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CHAPTER 5
Sustainable Management Criteria

This chapter describes the sustainable management criteria for each applicable sustainability indicator for the Colusa Subbasin. These sustainable management criteria are used by the Colusa GSAs to gauge progress towards achieving Sustainability Goals during GSP implementation. This chapter also describes undesirable results for each applicable sustainability indicator and how undesirable results are detected.

5.1 SUSTAINABILITY TERMINOLOGY

This section describes the sustainability goal and undesirable results for the Colusa Subbasin (Subbasin) for each applicable sustainability indicator.

- **Sustainability goal**: The sustainability goal qualitatively describes the overall objectives of the Groundwater Sustainability Plan (GSP) and desired conditions for the Subbasin.
- **Undesirable results**: Undesirable results statements describe the Subbasin conditions at which each applicable sustainability indicator would have significant and unreasonable effects on the beneficial uses and users of groundwater in the Subbasin.

5.1.1 Sustainability Indicators

A sustainability indicator is defined in the Sustainable Groundwater Management Act (SGMA) as one of six effects caused by groundwater conditions that, when significant and unreasonable, cause undesirable results. The six sustainability indicators are described by the California Department of Water Resources (DWR) in the document *Sustainable Management Criteria, Best Management Practices for the Sustainable Management of Groundwater* (DWR, 2017) as follows:

Indicator Symbol	Explanation
	"Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.
	Significant and unreasonable reduction of groundwater storage.
	Significant and unreasonable seawater intrusion.
	Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.
	Significant and unreasonable land subsidence that substantially interferes with land uses.
	Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water."

SGMA allows several pathways to meet the distinct local needs of each basin, including:

- Development of sustainable management criteria for each sustainability indicator
- Use of groundwater elevation as a proxy metric for other sustainability indicators
- Exclusion of specific indicators that are not applicable to the basin.

Five sustainability indicators are applicable to the Colusa Subbasin:

- chronic lowering of groundwater levels
- reduction of groundwater storage
- degraded water quality
- inelastic land subsidence
- depletions of interconnected surface water

Sustainable management criteria have been established herein for the chronic lowering of groundwater levels, degraded water quality, and inelastic land subsidence. Both depletions of interconnected surface water and reduction of groundwater storage utilize groundwater levels as a proxy. Seawater intrusion is not applicable to the Colusa Subbasin due to the distances between the Subbasin and the Pacific Ocean, bays, deltas, or inlets ranging from about 30 to 60 miles. Because seawater intrusion is not applicable to the Colusa Subbasin, only the five applicable sustainability indicators are addressed hereinafter.

Continued data collection and an improved understanding of Subbasin conditions in the future may lead to changes in the sustainable management criteria discussed herein. Section 7.4 describes the 5-year GSP update process. Including an evaluation of the progress towards meeting interim goals and a reassessment of sustainable management criteria in light of new data.

5.2 SUSTAINABILITY GOAL

23 CCR §354.24 requires establishment of a sustainability goal for the basin that culminates in the absence of undesirable results by 2042. The sustainability goal provides a qualitative description of the Subbasin's objectives relative to sustainable management and desired groundwater conditions in the Colusa Subbasin. Information from Chapter 3, Basin Setting, including information on historical, current, and future water budgets, and provisional estimates of sustainable yield, have informed understanding of the status of the Subbasin and, subsequently, development of the sustainability goal for the Colusa Subbasin. The sustainability goal is consistent with avoidance of locally-defined undesirable results and is supported by the quantitative minimum thresholds, measurable objectives, and interim milestones identified in this chapter. Demonstration of the absence of undesirable results supports a determination that a Subbasin is operating within its sustainable yield and thus the sustainability goal has been achieved.

The sustainability goal for the Colusa Subbasin is:

> *…to maintain, through a cooperative and partnered approach, locally managed sustainable groundwater resources to preserve and enhance the economic viability, social well-being and culture of all beneficial uses and users, including domestic, agricultural, municipal, environmental, tribal, and industrial, without experiencing undesirable results by managing use within the sustainable yield.*

5.2.1 Operate within Sustainable Yield

Projects and management actions that the Groundwater Sustainability Agencies (GSAs) could implement to ensure that the Colusa Subbasin is operated within its sustainable yield (i.e., to avoid undesirable results) are described in Chapter 6. The Introduction to Chapter 6 describes an adaptive management approach for implementing projects and management actions that will be informed by monitoring of groundwater conditions, and will lead to implementation of additional projects if Measurable Objectives are not being maintained and Minimum Thresholds are being approached.

An adaptive management approach recognizes that undesirable results do not currently exist in the Subbasin, and it is uncertain that undesirable results will develop in the future. The uncertainty is primarily related to the relatively small groundwater storage imbalances estimated to occur under future conditions (see Chapter 3, Section 3.3, Water Budget Information), the uncertainty associated with those estimates, and uncertainty associated with when and how potential future climate change actually affects the Subbasin. Monitoring of actual groundwater conditions over time will determine whether, when, and where implementation of projects and management actions may be needed to avoid undesirable results.

Despite the long-term adaptive implementation approach described above, certain Colusa Subbasin projects are currently moving toward implementation to address localized declining groundwater levels that are believed to be primarily drought-induced[1]. These "planned projects" are described in Chapter 6 and are regarded as projects that will contribute to long term sustainable groundwater management in addition to alleviating temporary drought-induced effects in the near term.

5.2.2 Achieving Sustainability within 20 Years

As discussed above, the Colusa Subbasin does not currently have undesirable results, which shows that the Subbasin is being managed sustainably. Additionally, it is uncertain that undesirable results will occur in the future. If monitoring detects that Measurable Objectives are not being maintained and Minimum Thresholds are being approached, the GSAs and other project proponents are committed to implementing projects and management actions to avoid undesirable results, as described in Chapters 6 and 7.

5.3 UNDESIRABLE RESULTS

As described in 23 CCR §354.26, undesirable results occur when one or more significant and unreasonable effects are caused by groundwater conditions occuring throughout the Subbasin, as assessed using the five applicable sustainability indicators described earlier: chronic lowering of groundwater levels, reduction of groundwater storage, degraded water quality, inelastic land subsidence, and/or depletions of interconnected surface water. The California Department of Water Resources (DWR)'s *Sustainable Management Criteria Best Management Practices* (BMP) was developed to help Groundwater Sustainability Agencies (GSAs) establish their sustainability criteria by first identifying the significant and unreasonable effects caused by groundwater conditions in the Subbasin that constitute undesirable results, and then identifying quantitative criteria to define when and where the effects of groundwater conditions cause undesirable results for each applicable sustainability indicator. These quantitative criteria define the number and location of monitoring points that may be below a specific minimum

[1] A series of mostly dry years beginning in about 2007 has resulted in increased irrigation demands within the Subbasin and curtailments of Central Valley Project surface water supplies, and consequently increase in groundwater pumping. In some locations these effects of drought are compounded by expansion of irrigation lands served solely by groundwater.

threshold prior to a GSA identifying conditions as an undesirable result. The *Sustainable Management Criteria* BMP states that "undesirable results will be defined by minimum threshold exceedances" (DWR, 2017).

This section presents the undesirable results statements for the Subbasin, which were developed through a process that characterizes specific groundwater conditions that lead to undesirable results in the Colusa Subbasin and identifies minimum thresholds that, when exceeded, may indicate that undesirable results could occur. Input from Subbasin stakeholders, the public, and GSA members was used in conjunction with data collected and evaluated for preparation of the Plan Area and Groundwater Conditions chapters of this GSP to guide development of the undesirable results statements. These statements utilize quantitative thresholds (as described later in this section) to indicate where and when undesirable results might occur in the representative monitoring network, and therefore the Subbasin.

Chapter 4 describes the Subbasin's monitoring networks and representative monitoring networks for each applicable sustainability indicator.

The five applicable sustainability indicators are addressed to determine whether and when significant and unreasonable impacts are occurring on beneficial uses and/or users in the Subbasin. For each indicator, the potential for undesirable results is described. Causes of groundwater conditions leading to significant and unreasonable effects are identified, and undesirable results defined based on current Subbasin conditions, the California Water Code, SGMA regulations, BMPs, and stakeholder input. For each sustainability indicator, the following have been developed:

- Description of undesirable results – describes groundwater conditions causing the specific significant and unreasonable effects that constitute undesirable results.
- Identification of undesirable results – describes the criteria used to define when and where groundwater conditions cause undesirable results, defined and detected by minimum threshold exceedances.
- Potential causes of undesirable results – describes groundwater conditions that could lead to undesirable results.
- Potential effects of undesirable results – describes what could happen to beneficial uses and users of groundwater if undesirable results were to occur.
- Evaluation of the presence of undesirable results – describes whether undesirable conditions are present in the Subbasin and/or are detected through monitoring.

As previously noted, undesirable results related to seawater intrusion are not present in the Subbasin and are not likely to occur. Thus, criteria for undesirable results related to this sustainability indicator are not applicable to this GSP.

5.3.1 Chronic Lowering of Groundwater Levels

5.3.1.1 Description of Undesirable Results for Chronic Lowering of Groundwater Levels

The undesirable result for the chronic lowering of groundwater levels is a result that would cause significant and unreasonable reduction in the long-term viability of beneficial uses and users over the planning and implementation horizon of this GSP.

An undesirable result for chronic lowering of groundwater levels in the Colusa Subbasin is experienced if sustained groundwater levels are too low to reasonably satisfy beneficial uses within the Subbasin over the planning and implementation horizon of this GSP. Undesirable results for the chronic lowering of groundwater levels have not occurred historically and are not currently occurring. Per the projected water budget (Chapter 3), these effects are not likely to occur in the foreseeable future.

Potential impacts of chronic lowering of groundwater levels and the extent to which they are considered significant and unreasonable were determined by the GSA members with input from local stakeholders and members of the public. During development of the GSP, potential undesirable results identified by stakeholders included:

- A significant and unreasonable number of wells going dry
- A significant and unreasonable reduction in the pumping capacity of existing wells
- A significant and unreasonable increase in the need for deeper wells or lower pump settings
- Adverse impacts to environmental uses and users, including reductions in the flows of interconnected surface waters and reductions in groundwater available to the root zones of groundwater-dependent ecosystems (GDEs)

5.3.1.2 Identification of Undesirable Results

An undesirable result is considered to occur for the chronic lowering of groundwater levels during GSP implementation when 25 percent or more of the representative monitoring wells (i.e., 12 of 48 wells) in the Colusa Subbasin fall below their minimum groundwater elevation threshold levels for 24 consecutive months. The 12 wells must be the same subset of wells, not any combination of 12 wells. Minimum threshold levels for each well were determined using the best available data by the process described in Section 5.4. Additional justification and information supporting the process and criteria used to define when and where the effects of the groundwater conditions may cause undesirable results is provided in Appendix 5A.

These criteria were determined based on an evaluation of the best available data pertaining to the Subbasin's specific conditions and characteristics, as described in the Plan Area and Basin Setting sections of this GSP (Chapter 2 and Chapter 3, respectively), in conjunction with input and feedback from the public, stakeholders, and GSA members. The GSAs determined these criteria based on the justification that minimum threshold exceedances of 25 percent or more of representative monitoring wells represent a "significant" impact, and that exceedance of these levels for 24 consecutive months or longer (e.g. no recovery of groundwater levels through two consecutive seasonal high periods) constitutes a chronic impact that would potentially harm the "long-term viability" of affected beneficial uses and users in the Subbasin. The criterion of 25 percent or more of the representative monitoring wells dropping below their

minimum thresholds for 24 consecutive months was regarded as an indicator of a significant, widespread problem representing undesirable results.

5.3.1.3 Potential Causes of Undesirable Results

Potential causes of groundwater conditions that would lead to this undesirable result for the chronic lowering of groundwater levels are groundwater pumping in excess of Subbasin sustainable yield, with sustainable yield affected by potential changes in recharge of precipitation and applied irrigation water and other factors. Potential local impacts to groundwater levels could be caused by one or more of the following:

- Reduction in surface water supplies available to the Subbasin, particularly surface water diversions from the Sacramento River and Stony Creek
- Increases in groundwater pumping to meet increased crop consumptive use caused by climate change or shifts to higher water use crops

For example, if Sacramento River surface water supplies available under Central Valley Project (CVP) contracts are reduced due to changes in federal water allocation policy or other factors, groundwater pumping would have increase to meet any water supply shortages. If surface water supplies remained unchanged but crop consumptive use increased due to climate change, groundwater pumping would need to increase to meet higher irrigation requirements. Increased groundwater pumping exceeding sustainable yield (as defined in Chapter 3) could cause lowering of groundwater levels leading to undesirable results.

5.3.1.4 Potential Effects of Undesirable Results

If groundwater levels were to reach levels indicating undesirable results have occurred, specific undesirable effects to beneficial uses and users of groundwater, land uses, property interests, and others could potentially include:

- De-watering of some existing groundwater production wells, starting with the shallowest wells (which are primarly domestic wells)
- Increased production well construction costs
- Increased groundwater pumping costs due to inreased lifts
- Adverse effects on GDEs if the depth to groundwater falls below the root zones of GDEs
- Forced changes to lower water use, lower economic return crops
- Adverse effects on property values and the regional economy

Implementation of the GSP is intended to avoid these effects by monitoring and implementing projects and management actions as needed to maintain groundwater levels above the minimum thresholds at representative monitoring wells.

5.3.1.5 Evaluation of the Presence of Undesirable Results

Section 5.4 discusses how minimum thresholds were selected. More information on how the thresholds were established is also included in Appendix 5A, along with hydrographs of groundwater levels for each monitoring site through 2020 and the established depth of the minimum threshold. Of the 48 monitoring wells, none were below the minimum threshold in the latest measurement in 2020, indicating that the Subbasin does not currently exceed the requirements for an undesirable result for the chronic lowering

of groundwater levels. The GSAs will continue to monitor groundwater levels to identify potential undesirable results as part of GSP annual reports and five-year updates, and adapt GSP implementation, as needed, to avoid undesirable results.

5.3.2 Reduction of Groundwater Storage

5.3.2.1 Description of Undesirable Results for the Reduction of Groundwater Storage

The undesirable result for the reduction of groundwater in storage is a result that would cause significant and unreasonable reduction in the long-term viability of beneficial uses and users over the planning and implementation horizon of this GSP.

An undesirable result for the reduction of groundwater storage is experienced if storage volumes are insufficient to reasonably satisfy beneficial uses within the Subbasin over the planning and implementation horizon of this GSP. Undesirable results related to groundwater storage have not occurred historically and are not currently occurring. Per the projected water budget (Chapter 3), these effects are not likely to occur in the foreseeable future.

5.3.2.2 Justification of Groundwater Levels as a Proxy

This GSP uses groundwater level minimum thresholds as a proxy for the reduction of groundwater storage sustainability indicator. GSP regulations allow GSAs to use groundwater level minimum thresholds as a proxy metric for any sustainability indicator provided the GSP demonstrates that there is a significant correlation between groundwater levels and the other metrics. In order to rely on groundwater levels as a proxy, one approach suggested by DWR is to:

> *Demonstrate that the minimum thresholds and measurable objectives for chronic declines of groundwater levels are sufficiently protective to ensure significant and unreasonable occurrences of other sustainability indicators will be prevented. In other words, demonstrate that setting a groundwater level minimum threshold satisfies the minimum threshold requirements for not only chronic lowering of groundwater levels but other sustainability indicators at a given site (DWR, 2017).*

Minimum thresholds for groundwater levels will effectively avoid undesirable results for reduction of groundwater storage if it is demonstrated that adequate storage remains in the Subbasin even if chronic lowering of groundwater levels occurs. Based on the estimated range of current storage volume in the Colusa Subbasin (Chapter 3) and the small percentage changes in storage estimated to occur over groundwater levels ranging from historical lows to the groundwater levels minimum thresholds, it is anticipated that an undesirable result related to the chronic lowering of groundwater levels would occur before the Subbasin would experience significant and unreasonable effects related to reduction of groundwater storage. This is because the base of fresh groundwater is generally far below the groundwater level minimum thresholds that have been adopted, and large volumes of groundwater would remain in storage even if minimum thresholds were reached.

As discussed in Chapter 3, the current groundwater storage volume within the Colusa Subbasin, above the crystalline basement rocks and base of freshwater, is estimated to be between about 26 million acre-feet (maf) and 140 maf. The estimated reduction of groundwater storage over the Colusa Subbasin

brought about by the average decline from the lowest historical groundwater levels measured at each of the 48 wells in the representative monitoring network prior to January 1, 2015 to the groundwater level minimum threshold for each of the 48 wells ranges from 1.4 to 7.7 maf, using the range of specific yield documented in Chapter 3. This represents a change of approximately five percent across the range of total estimated current groundwater storage volumes. This small percentage change is unlikely to trigger undesirable results based on storage impacts alone. Also, this range of estimated reduction in storage would not be likely to occur, because undesirable results would be triggered and addressed when groundwater levels in the first 12 of the 48 representative wells dropped to their minimum thresholds for 24 months.

Therefore, by setting minimum thresholds for groundwater levels as they have been, groundwater storage is effectively protected. The use of groundwater levels as a proxy metric for the groundwater storage sustainability indicator is effective and appropriate.

5.3.2.3 Identification of Undesirable Results

The undesirable result for the reduction of groundwater storage is monitored by proxy using groundwater levels and is considered to occur during GSP implementation when 25 percent or more of representative monitoring wells (i.e., 12 of 48 wells) fall below their minimum groundwater elevation thresholds for 24 consecutive months. The 12 wells must be the same subset of wells, not any combination of 12 wells. Minimum threshold levels for each well were determined using best available data by the process described in Section 5.4. Additional justification and information supporting the criteria used to define when and where the effects of the groundwater conditions cause undesirable results is provided in Appendix 5A.

These criteria were determined based on the evaluation of best available data pertaining to the Subbasin's specific conditions and characteristics, as described in the Plan Area and Basin Setting sections of this GSP (Chapter 2 and Chapter 3, respectively), in conjunction with input and feedback from the public, local stakeholders, and GSA members. The GSAs selected these criteria based on the justification that minimum threshold exceedances of 25 percent or more of representative monitoring wells represent a "significant" impact, and that exceedance of these levels for 24 consecutive months or longer (indicating a significant lack of groundwater recharge through two consecutive periods of seasonal groundwater fluctuation) constitutes a chronic impact that would potentially harm the long-term viability of affected beneficial uses and users in the Subbasin. The criterion of 25 percent or more of the representative monitoring wells dropping below their minimum thresholds for 24 consecutive months was regarded as an indicator of a significant, widespread problem representing undesirable results.

5.3.2.4 Potential Causes of Undesirable Results

Potential causes of undesirable results for the reduction of groundwater storage are groundwater pumping that exceeds the average sustainable yield in the Subbasin and/or decreases in precipitation in the contributing watersheds in the future. This could be caused by increases in consumptive use of water due to increased agricultural productivity, shifts from agricultural to urban land uses resulting in concomitant changes in primary water supply from surface water to groundwater, or other local changes in the hydrogeologic system such as increases to impervious surfaces. Increases in overall demand, especially for groundwater, and decreases in recharge of surface water and precipitation through pervious surfaces may cause groundwater conditions that lead to undesirable results if the net resultant groundwater use exceeds the average sustainable yield in the Subbasin (described in Chapter 3).

Based on the estimated range of current storage volume in the Colusa Subbasin and the small percentage changes in storage estimated to occur over groundwater levels ranging from historical lows to the groundwater levels minimum thresholds, undesirable results due to decreases in groundwater levels would occur before undesirable results due to a significant reduction of groundwater storage. As such, the use of groundwater levels as a proxy for the establishment of thresholds for reductions in groundwater storage is protective of groundwater storage.

5.3.2.5 Potential Effects of Undesirable Results

Undesirable results for reductions in groundwater storage could potentially cause significant and unreasonable effects on beneficial uses and users of groundwater. These effects could be:

- De-watering of some existing groundwater production wells, starting with the shallowest wells (which are primarly domestic wells)
- Increased production well construction costs
- Increased groundwater pumping costs due to inreased lifts
- Adverse effects on GDEs if the depth to groundwater falls below the root zones of GDEs
- Forced changes to lower water use, lower economic return crops
- Adverse effects on property values and the regional economy

Implementation of the GSP is intended to avoid these effects by monitoring and implementing projects and management actions as needed to maintain groundwater levels above the minimum thresholds at representative monitoring wells.

5.3.2.6 Evaluation of the Presence of Undesirable Results

Section 5.4 discusses how minimum thresholds were selected; more information on the process used to establish minimum thresholds for groundwater levels (as a proxy for groundwater storage) is also included in Appendix 5A. Current groundwater level data show that none of the 48 monitored wells were below the minimum threshold in the latest measurement in 2020, indicating that the Subbasin does not currently exceed the requirements for an undesirable result for the reduction of groundwater storage. The GSAs will continue to monitor groundwater storage through groundwater levels to identify potential undesirable results as part of GSP annual reports and five-year Updates, and adapt GSP implementation, as needed, to avoid these effects.

5.3.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator because seawater intrusion is not present and is not likely to occur in the Colusa Subbasin due to the distances between the Subbasin and the Pacific Ocean, bays, deltas, or inlets ranging from about 30 to 60 miles.

5.3.4 Degraded Water Quality

5.3.4.1 Description of Undesirable Results for Degraded Water Quality

The undesirable result for degraded water quality is a result that would cause a significant and unreasonable reduction in the long-term viability of beneficial uses, including domestic, agricultural, municipal, environmental, or other beneficial uses over the planning and implementation horizon of this is GSP. An undesirable result for degraded water quality in the Colusa Subbasin is experienced if, as the result of projects and management actions implemented under the GSP or other groundwater development (such as groundwater extraction or groundwater recharge), groundwater quality for regulated constituents is degraded to levels exceeding historical levels existing prior to January 1, 2015, or applicable water quality objectives, including drinking water standards, whichever are greater over the planning and implementation horizon of this GSP.

Existing regulatory programs address most water quality concerns, and the CGA and GGA will coordinate with these programs, the lead regulatory agencies, and the regulated community within the Colusa Subbasin during implementation of this GSP, including during development and implementation of projects and management actions.

The State Water Resources Control Board (SWRCB) and the Central Valley Regional Water Quality Control Board regulate point and nonpoint source discharges to land that have potential to impact groundwater quality under a range of policy and regulatory programs, including the Basin Plan Amendment for the Salt and Nitrate Control Program, and the Irrigated Lands Regulatory Program. The California Department of Toxic Substance Control regulates releases of toxic substances, including those that impact groundwater quality. The SWRCB Division of Drinking Water regulates groundwater sources used for public supply within the Colusa Subbasin.

The CGA and GGA will rely on existing monitoring and reporting carried out by the regulated community within the Colusa Subbasin when and where possible to address water quality concerns. The CGA and GGA will conduct supplemental water quality monitoring using existing wells or new monitoring wells constructed for that purpose when and where necessary to fill data gaps and to develop and implement projects and management actions.

Groundwater quality in the Colusa Subbasin is generally good, with local exceedances of water quality objectives for some constituents. The sole groundwater quality concern not addressed by the existing groundwater quality regulatory programs is mobilization of saline water from deeper parts of the aquifer along faults, other geologic structures, or other naturally-occurring zones with high salinity as a result of GSP projects and management actions and other groundwater development. Sustainable management criteria for salinity have been established to supplement existing regulatory programs.

Potential impacts of degraded water quality caused by GSP projects and management actions and the extent to which they are considered significant and unreasonable were determined by the GSA members with input from local stakeholders and members of the public. During development of the GSP, potential undesirable results identified by stakeholders included:

- A significant and unreasonable number of additional public supply wells requiring treatment, blending, control or replacement to remain in service
- A significant and unreasonable reduction in pumping capacity in existing public supply due to water quality degradation

- A significant and unreasonable reduction in pumping capacity in existing irrigation supply wells due to water quality degradation
- A significant and unreasonable increase the number of domestic supply wells exceeding water quality objectives
- Adverse impacts to environmental uses and users, including significant and unreasonable impairment to water quality of interconnected surface waters and groundwater available to the root zones of GDEs

5.3.4.2 Identification of Undesirable Results

The undesirable result for degraded water quality is considered to occur during GSP implementation when 25 percent of representative monitoring sites (i.e., 6 of 25 wells) exceed their minimum thresholds for two consecutive years. The six sites must be the same subset of sites, not any combination of six sites. Minimum thresholds were selected for each site by the process described in Section 5.4.

These criteria were determined based on the evaluation of best available data pertaining to the Subbasin's specific conditions and characteristics, as described in the Plan Area and Basin Setting sections of this GSP (Chapter 2 and Chapter 3, respectively), in conjunction with input and feedback from the public, local stakeholders, and GSA members. The GSAs selected these criteria based on the justification that minimum threshold exceedances at 25 percent or more of representative monitoring sites represent a "significant" impact, and that exceedance of these levels for two years or longer (indicating a significant and prolonged degradation of groundwater quality through two consecutive periods of seasonal groundwater fluctuation) constitutes an impact that would potentially harm the long-term viability of affected beneficial uses and users. Exceedance of minimum thresholds for two consecutive years at twenty-five percent of the representative network wells was estimated to be an indicator of a significant, widespread problem indicating undesirable results.

5.3.4.3 Potential Causes of Undesirable Results

Potential causes of undesirable results for degraded water quality may be caused by:

- Mobilization of saline water from deeper parts of the aquifer along faults, other geologic structures, or other naturally-occurring zones with high salinity as a result of GSP projects and management actions and other groundwater development
- Mobilization of poor quality water, including contaminant plumes, monitored under existing regulatory programs as the result of GSP projects and management actions and other groundwater development
- Mobilization of naturally-occurring constituents in soils, the unsaturated zone, or the aquifer matrix as the results of projects involving direct groundwater recharge
- Direct groundwater recharge using water with constituent concentrations exceeding applicable water quality objectives or historical concentrations for the same constituents in groundwater

5.3.4.4 Potential Effects of Undesirable Results

If groundwater quality were degraded such that undesirable results occurred, the effects could potentially cause a shortage in supply to groundwater users without additional treatment, with domestic wells being most vulnerable as treatment costs or access to alternate supplies can be high for small users. High salinity can impact both drinking water uses and agricultural uses, as there are maximum values associated with

aesthetics (taste, color, and odor) for drinking water and crop health and yield for agriculture. Water quality degradation could potentially impact GDEs, surface water quality and the health of aquatic species, cause changes in crops grown and irrigation practices, and cause adverse effects to property values.

5.3.4.5 Evaluation of the Presence of Undesirable Results

Section 5.4 discusses how minimum thresholds were selected. Appendix 5C presents the historical salinity results expressed as electrical conductivity (EC) and the established minimum threshold for each representative monitoring site. Of the 25 monitoring sites, four wells exceeded their respective minimum thresholds in the most recent monitoring event after January 1, 2015. Although the Colusa Subbasin does not currently exceed the requirements for an undesirable result for degraded water quality, the CGA and GGA will coordinate with the entities responsible for monitoring, reporting, and compliance with applicable regulations to assess whether actions are required and being taken to achieve compliance for the wells.

The GSAs will continue to coordinate with the regulated community to identify potential undesirable results as part of GSP annual reports and five-year updates, and adapt GSP implementation, as needed, to avoid undesirable results.

5.3.5 Inelastic Land Subsidence

5.3.5.1 Description of Undesirable Results for Inelastic Land Subsidence

The undesirable result for inelastic land subsidence due to groundwater withdrawal is a result that would cause significant and unreasonable impacts to critical infrastructure over the planning and implementation horizon of this GSP.

An undesirable result is experienced if groundwater withdrawal causes inelastic land subsidence that substantially interferes with the condition or functionality of critical infrastructure within the Colusa Subbasin over the planning and implementation horizon of this GSP.

Potential impacts of inelastic land subsidence and the extent to which they are considered significant and unreasonable were determined by the GSA members with input from local stakeholders and members of the public. During development of the GSP, potential undesirable results identified by stakeholders included:

- Significant and unreasonable impacts to critical infrastructure in the Colusa Subbasin, including canals, pipelines, roadways, bridges, and groundwater wells.

5.3.5.2 Identification of Undesirable Results

Inelastic land subsidence within the Colusa Subbasin is monitored at 60 sites in DWR's Sacramento Valley Subsidence Monitoring Benchmark Network. An undesirable result is considered to occur during GSP implementation when 15 percent or more of representative monitoring locations (i.e., 9 of 60 locations) measure a subsidence rate greater than the specified minimum threshold of either 0.6 or 0.5 feet per year (dependent on historical subsidence rates at each monitoring point) for 24 consecutive months. The nine locations must be the same subset of locations, not any combination of nine locations. Minimum threshold levels were selected for each monitoring point by the process described in Section 5.4.

These criteria were determined based on the evaluation of best available data pertaining to the Colusa Subbasin's specific conditions and characteristics, as described in the Plan Area and Basin Setting sections of this GSP (Chapter 2 and Chapter 3, respectively), in conjunction with input and feedback from the public, local stakeholders, and GSA members. The GSAs selected these criteria based on the justification that minimum threshold exceedances at 15 percent or more of representative monitoring sites represent a significant impact, and that exceedance of these levels for 24 consecutive months or longer (indicating significant inelastic land subsidence through two consecutive periods of seasonal groundwater fluctuation) would substantially interfere with the condition or functionality of critical infrastructure within the Colusa Subbasin. Exceedance of the minimum thresholds for 24 consecutive months at 15 percent of monitoring sites was estimated to be an indicator of a significant, widespread problem indicating undesirable results.

5.3.5.3 Potential Causes of Undesirable Results

Inelastic land subsidence due to groundwater withdrawal is caused by a reduction in pore pressure brought about by pumping. The reduction in pore pressure increases the effective stress borne by the aquifer skeleton. The increase in the effective stress causes compaction of compressible clays.

The potential causes of undesirable results for inelastic land subsidence are:

- Increasing pumping or decreasing recharge in subsidence-prone areas
- Initiating pumping in areas or at depths with no or minimal historical groundwater pumping

5.3.5.4 Potential Effects of Undesirable Results

If inelastic land subsidence reaches levels indicating that undesirable results have occurred, the effects could potentially cause damage to local infrastructure such as canals, pipelines, roadways, bridges, and groundwater wells. Excessive subsidence may also lead to decreased groundwater storage.

5.3.5.5 Evaluation of the Presence of Undesirable Results

Section 5.4 discusses how minimum thresholds were selected. Chapter 3 presents the graphs and maps showing the extent and rate of historical subsidence. Of the 60 monitoring sites, none were below the minimum threshold in the latest measurement from 2017 indicating that the Colusa Subbasin does not currently exceed the requirements for an undesirable result for inelastic land subsidence. The GSAs will continue to monitor groundwater levels to identify potential undesirable results as part of GSP annual reports and five-year updates, and adapt GSP implementation, as needed, to avoid undesirable results.

5.3.6 Depletions of Interconnected Surface Water

5.3.6.1 Description of Undesirable Results for Depletions of Interconnected Surface Water

The undesirable result for depletions of interconnected surface water is a result that causes significant and unreasonable adverse effects on beneficial uses and users of interconnected surface waters within the Colusa Subbasin over the planning and implementation horizon of this GSP. During development of the GSP, potential undesirable results identified by stakeholders included:

- Significant and unreasonable impacts to stream flows.
- Significant and unreasonable impact to riparian and riverine habitat.
- Significant and unreasonable impacts to GDEs.

5.3.6.2 Justification of Groundwater Elevations as a Proxy

The use of groundwater elevation as a proxy metric for this sustainability indicator is necessary because the network of existing stream gages is not adequate to measure changes in stream accretions and depletions as related to the Colusa Subbasin. The network is inadequate because gages are not located such that changes in streamflow can be correlated directly and solely to Colusa Subbasin groundwater conditions. Additionally, it is unlikely that the relatively small expected changes in streamflow associated with changes in groundwater conditions can be accurately quantified given the measurement error associated with the gages. In contrast, changes in streamflow volume and rates can be estimated by modeling of groundwater levels and stream stages together with characterization of soil and aquifer properties. However, the levels of uncertainty in the available Colusa Subbasin groundwater model are currently too great to allow reliable quantification of the rates and volume of stream depletions.

Depletions of interconnected surface water are driven by the gradient between water surface elevation in the surface water body and groundwater elevations in the connected, shallow groundwater system. By setting minimum thresholds in representative monitoring wells near interconnected surface water, the Glenn Groundwater Authority and Colusa Groundwater Authority can monitor and manage this gradient, and in turn, manage potential changes in depletions of interconnected surface water. Monitoring for impacts to interconnected surface waters will occur utilizing a subset of wells in the Subbasin selected for this purpose (see Chapter 4).

5.3.6.3 Identification of Undesirable Results

The undesirable result for depletions of interconnected surface water is considered to occur during GSP implementation when 25 percent of representative monitoring wells (i.e., 3 of 12 wells) fall below their minimum groundwater elevation thresholds for 24 consecutive months. The three wells must be the same subset of wells, not any combination of three wells. Minimum thresholds were selected for each site by the process described in Section 5.4. Additional justification and information supporting the criteria used to define when and where the effects of the groundwater conditions cause undesirable results is provided in Appendix 5A.

These criteria were determined based on the evaluation of best available data pertaining to the Subbasin's specific conditions and characteristics, as described in the Plan Area and Groundwater Conditions sections of this GSP, in conjunction with input and feedback from the public, local stakeholders and GSA members. The representative monitoring network was selected based on identification of existing monitoring wells with locations and depths considered appropriate for monitoring groundwater with potential to influence interconnected streams in the Colusa Subbasin. These interconnected streams are the Sacramento River, the Colusa Basin Drain and portions of Stony Creek below Black Butte Dam. Monitoring wells with screened intervals less than 200 feet deep located within 2,000 feet to five miles of the interconnected streams were selected.[2] These wells are expected to provide the best available monitoring of groundwater levels that have an influence on the volume and rates of stream depletion. Wells closer than 2,000 feet were excluded based on the assumption that wells in too close a proximity to an interconnected stream may be directly influenced by stream stage. Wells deeper than 200 feet and farther than five miles from interconnected streams were excluded because pumping at greater depths or distances was assumed to cause capture from multiple sources (e.g., recharge zones, springs, ponded water, and other wells), which

[2] For wells within a few thousand feet of a waterway, groundwater levels are expected to be controlled by the elevation of the connected surface water. For wells in intermediate locations between waterways and groundwater pumping centers, declines in water levels could also indicate current and future streamflow depletion (EDF, 2018).

cannot be resolved with existing data and models. The GSAs selected these criteria based on the justification that minimum threshold exceedances at 25 percent or more of representative monitoring sites represent a significant impact, and that exceedance of these levels for 24 consecutive months or longer (indicating significant depletions of interconnected surface water through two consecutive periods of seasonal groundwater fluctuation) constitutes an impact that would potentially harm the long-term viability of affected beneficial uses and users. The criterion of 25 percent or more of the representative monitoring wells dropping below their minimum thresholds for 24 consecutive months was regarded as an indicator of a significant, widespread problem representing undesirable results.

5.3.6.4 Potential Causes of Undesirable Results

Potential causes of undesirable results for depletions of interconnected surface water are likely tied to groundwater production, which could result in lowering of groundwater elevations in shallow aquifers near the connected streams. Increased groundwater production near interconnected streams may cause groundwater conditions that lead to undesirable results if this production changes the hydraulic gradient between the stream stage and the groundwater level. For the connected streams, an increase in the hydraulic gradient between the shallow groundwater and the stream bed may result in increases in the rate and volume of stream depletions.

5.3.6.5 Potential Effects of Undesirable Results

If depletions of interconnected surface waters reach levels indicating that undesirable results have occurred, the effects could potentially reduce the availability or change the timing of streamflow available for beneficial uses and uses of surface water. Additionally, reduced streamflow could potentially reduce the availability of water to GDEs and riparian habitats. In addition, reduced stream flows can lead to increased water temperatures which can also potentially negatively impact certain species.

5.3.6.6 Evaluation of the Presence of Undesirable Results

Section 5.4 discusses how minimum thresholds were selected; more information on how the thresholds were established is also included in Appendix 5A, along with hydrographs of groundwater levels through 2020 for the depletions of interconnected surface waters monitoring points and the established depth of the minimum threshold for each monitoring site. Of the 12 monitoring sites, none were below the minimum threshold in the latest measurement in 2020, indicating that the Colusa Subbasin does not currently exceed the requirements for an undesirable result for depletions of interconnected surface water.

5.4 SUSTAINABILITY THRESHOLDS

Sustainability thresholds include minimum thresholds, measurable objectives, and interim milestones. Sustainability thresholds are described below by sustainability indicator. No management areas are identified for the Colusa Subbasin (see Chapter 3), and sustainability thresholds apply basin-wide for each applicable sustainability indicator. Potential effects of the selected sustainability thresholds on other neighboring subbasins are summarized at the end of this section.

5.4.1 Chronic Lowering of Groundwater Levels

As described in Section 0, chronic lowering of groundwater levels is considered to be significant and unreasonable when:

> *… it causes a significant and unreasonable reduction in the long-term viability of beneficial uses and users over the planning and implementation horizon of this GSP.*

Chronic lowering of groundwater levels may cause undesirable results when 25 percent of monitoring wells fall below the minimum threshold for 24 consecutive months. The following subsections describe the sustainability thresholds used to monitor and track the chronic lowering of groundwater levels. Appendix 5A provides additional information describing how the minimum thresholds and measurable objectives were established. Appendix 5B documents an economic analysis of the groundwater level minimum thresholds. That analysis generally supports setting minimum thresholds at the specified levels.

As described in Chapter 3, Basin Setting, the Colusa Subbasin has one principal aquifer, and therefore one groundwater level monitoring network. Thresholds have been established for all 48 groundwater level representative monitoring wells, as presented in Chapter 4, Monitoring Networks. Minimum Thresholds

Minimum thresholds for the chronic lowering of groundwater levels were developed primarily by considering historical and current groundwater conditions, with lesser emphasis on projected future groundwater conditions. In general, groundwater levels during the 26-year historical period from 1990 through 2015 were used as the primary reference. This period includes relatively wet and dry periods including the back to back critically dry years of 2014 and 2015. Evaluation of historical and projected groundwater use in the Colusa Subbasin is further discussed in the Plan Area and Basin Setting chapters of this GSP. Minimum threshold values were defined for individual representative monitoring wells as the groundwater level beyond which conditions may lead to undesirable results for beneficial uses and users in the vicinity of each well. The minimum threshold for each groundwater level representative monitoring well was calculated by utilizing a simple stepwise function. The minimum threshold is calculated by finding the deeper value of:

1. **20th percentile of shallowest domestic well depths in the monitoring well's Thiessen polygon**: Based on stakeholder input, it was determined that dewatering of domestic wells may be a potential undesirable result that could potentially be used to confirm the adequacy of the minimum threshold methodology. Domestic wells are generally shallower than agricultural and municipal wells and thus more sensitive to undesirable effects from decreases in groundwater elevations, such as well stranding. Additionally, the loss of a domestic well usually results in a loss of water for consumption, cooking, and sanitation purposes, which can often have substantial impacts on the users of the water and can be financially difficult for the well owner to mitigate. To protect the beneficial users and use of groundwater from domestic wells, groundwater levels need to remain higher than the bottom depth of domestic wells. Analysis of the DWR Well Completion Report Database by the GSA suggests that not all wells provided in the database are still active. Some of the wells included in the database are old enough that the usable lifespan of the well has been exceeded, and some well depths and screen intervals would suggest that some wells have been dewatered prior to the implementation of SGMA (i.e., prior to January 1, 2015). The GSAs therefore determined, based on the analysis and feedback from the public and stakeholders, that protection of 100 percent of domestic wells in the database was not reasonable or warranted, and that protection of 80 percent of wells was reasonable and

acceptable. Consequently, it was determined that minimum threshold exceedances at more than 20 percent of domestic wells may constitute an undesirable result. This results in a minimum threshold that would protect 80 percent of domestic wells.

2. **50% of range below the historical low groundwater elevation**: To protect the conjunctive use of groundwater for agricultural production, groundwater levels must be able to fluctuate, lowering during droughts when groundwater pumping increases to augment reduced surface water availability, and increasing during years when surface water is available for recharge. For agricultural conjunctive use, the effects of declining groundwater levels are expected to be significant and unreasonable when groundwater levels drop below the lowest historical groundwater elevation by more than 50 percent of the historical range. After an analysis of available historical data, and with considerations of groundwater conditions, the GSAs determined that 50 percent of the historical range below the historical low groundwater level provided adequate operational flexibility at each representative monitoring well site. Consequently, minimum threshold exceedances of this level may constitute an undesirable result.

Appendices 5A and 5B provide additional information on the setting and evaluation of the minimum thresholds.

Setting minimum thresholds using this methodology is protective of beneficial users and uses of groundwater, including agricultural, municipal, and domestic uses in the Subbasin. The GSAs chose this methodology for calculating the minimum threshold to balance the needs of multiple beneficial uses and users of the groundwater by allowing for adequate flexibility to compensate for drought periods while potentially protecting up to 80 percent of nearby domestic wells, therefore avoiding undesirable results. Additionally, anecdotal evidence provided by the GSA member stakeholders suggest that groundwater levels seen in 2015 did not result in significant and unreasonable impacts to beneficial uses and users. Although some wells in that period were dewatered, those wells were generally replaced with deeper wells. The GSAs therefore consider the historical low groundwater elevation to be protective of current and future beneficial uses. In addition, this methodology includes consideration of the spatial location of each monitoring site and variable conditions (such as hydrogeological conditions or nearby infrastructure) across the Subbasin.

Figure 5-1 is a sample hydrograph with the calculated thresholds plotted, including the minimum threshold, in relation to historical groundwater levels. Similar hydrographs for all wells in the representative monitoring networks are included in Appendix 5A.

Table 5-1 presents the minimum thresholds for representative monitoring wells in the chronic lowering of groundwater levels monitoring network in the Colusa Subbasin. Additional information on the calculation of minimum thresholds is provided in Appendix 5A.

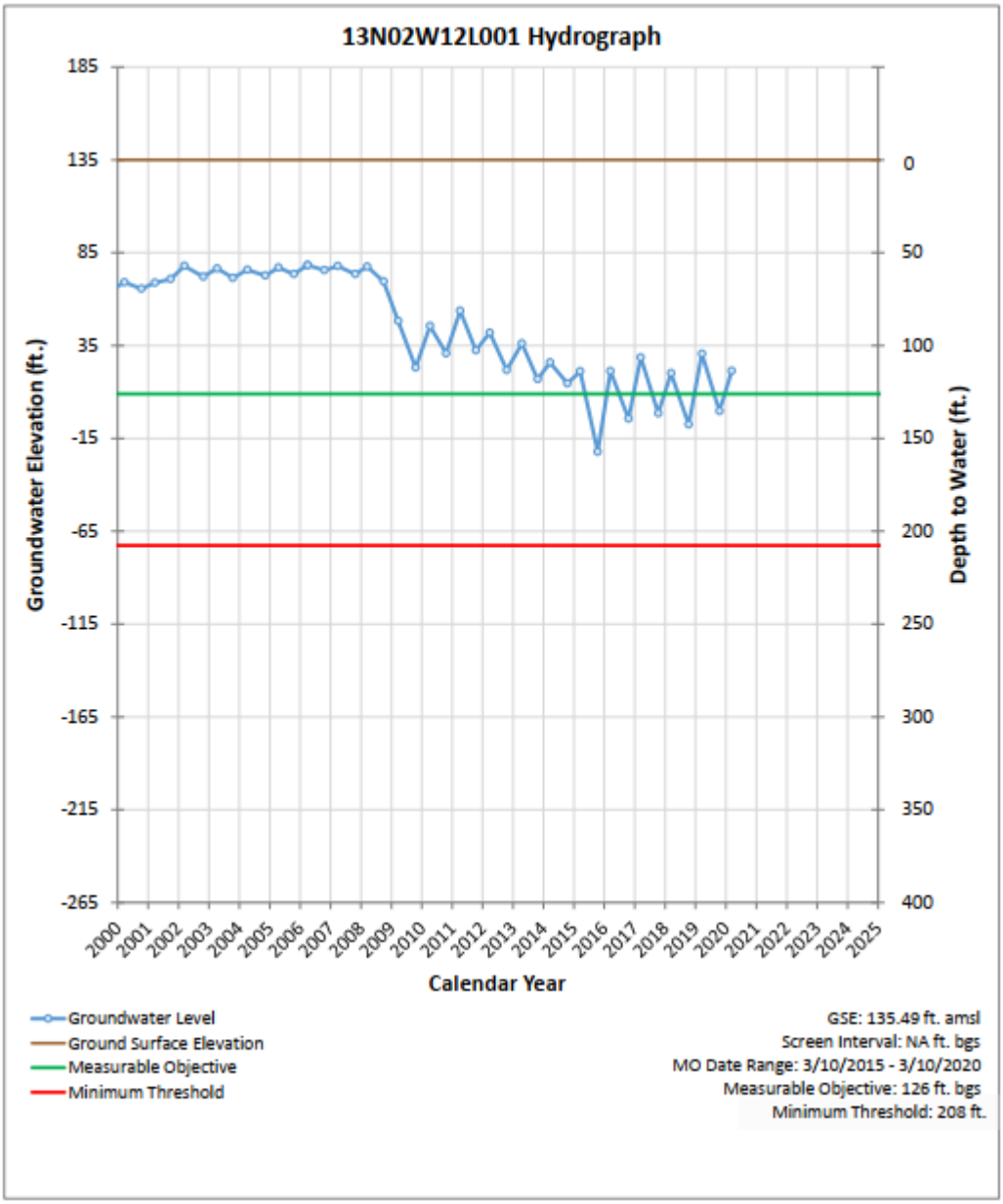

Figure 5-1. Hydrograph, Measurable Objective and Minimum Threshold for Groundwater Monitoring Well 13N02W12L001

5.4.1.1.1 Potential Effects on Other Sustainability Indicators

Groundwater levels have the potential to impact all other sustainability indicators applicable to the Colusa Subbasin. These potential effects are described below by sustainability indicator.

- **Reduction of Groundwater Storage:** Chronic lowering of groundwater levels is directly related to reduction of groundwater storage, as changes in groundwater levels are indicative of changes in groundwater storage in the Colusa Subbasin. As described in Section 5.4.2.1, the minimum thresholds for groundwater levels will effectively avoid undesirable results for reduction of groundwater storage since undesirable results related to chronic lowering of groundwater levels are expected to occur before the Subbasin would experience significant and unreasonable impacts related to groundwater storage, predominantly as a result of the large volume of groundwater in storage in the Subbasin.
- **Degraded Water Quality:** Chronic lowering of groundwater levels can impact groundwater quality by affecting the direction and rate of groundwater flows, potentially mobilizing saline water, and by affecting the location and characteristics of groundwater recharge or discharge, impacting the concentration of water quality parameters. The minimum thresholds determined for groundwater levels are not expected to contribute to undesirable results for degraded water quality, as they are protective of existing domestic well depths and historical groundwater elevations. Evaluation of 25 groundwater quality representative monitoring sites indicates that the Subbasins does not currently have undesirable results for degraded water quality. Implementation of the GSP is expected to maintain groundwater levels at the average of the last five years of measured groundwater level data (see Section 5.4.1.2). Given the similar trends in historical, current, and projected future groundwater levels, groundwater level sustainable management criteria are expected to support the maintenance of the generally good groundwater quality of the Colusa Subbasin.
- **Inelastic Land Subsidence:** Chronic lowering of groundwater levels can potentially cause inelastic land subsidence if it results in compaction of compressible clays in the subsurface. The minimum thresholds for groundwater levels are not expected to contribute to undesirable results for inelastic land subsidence, as they are protective of a range around historical groundwater elevations. Minimum thresholds for land subsidence have also been determined based on consideration of historical subsidence data between 2006-2017, providing flexibility around that range. Evaluation of 60 subsidence monitoring sites indicate that none were below the minimum threshold in the latest measurement from 2017, indicating that historical groundwater levels have not contributed to undesirable results for inelastic land subsidence.
- **Depletions of Interconnected Surface Water:** Reductions in groundwater levels can impact the rate and volume of stream depletions in interconnected streams and reduce the amount of groundwater available for GDEs. The representative groundwater level monitoring network used for monitoring the potential for depletions in interconnected streams is comprised of a selected, collocated subset of the representative monitoring network used for monitoring reductions in groundwater levels. For these selected wells, the interconnected stream depletions sustainable management criteria are more restrictive than the groundwater levels sustainable management criteria and take precedence over them. Therefore, coordinated implementation of the groundwater levels and the depletions of interconnected surface water sustainable management criteria are expected to be protective of interconnected surface waters and GDEs.

Table 5-1. Groundwater Level Representative Monitoring Network and Sustainability Criteria

SWN	CASGEM ID	Ground Surface Elevation, ft	Minimum Threshold GWE, ft amsl	Minimum Threshold DTW, ft bgs	Measurable Objective GWE , ft amsl	Measurable Objective DTW, ft bgs	Interim Milestone GWE ft amsl	Interim Milestone DTW ft bgs	Margin of Operational Flexibility, ft	20th Percentile Domestic Wells, ft bgs	50% of Range Below Historical Low, ft bgs
12N01E06D004	16331	28	-108	136	-1	29	-1	29	107	136	94
13N01E11A001	18534	32	-75	106	22	10	22	10	96	106	28
13N01W07G001	36246	90	-106	196	-9	99	-9	99	97	153	196
13N01W13P001	18549	32	-88	120	-2	34	-2	34	86	120	89
13N01W22P002	16357	60	-124	184	26	34	26	34	150	184	116
13N02W12L001	31899	135	-72	208	9	126	9	126	82	200	208
13N02W15J001	39884	213	-62	274	61	152	61	152	122	215	274
13N02W20H002	25005	343	95	248	174	169	174	169	79	248	201
14N01E35P001	38718	47	-118	165	18	29	18	29	136	165	48
14N01W04K003	18554	37	-86	124	12	25	12	25	99	124	44
14N02W13N001	18563	62	-80	142	24	38	24	38	104	142	78
14N02W22A002	54756	84	-126	210	84	0	84	0	210	210	0
14N02W29J001	18566	163	-86	248	22	141	22	141	107	216	248
14N03W14Q003	32324	173	-89	261	-13	186	-13	186	75	115	261
14N03W24C001	16691	173	-5	178	38	135	38	135	43	138	178
15N01W05G001	14309	47	-54	101	28	19	28	19	82	101	51
15N02W19E001	14319	87	-13	100	73	14	73	14	86	100	50
15N03W08Q001	N/A	113	43	70	107	6	107	6	64	70	10
15N03W20Q001	38293	129	60	69	103	26	103	26	43	69	34
16N02W05B001	25511	65	-71	136	33	32	33	32	104	136	74
16N02W25B002	33868	55	-25	80	30	25	30	25	55	80	54
16N03W14H003	24683	66	-94	160	72	-6	72	-6	166	160	3
16N04W02P001	16308	163	63	100	139	24	139	24	76	100	42
17N02W09H002	25514	67	-52	119	49	18	49	18	101	119	56
17N02W30J002	16960	63	-119	182	44	19	44	19	163	182	51
17N03W08R001	39127	107	-13	120	88	19	88	19	101	120	28
17N03W32H001	35475	100	-38	138	92	8	92	8	130	138	35
18N02W18D001	24953	82	-83	165	69	13	69	13	152	165	24
18N02W36B001	16914	75	-3	78	53	22	53	22	56	78	59

Table 5-1. Groundwater Level Representative Monitoring Network and Sustainability Criteria

SWN	CASGEM ID	Ground Surface Elevation, ft	Minimum Threshold GWE, ft amsl	Minimum Threshold DTW, ft bgs	Measurable Objective GWE , ft amsl	Measurable Objective DTW, ft bgs	Interim Milestone GWE ft amsl	Interim Milestone DTW ft bgs	Margin of Operational Flexibility, ft	20th Percentile Domestic Wells, ft bgs	50% of Range Below Historical Low, ft bgs
19N02W08Q001	25762	108	12	96	79	29	79	29	67	96	72
19N02W33K001	19793	87	21	66	71	16	71	16	50	66	53
19N04W14M002	25787	186	46	140	151	35	151	35	105	140	50
20N02W11A001	17170	125	49	76	119	6	119	6	70	76	22
20N02W18R005	23986	131	29	103	70	61	70	61	42	84	103
20N02W25F001	23989	102	37	65	96	6	96	6	59	65	16
20N02W33B001	17174	105	31	74	100	5	100	5	69	74	17
20N03W07E001	37860	179	-50	229	33	146	33	146	83	148	229
21N02W01F001	38535	161	71	90	116	45	116	45	45	90	89
21N02W04G002	24993	178	41	138	103	75	103	75	63	92	138
21N02W05M001	39676	189	39	150	130	59	130	59	91	134	150
21N02W33M001	38536	149	52	97	94	55	94	55	42	82	97
21N02W36A002	21239	135	24	112	91	44	91	44	68	81	112
21N03W01R002	25232	203	48	155	151	52	151	52	103	108	155
21N03W23D001	23992	205	26	179	142	63	142	63	116	89	179
21N03W34Q002	25789	167	-54	221	36	131	36	131	90	125	221
21N04W12A004	24650	248	-108	356	11	237	11	237	119	98	356
22N02W30H002	25726	204	30	175	100	104	100	104	71	76	175
22N03W24E001	25236	231	-42	273	37	194	37	194	79	90	273

CASGEM ID = California Statewide Groundwater Elevation Monitoring Identification Code
GWE = groundwater elevation
DTW = depth to water
ft = feet
amsl = above mean sea level
bgs = below ground surface

5.4.1.2 Measurable Objectives

Measurable objectives are quantitative goals that reflect desired Subbasin conditions and allow the Subbasin to achieve and maintain its sustainability goal. The measurable objectives for chronic lowering of groundwater levels in the Colusa Subbasin are shown in Table 5-1. The methodology for establishing these measurable objectives was determined by the Colusa Subbasin GSAs, including their respective Technical Advisory Committees, and bases the measurable objectives on the average of the last five years of measured groundwater level data. This method is generally representative of drought and recovery conditions within the Subbasin, as most wells utilize data collected between 2015 and 2020. These measurable objectives are expected to support achievement of the GSP sustainability goal and maintenance of groundwater sustainability over the planning and implementation horizon.

5.4.1.3 Margin of Operational Flexibility

The margin of operational flexibility is the difference between the measurable objective and the minimum threshold for each well. The margin of operational flexibility is intended to provide adequate flexibility to allow for increased groundwater production during drought years with recovery during normal or wet years, accounting for uncertainty in each. This ensures undesirable results are not triggered due to drought conditions that the GSAs cannot control, while allowing for adequate local recovery of groundwater levels after those drought periods, therefore maintaining sustainability in the long term. Because the measurable objective and minimum threshold at each well take into consideration the historical water budgets, seasonal and long-term trends, and periods of drought, the margin of operational flexibility also accounts for these factors.

The margins of operational flexibility for chronic lowering of groundwater levels are shown in Table 5-1.

5.4.1.4 Interim Milestones

Interim milestones are intended to provide a glidepath towards sustainability over the implementation horizon by providing progressive targets for groundwater levels every five years after GSP submittal. After sustainability is reached, interim milestones are not required and basins are managed according to the measurable objective (defined in the GSP Emergency Regulations as "…specific, quantifiable goals for **the maintenance** or improvement **of specified groundwater conditions**…to achieve the sustainability goal for the basin"). For basins that are already sustainable (such as the Colusa Subbasin), interim milestones are intended to provide numerical metrics for GSAs to track progress toward meeting the basin's sustainability goal and ensuring that the basin remains sustainable. Because the minimum thresholds and measurable objectives for chronic lowering of groundwater levels were established to support Subbasin sustainability, the interim milestones were established to maintain water levels in the Subbasin's margin of operational flexibility as established by the minimum thresholds and measurable objectives. The interim milestones for chronic lowering of groundwater levels are consistent with the measurable objectives, as shown in Table 5-1.

5.4.2 Reduction of Groundwater Storage

The undesirable result for the reduction of groundwater storage is:

> *…a result that would cause significant and unreasonable reduction in the long-term viability of beneficial uses and users over the planning and implementation horizon of this GSP.*

The undesirable result for the reduction of groundwater storage is monitored by proxy using groundwater levels. The thresholds set for the reduction of groundwater storage have been established so that when 25 percent of monitoring wells fall below the minimum threshold for 24 consecutive months, an undesirable result is detected. The following subsections describe the sustainability thresholds used for the reduction of groundwater storage.

5.4.2.1 Proxy Monitoring

Monitoring for a reduction of groundwater storage in the Subbasin uses groundwater levels as a proxy for determining sustainability, as permitted by 23 CCR §354.28(d). As described above, any benefits to groundwater storage are expected to coincide with groundwater level management.

The limiting factor to storage use is existing well infrastructure (depth of wells) and near surface conditions, not the volume of groundwater in storage (see Section 5.3.2.2). Therefore, the established groundwater levels minimum thresholds are protective against significant and unreasonable changes in groundwater storage. Minimum thresholds for groundwater levels will effectively avoid undesirable results for reduction of groundwater storage since undesirable results related to chronic lowering of groundwater levels would occur before the Subbasin would experience significant and unreasonable impacts related to groundwater storage, predominantly as a result of the large volume of groundwater in storage in the Subbasin (see Section 5.3.2.2). Therefore, by setting minimum thresholds for groundwater levels, storage is also effectively managed and the use of groundwater levels as a proxy metric for the groundwater storage sustainability indicator is appropriate. Minimum thresholds for groundwater levels, and thus for groundwater storage, are calculated with consideration of historical trends, water year type, and historical and projected groundwater use within the Colusa Subbasin, and support operation within the sustainable yield, as described in Section 5.2.

5.4.3 Seawater Intrusion

Seawater intrusion is not an applicable sustainability indicator because seawater intrusion is not present and is not likely to occur in the Colusa Subbasin due to the distance between the Subbasin and the Pacific Ocean, bays, deltas, or inlets.

5.4.4 Degraded Water Quality

The undesirable result for degraded water quality is described as:

> *Significant and unreasonable degradation of water quality that occurs when GSP projects or management actions cause an increase in the concentration of applicable constituents of concern in groundwater supply wells that lead to adverse impacts on beneficial uses or users of groundwater.*

The thresholds set for degraded water quality have been established so that when 25 percent of representative monitoring sites exceed the minimum threshold for two consecutive years, an undesirable result is detected. The following subsections describe the sustainability thresholds used for degraded water quality. The foregoing sustainability thresholds were established with the GSAs' understanding that additional new or existing wells will need to be added to the monitoring network over time. Additionally, the GSAs acknowledge that the sustainability thresholds will need to be reviewed and evaluated, and potentially refined, as additional wells are added, and additional data is collected and analyzed.

Thresholds have been established for all 25 groundwater quality representative wells, as presented in Appendix 5C. Management areas were not used in the calculations of any thresholds.

5.4.4.1 Minimum Thresholds

The minimum threshold for degraded water quality has been established as the higher of either 900 microSiemens per centimeter (μS/cm) electrical conductivity (EC), which is consistent with the recommended California Secondary Maximum Contaminant Level (SMCL), or the pre-2015 historical maximum recorded EC value.[3] In developing the minimum thresholds for groundwater quality, beneficial uses of groundwater as a drinking water supply and as an agricultural supply were considered. Setting minimum thresholds using this methodology is protective of beneficial users and uses of groundwater, including agricultural, municipal, and domestic uses in the Subbasin.

The minimum threshold for degraded water quality is calculated to be at an EC level that allows for adequate flexibility within the pre-2015 historical maximum EC level, to compensate for changing groundwater conditions during drought periods, while protecting SMCLs established for aesthetic reasons, such as taste, odor, and color. It is important to note that SMCLs are not based on public health concerns and established to address other non-health related concerns. Exceedance of these minimum threshold values may therefore cause undesirable results for domestic well users related to non-health related concerns at wells where the pre-2015 historical maximum EC level did not exceed the SMCL. At wells where the pre-2015 historical maximum EC level exceeded the recommended California SMCL, groundwater management through coordination with existing regulatory and monitoring programs with respect to this minimum threshold will ensure that degradation of groundwater quality does not exceed historical levels as a result of Subbasin groundwater management activities pursuant to the GSP.

5.4.4.2 Measurable Objectives

The measurable objective for degraded water quality is 700 μS/cm EC, which is consistent with the agricultural water quality objective providing for no yield reduction for crops commonly grown in the Colusa Subbasin. The measurable objective for degraded water quality therefore supports ongoing sustainability by protecting water quality within levels that are suitable for drinking water use and agricultural water use, among other beneficial uses. Measurable objectives have not been determined for other water quality constituents.

5.4.4.3 Margin of Operational Flexibility

The margin of operational flexibility for degraded water quality is 200 μS/cm EC (the difference between the measurable objective and minimum threshold). The margin of operational flexibility is intended to provide adequate flexibility to allow for changes in groundwater quality constituent concentrations during various basin conditions, such as drought years. This ensures undesirable results are not triggered due to temporary fluctuations in conditions that are anticipated to occur during the implementation horizon, accounting for uncertainty in future conditions. Because the measurable objective and minimum threshold at each site take into consideration historical water quality characteristics, the margin of operational flexibility also accounts for these factors.

[3] Consistent with SGMA, the GSP "is not required to address undesirable results that occurred before, and have not been corrected by, January 1, 2015" (Water Code Section 10727.2 (b) (4)).

5.4.4.4 Interim Milestones

Interim milestones are intended to provide a glidepath towards sustainability over the implementation horizon by providing progressive targets for groundwater quality every five years after GSP submittal. After sustainability is reached, interim milestones are not required and basins are managed according to the measurable objectives (defined in the GSP Emergency Regulations as "…specific, quantifiable goals for **the maintenance** or improvement **of specified groundwater conditions**…to achieve the sustainability goal for the basin"). For basins that are already sustainable (such as the Colusa Subbasin), interim milestones are intended to provide numerical metrics for GSAs to track progress toward meeting the Subbasin's sustainability goal and ensuring that the Subbasin remains sustainable. Because the minimum thresholds and measurable objectives for degraded water quality were established to support Subbasin sustainability, the interim milestones were established to maintain water quality constituent levels in the Subbasin's margin of operational flexibility as established by the minimum thresholds and measurable objectives. The interim milestone for degraded water quality is consistent with the measurable objective, and is set at 700 μS/cm.

5.4.5 Inelastic Land Subsidence

The undesirable result for inelastic land subsidence is:

> *…a result due to groundwater extraction that would cause significant and unreasonable impacts to critical infrastructure over the planning and implementation horizon of this GSP.*

The undesirable result for inelastic land subsidence is monitored by DWR extensometers, continuous global positioning system (CGPS) benchmarks, and traditional benchmarks. The thresholds set for inelastic land subsidence have been established so that when 15 percent of representative monitoring locations (i.e., 9 of 60 locations) exceed their minimum thresholds, an undesirable result is detected. Management areas were not used in establishing or calculating thresholds.

5.4.5.1 Minimum Thresholds

Minimum thresholds for inelastic land subsidence were determined based on consideration of historical subsidence using data available from the Sacramento Valley Height Modernization Project. Depending on the rate of historical subsidence, minimum thresholds were calculated as the maximum rate of subsidence, described below, above which conditions could collectively generate undesirable results in the Colusa Subbasin. While the sensitivity of local infrastructure to land subsidence is not well understood at this time, the Colusa Subbasin has extensive networks of pipelines and open canals and drains owned by various surface water suppliers that are used to convey irrigation and drain water. These networks are likely the existing infrastructure most sensitive to land subsidence. Should additional information be developed on the vulnerability of this infrastructure to subsidence, these minimum thresholds may be refined. The GSAs will continue monitoring to continue to improve basin understanding during GSP implementation.

The minimum threshold for this sustainability indicator was calculated in two ways. For representative monitoring sites that have experienced more than 1 foot (12 inches) of inelastic subsidence between 2006 and 2017, the minimum threshold has been set to 0.6 feet per year (7.2 inches). For representative monitoring sites that have experienced less than 1 foot of inelastic subsidence between 2006 and 2017, the minimum threshold has been set at 0.5 feet per year (6 inches). The historical record between 2006 and 2017 was chosen for this indicator because this period coincides with DWR's Sacramento Valley Height Modernization Project. Available data from this program begins in 2006 with the latest measurements being taken in 2017.

Dividing the subsidence monitoring benchmarks into two groups based on historical, measured subsidence recognizes that future rates of subsidence will likely be greater in areas with greater historical subsidence, and less in areas with less historical subsidence. The areas with greater historical subsidence may be underlain by sediments that have greater susceptibility to subsidence due to groundwater withdrawal (subsidence-prone areas). These areas also have a relatively greater reliance on groundwater as a source of supply. Projects and management actions developed to restore and sustain groundwater levels in these areas may reduce subsidence rates. Conversely, development of groundwater resources in subsidence-prone areas with limited historical groundwater pumping could increase subsidence rates. The sustainable management criteria will be reviewed and adjusted to account for potential changes in subsidence rates brought about by implementation of projects and management actions and future groundwater resource development. The extent of subsidence-prone areas will continue to be delineated as data gaps are filled through the ongoing subsidence monitoring programs (using data from benchmarks, extensometers and InSAR surveys) and subsidence-prone sediments are characterized during drilling for well construction, extensometer installation or other subsurface investigations needed for the development of specific projects and management actions.

Managing groundwater conditions in the Colusa Subbasin to avoid exceedance of the rate of inelastic subsidence established by the minimum thresholds is considered unlikely to cause a significant and unreasonable reduction in the viability of the use of critical infrastructure over the planning and implementation horizon of this GSP.

5.4.5.2 Measurable Objectives

The measurable objective for inelastic land subsidence is set at 0.25 feet (3 inches) of subsidence per year at each site. This rate, in conjunction with sustainable extractions of groundwater over the implementation horizon, is believed to provide enough operational flexibility during drought periods while protecting infrastructure and beneficial users and uses in the Subbasin.

One foot of historical subsidence over a five-year period is an average rate of 0.2 feet per year. The selected minimum threshold rates of 0.6 feet per year and 0.5 feet per year for the two groups, respectively, allows for possible future acceleration of land subsidence. However, because the measurable objective is set at 0.25 feet per year, projects and management actions will be implemented before the minimum threshold rates are reached.

DWR reports that the probable error in the subsidence values reported for the monitoring benchmarks is ±0.17 feet, meaning that for any reported value, the actual subsidence value is likely to fall in a range between plus or minus 0.17 feet of the reported value. The selected measurable objective subsidence rate of 0.25 feet per year is deliberately greater than the reported probable error of ±0.17 feet as a means of avoiding false exceedance of the measurable objective.

5.4.5.3 Margin of Operational Flexibility

The land subsidence margin of operational flexibility is 0.25 feet or 0.35 feet per year depending on the representative monitoring site. This value is approximately twice the potential error (0.17 feet) in the benchmark measurements, allowing for a range of allowable subsidence between the minimum thresholds and a measurable objective that is set within the measurable range (outside the typical range of measurement error and uncertainty) to allow for management if the measurable objective were to be exceeded. Because the measurable objective and minimum threshold at each site take into consideration historical data from the Sacramento Valley Height Modernization Project, the margin of operational flexibility also accounts for these data.

5.4.5.4 Interim Milestones

Interim milestones are intended to provide a glidepath towards sustainability over the implementation horizon by providing progressive targets for subsidence rates every five years after GSP submittal. After sustainability is reached, interim milestones are not required and basins are managed according to the measurable objectives (defined in the GSP Emergency Regulations as "…specific, quantifiable goals for **the maintenance** or improvement **of specified groundwater conditions**…to achieve the sustainability goal for the basin"). For basins that are already sustainable (such as the Colusa Subbasin), interim milestones are intended to provide numerical metrics for GSAs to track progress toward meeting the basin's sustainability goal and ensuring that the basin remains sustainable. Because the minimum thresholds and measurable objectives for inelastic land subsidence were established to support Subbasin sustainability, the interim milestones are to ensure subsidence rates remain in the Subbasin's margin of operational flexibility as established by the minimum thresholds and measurable objectives. The interim milestones for land subsidence are consistent with the measurable objectives and are set at 0.25 feet (3 inches) of subsidence per year at each site.

5.4.6 Depletions of Interconnected Surface Water

The undesirable result for depletions of interconnected surface water is:

> *…a result that causes significant and unreasonable adverse effects on beneficial uses and users of interconnected surface water within the Colusa Subbasin over the planning and implementation horizon of this GSP.*

The undesirable result for depletions of interconnected surface water is monitored by proxy using groundwater levels. The thresholds set for depletions of interconnected surface water have been established so that when 25 percent of monitoring wells (i.e., 3 of 12 wells) fall below the minimum threshold for 24 consecutive months, an undesirable result is detected. The following subsections describe the sustainability thresholds used for depletions of interconnected surface water. Additional information describing how the minimum thresholds and measurable objectives were established is also included in Appendix 5A.

The foregoing sustainable management criteria were established with the GSAs' understanding that additional new or existing wells will need to be added to the monitoring network over time. Additionally, the GSAs acknowledge that the sustainability thresholds will need to be reviewed and evaluated, and potentially refined, as additional wells are added, and additional data is collected and analyzed.

5.4.6.1 Minimum Thresholds

Minimum thresholds for depletions of interconnected surface waters were determined based on evaluation of historical data from the monitoring network for interconnected surface water, which is composed of 12 shallow groundwater wells located proximate to interconnected streams in the Colusa Subbasin. The minimum thresholds set at these sites for assessing impacts to interconnected surface waters were calculated by finding the groundwater elevations in Fall of 2015 and adding 10 feet to that depth. Measurements selected for Fall 2015 were found by selecting measurements closest to October 15, 2015, considered to the be period of lowest groundwater elevations during the last drought based on review of historical groundwater levels and hydrologic data. All wells recorded measurements within three days of this date, providing a relative "snapshot" of groundwater conditions during this time. Management areas were not used in calculating the minimum threshold, or any other threshold for depletions of interconnected surface waters. Figure 5-2 provides an example hydrograph with all depletions of interconnected surface

water thresholds plotted. Minimum thresholds for interconnected surface water are provided in Table 5-2. Additional information on the calculation of minimum thresholds is provided in Appendix 5A along with hydrographs for all representative monitoring wells in the interconnected surface water monitoring network showing the site-specific minimum thresholds. The minimum threshold was selected such that groundwater levels near interconnected surface water courses would be protective of the beneficial use of shallower groundwater near streams and rivers, including those of shallower domestic users and potential groundwater dependent ecosystems. Levels from Fall 2015 represent conditions during a drought period, but are generally believed to have still protected beneficial users at that time and therefore avoid undesirable results. The addition of 10 feet to the Fall 2015 groundwater depth to water is intended to provide an appropriate margin of operational flexibility in the future during GSP implementation based on recommendations made through discussion with the GSAs and stakeholders.

Consideration for the location, quantity, and timing of depletions of interconnected surface water along the primary waterways in the Colusa Subbasin is described in Chapter 3 and Appendix 3D. Volumes of projected (future) streamflow depletion during the GSP implementation period and sustainability monitoring horizon were assessed using the C2VSimFG-Colusa model, the best available information to support quantification of streamflow depletion. Documentation of this model is provided in Appendix 3D. Results of these analyses indicate that streamflow gain and loss do not appear to be strongly affected by increases in groundwater pumping needed to satisfy increased irrigation requirements resulting from potential future climate change, or by recharge projects than could be implemented in the Subbasin. Therefore, it is concluded, on a provisional basis, that the effects of groundwater management in the Colusa Subbasin will not have significant and unreasonable effects on beneficial uses and users of surface water.

While information and understanding of interconnected surface waters is limited, groundwater levels that exceed the minimum threshold in the future for an extended period of time could impact the beneficial uses and users of shallow groundwater by dewatering domestic wells and limiting resources for groundwater dependent ecosystems. However, as additional data are collected during GSP implementation, the understanding of interconnected surface waters may change and the threshold calculations revised to reflect a better understanding of this complex interaction and the Subbasin's unique conditions.

Special considerations were made in establishing the minimum threshold for monitoring well 21N02W36A002, which experienced drawdowns over an approximately eight-month period in 2015 and 2016. A deeper measurement recorded on October 20, 2015, was selected for the minimum threshold calculation for this well to better represented local conditions at that time. Figure 5-3 provides the depletions of interconnected surface water hydrograph with applicable thresholds plotted for well 21N02W36A002.

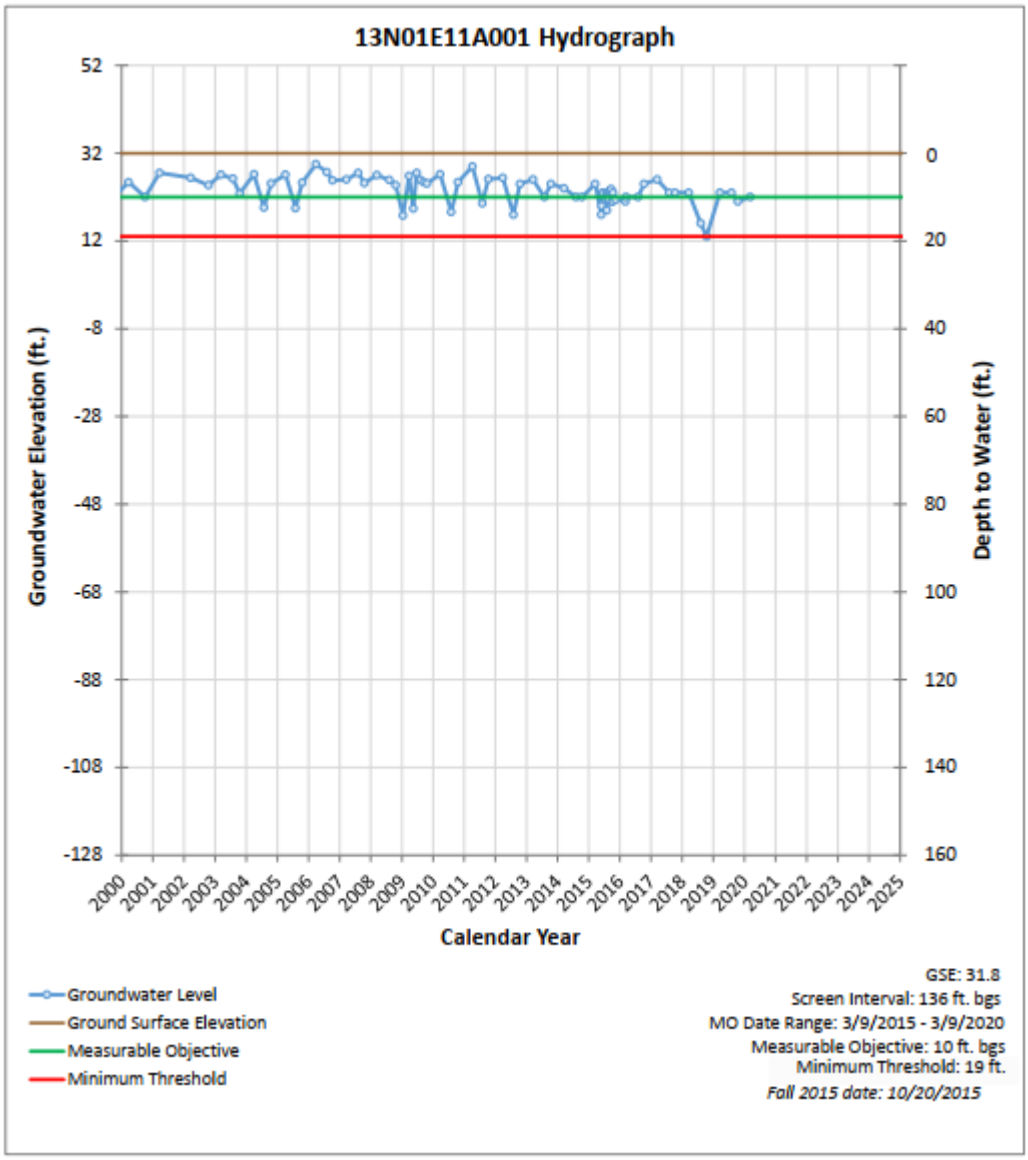

Figure 5-2. Hydrograph, Measurable Objective and Minimum Threshold for Interconnected Surface Water Monitoring Well 13N01E11A001

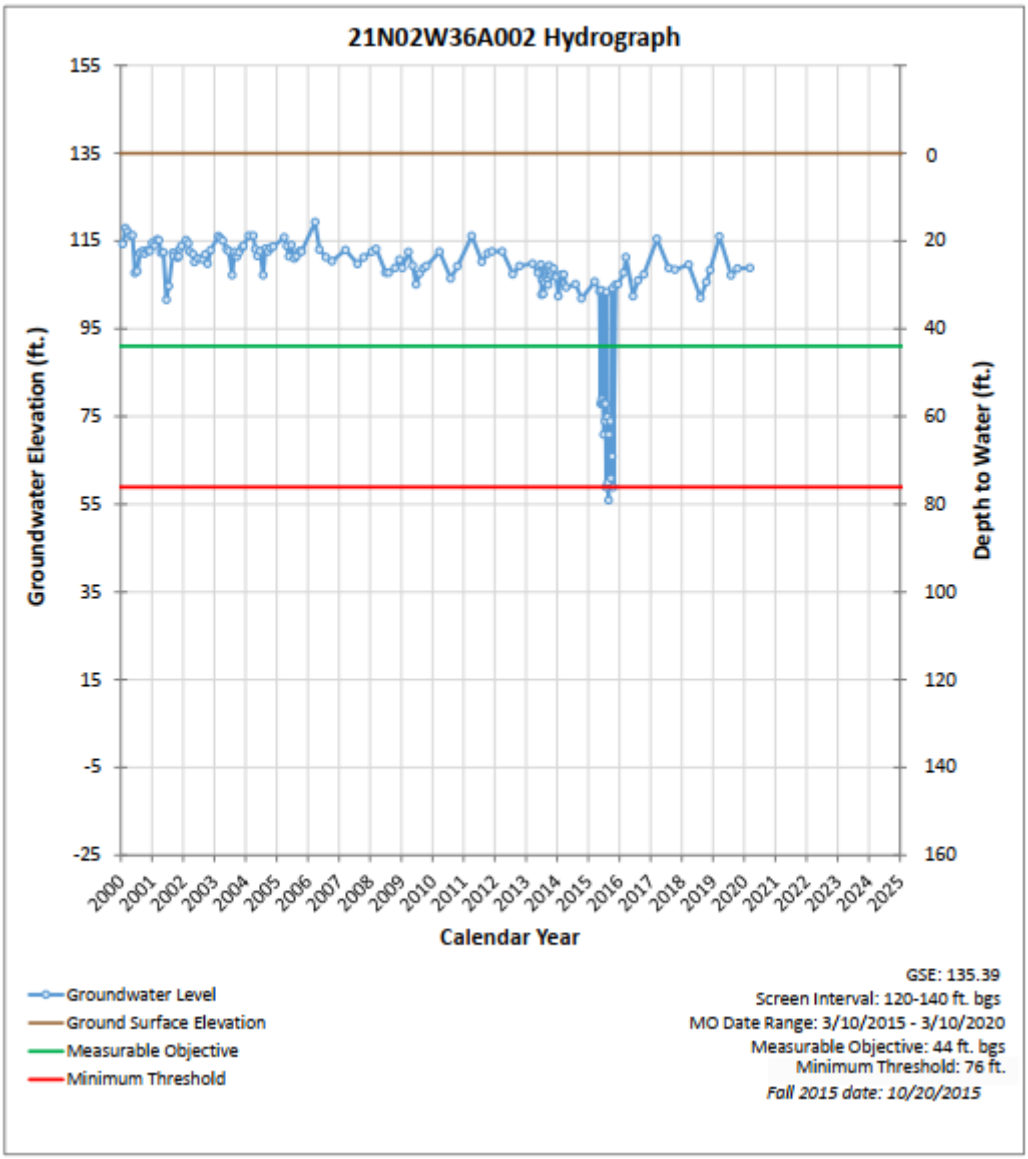

Figure 5-3. Hydrograph, Measurable Objective and Minimum Threshold for Interconnected Surface Water Monitoring Well 21N02W36A002

Table 5-2. Depletions of Interconnected Surface Water Representative Monitoring Network and Sustainability Criteria

SWN	CASGEM ID	Ground Surface Elevation, ft	Minimum Threshold GWE, ft amsl	Minimum Threshold DTW, ft bgs	Measurable Objective GWE, ft amsl	Measurable Objective DTW, ft bgs	Interim Milestone GWE, ft amsl	Interim Milestone DTW, ft bgs	Margin of Operational Flexibility, ft	Fall 2015 DTW, ft bgs
13N01E11A001	18534	32	13	19	22	10	22	10	9	9
13N01W07G001	36246	90	-19	110	-10	100	-10	100	10	100
14N01W04K003	18554	37	3	34	12	25	12	25	9	24
15N01W05G001	14309	47	19	29	27	20	27	20	9	19
17N02W30J002	16960	63	26	37	44	19	44	19	18	27
20N02W11A001	17170	125	106	20	119	6	119	6	14	10
20N02W25F004	23991	102	87	15	97	5	97	5	10	5
21N02W01F004	40029	162	105	57	126	36	126	36	21	47
21N02W05M003	23996	189	125	64	148	41	148	41	23	54
21N02W36A002	21239	135	59	76	91	44	91	44	32	76
22N02W30H004	38609	204	161	43	179	25	179	25	18	33
22N03W24E003	25758	231	194	36	208	23	208	23	13	26

CASGEM ID = California Statewide Groundwater Elevation Monitoring Identification Code
GWE = groundwater elevation
DTW = depth to water
ft = feet
amsl = above mean sea level
bgs = below ground surface

5.4.6.2 Measurable Objectives

Measurable objectives for depletions of interconnected surface water at representative monitoring locations are shown in Table 5-2. The measurable objective was calculated for each well using the average of the most recent five years of available groundwater level measurements. This methodology is consistent with that used in setting the measurable objectives for the chronic lowering of groundwater levels measurable objectives. This method is generally representative of drought and recovery conditions within the Subbasin as most wells utilize data recorded between 2015 and 2020. It is also consistent with the measurable objective calculation method for groundwater levels sustainability indicator.

5.4.6.3 Margin of Operational Flexibility

The margin of operational flexibility is the difference between the measurable objective and the minimum threshold for each well. The margin of operational flexibility is intended to provide adequate flexibility to allow for increased groundwater production during drought years with recovery during normal or wet years, accounting for uncertainty in each. This ensures undesirable results are not triggered due to drought conditions that the GSAs cannot control while allowing for adequate local recovery of groundwater levels after those drought periods, thereby maintaining sustainability in the long term. The margins of operational flexibility for depletions of interconnected surface water are shown in Table 5-2. The methodology used to set these margins of operational flexibility is consistent with that used for setting the margins of operational flexibility for the chronic lowering of groundwater levels. Because the measurable objective and minimum threshold at each well take into consideration the historical water budgets, seasonal and long-term trends, and periods of drought, the margin of operational flexibility also accounts for these factors.

5.4.6.4 Interim Milestones

Interim milestones are intended to provide a glidepath towards sustainability over the implementation horizon by providing progressive targets for groundwater levels every five years after GSP submittal. After sustainability is reached, interim milestones are not required and basins are managed according to the measurable objectives (defined in the GSP Emergency Regulations as "…specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions…to achieve the sustainability goal for the basin"). For basins that are already sustainable (such as the Colusa Subbasin), interim milestones are intended to provide numerical metrics for GSAs to track progress toward meeting the basin's sustainability goal and ensuring that the basin remains sustainable. Because the minimum thresholds and measurable objectives for the depletions of interconnected surface waters were developed to support Subbasin sustainability, the interim milestones were established to maintain water levels within the Subbasin's margin of operational flexibility as set by the minimum thresholds and measurable objectives. The interim milestones for depletions of interconnected surface water are shown in Table 5-2. The methodology used to set these interim milestones is consistent with that used for setting the interim milestones for the chronic lowering of groundwater levels.

5.4.7 Effects of Minimum Thresholds on Adjacent Basins

The minimum thresholds described in the preceding sections have been selected and evaluated to ascertain that they do not cause undesirable results in adjacent basins, and that they do not affect the ability of adjacent basins to achieve their groundwater sustainability goals.

Based on groundwater model results, sustainable management of the Colusa Subbasin under SGMA is not expected to significantly affect the net groundwater exchange with surrounding subbasins. Table 3-10 in

Chapter 3, *Basin Setting*, summarizes the average annual groundwater system inflows and outflows over the historical, current, and projected (future) water budget periods. Over all scenarios, subsurface inflows and subsurface outflows to and from the Colusa Subbasin generally remain unchanged. Total subsurface inflows are approximately 200 to 209 thousand acre-feet per year (taf/yr), on average, while total subsurface outflows are approximately 146 to 149 taf/yr, on average. The variations between scenarios is considered to be within the uncertainty of the model, indicating no significant change in the net groundwater exchange with surrounding subbasins.

Likewise, groundwater model results do not suggest that sustainable management of the Colusa Subbasin will significantly affect the net depletions of interconnected surface water along waterways that flow through the Subbasin. As summarized in Appendix 3D, streamflow gain and loss along the Sacramento River, Stoney Creek, and the Colusa Drain do not appear to be strongly affected by increases in groundwater pumping needed to satisfy increased irrigation requirements resulting from potential future climate change, or by recharge projects than could be implemented in the Subbasin. Therefore, it is concluded, on a provisional basis, that the effects of groundwater management in the Colusa Subbasin will not have significant and unreasonable effects on beneficial uses and users of interconnected surface water.

The GSAs will continue to monitor the effects of groundwater management according to the sustainability thresholds described in this chapter throughout GSP implementation, including those effects on adjacent Subbasins.

5.5 REFERENCES

DWR, See *California Department of Water Resources*

California Department of Water Resources (DWR). 2017. *Draft Sustainable Management Criteria Best Management* Practices. Accessed on September 10, 2020. Available online at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-6-Sustainable-Management-Criteria-DRAFT_ay_19.pdf

Environmental Defense Fund (EDF). 2018. Addressing Regional Surface Water Depletions in California: A Proposed Approach for Compliance with the Sustainable Groundwater Management Act. Accessed June 30, 2021. Available online at: https://www.edf.org/sites/default/files/documents/edf_california_sgma_surface_water.pdf