

Salinas Valley Deep Aquifers Study

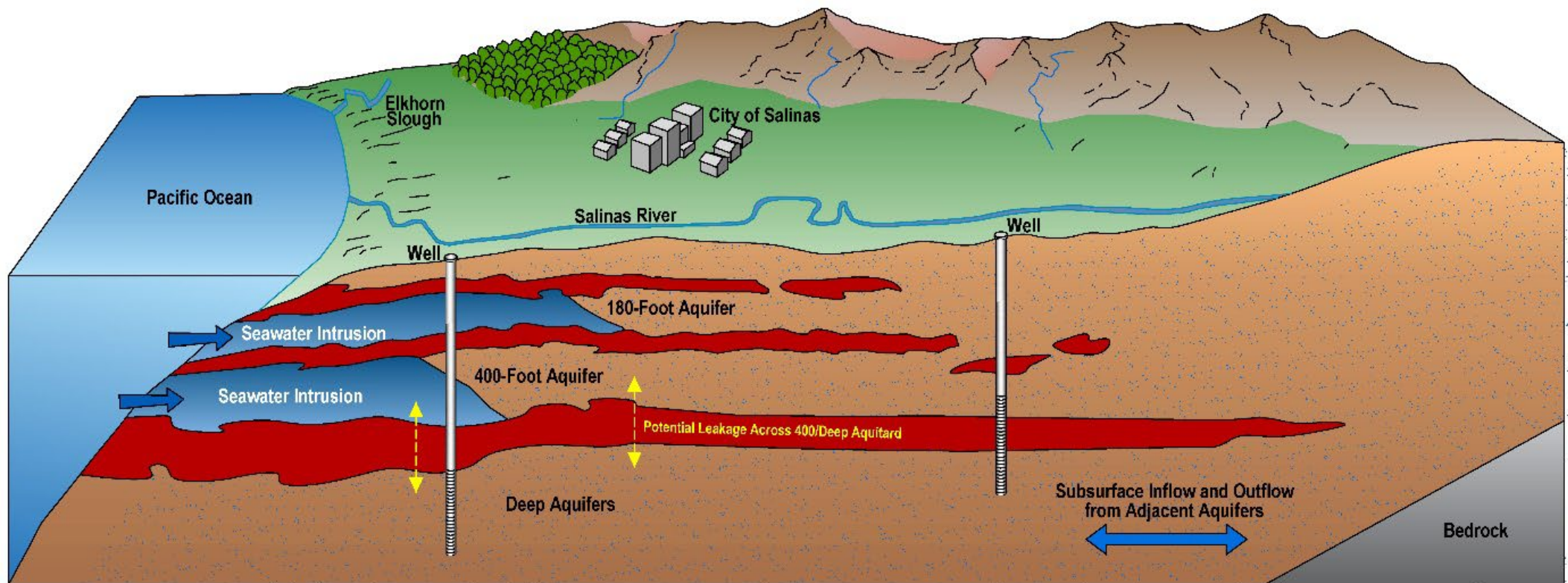


Final Presentation

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Deep Aquifers within the Salinas Valley

- Key municipal and agricultural source of water
- Particularly important in seawater intruded areas



Summary of Study Contributions



Developed definition, extent, and HCM of the Deep Aquifers



Developed a water budget for the Deep Aquifers



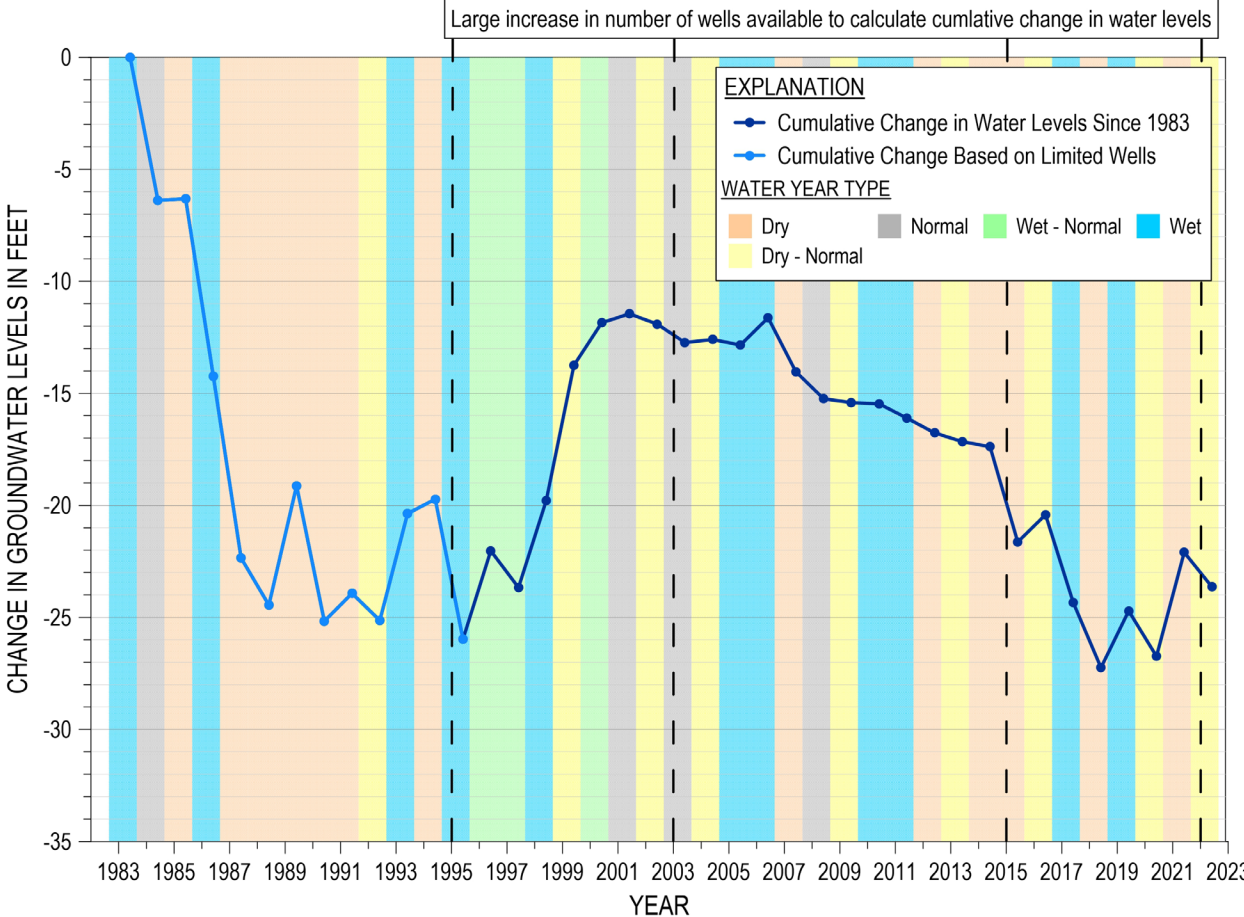
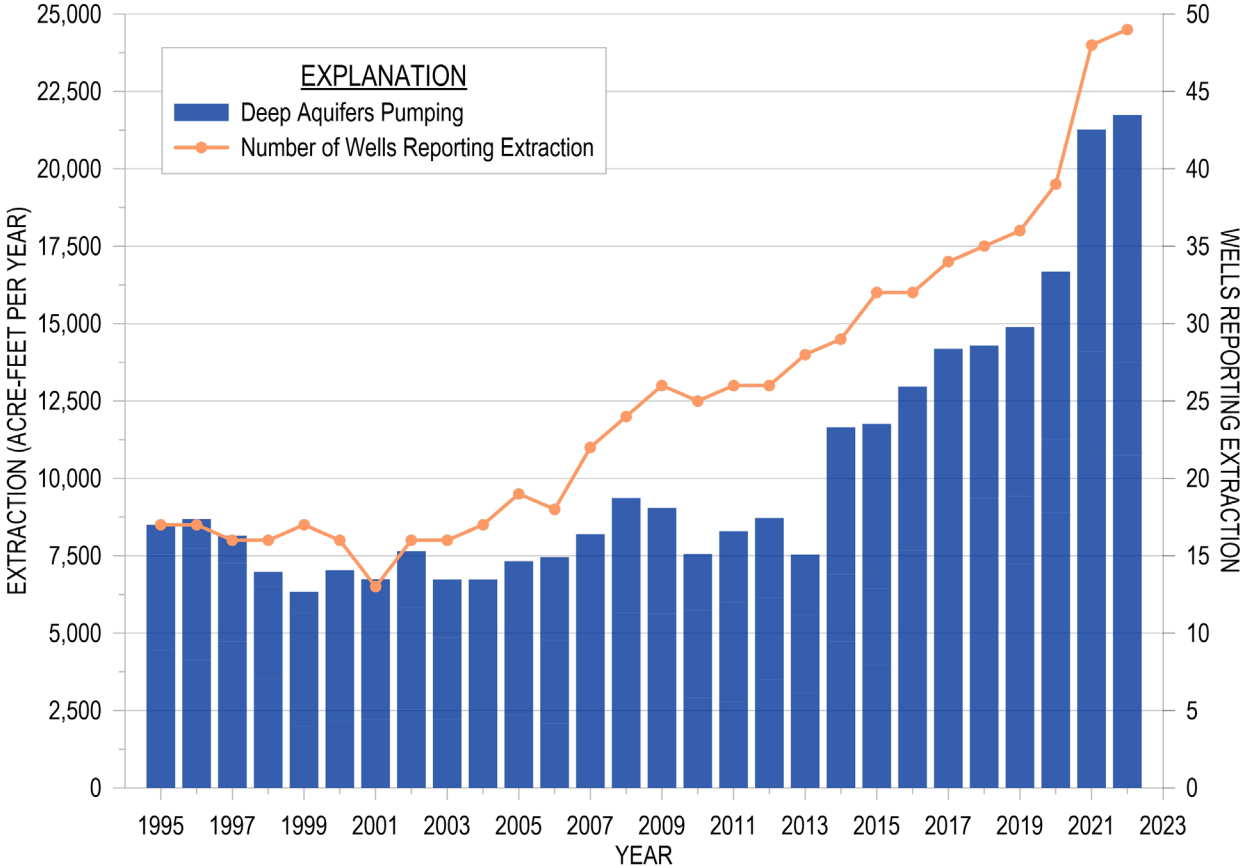
Made monitoring recommendations



Provided guidance for management based on the Study's findings

Scope and Approach

Need for Study to Better Understand the Deep Aquifers for Management



Groundwater Elevations have Declined as Wells and Extraction Increased

Study Focused on Key Questions for Management

How should the Deep Aquifers be defined?

What is the lateral extent?

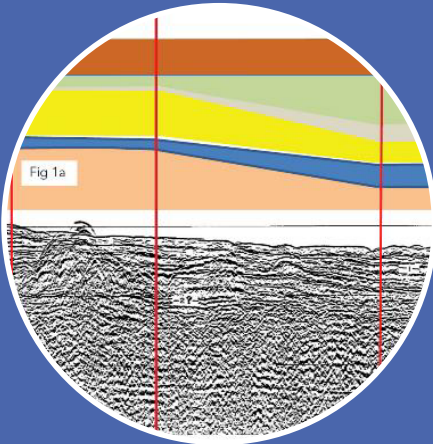
Does it receive inflows?

What is the water budget?

How should monitoring be focused?

What principles should guide management?

Collected Key Data to Define Extent and Properties



Geophysics
maps important
geologic features

RAMBOLL



Aquifer testing
provides data on
groundwater
movement and storage



**Groundwater
chemistry**
assesses variation
across extent and
relationship with
overlying aquifer



**Isotope
Analysis**
indicates age of water
and relationship with
overlying aquifer

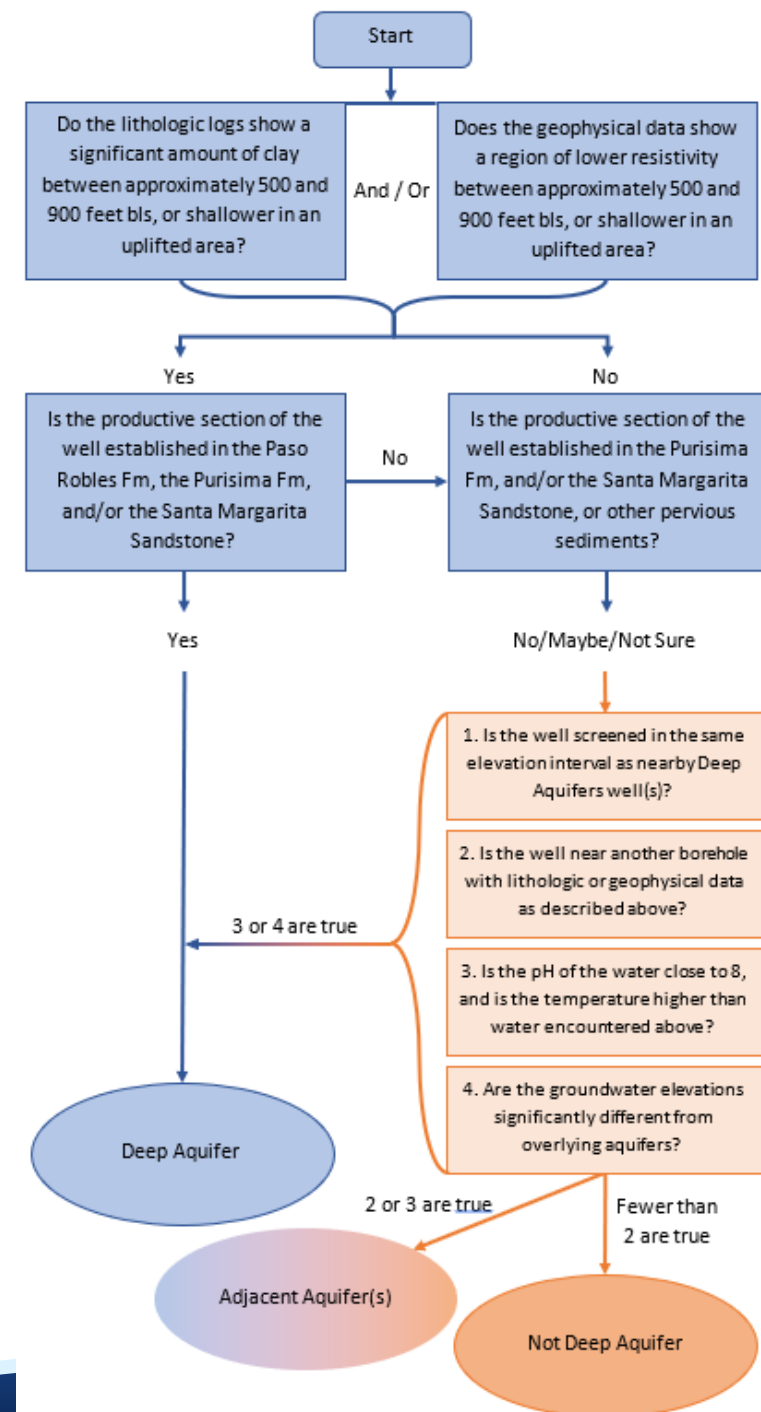


Findings

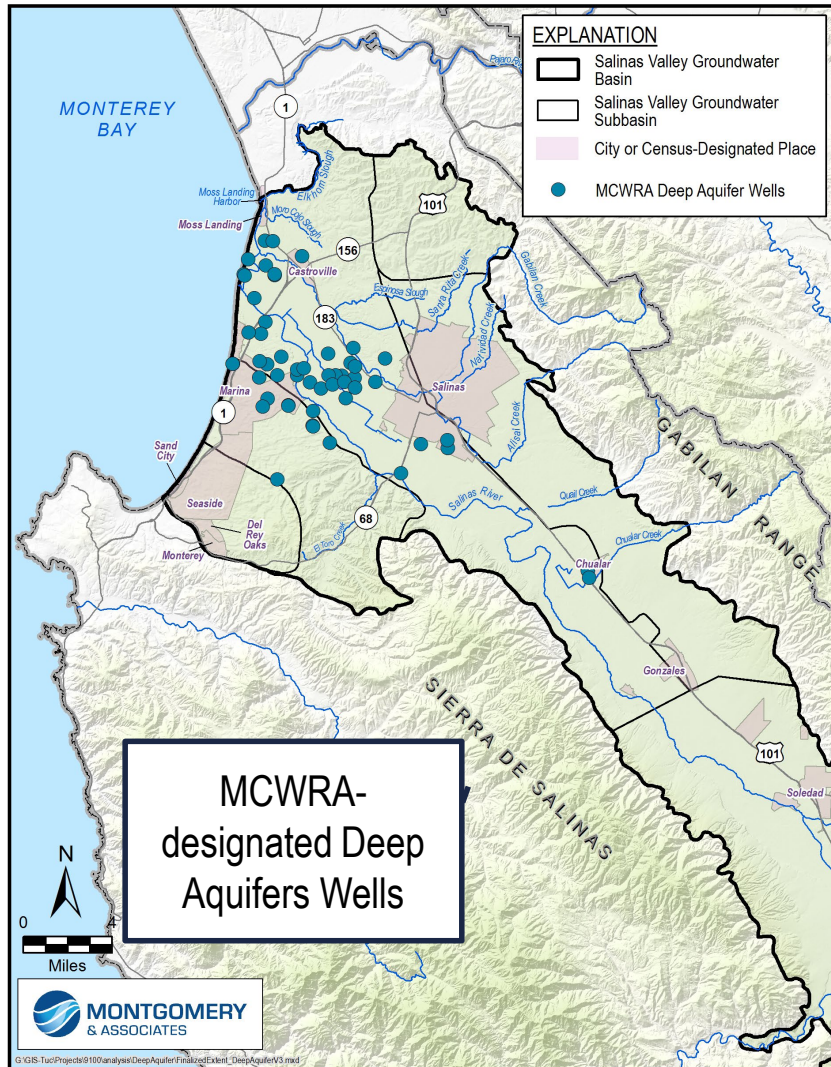
Study Developed Scientifically Robust Definition of the Deep Aquifers

Water-bearing sediments present below the 400-Foot Aquifer, or its stratigraphic equivalent.

- **Aquitard**
- **Depth**
- **Geologic Formation**



Study Delineated Geographic Extent



Deep wells confirm Aquitard

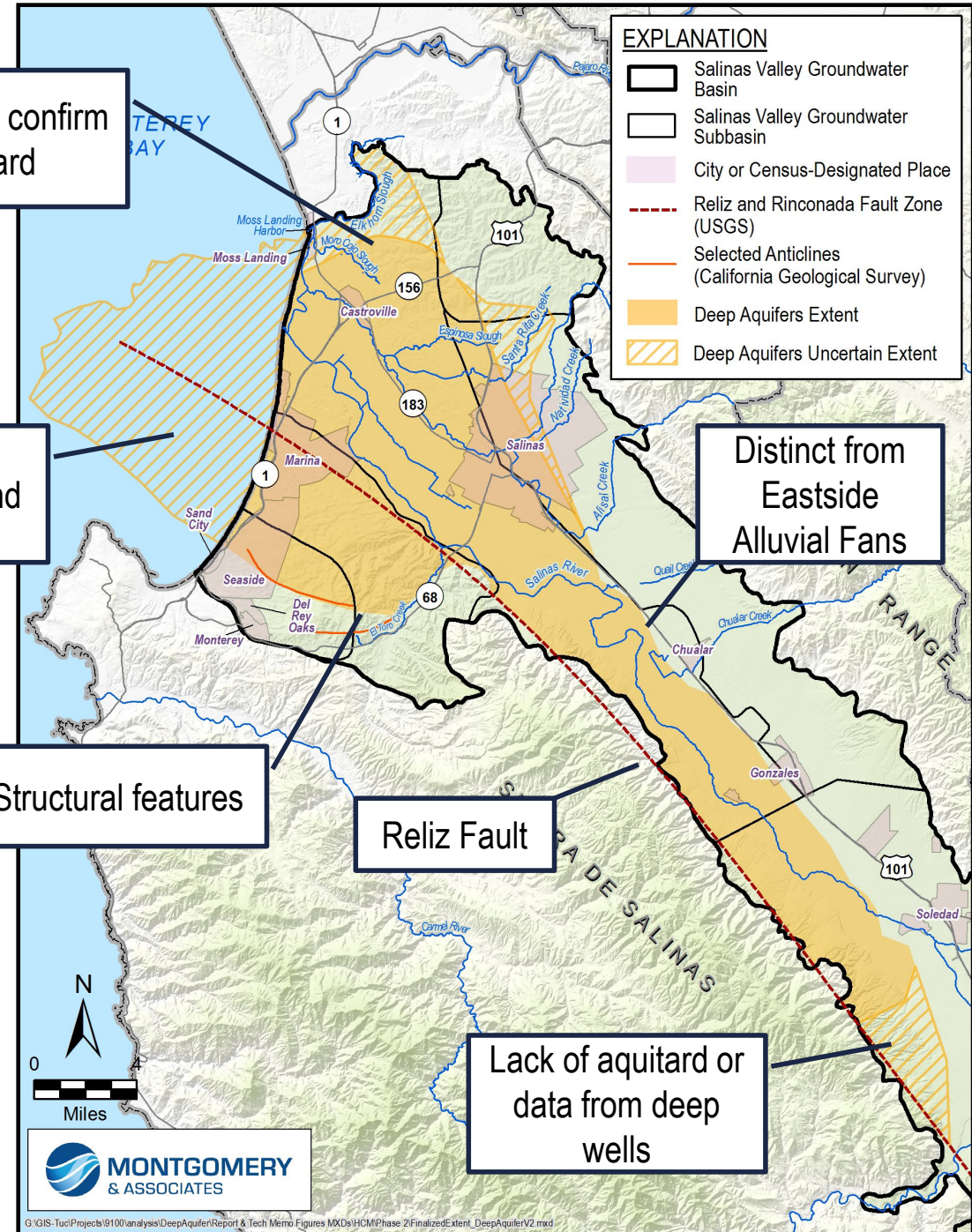
Geologic formations extend off-shore

Structural features

Reliz Fault

Lack of aquitard or data from deep wells

Distinct from Eastside Alluvial Fans



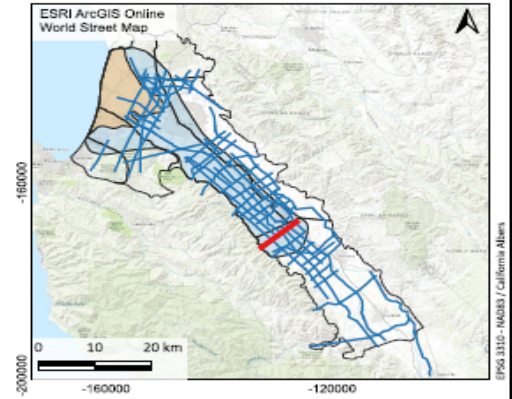
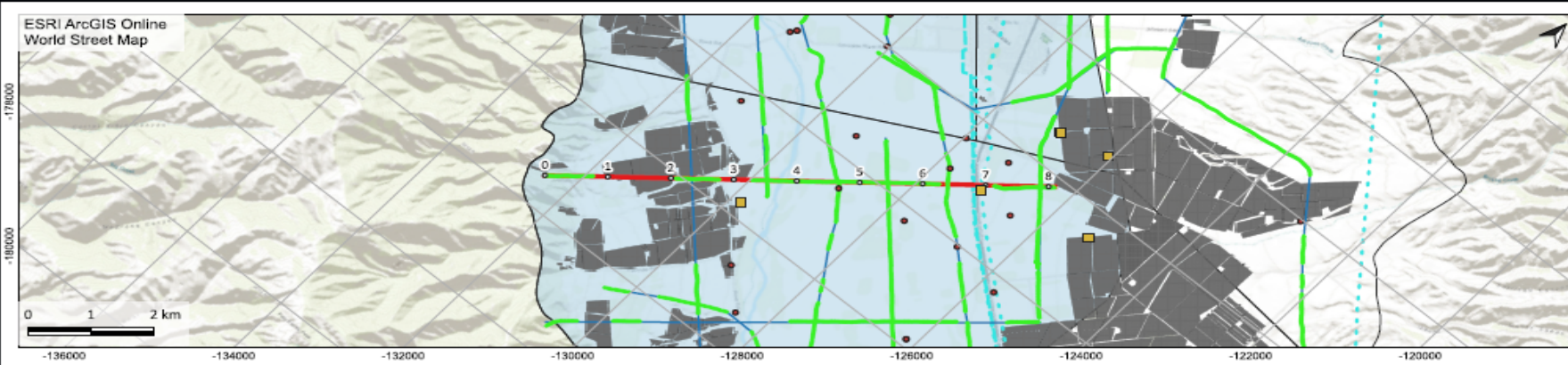
G:\GIS-Tuc\Projects\9100\analysis\DeepAquifer\Report & Tech Memo Figures\MXD\HCM\Phase 2\Finalized\Extent_DeepAquiferV2.mxd

Study Used AEM to Map Aquitard

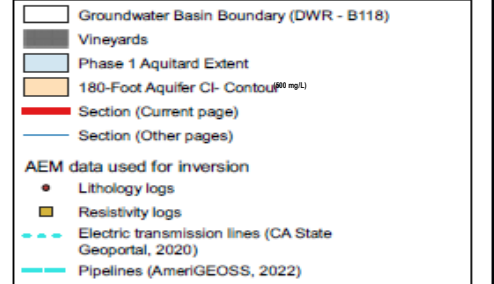


Salinas Line 101200

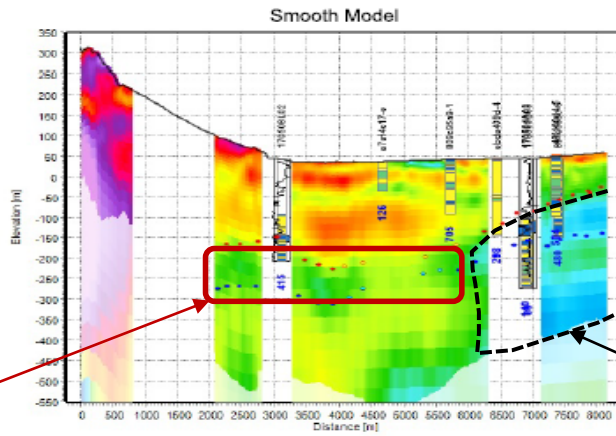
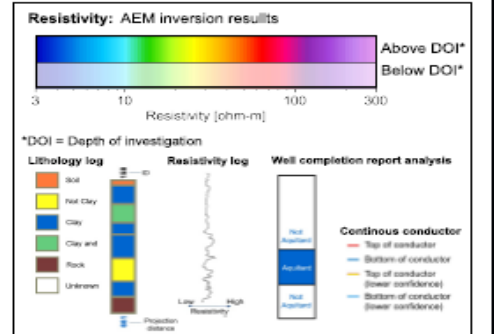
AEM Model Sections



Legend for Maps



Legend for Model Sections

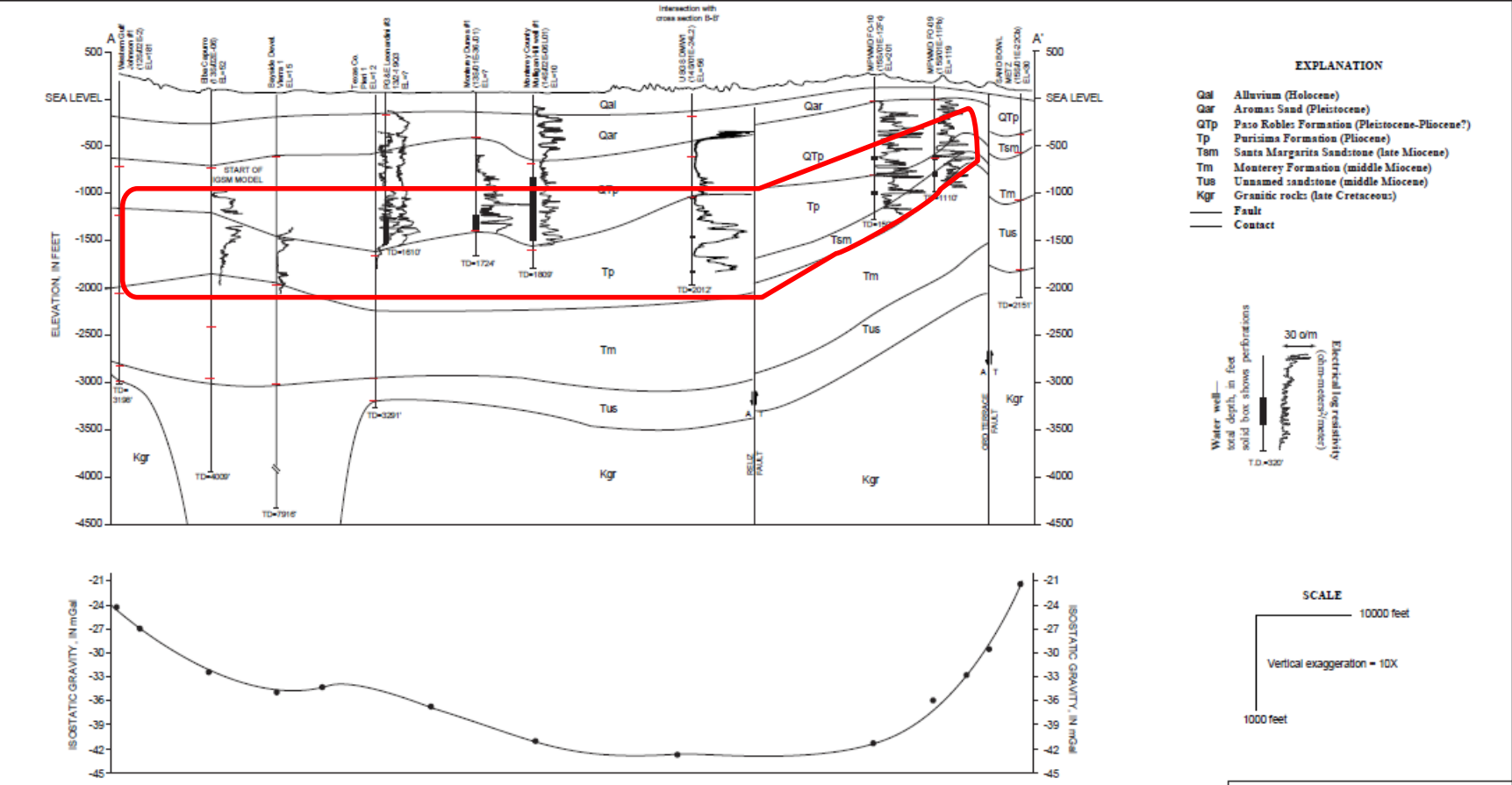


400/Deep Aquitard

Alluvial Fan presence and extent



Study found Deep Aquifers Extend into Seaside Subbasin

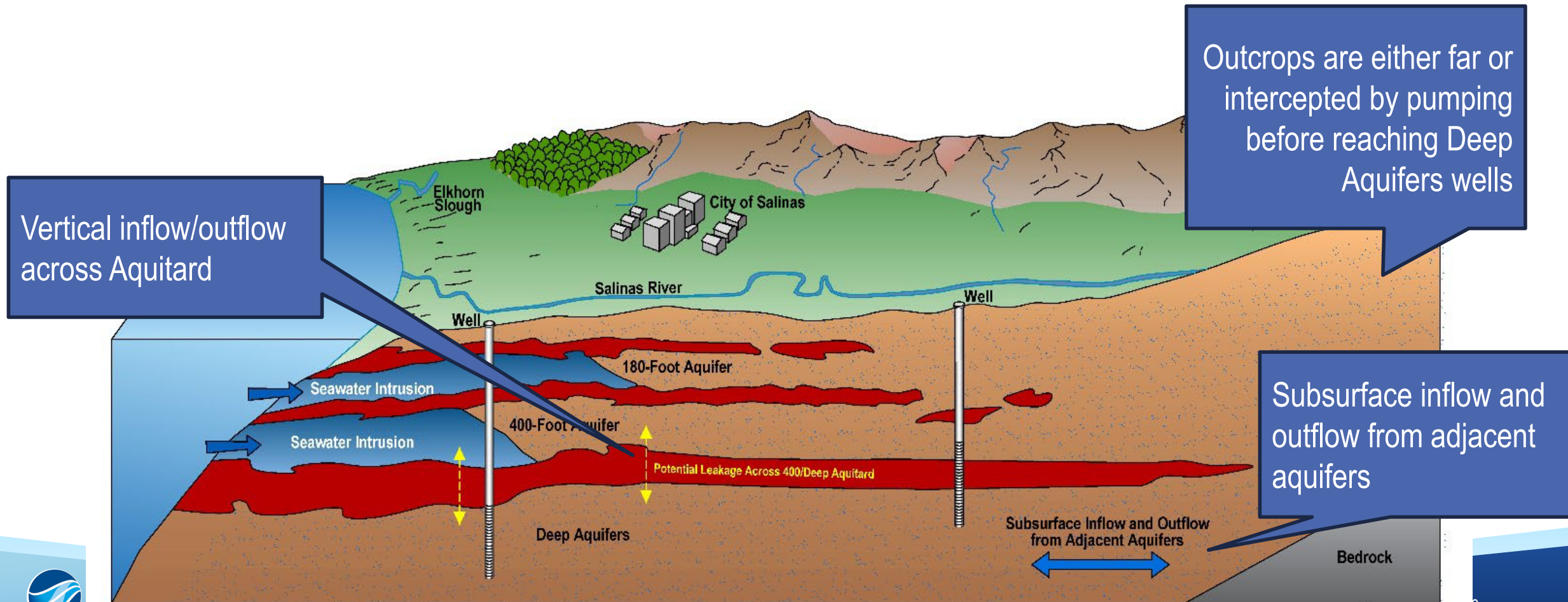


Cross Section A-A' from Feeny and Rosenberg, 2003, Adapted to Exemplify the Deep Aquifers' Geology and Generalized Zone where the Deep Aquifers are Encountered (as shown with red outline)

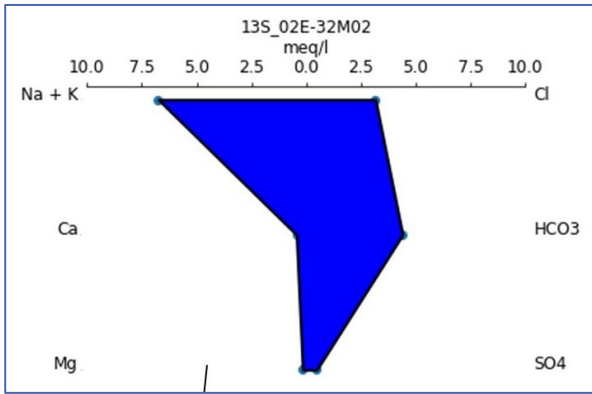
GEOLOGIC CROSS SECTION A—A'		
For: Marina Coast Water District		
DEEP AQUIFER INVESTIGATIVE REPORT		
March 2003	Lew Rosenberg, CEG 1777 Martin Feeny, CHG 145	Figure 4

Deep Aquifers do not directly receive natural, surficial recharge

- Observed data shows no evidence of modern recharge (post-1953)



Study Identified 3 Regions of the Deep Aquifers

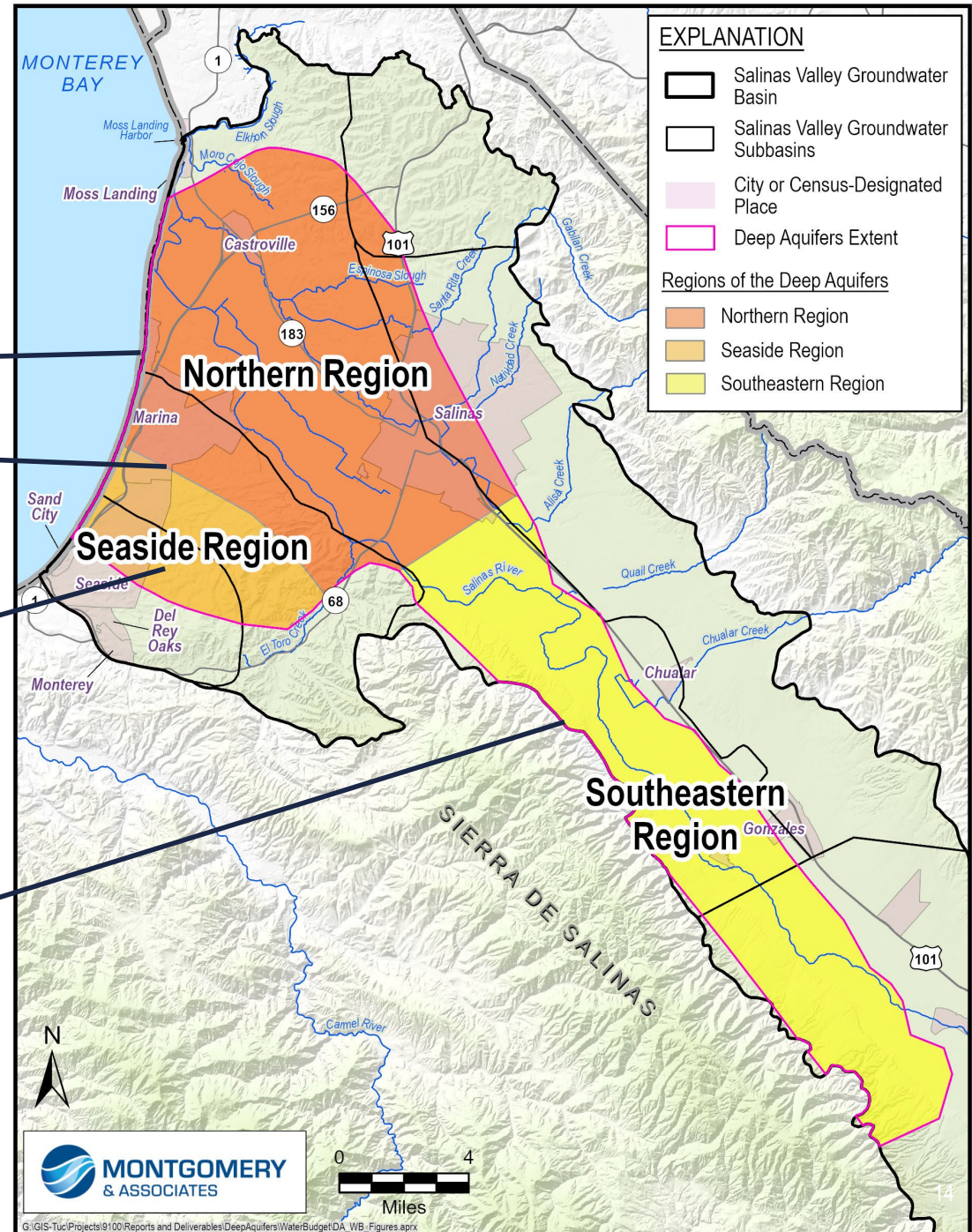
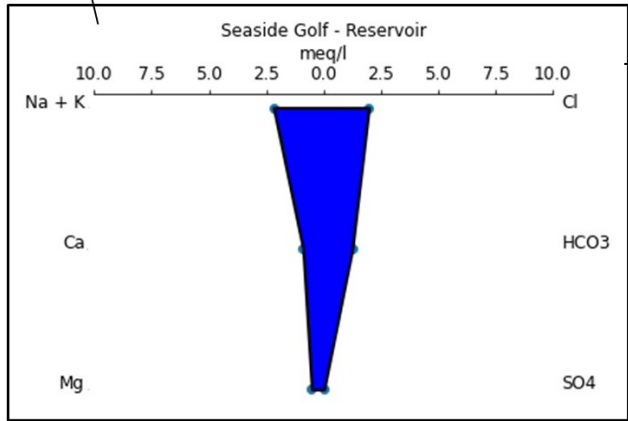


Paso Robles Formation and Purisima Formation

Groundwater Level Divide

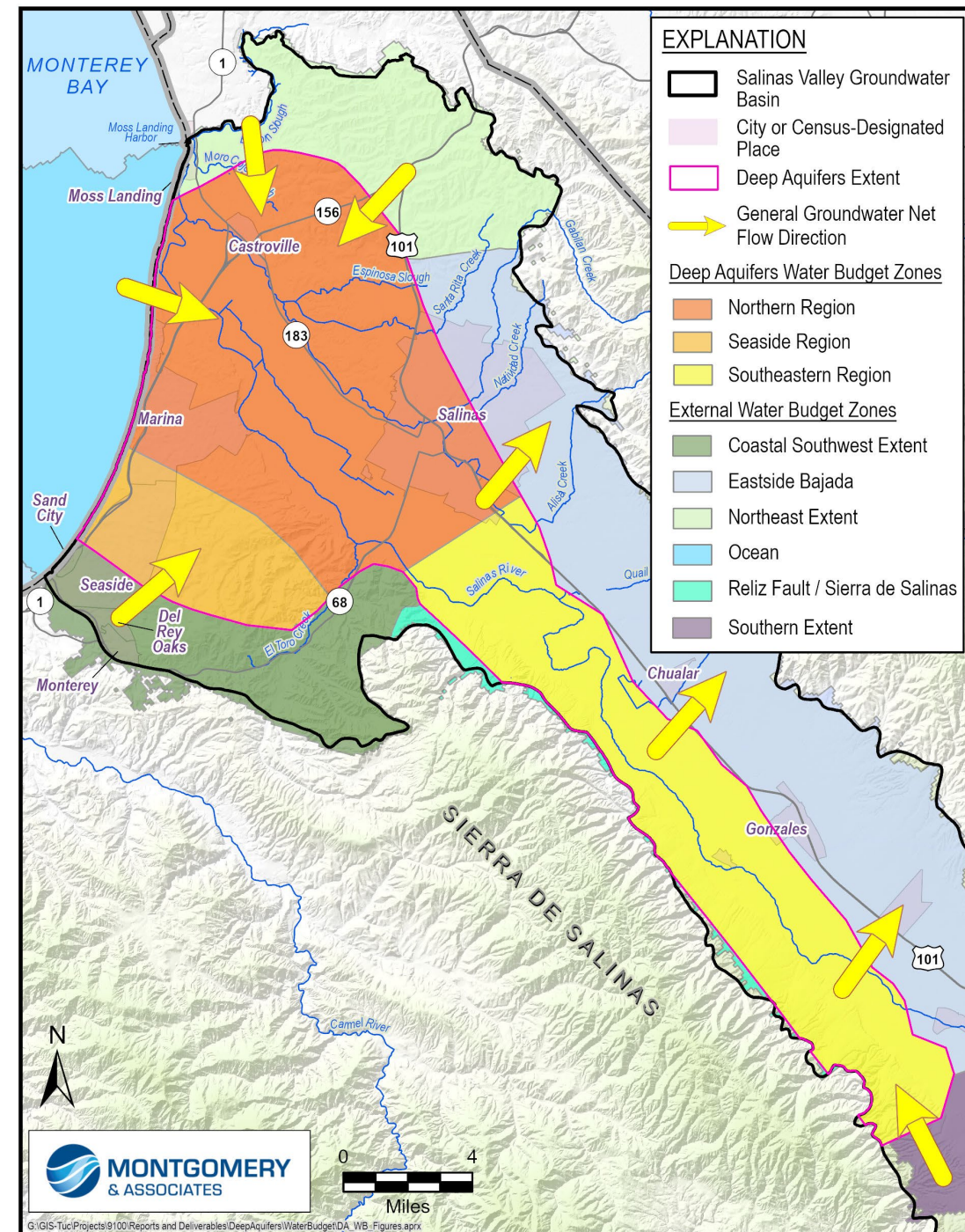
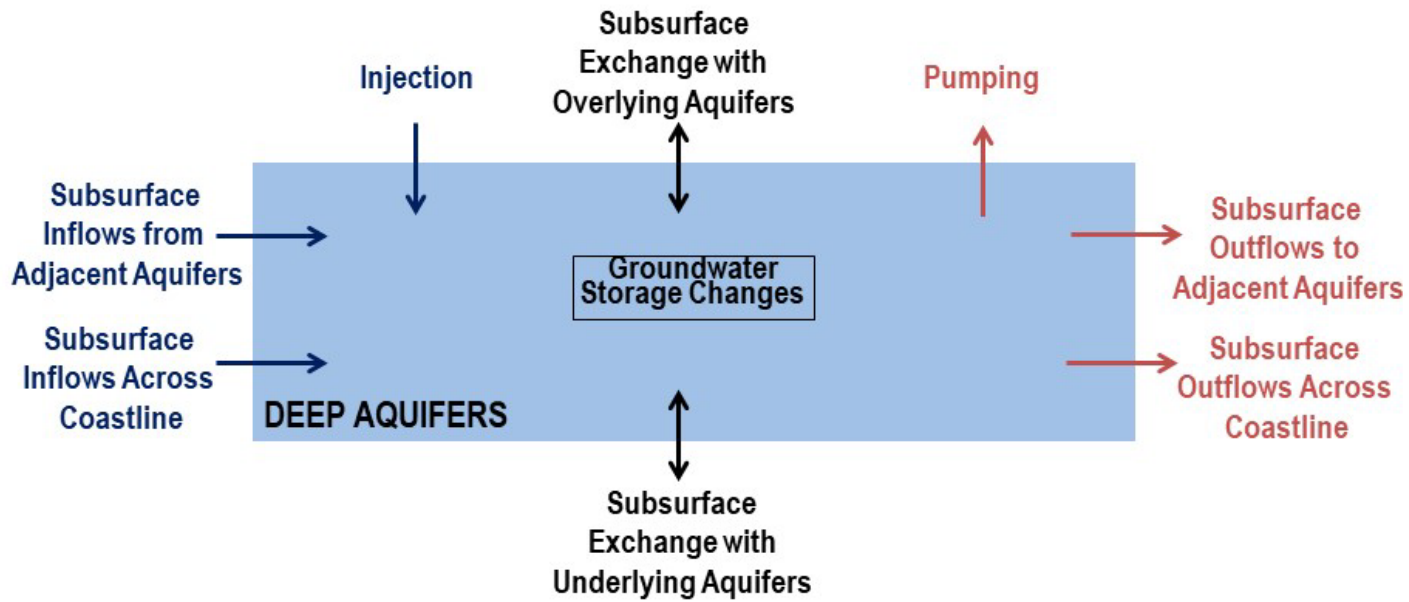
Santa Margarita Sandstone and Paso Robles Formation

Lack of true Deep Aquifers wells

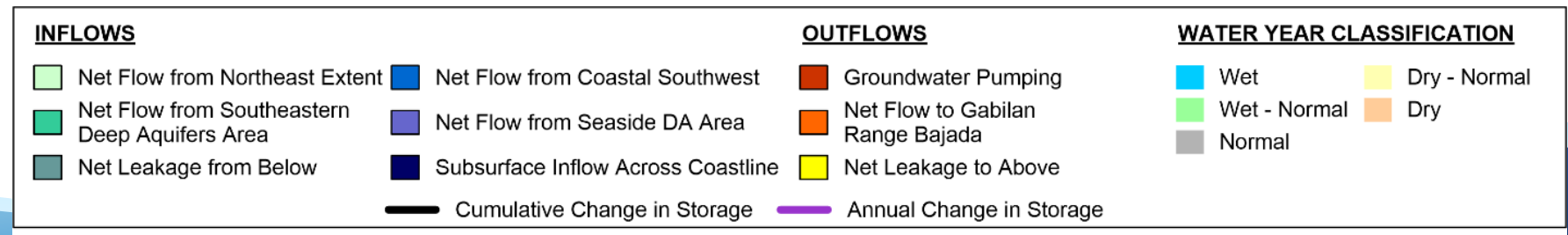
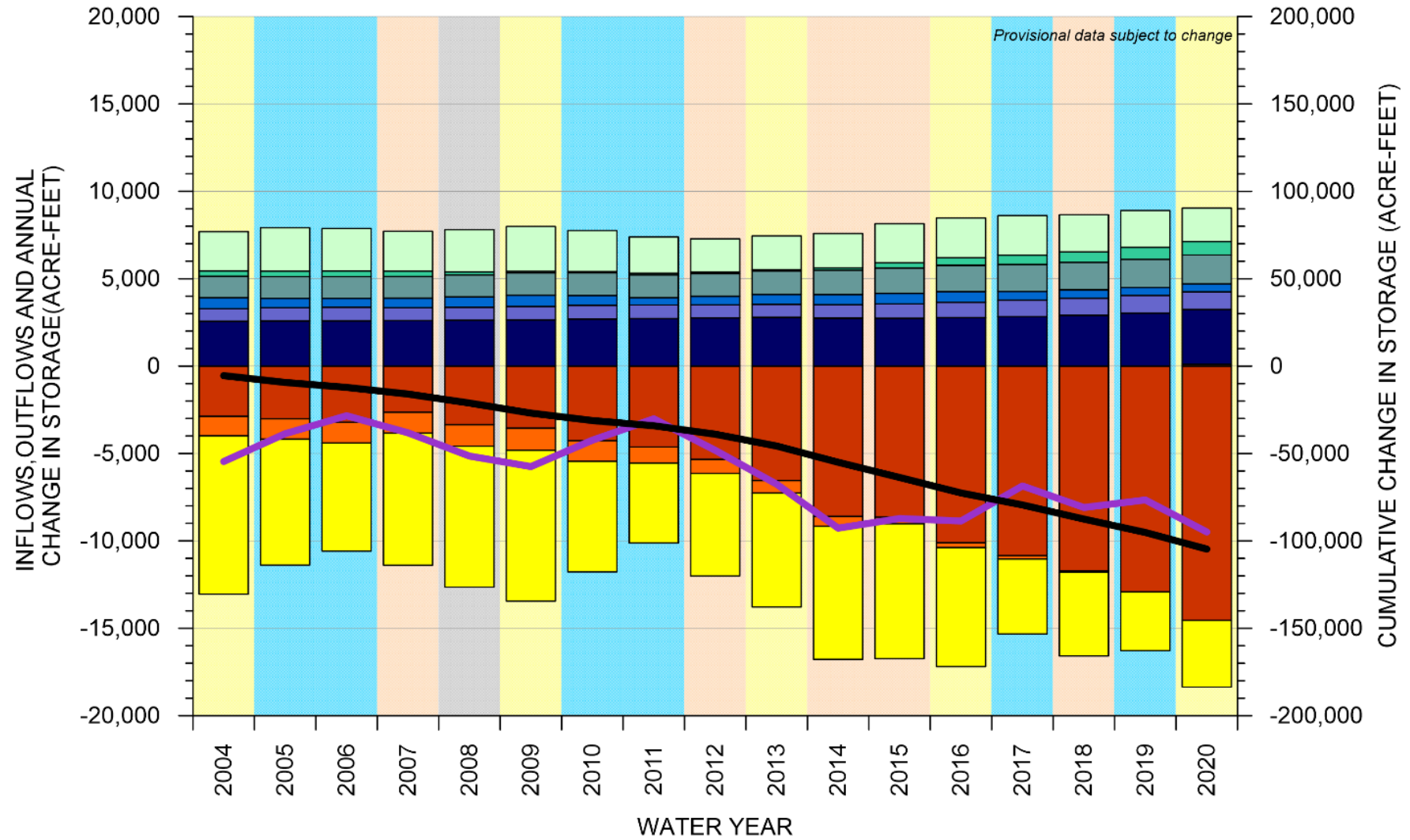
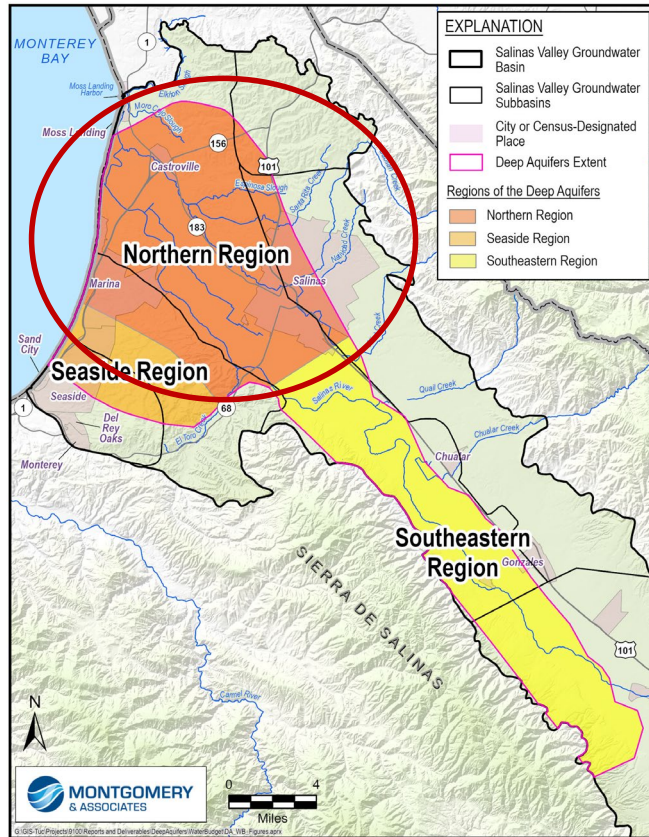


Study Modeled Deep Aquifers Subsurface Inflows and Outflows

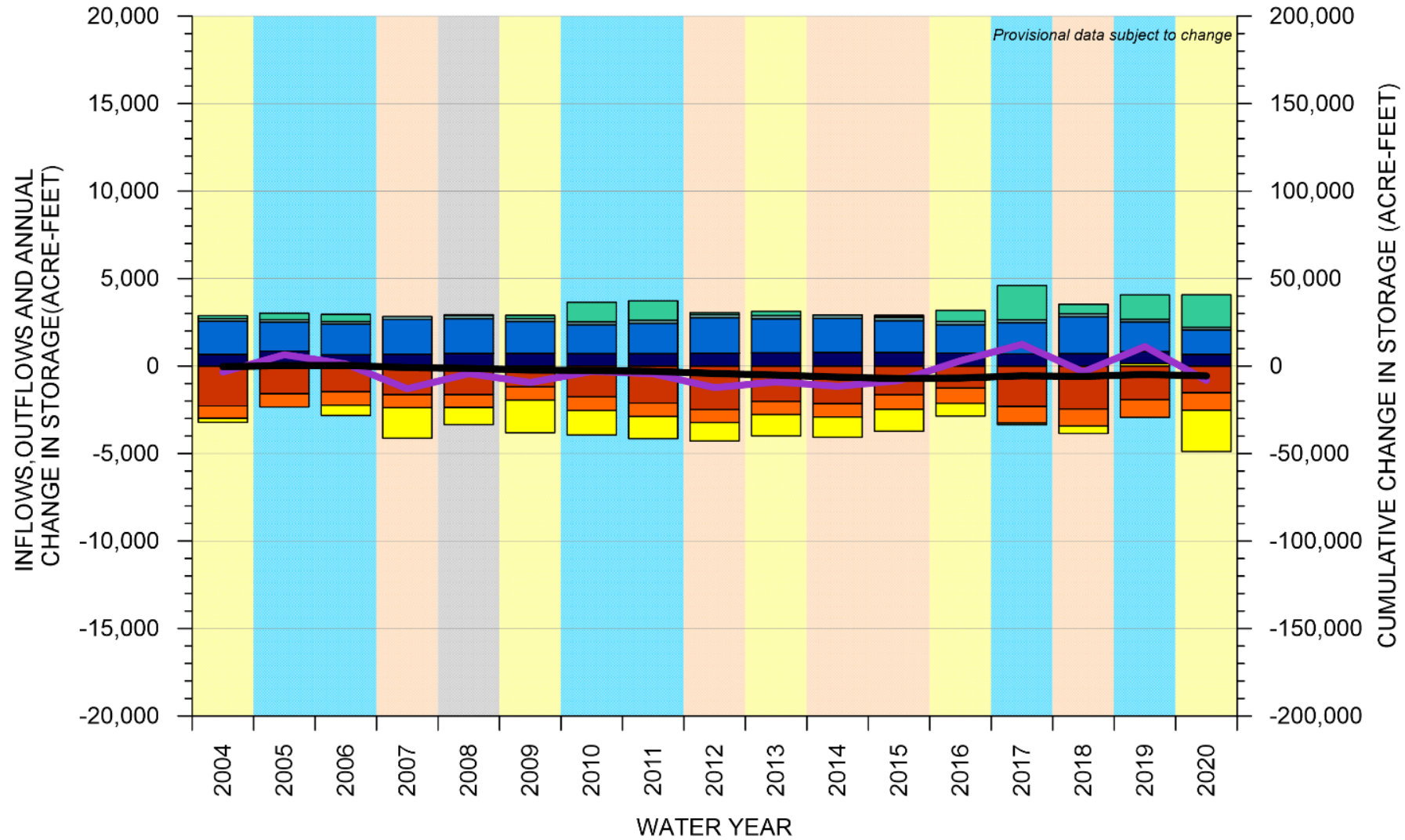
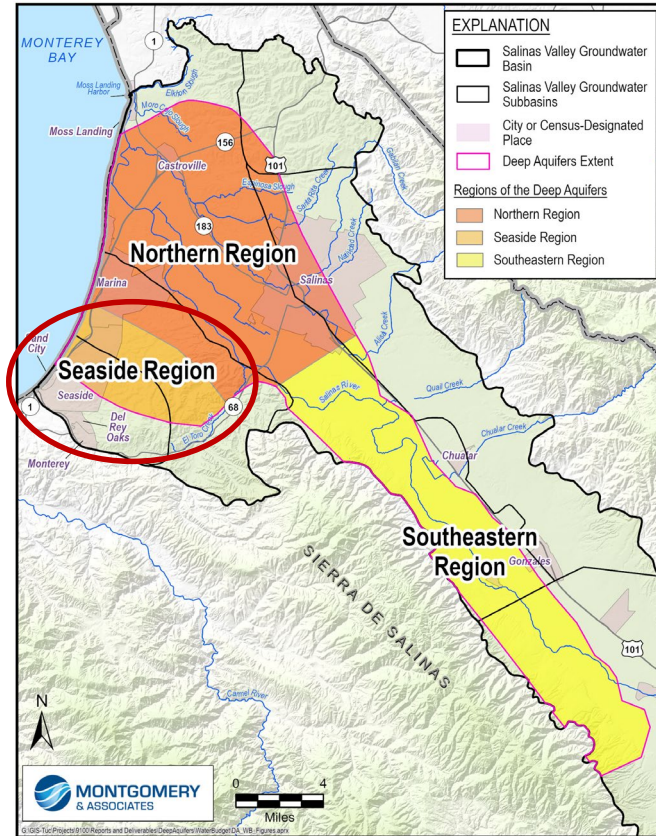
Groundwater flows toward areas of lowest groundwater levels



Northern Region 2018-2020



Seaside Region 2018-2020



INFLWS

- Injection
- Net Leakage from Below
- Net Flow from Coastal Southwest

- Net Flow from Seaside DA Area
- Subsurface Inflow Across Coastline

OUTFLOWS

- Groundwater Pumping
- Net Flow to Northern Area
- Net Leakage to Above

WATER YEAR CLASSIFICATION

- Wet
- Wet - Normal
- Normal
- Dry - Normal
- Dry

— Cumulative Change in Storage

— Annual Change in Storage

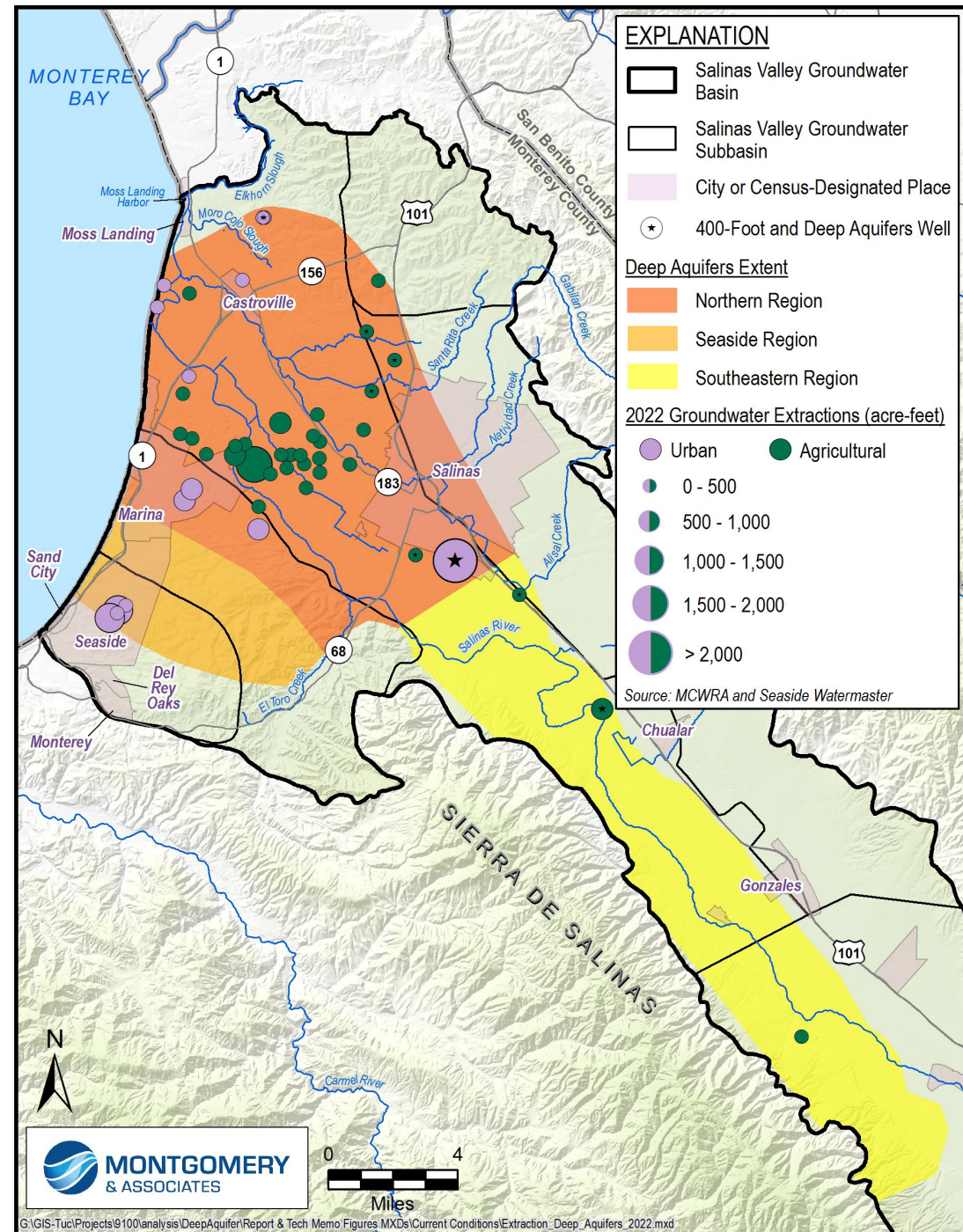
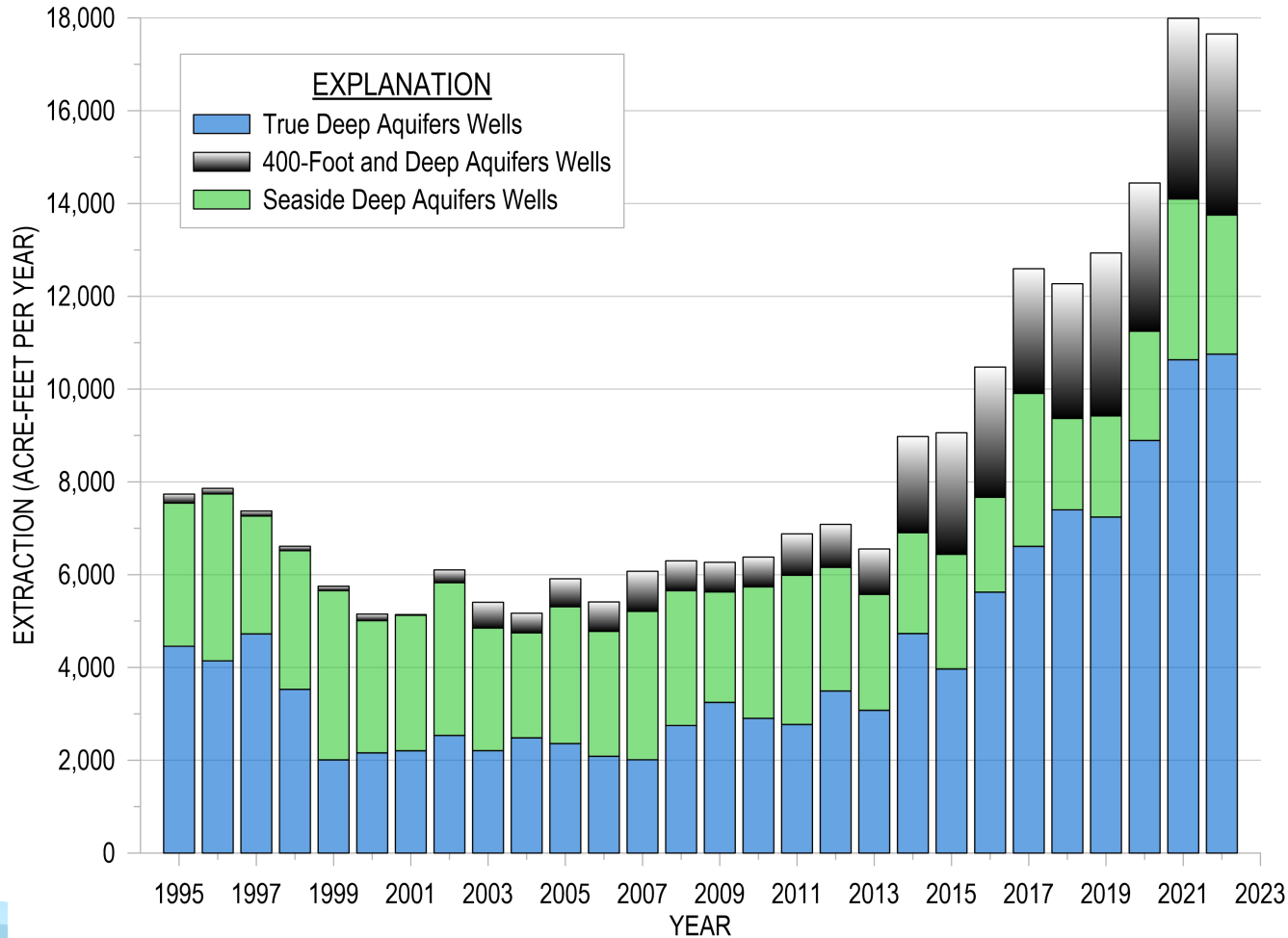
Simulated Recent Water Budget

Shows Decrease in Storage in Deep Aquifers

Water Budget Component (2018-2020 in AF/yr) <i>Positive = Net Inflow, Negative = Net Outflow</i>	Seaside Region	Northern Region	<i>Southeastern Region</i>	<i>Full Deep Aquifers Extent</i>
Pumping	-2,000	-13,100	-2,500	-17,600
Injection	1,300			
Decrease in Storage	0	-8,400	-1,200	-9,600
Subsurface Flow from Adjacent/Overlying Aquifers	1,700	3,100	300	5,100
Flow from Other Deep Aquifers Regions	-1,000	1,700	-700	1,700

**Need to change sign of Decrease in Storage to balance water budget*

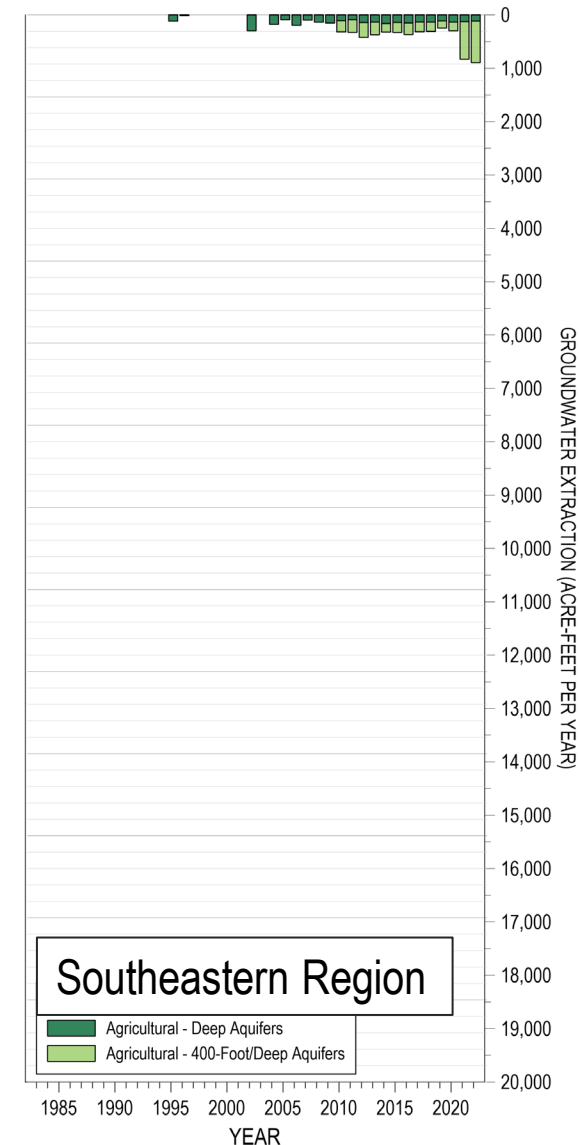
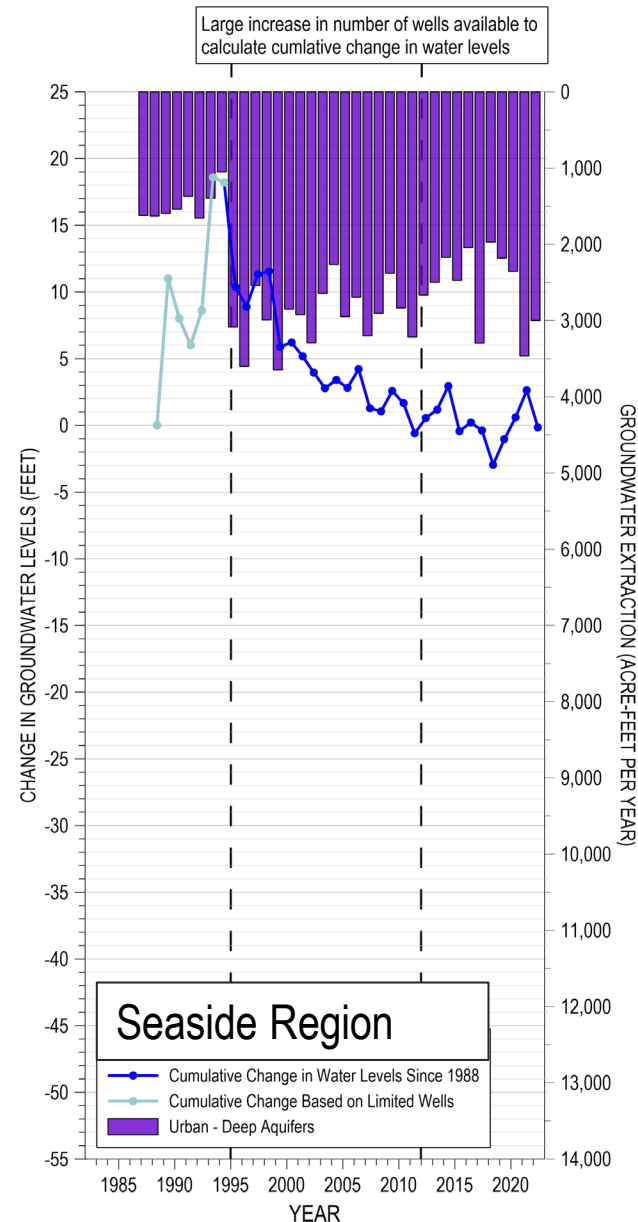
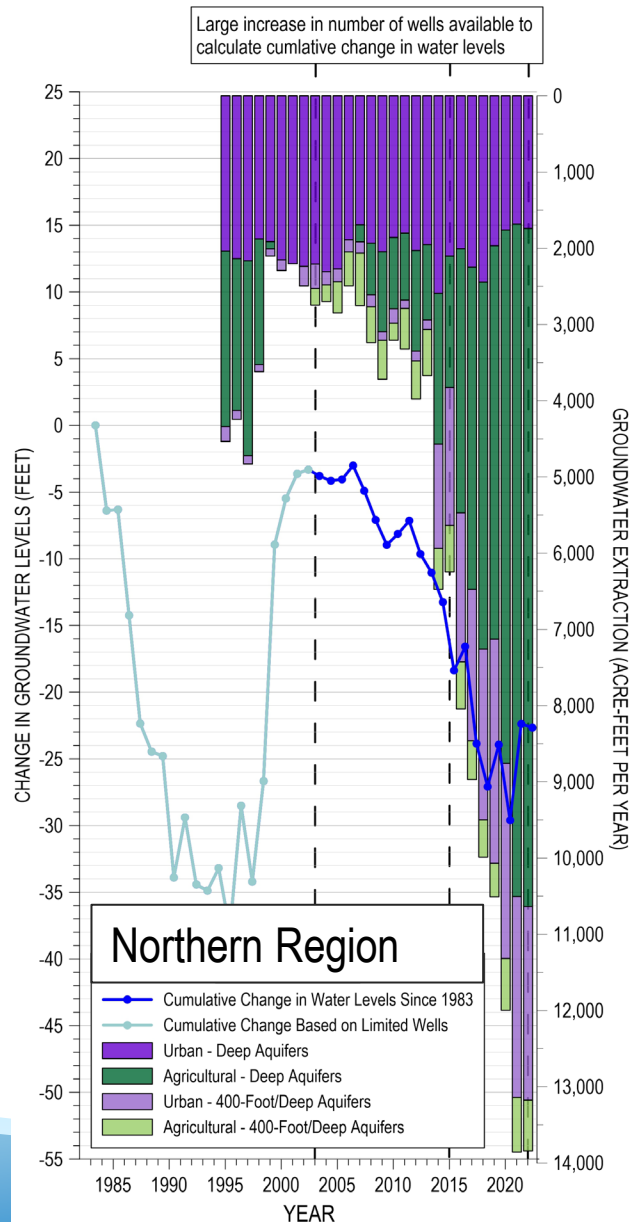
Extraction from the Deep Aquifers



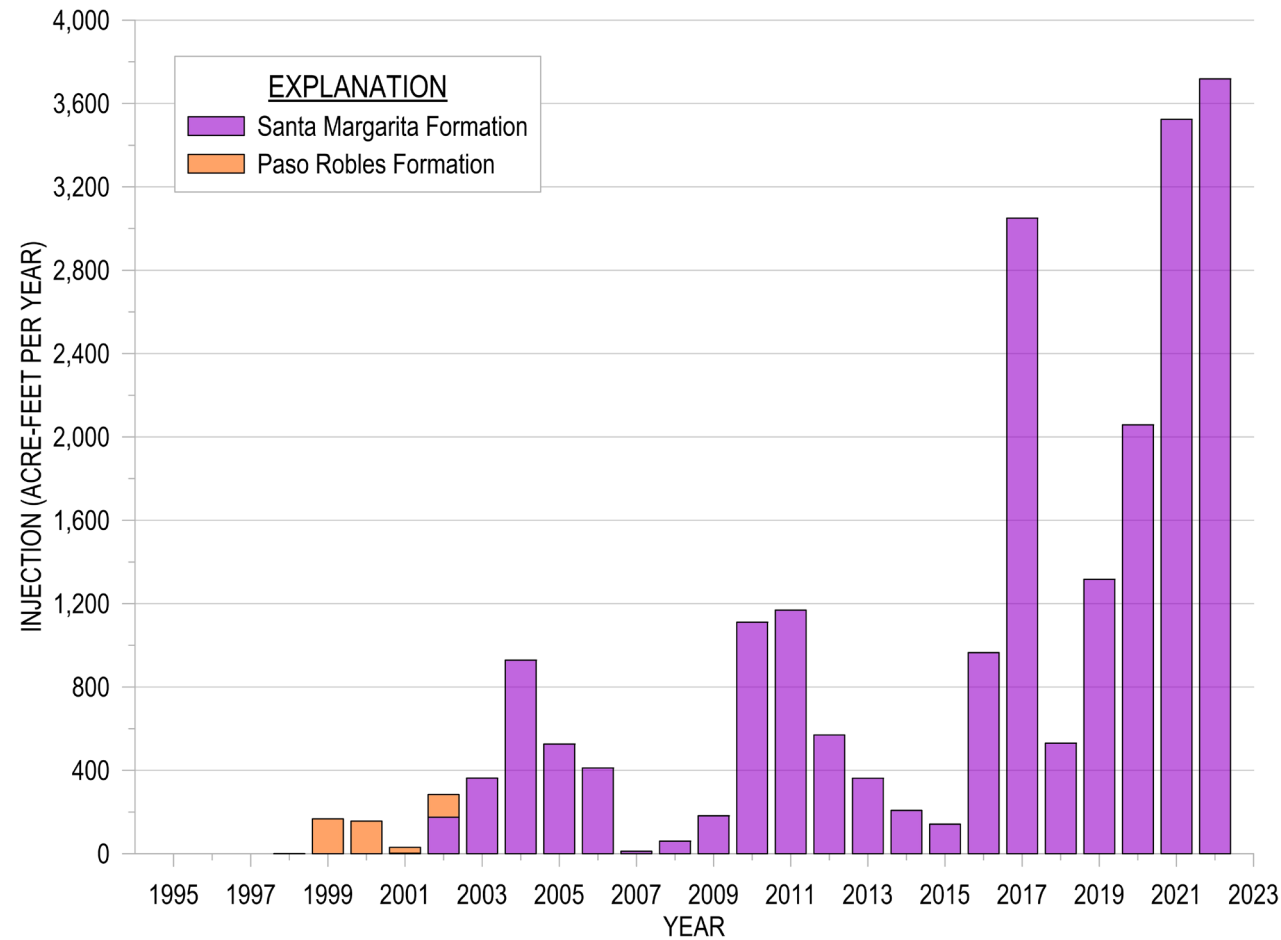
Pumping and Cumulative Change in Groundwater Elevations by Region

Extraction from Deep Aquifers is between 13,800 and 17,700 AF/yr

Groundwater elevations are declining

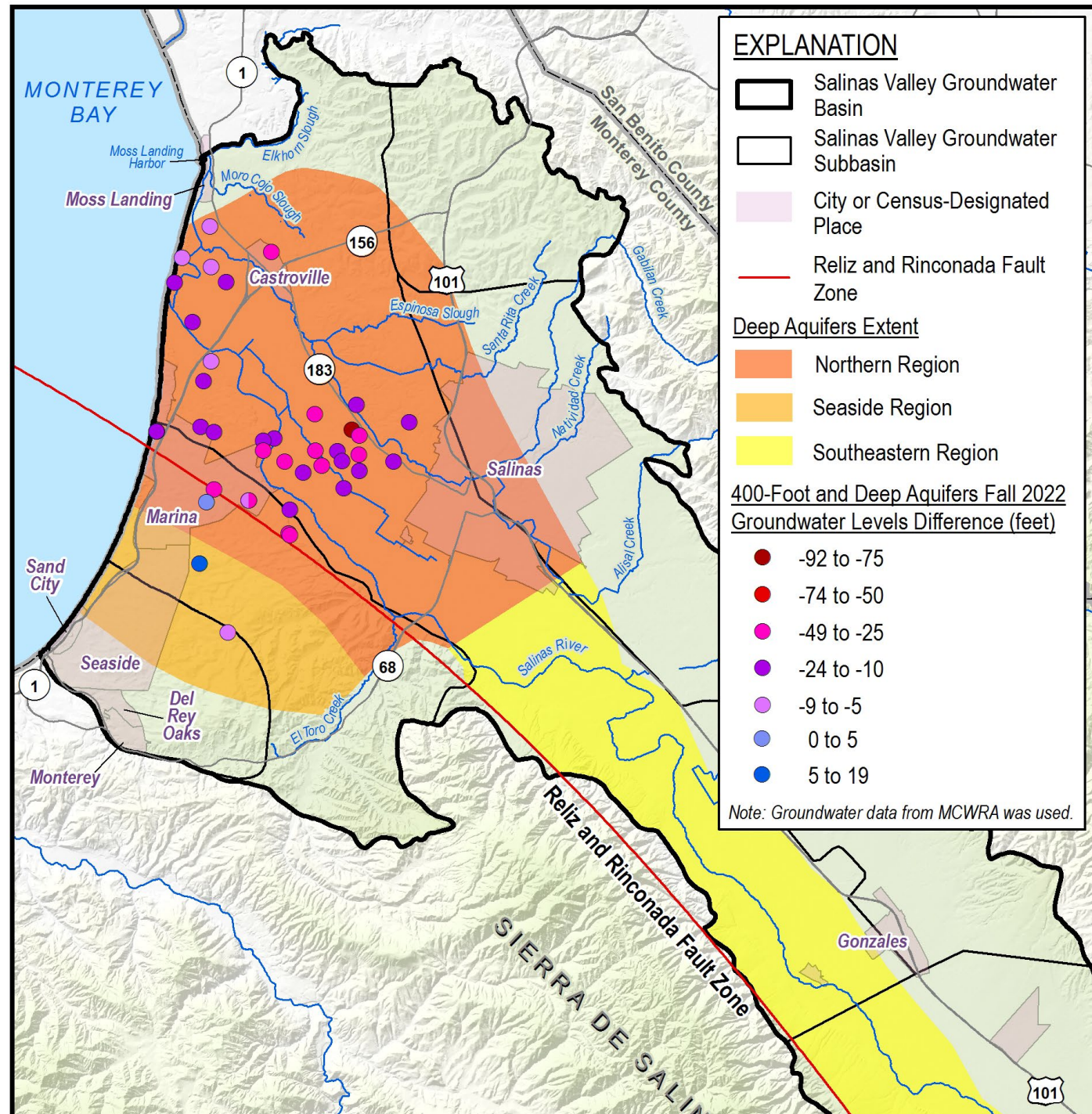


Injection into the Deep Aquifers – Seaside Region



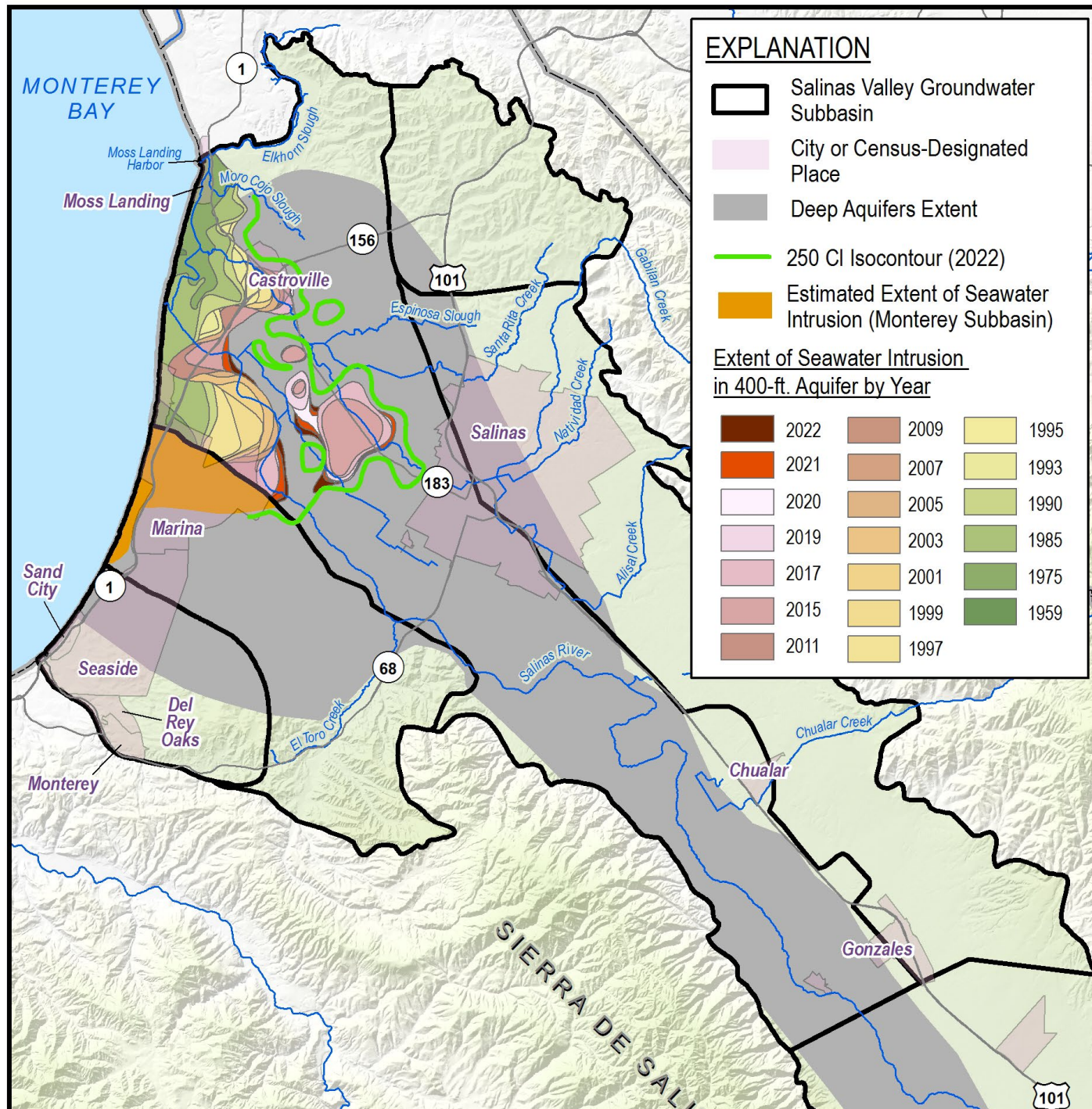
Current Vertical Gradient is Mostly Downwards

Difference in Fall 2022 Groundwater Levels Between the 400-Foot and Deep Aquifers

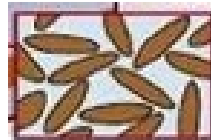
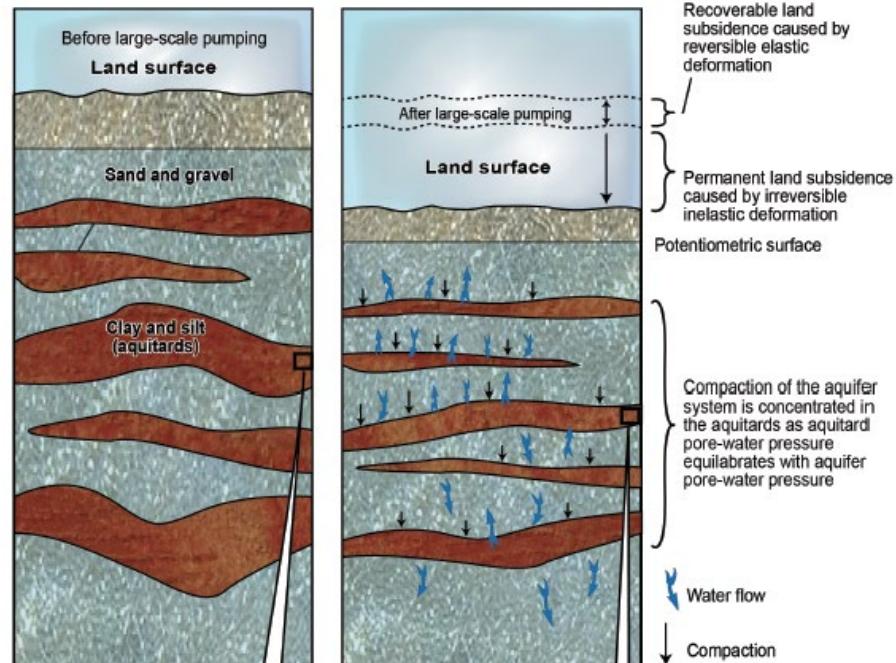


Seawater Intrusion in 400-Foot or Equivalent Aquifer

- Historical extent of 500 mg/L chloride isocontour
- 2022 250 mg/L chloride isocontour



Land Subsidence



Healthy clay
The granular structure of healthy clay is filled with water.



Damaged clay
Once the clay compacts it can never be repaired permanently limiting future water storage.

- Water extracted from the Deep Aquifers lowers pressures
- As clays are depressurized, they compact
- Compacted clays lead to collapsed ground
- Do not know whether/when subsidence will occur until it does

Example: San Joaquin Valley & Corcoran Clay

Summary of Current Conditions

Analysis of historical and current conditions does not change conceptual understanding



Current conditions confirm previous conclusions that the Deep Aquifers are in overdraft and not being recharged, and they're at risk of seawater intrusion



Continued overdraft put the Deep Aquifers at risk for irreversible damage



Data is sufficient for moving forward with management

Guidance for Management

Regulatory Context

Guidance for Management

Regulatory Context

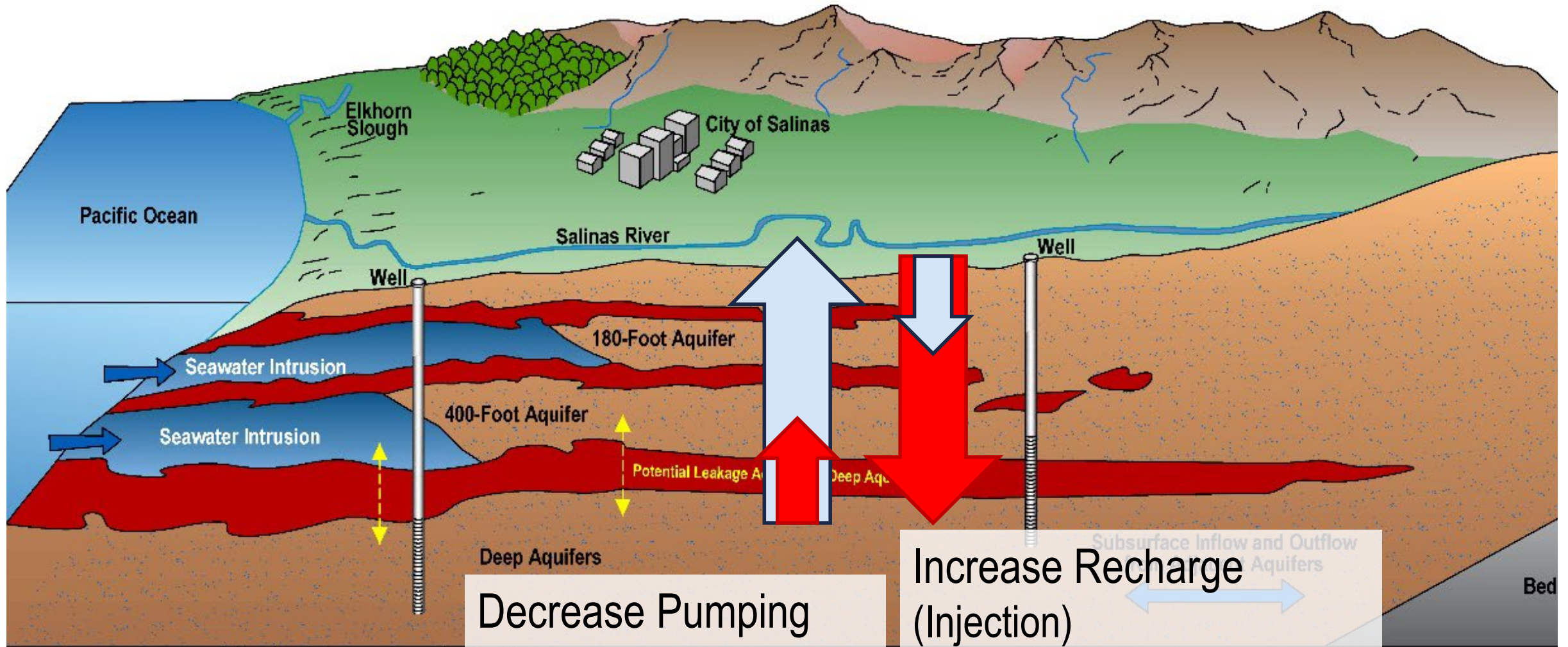
Regulatory Context:

- Seaside Subbasin is Adjudicated
- Other subbasins subject to the Sustainable Groundwater Management Act (SGMA)
- Management must meet adjudication or SGMA regulatory goals

Agency Authority:

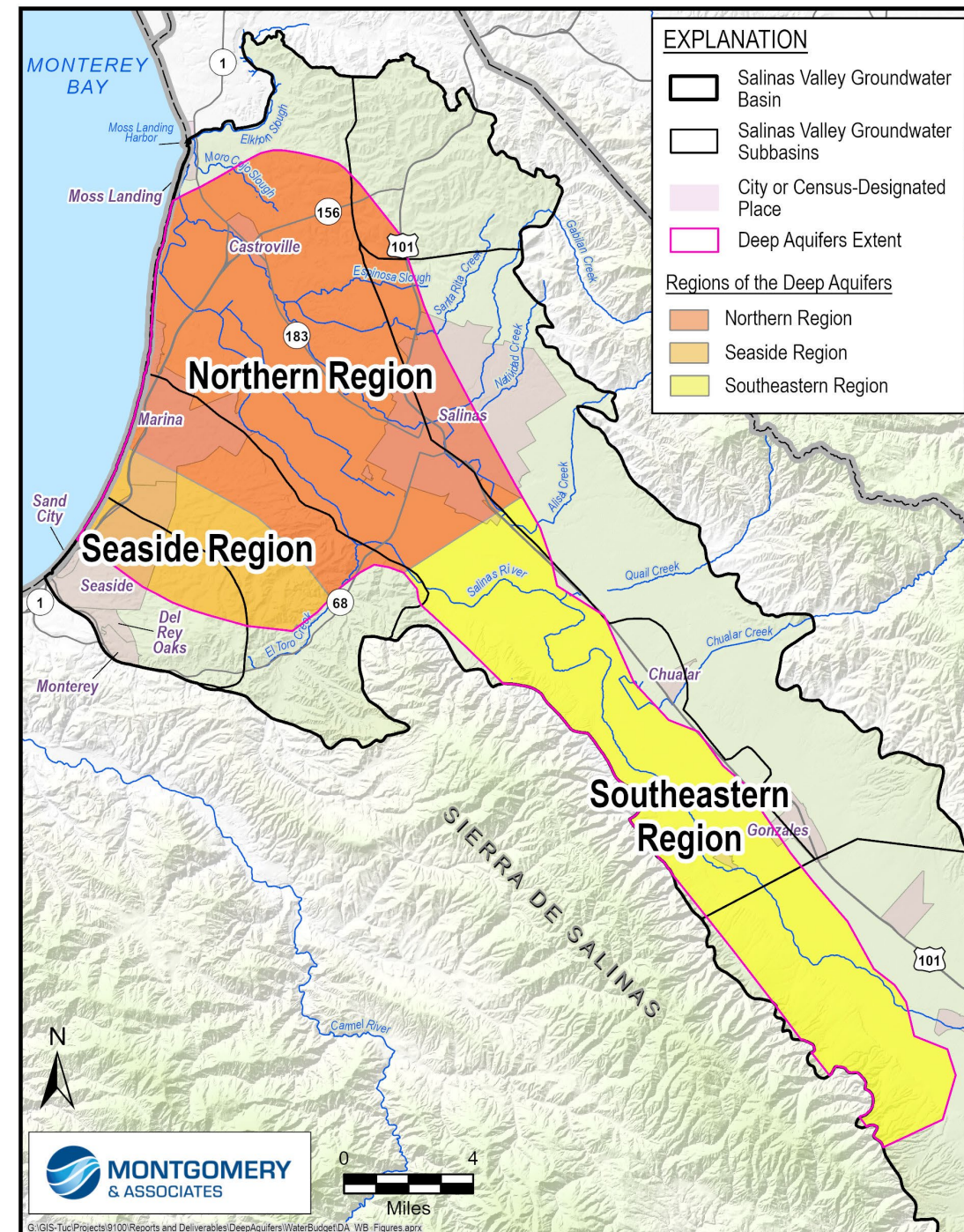
- Sufficient jurisdictional and legal authority exist to manage the Deep Aquifers (MCWRA, EHB, MCWD, SVBGSA, Seaside Watermaster, cities and County)
- Agencies should work collaboratively to manage across the extent of the Deep Aquifers and adjacent aquifers

Types of Management Actions and Projects



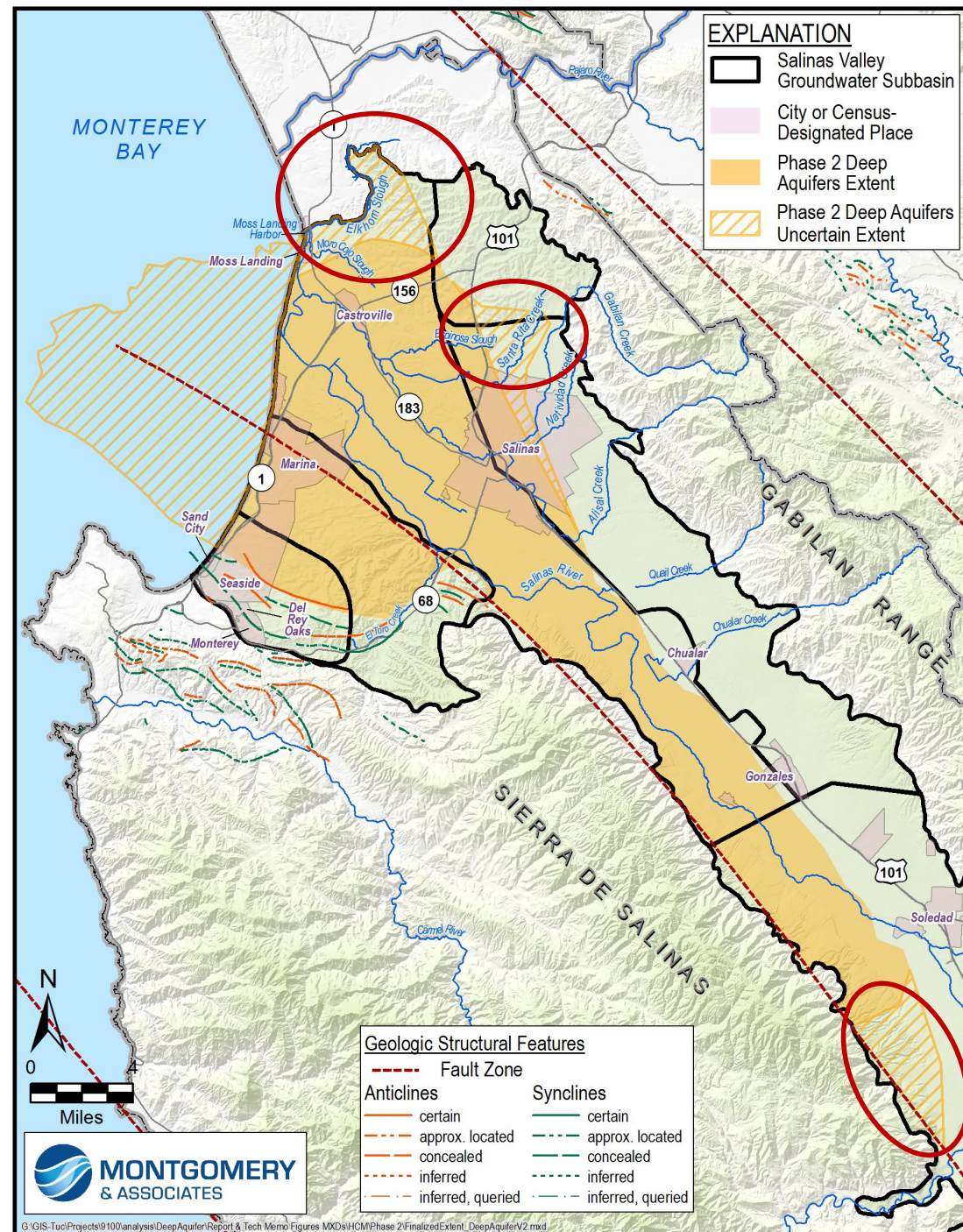
Location of Management

- Differentiate groundwater management by the 3 regions
- In Southeastern Region
 - Lack of true Deep Aquifers wells
 - Monitor first
 - Then manage if Deep Aquifers groundwater elevations are found to be declining
- Manage together with adjacent and overlying aquifers



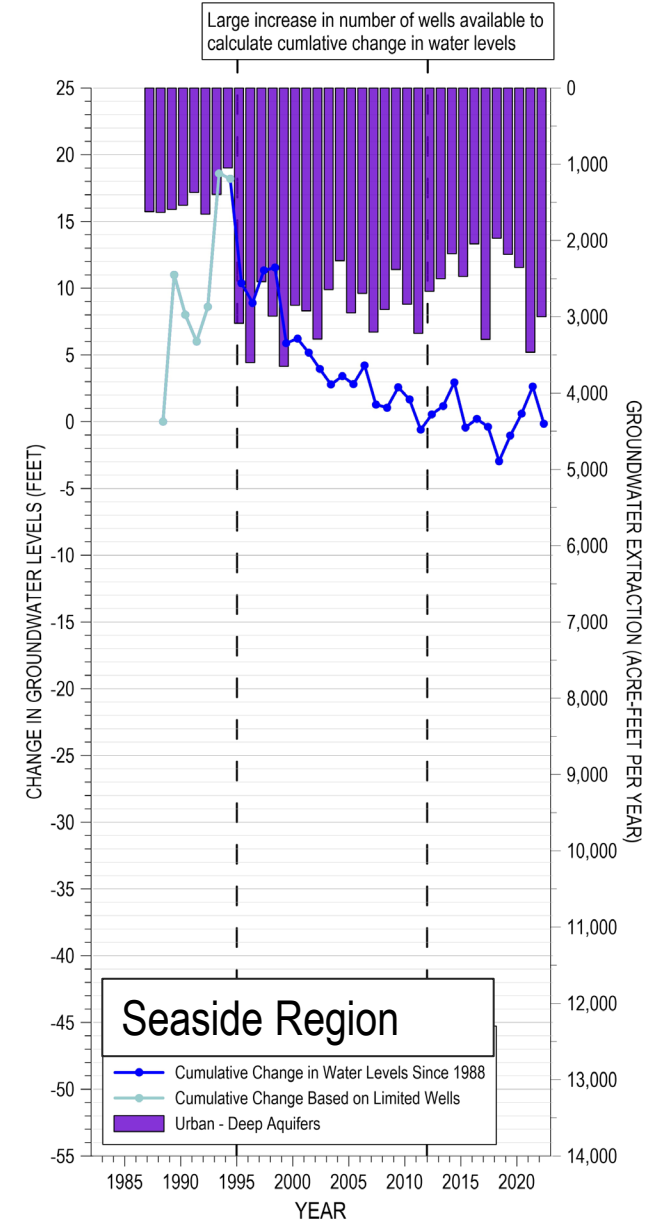
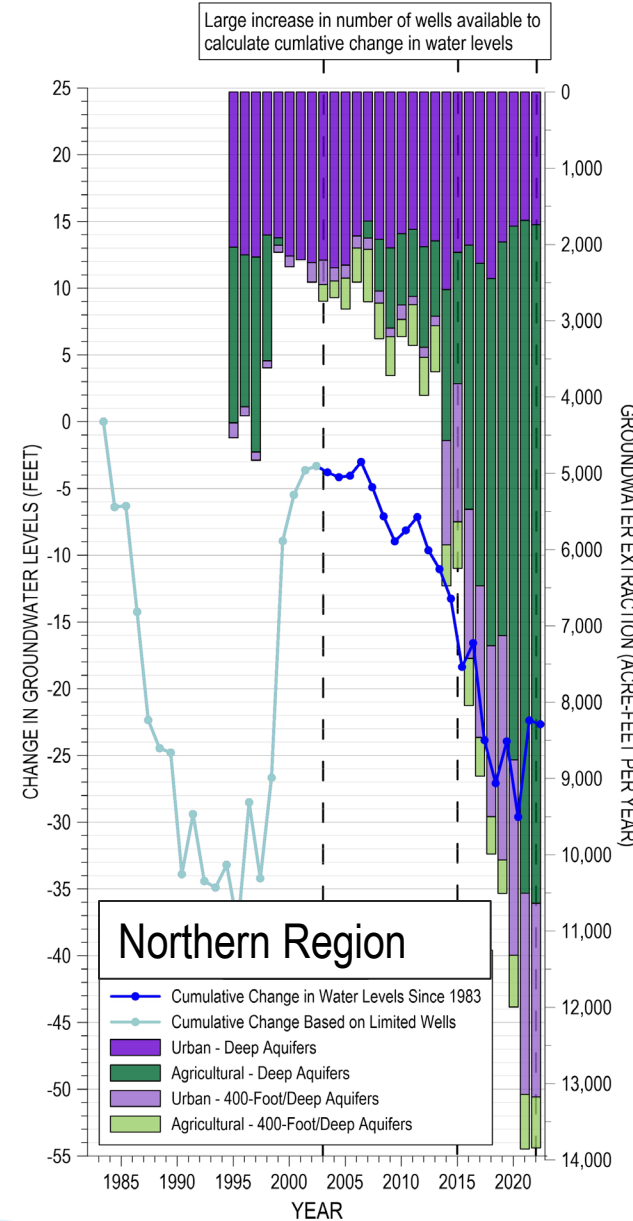
Areas of Uncertainty

- Take precautionary approach to new deep wells and increasing net extraction, unless shown not to be Deep Aquifers



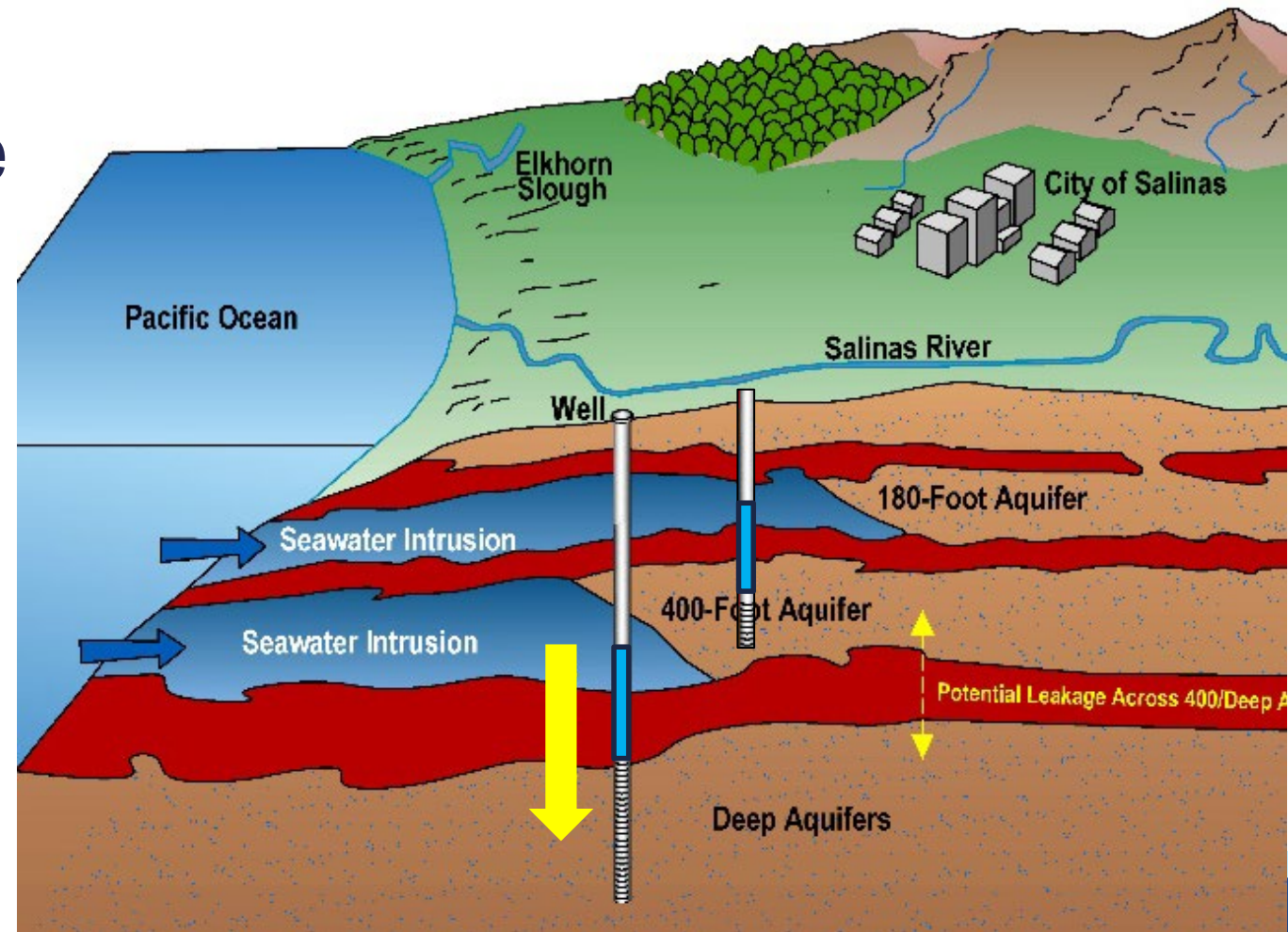
Current Net Extraction is Not Sustainable

- Prevent increases in net extraction from new wells
- Reduce net extraction



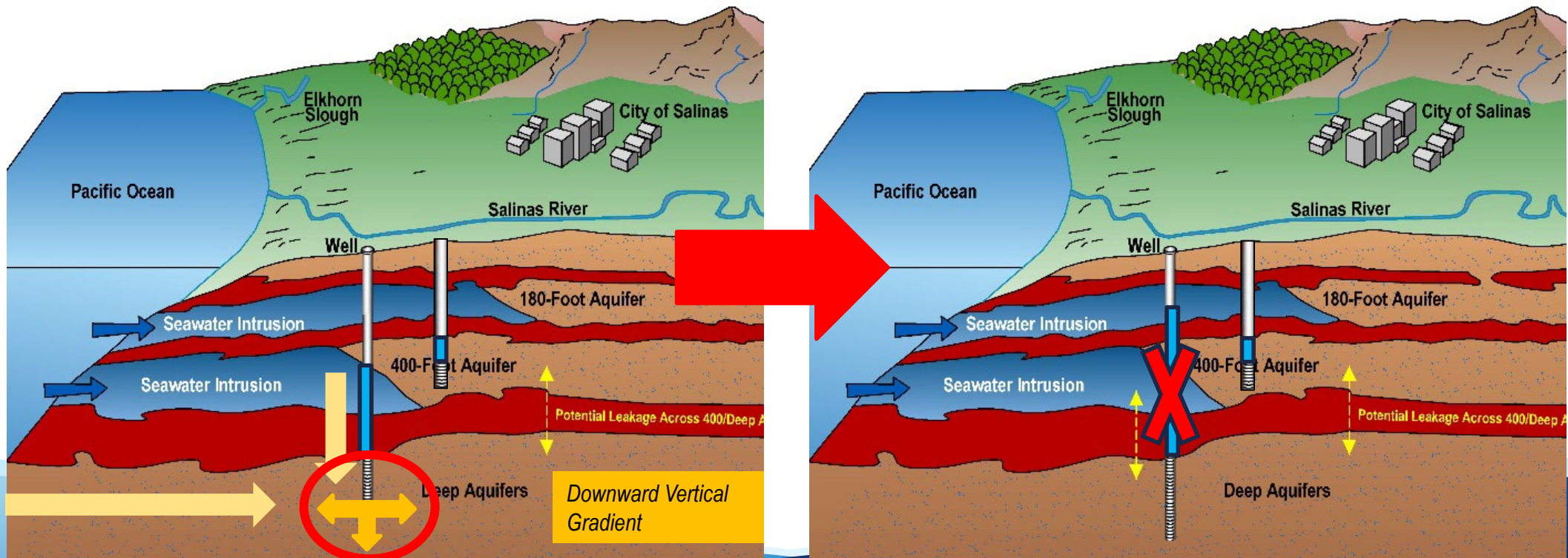
Hydrogeologic Principles to Guide Management to Prevent Subsidence

- Keep Deep Aquifers groundwater elevations above historical levels at a minimum



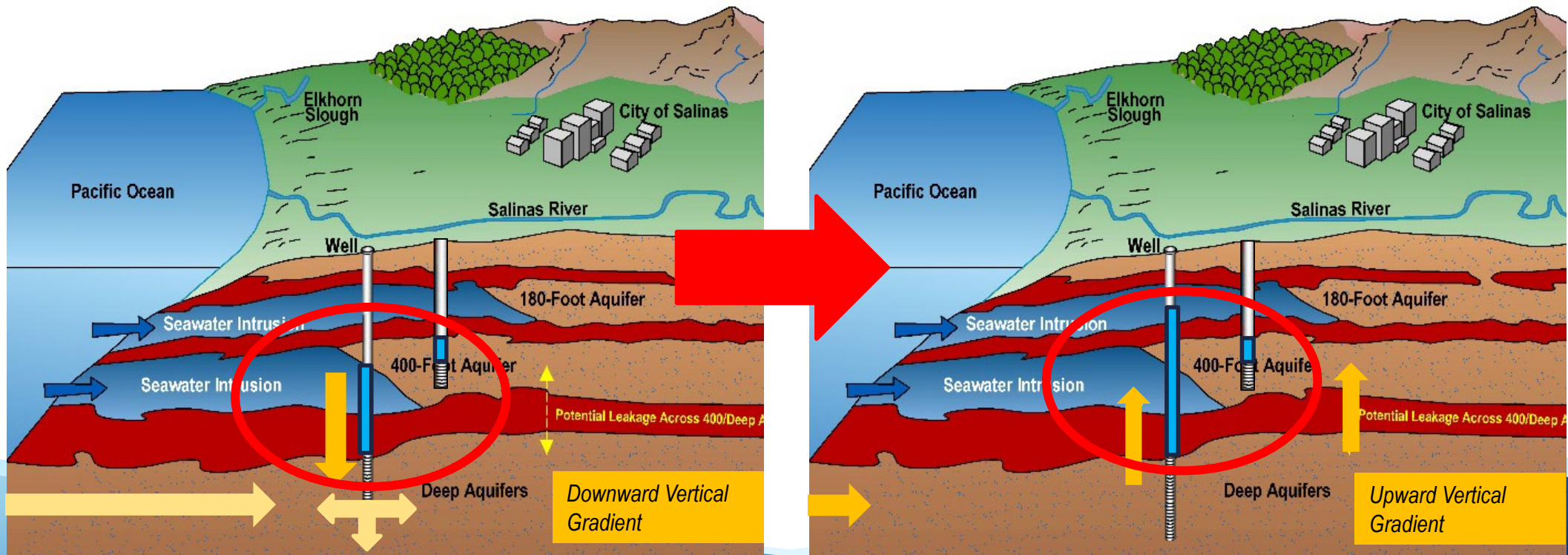
Hydrogeologic Principles to Guide Management to Prevent Seawater Intrusion

- If evidence of seawater intrusion leakage downward is detected, destroy wells that may facilitate leakage



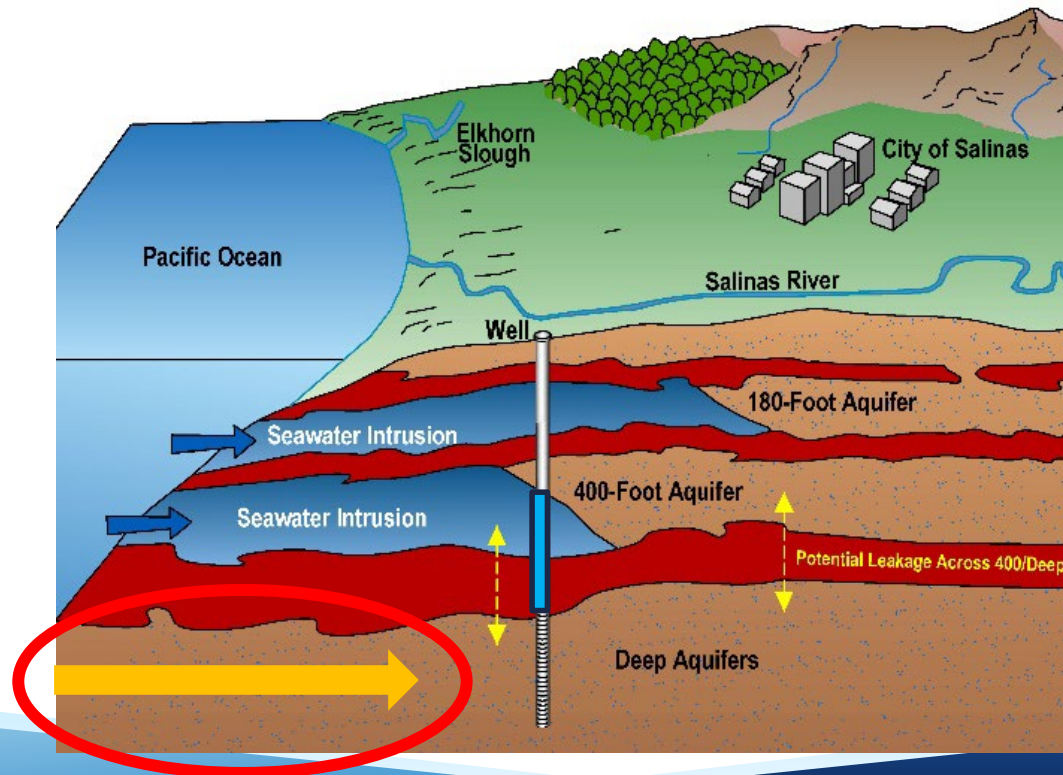
Hydrogeologic Principles to Guide Management to Prevent Seawater Intrusion

- To prevent downward migration: raise groundwater levels to above the overlying aquifer where intrusion is present



Hydrogeologic Principles to Guide Management to Prevent Seawater Intrusion

- Evaluate and select preferred option for controlling lateral seawater intrusion from ocean
- If intrusion is detected in the Deep Aquifers, stop extraction in vicinity of intrusion and implement preferred action

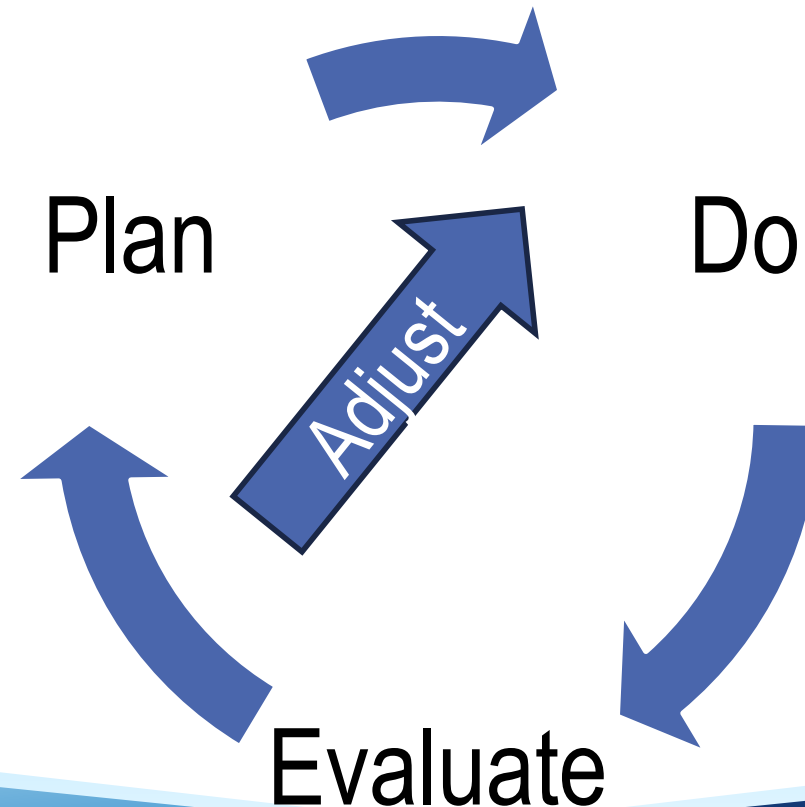


Process to Manage

- Use simulated sustainable/safe yield by Area to guide initial groundwater management
- Adjust management over time according to changes in observed groundwater elevations
- Include wells screened fully and partially in the Deep Aquifers
- Manage together with overlying and adjacent aquifers

Process to Manage

- Adaptively manage Deep Aquifers such that quantity of extraction and injection is reviewed and revised periodically based on groundwater elevations



Monitoring Recommendations

Monitoring Recommendations

Extraction

Collect extraction data from all wells in Deep Aquifers.

Elevations

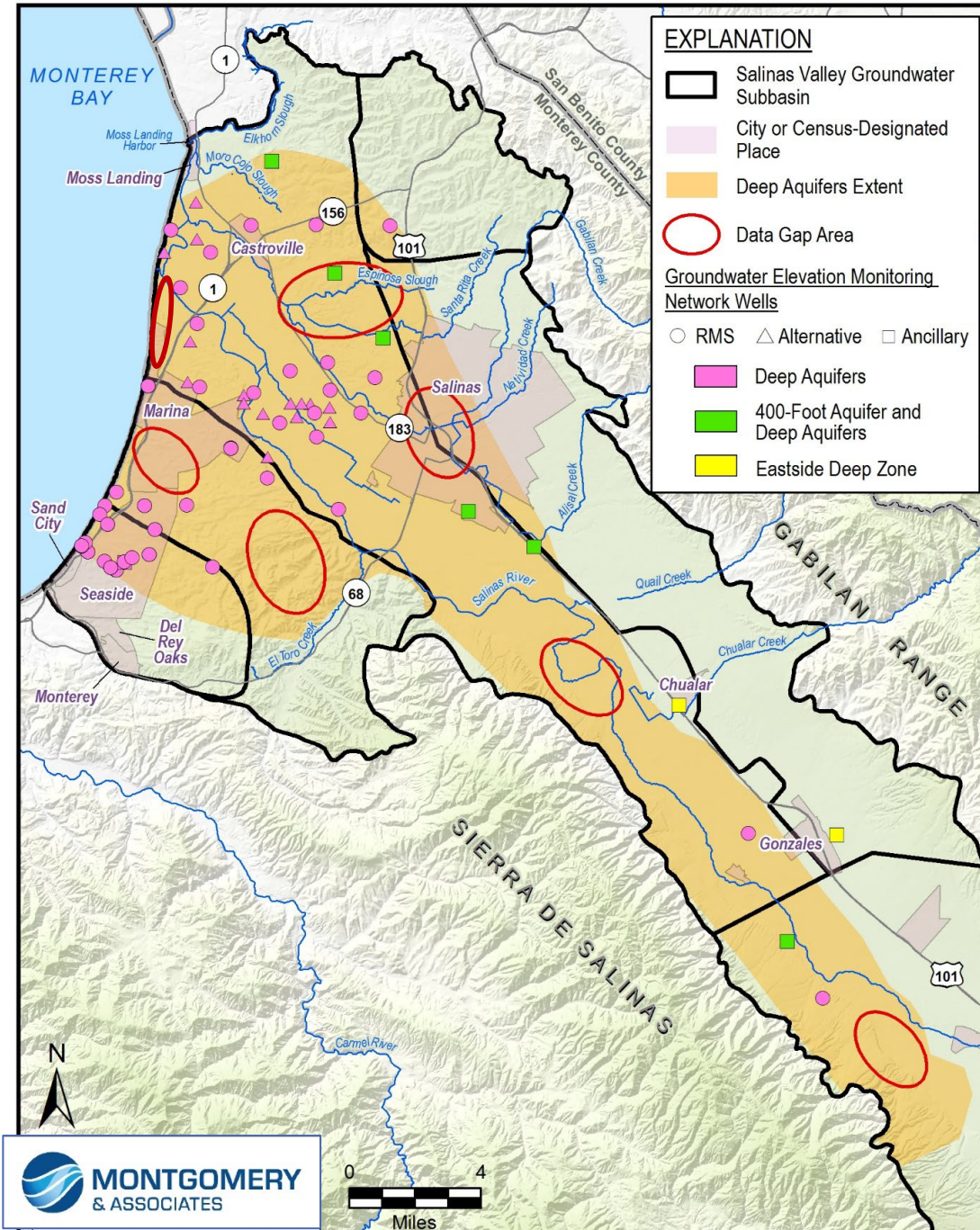
Monitor 82 wells, including 4 recently drilled wells, 5 existing production wells, and filling the 7 data gaps.

Quality

Sample an additional 16 wells to bring wells monitored to 66.

Groundwater Elevation Data Gaps

Coastal data gaps to also watch for seawater intrusion from Ocean



Additional Monitoring and Assessment



Induction Logging

- Detect chloride increases in key wells



Isotope Sampling

- Further assess relationship with adjacent aquifers



Periodic Assessment

- Evaluate trends and changes every 5 years



SUMMARY OF STUDY CONTRIBUTIONS



Developed definition, extent, and HCM of the Deep Aquifers



Developed a water budget for the Deep Aquifers



Made monitoring recommendations



Provided guidance for management based on the Study's findings

Questions/Comments
