TODD GROUNDWATER

July 8, 2020

DRAFT MEMORANDUM

To: Turlock Subbasin Joint Technical Advisory Committees (TACs)

From: Phyllis Stanin, Vice President/Principal Geologist

Re: Framework for Definitions of Undesirable Results

In meetings over the last five months, the joint TACs have been reviewing technical information on the six sustainability indicators as defined in the Sustainable Groundwater Management Act (SGMA). These discussions have focused on adverse impacts to beneficial uses of groundwater resources and conditions that might constitute undesirable results in the Turlock Subbasin. Discussions to date have identified potential adverse impacts related to almost all of the sustainability indicators.

To assist in the translation of adverse impacts to a definition of undesirable results, the technical team has prepared this memorandum to provide working definitions as a starting point for review and revisions. The definitions provide a framework for selection of sustainable management criteria associated with the sustainability indicators. This memorandum can be viewed as a working document as the joint TACs work through the sustainable management criteria for each sustainability indicator. Relevant groundwater conditions and materials reviewed by the joint TACs are summarized briefly in this memorandum for context; additional information is described more fully in the GSP section on the basin setting.

SUSTAINABILITY INDICATORS

In its definition of undesirable results, SGMA identifies six sustainability indicators, which organize potential adverse groundwater conditions into categories as shown below.

SGMA Sustainability Indicators

					
Chronic Lowering of Water Levels	**Reduction of Groundwater in Storage**	**Degraded Water Quality**	**Seawater Intrusion**	**Inelastic Land Subsidence**	**Depletion of Inter-connected Surface Water**

Undesirable results occur if conditions associated with any of the indicators are determined by the agencies to be significant and unreasonable. Undesirable results selected by the joint TACs must be accompanied by the following information in the GSP:

- The groundwater conditions that have caused or may cause undesirable results as described in the basin setting, other GSP technical sections, or as documented by the numerical model.
- The criteria used to define when and where the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based on a quantitative description of the *combination of minimum threshold exceedances* that cause significant and unreasonable effects in the Subbasin.
- Potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results.

Undesirable results are evidenced by a quantitative minimum threshold (MT), exceedances of which may trigger undesirable results. The undesirable result conditions may be determined by a combination of MT exceedances rather than an exceedance of an MT in just one well during one measurement event, for example. The undesirable result definition can incorporate an element of time with more than one consecutive MT exceedance at a monitoring location needed before an undesirable result occurs.

Metrics for each sustainability indicator MT are suggested in the regulations (e.g., water levels, rates of subsidence); however, if correlations between the indicator and an alternative metric can be shown, that metric can be used as a proxy. For example, a water level (rather than a rate of subsidence) is often used as a MT proxy for the land subsidence indicator when undesirable results for land subsidence can be directly linked to water levels in monitoring wells. Suggested metrics for each sustainability indicator are summarized below. As indicated in the table, water levels can possibly be used as a proxy for almost all of the sustainability indicators.

Metrics for Minimum Thresholds (MTs)

					
Groundwater Elevation (water levels)	**Volume of Groundwater (water levels as a proxy)**	**Constituent Concentration (water levels as a possible proxy)**	**Chloride isocontour**	**Rate of subsidence (water levels as a proxy)**	**Rate or volume of depletion (water levels as a proxy)**

CHRONIC LOWERING OF WATER LEVELS IN THE TURLOCK SUBBASIN

Several public meetings have been held regarding the water level declines in the Subbasin. The joint TACs identified beneficial uses of Subbasin groundwater and adverse impacts

associated with declining water levels that have limited the use of existing wells. Adverse impacts to municipal, domestic and agricultural wells have included loss of capacity, failed wells (dry wells, collapsed casing, and other issues), and water quality concerns. The joint TACs noted that aging infrastructure is constraining the use of groundwater and discussed management actions to mitigate certain well issues.

A draft framework for defining undesirable results for the chronic lowering of water levels sustainability indicator is provided below.

> Significant and unreasonable water level declines such that water supply wells are adversely impacted during multi-year droughts in a manner that cannot be readily managed or mitigated.
>
> This will be evidenced by an exceedance of minimum thresholds (minimum water levels to be determined) in xx% of GSP monitoring wells in # consecutive semiannual monitoring events.

Minimum thresholds (i.e., water levels) will be developed in representative monitoring wells at key locations across the Subbasin.

REDUCTION OF GROUNDWATER IN STORAGE

Due to the relative thick zone of fresh groundwater within the aquifer system, adverse impacts associated with the depletion of groundwater supply have not been observed in the Subbasin. At meetings of the joint TACs in February and March 2020, TAC members reviewed original cross sections in the Subbasin constructed by the technical team for the GSP, which illustrate relatively small changes in groundwater levels over time relative to the thickness of the aquifer.

With increases in agricultural production and associated pumping, water levels have declined up to about 80 feet in some areas of the Subbasin over the 25-year historical study period. However, in those areas, the freshwater aquifers are approximately 1,000 feet thick. Modeling indicates about 1.5 million acre-feet (MAF) of groundwater has been removed from storage. Yet this is a relatively small percentage of the total groundwater in storage. DWR estimates that Turlock Subbasin has between 23 MAF and 30 MAF of fresh groundwater in storage (DWR, 2006). Accordingly, these 25-year declines may not indicate a significant and unreasonable depletion of supply.

It is noted that these groundwater declines are associated with adverse impacts related to other sustainability indicators including the chronic lowering of water levels discussed above. Further, regulations require that MTs associated with reduction in groundwater in storage be supported by the sustainable yield of the Subbasin. As such, it is likely that the MTs selected for the chronic lowering of water levels – as well as the ongoing analysis of sustainable yield – will be sufficient to avoid any significant and unreasonable depletion of groundwater in storage in the future.

DEGRADED WATER QUALITY

The joint TACs have reviewed information from the technical team regarding the need to coordinate water quality management with other ongoing regulatory programs and agencies. In California, the State Water Resources Control Board (SWRCB) and the associated Regional Water Quality Control Boards (Water Boards), are the state agencies with primary responsibility for the coordination and control of water quality. The GSAs do not have the mandate or authority to duplicate the numerous Water Board programs (or programs by other regulatory agencies) that are currently addressing water quality issues in the Turlock Subbasin. However, the GSAs must not exacerbate current water quality or create new water quality issues with their management actions and projects.

In several joint TAC meetings, members have discussed various constituents of water quality concern in the Turlock Subbasin. Two constituents that appear to have widespread distributions of elevated concentrations are nitrate and arsenic.

Common sources of nitrate in groundwater include excess application of nitrogen fertilizer in irrigated areas, feedlot and dairy drainage, leaching from septic systems, wastewater percolation, industrial wastewater, and food processing wastes. Nitrate is being managed through the Irrigated Lands Regulatory Program (ILRP), as administered by the Central Valley Water Board. A combination of Best Management Practices and local monitoring programs are addressing the nitrate concentrations in the Subbasin. The GSAs should coordinate with these programs to ensure appropriate future management related to water quality.

Arsenic is a naturally-occurring trace element in the rocks, soils, and groundwater of the Turlock Subbasin. Elevated concentrations of arsenic in groundwater occur through dissolution of iron or manganese oxyhydroxides under reducing conditions. Dissolved arsenic can also result from pH-dependent desorption under oxic conditions. In general, elevated arsenic concentrations are correlated with deeper groundwater where the dissolved oxygen content is relatively low and pH is high. Drinking water wells in the Subbasin are monitored for arsenic and several municipalities note that increasing arsenic concentrations have been correlated with declining water levels.

There are additional water quality constituents of concern in the Subbasin. For example, there is saline water at depth that may degrade water quality if water levels are allowed to decline significantly. Based on the thickness of the aquifer, the depth of the wells, and the depth of this saline water, however, this seems unlikely – especially with the recognition that the chronic lowering of water levels indicator and sustainable yield analysis will likely require MTs that are also protective of water quality issues at depth. Also, there are localized contaminant plumes that have been identified in some municipal wellfields. For example, the City of Turlock manages groundwater pumping to avoid exacerbating plumes of tetrachloroethene (also referred to as PCE).

Constituents of concern require further examination; in the interim, a draft framework for defining undesirable results for the degraded water quality sustainability indicator is provided below.

Undesirable results would occur when significant and unreasonable impacts to groundwater quality, as caused by water management actions, affect the reasonable and beneficial use of groundwater by overlying users.

This is determined when the minimum threshold for an individual groundwater quality constituent of concern is exceeded in greater than xx% of the designated monitoring points within the Subbasin or within xx% of municipal drinking water wells in two consecutive monitoring events. Minimum thresholds shall be set for each constituent included in the water quality monitoring program based on the relevant drinking water standards.

SEAWATER INTRUSION

After numerous discussions, the joint TACs have determined that undesirable results for this sustainability indicator are not occurring and have no potential to occur in the Turlock Subbasin. Accordingly, this indicator has been determined by the joint TACs as not applicable in this Subbasin. Therefore, in accordance with the GSP regulations, no sustainable management criteria are established for this sustainability indicator.

INELASTIC LAND SUBSIDENCE

The potential for inelastic land subsidence in the Turlock Subbasin has been discussed at several meetings of the joint TACs including a recent, focused discussion during the June 25, 2020 meeting. At that meeting, discussion topics included concepts of inelastic land subsidence, the absence of historical subsidence in the Subbasin and areas of potential risk for future subsidence including dewatering of the Corcoran Clay in the western Subbasin. Numerous strategies to monitor for the future potential of inelastic land subsidence were reviewed, including InSAR data published periodically by DWR, surveyed benchmarks, continuous GPS stations, extensometers, and the use of water levels as a proxy.

The technical team emphasized the linkage between undesirable results and impacts to land use including critical infrastructure such as roads, utilities, pipeline, canals, and well casings. The technical team also presented the undesirable results definition for inelastic land subsidence from the Merced Subbasin GSP because of its relevance in the Turlock Subbasin.

This definition, and the monitoring strategies described above, are incorporated into the draft framework for defining undesirable results for the inelastic land subsidence sustainability indicator presented below.

Significant and unreasonable inelastic land subsidence that adversely affects land use or reduces the viability of the use of critical infrastructure (specific examples of critical infrastructure to be determined).

This will be evidenced by an exceedance of minimum thresholds (to be determined) at x# of land subsidence monitoring locations (to be determined – may include CGPS stations, water levels in wells, etc.) measured in two

consecutive spring monitoring events. GSP monitoring events will be supplemented by an annual screening-level analysis from InSAR data provided by DWR and presented in each annual report.

Land subsidence monitoring will also consider monitoring of local critical infrastructure or transportation corridors by others (e.g., CalTrans).

A separate memorandum focused on the inelastic land subsidence sustainability indicator is being developed for the Turlock Subbasin.

DEPLETION OF INTERCONNECTED SURFACE WATER

Depletion of surface water that affects land use has not been discussed in detail by the joint TACs because the ongoing modeling analysis of projected water budgets will provide information on local surface water/groundwater interaction. No undesirable results have been identified to date. The potential for undesirable results would occur if significant and unreasonable surface water depletions affect surface land uses.

As used in both the adjacent Merced and Delta Mendota subbasins, water levels may provide a reasonable proxy for the MTs associated with this sustainability indicator along the river boundaries in the Turlock Subbasin. MTs selected in adjacent subbasins will be considered for adoption in the Turlock Subbasin. In the Modesto Subbasin, the GSAs will continue to meet and coordinate on technical issues including sustainable management criteria.

SUSTAINABLE YIELD

While not a separate sustainability indicator, GSP regulations require that a single value be defined for the sustainable yield of the Turlock Subbasin. Operation within the sustainable yield is referenced in SGMA as part of the estimated water budget for the Subbasin and as the outcome of avoiding undesirable results. In general, operation of the Subbasin within its defined sustainable yield is inherent in sustainable management and is used to develop projects and programs needed to achieve sustainability.

Historical water budgets indicate overdraft conditions with a deficit of about 65,000 acre-feet per year (AFY). Projected water budgets and sustainable yield analyses are being developed to provide a target deficit to use to balance the Subbasin.