

CALIFORNIA DEPARTMENT OF WATER RESOURCES

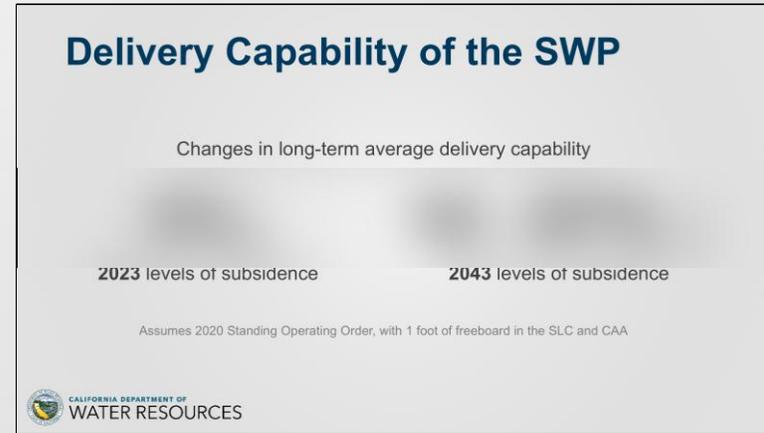
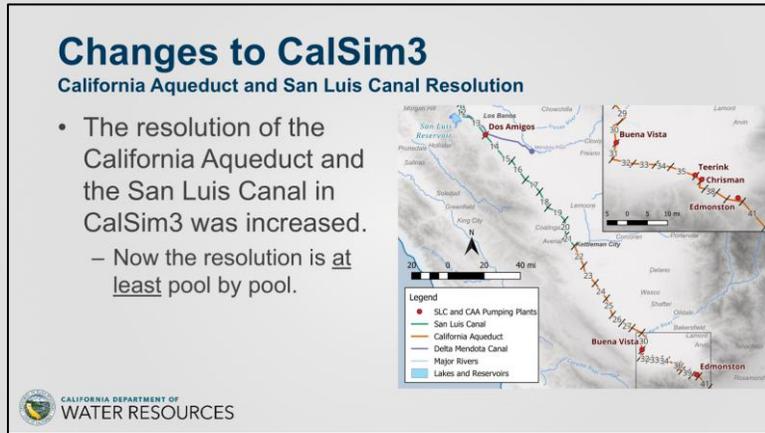
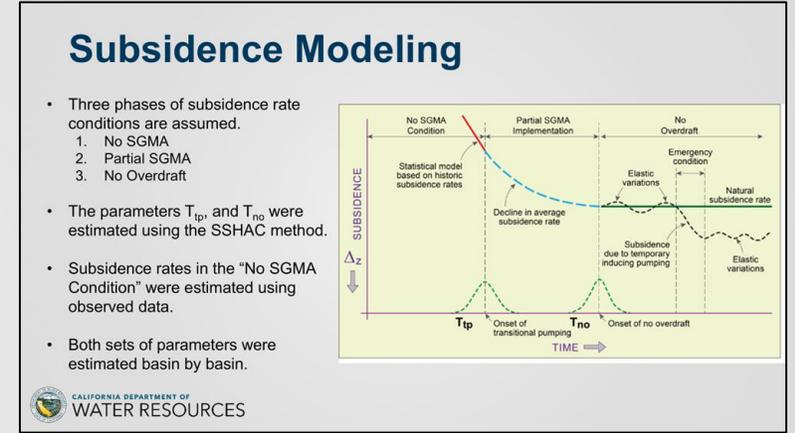
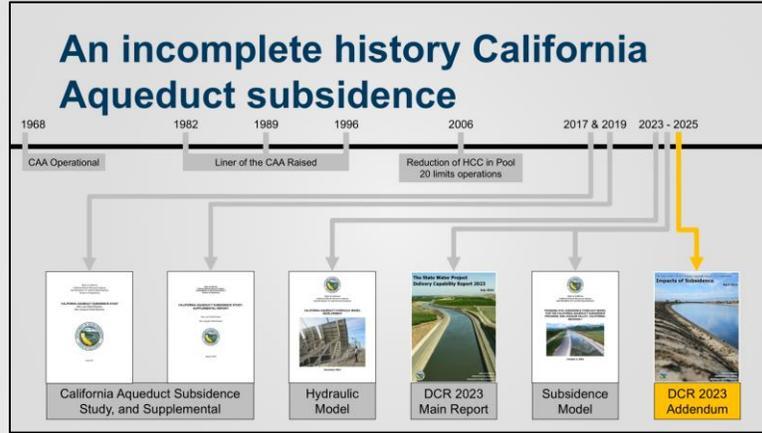
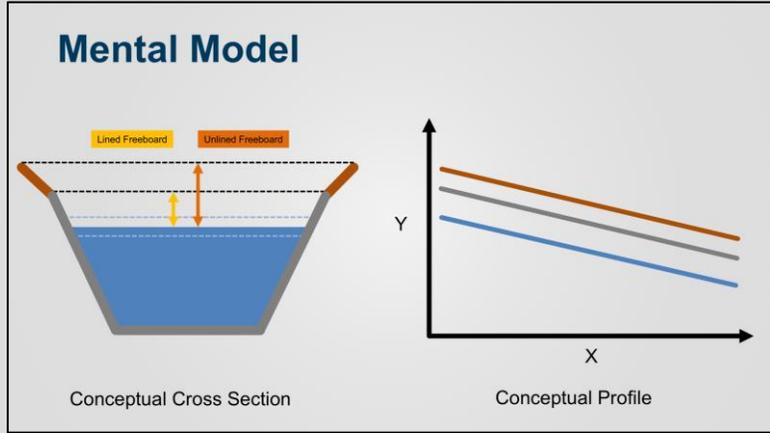
DCR 2023 Subsidence Addendum

CWEMF Annual Meeting
May 12th, 2025
Zachary Roy, PE

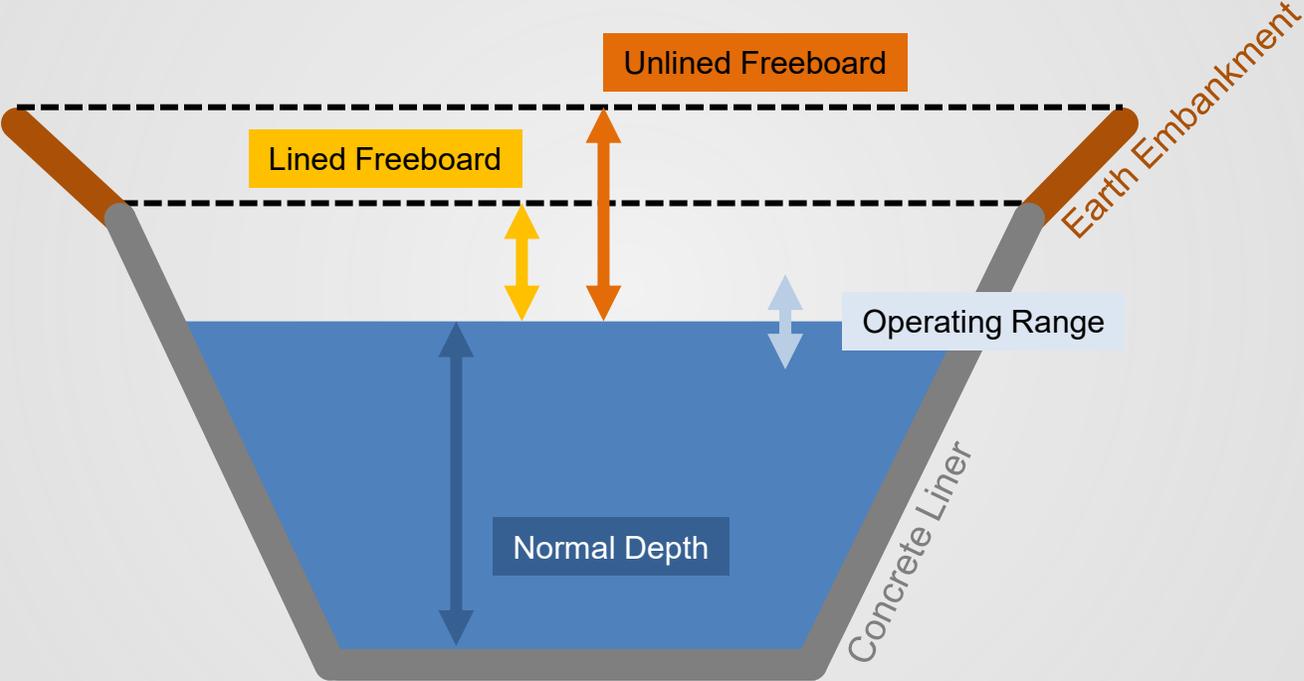


Photo: DWR Pixel, Florence Low CA DWR

Overview

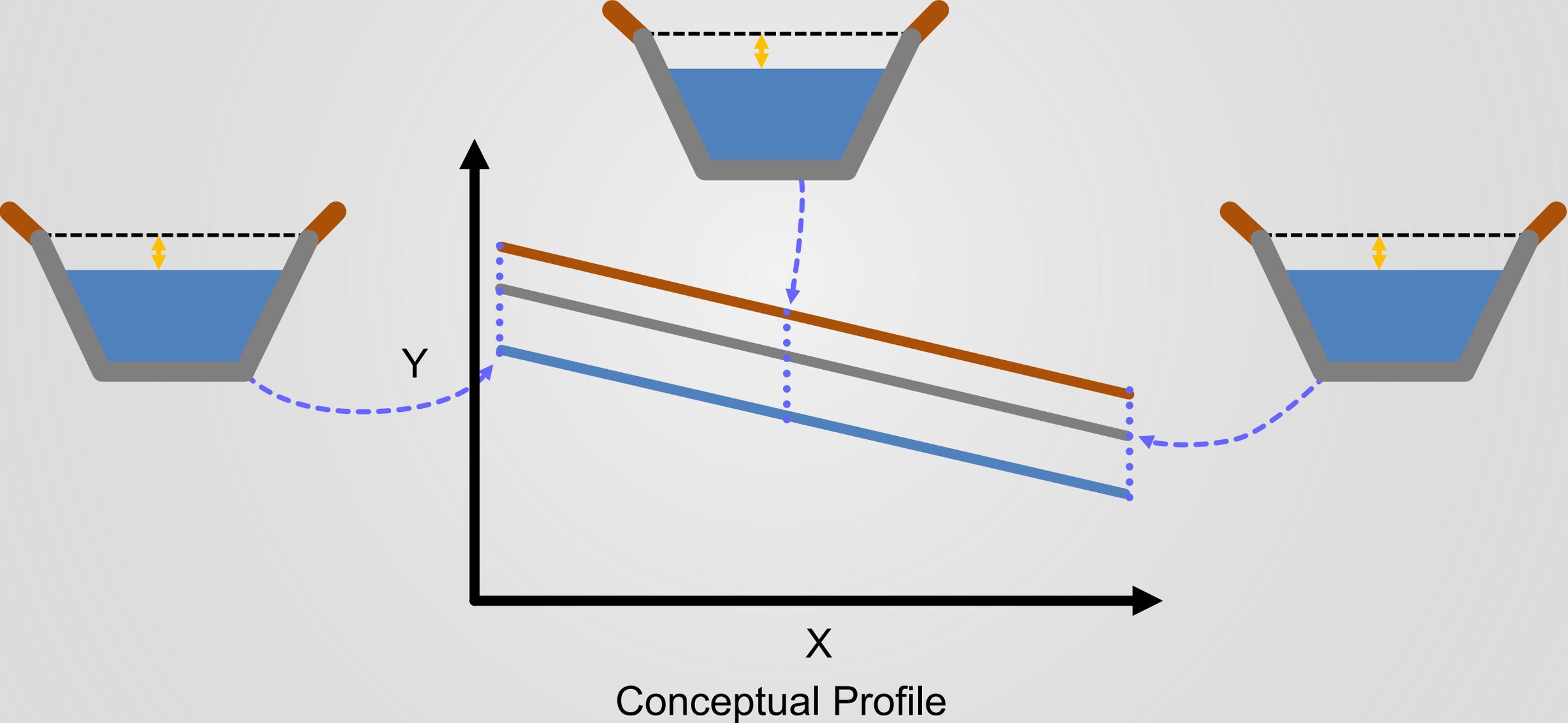


Mental Model



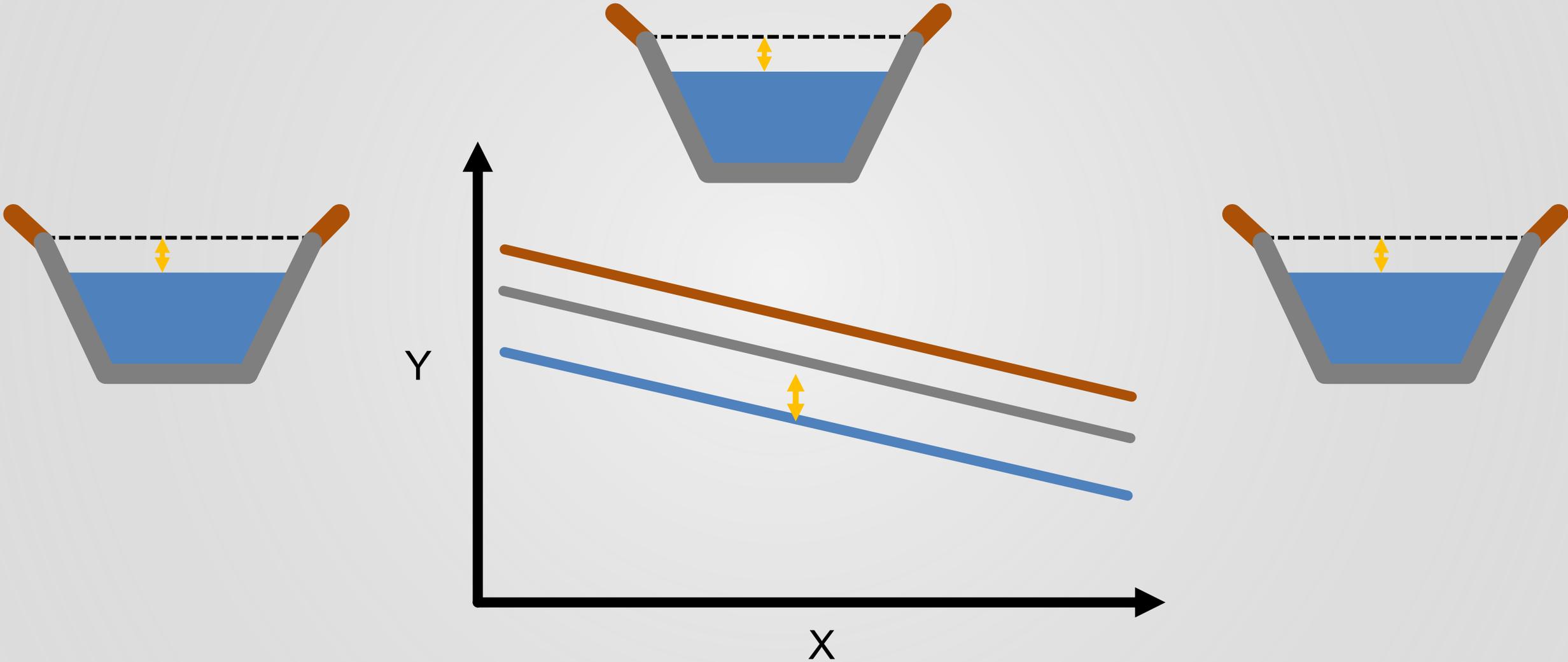
Conceptual Cross Section

Mental Model



Mental Model

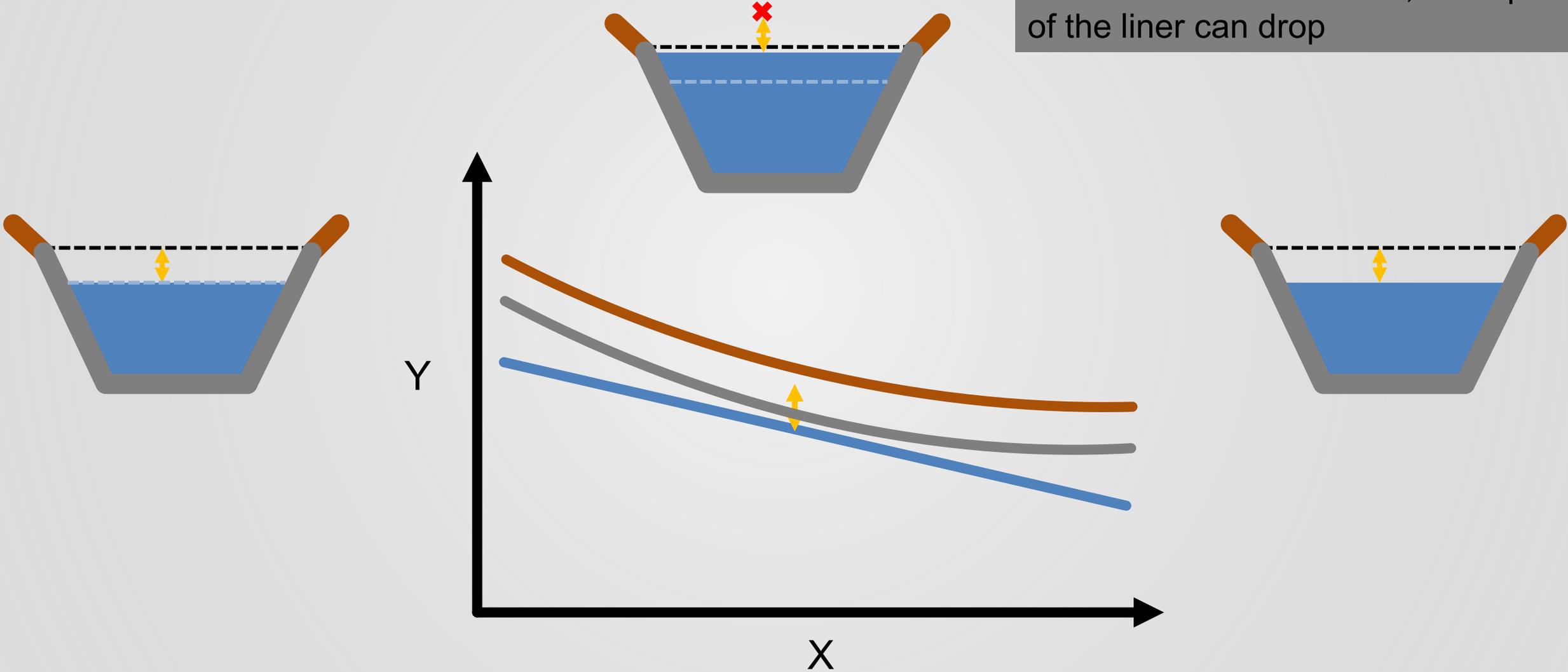
Operators need to maintain a minimum lined freeboard



Mental Model

Operators need to maintain a minimum lined freeboard

When subsidence occurs, the top of the liner can drop

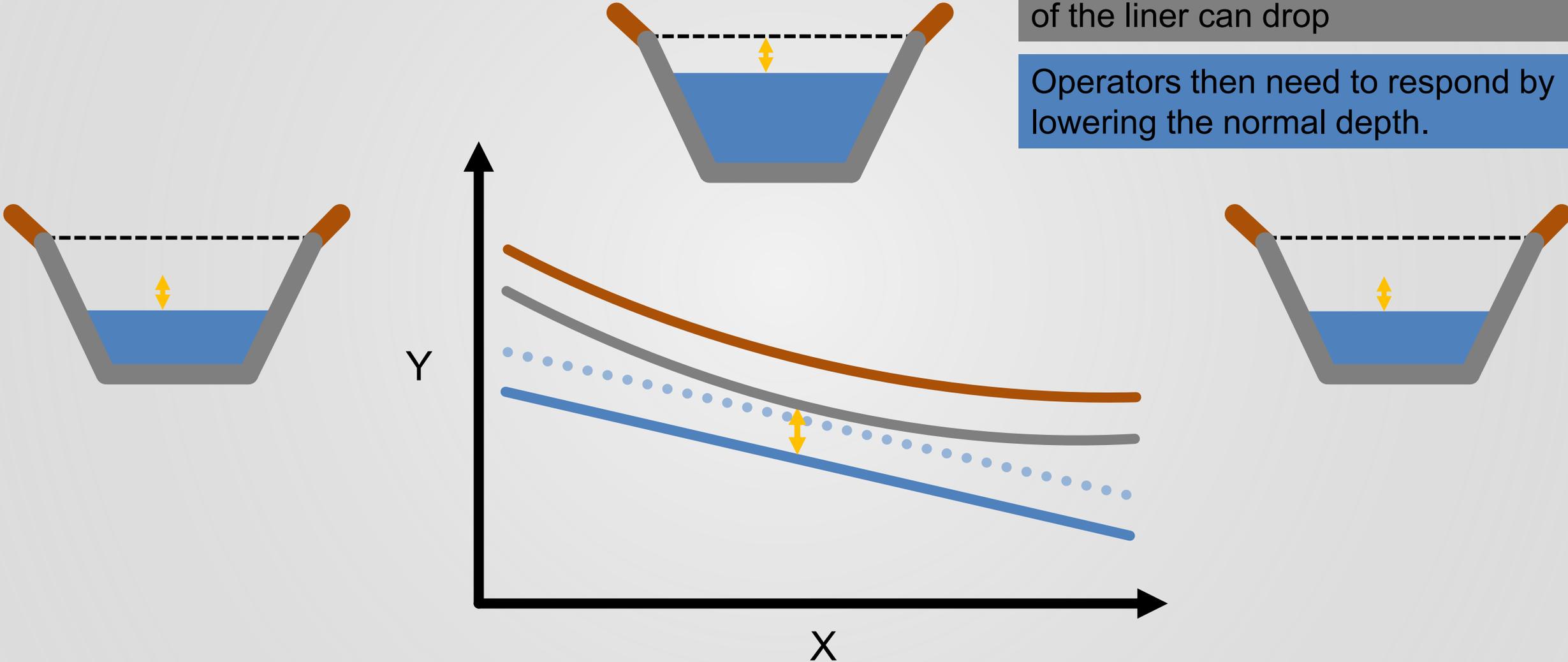


Mental Model

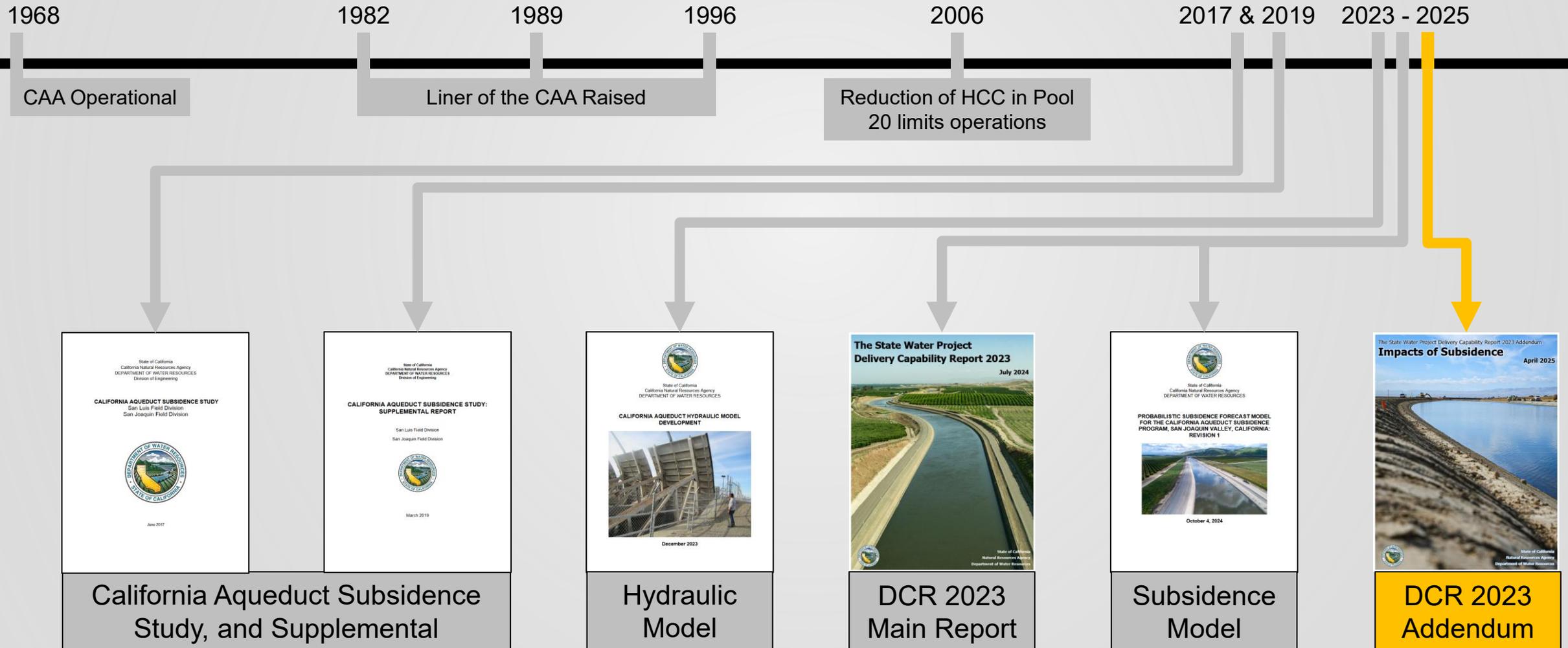
Operators need to maintain a minimum lined freeboard

When subsidence occurs, the top of the liner can drop

Operators then need to respond by lowering the normal depth.

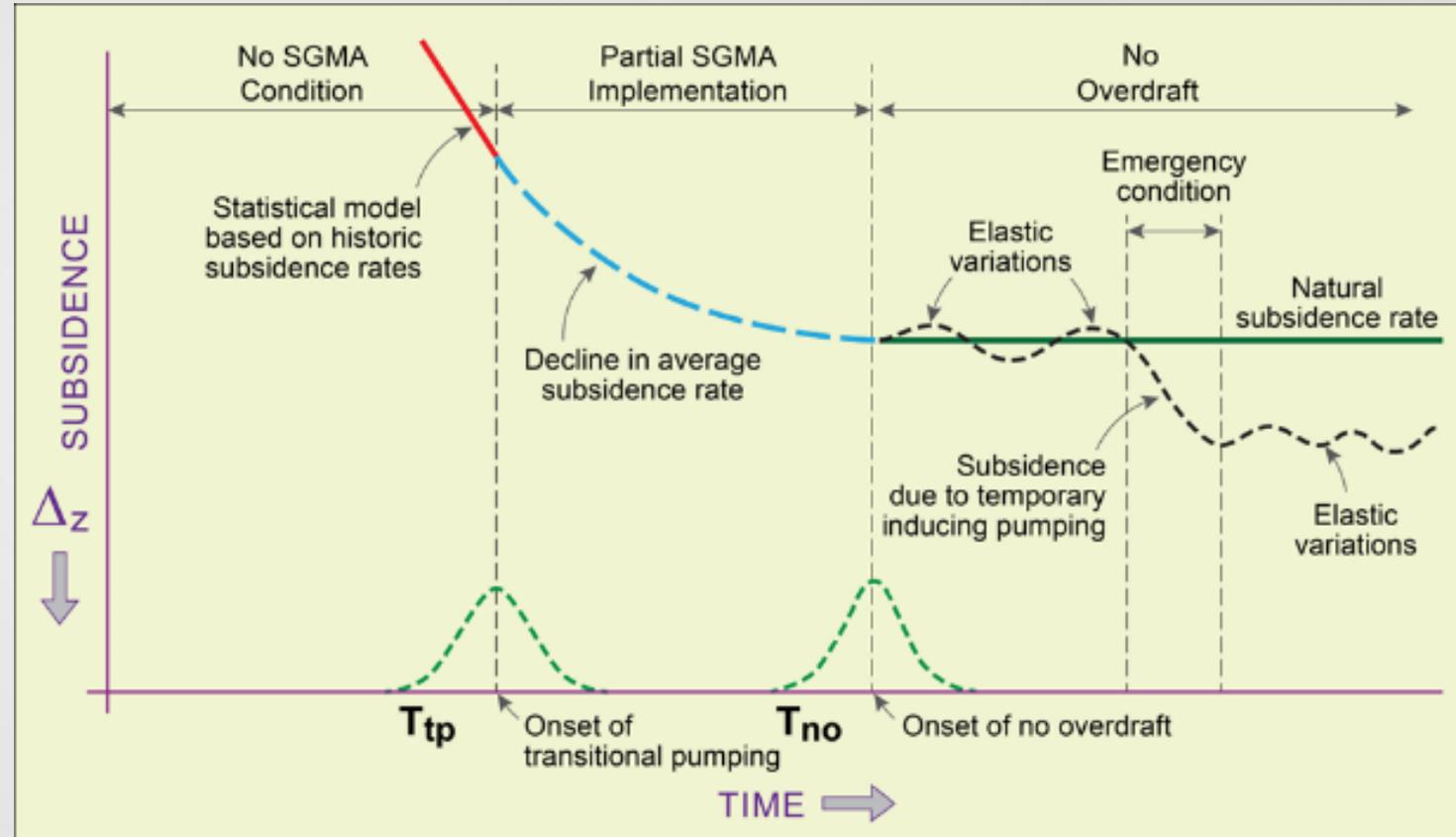


An incomplete history California Aqueduct subsidence



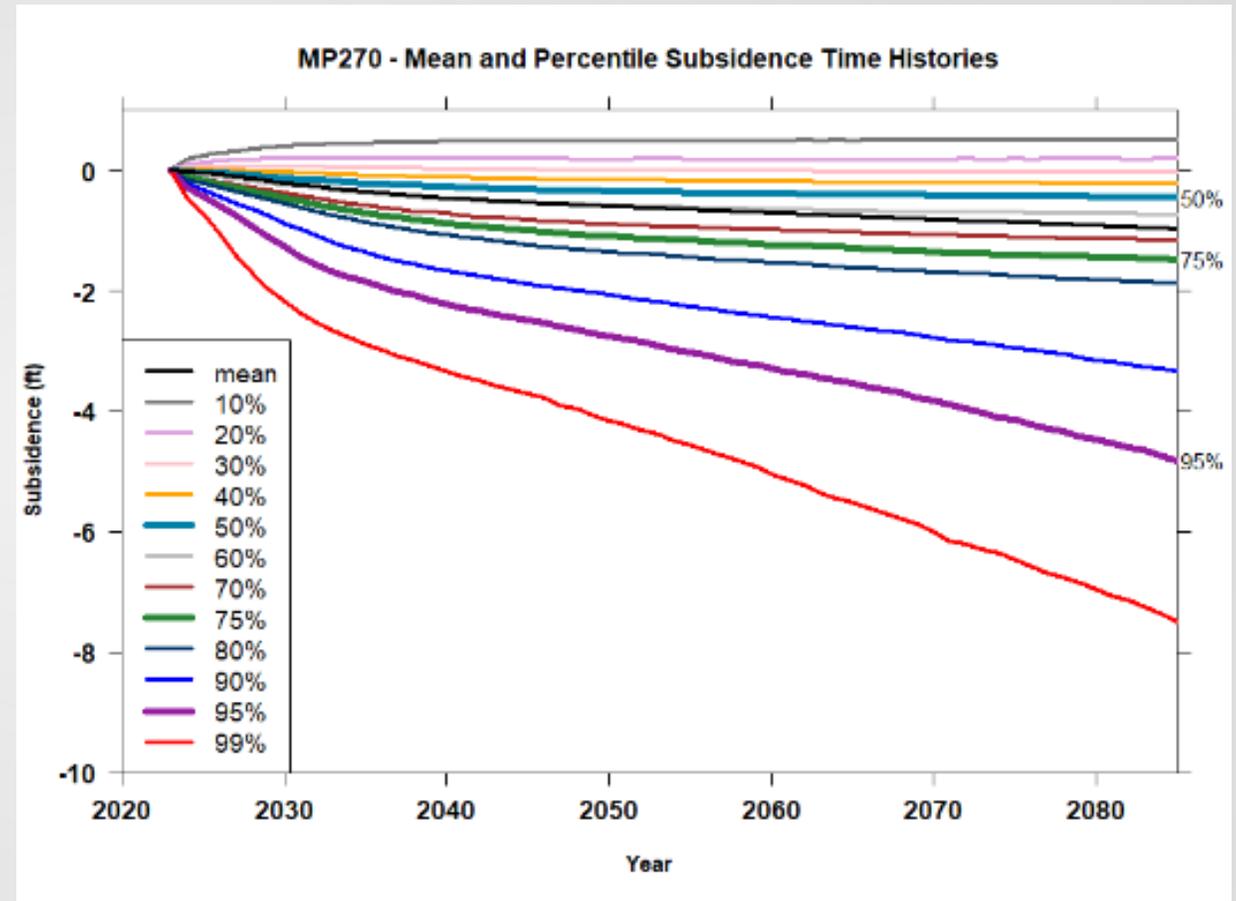
Subsidence Modeling

- Three phases of subsidence rate conditions are assumed.
 1. No SGMA
 2. Partial SGMA
 3. No Overdraft
- The parameters T_{tp} , and T_{no} were estimated using the SSHAC method.
- Subsidence rates in the “No SGMA Condition” were estimated using observed data.
- Both sets of parameters were estimated basin by basin.



Subsidence Modeling

- Using the Probabilistic Subsidence Forecast Model we can generate subsidence forecasts for many points along the California Aqueduct.
- Note that the PSFM generates many forecasts, which are characterized by a non-exceedance value.
 - This “Non-Exceedance Subsidence Percentile” is independent of the “Level of Concern” percentile used in the DCR Climate Modeling.

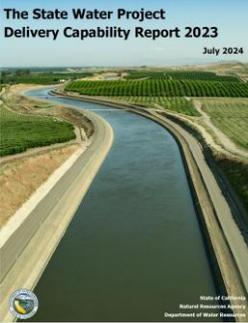


Why do we need CalSim3?

- How many feet of subsidence can be expected? → ✓ **Probabilistic Subsidence Forecast Model**
- What is the maximum steady flow through the subsided SLC and Aqueduct? → ✓ **California Aqueduct Hydraulic Model**
- How much water can be delivered under subsided conditions? → ✓ **CalSim3**

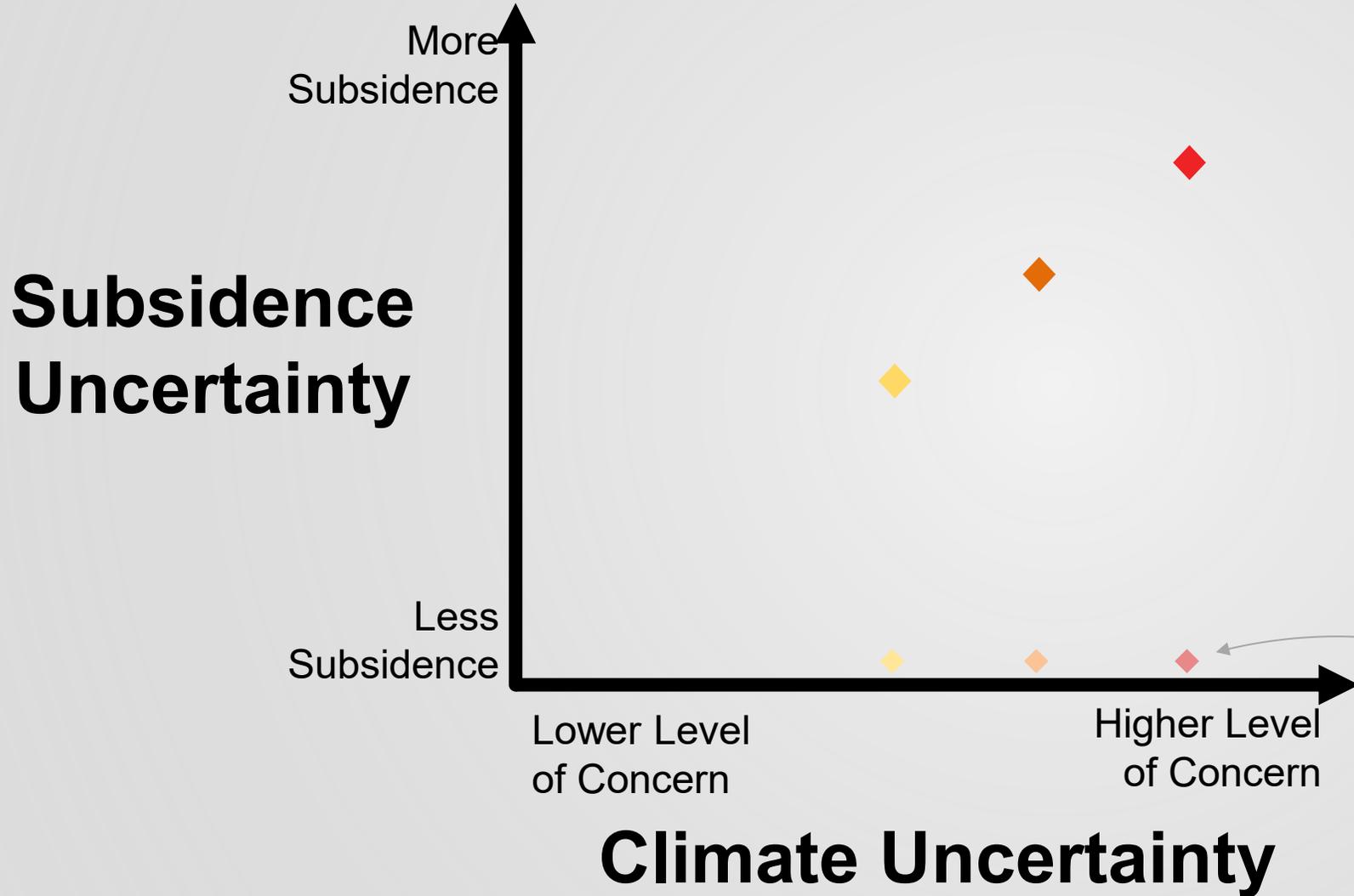


Bringing it into the DCR

	Existing Conditions	2043 (50% LOC)	2043 (75% LOC)	2043 (95% LOC)
 <p>The State Water Project Delivery Capability Report 2023 July 2024</p> <ul style="list-style-type: none"> Adjusted Historical Hydrology CAA/SLC Design Capacity 	<ul style="list-style-type: none"> 50% LOC Hydrology CAA/SLC Design Capacity 	<ul style="list-style-type: none"> 75% LOC Hydrology CAA/SLC Design Capacity 	<ul style="list-style-type: none"> 95% LOC Hydrology CAA/SLC Design Capacity 	
 <p>The State Water Project Delivery Capability Report 2023 Addendum Impacts of Subsidence May 2025</p> <ul style="list-style-type: none"> Adjusted Historical Hydrology 2023 Levels of Subsidence 	<ul style="list-style-type: none"> 50% LOC Hydrology 2043 Levels of Subsidence (50% NESP) 	<ul style="list-style-type: none"> 75% LOC Hydrology 2043 Levels of Subsidence (75% NESP) 	<ul style="list-style-type: none"> 95% LOC Hydrology 2043 Levels of Subsidence (95% NESP) 	

Note: the 95% LOC Scenario could not be simulated due to operational infeasibilities in the Hydraulic Model.

Climate + Subsidence Uncertainty



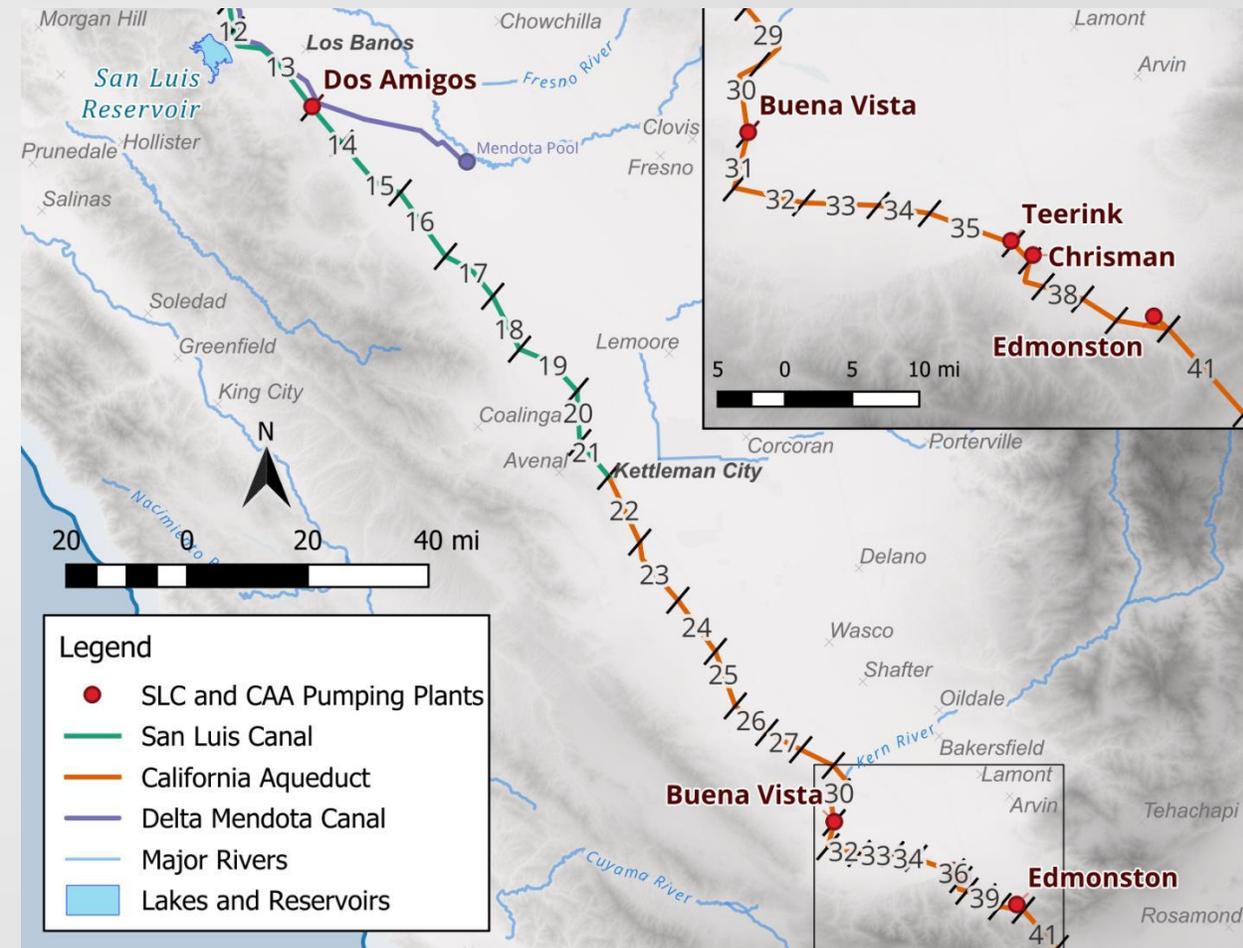
We've picked 3 scenarios that explore the combination of conditions from **middle-of-the-road** to **extreme**.

DCR Main Report Scenarios did not include subsidence.

Changes to CalSim3

California Aqueduct and San Luis Canal Resolution

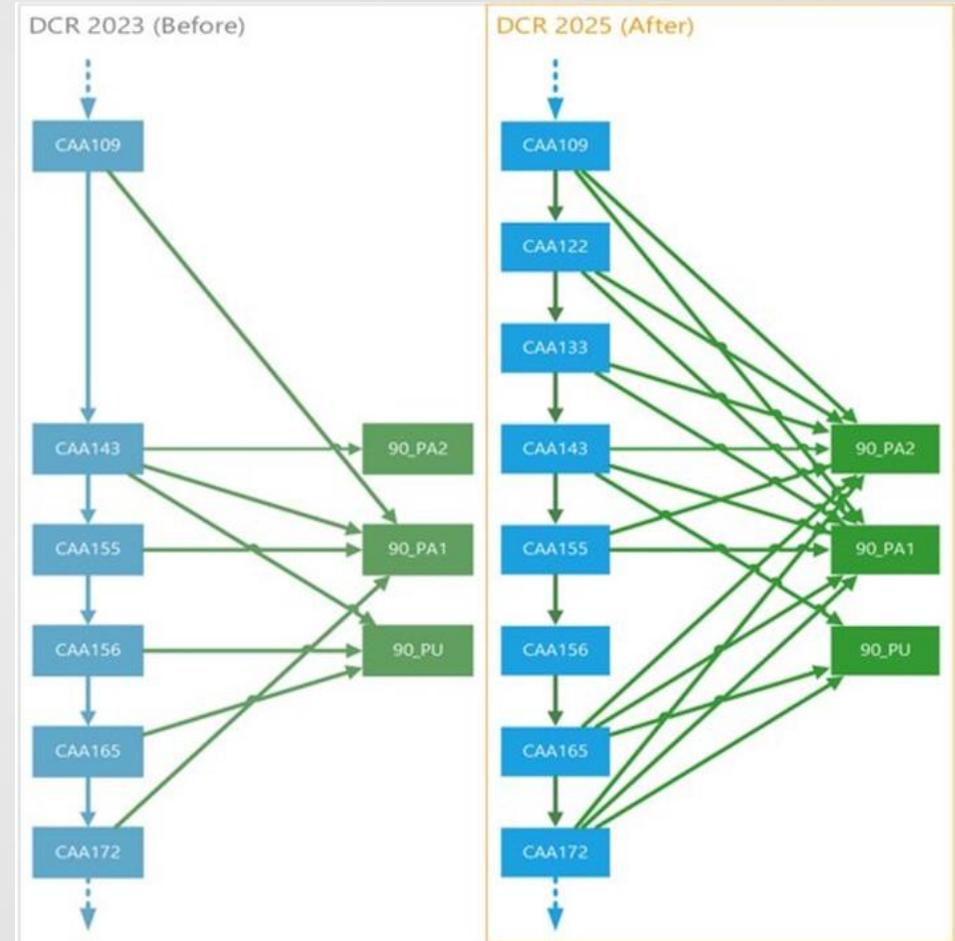
- The resolution of the California Aqueduct and the San Luis Canal in CalSim3 was increased.
 - Now the resolution is at least pool by pool.



Changes to CalSim3

Delivery Resolution

- Additionally, the “resolution” of diversions from the CAA & SLC was increased so diversions would be coming out of the correct pools.



Changes to CalSim3

Hydraulic Conveyance Capacity Code

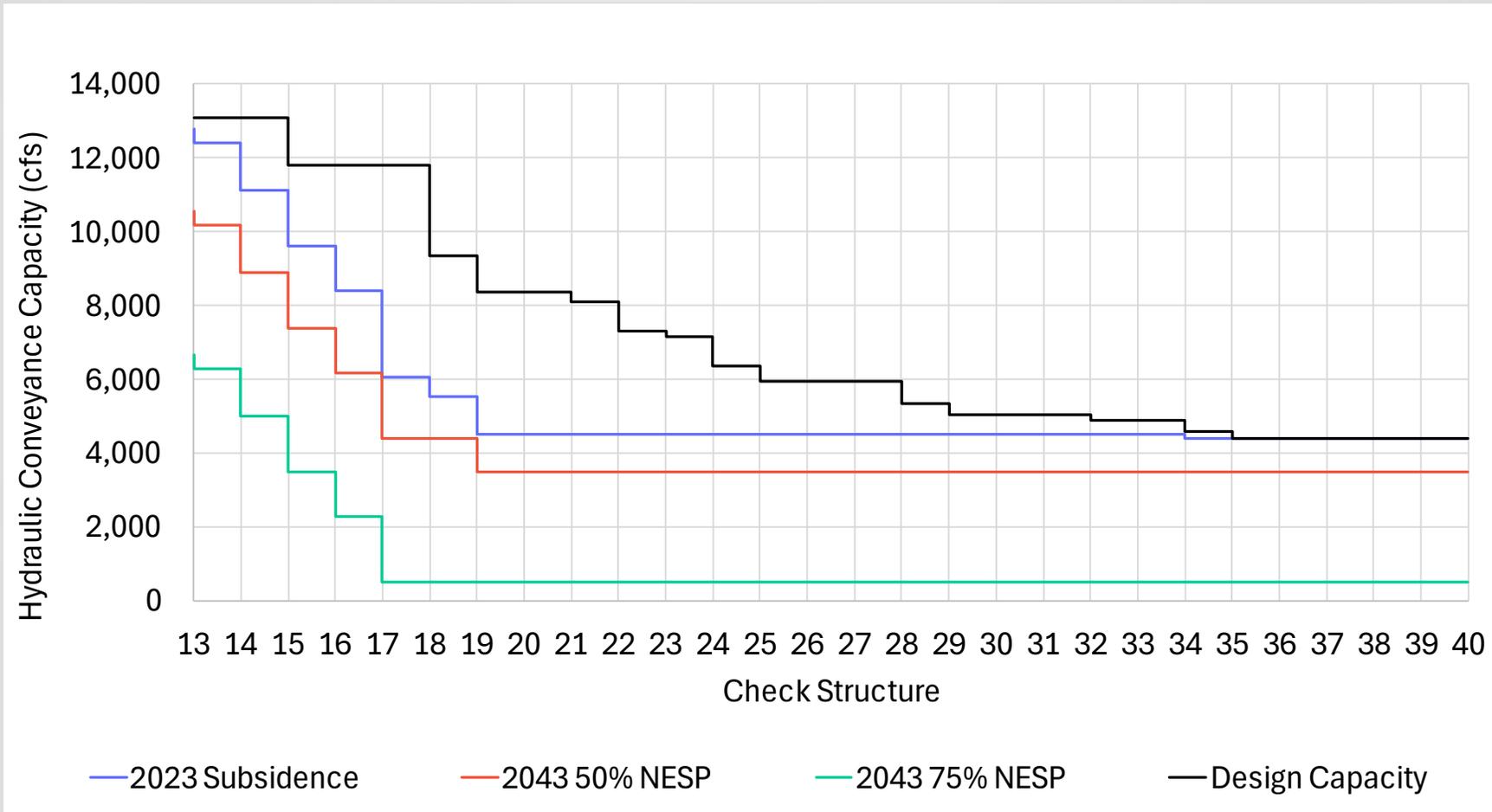
- Finally, the Hydraulic Conveyance Capacity for each pool is now controlled via a lookup table.

```
! Read in Capacities for CAA from lookup table
! SWP Capacity
define CAA_P14_SWP_cap {
  select P14_SWP_CAP
  from CASP_CAA_CAPACITY_SCENARIOS
  where scenario=CAA_Capacity_Scenario_ID, Month=month
}
```



Changes to CalSim3

Hydraulic Conveyance Capacity Values



Delivery Capability of the SWP

Changes in long-term average delivery capability

3% ↓

2023 levels of subsidence

18 - 87% ↓

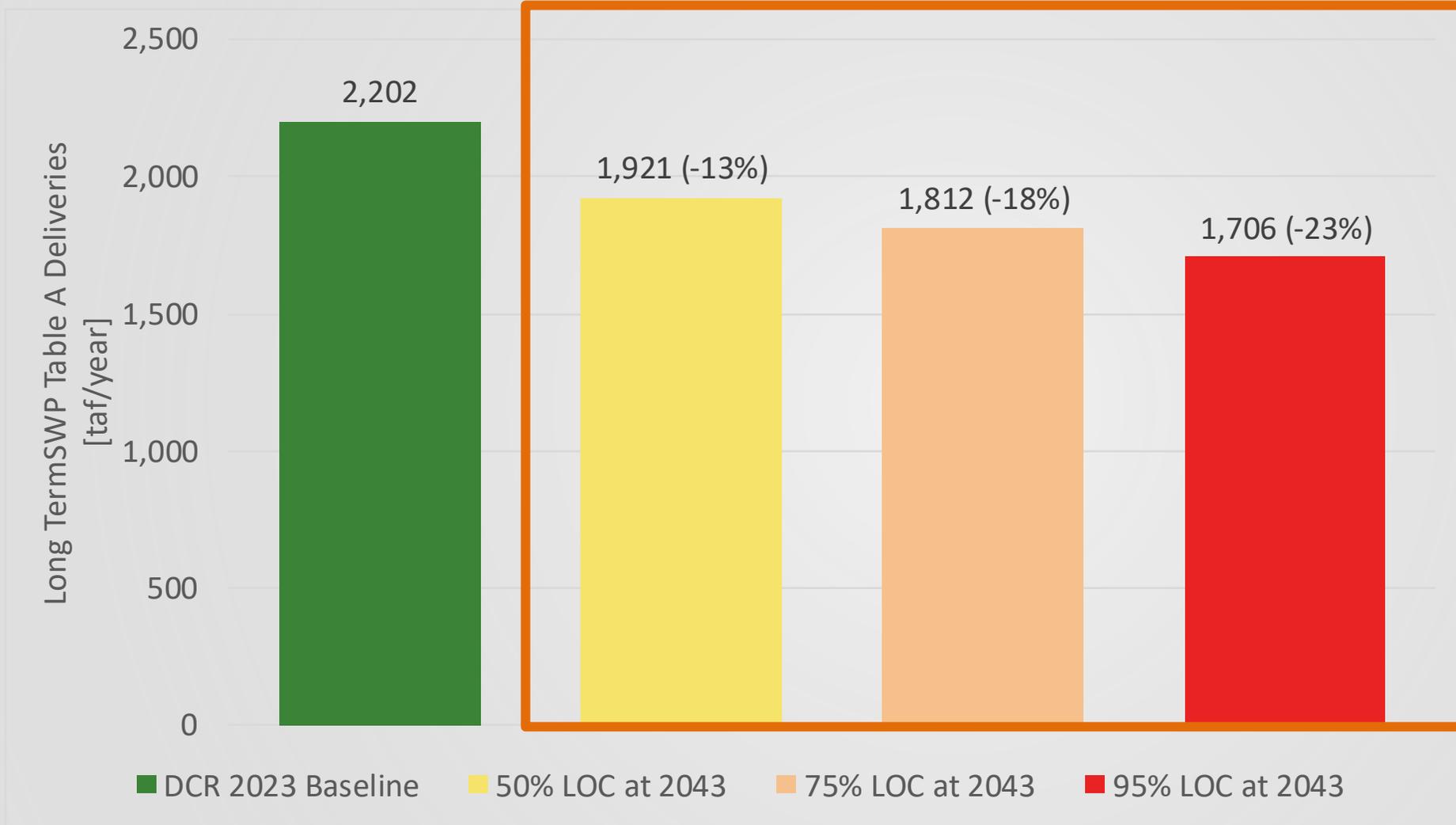
2043 levels of subsidence

Assumes 2020 Standing Operating Order, with 1 foot of freeboard in the SLC and CAA



DCR 2023 Main Report

Average Annual SWP Table A Deliveries

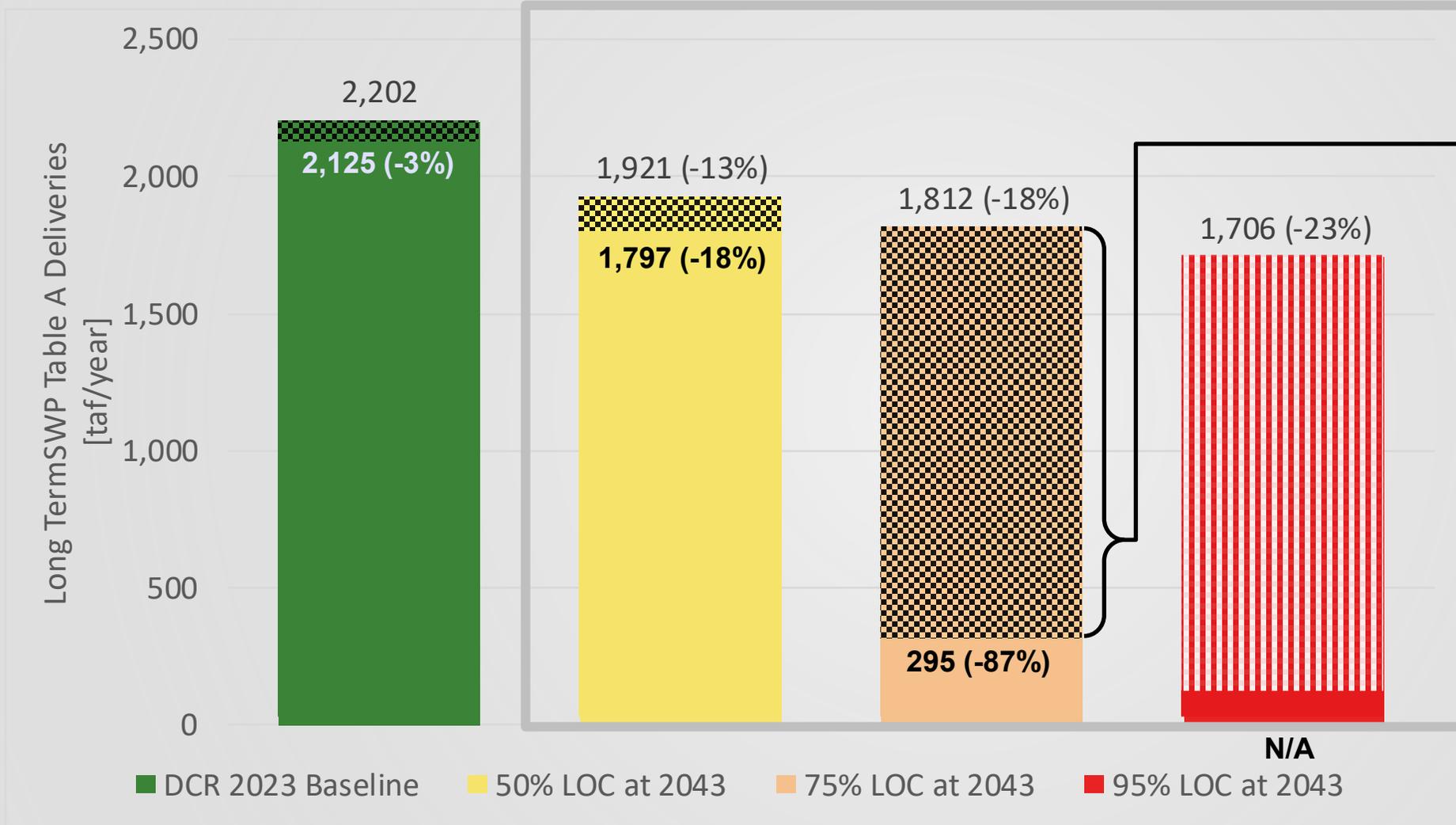


Climate change with NO adaptation likely to decrease average long-term deliveries by 13-23%



DCR 2023 Impacts of Subsidence Addendum

Average Annual SWP Table A Deliveries



Reductions due to subsidence.

Note: the 95% LOC Scenario could not be simulated due to operational infeasibilities in the Hydraulic Model.

The scenario is discussed qualitatively in the Addendum. Some deliveries would still occur, but the total volume of those are small, around 140 taf/year, mostly from the North and South Bay Aqueducts.



Known Model Limitations

- Some CalSim3 assumptions weren't changed.
 - For example, the allocation logic does not change significantly, even if the Aqueduct becomes inoperable due to subsidence.
- The Subsidence Forecast Model does not simulate physical processes; it is a statistical model.
 - The SFM is *very* sensitive to the timing of SGMA implementation.
 - The SFM is sensitive to the likelihood of drought, and the durations of drought periods.
- The Standard Operating Order (SOO) for the Aqueduct are assumed unchanged through the time horizon.
 - In the face of on-going subsidence reductions, operational adaptations and prioritizations will likely be forced to occur.



Thank you!

QUESTIONS?