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MEMORANDUM

To: All Stakeholders

From: Christina Buck, Asst. Director Butte County Dept. Water and Resource Conservation

Date: April 24, 2026

Subject: **Strawman Proposal for Land Subsidence SMC for Discussion and Relevant Context**

Relevant Context

The attached strawman proposal for the Sustainable Management Criteria (SMC) related to Land Subsidence is provided to facilitate discussion and receive public input on whether the SMC for Land Subsidence should be amended in the Groundwater Sustainability Plan (GSP) in response to the Department of Water Resources' (DWR) Recommended Corrective Actions. The following provides important relevant context to support discussions. This topic is anticipated to go to the Vina Stakeholder Advisory Committee (SHAC) in May and the Joint Boards in June.

No Observed Land Subsidence in Vina Subbasin

Under the Sustainable Groundwater Management Act (SGMA), land subsidence is one of six sustainability indicators that is required to be managed in the GSP to avoid "undesirable results," which is defined as significant and unreasonable land sinking caused by excessive groundwater pumping. The 2025 Water Year Annual Report (and previous annual reports) show that no inelastic land subsidence has been recorded in the Vina Subbasin. Below, Figure 5-2 is included for quick reference from the 2025 Annual Report showing "no significant change" of vertical displacement over a 5-year period. The entire report is available online.

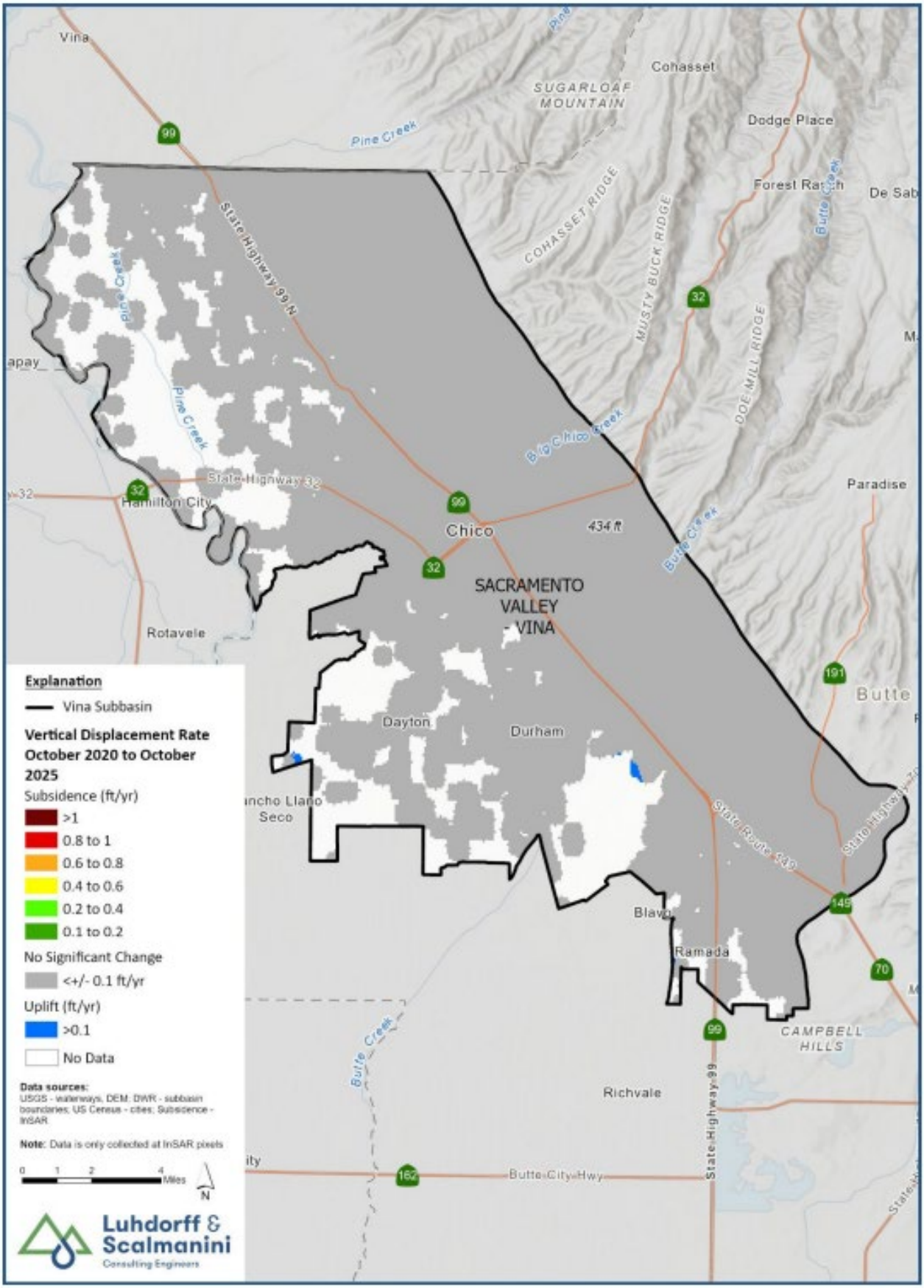

Figure 5-2. Vina Subbasin Vertical Displacement in Ground Surface from 10/2020 to 10/2025

DWR Recommended Corrective Actions

DWR provided recommended corrective actions (RCAs) in its GSP Determination Letter identifying several areas for improvement with respect to the land subsidence sustainability indicator. It is DWR's expectation that RCAs should be considered by the GSAs in the first periodic evaluation of the GSP (due to be submitted in January 2027). Provided below is Recommended Corrective Action 5, as stated in the Determination Letter:

> *Provide additional information on criteria used to identify undesirable results, and sustainable management criteria for land subsidence, including:*
>
> a. *Provide a clear, quantitative definition of when undesirable results for land subsidence may occur in the Subbasin, as required by the GSP regulations, to support the selection of land subsidence minimum thresholds that demonstrate avoidance of undesirable results.*
> b. *Establish sustainable management criteria for land subsidence for the Subbasin utilizing a monitoring network that directly measures land elevation change such as remote sensing data, survey monuments, or global positioning system stations.*

The Vina Subbasin Groundwater Sustainability Plan (2022) currently uses groundwater levels as a proxy, using the groundwater level SMC and monitoring network for land subsidence as well. This needs to be addressed.

Recently Released DWR Best Management Practices (BMP) on Land Subsidence

In January 2026, DWR released its Best Management Practices (BMP) on Land Subsidence. This document provides guidance to Groundwater Sustainability Agencies on how to monitor, evaluate, and establish Sustainable Management Criteria for land subsidence in a manner that identifies and avoids significant and unreasonable impacts to infrastructure and land use. It describes four different land subsidence management scenarios and suggests different approaches depending on the conditions in the subbasin. The Vina Subbasin falls into **Scenario 2**, which describes conditions where little or no subsidence has been observed to date, but groundwater levels may be allowed to decline below historical lows (based on how Groundwater Levels Minimum Thresholds are set), creating a risk of inelastic subsidence and requiring monitoring and SMC that identify and avoid resulting impacts. Land Subsidence is a sustainability indicator DWR has provided clear guidance on, in addition to the RCAs.

Neighboring Subbasins

Additionally, the approaches neighboring subbasins have taken regarding Land Subsidence monitoring and SMC may also be of interest to the Vina Subbasin. This is summarized in Table 5 of the 'Joint GSP Evaluation for the North Sacramento River Corridor' Tech Memo and is included below.

Requested Input

Attached to this Memo is a preliminary approach or "strawman" that has been provided to solicit input, encouraging stakeholders to engage and give feedback on whether the SMC for Land Subsidence should be amended in the GSP. Please reach out to cbuck@buttecounty.ca.gov with questions or to schedule a time to connect and discuss this further. An open, public meeting will also be scheduled to support further dialogue on the topic.

MONTGOMERY & ASSOCIATES

Table 5. Summary of Land Subsidence SMC

Subbasin	Approved GSP Section Reference	MT	Undesirable Results (UR)	MO	InSAR Network?	Five-Year IM (2027)	Current Conditions*
Vina**	*Section 3.7. p. 194-195*	*GWL MT Used as Proxy*	*GWL UR Used as Proxy*	*GWL MO Used as Proxy*	Used as Supplement	*GWL IM Used as Proxy*	*On track to meet IM (Section 5.2.3. p. 38)*
Butte**	*Section 4.3.5. p. 225-226*	0.5 foot over a five-year period	25% of monitoring locations fall below MT	0.25 foot over five-year period	Used as Supplement	No IM identified	No indication of UR *(Section 5.2. p. 41)*
Red Bluff	*Section 3.2.3. p. 312-314*	0.5 foot over a five-year period	0.5 foot over a five-year period – *result of declining GWL*	one foot over 20 years	Yes – eight pixels collocated near WL RMS	-0.25 feet	No indication of UR *(Section 5.2. p. 35)*
Los Molinos	*Section 3.2.3. p. 306*	0.5 foot over a five-year period	0.5 foot over a five-year period – *result of declining GWL*	one foot over 20 years	Yes – nine pixels collocated near WL RMS	-0.25 feet	No indication of UR *(Section 5.2. p. 37)*
Corning	*Section 6.9. p. 483-491*	0.5 foot over a five-year period	0.5 foot over a five-year period – *result of declining GWL*	0 ft/yr	Yes	< 0.1 ft/yr	No Indication of UR *(Section 5.2. p. 37)*
Colusa *(only subbasin with current measurable subsidence)*	*Section 5.4.5. p. 388-393*	Cumulative subsidence of two feet (from Jan. 2024) in 1 PLSS section***, *or* >0.1 ft/yr across 10 contiguous PLSS sections for two consecutive years	Cumulative subsidence of >two feet (from Jan. 2024) in one PLSS, *or* >0.1 ft/yr across 10 contiguous PLSS sections for two years	0 ft/yr	Yes	0.3 ft/yr	No indication of UR – Measured subsidence (>0.1 feet) occurred in three locations, but were not contiguous PLSS *(Section 6.1.4. p. 47-50)*

ft/yr = feet per year

*Current Conditions as described in WY 2024 Annual Report. Note that the sections indicated referencing relevant section in the most recent, 2024, Annual Report, which was made public in early spring 2025.

**Vina and Butte Subbasins have an RCA to revise their monitoring network to include InSAR data

***PLSS section: Defined as one square mile, or 640 acres

Land Subsidence Sustainable Management Criteria – Strawman Proposal for Discussion

This is provided to facilitate discussion and the potential development of a Plan Amendment to address DWR's Recommended Corrective Action related to Land Subsidence. This draws from DWR's Land Subsidence BMP released in January 2026 and approaches used by neighboring subbasins and others across the state. This is written as direct language that could be used to amend the GSP and/or used in the Periodic Evaluation.

Sustainability Indicator Description

Land subsidence in the Subbasin is evaluated using direct measurements of land surface deformation, primarily through Interferometric Synthetic Aperture Radar (InSAR) data, supplemented by available Global Positioning System (GPS) measurements where applicable. These datasets provide spatially distributed estimates of vertical land surface change and are used to assess both the rate and cumulative magnitude of subsidence across the Subbasin.

Consistent with the Department of Water Resources (DWR) Land Subsidence Best Management Practice (BMP), the Subbasin is characterized as having no documented history of significant inelastic land subsidence, but recognizes that subsidence may occur if groundwater elevations decline sufficiently to induce compaction of fine-grained sediments. Accordingly, the Sustainable Management Criteria (SMC) are designed to identify conditions under which subsidence could result in significant and unreasonable impacts to beneficial uses and users, including infrastructure and land use.

Monitoring Network

The complete monitoring network will include all available InSAR data and any GPS monitoring sites available within the Vina Subbasin. These datasets will be used for analysis and basin setting understanding.

Representative land subsidence monitoring locations in the Vina Subbasin are selected from the full InSAR dataset based on data quality, spatial distribution, hydrogeologic conditions, proximity to infrastructure, and, where feasible, co-location with groundwater monitoring wells. These locations provide a consistent framework for evaluating Sustainable

Management Criteria, while the full InSAR dataset is used to assess basin-wide subsidence conditions and identify emerging trends. (See Attachment A below for more details)

The RMS land subsidence monitoring network will consist of:

- DWR-provided InSAR data, evaluated across representative pixels distributed throughout the Subbasin;
- Available GPS monuments used to corroborate InSAR-derived displacement estimates (one site in Vina);

Representative monitoring locations are defined using spatially distributed InSAR pixels and, where feasible, nearby groundwater level monitoring wells to support interpretation of relationships between groundwater conditions and subsidence. Locations are selected to support spatial evaluation of subsidence trends with emphasis on:

- Areas of groundwater extraction (west of highway 99)
- Areas with fine-grained sediments
- Locations near critical infrastructure (wells, roads/highways)

InSAR data are evaluated at least annually, with consideration of both annual rates and cumulative deformation trends.

Measurement Uncertainty

Subsidence rates less than approximately 0.05 to 0.10 feet per year are considered within the range of InSAR measurement uncertainty and are not interpreted as indicative of inelastic land subsidence.

Measurable Objective (MO)

0.0 feet per year of land subsidence at representative monitoring locations, recognizing that minor variation within measurement uncertainty does not indicate inelastic subsidence. [This is consistent with DWR's Land Subsidence BMP.]

Minimum Threshold (MT)

A rate greater than 0.2 feet per year of subsidence at any representative monitoring location, or 0.5 foot cumulative subsidence over a 5-year period at the same location.

Interim Milestones (IMs)

Subsidence rates maintained at 0.0 feet per year of land subsidence at representative monitoring locations, recognizing that minor variation within measurement uncertainty does not indicate inelastic subsidence.

Undesirable Results

Subsidence exceeding the Minimum Threshold that results in significant and unreasonable impacts to beneficial uses and users, including infrastructure, namely highways, roads, drainage infrastructure, or well casings.

This occurs when:
1. The Minimum Threshold (0.2 ft/yr) is exceeded for two consecutive years at the same representative monitoring location with confirmed associated impacts to infrastructure, or
2. >0.1 ft/yr rate is exceeded across 10 contiguous PLSS sections* for two consecutive years. [similar to Colusa subbasin approach]

*PLSS section: Defined as one square mile, or 640 acres

Relationship to Groundwater Conditions

Subsidence is associated with reductions in groundwater elevations. Groundwater levels are evaluated alongside InSAR data to assess risk of inelastic compaction and inform management actions.

Attachment A: Land Subsidence Monitoring Network

Representative InSAR Monitoring Locations

To support evaluation of land subsidence, the Vina Subbasin utilizes **InSAR-derived land surface deformation data across the full Subbasin extent**. All available InSAR data are reviewed annually to evaluate spatial patterns, identify potential areas of deformation, and assess overall subsidence conditions.

For purposes of Sustainable Management Criteria (SMC) evaluation and long-term tracking, a subset of **representative monitoring locations** is designated from the full InSAR dataset. These representative locations are not intended to replace the full dataset, but rather to provide a **consistent, stable, and interpretable set of monitoring points** for evaluating compliance with SMC over time.

Representative monitoring locations are defined using the following criteria:

- **Data Quality and Reliability**
  Selected locations are based on InSAR pixels exhibiting consistently high data quality, including stable coherence and minimal evidence of processing artifacts or anomalous variability over the available time series.

- **Spatial Representation of the Subbasin**
  Monitoring locations are distributed across the Subbasin, including each management area, to capture spatial variability in groundwater conditions and potential subsidence response.

- **Hydrogeologic and Pumping Conditions**
  Locations are selected in areas representative of:
    - Concentrated groundwater extraction (west of highway 99)
    - Fine-grained sediment deposits where compaction risk may be higher
    - Areas with observed groundwater level declines or greater variability
- **Proximity to Critical Infrastructure**
  Representative locations include areas near infrastructure that could be sensitive to land subsidence, such as roads, pipelines, and flood conveyance features, to ensure that monitoring captures conditions relevant to beneficial uses and users. This includes…highway 99, highway 32, locations throughout the City of Chico, and the community of Durham…
- **Integration with Groundwater Monitoring**
  Where feasible, representative InSAR locations are selected near existing groundwater level monitoring wells to support evaluation of the relationship between groundwater elevations and land surface deformation.

In many cases, a representative monitoring location consists of a **central InSAR pixel supported by a small group of adjacent pixels**, allowing for confirmation that observed deformation patterns are spatially consistent and not attributable to localized data artifacts.

The number and distribution of representative monitoring locations are periodically reviewed and may be refined over time as additional data become available or as understanding of subsidence conditions evolves. However, changes to representative locations will be made in a manner that maintains continuity in long-term trend evaluation.

This approach is consistent with DWR's monitoring and land subsidence BMP guidance, which emphasizes the use of **spatially distributed data to assess basin-wide conditions**, while also identifying **representative monitoring locations sufficient to detect conditions that could lead to significant and unreasonable impacts**.