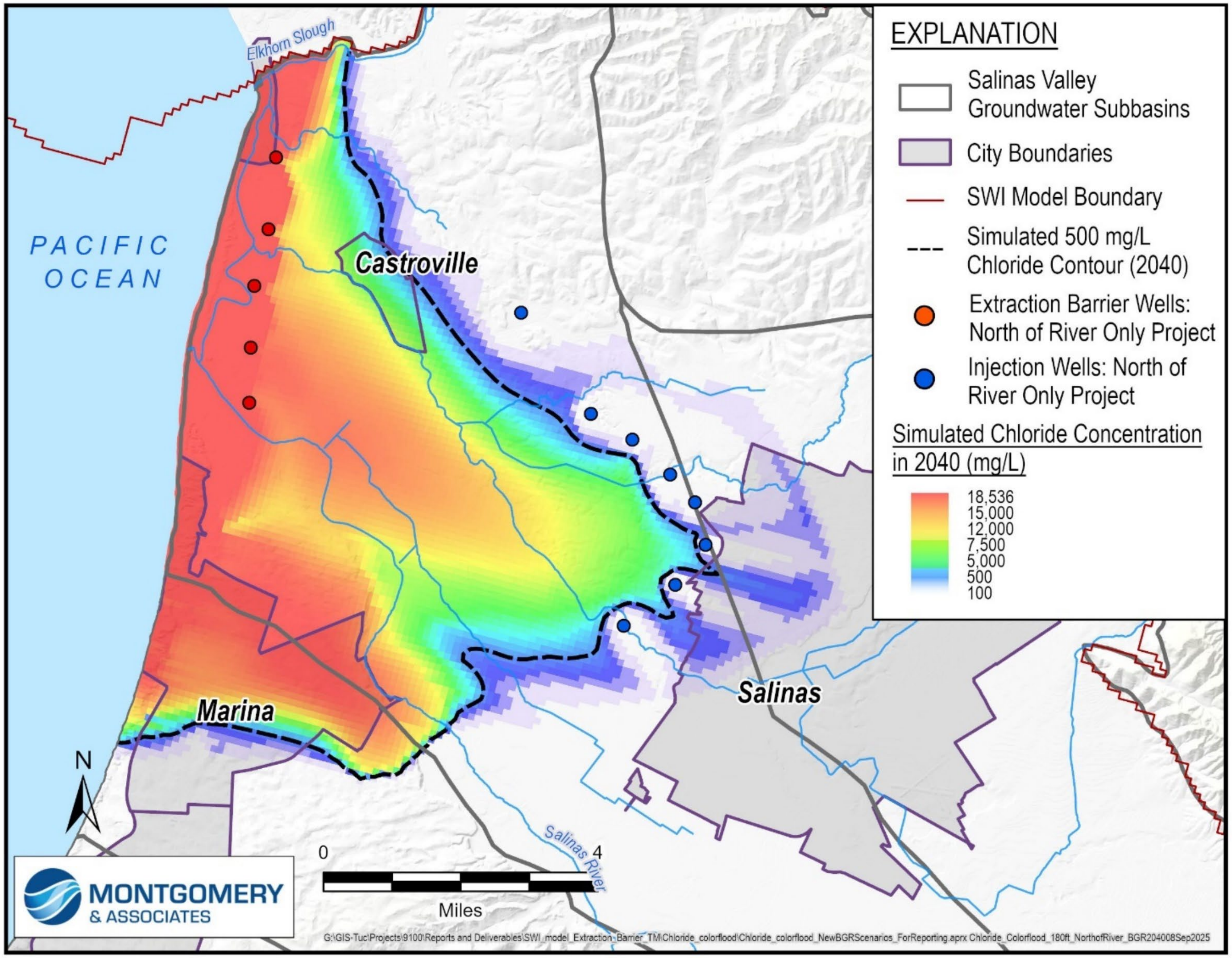


Figure 45 North of River Project Chloride Concentrations Modeling Results for 180-Foot Aquifer

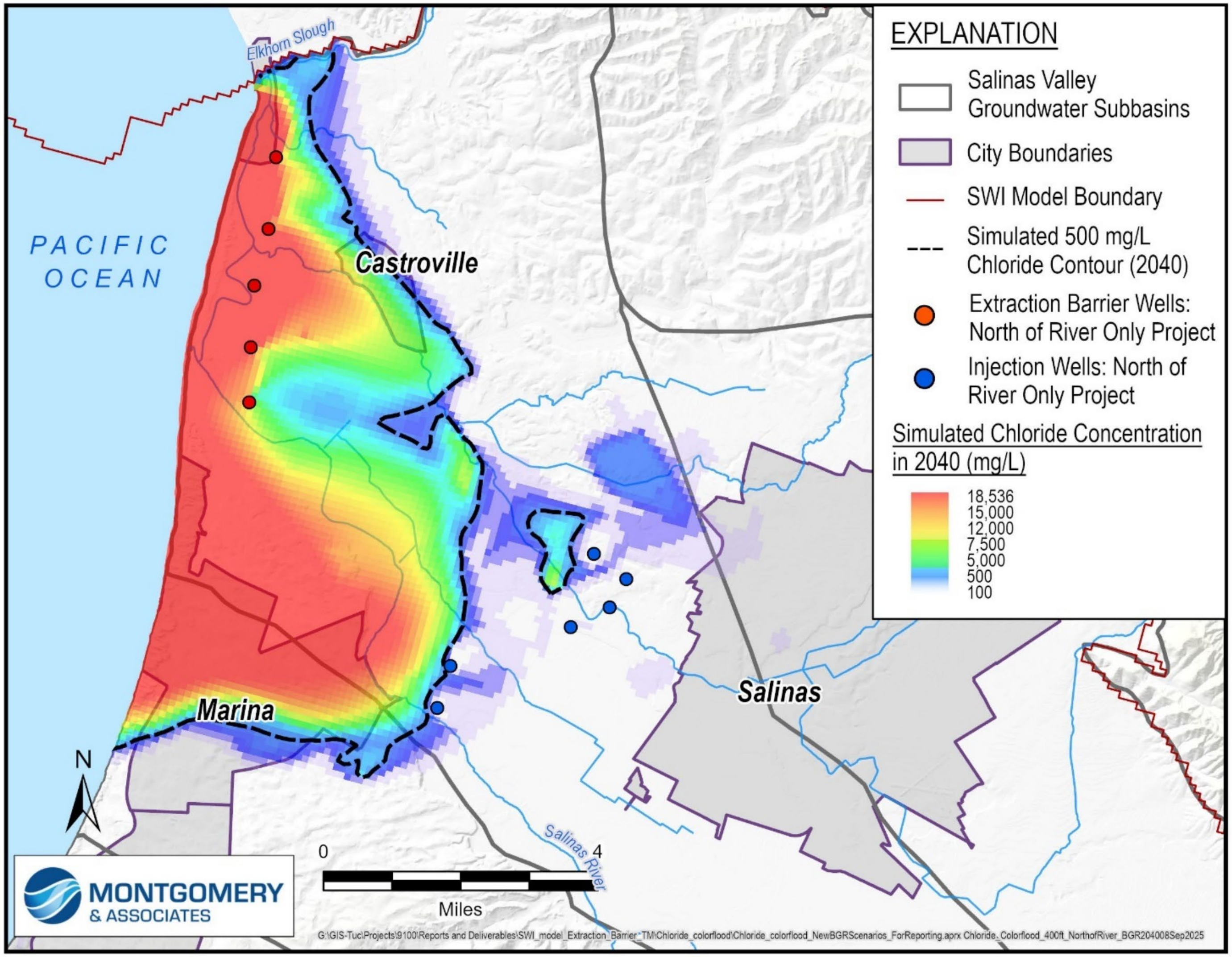


Figure 46 North of River Project Chloride Concentrations Modeling Results for 400-Foot Aquifer

3.3.8 180-Foot Extraction/400-Foot Injection Project Scenario

This scenario is designed to achieve seawater intrusion management benefits like those of the Medium Project scenario, while attempting to reduce infrastructure costs and groundwater level impacts in the 400-Foot Aquifer. This scenario uses the 10 same 180-Foot Aquifer extraction wells that were used in the Medium Project scenario, and the same 400-Foot Aquifer injection wells used in the Injection-Only scenario plus 2 additional injection wells to the north near Castroville and 2 additional wells to the south near the City of Marina. Previous simulations indicated approximately 29,000 AFY of injection alone into the 400-Foot Aquifer would be effective at stopping seawater intrusion. To provide adequate water for injection, extraction from the 180-Foot Aquifer is increased from 36,300 AFY (per the Medium Project scenario) to 41,400 AFY. There are no direct deliveries in this scenario; the treated water is injected into the 400-Foot Aquifer. Current groundwater users continue to pump water as they currently do. Figure 47 shows the project scenario layout.

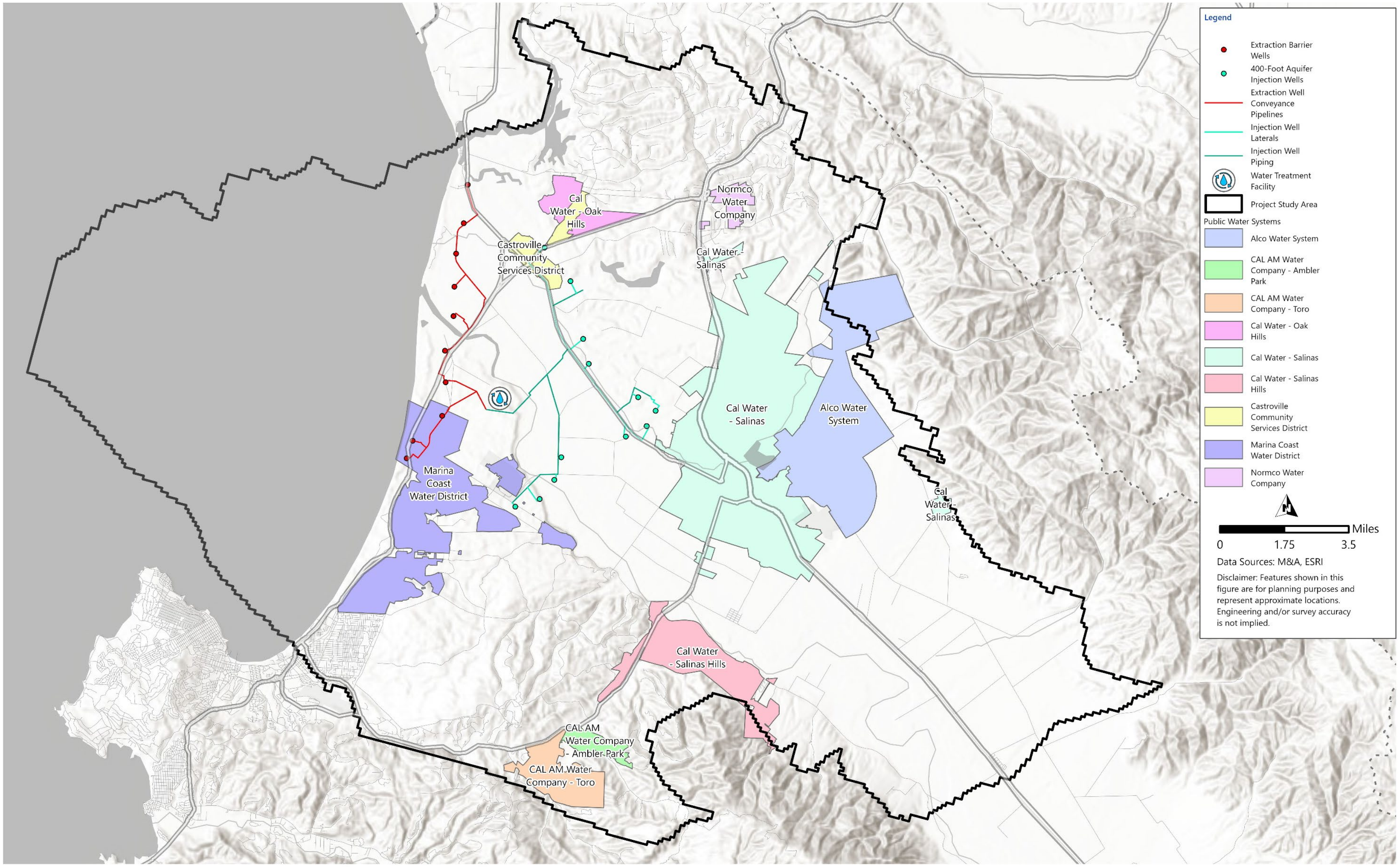


Figure 47 180-Foot Extraction/400-Foot Injection Project Scenario

3.3.8.1 Supply and Demand Volumes

The total volume extracted for the 180-Foot Extraction/400-Foot Injection Project scenario is approximately 41,400 AF. This is extracted from the 180-Foot Aquifer using the 10 wells that are included in the Medium Project scenario. Using the same treatment recovery of 70 percent, like the other project scenarios, the total amount of treated water available for injection is approximately 29,000 AF. This volume of injection water will be distributed through 12 injection wells in the 400-Foot Aquifer. The total extraction, injection and delivery volumes are shown in Table 17.

Table 17 180-Foot Extraction/400-Foot Injection Project Supply and Demand Volumes

Supply	
Total Extraction Capacity in 180-Foot Aquifer (gpm)	25,700
Total Extraction Capacity in 400-Foot Aquifer (gpm)	0
Total (gpm)	**25,700**
Total (AFY)	41,400
Total Potable Volume AFY at 70%	29,000
Demand (AFY)	
Injection in the 180-Foot Aquifer	0
Injection in the 400-Foot Aquifer	29,000
Total Injection Volume (AFY)	**29,000**
Total Demand % of Total Supply	**70%**

Notes:
(1) Extraction well volumes are in gpm, unless noted otherwise.
(2) Values rounded to the nearest 100.

3.3.8.2 Water Treatment and Outfall

Similar to the Medium and Injection-Only Project scenarios, the 180-Foot Extraction/400-Foot Injection Project scenario has the same treatment process assumptions and performance criteria. The treatment cost for the Medium Project scenario was linearly adjusted to represent a treatment facility approximately the same size as the small alternative.

3.3.8.3 Project Costs

The total cost of the 180-Foot Extraction/400-Foot Injection Project scenario is shown in Table 18. The construction costs have the same cost contingencies and soft costs factors included as all the other project scenarios considered previously in this TM.

The 180-Foot Extraction/400-Foot Injection Project scenario is assumed to be financed through a federal or state low interest loan program (e.g., SRF or WIFIA) with a 30-year repayment period. The projected lifecycle of the project was assumed to be the same, which is through the year 2070 resulting in a total lifecycle for financing of 40 years. The O&M costs for the 180-Foot Extraction/400-Foot Injection Project is estimated at approximately $125.6M with an annual financing cost of approximately $53.9M. Using a 4 percent interest rate and a 2.75 percent discount rate, the annualized net present value of the 180-Foot

Extraction/400-Foot Injection Project is approximately $138M which results in an annualized project unit cost of $2,945 per AF.

Table 18 180-Foot Extraction/400-Foot Injection Project Costs

Project Component	Cost(1)	
Well Sites	$	52,550,000
Outfall Cleaning and Modification	$	6,250,000
Extraction Distribution	$	57,000,000
Potable Water Distribution Transmission Mains	$	69,650,000
Potable Water Booster Pump	$	41,600,000
Injection Well Sites	$	27,650,000
Injection Well Laterals	$	6,450,000
ROC Storage	$	3,400,000
Land Costs	$	11,200,000
Water Treatment Plant Costs	$	522,000,000
Construction Subtotal	**$**	**797,750,000**
Engineering Planning and Design (10%)	$	79,780,000
Environmental Planning and Permitting (2%)	$	15,960,000
Administrative and Legal (1%)	$	7,980,000
Construction Management (4%)	$	31,910,000
Soft Costs Subtotal	**$**	**135,630,000**
Grand Total Project Costs	**$**	**933,380,000**

Notes:
(1) All costs include: 30 percent construction contingency, Monterey County sales tax of 7.75 percent applied to 50 percent of costs, and 0.25 percent monthly escalation to July 2030 as the estimated midpoint of construction.

3.3.8.4 Seawater Intrusion Mitigation Effectiveness

Results of the 180-Foot Extraction/400-Foot Injection Project simulation suggest that, with some modifications, this scenario might be able to reverse seawater intrusion and avoid undesirable results in both the 180-Foot and 400-Foot Aquifers. Figures 48 and Figure 49 compare the simulated 2040 intrusion extent with the 2040 No Project intrusion extent and the seawater intrusion MT. Between 2030 and 2040 in the 180-Foot Aquifer, seawater retreats in the north away from Castroville and in the south away from the City of Marina but continues to progress inland toward northern Salinas. Areas in the 180-Foot Aquifer where seawater retreats are closer to the extraction barrier, while the area where seawater continues to intrude is farther inland. Further refinements to this scenario, such as including cleanup wells, may successfully halt and reverse seawater intrusion in the 180-Foot Aquifer. The 500 mg/L chloride front in the 400-Foot Aquifer retreats in most areas due to the injection wells placed in this aquifer.

In the 400-Foot Aquifer, the 2040 extent of seawater intrusion is generally seaward of MT. Modifications to the 180-Foot Extraction/400-Foot Injection Project will be necessary to avoid undesirable results in the 180-Foot Aquifer.

Figures 50 and 51 show the simulated 180-Foot Extraction/400-Foot Injection Project chloride concentrations in the 180-Foot and 400-Foot Aquifers in 2040. Seawater intrusion beneath the City of

Salinas is at lower concentrations (<5,000 mg/L); this is intrusion that is too far away to be captured by the extraction barrier. This residual seawater intrusion could be extracted with cleanup wells.

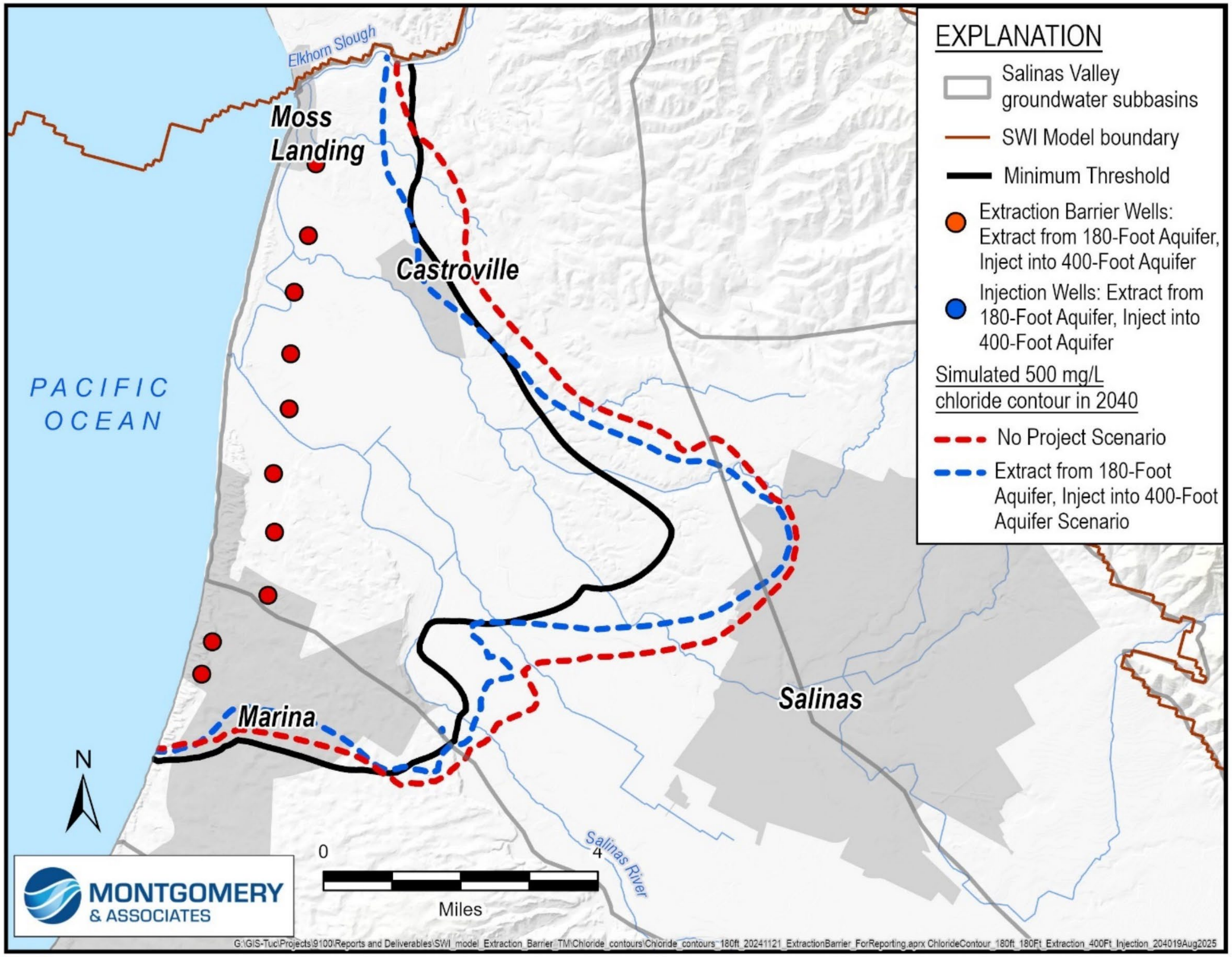


Figure 48 180-Foot Extraction/400-Foot Injection Project Modeling Results for 180-Foot Aquifer

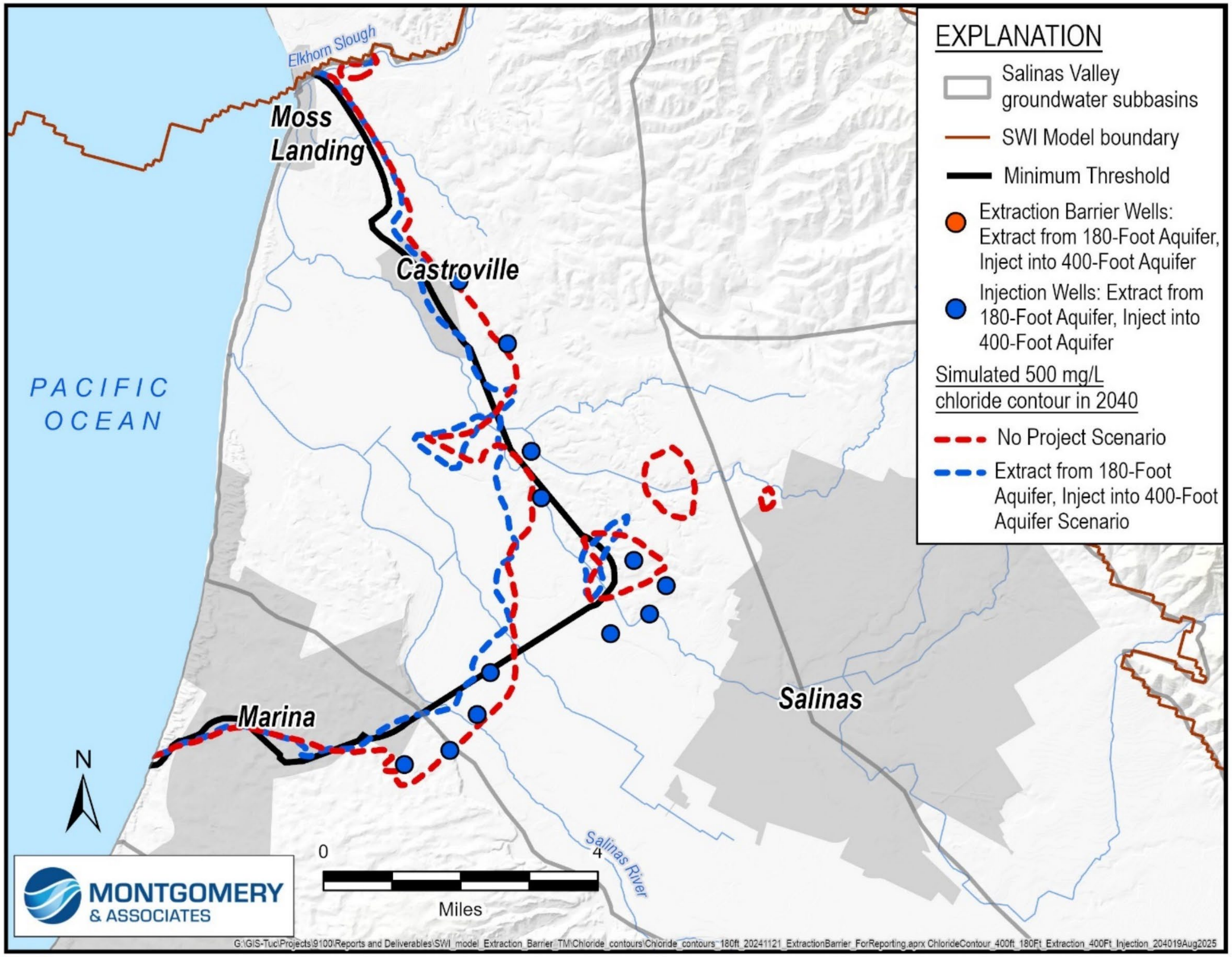


Figure 49 180-Foot Extraction/400-Foot Injection Project Modeling Results for 400-Foot Aquifer

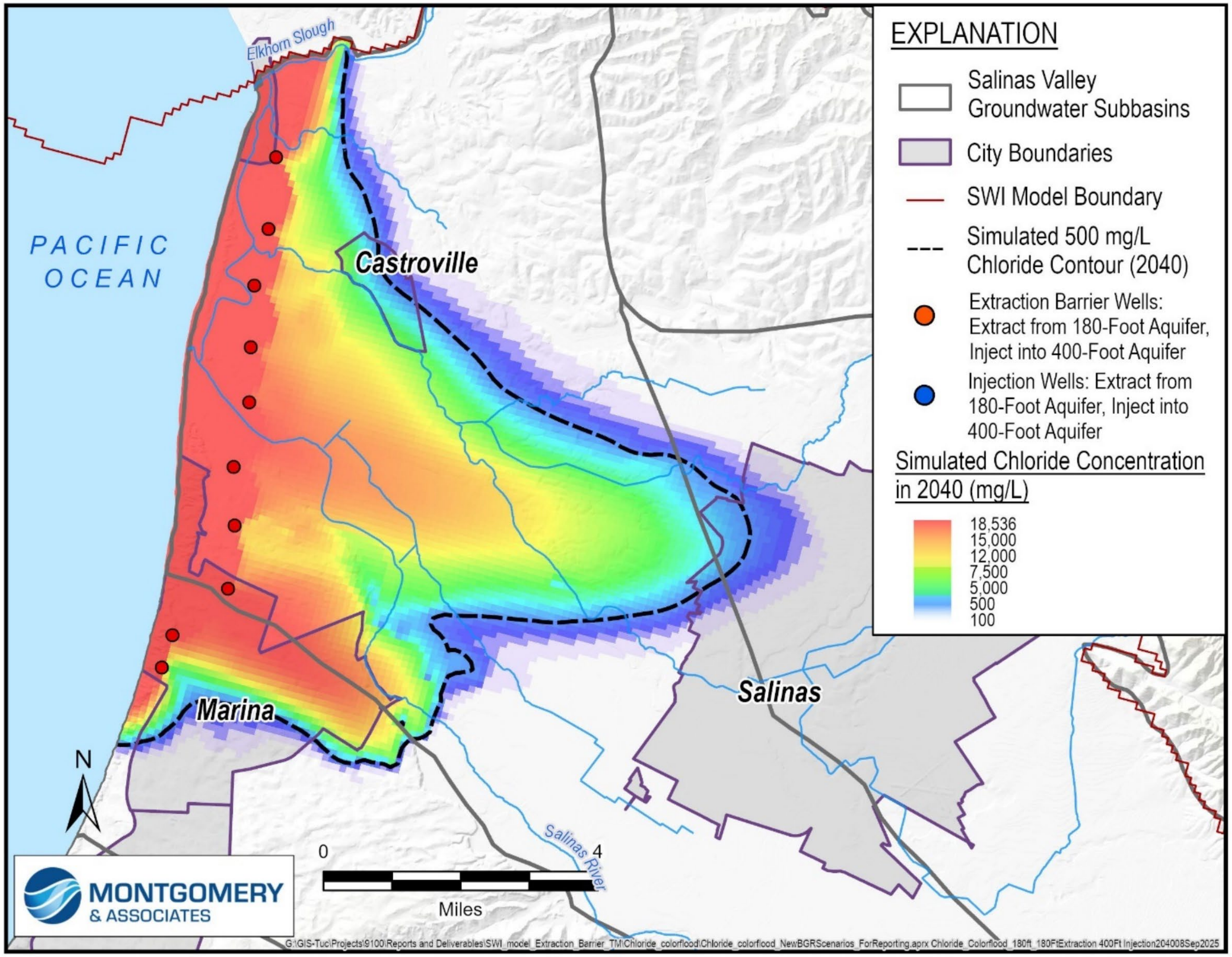


Figure 50 180-Foot Extraction/400-Foot Injection Project Chloride Concentrations Modeling Results for 180-Foot Aquifer

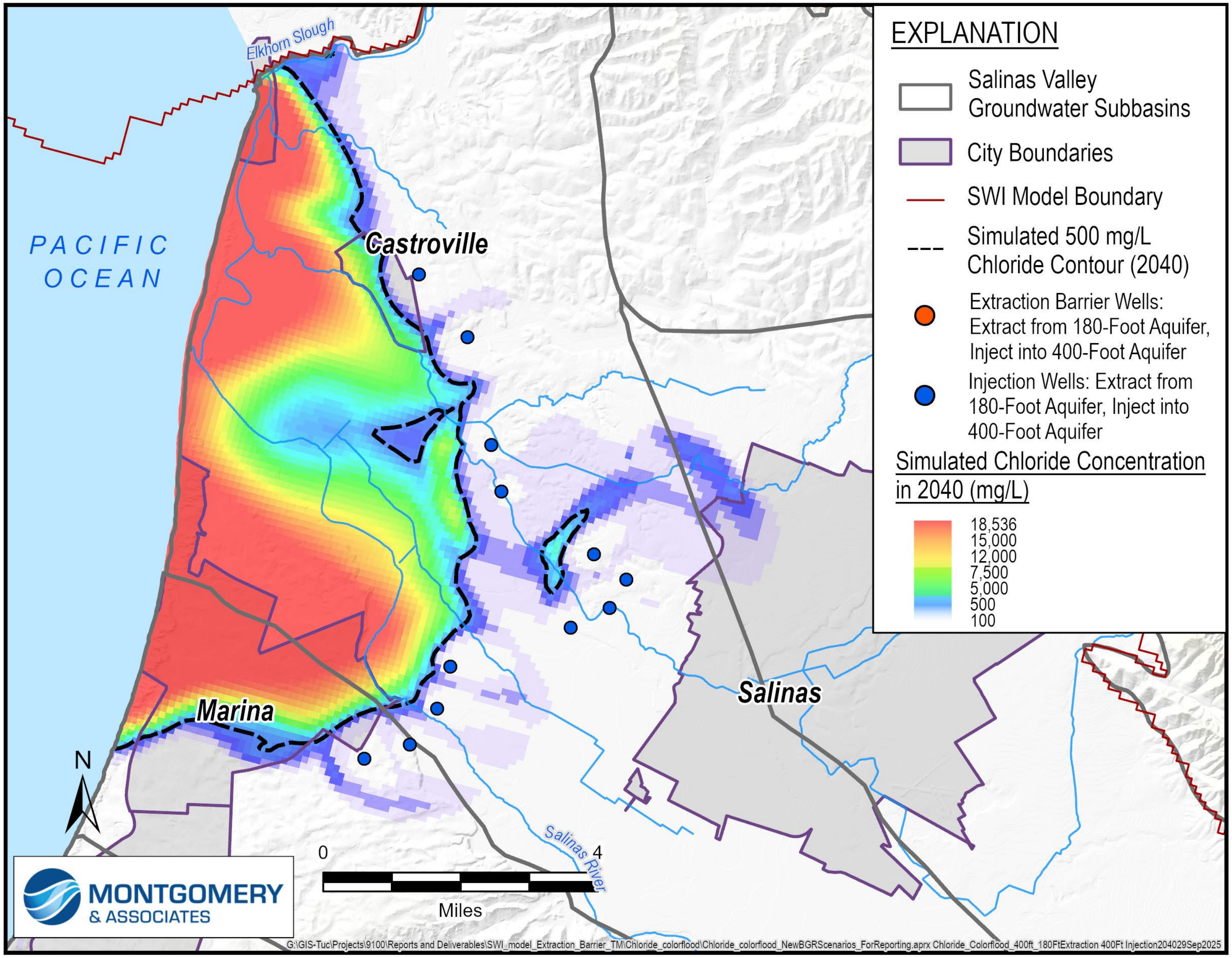


Figure 51 180-Foot Extraction/400-Foot Injection Project Chloride Concentrations Modeling Results 400-Foot Aquifer

SECTION 4 SUMMARY OF SCENARIOS

The purpose of this TM is to present the BGRP scenarios that have been evaluated to analyze whether a project of this type could meet the sustainability criteria for seawater intrusion.

The analysis was an iterative process to model the effectiveness of implementing the range of BGRP scenarios and facility configurations. The BGRP concept includes extraction wells to intercept brackish water in the seawater intrusion zone near the Monterey Bay coastline, preventing further inland intrusion. Extracted water is treated with RO to produce potable-quality water. The resulting potable- or agricultural-quality water is distributed to regional end users to offset pumping or injected inland to raise groundwater levels and push back the seawater front. ROC (brine) would be discharged through the M1W ocean outfall.

The cumulative investigation into BGRP scenarios and the modeling has led to the development of seven project scenarios that vary in their volumes produced, type of delivery, and location representing a range of possible solutions to meet the subbasin's MTs. The seven BGRP scenarios considered are:

1. Extraction, Treatment, and Direct Deliveries Plus Injection – Small.
2. Extraction, Treatment, and Direct Deliveries Plus Injection – Medium.
3. Extraction, Treatment, and Direct Deliveries Plus Injection – Large.
4. Extraction, Treatment, and Injection Only.
5. Extraction, Treatment, and Eastside Injection.
6. Extraction North of the Salinas River, Treatment, and Direct Deliveries Plus Injection.
7. Extraction from the 180-Foot Aquifer, Treatment, and Injection in the 400-Foot Aquifer.

4.1 Comparison of Scenarios

Figure 52 shows the three direct delivery scenarios (Small, Medium, and Large) chloride contours in 2040 for the 180-Foot Aquifer compared to No Project. Figure 53 shows additional BGRP scenarios (Injection Only, Eastside Subbasin Injection, North of River, and 180-Foot Extraction/400-Foot Injection) chloride contours in 2040 for the 180-Foot Aquifer compared to No Project. As can be seen in these two figures, the Large and Injection-Only Projects best meet the goal (MT) for the 180-Foot Aquifer, closely followed by the Medium Project. Figure 54 shows the original three scenarios (Small, Medium, and Large) chloride contours in 2040 for the 400-Foot Aquifer compared to No Project. Figure 55 shows the remaining BGRP scenarios (Injection Only, Eastside Subbasin Injection, North of River, and 180-Foot Extraction/400-Foot Injection) chloride contours in 2040 for the 400-Foot Aquifer compared to No Project. As can be seen in these figures, the Large, Medium, and Injection-Only projects best meet the goal (MT) for the 400-Foot Aquifer by 2040.

A comparison of the projects is included in Table 19.

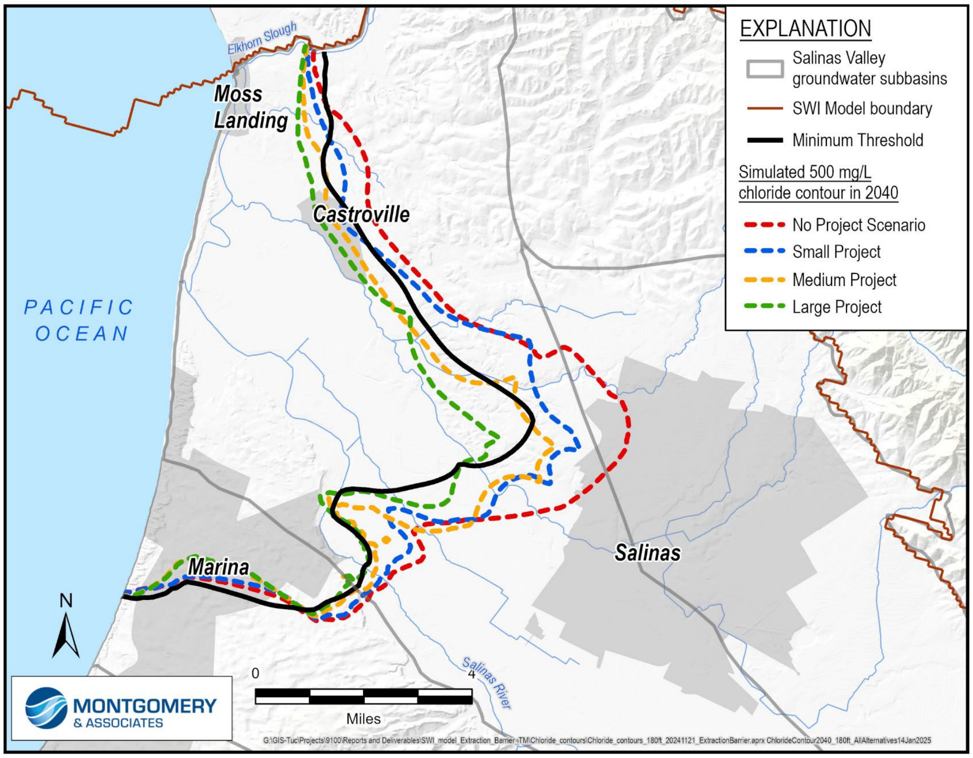


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Figure 52 Chloride Contour for 180-Foot Aquifer for Small/Medium/Large Scenarios

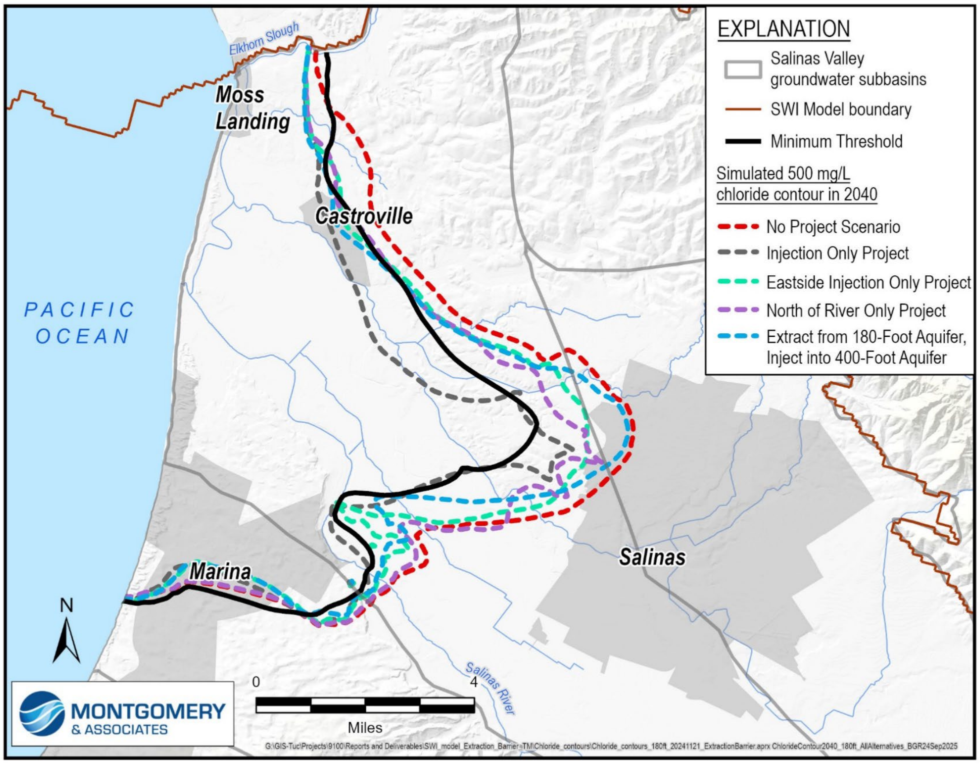

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Figure 53 Chloride Contour for 180 -Foot Aquifer for Remaining Scenarios

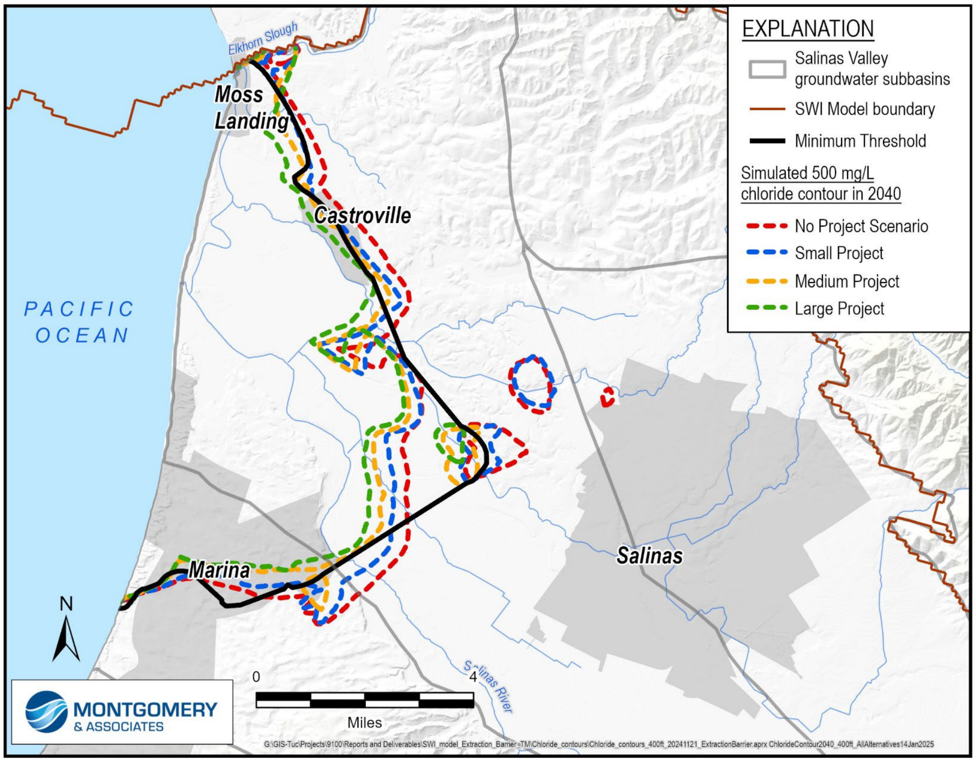

Figure 54 Chloride Contour for 400-Foot Aquifer for Small/Medium/Large Scenarios

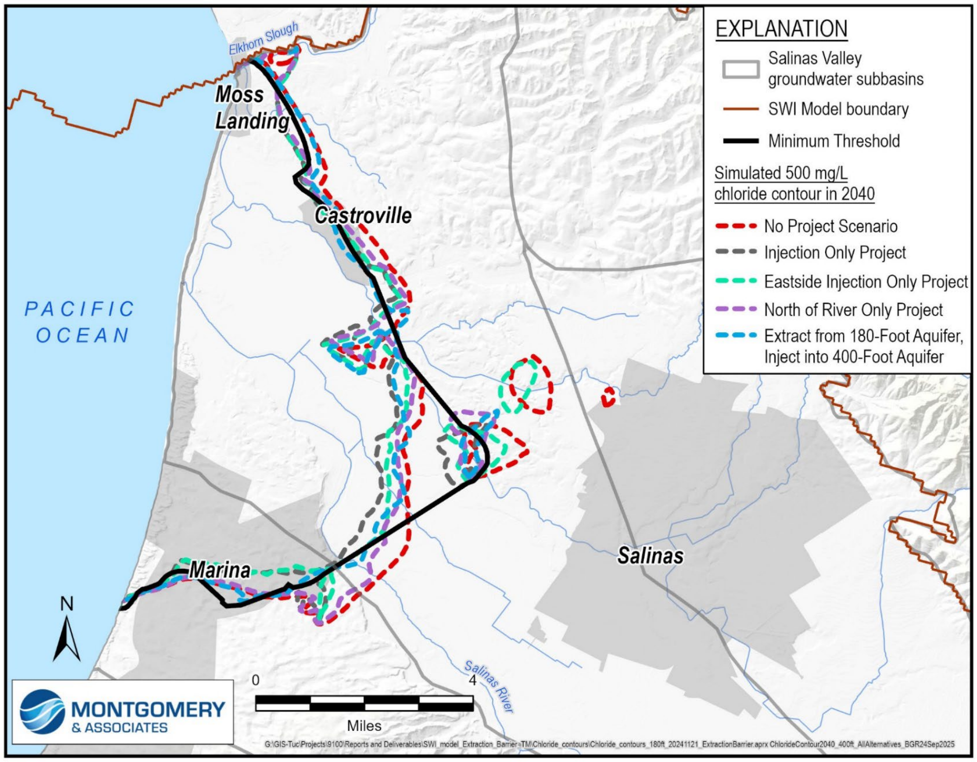

Figure 55 Chloride Contour for 400-Foot Aquifer for Remaining Scenarios

Table 19 Comparison of BGRP Scenarios

Project Component	Small	Medium	Large	Injection Only	Eastside Injection	North of River	Extract 180/ Inject 400
Number of Extraction Wells	12	20	24	20	20	10	10
Total Volume Extracted (AFY)	39,700	67,000	96,800	67,000	67,000	29,800	41,400
Total Length of Extraction Pipe (feet)	41,400	66,000	128,770	66,000	66,000	50,700	66,000
Total Volume Treated (AFY)	28,000	46,900	67,800	46,900	46,900	20,900	29,000
End Users	▪ Alco. ▪ Cal Water – Salinas. ▪ CCSD. ▪ MCWD. ▪ CSIP.	▪ Alco. ▪ Cal Water – Salinas. ▪ CCSD. ▪ MCWD. ▪ CSIP.	▪ Alco. ▪ Cal Water – Salinas. ▪ CCSD. ▪ MCWD. ▪ CSIP. ▪ Cal Water – Salinas Hills. ▪ Agriculture wells in seawater intrusion. ▪ Agriculture wells within 1,000 feet. ▪ Normco. ▪ Toro. ▪ Oak Hills. ▪ Ambler Park.	▪ Injection Only.	▪ Injection Only.	▪ CCSD. ▪ CSIP.	▪ Injection Only.
Total Volume Delivered to End Users (AFY)	19,400	27,700	41,500	0	0	6,000	0
Number of Injection Wells	9	12	12	20	12	12	12
Total Volume Injected (AFY)	8,600	19,100	26,200	44,800	44,800	14,900	29,000
Total Length of Treated Water Piping (feet)	204,400	204,400	331,700	139,800	92,462	132,521	85,600
Total Cost ($M)	$720	$1,013	$1,482	$955	$949	$632	$933

4.2 Next Steps

SVBGSA will be using this information to prepare a USBR Report for large, recycled water or desalination projects. SVBGSA is also evaluating demand management, new surface water diversions, and aquifer storage and recovery, as other means to reduce the impact of seawater intrusion and meet the required MT. The USBR Report will further evaluate a BGRP scenario selected as the preferred approach, as well as at least one alternative project that can meet the seawater intrusion MT.