California Aqueduct Subsidence Program

Subsidence “Task Force” Sept. 16, 2024

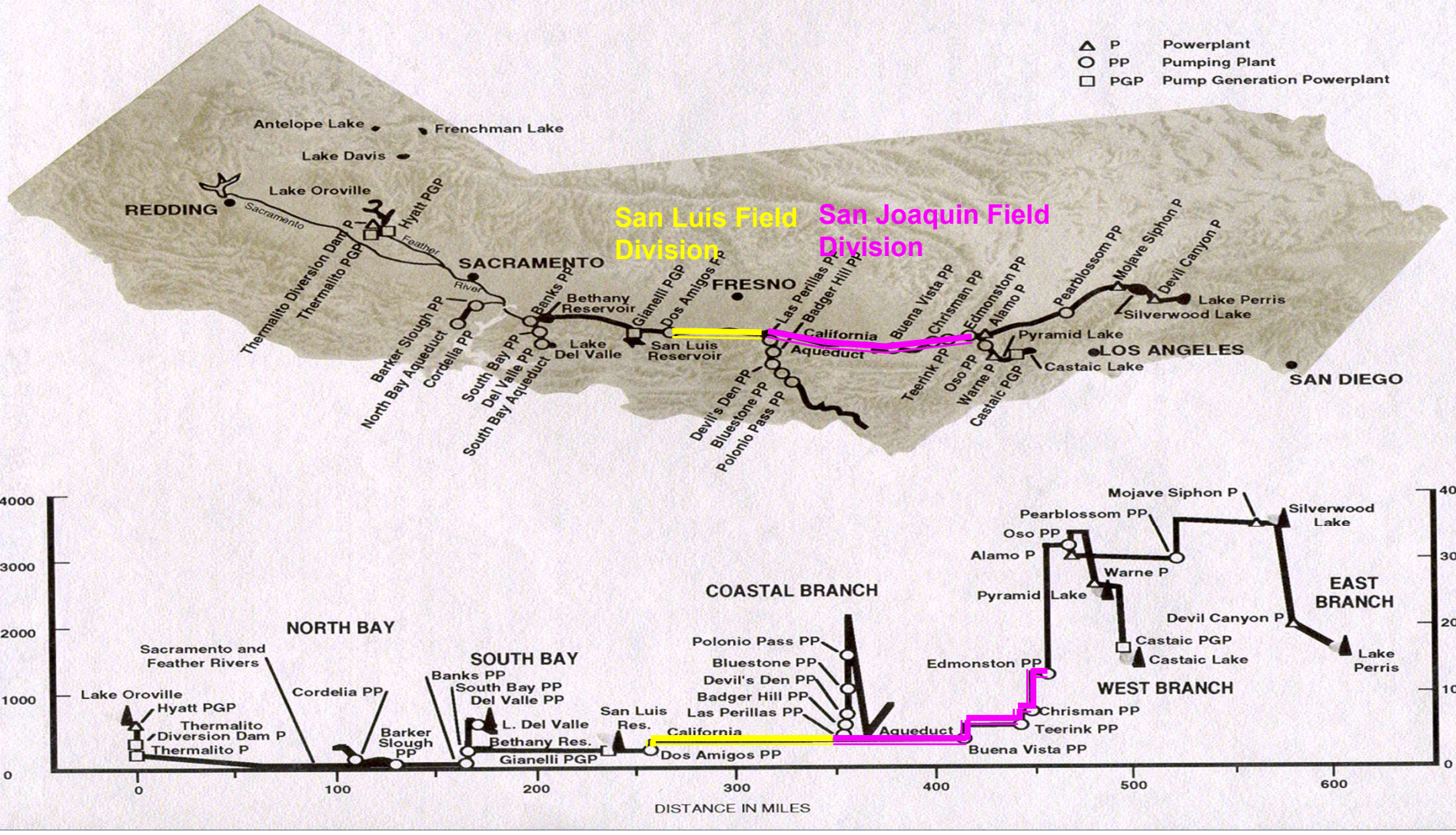
SWP's California Aqueduct Subsidence Program (CASP)

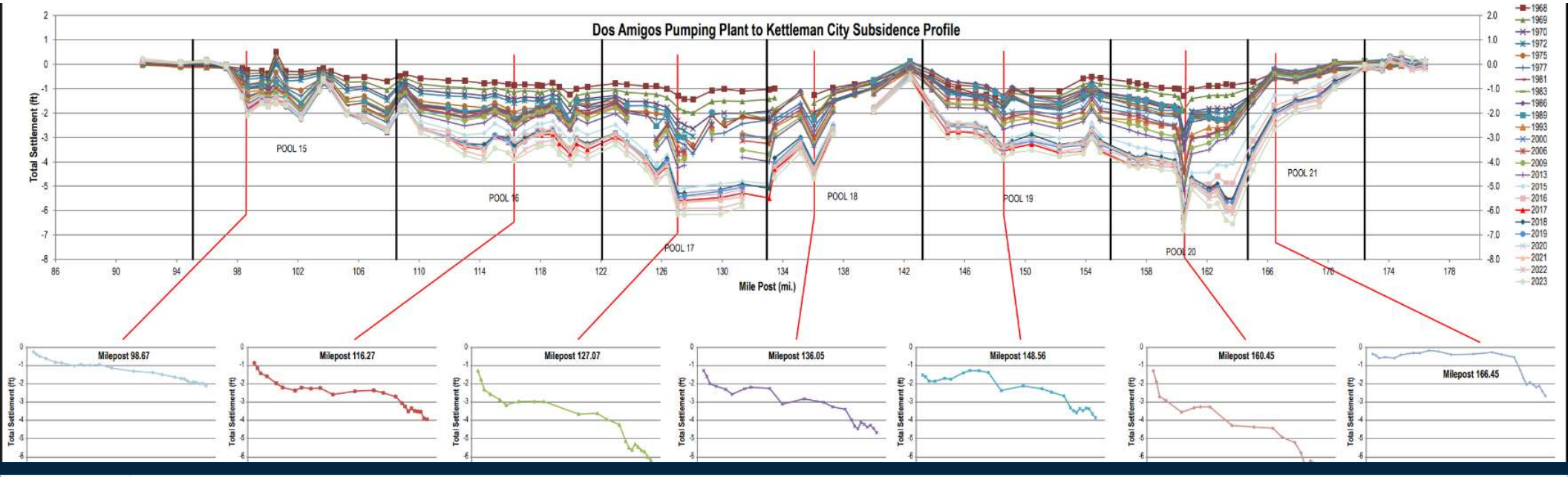
- Introduction: Program Manager – **Jesse Dillon, P.E.**

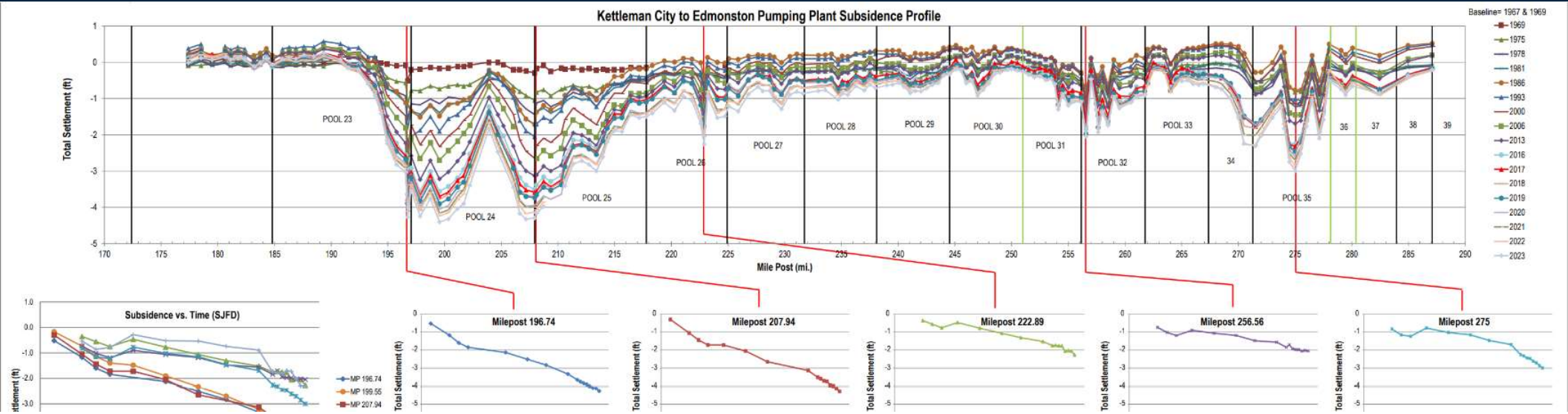
Program Purpose:

To develop and implement beneficial and affordable preventive and corrective actions to mitigate the adverse effects of subsidence on the California Aqueduct.

Location and Profile of State Water Project Facilities




Dos Amigos Pumping Plant to Kettleman City Subsidence Profile
Total Settlement (ft)
Mile Post (mi.)
POOL 15
POOL 16
POOL 17
POOL 18
POOL 19
POOL 20
POOL 21
1968
1969
1970
1972
1975
1977
1981
1983
1986
1989
1993
2000
2006
2009
2013
2015
2016
2017
2018
2019
2020
2021
2022
2023
Milepost 98.67
Milepost 116.27
Milepost 127.07
Milepost 136.05
Milepost 148.56
Milepost 160.45
Milepost 166.45

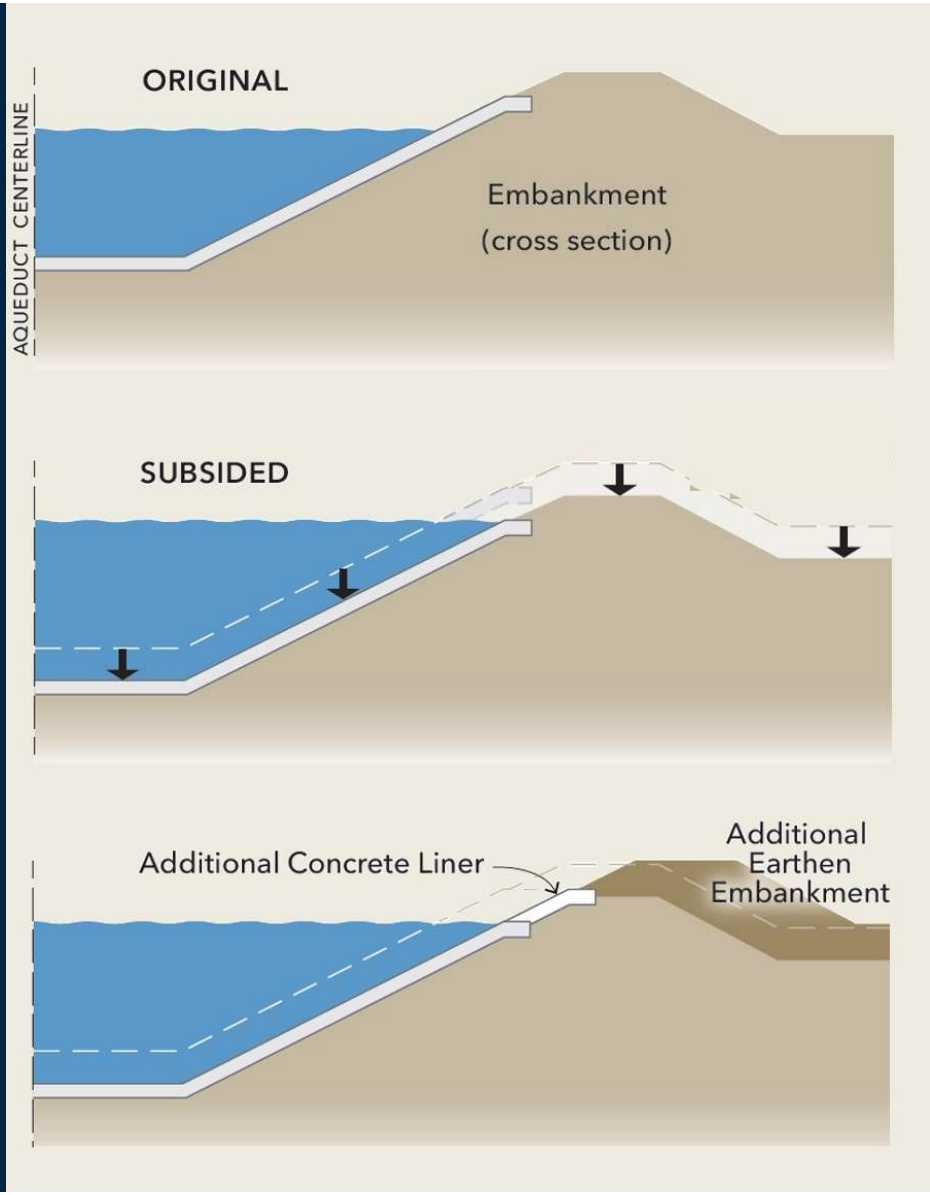

Kettleman City to Edmonston Pumping Plant Subsidence Profile
Baseline= 1967 & 1969
Total Settlement (ft)
Mile Post (mi.)
POOL 23
POOL 24
POOL 25
POOL 26
POOL 27
POOL 28
POOL 29
POOL 30
POOL 31
POOL 32
POOL 33
34
POOL 35
36
37
38
39
1969
1975
1978
1981
1986
1993
2000
2006
2013
2016
2017
2018
2019
2020
2021
2022
2023
Subsidence vs. Time (SJFD)
MP 196.74
MP 199.55
MP 207.94
Milepost 196.74
Milepost 207.94
Milepost 222.89
Milepost 256.56
Milepost 275

Subsidence and the State Water Project

Through the western side of the San Joaquin Valley:

- Reductions in the system's capacity to move water due to subsidence are as high as 46%.
- The current reductions in conveyance capacity will increase as subsidence continues.

Re-establishing system capacities lost to subsidence will require billions of dollars over the next 20 years.



California Aqueduct Subsidence Program Highlighted Near-Term Efforts

Preventive Action Components

- Problem Identification
  (California Aqueduct Subsidence Study Reports - CASS)
- Supplementary CASP Studies:
  - Oil and Gas Extraction Impacts
  - Shallow Subsidence Impacts
- Asset Management/Preservation Activities:
  - Groundwater Sustainability Agency (GSA) / Groundwater Sustainability Plan (GSP) Coord. and Review
  - CA AQ Infrastructure Preservation Thresholds
  - CA AQ Subsidence & Groundwater Monitoring
    - CASP Instrumentation Installation Project
  - Subsidence & Groundwater Modeling

Corrective Action Components

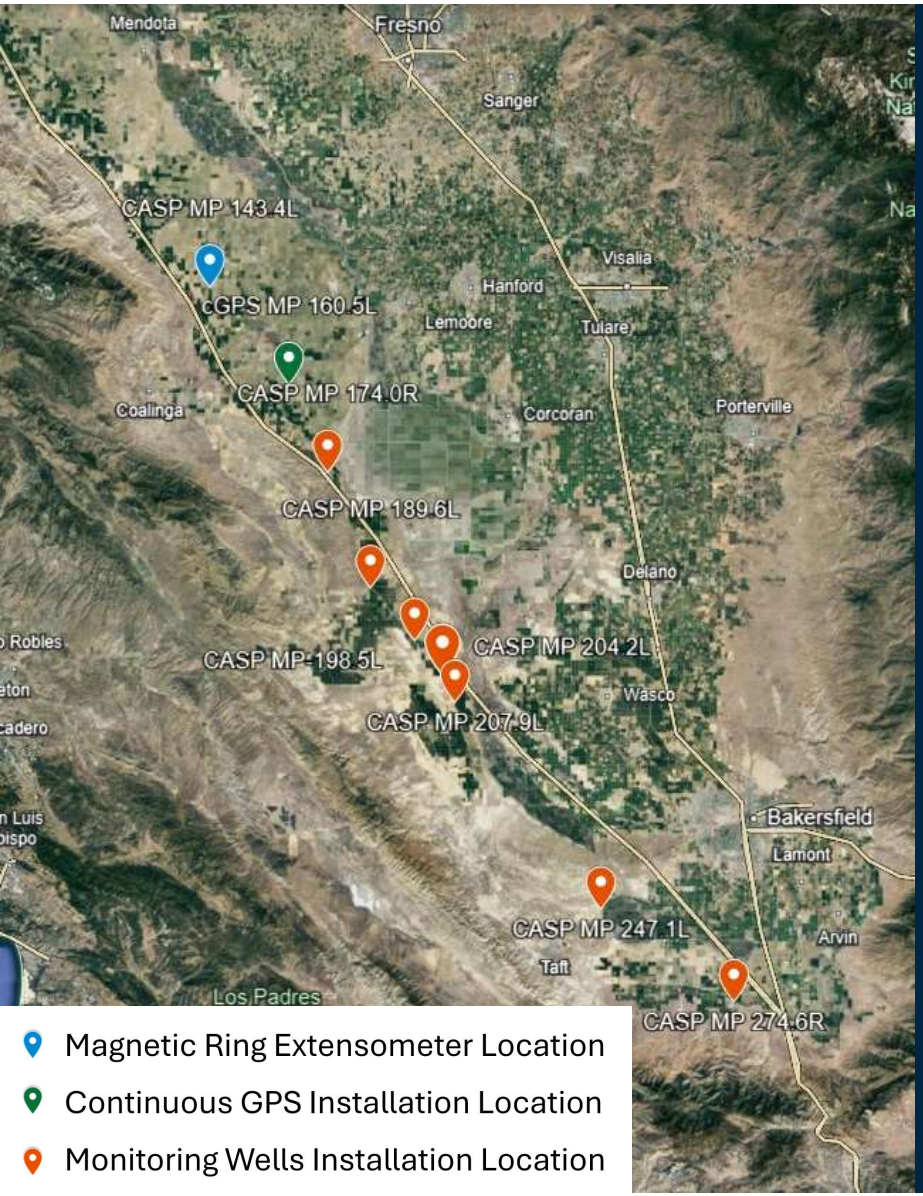
- Model Development:
  - Future Subsidence Projections
  - Hydraulic Conveyance Capacity (HEC-RAS)
  - Delivery Capacity (CalSIM)
  - Power Use
  - Flood Risk
  - Economic Analysis
- Consequences of No Action (Baseline)
- CASP Project Definition Tool (Cost Est.)
- Near-term "Interim Action" Projects
- Early Implementation Planning/Actions
  - Alternative Formulation
  - Alternative Analysis
- Long-Term Planning/Actions
  - Alternative Formulation
    (incl. Extraordinary Maintenance Justification - XMJ)
    - Rehabilitation Projects (incl. Pools 17&18, Check 17, Pools 20&21)
  - Alternative Analysis

California Aqueduct Subsidence Program
Subsidence and Groundwater Monitoring Project

State General Funded Appropriation to proactively fill subsidence and groundwater monitoring data gaps along the California Aqueduct

Increase the general understanding of subsidence cause and effect

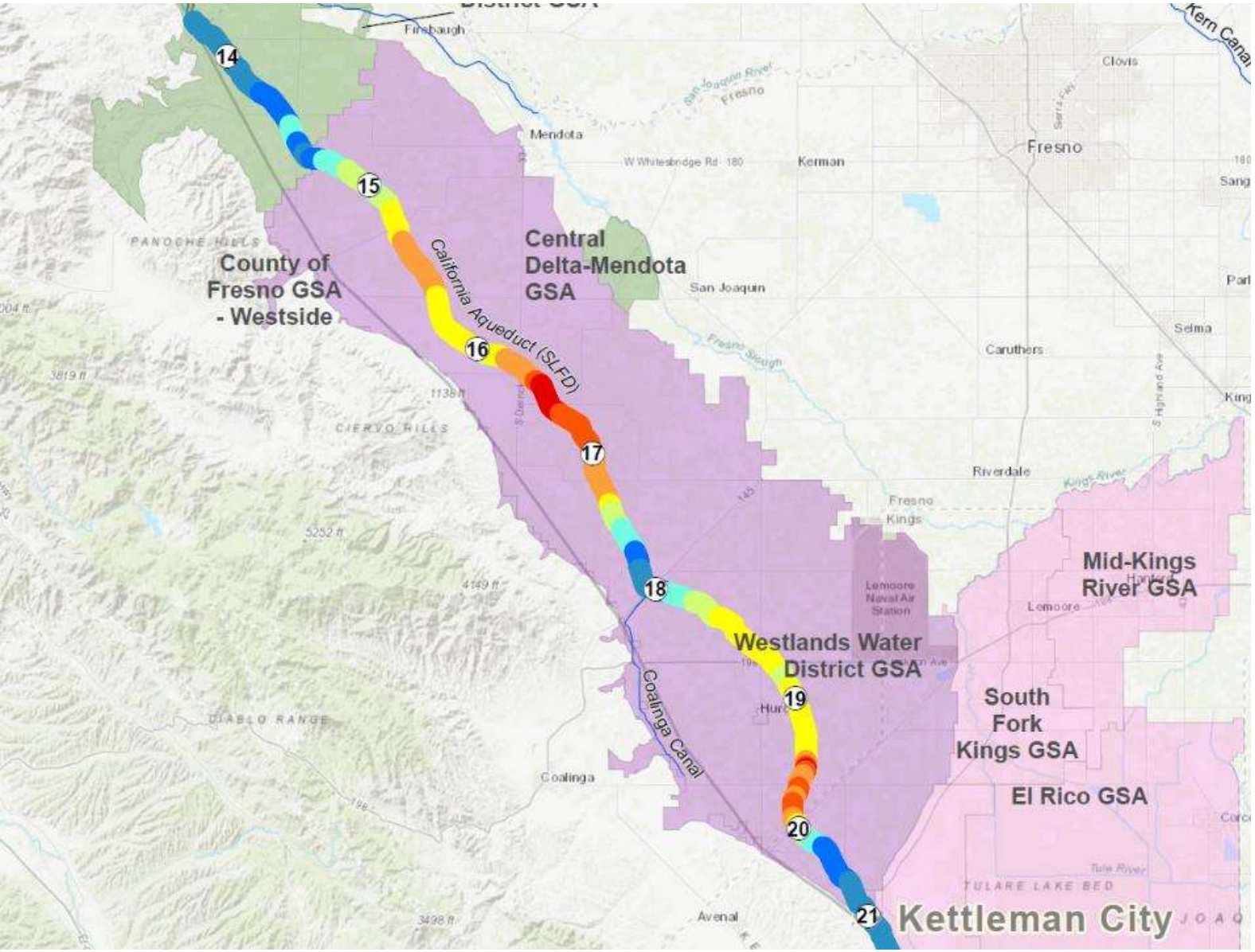
Aid the SWP in working with Groundwater Sustainability Agencies (GSAs) on their groundwater basin management actions, monitoring, and Groundwater Sustainability Plan (GSP) updates



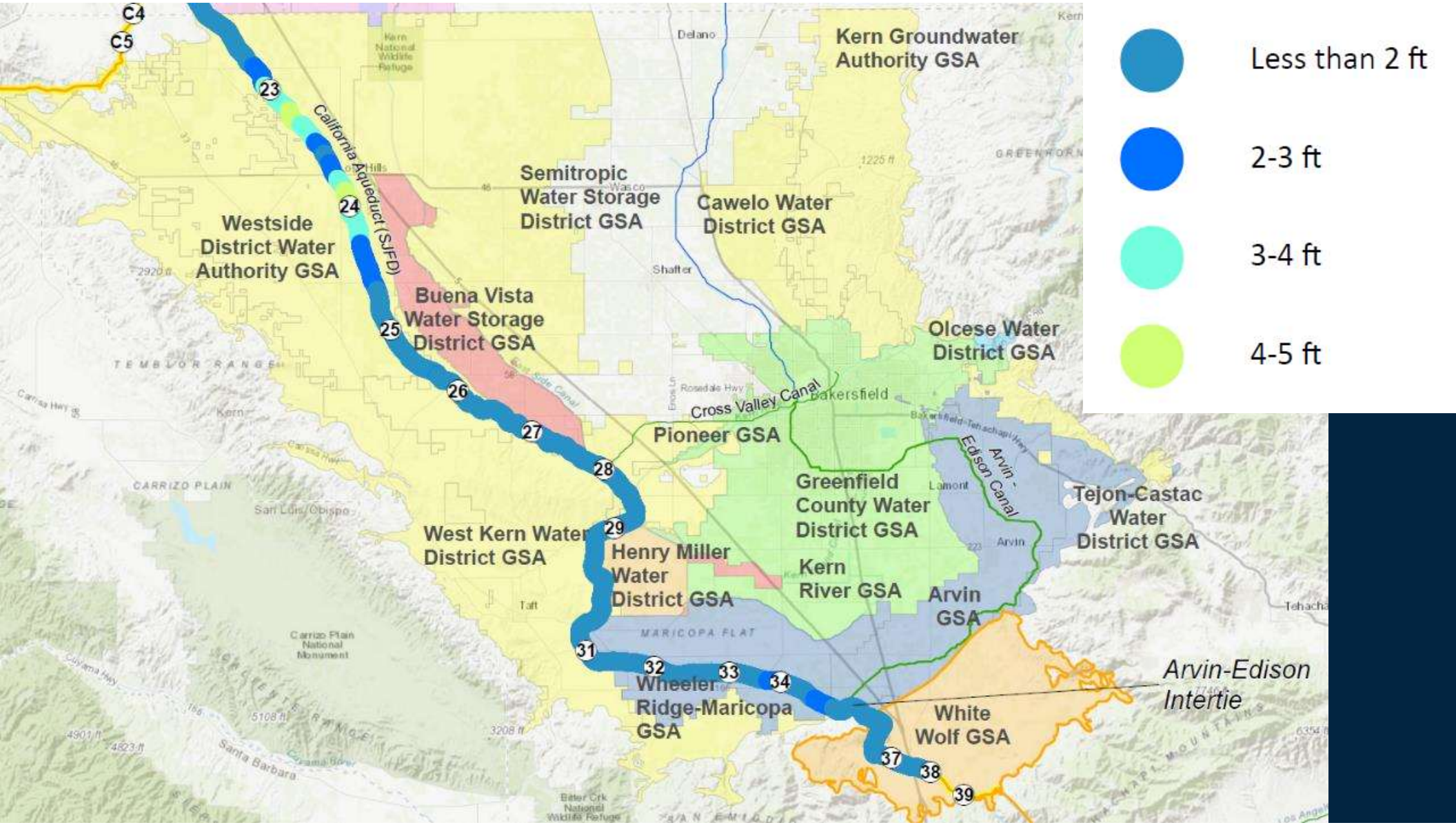
CASP 2023-24 Monitoring Project Installation Sites

The CASP Monitoring Project involves the installation of equipment to provide real-time data to monitor groundwater levels and other ground surface spatial information to help inform how subsidence is affecting the Aqueduct.

CASP worked through **9 of 23** proposed monitoring sites in the southern San Joaquin Valley.



- Less than 2 ft
- 2-3 ft
- 3-4 ft
- 4-5 ft
- 5-6 ft
- 6-7 ft
- 7-8 ft
- 8-9 ft


C4
C5
23
24
25
26
27
28
29
31
32
33
34
37
38
39
California Aqueduct (SJFD)
Kern Groundwater Authority GSA
Semitropic Water Storage District GSA
Cawelo Water District GSA
Westside District Water Authority GSA
Buena Vista Water Storage District GSA
Olcese Water District GSA
Pioneer GSA
Cross Valley Canal
Greenfield County Water District GSA
Tejon-Castac Water District GSA
West Kern Water District GSA
Henry Miller Water District GSA
Kern River GSA
Arvin GSA
Wheeler Ridge-Maricopa GSA
White Wolf GSA
Arvin-Edison Intertie
Less than 2 ft
2-3 ft
3-4 ft
4-5 ft

California Aqueduct Subsidence Program Highlighted Near-Term Efforts

Preventive Action Components

- Problem Identification
  (California Aqueduct Subsidence Study Reports - CASS)
- Supplementary CASP Studies:
  - Oil and Gas Extraction Impacts
  - Shallow Subsidence Impacts
- Asset Management/Preservation Activities:
  - Groundwater Sustainability Agency (GSA) / Groundwater Sustainability Plan (GSP) Coord. and Review
  - CA AQ Infrastructure Preservation Thresholds
  - CA AQ Subsidence & Groundwater Monitoring
    - CASP Instrumentation Installation Project
  - Subsidence & Groundwater Modeling

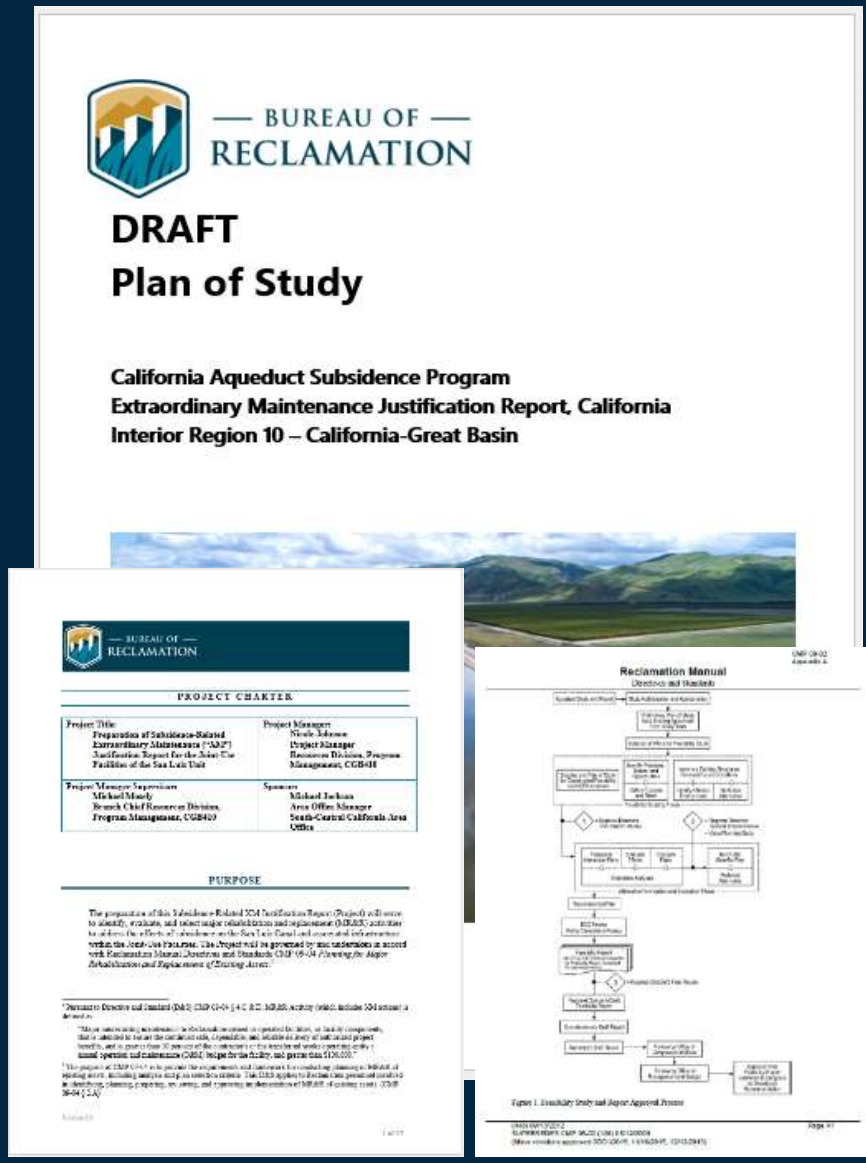
Corrective Action Components

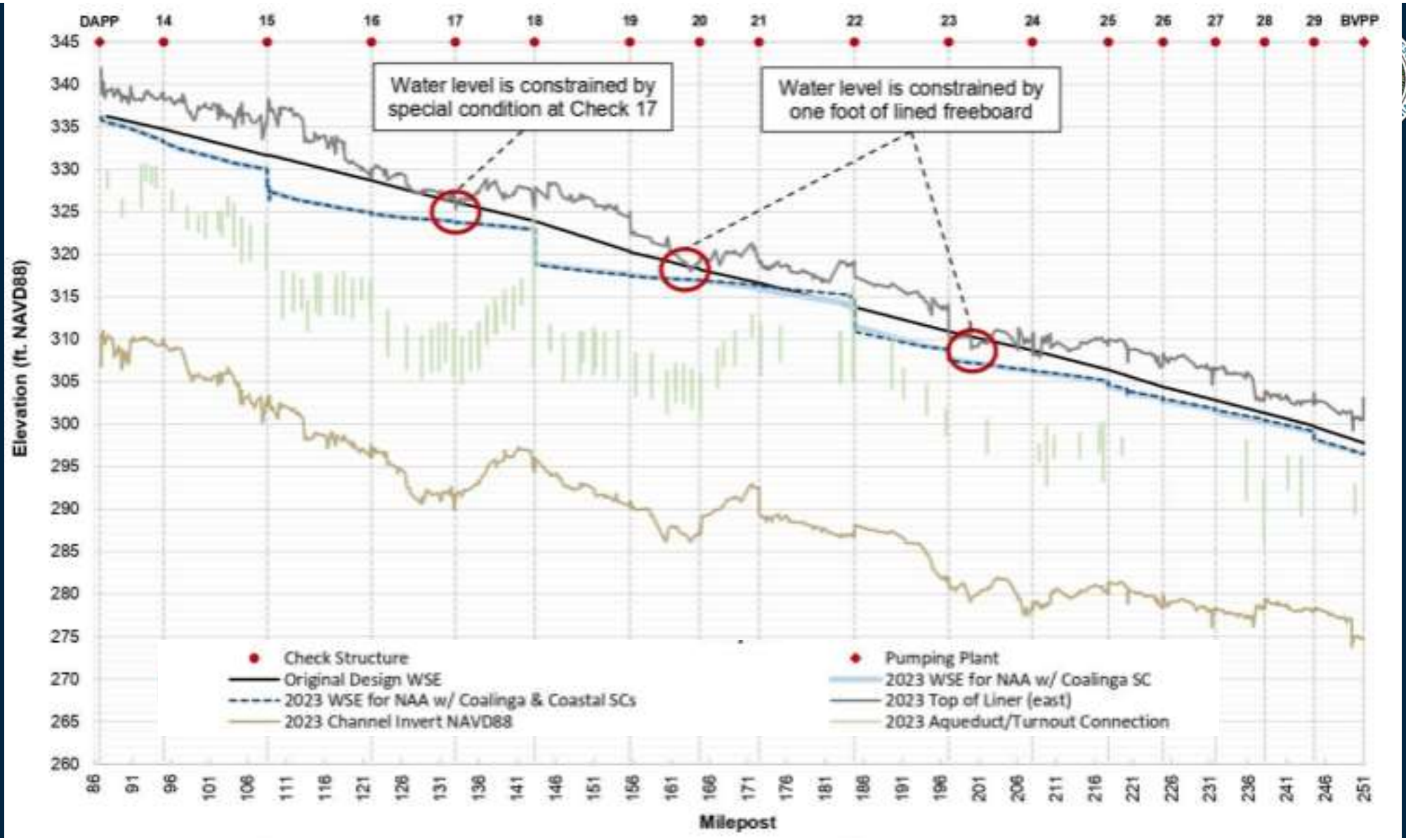
- Model Development:
  - Future Subsidence Projections
  - Hydraulic Conveyance Capacity (HEC-RAS)
  - Delivery Capacity (CalSIM)
  - Power Use
  - Flood Risk
  - Economic Analysis
- Consequences of No Action (Baseline)
- CASP Project Definition Tool (Cost Est.)
- Near-term "Interim Action" Projects
- Early Implementation Planning/Actions
  - Alternative Formulation
  - Alternative Analysis
- Long-Term Planning/Actions
  - Alternative Formulation
    (incl. Extraordinary Maintenance Justification - XMJ)
    - Rehabilitation Projects (incl. Pools 17&18, Check 17, Pools 20&21)
  - Alternative Analysis

Reclamation - XMJ

1. To secure an appropriation for Reclamation of its 45% share of costs under the 1961 JUF Agreement, an Extraordinary Maintenance Justification (XMJ) Report is required.
2. Trigger for XMJ Study requirement is whenever Reclamation must pay **≥ $10M** for a Project (e.g., for projects with a total project cost exceeding $22.2M and a 45%-USBR / 55%-DWR cost share split, per the JUF Agreement.)
3. New policy **effective October 2018**, Reclamation Manual **CMP 09-04**: *Planning for Major Rehabilitation and Replacement of Existing Assets*. Required to support federal decision-making and funding for Major Rehabilitation and Replacement (**MR&R**) of existing JUF assets. Format for XMJ Report should utilize similar parameters for a federal feasibility study as detailed in Reclamation publication CMP 09-02.
4. USBR can only seek appropriations to support the **original authorized JUF purposes.** Authorized purposes are elaborated in the:
    1. The Federal San Luis Act, Act of June 3, 1960.
    2. 1961 Coordinated Operations Agreement (between DWR and Reclamation) and supplements thereto; and
    3. the 1961 Joint Use Facilities (JUF) Agreement (between the DWR and Reclamation) and supplements thereto.
5. The investments must be justified based on the **greatest net public benefits**.
6. Reclamation cannot decide to construct MR&R projects or request implementation funding **until the XMJ Report(s) are completed**.

XMJ Study must be completed **before** Reclamation will be **eligible to receive appropriations** to pay to DWR that portion of Reclamation's costs for addressing subsidence.




DAPP
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
BVPP
Water level is constrained by special condition at Check 17
Water level is constrained by one foot of lined freeboard
Elevation (ft. NAVD88)
345
340
335
330
325
320
315
310
305
300
295
290
285
280
275
270
265
260
Check Structure
Original Design WSE
2023 WSE for NAA w/ Coalinga & Coastal SCs
2023 Channel Invert NAVD88
Pumping Plant
2023 WSE for NAA w/ Coalinga SC
2023 Top of Liner (east)
2023 Aqueduct/Turnout Connection
86
91
96
101
106
111
116
121
126
131
136
141
146
151
156
161
166
171
176
181
186
191
196
201
206
211
216
221
226
231
236
241
246
251
Milepost

CASP – Recent Tools

Probabilistic Subsidence Forecast Model

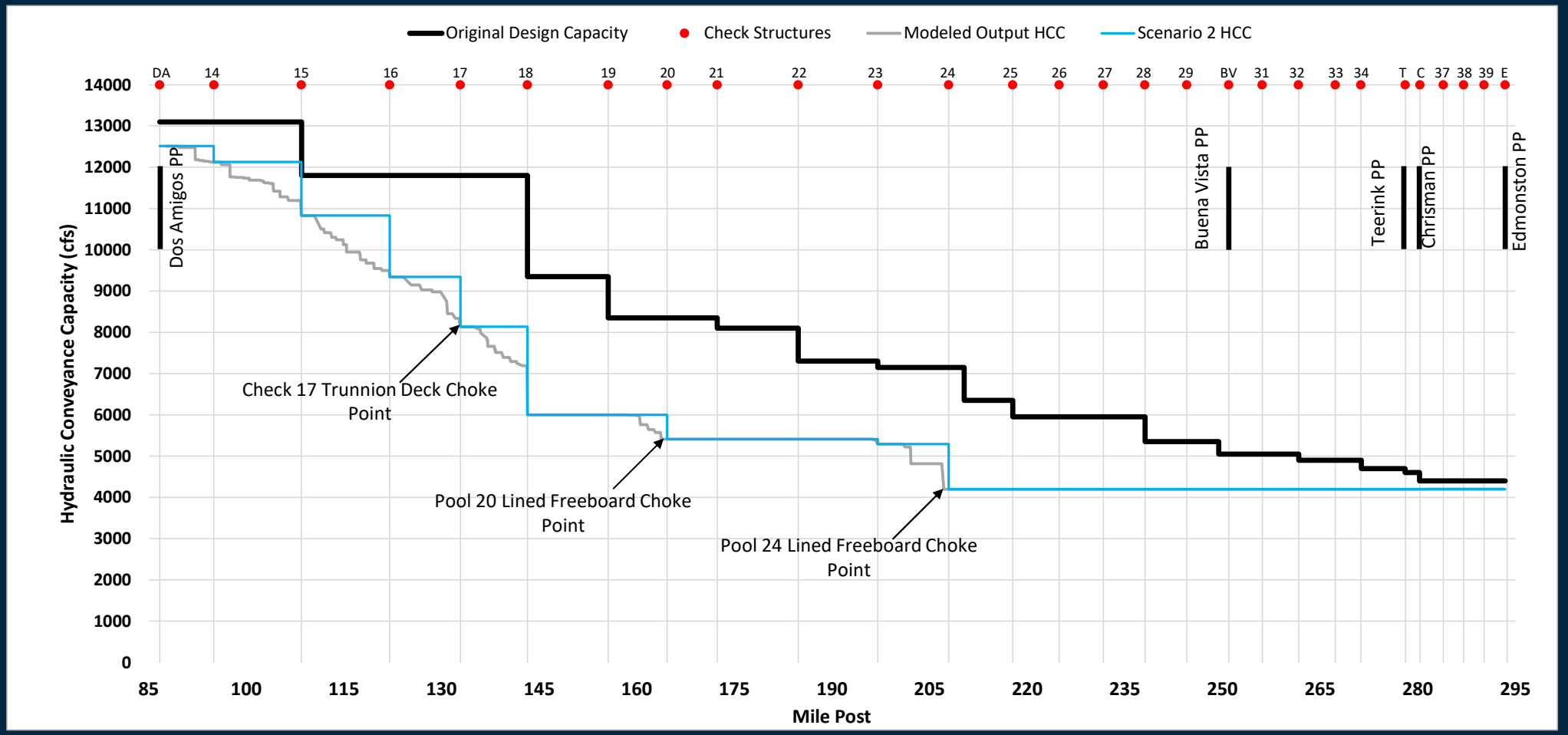
The output from the Probabilistic Subsidence Forecast model provides the distribution of forecasted subsidence magnitudes, rendered as profiles of elevation along the Aqueduct, for any year of interest through the SWP/CASP planning horizon (2085).

Hydraulic Conveyance Capacity (HCC) Model

The output from the Hydraulic Conveyance Capacity Model provides the estimate of the Aqueduct's steady-state hydraulic conveyance capacity under the input elevational conditions and the assumed operating parameters.

https://water.ca.gov/Programs/Engineering-And-Construction/Subsidence

Hydraulic Conveyance Capacity Model



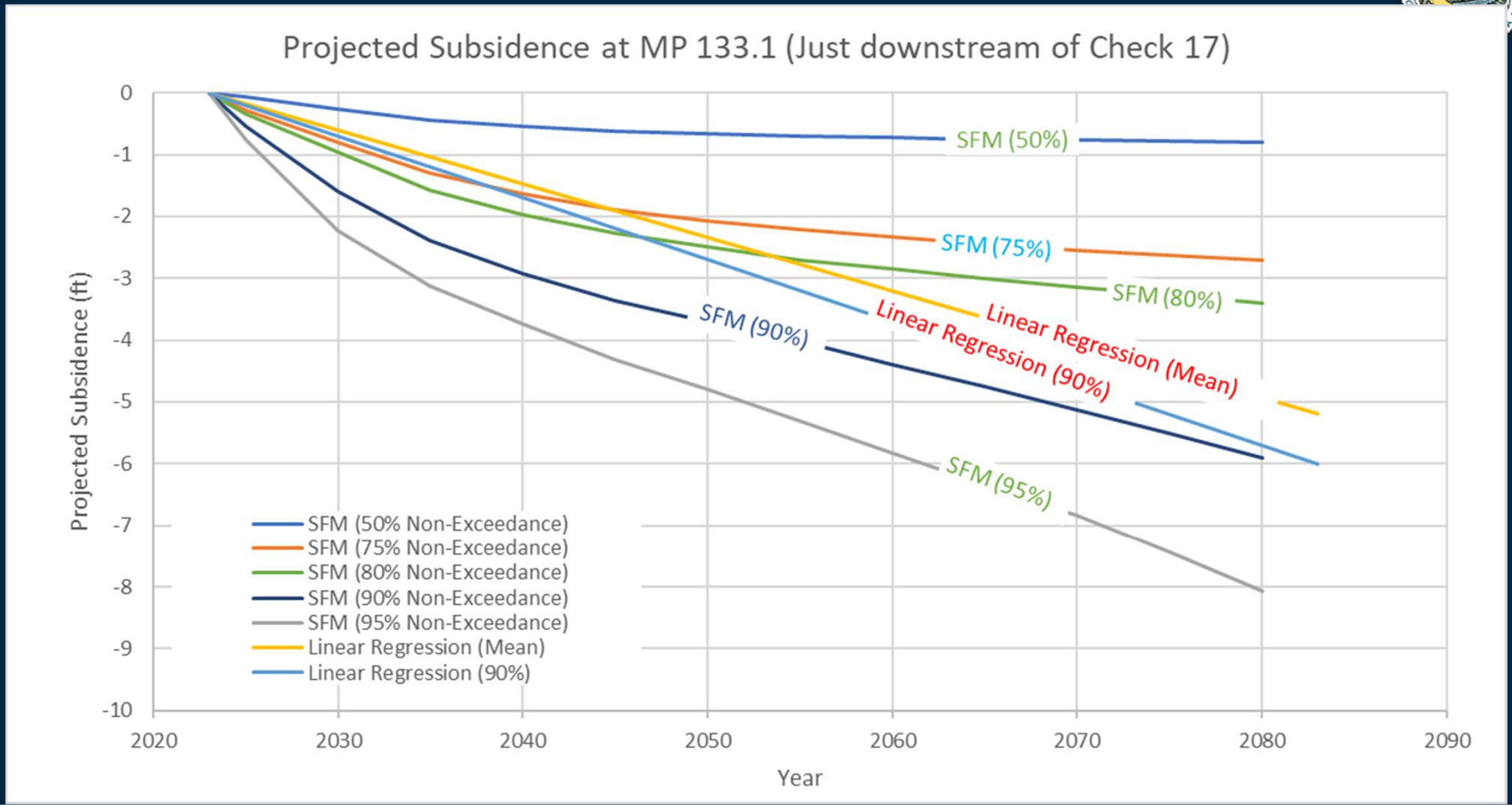
Probabilistic Subsidence Forecast Model

- Simulates a plausible range of future land-surface altitude conditions, with emphasis on areas of localized subsidence (i.e., “subsidence bowls”).
- Primarily based on an empirical relationship between historical subsidence rate and annual water deliveries from the CVP and SWP to users in the San Joaquin Valley.
- The forecast model considers three conditions that determine the rate of subsidence:
  - No SGMA condition,
  - Partial SGMA Implementation, and
  - Cessation of Overdraft condition.

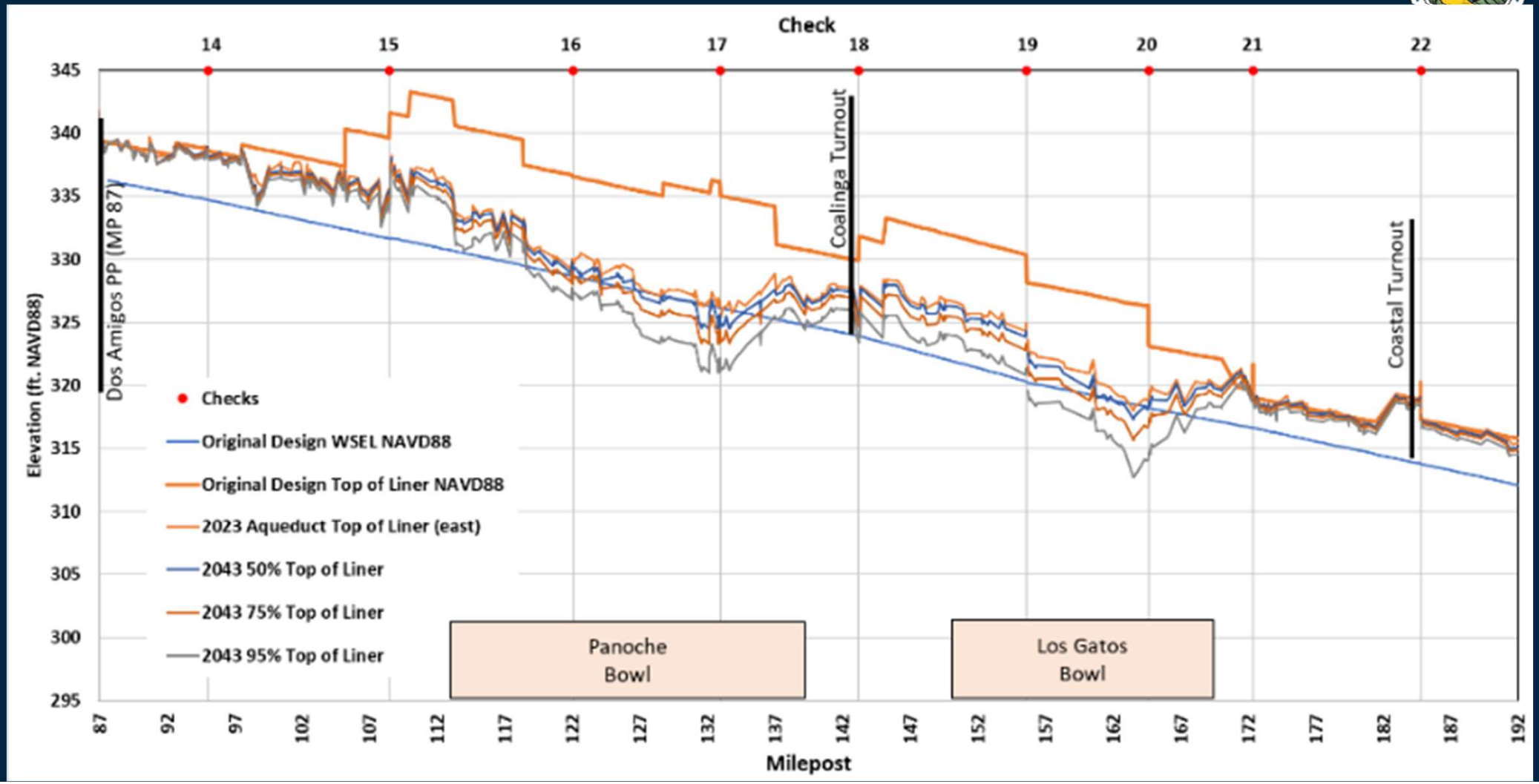
Report Being Updated: Sept. 2024
Incorporation of 2024 data

- **The output from the probabilistic forecast model provides the distribution of forecast subsidence magnitudes, rendered as profiles of elevation along the Aqueduct, for any year of interest through the 2085 CASP planning horizon.**
- Compared to earlier trend extrapolations (*i.e., regression analysis*), the model **better represents the structure of uncertainties** underlying forecasts and allows **a better understanding of how those uncertainties affect future subsidence**.

Example Subsidence Projections at MP 133.1



Projected Top of Liner Elevations in 2043 - SLC



Necessity of CASP "Interim Actions"

- Under the existing Standing Operating Order (SOO), predicted future subsidence will result in substantial additional water delivery impacts **before** long-term solutions can be implemented.

- The objective of "Interim Actions" is to ***reduce impact of subsidence on water deliveries and flexibility prior to implementation of long-term solutions:***

  Focused on non-structural and structural actions that can be implemented quickly without regrettable effects on the long-term solutions while:

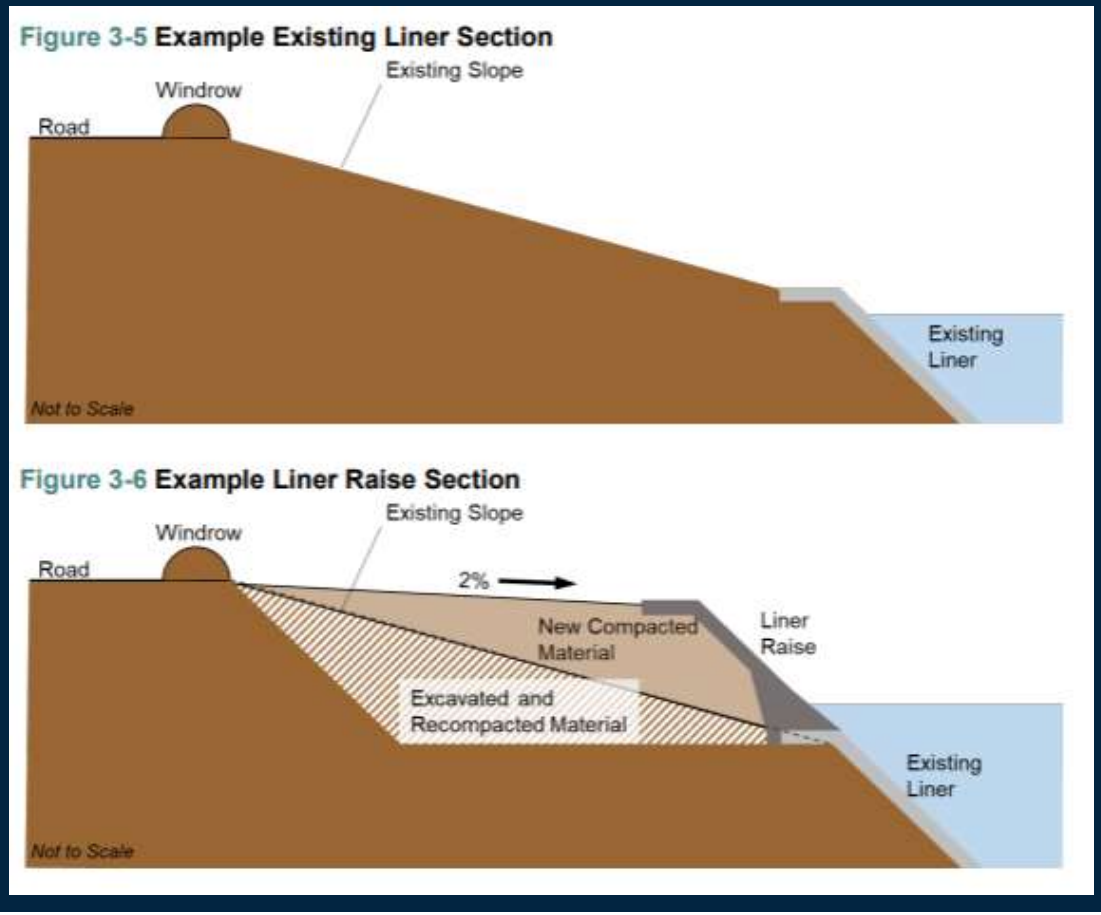
  - Defining individual projects as those actions which provide independent utility

CASP "Interim Action" Projects (SLFD & SJFD)

The "Interim Action" Projects include approximately 42 miles of liner raises in:

- Pools 17 & 18
- Pools 20 & 21
- Pool 24
- Pool 31, and
- The removal of the gates at Check 17

CASP "Interim Action" Projects (SLFD & SJFD)



Questions?

Jesse Dillon
916.699.8403
jesse.dillon@water.ca.gov

Thank you!