



KERN COUNTY SUBBASIN PROBATIONARY HEARING DRAFT STAFF REPORT

**Appendix D – State Water Board Review of the
2020 Groundwater Sustainability Plans and DWR
Incomplete Determination**

January 2025

Deficiency CRD – Defining and Avoiding Undesirable Results Related to Coordination

D.1.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

This subsection and following subsections describe the portions of the Coordination Agreement, individual GSPs, or DWR’s determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 GSPs defined an undesirable results as “the point at which significant and unreasonable impacts over the plan’s duration, as caused by water management action, as determined by SMC, affect the reasonable and beneficial use of and access to, groundwater by overlying users.”

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2020 coordination agreement defined an undesirable result as occurring when, “minimum thresholds for SMC are exceeded in at least three adjacent management areas that represent at least 15% of the subbasin area or greater than 30% of the subbasin (as measured by each management area). A management area would only contribute to an undesirable result when local undesirable results are occurring. Different management area’s define local undesirable results as occurring based on various conditions as noted:

Buena Vista Water Storage District (BVWSD) states that the minimum threshold is the trigger level for assessment of undesirable result but did not clearly define what would constitute an occurrence of a local undesirable result (2020 Buena Vista GSA GSP, p. 132).

Henry Miller Water District (HMWD) did not clearly define when the respective management areas would contribute to an undesirable result but stated, “if a level reading from any two (2) monitoring wells for any two consecutive years is below this value, the GSA has exceeded its MT,” (2020 Henry Miller Water District GSP, p. 80).

Olcese GSA defined a local undesirable result as occurring if one MT exceedance occurs for groundwater levels, subsidence, or groundwater storage, but does not define a quantitative definition for an undesirable result with groundwater quality (2020 Olcese GSP, p. 73).

Kern River GSA (KRGSA) defined a local undesirable result as occurring under various conditions in each of their three management area’s subareas (further division of the management area). This includes a local undesirable result as occurring if a single

groundwater level MT exceedance occurred for more than 3 consecutive months within the KRGSA Urban Management Area or KRGSA banking Management Area. The KRGSA Agricultural management area is further fragmented and defined a local UR as occurring when 40% of agricultural wells for more than 2 consecutive years, 40% of urban wells for more than 2 consecutive years, or the exceedances in a specific single monitoring well (2020 Kern River GSA GSP, pp. 5-10).

The Kern Groundwater Authority (KGA) states for each of the 15 Management Area Plans, “each management area has defined the criteria for the number of representative monitoring sites to exceed their minimum threshold for the management area to become an undesirable result watch area and potentially an undesirable result at the basin level,” (2020 Kern Groundwater Authority GSA GSP, p. 170). The various Management Area Plans defined the following:

Cawelo Water District (Cawelo WD) defined that a local undesirable result would be triggered when 30% or more of the monitoring wells in the management area fall below MTs during three consecutive spring measurements (2020 Cawelo Water District Management Area Plan, p. 150).

Rosedale-Rio Bravo Water District (RRBWSD) subdivides its management area into five zones and states that, “the RRBMA will seek to maintain at least two water level monitoring points for each monitoring zone. To the extent that average water levels in of [sic] designated monitoring points has exceeded the minimum threshold of the monitoring zone, it will be considered an undesirable result. To the extent that two of the North, Central, and South of River zones exceed this criterion, the RRBWSD will consider it an undesirable result. To the extent that either the South or East zones exceed this criterion, the RRBMA will consider it an undesirable result.” (2020 Rosedale Rio Bravo Management Area Plan, p. 69).

Pioneer Project, West Kern Water District (WKWD) , and Westside District Water Authority (WDWA) Management Area Plans did not clearly define when local undesirable results would occur and contribute to the overall basin undesirable result (2020 Pioneer GSA, 2020, pp. 5-1; 2020 West Kern Water District GSA, pp. 5-3; 2020 Wastside District Water Authority Management Area Plan, p. 80) .

Arvin Edison Water Storage District (AEWSD) and Wheeler Ridge-Maricopa Water Storage District (WRMWSD) quantitatively define a local undesirable result to occur when 40% of RMS or one well for WQ RMW MTs are exceeded over four consecutive measurements (2 years) (2020 Arvin-Edison Water Storage District Management Area Plan, p. 115; 2020 Wheeler Ridge-Maricopa Water Storage District Management Area Plan, p. 107).

Eastside WMA defined a local undesirable result to occur when MTs are exceeded in no less than 50% of their 9 RMWs, rounded down to the nearest whole number, four (4) wells, over 2 years (2020 Eastside Water Management Area Management Plan, p. 83).

Kern-Tulare Water District (KTWD) defined the undesirable result for the District to occur when 30% of MTs are exceeded in monitoring wells located within the district (2020 Kern Tulare Water District Management Area Plan, pp. 3-1).

Northern Kern Water Storage District (NKWSD) and Shafter Wasco Irrigation District (SWIS), Semitropic GSA (SWSD) and South San Joaquin Municipal Utilities District (SSJMUD), state that the management area will be considered to contribute to an undesirable result when 51% of RMS in a management area exceed their MTs (2020 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, p. 190; 2020 Semitropic Water Storage Management Area Plan, p. 148; 2020 Southern San Joaquin Utility District Management Area Plan, p. 144).

Shafter Wasco ID 7th Standard Annex defined an undesirable result to occur if one of the three RMS wells exceed MTs over three consecutive monitoring periods (2020 Shafter-Wasco ID 7th Standard Annex Management Area Plan, p. 80).

Tejon Castac Water District (TCWD) defined an undesirable result as occurring if an MT exceedance occurred in the single RMW in a manner inconsistent with the temporal driver of natural climatic and hydrologic variability (2020 Tejon-Castac Water District Management Area Plan, p. 63).

D.1.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

In its January 28, 2022, incomplete determination letter, DWR identified a deficiency in the subbasin's 2020 GSP related to coordination:

Deficiency 1 – The [2020] GSPs do not establish undesirable results that are consistent for the entire subbasin.

DWR defined three sub-deficiencies:

1. [T]he Plan's lack an explanation of the specific effects, occurring throughout the Subbasin, that, when significant and unreasonable, would be undesirable results. As described below, the Coordination Agreement includes a calculation framework for determining when a certain portion of the Subbasin experiences negative effects, which have been defined in isolation by a multitude of individual management areas. However, this calculation framework is not accompanied by any cogent description of Subbasin-wide effects caused by groundwater management that the entire Subbasin is attempting to avoid by implementing the Plan.[...] The Plan provides no specific information on the Subbasin-wide effects of groundwater lowering related to accessing groundwater by beneficial uses and users.
2. Notwithstanding the first component of this deficiency and taking the Subbasin's area-based approach at face value, the second component of this deficiency relates to the individual GSPs' and Management Area Plan's widely

varying approaches to define the management-area-specific undesirable results. [...] The Coordination Agreement states that an undesirable result occurs “when the minimum thresholds for groundwater levels are exceeded in at least three (3) adjacent management areas that represent at least 15% of the Subbasin or greater than 30% of the Subbasin (as measured by each management area). Minimum thresholds shall be set by each of the management areas through their respective management area plans or Groundwater Sustainability Plans.” It is apparent to Department staff that the Coordination Agreement’s use of the term “minimum thresholds” in the definition above does not refer to minimum thresholds as defined in the GSP Regulations. Instead, it refers to some, often byzantine, combination of several minimum threshold exceedances, at times coupled with a temporal constraint.

3. [T]he Plan’s incomplete descriptions of the conditions under which an undesirable result would occur, according to the Coordination Agreement’s land area calculation framework and the various GSPs and Management Area Plans. By the Subbasin’s definition of an undesirable result [...] tracking which management area(s) have been triggered as “undesirable” [...] is paramount to determining when an undesirable result occurs. [...] Department staff found this to be true for all applicable sustainability indicators.

(2020 Incomplete Determination of Kern County Subbasin, pp. 13-40)

DWR’s 2020 GSP Corrective Actions

To address the deficiency in the 2020 GSP, DWR staff recommended that the GSAs do the following corrective actions:

- 1a. The Plan’s Coordination Agreement should be revised to explain how the undesirable results definitions are consistent with the requirements of SGMA and the GSP Regulations, which specify that undesirable results represent effects caused by groundwater conditions occurring throughout the Subbasin. The discussion should include descriptions of how the Plans have utilized the same data and methodologies to define the Subbasin-wide undesirable results and how the Plan has considered the interests of beneficial uses and users of groundwater (2020 Incomplete Determination of Kern County Subbasin, 2022).
- 1b. Because of the fragmented approach used in the Subbasin that could allow for substantial exceedances of locally defined minimum thresholds over sustained periods of time, the GSAs must commit to comprehensively reporting on the status of minimum threshold exceedances by area in the annual reports and describe how groundwater conditions at or below the minimum thresholds may impact beneficial uses and users prior to the occurrence of a formal undesirable result (*Ibid.*).

- 1c. The GSAs must adopt clear and consistent terminology to ensure the various plans are comparable and reviewable by the GSAs, interested parties, and Department staff. This terminology should also adhere to the definitions of various terms in SGMA and the GSP Regulations including the understanding that undesirable results are conditions occurring throughout the Subbasin. The Plan and associated coordination materials must also be revised to clearly document how all of the various undesirable results definitions and methodologies achieve the same common sustainability goal. [...] GSAs need to provide a comprehensive description of the groundwater conditions that would lead to localized undesirable results in the GSAs and other management areas which ultimately contribute to the 15 percent or 30 percent of land area criteria. (*Ibid.*).

Deficiency GL – Defining and Avoiding Undesirable Results Related to Chronic Lowering of Groundwater Levels

D.2.1 State Water Board Review of the Kern County Subbasin 2020 Groundwater Sustainability Plan

This subsection and the following subsections describe the portions of the Coordination Agreement, individual GSPs, or DWR’s determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement for the Kern County subbasin described undesirable results for groundwater levels as “the point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, affect the reasonable and beneficial use of, and access to, groundwater by overlying users” (2020 Coordination Agreement, p. 299).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

MTs are the numeric values used to define undesirable results. MOs are specific, quantifiable goals for the maintenance or improvement of groundwater conditions to achieve the sustainability goal for the basin.

The 2020 Coordination Agreement quantified undesirable groundwater level results as the unreasonable lowering of groundwater levels when MTs “are exceeded in at least three (3) adjacent Management Areas that represent at least 15% of the subbasin or

greater than 30% of the subbasin (as measured by each Management Area)” (2020 Coordination Agreement, Appendix 3). The MTs were set for each Management Area in their respective GSP. Additionally, local conditions that would need to occur in each Management Area to contribute toward the basin-wide quantitative undesirable result definition was not well defined across the subbasin (2020 Coordination Agreement, p. 299).

The 2020 GSPs did not describe how groundwater conditions at the MTs would impact beneficial uses of groundwater (e.g., estimating how many wells in the subbasin would be dry if groundwater levels were to drop to the MTs). Therefore, the associated impacts on beneficial uses and users are unknown.

Representative Monitoring Sites and Monitoring Network

The groundwater level monitoring network as described in the 2020 Coordination Agreement includes about 170 monitoring wells shown on a map (2020 Coordination Agreement, App. 3 Fig. 3-1). The Coordination Agreement does not summarize the number of wells to be monitored for chronic lowering of groundwater elevations, nor does it provide a summary table listing all Representative Monitoring Wells and their sustainable management criteria. DWR’s SGMA Portal “Summary of Monitoring Sites” indicates there are 234 monitoring wells for the subbasin. Total depth information is not available for 50 of these 234 wells and values for the remainder range from 219 to 2,290 feet below ground surface.

The KRGSA proposed 34 wells to be monitored for water levels semi-annually in the spring between January 15 and March 30 and in the fall between September 15 and November 15 (2022 KRGSA GSP, pp. 6-3 to 6-7). The BVWSD GSA proposed 13 wells to be monitored for water levels (two of which are nested for two discrete intervals) also semi-annually in the spring and fall (2022 BVGSA GSP, pp. 93-95). The 13 monitoring locations consist of 9 monitoring wells, 3 production wells, and 1 landowner well. The spatial density of the proposed water level monitoring for the BVGSA is one monitoring location per 5.5 square miles (2022 BVGSA GSP, p. 95). The HMWD GSA GSP proposed 5 wells to be monitored for water levels. The SOKR GSA proposed 16 wells to be monitored semi-annually for water levels (2022 SOKRGSA GSP, p. 281). The spatial density of the proposed water level monitoring for the SOKRGSA is 9.7 monitoring sites per 100 miles squared. The KGA GSA proposed 194 to be monitored semi-annually in the spring and fall (2022 KGA GSA GSP, p. 271). The Olcese GSA proposed two wells to be monitored semi-annually in the spring and fall (2022 Olcese GSP, p. 94). The GSA proposed also monitoring groundwater elevations in three additional wells, two district production wells and a new shallow monitoring well, to inform management decisions: the three additional wells would not be part of the SGMA compliance monitoring network.

Well Impact Mitigation

The 2020 Coordination Agreement and GSPs did not mention plans for any well impact mitigation that would lessen the significance of impacts to wells from groundwater level declines allowed in the GSPs.

Projects and Management Actions

The local GSAs have proposed Projects and Management Actions for the subbasin to address groundwater level decline and loss of storage (as well as land subsidence and groundwater quality). The discussion of projects and management actions was general in most GSPs and did not specify the criteria that would trigger implementation, a timetable for implementation, a description of how the GSAs would meet costs, or an explanation of the source and reliability of the water necessary for the supply augmentation projects.

Many of the GSAs summarized the projects and management actions in the Todd Groundwater Tech Memo, an appendix in the Coordination Agreement (2020 Coordination Agreement, Appendix. 2, pp. 22-23). The proposed project and management actions include demand reduction (e.g. agricultural demand reduction, crop fallowing, and land-use conversion to urban), new supply projects from imported water (e.g. projected water purchases, new conveyance facilities, and expansion of surface water deliveries to reduce pumping), and other categories of supply from recharge, diversions, reallocations, and brackish water treatment. Water budget benefits of the proposed projects and management actions are projected to be about 422,000 AF/Y and most of that benefit is expected to come from demand reduction. The water budget aspects of the proposed projects and management actions were included in the Groundwater Flow Model of the Kern County Subbasin Model (C2VSimFG-Kern).

The KGA GSA umbrella GSP listed 173 projects and management actions from 18 member agencies (2020 Kern Groundwater Authority GSA GSP, Table 4-1). Olcese GSP provided a list of projects containing three contingent and three non-contingent projects (2020 Olcese GSP, Table PMA-1). The projects and management actions mainly include installing one shallow well to monitor the aquifer's hydraulic connection, installing the second shallow monitoring well in the vicinity of GDEs, developing a network of subsidence benchmarks, conducting new studies to fully understand the basin setting, and refining the definitions of SMCs for applicable sustainability indicators (Ibid.). KRGSA summarized six supply augmentation and land use change projects to provide about 148,972 AFY to 150,823 AFY of additional water supply to the KRGSA (2020 Kern River GSA GSP, Table 7-1, Section 7, p. 2).

BVWSD GSA suggested five categories of projects that will enable the GSA to sustainably manage groundwater, including water measurement, sustainability monitoring, groundwater recharge and recovery, water distribution system improvement, and water conservation and treatment (2020 Buena Vista GSP, p. 225). HMWD GSA suggested one project to optimize the recovery of Pioneer Project banked supplies in dry years (2020 Henry Miller Water District GSP, p. 85). Since HMWD is a recharge

participant in the Pioneer Project and banked water from different resources since 1995, the district has a second priority right to recover the banked supplies when surface supplies are sparse and deliver recovered water to the lands in the district (ibid). NKWSD projects and management actions focused mainly on improving the water conveyance infrastructure, expanding water banking program, and reusing of oilfield produced water (2020 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, p. 246).

Potential Effects of Minimum Thresholds on Other Sustainability Indicators

The 2020 Coordination Agreement did not explain how MTs had been selected to avoid causing undesirable results. The 2020 Coordination Agreement also did not explicitly discuss how groundwater level MTs relate to the MTs for other sustainability indicators; nor did the 2020 Coordination Agreement explain how the GSAs had determined that basin conditions at groundwater level MTs will avoid undesirable results for each of the sustainability indicators (2022 Inadequate Determination, p. 18).

D.2.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

In the January 28, 2022, DWR determination letter, DWR identified a deficiency in the 2020 GSPs related to groundwater level SMC:

“Deficiency 2. The [2020] Plan does not set minimum thresholds for chronic lowering of groundwater levels in a manner consistent with the requirements of SGMA and the GSP Regulations” (2020 Incomplete Determination of Kern County Subbasin, p. 18).

DWR further noted that the approaches to developing groundwater level MTs was not coordinated across GSPs, stating that “the approaches used and the level of analysis to support those approaches, is disparate across the various plans” (*Id.*, p. 19).

Plain-Language Definition of an Undesirable Result

The GSP defined an undesirable result related to chronic lowering of groundwater levels as “[t]he point at which significant and unreasonable impacts over the planning and implementation horizon, as determined by depth/elevation of water, affect the reasonable and beneficial use of, and access to, groundwater by overlying users.” (2020 Coordination Agreement, Appendix 3), and DWR found that the GSPs:

[D]o not consistently explain how the lowering of groundwater levels to minimum thresholds and measurable objectives that are set below historical lows will impact other sustainability indicators specifically water quality, land subsidence, and reduction of groundwater storage (2020 Incomplete Determination of Kern County Subbasin, p. 2).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

DWR noted that the GSPs “do not consistently explain how the lowering of groundwater levels to minimum thresholds and measurable objectives that are set below historical lows will impact other sustainability indicators specifically water quality, land subsidence, and reduction of groundwater storage” (2022 Inadequate Determination, p. 19).

DWR’s 2020 GSP Corrective Actions

DWR determined for all GSPs that the GSAs needed to take corrective actions to address groundwater level deficiencies, “All GSPs must demonstrate the relationship between the minimum thresholds for each sustainability indicator, including an explanation of how the GSA has determined that basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators”. Additionally, DWR presented GSP-specific corrective actions in Table 2 of the 2020 Incomplete Determination of Kern County Subbasin GSP (*Id.*, pp. 20-35). Some GSPs proposed limiting groundwater level declines to 2013-2016 drought levels while others proposed MTs that were lower than recent drought groundwater levels with proposed mitigation for domestic well impacts. Alternatively, other GSPs for the subbasin proposed trend-projected groundwater level declines as their MTs (*Id.*, p. 19). Table 2 also summarizes DWR’s proposed corrective actions. For example, DWR recommended that the KGA GSP provide description including maps of the areas not covered by their various Management Area Plans and to establish sustainable management criteria for these locations (*Id.*, p. 20).

Deficiency LS – Defining and Avoiding Undesirable Results Related to Land Subsidence

D.3.1 State Water Board Review of the Kern County Subbasin 2020 Groundwater Sustainability Plan

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement defined the Subbasin-wide undesirable result for land subsidence as, “[t]he point at which significant and unreasonable impacts, as determined by a subsidence rate and extent in the basin, that affects the surface land uses or critical infrastructure. This is determined when subsidence results in significant and unreasonable impacts to critical infrastructure as indicated by monitoring points established by a basin wide coordinated GSP subsidence monitoring plan” (2020 Coordination Agreement, Appendix 3, pdf, p. 300). The subbasin did not develop a coordinated, Subbasin-wide “assessment of critical infrastructure that would be

susceptible to substantial interference from future subsidence” (2020 Incomplete Determination of Kern County Subbasin, p. 37).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The 2020 Coordination Agreement described an undesirable result as “[t]he point at which significant and unreasonable impacts, as determined by a subsidence rate and extent in the basin, that affects the surface land uses or critical infrastructure. This is determined when subsidence results in significant and unreasonable impacts to critical infrastructure as indicated by monitoring points established by a basin wide coordinated GSP subsidence monitoring plan” (2020 Coordination Agreement, Appendix 3, pdf, p. 300). The basin-wide, coordinated MOs and MTs were not established for the subbasin.

To avoid damages to infrastructure, some GSPs set the MTs and MOs for chronic lowering of groundwater levels at elevations that are intended to be protective of critical infrastructure (e.g., 2020 Cawelo GSP, p. 154; 2020 Buena Vista Water Storage District GSP, p. 157; KTWD Plan, Chapter 3, p. 2; Southern San Joaquin Municipal Utility District Plan, p. 148; Tejon-Castac Water District Plan, p. 65). The HMWD GSA identified the California Aqueduct as the only critical infrastructure and defined the MT as “the point at which freeboard on the California Aqueduct Pools 29 and 30 is reduced by two-feet relative to the freeboard values in the most recent Aqueduct Subsidence Study” (2020 Henry Miller Water District GSP, p. 81). According to the recent California Aqueduct Subsidence Study, 14.8 miles of the canal (from Pools 22 to 40) were calculated to have less than 2.5 feet of freeboard because of subsidence (DWR, 2017). It is expected that the two feet reduction in freeboard on the Pools 29 and 30 may cause storage and flow capacity issues (2020 Henry Miller Water District GSP, p. 81).

Other GSAs, either did not define MTs and MOs for land subsidence or did not include adequate justification to show how the defined MTs would prevent any impact of subsidence on the critical infrastructure. Olcese GSA claimed no evidence of critical infrastructure being affected by land subsidence and therefore defined no MTs and MOs for land subsidence (2020 Olcese GSP, p. 83). KRGSA claimed no historical subsidence in urban areas (2020 Kern River GSA GSP, Ch. 5, p. 33). However, the GSA set the MTs for agricultural areas according to historical water level. For agricultural areas in the northwest and north-central portions, the MTs were selected to be the historic low water level that occurred during the 2012–2016 drought (*Id.*, p. 34). For agricultural areas in the south and east, the MTs were defined as the allowance of 20 ft below the historic low water levels (*Id.*, p. 34).

Some Management Area Plans stated that the current subsidence rates are not detrimental and there is no historical record of impacts on local infrastructure (2020 Pioneer GSA Management Area Plan, Section 7, p. 22; 2020 West Kern Water District GSA Management Area Plan, Section 7, p. 33). Pioneer GSA set MTs for the subsidence without adequate justification on how the defined MTs (0.5 inch per year)

prevent the undesirable results in the future (2020 Pioneer GSA Management Area Plan, Section 7, p. 22). WKWD GSA claimed that “[b]ecause subsidence has not impacted local infrastructure, and the fact that surface elevations have increased since 1994, an MT rate for subsidence of 2 inches per year (as measured at Kern Water Bank Extensometer 30S/25E16L) is reasonable for warranting a management action to investigate the cause” (2020 West Kern Water District GSA Management Area Plan, Section 7, p. 33). WRMWSD Management Area defined the MTs for California Aqueduct as the only critical infrastructure to be 0.5 inch per year (2020 Wheeler Ridge-Maricopa Water Storage District Management Area Plan, p. 123). The GSA claimed that “[t]he rationale for this Minimum Threshold rate of subsidence is that such subsidence has been historically managed by DWR through maintenance and improvements to its facilities” (*Ibid.*). It is unclear how the subbasin is accounting for loss of storage capacity where subsidence is allowed to continue and impact other water conveyance infrastructure in the basin.

RRWSD Management Area Plan, a KGA member agency, claimed that the historical extensometer data, located in the Kern Water Bank, proved subsidence is not an applicable sustainability indicator in the area, and as of June 2018, the land surface elevation was 0.27 feet higher than the land surface in June 1994 (2020 Rosedale Rio Bravo Management Area Plan, p. 55). RRBWSD states that until a regional subsidence program is developed, a threshold of two feet will be assigned for subsidence (2020 Rosedale Rio Bravo Management Area Plan, p. 78). KGA GSA stated that “[t]he development of minimum thresholds for land subsidence at the basin level is ongoing due to data gaps in monitoring and identification of undesirable results in the Subbasin” (2020 Kern Groundwater Authority GSA GSP, p. 178).

Representative Monitoring Sites and Monitoring Network

The 2020 GSPs described the use of continuous global positioning surveys (CGPS), extensometers, level surveying (benchmark monuments), and satellite data using interferometric synthetic aperture radar (InSAR). The GSAs used two extensometers located in the SWSD and KWB (2020 Coordination Agreement, Technical Memorandum, Figure 2, pdf, p. 323). The Coordination Agreement stated the possibility of adding additional extensometer locations but did not offer any further information on the exact timeline (2020 Coordination Agreement, Technical Memorandum, p.7).

In addition to extensometers, the Scripps Orbit and Permanent Array Center (SOPAC) Continuous GPS sites, the NOAA Continuously Operating Reference Stations (CORS), Southern California Integrated GPS Network, the United States Bureau of Reclamation (USBR) Friant-Kern Benchmark Subsidence Survey, and the NKWSD subsidence monitoring sites were listed in the subbasin's regional subsidence monitoring network (2020 Coordination Agreement, Technical Memorandum, Figure 2; 2020 North Kern WSD Plan, Table 2-31, p. 177). Lastly, the GSAs stated the use of InSAR data to

monitor regional land surface changes (2020 Coordination Agreement, Technical Memorandum, pp. 6-10).

The KGA GSA was the lead on a coordinated effort to fill the data gaps in the regional subsidence monitoring network. Five Areas of Interest (AOIs) were identified to improve the subbasin's monitoring network. Of the selected AOIs, two areas were located along the Friant-Kern Canal, two areas were along the California Aqueduct, and one area was located along the northern boundary of the subbasin where a significant amount of subsidence has been reported in the InSAR data (2020 Coordination Agreement, Technical Memorandum, p. 4). The technical memorandum did not indicate the exact timeline for implementation, or a description of how the GSAs would meet funding requirements.

Infrastructure Mitigation

The 2020 GSPs did not include specific plans to mitigate the impacts of subsidence even though the developed SMCs allowed continued subsidence.

Projects and Management Actions

The 2020 Coordination Agreement listed the proposed future (WY2021–WY2040) projects and management actions provided by GSAs to project future water budgets in the subbasin. The management actions were categorized into three groups: 1) demand reduction by land use change (reduce crop water use, fallowing of agricultural land and using the land as recharge basins, and conversion of agricultural land to urban land), 2) increase of imported water supply (increasing imported surface water, adding new water conveyance facilities, and expanding the surface water delivery areas), and 3) increase of local water supply (recharging treated waste water from urban areas and oil production operations, increasing stream flow diversion, reallocation of water, and treating the brackish groundwater in areas not currently in overdraft and mixing it with surface water) (2020 Coordination Agreement, p. 22).

KGA umbrella GSP listed 173 projects and management actions from 18 member entities with the implementation status, benefits of the project, and project description (2020 Kern Groundwater Authority GSA GSP, Table 4-1). Olcese GSP provided a list of projects containing three contingent and three non-contingent projects with details on the suggested timeline for initiation and completion (2020 Olcese GSP, Table PMA-1). The projects and management actions mainly include installing one monitoring shallow well to understand the aquifer's hydraulic connection, installing the second monitoring shallow wells in the vicinity of GDEs, developing a network of subsidence benchmarks, conducting new studies to fully understand the basin setting, and refining the definitions of SMCs for applicable sustainability indicators (Ibid.). The KRGSA summarized six supply augmentation and land use change projects to provide about 148,972 AFY to 150,823 AFY of additional water supply to the KRGSA (2020 Kern River GSA GSP, Table 7-1, Section 7, p. 2).

To provide a secure water supply for the future, BVWSD GSA suggested five categories of projects that will enable the GSA to sustainably manage groundwater, including water measurement, sustainability monitoring, groundwater recharge and recovery, water distribution system improvement, and water conservation and treatment (2020 Buena Vista GSP, p. 225). HMWD GSA suggested one project to optimize the recovery of Pioneer Project banked supplies in dry years (2020 Henry Miller Water District GSP, p. 85). Since HMWD is a recharge participant in the Pioneer project and banked water from different resources since 1995, the district has a second priority right to recover the banked supplies when surface supplies are sparse and deliver recovered water to the lands in the district (*Ibid.*). NKWSD projects and management actions focused mainly on improving the water conveyance infrastructure, expanding water banking program, and reusing of oilfield produced water (2020 North Kern Water Storage District and Shafter-Wasco Irrigation District Management Area Plan, p. 246).

The discussion of projects and management actions was general in most GSPs and did not specify the criteria that would trigger implementation, a timetable for implementation, a description of how the GSAs would meet costs, or an explanation of the source and reliability of the water necessary for the supply augmentation projects.

D.3.2 Department of Water Resources' 2020 Groundwater Sustainability Plan Incomplete Determination

In the January 28, 2022, DWR Incomplete Determination Letter, DWR identified a deficiency in the 2020 GSPs related to the land subsidence SMC:

Deficiency 3 – The [2020] Plan's land subsidence sustainable management criteria do not satisfy the requirements of SGMA and the GSP regulations.

(2020 Incomplete Determination of Kern County Subbasin, p. 35)

Plain-language Definition of an Undesirable Result

The DWR 2020 GSP Incomplete Determination indicated that the GSAs should “document the conditions for undesirable results for which the GSAs are trying to avoid, supported by their understanding of land uses and critical infrastructure in the Subbasin and the amount of subsidence that would substantially interfere with those uses” (*Id.*, pp. 38-39).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

DWR staff noted issues with the way the GSAs defined an undesirable result, stating that:

“the Coordination Agreement should be revised to clearly identify the undesirable result parameters for each of the GSPs, management areas, and management area plans so it is clear how the various plans work together at the Subbasin level” (*Id.*, p. 39).

DWR also noted issues with how the minimum threshold was defined, stating that: “The revised Plan, and component GSPs and management areas, should identify the rate and extent of subsidence corresponding with substantial interference that will serve as the minimum threshold, or should thoroughly demonstrate that another metric can serve as a proxy for that rate and extent” (*Ibid.*).

And,

“The Plan should include clearly defined undesirable and appropriate minimum thresholds and measurable objectives” (*Id.*, p. 38).

Some plans appeared to use the MTs and MOs developed for the chronic lowering of groundwater level as a proxy for subsidence; however, DWR staff noted that the developed criteria:

“...do not include the required demonstration showing that the values developed for chronic lowering of groundwater levels are reasonable proxies for the amount of land subsidence that would substantially interfere with surface land uses” (*Ibid.*).

Although GSAs proposed projects and management actions, it was not clear how implementing these projects is consistent with avoiding MTs and undesirable results. Furthermore, DWR staff concluded that:

“Because the Plan lacks a coordinated, Subbasin-wide management approach for subsidence, Department staff cannot meaningfully and completely review the fragmented approaches to establish sustainable management criteria for subsidence in the various GSPs and management area plans” (*Ibid.*).

And,

... “the Plan, including the Coordination Agreement and all GSPs, should be revised to present a Subbasin-wide management approach for subsidence that includes the elements required by SGMA and the GSP Regulations” (*Ibid.*).

Department of Water Resources’ 2020 Groundwater Sustainability Plan Corrective Actions

DWR staff proposed corrective action 3 to address the subsidence deficiency in the 2020 GSP. DWR staff recommended that:

- The Subbasin’s GSAs should coordinate and collectively satisfy the requirements of SGMA and the GSP Regulations to develop the sustainable management criteria for land subsidence. The GSPs should document the conditions for undesirable results for which the GSAs are trying to avoid, supported by their understanding of land uses and critical infrastructure in the Subbasin and the

amount of subsidence that would substantially interfere with those uses.

- The revised Plan, and component GSPs and management areas, should identify the rate and extent of subsidence corresponding with substantial interference that will serve as the minimum threshold, or should thoroughly demonstrate that another metric can serve as a proxy for that rate and extent.
- ... the Coordination Agreement should be revised to clearly identify the undesirable result parameters for each of the GSPs, management areas, and management area plans so it is clear how the various plans work together at the Subbasin level.
- The revised Plan should explain how implementing projects and management actions proposed in the various GSPs is consistent with avoiding subsidence minimum thresholds, sufficient to avoid substantial interference, similar to the original Plan's assessment of whether implementation would avoid undesirable results for groundwater levels.
- If land subsidence is not applicable to parts of the Subbasin, the GSPs must provide supported justification of such. The supporting information must be sufficiently detailed and the analyses sufficiently thorough and reasonable and must be supported by the best available information and best available science. (2020 Incomplete Determination of Kern County Subbasin, pp. 38-39).

Deficiency GWQ – Defining and Avoiding Undesirable Results Related to Groundwater Quality

D.4.1 Kern County Subbasin 2020 Groundwater Sustainability Plans

This subsection and the following subsections describe the portions of each GSP or DWR determination relevant to the proposed Board deficiencies.

Plain-language Definition of an Undesirable Result

The 2020 Coordination Agreement defined an undesirable result for degraded groundwater quality as “the point at which significant and unreasonable impacts over the planning and implementation horizon, as caused by water management actions, that affect the reasonable and beneficial use of, and access to, groundwater by overlying users” (2020 Coordination Agreement, Appendix A).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

GSAs defined an undesirable result as occurring when minimum thresholds for a groundwater quality constituent of concern is exceeded in at least three (3) adjacent Management Areas that represent at least 15% of the subbasin or greater than 30% of the designated monitoring points within the basin (as measured and set by each management area). A Management Area would only contribute to an undesirable result when local undesirable results are occurring. Different Management Areas define local undesirable results as occurring based on various conditions as mentioned in Section 4.1.1. It should also be noted that the method for determining which constituents should be considered for SMC and how SMC are monitored varied across all plans. A few examples are provided as follows:

BVWSD GSP proposed to use groundwater quality data from representative monitoring wells and public water system (DDW) wells and set conservative MTs (drinking water standards vs. agricultural) for analyte concentration regardless of existing exceedances. Minimum thresholds were set for Arsenic, Boron, Chloride, DBCP, Hexavalent Chromium, Nitrate, Sodium, TCP, and TDS (2020 Buena Vista GSP, p. 150). The quantitative definition of what would contribute to an UR for degradation of groundwater quality was not defined.

KRGSA GSP proposed to use groundwater quality data from DDW, DWR, KCWA, USGS, and other data sources. After the conducted a statistical analysis, between groundwater levels and constituent concentrations, the GSA determined that only arsenic could be impacted by groundwater management actions and set SMC at groundwater level lows as a proxy for degradation of groundwater quality (2020 Kern River GSA GSP, pp. 3-39 and 5-28). The Kern River GSP defined a local undesirable result as occurring under various conditions in each of their three subareas (additional management areas). This includes a local UR as occurring if a single groundwater level MT exceedance occurred for more than [three] consecutive months within the KRGSA Urban Management Area or KRGSA banking Management Area. The KRGSA Agricultural Management Area is further fragmented and defined a local undesirable result as occurring when one of the following occurred: (1) 40% of agricultural wells for more than [three] consecutive years, (2) 40% of urban wells for more than [two] consecutive years, or (3) there are exceedances in a specific single monitoring well (*Id.*, pp. 5-10).

In other cases, SMC for degradation of groundwater quality were not set. For example, the Olcese GSP did not establish SMC for the degradation of groundwater quality since “drinking and irrigation water quality are monitored by existing regulatory compliance efforts and no casual nexus between groundwater quality and water management activities are identified” (2020 Olcese GSP, p. 83).

Variations of the above examples result in additional use of data and methodologies to establish SMC. Additional issues related to coordination between plans are discussed in more detail in Section 4.1.1.

Monitoring

As mentioned above, the GSPs utilized various data and methods for setting SMC in their 2020 GSPs. This is also true for monitoring network sampling, parameters collected, spatial density, and frequency. The following examples serve to demonstrate a few examples of the variability between the GSPs. Other methods may be included in GSPs that are not listed here. Examples from 2020 Plans for monitoring are as follows:

KRGSA GSP proposed to monitor groundwater levels as a proxy to groundwater quality in 19 wells, monthly. The GSA proposed to also use periodic DDW and ILRP data from local Public Water systems and small water systems that may be used periodically for groundwater characterization (2020 Kern River GSA GSP, Sec. 6, pp. 7-12).

BVWSD GSP proposed to collect groundwater quality samples from ILRP wells (GQTMWP wells), district production wells, and landowner wells on a semi-annual basis. A total of 13 sites, within the 72 square-mile management area of Buttonwillow, were included in the network resulting in a monitoring network with a spatial density of one site per 6.8 square miles (2020 Buena Vista GSP, p. 104). The Maple Management Area monitoring network was not defined in the GSP as the monitoring plan for this management area will be developed and monitored by the KRGSA (Ibid, pp. 102-104).

AEWSD Management Area Plan (KGA Member) defined a MT for one of eight proposed RMS for degradation of groundwater quality that would be sampled annually, resulting in a density of 4.84 sites per 100 square-mile area or one site per 20 square miles. The proposed RMS are all presumed to be active and in use for industrial, irrigation, or municipal use (2020 Arvin-Edison Water Storage District Management Area Plan, pp. 144-146).

The above examples demonstrate the basin's fragmented approach for monitoring degradation of groundwater quality in the subbasin. Additional data and methodologies are defined in the numerous 2020 GSPs and Management Area Plans which make it difficult to evaluate for sustainability.

D.4.2 DWR's 2020 GSP Incomplete Determination

In its January 28, 2022, incomplete determination letter, DWR identified the following deficiencies in the subbasins 2020 GSPs related to groundwater quality:

Deficiency 1 – The GSPs do not establish undesirable results that are consistent for the entire subbasin.

[This] deficiency (also described in Section 4.1.1) relates to the below sub-deficiencies as they impact groundwater quality, potentially in addition to other sustainability indicators, as defined by DWR:

1. GSAs do not establish a consistent definition of undesirable results within the subbasin. Particularly where the two-tiered approach does not specify when a management area would contribute to the basin wide definition of an undesirable result (3 adjacent management areas exceedances accounting for at least 15% of basin area or management area exceedances totaling more than 30% of the basin area). As defined in Section 4.1.1, different management areas would contribute, if at all, to the basin definition of an undesirable result under widely variable instances (2023 DWR Determination Letter, pp. 13-14).
2. GSAs use disparate data and methodology to set SMC throughout the subbasin (*Ibid.*). (Board staff observed that this deficiency has resulted in differences in parameters measured, frequency in monitoring, and SMC concentrations.)

And,

Deficiency 2 – The Plan does not set minimum thresholds for chronic lowering of groundwater levels in a manner consistent with the requirements of SGMA and the GSP regulations.

[This] deficiency relates to the below sub-deficiencies that may impact groundwater quality as defined by DWR:

The GSPs also do not consistently explain how the lowering of groundwater levels [sic] minimum thresholds and measurable objectives that are set below historical lows will impact other applicable sustainability indicators, particularly groundwater quality (2022 Inadequate Determination, p. 19).

Additionally, the GSPs use differing constituents and methods to establish minimum thresholds including some GSPs using groundwater levels as a proxy for degradation of water quality. Department staff recognize that a subbasin the size of the Kern County Subbasin will have a wide variety of water quality concerns requiring different management strategies; however, at this time, it is clear that the GSPs do not consider, or at least do not document, the potential for degradation to occur due to further lowering of groundwater levels beyond the historic lows. The GSPs should also consider and discuss the opportunities to coordinate and leverage existing programs and agencies to help understand whether implementation of the GSPs is resulting in degradation of water quality. (*Id.*, p. 19-20).

Plain-Language Definition of an Undesirable Result

The coordination agreement defined the undesirable result for degradation of groundwater quality as “the point at which significant and unreasonable impacts over

the planning implementation horizon, as caused by water management action, that affect the reasonable and beneficial use of and access to, groundwater by overlying users” (2020 Coordination Agreement, Appendix 3, p. 2).

Quantitative Definition of an Undesirable Result, Minimum Thresholds and Measurable Objectives and Associated Impacts

The Coordination Agreement defined the quantitative definition for an undesirable result as occurring when, “minimum thresholds for SMC are exceeded in at least three adjacent management areas that represent at least 15% of the subbasin area or greater than 30% of the designated monitoring points within the basin. Minimum thresholds shall be set by each management areas through their respective Groundwater Sustainability Plans” (2020 Coordination Agreement). The condition in which each management area would be considered to contribute to the undesirable result, as defined in the coordination agreement, is inconsistently defined in each of the plans (see Section 4.1.1).

DWR staff expressed concern with the way the undesirable results and sustainable management criteria are defined and set in the individual plans, and then defined at the Subbasin level, and believe that there is a real possibility of groundwater conditions being significantly worse than the established minimum thresholds in various portions of the Subbasin before the GSAs determine the Subbasin as a whole has experienced an undesirable result (2020 Incomplete Determination of Kern County Subbasin, p. 13).

DWR's 2020 GSP Corrective Actions

To address the deficiency in the 2020 GSP, DWR staff recommended that the GSAs do the following corrective actions:

DWR Deficiency 1 corrective actions:

- 1a. The Plan's Coordination Agreement should be revised to explain how the undesirable result definitions are consistent with the requirements of SGMA and the GSP Regulations, which specify that undesirable results represent effects caused by groundwater conditions occurring throughout the Subbasin. The discussion should include descriptions of how the Plans have utilized the same data and methodologies to define the Subbasin-wide undesirable results and how the Plan has considered the interests of beneficial uses and users of groundwater (2022 Inadequate Determination).
- 1b. Because of the fragmented approach used in the Subbasin that could allow for substantial exceedances of locally defined minimum thresholds over sustained periods of time, the GSAs must commit to comprehensively reporting on the status of MT exceedances by area in the annual reports and describe how groundwater conditions at or below the MTs may impact beneficial uses and users prior to the occurrence of a formal undesirable result.

- 1c. The GSAs must adopt clear and consistent terminology to ensure the various plans are comparable and reviewable by the GSAs, interested parties, and Department staff. This terminology should also adhere to the definitions of various terms in SGMA and the GSP Regulations including the understanding that undesirable results are conditions occurring throughout the Subbasin. The Plan and associated coordination materials must also be revised to clearly document how all of the various undesirable result definitions and methodologies achieve the same common sustainability goal.[...] GSAs should provide a comprehensive description of the groundwater conditions that would lead to localized undesirable results in the GSAs and other management areas which ultimately contribute to the 15 percent or 30 percent of land area criteria.

(2020 Incomplete Determination Kern County Subbasin, pp. 16-17)

DWR Deficiency 2 corrective actions (specific to groundwater quality sub-deficiency):

- 2a. Based on the groundwater level declines allowed for by many of the minimum thresholds, the GSPs need to explain how those groundwater level declines relate to the degradation of groundwater quality sustainability indicator. The GSPs must describe, among other items, the relationship between minimum thresholds for a given sustainability indicator (in this case, chronic lowering of groundwater levels) and the other sustainability indicators, degradation of water quality in particular. The GSPs generally commit to monitoring a wide range of water quality constituents, but they do not establish a consistent definition of undesirable results. Additionally, the GSPs use differing constituents and methods to establish minimum thresholds including some GSPs using groundwater levels as a proxy for degradation of water quality.
- 2b. The GSPs should also consider and discuss the opportunities to coordinate and leverage existing programs and agencies to help understand whether implementation of the GSPs is resulting in degradation of water quality.

(2020 Incomplete Determination of Kern County Subbasin, pp. 19-35)