TURLOCK GSP

2070 CLIMATE CHANGE SCENARIO

MARCH 25, 2021

Agenda

- Climate Change
  - Regulatory Requirements
  - Approach and Assumptions
  - Input Data
  - Model Results

DWR SGMA Regulations for Climate Change

§ 354.18. (c) Each Plan shall quantify the … projected water budget for the basin as follows:

(3) Projected water budgets … shall … estimate future baseline conditions concerning hydrology, water demand and surface water supply availability or reliability over the planning and implementation horizon:

(A) Projected hydrology shall utilize **50 years of historical precipitation, evapotranspiration, and streamflow information** … (and) shall also be applied … to evaluate future scenarios of hydrologic uncertainty **associated with projections of climate change** and sea level rise.

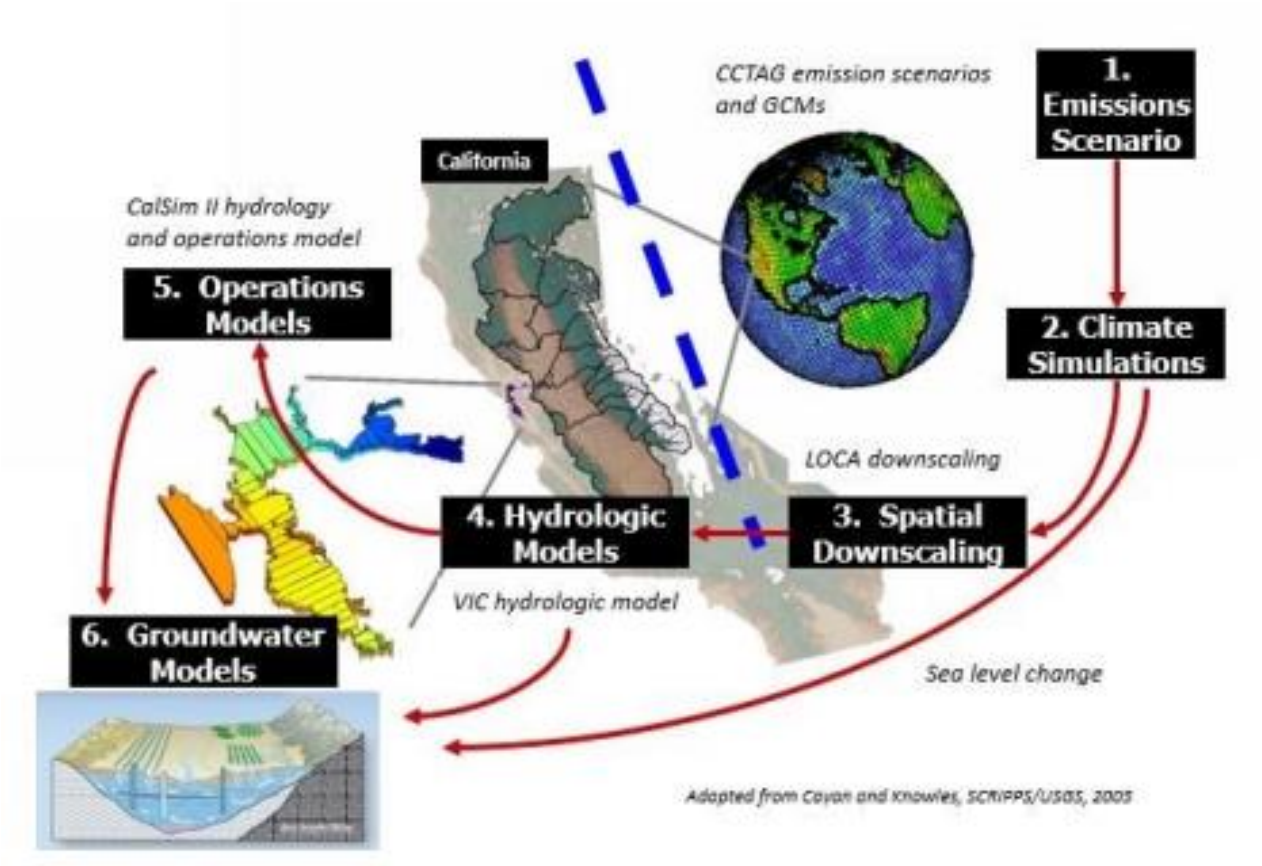
(B) Projected water demand shall utilize **the most recent land use, evapotranspiration, and crop coefficient information** … (and) shall also be applied … to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and **climate**.

(C) Projected surface water supply shall utilize **the most recent water supply information** as the … (and) shall also be applied … to evaluate future scenarios of surface water supply availability and reliability as a function of the … projected changes in local land use planning, population growth, and **climate**.

Climate Change Analysis Goals

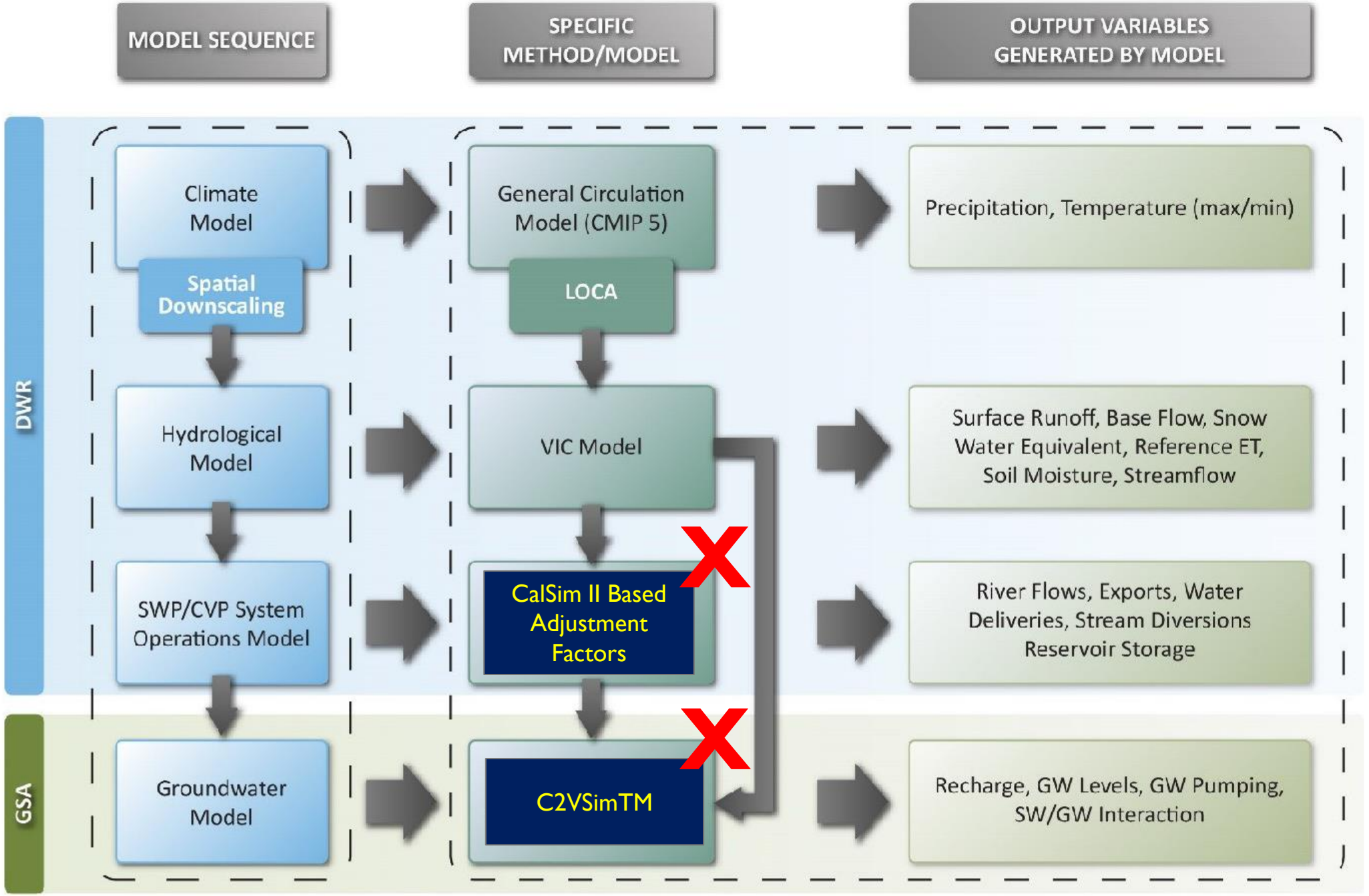
- Meet the GSP regulatory requirements
- Reasonably represents the climate change conditions in Turlock Subbasin and Tuolumne River Watershed.
  - Use the methodology developed by, and described in, DWR's Water Budget BMP (DWR, 2018a) with refinements to facilitate local surface water operations.
  - Provide a uniform approach and CC scenarios that is spatially distributed and possesses appropriate temporal trends that is applicable to both the Upper watershed and the Valley floor.

Climate Change Data Downscaling to Groundwater Model Applications



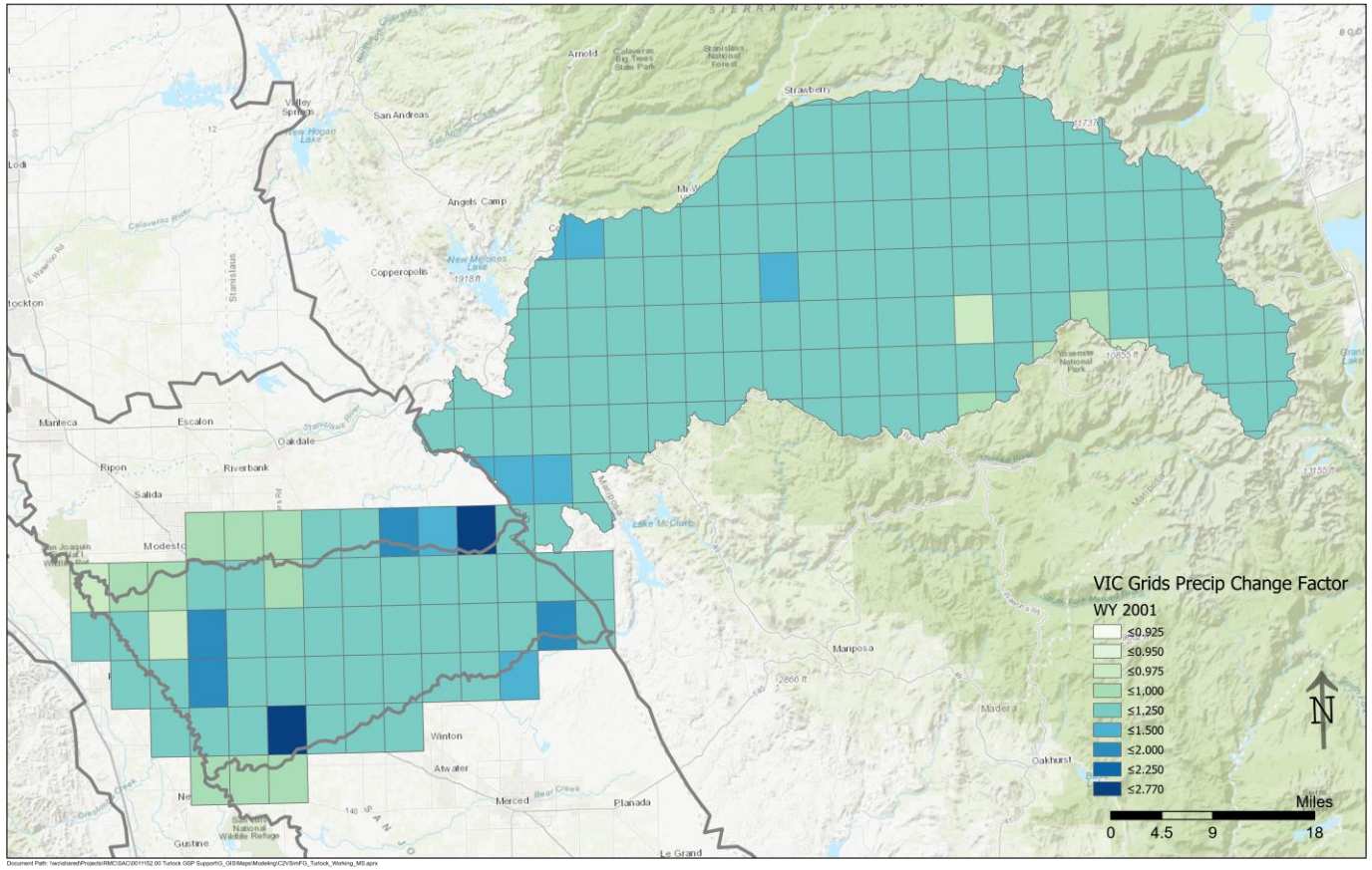
- Data from Global Climate Models (GCMs) are downscaled to a regional planning scale
- Downscaled data is available in pre-existing datasets by VIC grid cells:
  - Temperature
  - Precipitation
  - Evapotranspiration

Source: DWR SGMA Climate Change Guidance


MODEL SEQUENCE
SPECIFIC METHOD/MODEL
OUTPUT VARIABLES GENERATED BY MODEL
DWR
GSA
Climate Model
Spatial Downscaling
Hydrological Model
SWP/CVP System Operations Model
Groundwater Model
General Circulation Model (CMIP 5)
LOCA
VIC Model
CalSim II Based Adjustment Factors
C2VSimTM
Precipitation, Temperature (max/min)
Surface Runoff, Base Flow, Snow Water Equivalent, Reference ET, Soil Moisture, Streamflow
River Flows, Exports, Water Deliveries, Stream Diversions Reservoir Storage
Recharge, GW Levels, GW Pumping, SW/GW Interaction

Precipitation

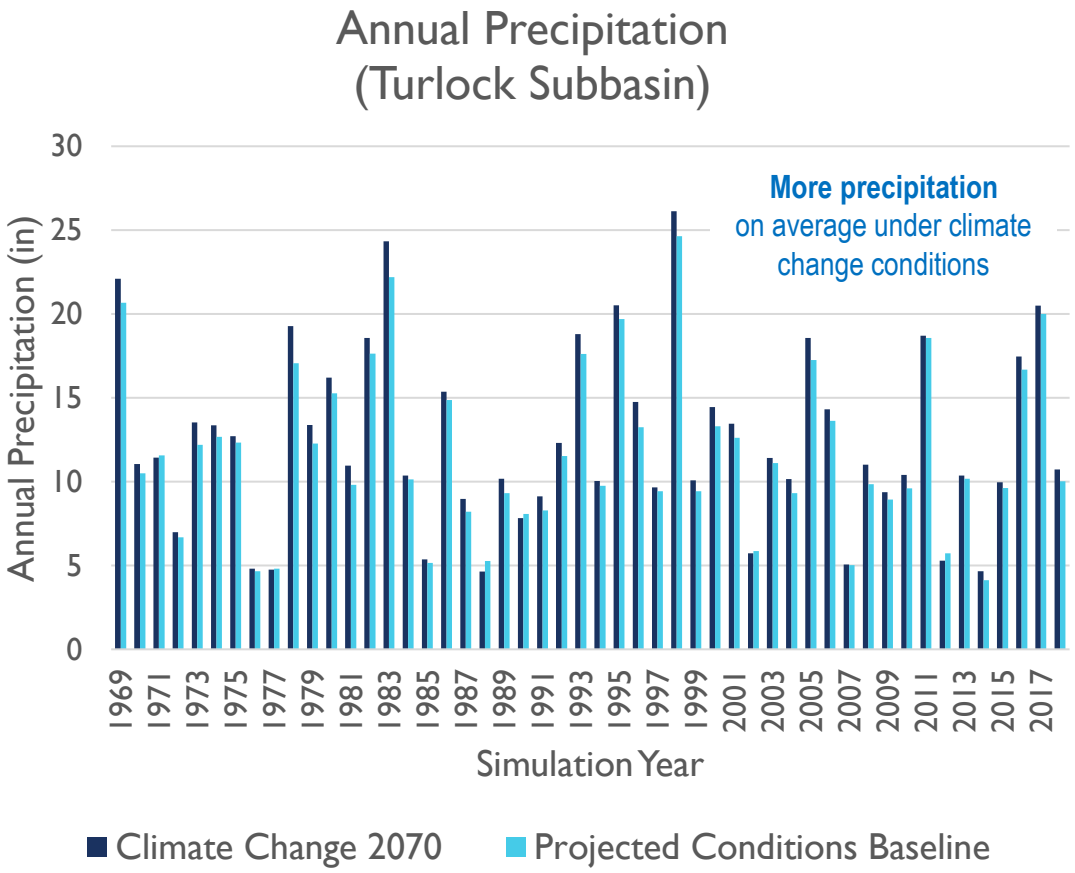
2001 (Avg) Change Factors

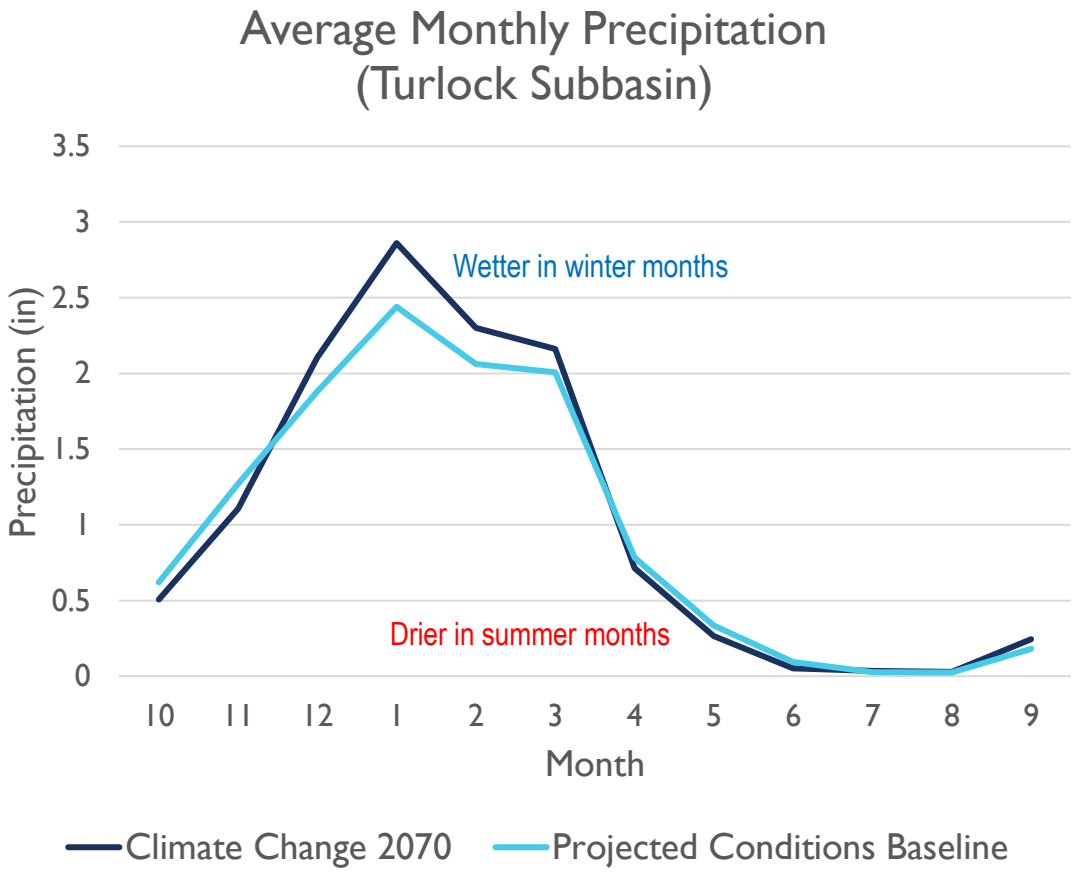


Annual Change Factors

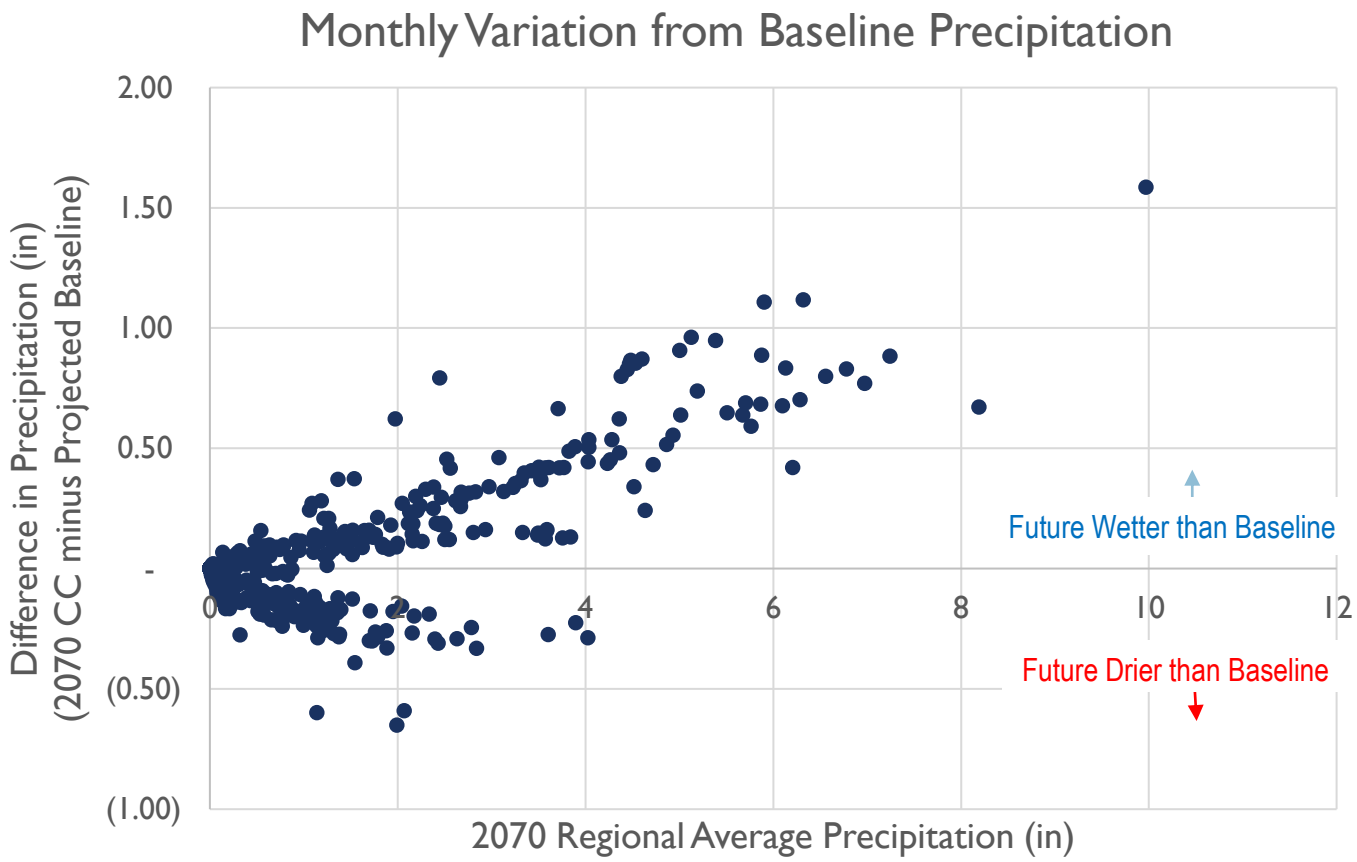
- Source: VIC
- Upper Watershed
  - Min 0.96
  - Avg 1.09
  - Max 1.33
- Lower Watershed
  - Min 0.96
  - Avg 1.15
  - Max 2.77

PRECIPITATION





Precipitation – Turlock Subbasin

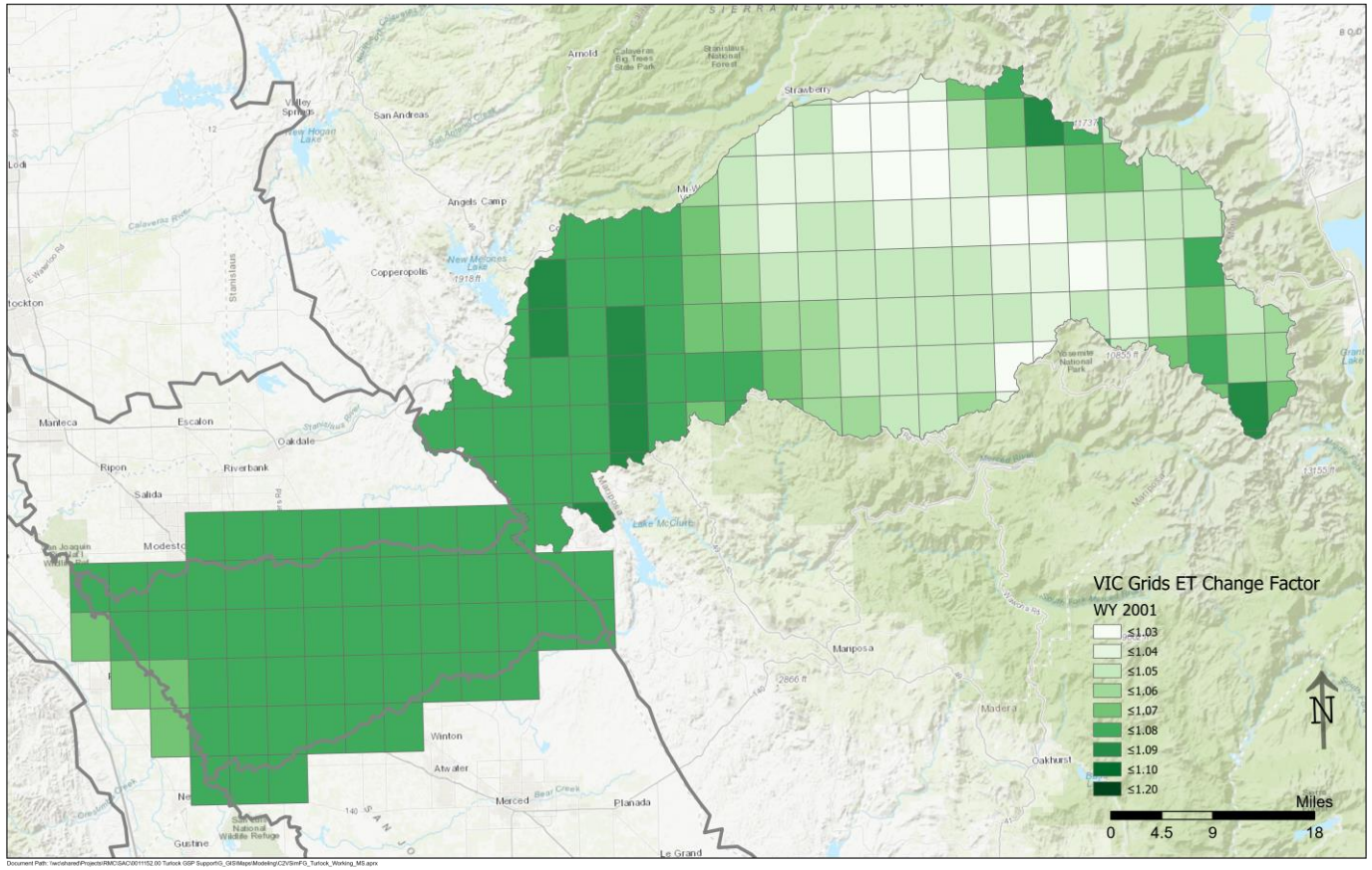


Annual Precipitation

- Projected Conditions
  - Min 4.12 in
  - Avg 11.73 in
  - Max 24.64 in
- Climate Change (2070)
  - Min 4.64 in
  - Avg 12.38 in
  - Max 26.12 in

ET_0 Change Factor

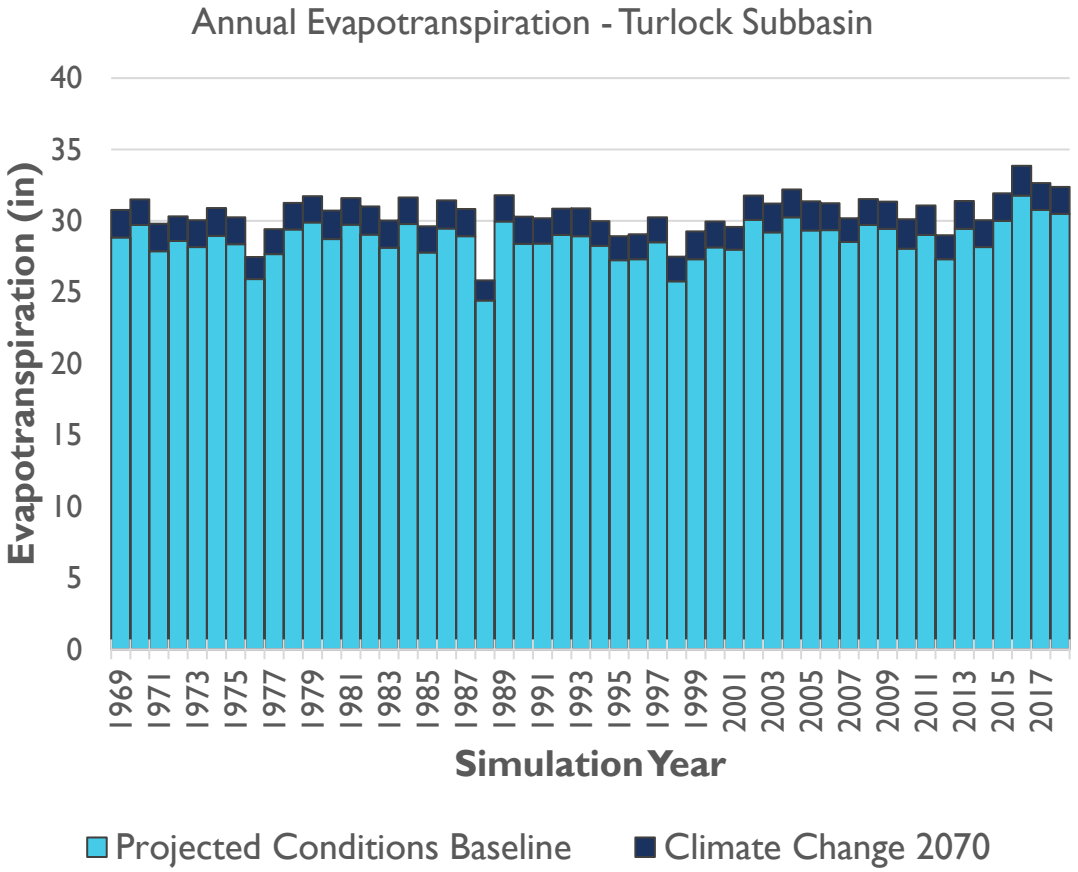
2001 (Ave) Change Factors

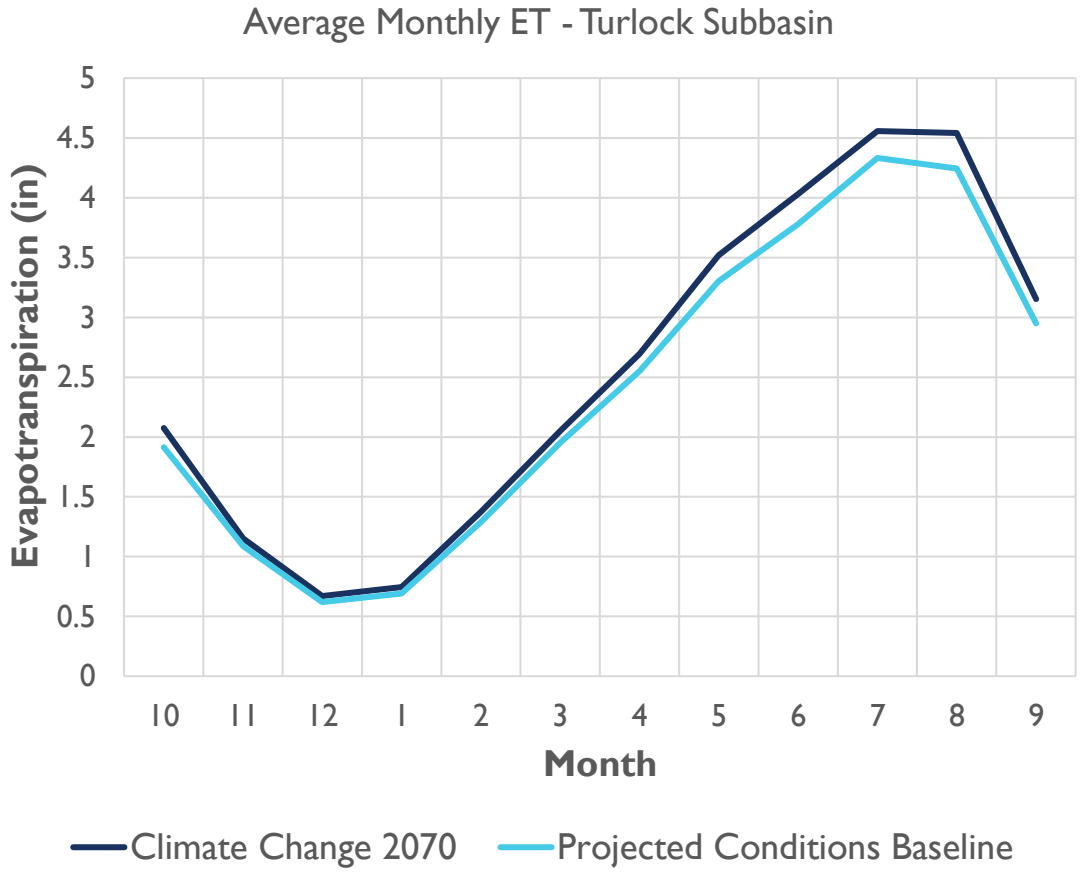


Annual Change Factors

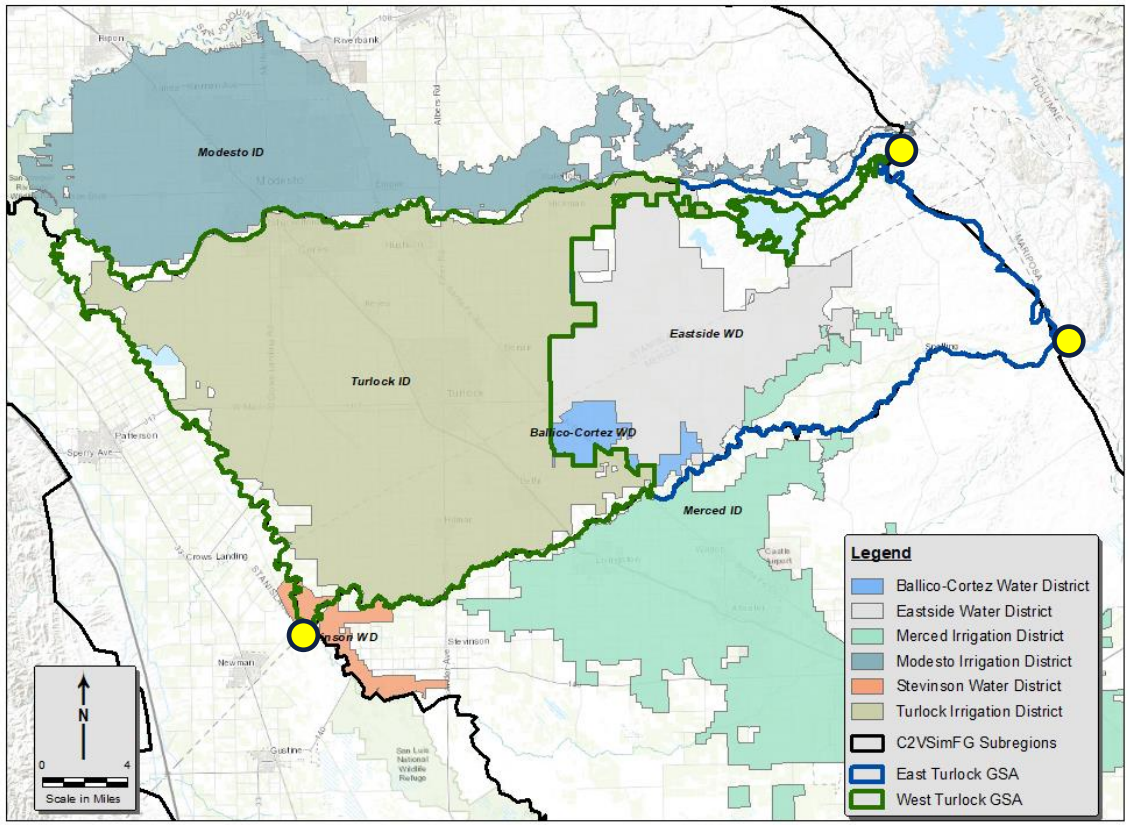
- Source: VIC
- Upper Watershed
  - Min 1.01
  - Avg 1.06
  - Max 1.09
- Lower Watershed
  - Min 1.07
  - Avg 1.07
  - Max 1.08

ET_0 Change Factor



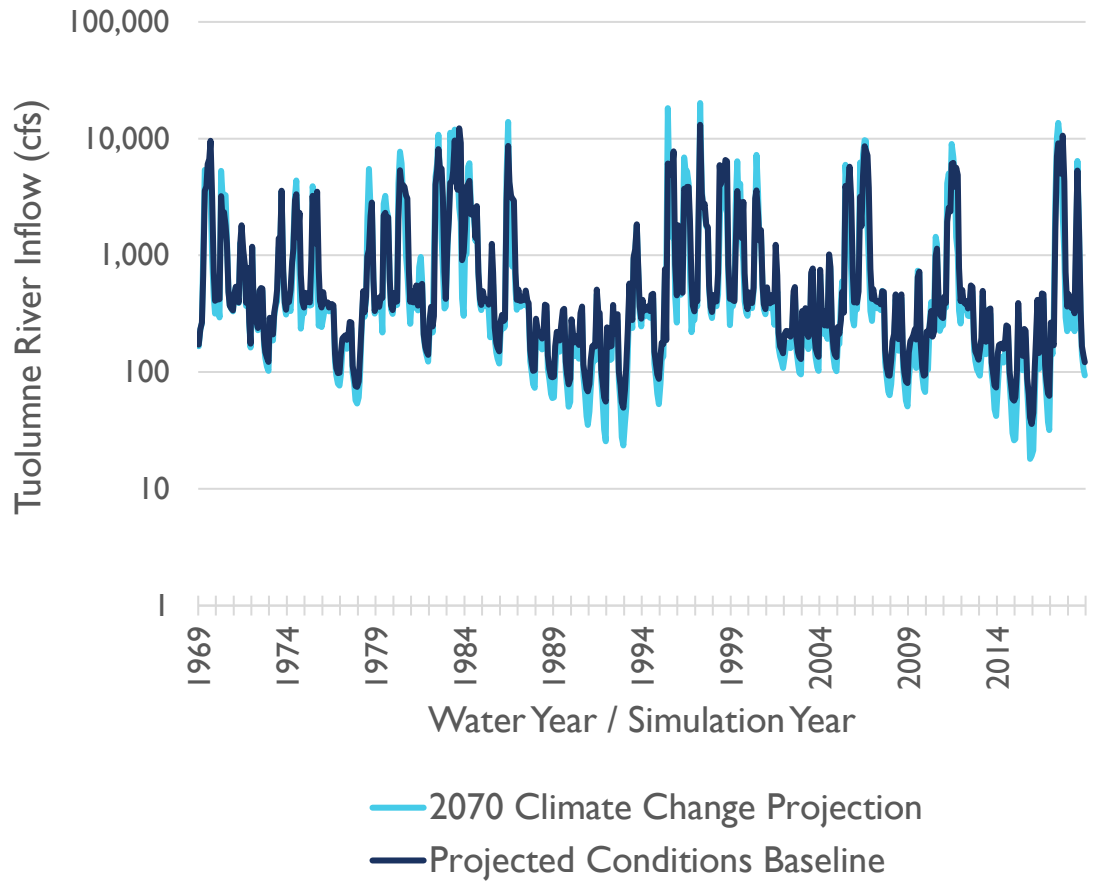


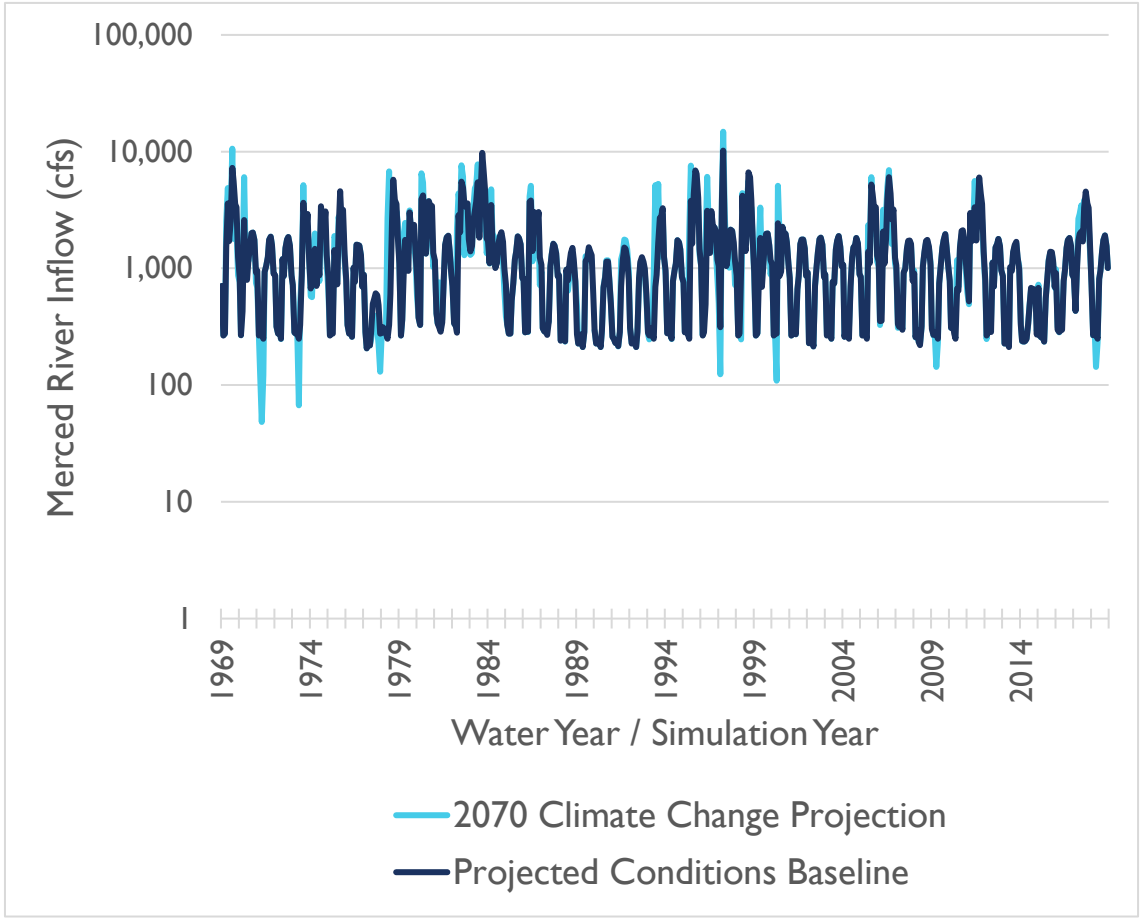
Stream System



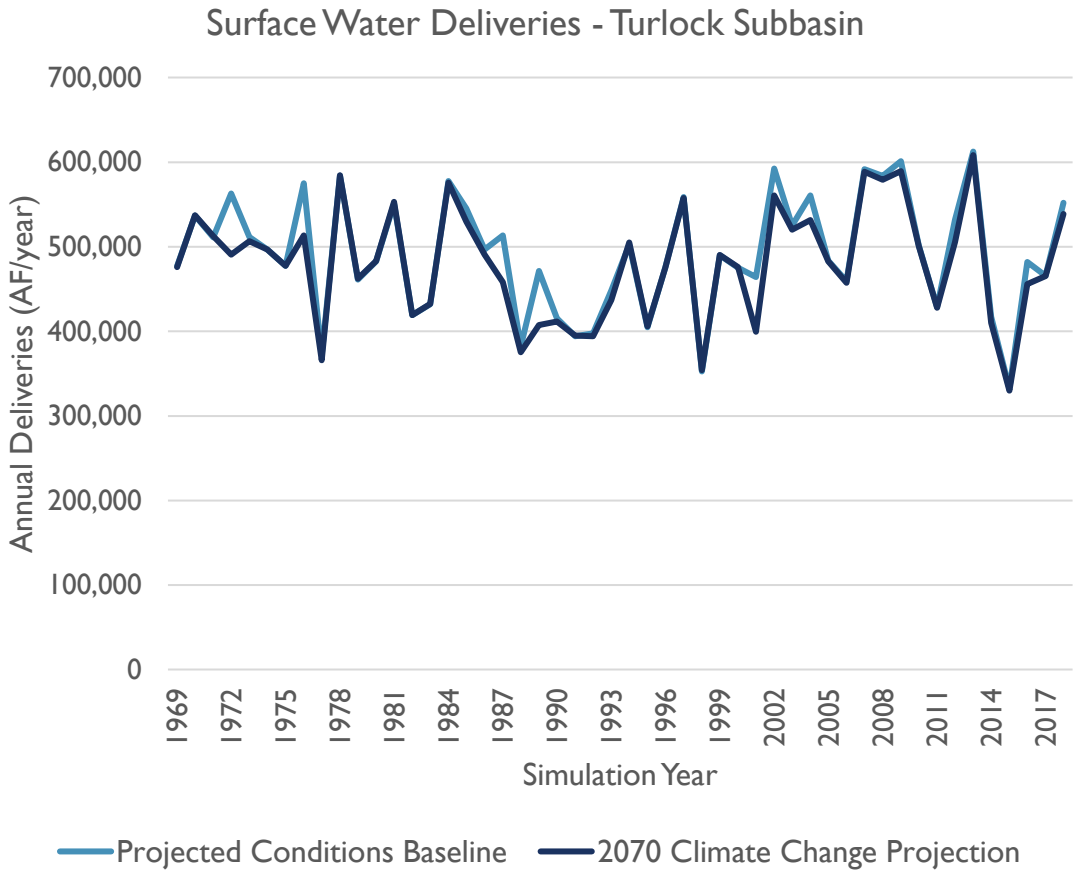
- Modeling Approach
  - Based on CalSIM II Water Storage Investment Program (WSIP)
  - CalSim II generated perturbation factors
- Stream Inflow
  - Merced River
  - Tuolumne River
  - Stanislaus River
  - San Joaquin River
- Surface Water Deliveries
  - Turlock Irrigation District
  - Merced Irrigation District
  - Modesto Irrigation District
  - Oakdale Irrigation District
  - Riparian Diverters

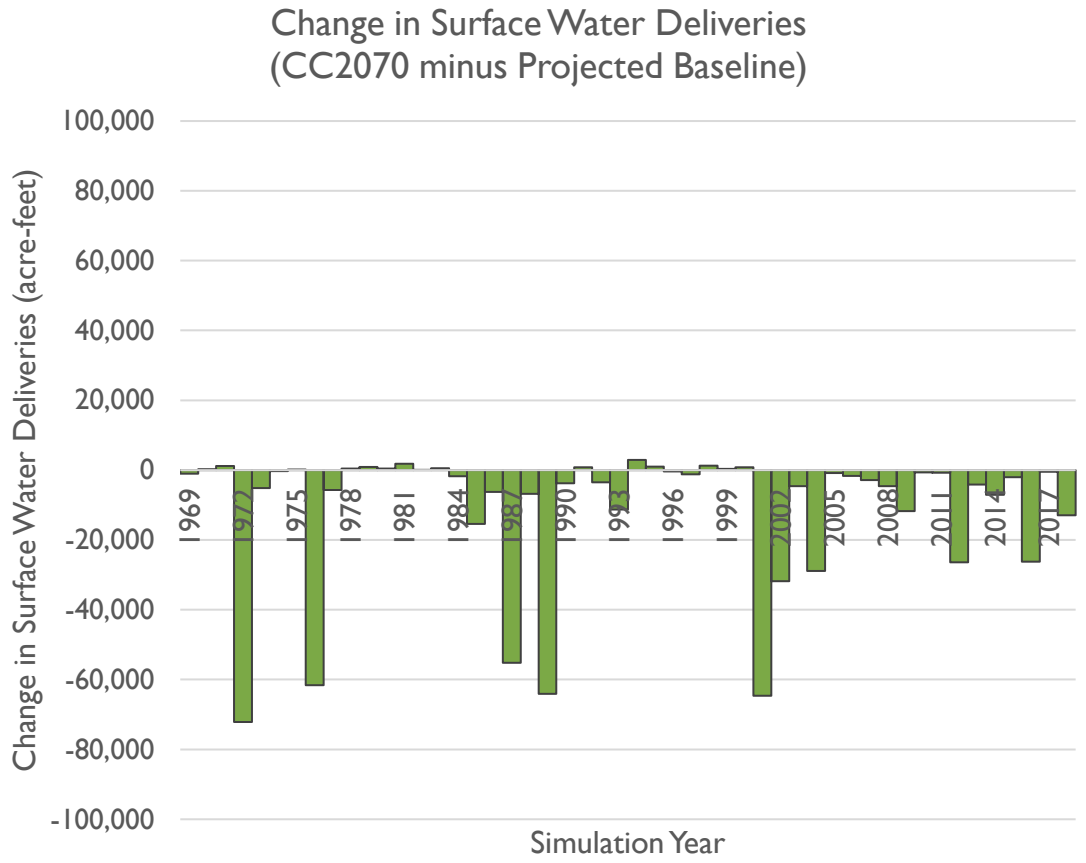
Stream Inflow



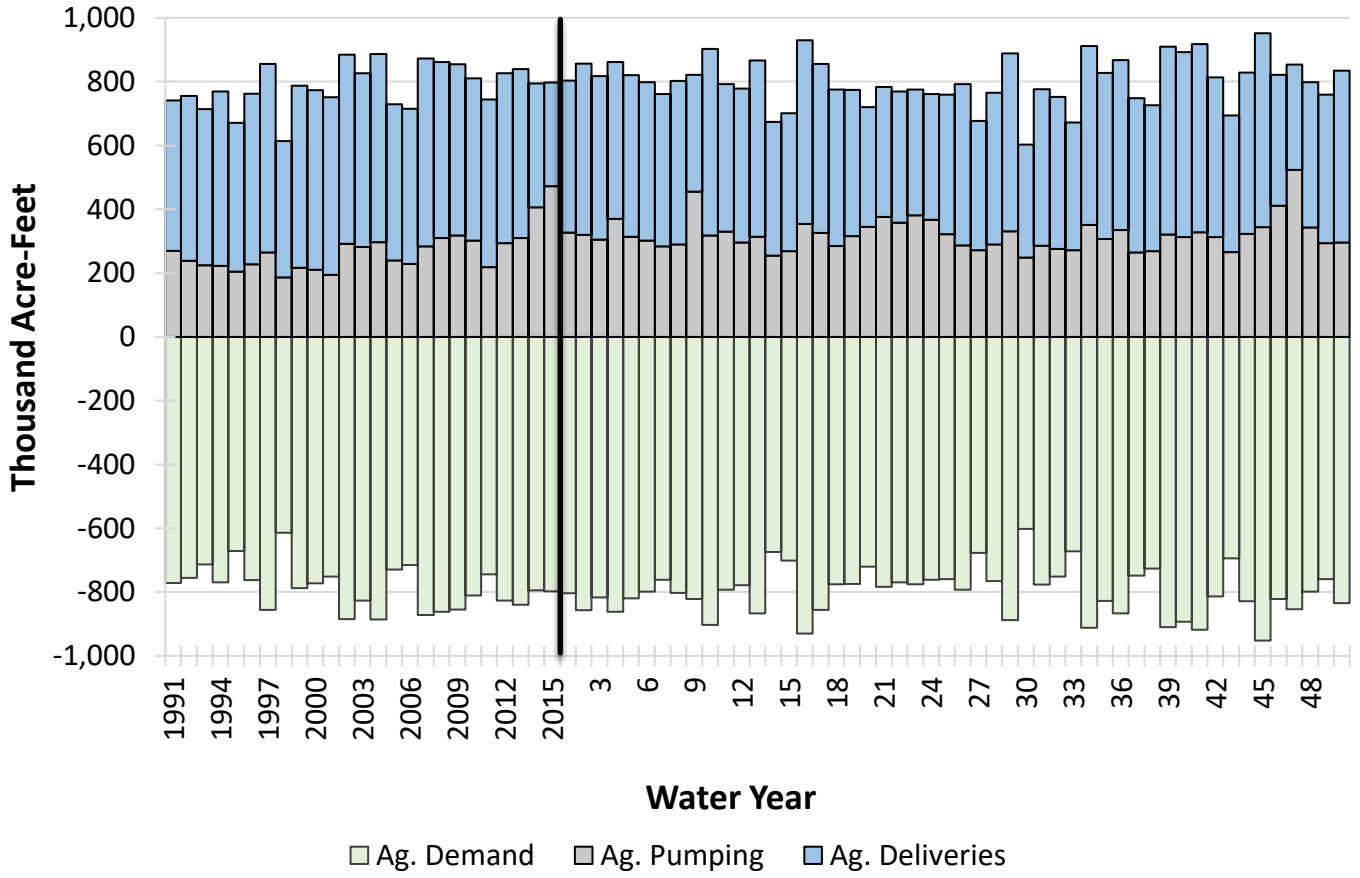


Surface Water Deliveries – Turlock Subbasin





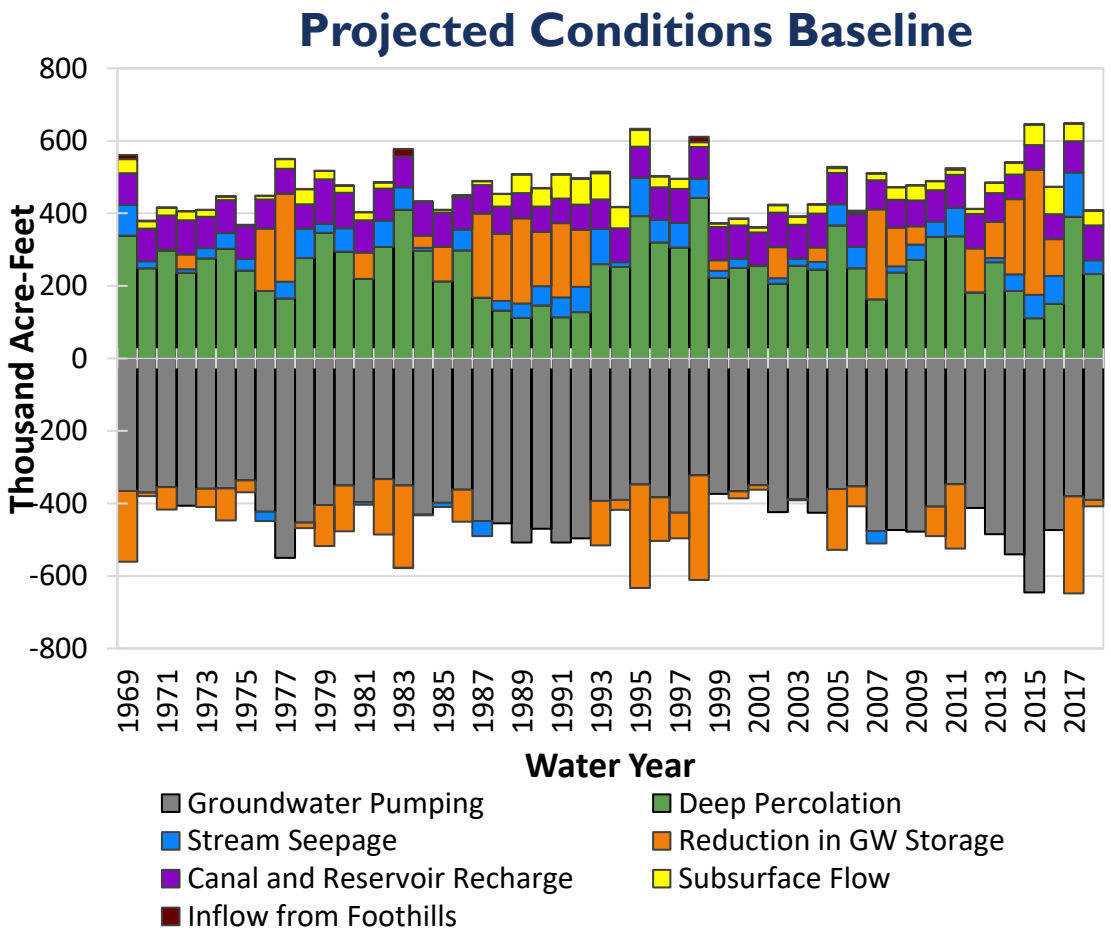
Land and Water Use under Climate Change

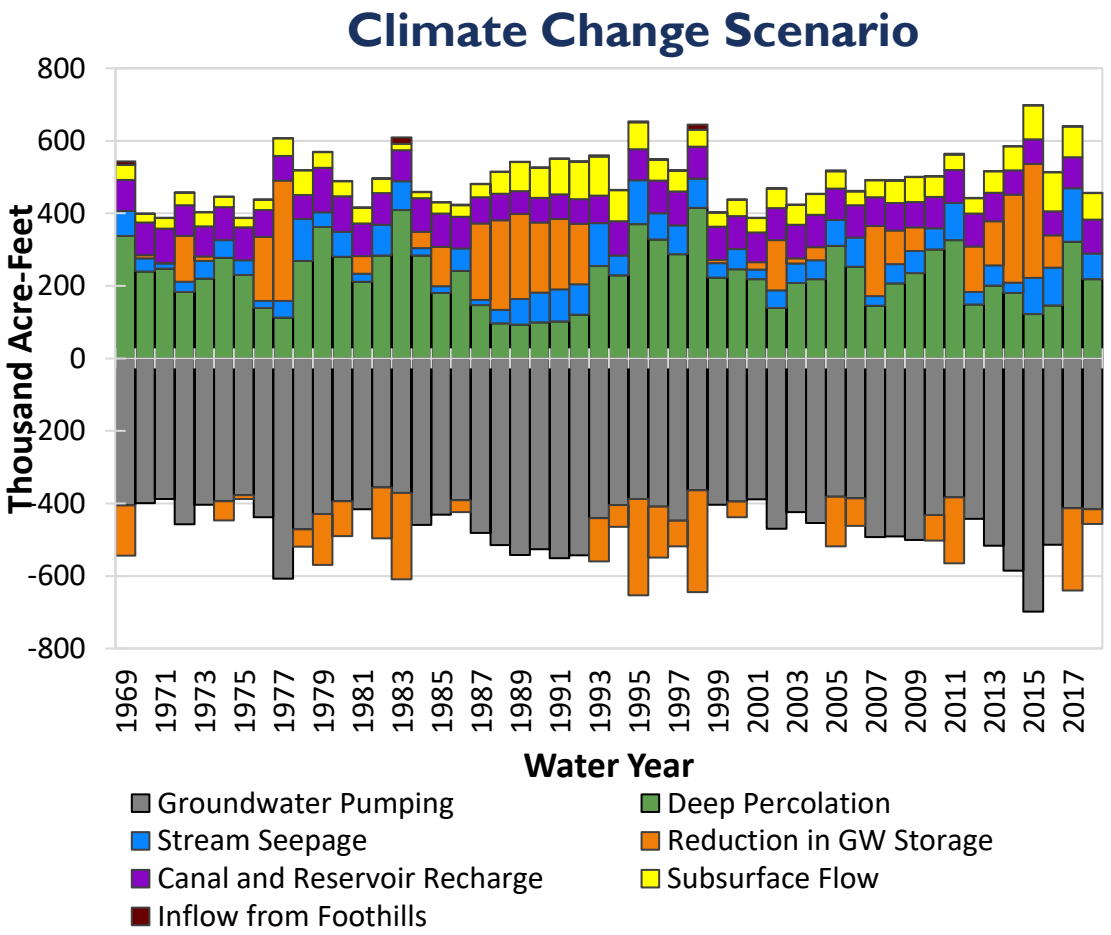


Budget Summary (CC ÷ Baseline)

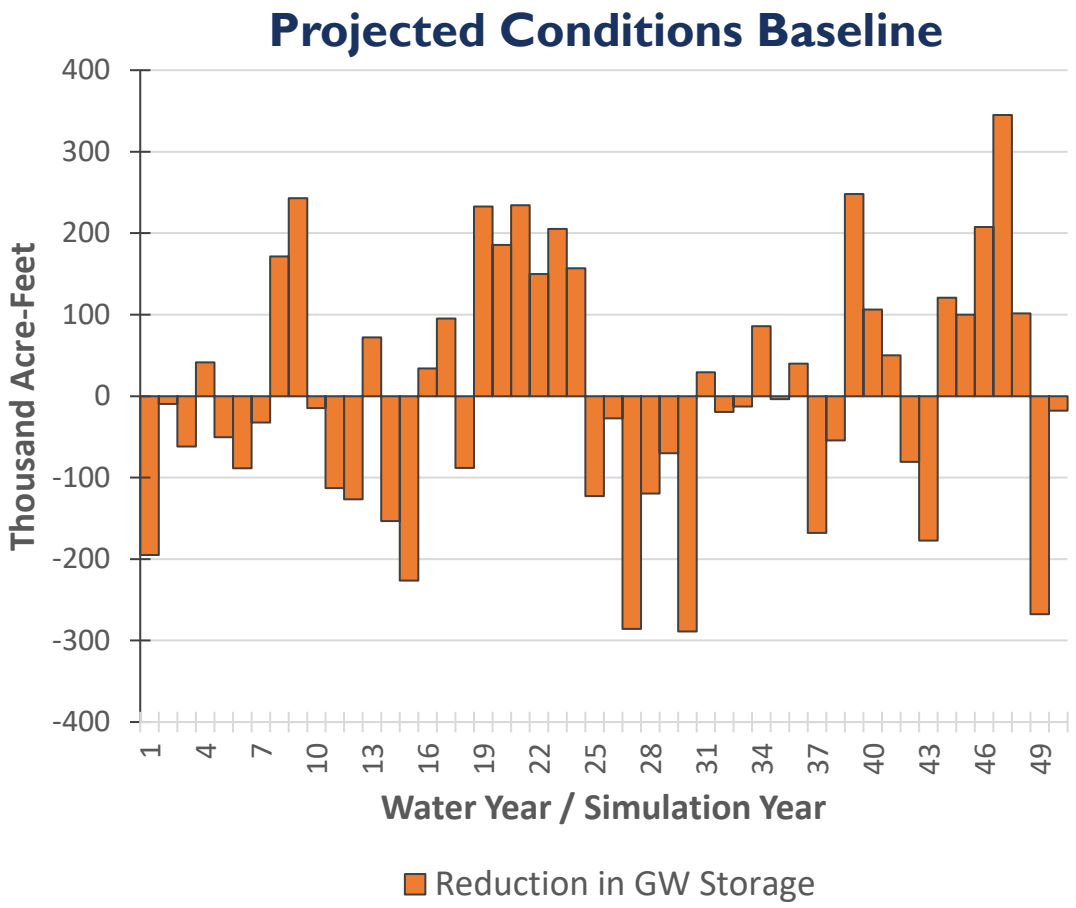
- Ag Demand 108%
- Surface Water 98%
- Pumping 112%

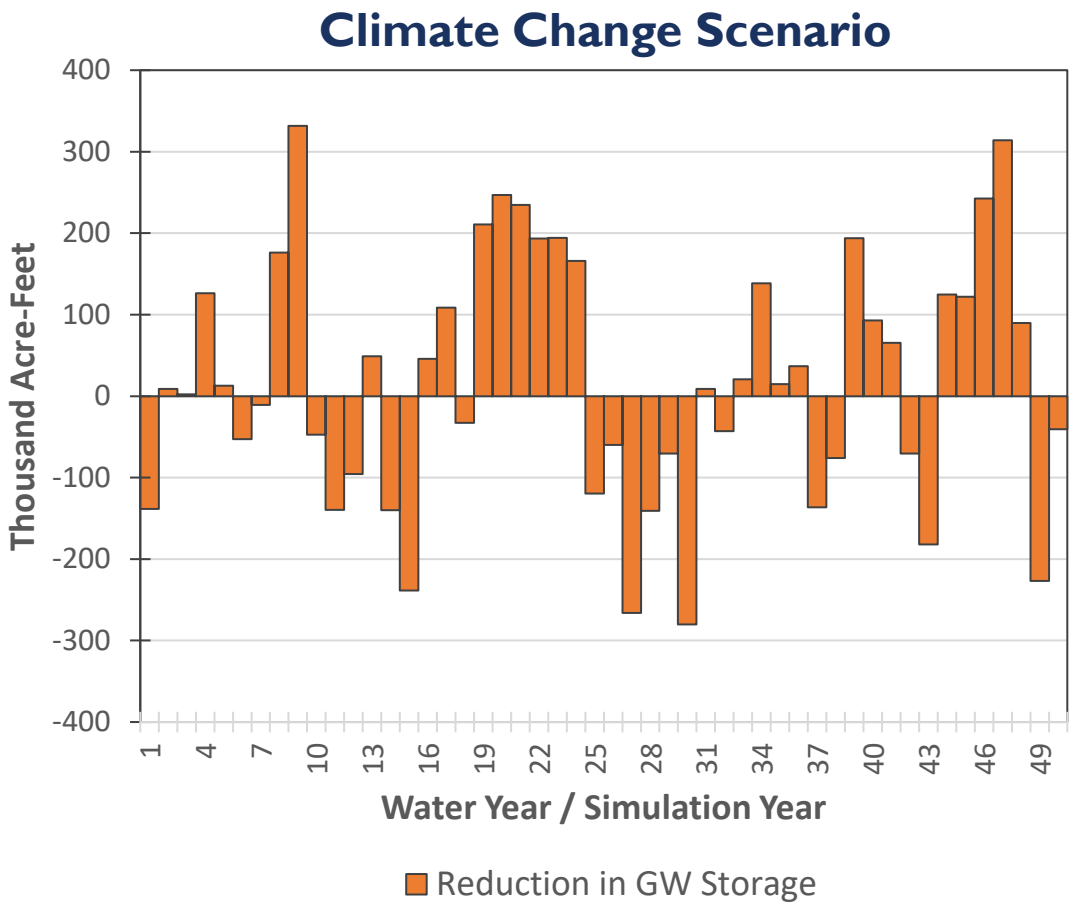
GROUNDWATER BUDGET UNDER CLIMATE CHANGE





CHANGE IN STORAGE UNDER CLIMATE CHANGE





Climate Change Summary

Conditions under the climate change scenario (DWR 2070) indicates:

- Land Surface System
  - Increased agricultural demand due to higher evapotranspiration
  - Decreased surface water supply due to earlier precipitation and snowmelt
  - Increased groundwater pumping meet agricultural demand
- Groundwater System
  - Declining groundwater storage and water levels due to increased production
  - Increased stream seepage due to lower groundwater levels

QUESTIONS?