

# Review Sustainable Management Criteria

Groundwater Sustainability Plan: Staff will provide an update on draft Sustainable Management Criteria for groundwater levels, land subsidence and seawater intrusion, including development of a range of potential options for determining Undesirable Results for land subsidence and seawater intrusion



# Chronic Lowering of Groundwater-Levels: Key Points/Considerations



- SGMA Definition: Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the 50-year planning and implementation horizon.
- Groundwater levels will be measured using a Representative Monitoring Point network of wells throughout the basin; this network is a subset of the entire GSA well monitoring network.

## Main Themes from previous AC Input Reflected in preliminary SMCs

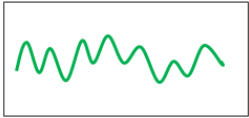
- For areas with stable trends, maintain groundwater levels within or near historical conditions while accounting for future droughts and climate variability.
- For areas with declining trends, protect beneficial users that could be impacted by the declining groundwater levels and stabilize and reverse the declining trends.

# Draft Methodology\* Developed for Distinct Observed Patterns

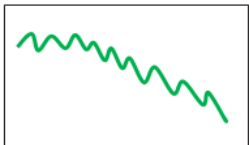


## Preliminary factors and metrics considered.

- Water Supply Well Depths (incorporate protections for existing water wells)
- Historical Low Groundwater-Levels
- Projected Future Groundwater-Levels
- *Groundwater-Dependent Ecosystems (TBD)*



1. For wells with stable groundwater-level trends, **maintain groundwater levels within or near historical conditions while accounting for future droughts and climate variability.**



2. For wells with historical declining trends, **stabilize and reverse the declining trends and restore groundwater-levels to pre-2010 levels.**

\*Incorporates initial advisory committee input on significant and unreasonable effects



# Remaining Questions and Issues

1. Assess historical data availability to better define historical “averages” - *ongoing*
2. Assess and describe potential impacts on beneficial users – *ongoing*
  - Further assess water well depth datasets to best incorporate protection of existing well users
3. **Reassess appropriateness of SMCs based on future projected model scenarios, in particular, for areas with identified groundwater-level declines – *late summer/fall***
4. Develop range of options for establishing Undesirable Results for Board consideration with AC input – *late summer/fall*



# Land Surface Subsidence: Key Points/Consideration Reminders

- GSAs are only responsible for managing inelastic (or unrecoverable) subsidence caused by groundwater pumping
- GSA not responsible for **managing** elastic (recoverable) subsidence nor for subsidence caused by anything other than groundwater pumping
- Limited datasets do not indicate historical, inelastic land surface subsidence due to groundwater pumping within the Subbasin.

# Strawman Proposal Considered by Advisory Committee



Initial strawman of proposed approach and methodology for establishing SMCs considered at May 13 advisory committee meeting:

- Reflects a desire that the Subbasin continue to prevent-inelastic (irrecoverable) subsidence due to groundwater pumping
- Accounts for measurement error (0.1 feet or ~1-inch)
- Recognizes the need to develop method to correlate subsidence with groundwater pumping should future subsidence be observed

# Initial Input and Remaining Questions and Issues



The Advisory Committee was generally comfortable with the proposal and the recommendations which included:

- (1) using InSAR as the measurement tool (spatial resolution of approximately 2.5 acres) for monitoring total subsidence; and
- (2) should InSAR indicate total subsidence, conducting additional evaluation of whether the subsidence is inelastic and due to groundwater pumping.

## **Remaining Issues/Questions for Discussion Today:**

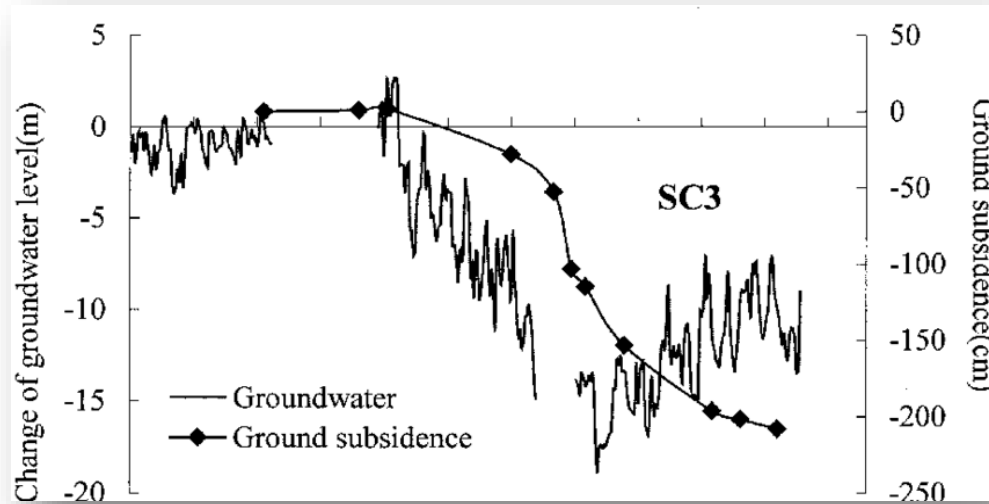
1. Further assess methodology and develop process for how to determine whether any potential future observed subsidence is due to groundwater pumping or other factors
2. Develop range of options for establishing Undesirable Results for Board consideration with AC input



## Remaining Issues/Questions:

Develop process for determining whether any potential future observed subsidence is due to groundwater pumping or other factors

- Assess whether areas exhibiting subsidence are in the vicinity of known or estimated groundwater pumping – evaluate any trends/changes in groundwater pumping for correlation with any trends in subsidence



- Evaluate whether groundwater levels are below historical lows (compare with SMC for Chronic Lowering of GWLs) – if so, determine whether there is a statistical correlation between groundwater levels and observed subsidence



Example Correlation Plot from other area (from Liu et al., 2004)



# Remaining Issues/Questions:



## Develop range of options for establishing Undesirable Results for Board consideration with AC input

### 1. Definition of Undesirable Result Option #1 as Discussed at May 13 AC Meeting

- If annual minimum threshold exceeded or five continuous years of subsidence ***in any area*** even if each year's annual subsidence rate is less than the minimum threshold

### 2. Definition of Undesirable Result Option #2 (new)

- If annual minimum threshold exceeded or five continuous years of subsidence ***with cumulative amount exceeding 0.2 feet total in any area*** even if each year's annual subsidence rate is less than the minimum threshold.

### 3. Definition of Undesirable Result Option #3 (new)

- If annual minimum threshold exceeded or five continuous years of subsidence ***occurring over 25 contiguous acres of developed land or infrastructure facilities*** even if each year's annual subsidence rate is less than the minimum threshold

### Applies to All Three Options:

- The *annual* minimum threshold is set to 0.1 feet of subsidence per year (measured at each ~2.5 acre pixel) accounting for inherent InSAR error.
- Any exceedance of a minimum threshold is an undesirable result, if the exceedance is irreversible and caused by groundwater pumping.
- Before establishing that an undesirable result has occurred, evaluate whether the change in ground surface elevation is subsidence due to groundwater pumping or other factors.



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

### Undesirable Result Option #1 as Discussed at May 13 AC Meeting:

Any exceedance of the *annual* minimum threshold is set to 0.1 feet of subsidence per year is an undesirable result, if the exceedance is irreversible and caused by groundwater pumping

It is furthermore an undesirable result if any area experiences five continuous years of subsidence due to groundwater pumping, even if each year's annual subsidence rate is less than the minimum threshold.

### Considerations

- Based on review of available InSAR datasets (2015-2019), no areas have exceeded the annual MT of 0.1 feet
- If subsidence is observed at or near the measurement limit of 0.01 feet for a continuous five year period due to groundwater pumping, a very small amount of subsidence (as low as 0.05 feet or ~1/2-inch) could trigger an undesirable result
- Conversely, a relatively high amount of subsidence (up to nearly 0.5 feet or ~6 inches) due to groundwater pumping may not trigger an undesirable result if the annual amount is slightly less than 0.1 feet



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

### Undesirable Result Option #2:

Any exceedance of the *annual* minimum threshold is set to 0.1 feet of subsidence per year is an undesirable result, if the exceedance is irreversible and caused by groundwater pumping

It is furthermore an undesirable result if any area experiences five continuous years of subsidence due to groundwater pumping **resulting in a cumulative amount of subsidence exceeding 0.2 feet**, even if each year's annual subsidence rate is less than the minimum threshold.

### Considerations

- 0.2 feet is the approximate amount of ground surface lowering and subsequent uplift observed in southern Santa Rosa Plain determined to be within the *elastic range* of subsidence
- Provides a known minimum limit for elastic subsidence from local area with similar clay-rich geologic materials, while maintaining protections to avoid the potential for future inelastic subsidence



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

### Undesirable Result Option #3:

Any exceedance of the *annual* minimum threshold is set to 0.1 feet of subsidence per year **occurring over 25 contiguous acres of developed land or infrastructure facilities** is an undesirable result, if the exceedance is irreversible and caused by groundwater pumping

It is furthermore an undesirable result if such contiguous acres experience five continuous years of subsidence due to groundwater pumping, even if each year's annual subsidence rate is less than the minimum threshold.

### Considerations

- Spatial resolution of InSAR measurements is 100 meter by 100 meter per pixel (or approximately 2.5 acres)
- Focuses declaration of undesirable result on areas of the basin more likely to experience damage from inelastic subsidence
- Helps avoid potential for triggering an undesirable result for a single relatively small area



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

1. Do you have concerns with any of the three options presented for defining Undesirable Results?
2. Do you have a preference amongst these options for defining Undesirable Results?
3. Are there additional modifications or other options for defining Undesirable Results you think should be considered?

# Seawater Intrusion: Key Points/Considerations Reminders



- Available data suggest some seawater intrusion into the Baylands area of Petaluma Valley from San Pablo Bay, however characterizing the distribution and trends is limited by significant data gaps.
- Future efforts to fill data gaps needed
- The GSA may establish that seawater intrusion is acceptable in areas with minimal groundwater pumping or where salt tolerant crops are grown, where seawater intrusion may not cause a significant or unreasonable condition.
- Management of high salinity connate waters (older water not associated with recent seawater) is not covered by this SMC

# Strawman Proposal Considered by Advisory Committee



Initial strawman of proposed approach and methodology for establishing Seawater Intrusion SMC considered at May 13 advisory committee meeting:

- Reflects a desire to protect beneficial users from any potential future seawater intrusion due to groundwater pumping
- Incorporates water quality thresholds for existing beneficial uses (eg, drinking water and crop tolerance levels)
- Acknowledges the very limited groundwater use in areas of existing brackish groundwater
- Acknowledges need to address significant data and information gaps

# Initial Advisory Input



While there was general agreement on the approach, members expressed concerns that:

- (1) the location of the proposed minimum threshold isocontour is based on incomplete data;
- (2) Rationale for selecting 150 mg/l measurable objective unclear and may be unattainable
- (3) Criteria should consider local crop tolerances; and
- (4) Impacts of sea-level rise should be considered.



# Remaining Questions and Issues



1. Review crop tolerance information for chloride
2. Ensure all available data is incorporated
3. Assess options for integrating and responding to future sea level rise and planned potential restoration efforts
4. Develop range of options for establishing Undesirable Results for Board consideration with AC input
5. Develop an approach to collect the data and information needed to more fully develop this SMC during the implementation of the GSP, including characterization and monitoring activities



# Remaining Questions and Issues

## Review crop tolerance information for chloride

- Crop tolerances for chloride range from 100 to 350 mg/L for vineyards and 175 to 700 mg/L for vegetables based on available published sources
- A local study in Carneros area of Napa County found that grapes can tolerate up to 262 mg/L without showing adverse effects

“...the maximum Cl concentration in the irrigation water that grapes can tolerate without showing any adverse symptoms is 7.4 meq/L (262 mg/L).” – *Suitability Study of Napa Sanitation District Recycled Water For Vineyard Irrigation.*, UC Cooperative Extension, 2006.

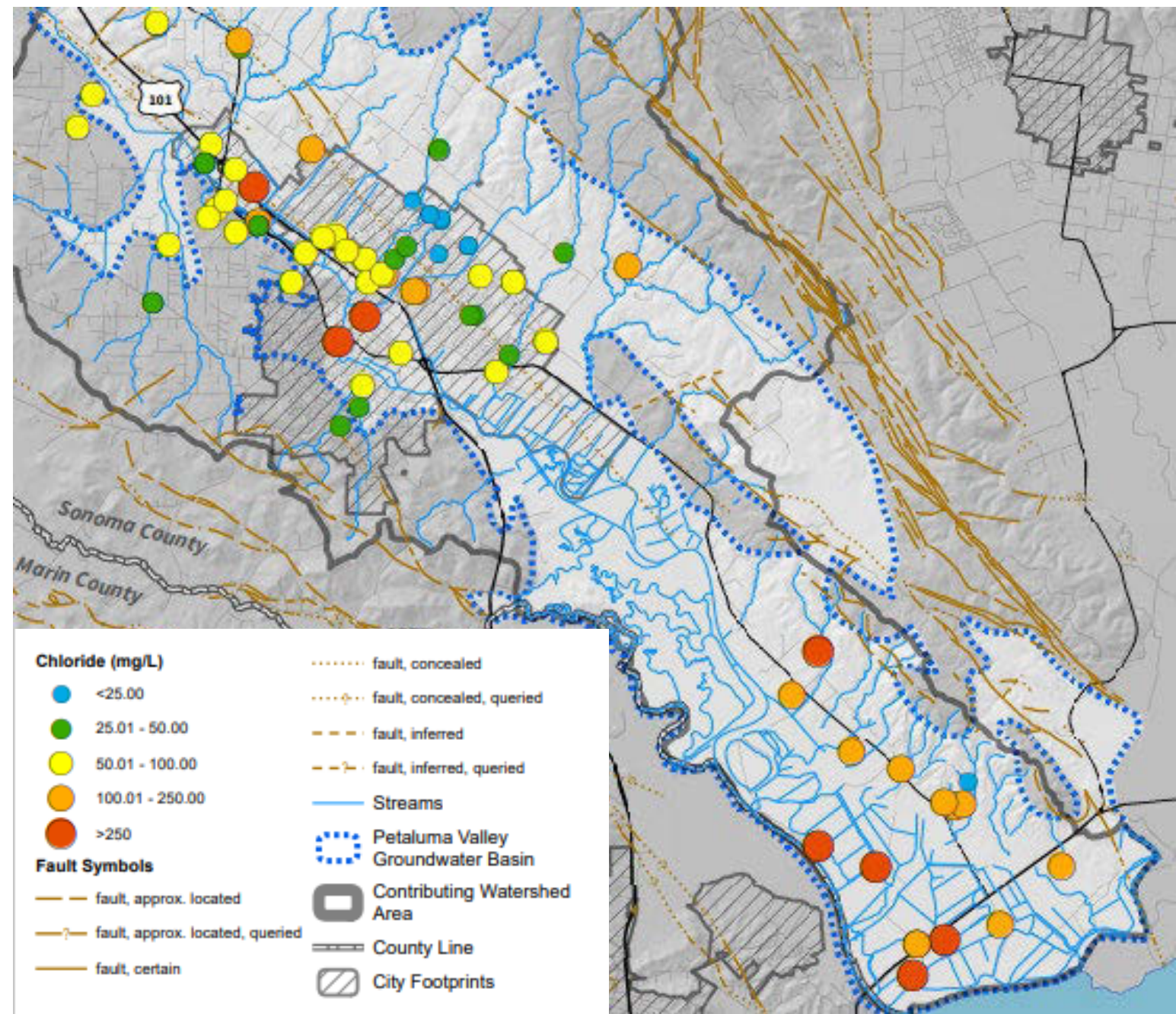
## Remaining Issues/Questions:

Gathering Additional Data -

Informational Sources:

*Status Update*

- Staff obtaining any additional chloride concentration data from USGS and reports on file with Permit Sonoma
- Incorporating into data management system and adding to datasets/figures
- Contacting USGS to determine whether they have insights as to source of chlorides in groundwater samples
- Reviewing available well construction datasets to better correlate wells with chloride data to specific depths of aquifer system



## Remaining Issues/Questions:

Assess options for integrating and responding to future sea level rise and planned potential restoration efforts



1. Projections of sea-level rise will be incorporated into model to help provide indirect assessment of potential impacts on seawater intrusion
  - While model does not simulate water quality, changes in fluxes from and into the Baylands can be assessed to evaluate areas that may be more at risk to better inform placement of MT/MO line
2. Ongoing coordination with Baylands Strategy partners on potential future restoration initiatives
3. Re-evaluate with actual sea-level and any new projections at 5-year increments during implementation of the GSP



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

### Undesirable Result Option #1 as Discussed at May 13 AC Meeting:

An undesirable result occurs based on any exceedance of the minimum threshold\* chloride isocontour, or any exceedance of the minimum threshold chloride concentrations at a representative monitoring point.

\*The proposed minimum threshold is 250 mg/L.

### **Considerations**

- Could trigger an undesirable result even if areas of potential impact do not have existing beneficial uses of groundwater
- Will not be feasible to monitor entire segment of minimum threshold line based on insufficient monitoring network



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

### Undesirable Result Option #2:

An undesirable result occurs based on an exceedance of the minimum threshold\* chloride isocontour into or toward areas that contain existing beneficial uses of groundwater, or any exceedance of the minimum threshold chloride concentrations at a representative monitoring point in these areas

\*The proposed minimum threshold is 250 mg/L

### **Considerations**

- Focuses determination of undesirable result on areas where impacts would be significant
- Would require accurate inventory and mapping of beneficial users of groundwater in these areas
- Could require some way to account for or address potential future beneficial uses in new areas



## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

### Undesirable Result Option #3:

An undesirable result occurs based on any exceedance of the minimum threshold\* chloride isocontour for three consecutive years, or any exceedance of the minimum threshold chloride concentrations at a representative monitoring point for three consecutive years.

\*The proposed minimum threshold is 250 mg/L.

### **Considerations**

- Provides some buffer to account for any short-term fluctuations of chloride concentrations due to year-to-year climate variations
- May want to add actions that would be triggered after first year of an exceedance (eg., investigations into potential causes of exceedances)



# Summary of Seawater Intrusion Options

- **Undesirable Result Option #1 as Discussed at May 13 AC Meeting**
  - An undesirable result occurs based on **any** exceedance of the minimum threshold\* chloride isocontour, or any exceedance of the minimum threshold chloride concentrations at a representative monitoring point.
- **Undesirable Result Option #2 (New)**
  - An undesirable result occurs based on **an** exceedance of the minimum threshold\* chloride isocontour **into or toward areas that contain existing beneficial uses of groundwater**, or **any** exceedance of the minimum threshold chloride concentrations at a representative monitoring point **in these areas**.
- **Undesirable Result Option #3 (New)**
  - An undesirable result occurs based on **any** exceedance of the minimum threshold\* chloride isocontour **for three consecutive years**, or **an** exceedance of the minimum threshold chloride concentrations at a representative monitoring point **for three consecutive years**.
- The proposed **\*minimum threshold of 250 mg/L** applies to all three options.





## Remaining Issues/Questions:

Develop range of options for establishing Undesirable Results for Board consideration with AC input

1. Do you have concerns with any of the three options presented for defining Undesirable Results?
2. Do you have a preference amongst these options for defining Undesirable Results?
3. Are there additional modifications or other options for defining Undesirable Results you think should be considered?