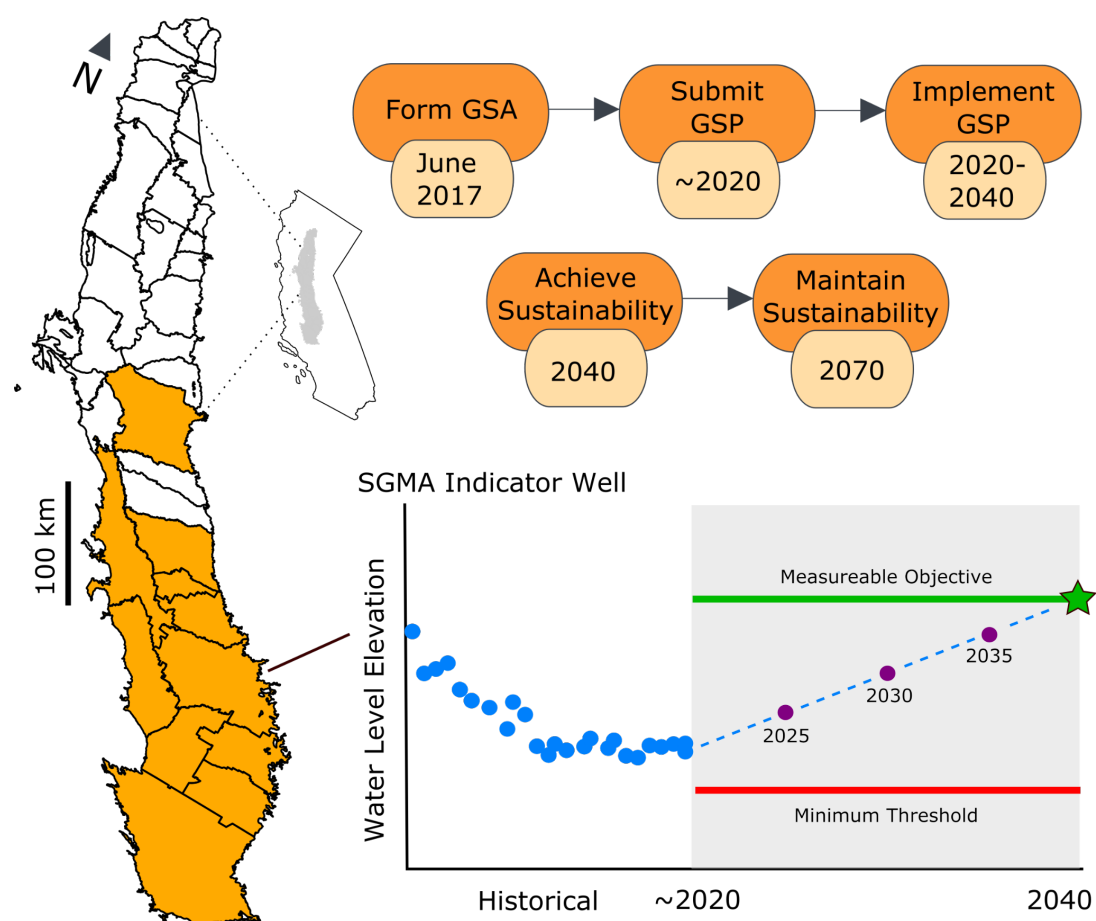# Evaluating long-term land subsidence sustainability goals set by SGMA in the Central Valley, California, USA (2020-2070)

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Sustainable Groundwater Management Act (SGMA)

In 2014, California lawmakers passed the Sustainable Groundwater Management Act (SGMA). Our focus is on the critically overdrafted basins in the California's southern Central Valley (denoted in orange below). By 2020, each basin was required to form a groundwater sustainability agency (GSA) and draft a groundwater sustainability plan (GSP). These GSPs were designed to achieve sustainability by 2040 and maintained through 2070.

Form GSA June 2017 → Submit GSP ~2020 → Implement GSP 2020-2040

Achieve Sustainability 2040 → Maintain Sustainability 2070

SGMA Indicator Well

Study Goals:
1. Compile and evaluate database of SGMA sustainability indicators wells and subsidence rates across the southern Central Valley for its spatial coverage and completeness.
2. Model future scenarios of groundwater pumping that are reflective of both wet and dry conditions
3. Use the modelled scenarios to determine where future groundwater depletion and subsidence may be most severe in the Central Valley

Central Valley Hydrologic Model 2 (CVHM2)

Simulating monthly water budgets between 1961 and 2020.

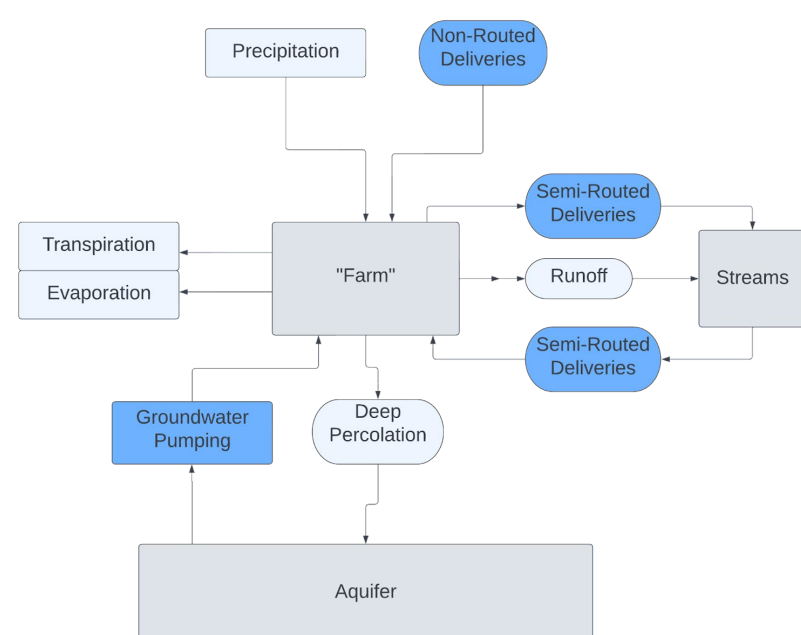Six sets of data constrain model parameters:
- Hydrologic
- Lithologic
- Water consumption
- Land use (farm & urban)
- Surface water inflows
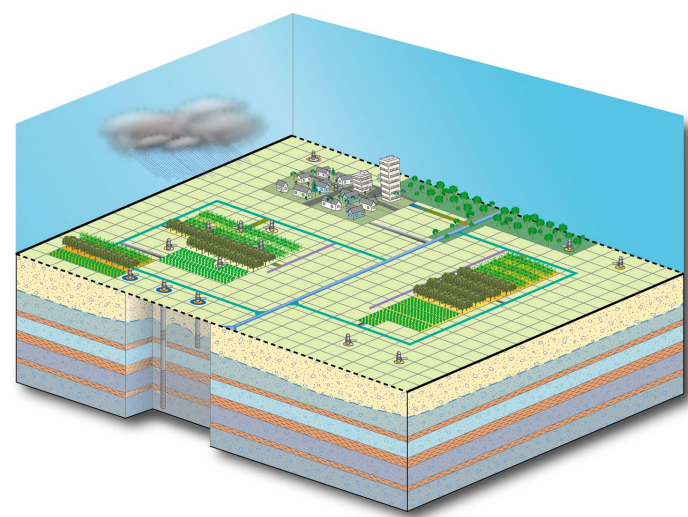
Farm Process Package (MODFLOW)

Uses acreage and crop type in agricultural areas as a proxy for groundwater pumping.

Each crop is assigned a "crop coefficient". This coefficient reflects that crop's water demand on a per acre basis.
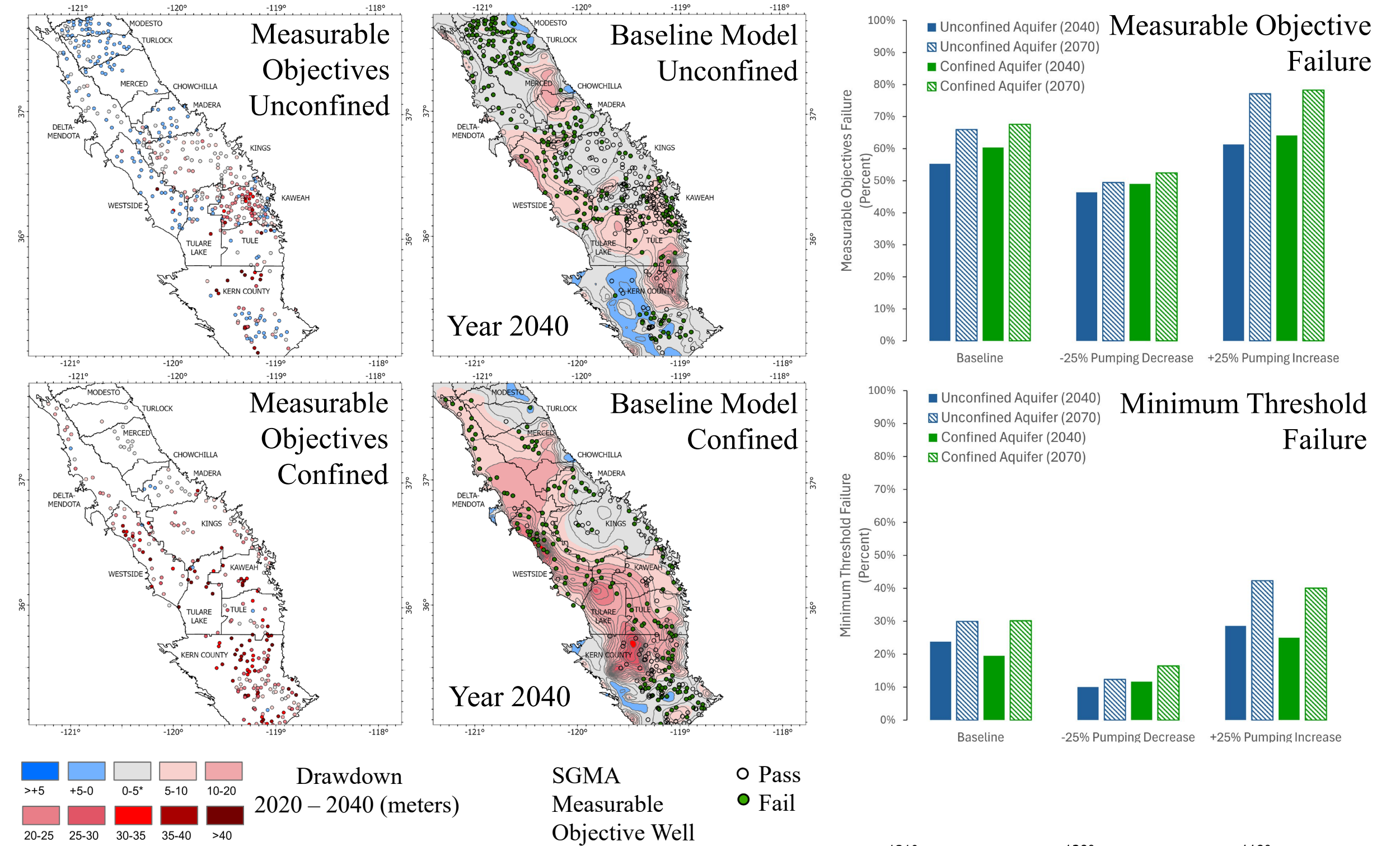
Sustainability Indicators (Water Level & Subsidence)

MADERA SUBBASIN
Sustainable Groundwater Management Act (SGMA)
Joint Groundwater Sustainability Plan
January 2020
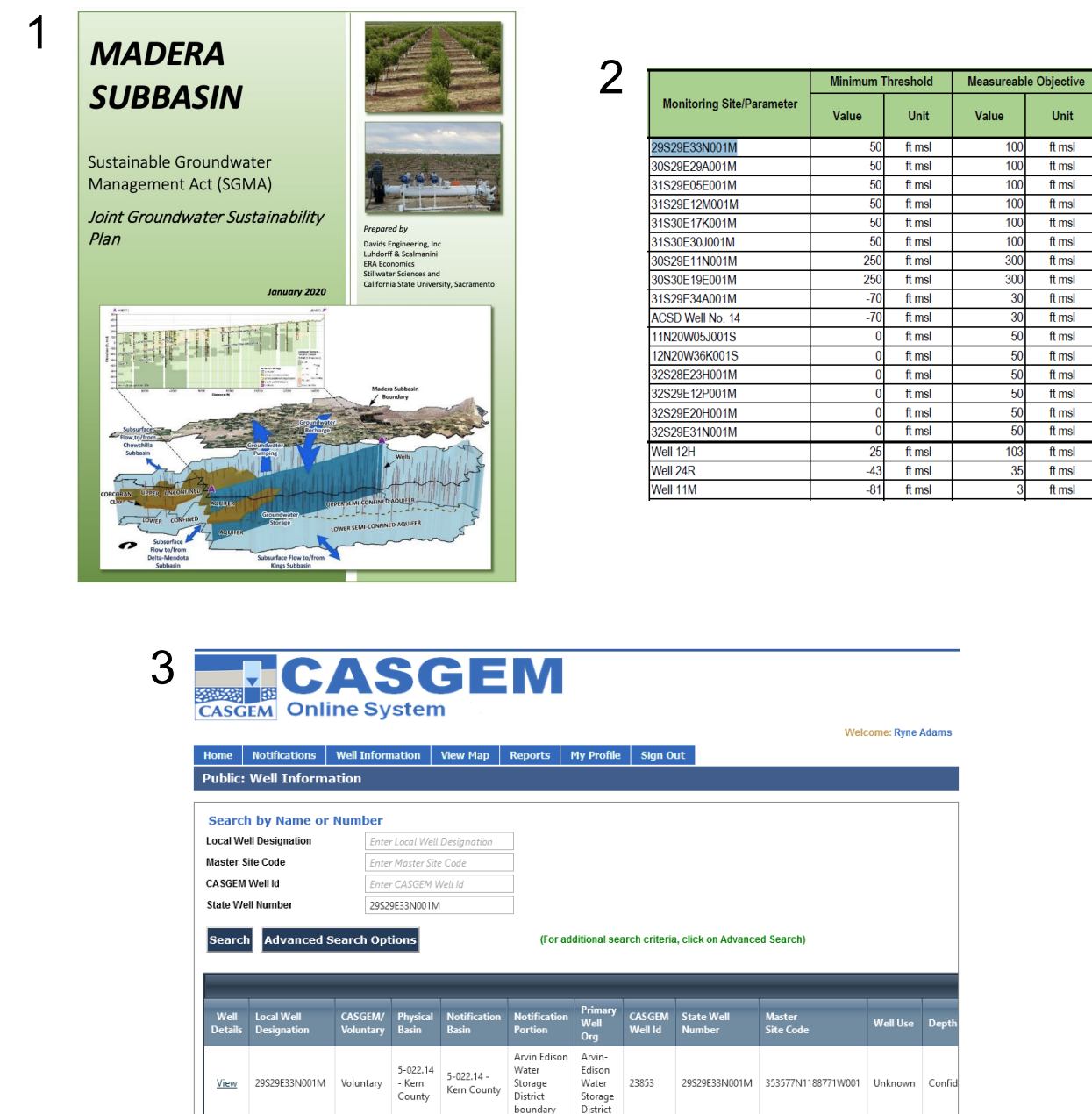
SGMA Indicator Wells:
1. Synthesize GSP plans for each basin (Madera example)
2. Each monitoring well site has 2040 measurable objective & 2040 minimum threshold water levels and subsidence goals
3. CASGEM database of state well numbers to locate monitoring well and determine if well depth information exists

CVHM2: Simulating Future Pumping

Future climate is modelled by using historical water year data to simulate future climate from 2021 - 2070 (Baseline Scenario)

Follows the approach of Kern County GSP (Todd, 2020).

Modelled Future Scenarios:
(1) Baseline Pumping
(2) 25% pumping increase
(3) 50% pumping increase

Past WY	2003-2014	1992-2014	1995-2012
Future WY	2021-2032	2033-2052	2053-2070

- Ground water level targets vary widely within and between GSAs (e.g. Kaweah)
- Key areas of future depletion and subsidence include Westside, Kaweah, Tulare Lake, Tule and Kern GSAs.
- Transboundary groundwater depletion and subsidence between GSAs is evident in both 2040 and 2070.
- SGMA indicator wells and subsidence monitoring stations fail to meet sustainability criteria in baseline and reduced pumping scenarios.

Measurable Objectives Unconfined — Year 2040

Baseline Model Unconfined — Year 2040

Measurable Objectives Confined

Baseline Model Confined — Year 2040

Drawdown 2020 – 2040 (meters)
>+5 +5-0 0-5 5-10 10-20 20-25 25-30 30-35 35-40 >40

SGMA Measurable Objective Well — ○ Pass ● Fail

Measurable Objective Failure

Minimum Threshold Failure

Unconfined Aquifer (2040), Unconfined Aquifer (2070), Confined Aquifer (2040), Confined Aquifer (2070)
Baseline, -25% Pumping Decrease, +25% Pumping Increase

Average Ground Level Elevation Change 2015-2022

Legend
SGMA Subsidence Monitoring Stations
Canals
Central Valley Groundwater Basins
Average Ground Level Elevation Change 2015-2022 VALUE (m/yr)
2.249 – 4.521
0.864 – 2.248
0.019 – 0.863
-0.496 – 0.018
-1.341 – 0.497
-2.727 – 1.342
-5 – 2.728
-8.726 – 5.001
-14.838 – 8.727

Subsidence Failure
Measurable Objectives (2040), Measurable Objectives (2070), Minimum Thresholds (2040), Minimum Thresholds (2070)
Baseline, -25% Pumping Decrease, +25% Pumping Increase

Baseline Model Subsidence Rate (cm/yr) — Year 2070

Modeled Subsidence Rate (cm/yr)
0 2 4 6 8 10 12 14 16
Minimum Threshold Station — ○ Pass ● Fail