DECEMBER 2021

CHAPTER 3: SUSTAINABLE
MANAGEMENT CRITERIA

SISKIYOU COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT

Scott Valley Groundwater Sustainability Plan

FINAL DRAFT REPORT

SISKIYOU COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
GROUNDWATER SUSTAINABILITY AGENCY
SCOTT RIVER VALLEY GROUNDWATER SUSTAINABILITY PLAN

BOARD

Brandon Criss, County of Siskiyou
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Nancy Ogren, County of Siskiyou
Ray A. Haupt, County of Siskiyou

STAFF

Matt Parker, Natural Resources Specialist, County of Siskiyou

TECHNICAL TEAM

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Thomas Harter, UC Davis

Andrew Calderwood, UC Davis
Brad Gooch, UC Davis
Cab Esposito, LWA
Katrina Arredondo, LWA
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3.1 Introduction and Definition of Terms

This section defines sustainable groundwater management in the Basin through description of an overall sustainability goal for the Basin, and through description and quantification of sustainable management criteria (SMC) for each of the sustainability indicators. SGMA requires that a GSP design the SMC to avoid undesirable results that did not already exist prior to 2015. The plan is not required to, but may also address undesirable results that occurred before January 1, 2015 (California Water Code 10727.2(b)(4)). Building on the Basin conditions described in Chapter 2, this section describes the processes and criteria used to define the undesirable results, measurable objectives, and minimum thresholds for each sustainability indicator.

The following terms, defined below, are used throughout this chapter.

Sustainability Goal: The overarching goal for the Basin with respect to managing groundwater conditions to ensure the absence of undesirable results.

Sustainability Indicators (SI): Six indicators defined under SGMA: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, degraded groundwater quality, land subsidence, and depletion of interconnected surface water. These indicators describe groundwater-related conditions in the Basin and are used to determine occurrence of undesirable results (23 CCR 354.26).

Sustainable Management Criteria (SMC): Minimum thresholds, measurable objectives, and undesirable results, consistent with the sustainability goal, that must be defined for each sustainability indicator.

Undesirable Results (UR): Conditions, defined under SGMA as:

> "… one or more of the following effects caused by groundwater conditions occurring throughout a basin: 1. Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon…. 2. Significant and unreasonable reduction of groundwater storage. 3. Significant and unreasonable seawater intrusion. 4. Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies. 5. Significant and unreasonable land subsidence that substantially interferes with surface land uses. 6. Depletion of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water."

Minimum Thresholds (MinT): a quantitative value representative of groundwater conditions at a site (or sites), that, if exceeded, may cause an undesirable result. The term "maximum threshold" (MaxT) is the equivalent value for sustainable management criteria with a defined maximum limit (e.g., groundwater quality).

Measurable Objectives (MO): specific and quantifiable goals that are defined to reflect the desired groundwater conditions in the Basin and achieve the sustainability goal within 20 years. Measurable objectives are defined in relation to the six undesirable results and use the same metrics as minimum thresholds.

Interim Milestones: periodic goals (defined every five years, at minimum), that are used to measure progress toward measurable objectives and the sustainability goal.

Representative Monitoring Points (RMP): for each sustainability indicator, a subset of the entire monitoring network where minimum thresholds, measurable objectives, and milestones are measured and evaluated.

Projects and Management Actions (PMAs): creation or modification of a physical structure / infrastructure (project) and creation of policies, procedures, or regulations (management actions) that are implemented to achieve Basin sustainability.

3.2 Sustainability Goal

The overall sustainability goal of groundwater management in the Basin is to maintain groundwater resources in ways that best support the continued and long-term health of the people, the environment, and the economy in Scott Valley, for generations to come. This includes managing groundwater conditions for each of the applicable sustainability indicators in the Basin so that:

- Groundwater elevations and groundwater storage do not significantly decline below their historically measured range, protect the existing well infrastructure from outages, protect groundwater-dependent ecosystems, and avoid significant additional stream depletion due to groundwater pumping.
- Groundwater quality is suitable for the beneficial uses in the Basin and is not significantly or unreasonably degraded.
- Significant and unreasonable land subsidence is prevented in the Basin. Infrastructure and agricultural production in Scott Valley remain safe from permanent subsidence of land surface elevations.
- Groundwater pumping effects on stream depletion in the Scott River are not allowed to worsen beyond current conditions. Moreover, some effects of the existing stream depletion due to groundwater pumping are reversed through projects and management actions that consider and are consistent with the programmatic structures of the NCRWQCB Basin Plan (including the TMDL Action Plan) and of the Public Trust Doctrine.
- The GSA's groundwater management is efficiently and effectively integrated with other watershed and land use planning activities through collaborations and partnerships with local, state, and federal agencies, private landowners, and other organizations, to achieve the broader "watershed goal" of sufficient surface water flows that sustain healthy ecosystem functions.

3.3. Monitoring Networks

The monitoring networks described here support data collection to monitor the chronic lowering of groundwater levels, reduction of groundwater in storage, degradation of water quality, land subsidence, and depletion of interconnected surface water sustainability indicators. The monitoring networks for each sustainability indicator are critical to demonstrating the Basin's sustainability over time. No monitoring network is identified for the seawater intrusion sustainability indicator as it is not applicable to the Basin.

Per 23 CCR Section 354.34, monitoring networks should be designed to:

- Demonstrate progress towards achieving measurable objectives described in the Plan.
- Monitor impacts to the beneficial uses or users of groundwater.
- Monitor changes in groundwater conditions relative to measurable objectives and minimum or maximum thresholds, and
- Quantify annual changes in water budget components.

The monitoring networks for each sustainability indicator are critical to demonstrating the Basin's sustainability over time.

Monitoring networks are required to have sufficient spatial density and temporal resolution to evaluate the effects and effectiveness of Plan implementation and represent seasonal, short-term, and long-term trends in groundwater conditions and related surface conditions. Short-term is considered here to be a time span of 1 to 5 years, and long-term is considered as 5–20 years. Monitoring networks are necessary to measure progress and benefits of any implemented projects and management actions, and to monitor for any direct or indirect impacts due to this implementation (i.e., effects on other sustainability indicators or beneficial uses and users, including groundwater dependent ecosystems). The spatial densities and frequency of data measurement are specific to monitoring objectives, the parameter to be measured, degree of groundwater use, and Basin conditions, among other factors. A description of the existing and planned spatial density and data collection frequency is included for each monitoring network. Detailed descriptions, assessments and plans for improvement of the monitoring network are provided for each sustainability indicator in the following sections. An overview of the monitoring network established for each sustainability indicator is provided in Table 1.

Notes regarding Table 1:

1. This table only includes monitoring networks used to measure sustainability indicators. It does not include additional monitoring necessary to monitor the various water budget components of the Basin, described in Chapter 2, or to monitor the implementation of projects and management actions, which are described in Chapter 4.
2. The groundwater level monitoring network is also used for monitoring non-riparian groundwater dependent ecosystems.
3. Land surface elevation changes are monitored through satellite remote sensing.

Sustainability Indicator	Metric	Number of Sites in Current Network
1. Chronic Lowering of Groundwater Levels	Groundwater level	21 (Priority 1)
2. Reduction of Groundwater Storage	Volume of water per year, computed from water level changes	Uses chronic lowering of groundwater levels network
3. Groundwater Quality	Concentration of selected water quality parameters	3
4. Land subsidence	Land surface elevation (measured remotely)	Spatially continuous
5. Stream depletion due to groundwater pumping	Stream depletion reversal, quantified at the Fort Jones USGS Stream Gauge through computation with SVIHM. SVIHM is based on water level, streamflow, land use, water diversions, and multiple other repeated, continuous, or one-time monitoring data.	Spatially continuous and integrated into one master RMP

Table 1: Summary of monitoring networks, metrics, and number of sites for sustainability indicators.

In summary, there are four monitoring networks: a water level monitoring network, a water quality monitoring network, a land subsidence monitoring system, and a stream depletion monitoring system. The first two monitoring networks utilize independent, but potentially overlapping, networks of wells. The third utilizes satellite remote sensing, and the fourth utilizes the Scott Valley Integrated Hydrologic Model (SVIHM), which incorporates numerous, diverse datasets including water level and streamflow monitoring data. Detailed descriptions, assessments, and plans for future improvement of the well monitoring networks and protocols for data collection and monitoring are addressed for each sustainability indicator in the following sections.

Identification and Evaluation of Potential Data Gaps

Per 23 CCR Section 351(l), data gaps are defined as, “a lack of information that significantly affects the understanding of the basin setting or evaluation of the efficacy of Plan implementation and could limit the ability to assess whether a basin is being sustainably managed”. A detailed discussion of potential data gaps, and strategies for resolving them, is included as Appendix 3-A. Data gaps are primarily addressed in this chapter through the ‘Assessment and Improvement of Monitoring Networks’, associated with each sustainability indicator in the Basin. Of particular focus for the monitoring networks are the adequacy of the number of sites, frequency of measurement, and spatial distribution in the Basin. In addition to the monitoring network-specific data gaps, information was identified that would be valuable to collect. This information is valuable to support increased understanding in the Basin setting, understanding of conditions in comparison to the sustainable management criteria, data to calibrate or update the model, and to monitor efficacy of PMAs. These additional monitoring or information requirements depend on future availability of funding and are not yet considered among the GSP Representative Monitoring Points (RMPs). They will be considered as potential RMPs and may eventually become part of the GSP network at the 5-year GSP update. The list includes:

- Streamflow gauges on the tributaries to Scott River
- Streamflow gauges on the mainstem of Scott River
- Wells near the mainstem of Scott River to measure groundwater levels (see Section 3.3.5) for use in SVIHM model calibration, as part of ISW monitoring, and for measuring PMA efficacy.

- Additional biological data that would be useful for monitoring and evaluation of GDEs including streamflow depletion impacts on juvenile salmonids

A detailed discussion of these potential data gaps and suggested approach and monitoring prioritization can be found in Appendix 3-A. The GSA may engage with other entities and water users to collaboratively fill these data gaps as appropriate and feasible.

Network Enrollment and Expansion

With the exceptions of streamflow, land subsidence, and stream depletion due to groundwater pumping, monitoring is performed using wells. Some wells will be monitored for water level, some for water quality, some for both. Prior to enrolling wells into the GSA's monitoring network, wells will be evaluated, using the selection criteria listed below, to determine their suitability. The selection criteria for potential wells to be added to the monitoring network include the following:

- Well Location
- Monitoring History
- Well Information
- Well Activity (e.g., is the well inactive, routinely pumped, etc.)
- Well Access

Well Location

The location and design of a well network is important to ensure adequate spatial distribution, coverage, and well density. Objectives for network design include sufficient coverage and density of wells to capture hydraulic gradients and overall groundwater in storage. Additionally, wells important for the measurement of groundwater level and groundwater quality must be included in areas within or adjacent to planned GSP projects and management actions and locally defined areas where existing operations are found to pose a significant risk of affecting groundwater levels or quality. Statistical methods will be used to aid in extrapolating measurements from a limited number of monitoring sites to groundwater conditions the entire Basin to measure compliance with the minimum or maximum thresholds set and to measure progress towards interim milestones.

Monitoring History

Wells with a long monitoring record provide valuable historical groundwater level or water quality data and enable the assessment of long-term trends. Such wells were preferentially selected for a network over wells with limited monitoring data.

Well Information

In addition to well location, information about the construction of the well, including the well depth and screened interval(s) is necessary to provide context for the measurement taken at the well, such as which water bearing formation is being sampled. Well information is critical for an effective well network, so the groundwater aquifer can be efficiently monitored. For wells that are candidates for being added to the well network, the GSA will continue to verify well information with well logging.

Well Access/Agency Support

In order to be a functional component of the monitoring network, the ability to gain access to the well to collect samples at the required frequency is critical.

Wells in existing monitoring programs, particularly for water quality, are located near populated areas, leaving sections of the remainder of the Basin without monitoring data. The planned additional wells for inclusion in a network are intended to provide data representative of different land uses, activities, and geologic units to improve upon the existing spatial coverage in the Basin. Any wells added to the monitoring network will be evaluated using the criteria listed above to ensure well suitability. A more detailed evaluation of the required spatial density and monitoring frequency of the individual sustainability indicator monitoring network(s) has been conducted to determine appropriate attributes so that the monitoring network is representative of Basin conditions and enables evaluations of seasonal, short-term, and long-term trends.

The monitoring networks will continue to be developed throughout GSP implementation. Individual sustainability indicator monitoring networks will be expanded throughout GSP implementation, as necessary, to address monitoring objectives and support any projects and management actions (PMAs). Expansion of individual sustainability indicator monitoring networks that rely on wells will involve identification of additional existing wells in the Basin that could be included in the monitoring network once evaluated, using the selection criteria, and approved for inclusion in the network. Evaluations of the monitoring network will be conducted at least every five years to determine whether additional wells are required to achieve sufficient spatial density, whether wells are representative of land uses in the Basin, and whether wells provide monitoring in key areas identified by stakeholders. If additional sites are required to ensure sufficient spatial density, then existing wells may be identified or new wells may be constructed at select locations, as required. The monitoring frequency and timing that enable evaluation of seasonal, short-term, and long-term trends will also be assessed throughout GSP implementation. Where it is necessary, the GSA will coordinate with existing programs to develop an agreement for data collection responsibilities, monitoring protocols and data reporting and sharing. For existing monitoring programs implemented by agencies, monitoring would be conducted by agency program staff or their contractors. For water quality monitoring, samples will be analyzed at contracted analytical laboratories. To prevent bias associated with date of sample collection, all samples should be collected on approximately the same date (i.e., +/- 30 days of each other) each year.

3.3.1 Groundwater Elevation Monitoring Network

3.3.1.1 Description of Monitoring Network

This section describes the process used to select wells as potential Representative Monitoring Points (RMPs) for monitoring the Groundwater Elevation sustainability indicator. These wells are mapped in Figure 1 and listed in Table 2. Features potentially affected by groundwater levels, and therefore relevant to the selection of the RMPs, are shown in Figure 2

The objective of the groundwater level monitoring network design is to capture sufficient spatial and temporal detail of groundwater level conditions to assess groundwater level changes over time, groundwater flow directions, and hydraulic gradients between aquifers and surface water features. The monitoring network is critical for the GSA to show compliance with SGMA and quantitatively show the absence or improvement of undesirable results. The design of the monitoring network must enable adequate spatial coverage (distribution, density) to describe groundwater level conditions at a local and Basin-wide scale for all beneficial uses. Revisions to the monitoring network and schedule will be considered after review of the initial five years of monitoring data and as part of any future GSP updates.

Monitoring Network Development

Considerations for making the RMP selections included, in order of priority: spatial coverage, date of last observation, and participation in existing monitoring programs (such as DWR's CASGEM or the continuous transducer measurement network). All of the wells selected to be potential RMPs are associated with water level data, and all but one well (Z36) are associated with water level data collected in the past 3 years. Wells with recent data were prioritized because this reduces the likelihood that a well has been destroyed or made inaccessible; well Z36 was last measured in 2009, but was included as a Priority 2 well due to its position near the western boundary of the Basin.

Some of the wells in the potential RMP network are already enrolled in programs such as CASGEM; the inclusion of these wells in the finalized RMP network is all but assured barring an unlikely well failure. The

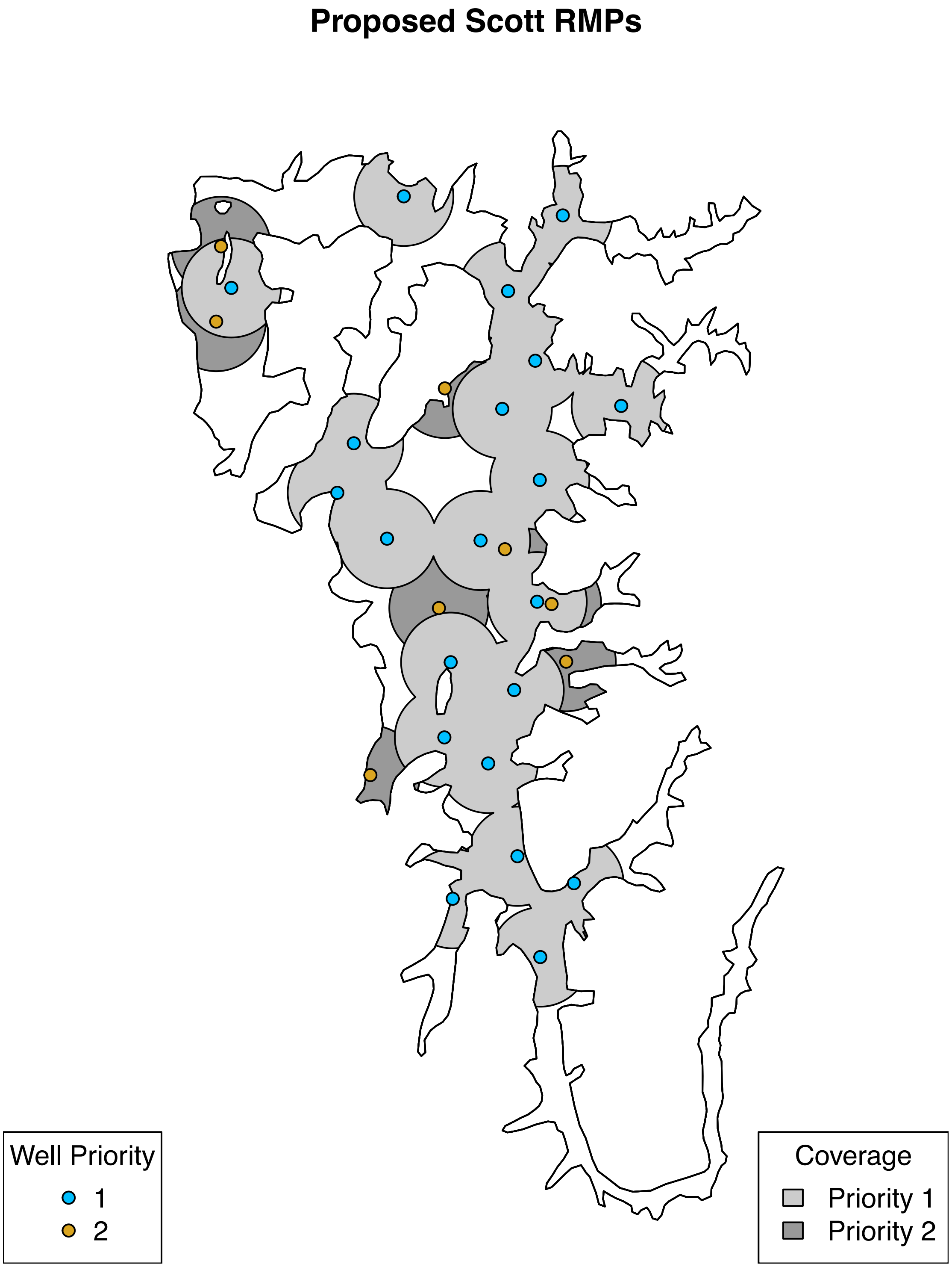

Figure 1: Potential RMPs for the groundwater levels and storage monitoring network.

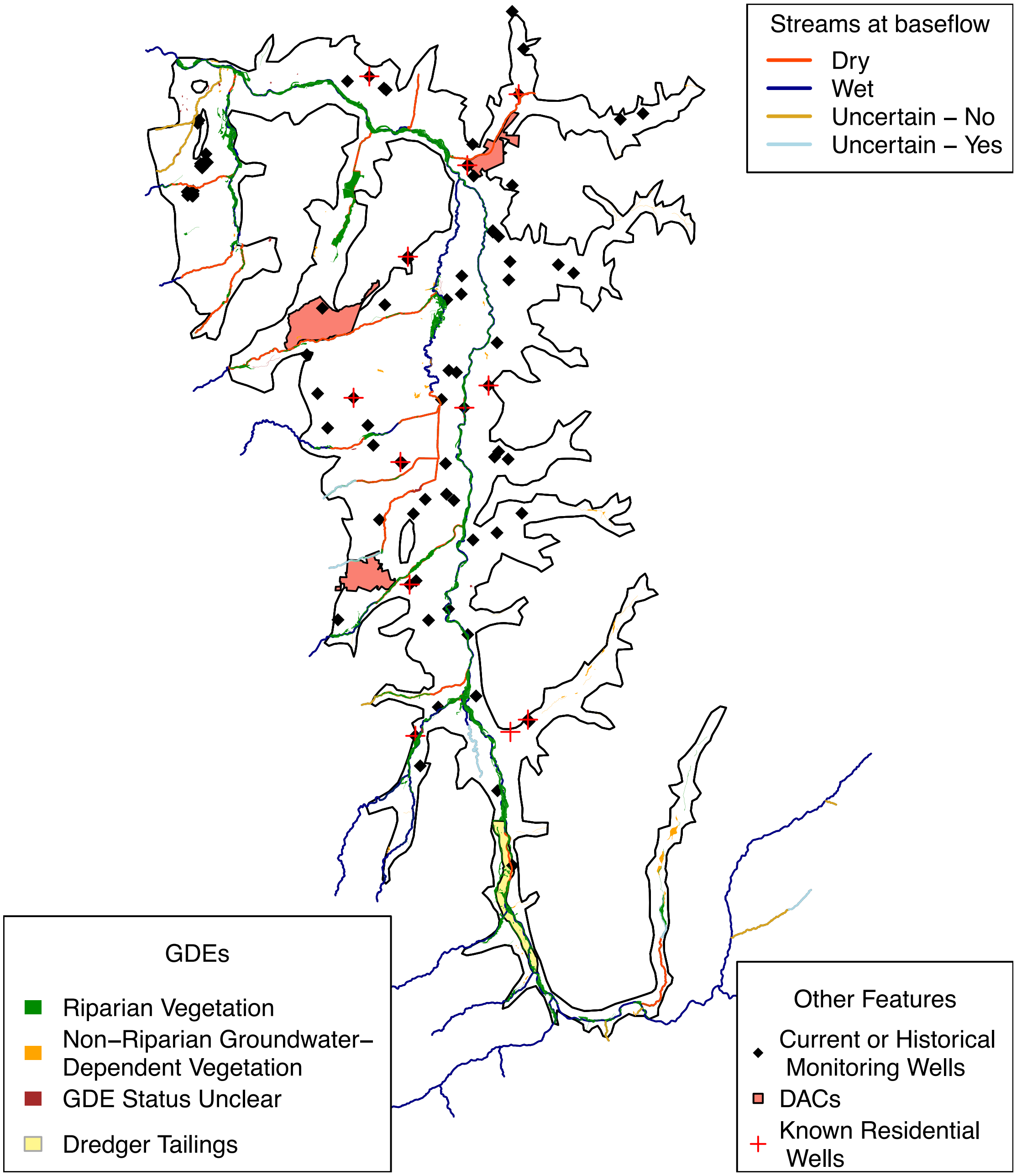

Figure 2: Features informing or possibly affected by proposed groundwater elevation monitoring network. The domestic wells depicted here are the incomplete set of wells in the Basin with known location and domestic use type.

Well ID	Well Depth (ft bgs)	Latitude	Longitude	Priority
42N09W27N002M	60	41.45550	-122.87500	1
43N09W23F001M	60	41.56440	-122.85400	1
43N09W02P002M	80	41.60330	-122.85300	1
44N09W25R001M	140	41.62880	-122.83000	1
44N09W29J001M	60	41.63350	-122.90000	1
C26	80	41.55156	-122.91861	1
E3	60	41.38404	-122.83016	1
H6	–	41.52079	-122.86176	1
K9	60	41.50116	-122.83618	1
L31	–	41.48035	-122.87324	1
L32	203	41.53508	-122.92515	1
M10	43	41.41704	-122.84147	1
M12	–	41.44735	-122.85549	1
M2	140	41.56655	-122.80190	1
N17	179	41.40239	-122.86919	1
P43	75	41.40870	-122.81640	1
Q32	57	41.54132	-122.83663	1
R24	100	41.47181	-122.84508	1
SCT_173	70	41.58061	-122.84017	1
SCT_186	48	41.52045	-122.90276	1
QV09	40	41.60156	-122.97439	1
D31	81	41.49809	-122.87911	2
G31	236	41.48168	-122.82268	2
L18	170	41.50055	-122.82983	2
Z36	197	41.44233	-122.90688	2
SCT_202	184	41.57059	-122.87943	2
QV18	140	41.59028	-122.98056	2
QV01	82	41.61514	-122.97947	2
SCT_183	100	41.51815	-122.85098	2

Table 2: Wells designated for potential inclusion in the groundwater levels and storage monitoring network as Representative Monitoring Points (RMPs). There are twenty-one Priority 1 wells and eight Priority 2 wells listed, to achieve the coverage on Figure 1. Well depth is taken from Well Completion Reports (WCRs); each well was matched to a WCR, but some WCRs do not contain depth or screened interval information, and there is some uncertainty regarding the accuracy of the match.

remaining wells are privately owned, and data gathered to date in these wells has been provided voluntarily. Access agreements with each well owner will need to be finalized prior to their inclusion in the final RMP network.

Considerations for making the RMP selections include, in order of priority: spatial coverage, date of last water level observation, and inclusion in existing monitoring programs (such as DWR's CASGEM or the continuous transducer measurement network). All of the wells selected to be potential RMPs are monitored for water level, and all but three wells (Z36, N17, K9) possess water level data collected in the past 3 years. Wells with recent data were prioritized because the presence of current data reduces the likelihood that a well has been destroyed or made inaccessible; the three wells with older measurements were identified as Priority 2 wells due to their potential to provide additional spatial coverage.

Five of the wells in the potential RMP network are already enrolled in programs such as CASGEM; the inclusion of these wells in the finalized RMP network is all but assured barring an unlikely well failure. The remaining wells are privately owned and data gathered to date from these wells have been provided voluntarily. Access agreements are currently only available for wells with transducers maintained by LWA. The current UCANR county representative, in coordination with the GSA, is planning to seek access agreements with well owners not currently signatories to access agreements.

Spatial coverage criteria

DWR's guidance on monitoring networks (DWR 2016) recommends a range of well densities to adequately monitor groundwater resources, with a minimum of 0.2 wells and a maximum of 10 wells per 100 sq mi (259 sq km). Because the Basin covers approximately 100 sq mi (259 sq km), these recommendations would translate directly into a range from 1 to 10 RMP wells, evenly spaced in the Basin. At a minimum, one well monitoring each of the 6 defined hydrogeologic zones (see Figure 27 in Ch. 2, Section 2.2.3.1 of this GSP for the mapped zones) would be desired, so the low end of this range is not suitable for Scott Valley. Additionally, in a previous monitoring program in the Scott Valley, operated by the Groundwater Advisory Council, the desired density was 1-mile (1.6-km) spacing between wells. To provide some continuity with previous monitoring efforts, and to provide some redundancy in the event of inaccessible wells, a network of potential RMPs was selected using a coverage radius of 1.25 mi (2.0 km).

Measurement schedule

The water elevation in RMP wells will be measured, at a minimum, twice per year to capture the fall low and spring high water levels. Wells in the Community Groundwater Monitoring Program network have been measured monthly. In some wells, transducers may provide daily or higher resolution water elevation measurements. In wells without transducers, at least monthly manual measurements of static water levels is recommended.

3.3.1.2 Assessment and Improvement of Monitoring Network

As discussed above, the spatial density and distribution of the wells in the monitoring network are sufficient and satisfy DWR's guidance on well density (DWR 2016). The current monitoring schedules of monthly measurements in the Community Groundwater Monitoring Wells are sufficient to evaluate seasonal trends, though continuous monitoring probes may be installed in some locations to better monitor the effects of PMAs or implementation of timely management actions. Evaluations of the network will occur on a five-year basis. Additional wells may be added throughout GSP implementation in response to changes in land use, project implementation, or with new water level concerns.

Monitoring protocols for data collection are provided in Appendix 3-B.

3.3.2 Groundwater Storage Monitoring Network

This GSP will adopt groundwater levels as a proxy for groundwater storage. The groundwater level network described in Section 3.3.1 will also serve as the groundwater storage network. The network currently provides reasonable coverage of the major water-bearing formations in the Basin and will provide reasonable estimates of groundwater storage. The network also includes municipal, agricultural, and municipal wells of shallow to deep depths. Expansion of the network to close data gaps will benefit the characterization of both the groundwater level and storage sustainability indicators.

Historic groundwater storage changes are computed with the Scott Valley Integrated Hydrology Model (SVIHM, see Chapters 2.2.3.1 and 3.3.5). Throughout the implementation period of this Plan, updates of SVIHM provide updated time series of groundwater storage changes at least every five years.

To obtain groundwater storage changes for the most recent, non-simulated period (currently 2018 – 2021), the latest version of SVIHM, currently, for example, simulating the period 1991-2018, is used to establish a linear regression equation of year-specific spring-to-spring Basin groundwater storage change, $\Delta Storage$, as a function of the year-specific average SVIHM-simulated groundwater level change, ΔWL, at the RMP locations of the groundwater level network:

$$\Delta Storage = intersect + slope\ *\ \Delta WL$$

where "intersect" and "slope" are parameters of the linear regression equation, obtained from statistical analysis of $\Delta Storage$ and ΔWL during the simulation period. The regression analysis is performed using the specific, actual monitoring locations available each year for spring-to-spring water level change observations. The "intersect" and "slope" parameters in the above equation can be updated when new, updated, or re-calibrated versions of SVIHM become available, or when individual RMPs in the water level monitoring network are added or removed.

The above equation is then used to annually compute groundwater storage change using the actually measured average change in groundwater levels within the Basin's groundwater level monitoring network. The resulting estimate of annual groundwater storage change (in units of thousand-acre-feet, positive or negative) is then summed with previous year's estimates and combined with the simulated groundwater storage change timeline for the historic period (see Chapter 2.2.3).

This regression-based method allows for computation of groundwater storage change from measured groundwater level monitoring for the years between the end of the SVIHM simulation period (to be updated at least every five years, currently 2018) and the current reporting year (currently 2021). As SVIHM is updated in the future, regression-based estimates of groundwater storage change for a given year (e.g., for 2021) may be replaced with the simulated SVIHM groundwater storage changes for the same year.

In summary, the combination of simulated groundwater storage change in SVIHM and regression-estimated groundwater storage changes for the post-simulation period provides a time series of cumulative groundwater storage change for the entire period from 1991 to present time (where "present time" is the most recent year in the GSP implementation).

3.3.3 Groundwater Quality Monitoring Network

3.3.3.1. Description of Monitoring Network

The objective of the groundwater quality monitoring network design is to capture sufficient spatial and temporal detail to define groundwater quality conditions with respect to the established maximum thresholds and undesirable results, and to identify trends in groundwater quality over time. The network data will provide an ongoing water quality record for future assessments of groundwater quality. An assessment of groundwater quality conditions in the Basin and a determination of the relevant constituents of concern (COCs) are provided in Section 2.2.3.

The initial groundwater quality monitoring network is limited to wells that are part of existing, ongoing monitoring programs in the Basin that monitor for the two COCs for which SMC are set: nitrate and specific conductivity. The initial RMP well network is limited to all public water system wells[1], as shown in Table 3. The public water systems in the Basin include two community water system (CWS) wells in Fort Jones, and one transient non-community system (TNCWS) well for Kidder Creek Orchard Camp. All monitoring schedules for these wells were obtained from the Safe Drinking Water Information System Federal Reporting Services System (SDWIS)[2]. Data from these existing programs are not representative of groundwater quality associated with agricultural irrigation, stock watering, domestic wells, or groundwater discharge to

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[1] Public water system is defined as a system that supplies water to 15 or more connections or to at least 25 people for 60 or more days per year. This includes community, non-community non-transient and transient water systems as defined in the Safe Drinking Water Act.

[2] https://sdwis.waterboards.ca.gov/PDWW/JSP/NMonitoringSchedules.jsp?tinwsys_is_number=4710&tinwsys_st_code=CA&ReportFormat=DWW

streams. The wells in the monitoring network are almost exclusively located within and near the semi-urban areas of the Basin as shown in Figure 3. As the initial monitoring network (Table 3) has limited spatial coverage, the network will be augmented with at least five additional wells that will be appropriately located to improve spatial coverage of the Basin. Areas of the Basin with no representative wells exemplify large spatial data gaps; existing wells in these areas can be added to the monitoring well network once they are evaluated using the selection criteria. Well information used to determine if a potential candidate well should be added to the monitoring network can be collected through activities such as well logging, camera inspection, or collection of grab samples. The design of the expanded monitoring network must enable adequate spatial coverage (distribution, density) that allows characterization of groundwater quality conditions at a local and Basin-wide scale for all beneficial uses, which the current monitoring network does not. In addition to the wells listed in Table 3, additional wells may be added throughout GSP implementation to meet the objectives of the monitoring network in response to changes in land use, project implementation, or with new water quality concerns.

Name of Network	Number of Wells	Agency	Constituent	Frequency
Municipal	2	City of Fort Jones	Nitrate	Annually
Municipal	2	City of Fort Jones	Specific Conductivity	Periodically
Public Water Supply	1	Kidder Creek Orchard Camp	Nitrate	Annually
Expanded GSA Monitoring Network	A minimum of 5 wells; sites to be determined	GSA	Nitrate and specific conductivity	Frequency to be determined.

Table 3: Existing and planned elements of the groundwater quality monitoring network. Per the monitoring schedules available on EPA's Safe Drinking Water Information System (SDWIS), specific conductivity is on a monitoring schedule of 108 months for each of the two active wells in Fort Jones.

The planned additional wells are intended to gather groundwater quality data representative of different land uses and activities, and to improve upon the existing spatial coverage in the Basin. This includes wells that are located in areas with potential water quality concerns. Specifically, monitoring wells will be added to locally identified sites that may be vulnerable to water quality impacts, including locations used for the loading and unloading of cattle. Cattle manure, deposited in large amounts at the land surface, may cause nitrate contamination of groundwater. Funding has been made available through NCRWQCB for sample analysis and results of this sampling will be used to help inform the monitoring network expansion. Any wells added to the monitoring network will be evaluated using the criteria listed above to ensure well suitability.

3.3.3.2. Assessment and Improvement of Monitoring Network

As the existing monitoring network has limited spatial coverage and is not representative of all land uses in the Basin, an expansion of the network is required to adequately characterize and monitor groundwater quality in the Basin. An assessment and expansion of the monitoring network is planned within the first five years of GSP implementation. Further evaluations of the monitoring network will be conducted, at minimum, on a five-year basis, particularly with regard to the sufficiency of the monitoring network in meeting the monitoring objectives.

Data gaps have been identified, particularly in spatial coverage of the Basin with monitoring data that is representative of different land uses and beneficial uses in the Basin (also see Appendix 3-A). These data gaps will be addressed in the planned expansion of the network, and these data deficiencies will be resolved through the addition of suitable existing wells and construction of new wells, as necessary. The location and number of these wells will be informed by the evaluation completed as part of the monitoring network design. In the North Coast Hydrologic Region, for example, dairy operators are required to monitor and report

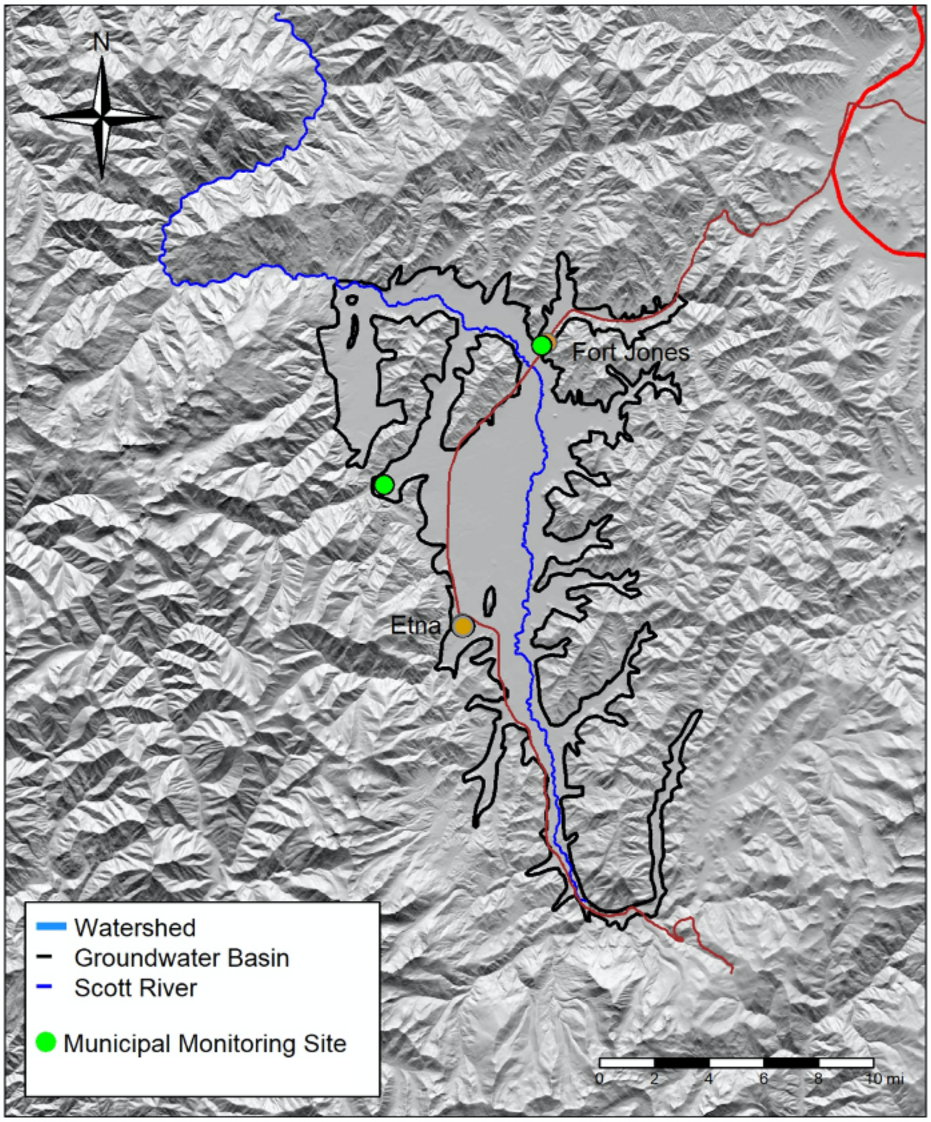


Figure 3: Locations of existing groundwater quality networks in Scott Valley with monitoring for COCs.

groundwater data to NCRWQCB, making these wells possible candidates for network expansion. Annual groundwater monitoring of nitrate was first required in 2012 as part of the Waste Discharge Requirements for Dairies (Order No. R1-2012-0002). Order No. R1-2019-0001 extends the dairy monitoring program, but changes sampling frequency to every three years after the year 2022. The 2020 NCRWQCB report North Coast Hydrologic Region Salt and Nutrient Planning Groundwater Basin Evaluation and Prioritization emphasizes the need for expanded groundwater monitoring through monitoring and reporting programs (MRPs) in Waste Discharge Requirements (WDRs) and Waivers. Additionally, Regional Water Board staff are assessing a Basin Plan amendment for a Groundwater Protection Strategy with new regulatory options or strategies (NCRWQCB 2020). Additional candidate wells include domestic wells, wells included in the monitoring network for groundwater levels, and Quartz Valley Indian Reservation (QVIR) monitoring wells.

Monitoring protocols for data collection are provided in Appendix 3-B.

3.3.4 Subsidence Monitoring Network

3.3.4.1 Description of Monitoring Network

Interferometric Synthetic Aperture Radar (InSAR) is a satellite-based remote sensing technique that measures vertical ground surface displacement changes at high degrees of measurement resolution and spatial detail. DWR provides vertical displacement estimates derived from InSAR data collected by the European Space Agency Sentinel-1A satellite and processed under contract with TRE ALTAMIRA Inc. Point data are average vertical displacements of a 328-by-328 ft (100-by-100-m) area and Geographic Information System (GIS) rasters are interpolated from the point data. As shown in Figure 24 in Chapter 2, spatial distribution of the point data covers most of the Basin and the entire Basin area is covered through interpolation of rasters. The data provide good temporal coverage and are available on multiple timescales. The annual rasters begin and end on each month of the covered year and the cumulative rasters are available for the full time period (2015-2019). Monthly timeseries are available for each point data location.

Representative Monitoring

The DWR (TRE ALTAMIRA) InSAR data will be used to monitor subsidence in the Basin. There are no explicitly identified representative subsidence sites because the satellite data consists of thousands of points. Figure 24 in Chapter 2 shows the coverage of the subsidence monitoring network, which will monitor potential surface deformation trends related to subsidence. Data from the subsidence monitoring network will be reviewed annually. The subsidence monitoring network allows sufficient monitoring both spatially and temporally to adequately assess that the measurable objective is being met.

3.3.4.2 Assessment and Improvement of Monitoring Network

As subsidence is currently not a significant concern for the Basin, and is not likely to be in the future, the InSAR-based subsidence monitoring network allows sufficient monitoring both spatially and temporally to adequately assess that the measurable objective (currently in attainment) is being maintained. In addition, the data provided by DWR (TRE Altamira) are spatially and temporally adequate for understanding short-term, seasonal, and long-term trends in land subsidence, and are consistent with the data and reporting standards outlined in Reg. § 352.4. However, data gaps do exist in the subsidence network, including the lack of data prior to 2015 and no Continuous Global Positioning System (CGPS) stations to ground truth the satellite data. The DWR/TRE ALTAMIRA InSAR dataset is the only subsidence dataset currently available for the Basin and only has data extending back to 2015. Historical subsidence data measured prior to 2015 is currently unavailable. Compared to satellite data, CGPS stations offer greater accuracy and higher frequency and provide a ground-truth check on satellite data. However, there are no CGPS or useful borehole extensometer stations located within or near the Basin boundary. Due to little current evidence of subsidence since 2015 (see Section 2.2.2.4), no future CGPS or borehole extensometer stations are proposed for the Basin at this time. If subsidence becomes a concern in the future, then installation of CGPS stations and/or borehole extensometers can be proposed. The subsidence monitoring network will be used to determine if and where future CGPS stations would be installed or ground-based elevation surveys performed. In addition, if subsidence anomalies are detected in the subsidence monitoring network, ground truthing, elevation surveying, and GPS studies may be conducted.

Monitoring protocols for data collection are provided in Appendix 3-B.

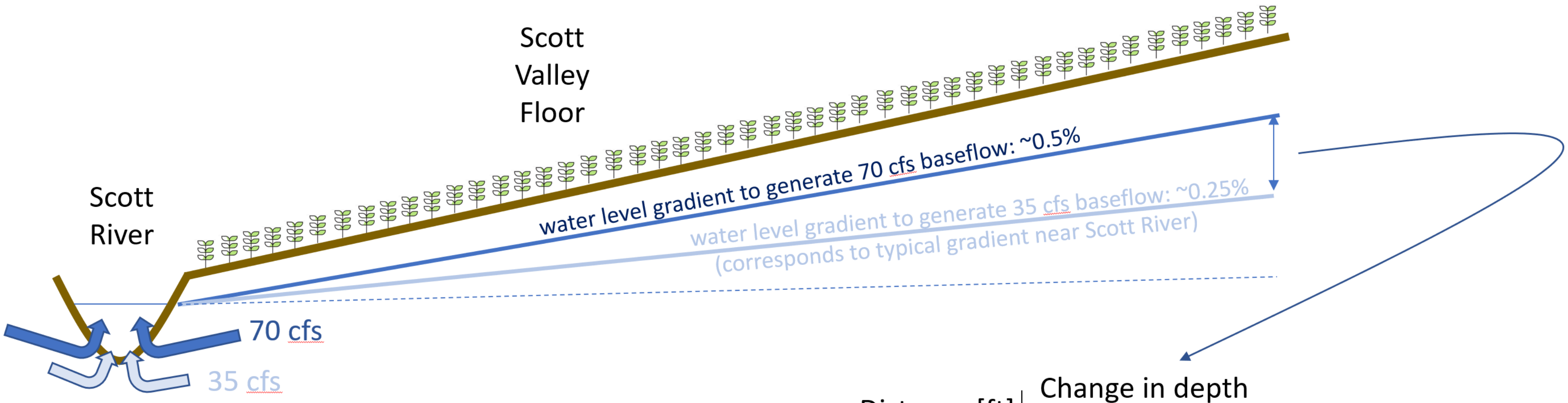
3.3.5 Depletion of Interconnected Surface Water Monitoring Network

3.3.5.1. Description of Monitoring Network

The GSP Regulations provide that the monitoring network for Depletion of Interconnected Surface Water should include "[m]onitor[ing] surface water and groundwater where interconnected surface water conditions exist, to characterize spatial and temporal exchanges between surface water and groundwater and to calibrate and apply the tools and methods necessary to calculate depletion of surface water caused by groundwater extractions. (23 CCR 354.34(c)(6).)

Groundwater Levels as Proxy for Stream Depletion Monitoring – not suitable

Water levels are not a suitable proxy for surface water depletion in the Scott Valley, although they have been proposed in other groundwater basins (e.g., in the GSP adopted recently by the Santa Cruz Mid-County Groundwater Agency). This is because in the Scott Valley system (1) groundwater levels are affected by many factors including, but not limited to groundwater use, and (2) the typical variability induced by seasonal climate, recharge, and pumping changes is greater than the change in head that would correspond to a significant change in outflow to the stream system. In other words, the head data currently available are too noisy to be useful for assessing stream depletion due to groundwater pumping or stream depletion reversal due to specific projects and management actions (PMAs).



Distance [ft]	Change in depth to water table [ft]
100	0.25
300	0.75
1,000	2.5
3,000	7.5

This simple concept ignores any other interfering factors affecting water level changes: recharge in nearby tributaries, recharge from nearby irrigation return flows, pumping in nearby wells

Figure 4: Conceptual cross-section across the valley floor near the Scott River (left), showing the land surface (brown, with crop cover) and two hypothetical water tables: at a gradient of about 0.5 percent, corresponding to a baseflow of about 70 cfs, and at a gradient of about 0.25 percent, corresponding to a baseflow of about 35 cfs. Gradients are approximate. The inserted table shows the resulting difference in water table depth between these two hypothetical water table locations, at different distances from the Scott River. The conceptual cross-section does not account for water table influences from nearby pumping, irrigation return flows, or tributaries.

Specifically, the average decrease in summer streamflow before and after the 1970s (69.9 and 35.0 cfs, respectively [1.98 and 0.99 cms, respectively]), is approximately 35 cfs (0.85 cms) in baseflow. This difference in baseflow is caused by a Basin average decline in water table gradient toward the Scott River (Section 2.2.3.3) of approximately 3/10ths of one percent (see Figure 4). At 100 ft (30.5 m) from Scott River, this is a 3 in (7.6 cm) difference in water level if the water table next to the Scott River remains the same. This is much smaller than the typical transient variations induced by pumping wells and seasonal climate variability in water levels measured in monitoring wells near the river (see Chapter 2). Additionally, water levels near the stream – and more so away from the stream - are influenced by factors other than groundwater pumping outside of the Adjudicated Zone, including proximity to tributaries and their recharge history, proximity to wells and their pumping history, irrigation methods and agricultural return flows in nearby fields, and aquifer heterogeneity.

For example, monthly water table depth in 2006 – 2018 in “valley floor” wells varied across wells and time, from less than 5 feet to over 20 feet (Harter, n.d.). The median summer water table elevation in dry years is only about 2 feet lower than the median elevation in average or wet years. Between dry years with similarly low stream flows (less than 10 cfs at the USGS Fort Jones gauge, e.g., 2009, 2013, 2014), differences in median water level of “valley floor” observation wells were on the order of 1 to 2 feet (Harter, n.d.).As a result of the magnitude of these fluctuations, partly due to the interference from hydrologic inputs/stresses other than PMAs, water level monitoring is not a suitable tool to measure whether groundwater users’ PMAs have effectively decreased stream depletion.

However, the GSP recognizes that groundwater levels are fundamentally linked with groundwater-stream flux rates, and these measurements can be useful when judiciously used in combination with the SVIHM. In addition, use of observing long-term trends in the hydraulic gradient between the aquifer and stream has been suggested as a tool to comply with SGMA requirements for depletion of interconnected surface water (Hall et al. 2018). While groundwater levels as a proxy for stream depletion monitoring are by themselves not suitable for the Basin, these measurements will be collected and used to assess long-term trends in water level gradients and to avoid long-term, Basin scale water level declines (see Sections 3.3.1 and 3.4.1). These data, among many others, are also used to calibrate and improve SVIHM. SVIHM in turn accounts for and processes a much wider range of relevant land use, hydrologic, and geologic data that would not be reflected in water level data alone. Using more appropriate, comprehensive information, including measured water level dynamics, SVIHM computes water level changes due to PMAs and estimates stream depletion reversal occurring specifically due to PMAs in ways that cannot be achieved with water level measurements alone (see below).

Streamflow as Proxy for Stream Depletion Monitoring – not suitable

Direct measurement of streamflow at the Fort Jones gauge is also not a suitable proxy for surface water depletion in the Scott Valley because it is affected by several factors other than groundwater use outside the Adjudicated Zone. The Fort Jones gauge streamflow during the summer baseflow season is a direct measure of the total groundwater contribution from the Scott Valley Basin to the stream. That groundwater contribution to streamflow is a function of groundwater use inside and outside the Adjudicated Zone, of winter and spring recharge from precipitation and irrigation on the valley floor, of winter and spring recharge from tributaries on the upper alluvial fans, of mountain front recharge, and of surface water diversions (Chapter 2.2.3.3.). It is a function of both, their total amounts and the temporal dynamics of these amounts (pumping, recharge, diversions, etc.).

Legal Requirements for Quantifying Stream depletion due to Groundwater Pumping

Per 23 CCR Section 354.28(c), minimum thresholds for depletion of interconnected surface water shall be a rate or volume of surface water depletion caused by groundwater use that has adverse impacts on beneficial uses of the surface water. Minimum thresholds represent the threshold, above/below which undesirable results may occur. The legal requirements for the minimum threshold allow for the use of a numerical groundwater and surface water model to quantify (“monitor” or “measure”) the amount of surface water depletion due to groundwater pumping and to set the minimum threshold using the model.

Quantifying Stream Depletion due to Groundwater Pumping with SVIHM

The numerical model described in Chapter 2, the Scott Valley Integrated Hydrogeological Model (SVIHM), is the best available tool to evaluate surface water depletion SMC conditions in Scott Valley and to quantify the amount of depletion attributable to groundwater use outside of the Adjudicated Zone. The current version of SVIHM simulates Scott Valley conditions for 1991–2018 climate conditions based on the best available information, including numerous climate, production well, geographic, geologic, and land use monitoring data from Scott Valley and calibrated against hundreds of streamflow and water level measurements. A SGMA-compliant software (MODFLOW 2005) is used for SVIHM.

After GSP adoption in 2022, the process for computing ("measuring") stream depletion in a given month, season, or water year with SVIHM is defined through the following specific modeling process:

1. **"Current"** is defined as a recently completed water year at the time new simulations are implemented. For example, if this modeling exercise is implemented in 2029, "current" may be the water year 2027 or 2028.
2. There are two operating modes for SVIHM:
   - The **calibrated timeline mode**. The calibrated SVIHM version is implemented for a simulation period from 1991 to current, representing actual climate and stream inflow conditions to the Basin for the period of 1991 to current and representing the actual historical evolution of PMAs and other land use and land management changes in the Basin. This mode is used to update and re-calibrate SVIHM using three types of datasets (target data, conceptual and input data, and PMA data, see Section 3.3.5.2 below).
   - The **scenario mode**. The scenario mode can be thought of as a future time period of the same length as 1991 to current (at the writing of this GSP, a 28-year period from 1991 to 2018) over which a specific scenario is implemented, for "measurement" purposes: For all scenario simulations described below (PMA Model, BAU Model, No Pumping Reference Model), the monthly (or daily) time series of climate conditions (precipitation, evapotranspiration (ET), inflow from tributaries, etc.) is that from 1991 to current. But the scenarios represented (PMA, BAU, No Pumping) are static over the entire simulation period, where "static" means that the set of PMAs (PMA portfolio), BAU, or No Pumping conditions does not change its pattern or land use and land management rule set over time. The PMA portfolio may be structured dynamically; for example, it may include projects that only occur in dry years or run only from July to September each year, but the structure of the PMA portfolio rule set does not change. This characteristic of the scenario mode allows it to be used to "measure" stream depletion and the reversal of stream depletion due to specific PMAs or PMA portfolios over a representative period of time.
3. **"Measuring"** or "monitoring" the impacts on streamflow from projects and management actions (PMAs) or under any No Pumping Reference Model is implemented by using the model in "scenario" mode. Specifically, the computation ("measurement") is implemented by first simulating two scenarios and then computing the difference in outcomes (streamflow), e.g., between the BAU simulation and the PMA or between the BAU simulation and the No Pumping Reference Model simulation. In other words, the impact of an action (PMA, No Pumping Reference) is measured by running two SVIHM scenario simulations: one simulation without the action and one simulation with the action. Each simulation provides a time series of monthly streamflow information for the 28-year (or longer) simulation period. For each month in the 28-year simulation period (336 months) the impact of the action is computed as the difference in streamflow (measured in cfs) between the two scenario simulations. Because the model runs over at least 28 years (1991-current), the approach allows for computing ("measuring") the stream depletion reversal (and remaining stream depletion) under a wide range of wet, average, and dry year conditions with monthly (or daily) varying, real climate characteristics as observed over the period 1991 to current. Some important characteristics of these computations ("measurements") are summarized here:

- Changes can be computed ("measured") for any specific date (month) in the simulation period (1991-current)
- Changes can be computed ("measured") at any location within the stream network in the Basin. The stream network has a resolution of 330 ft (100 m).
- In addition to changes in flow, the two simulations (with and without an action) can be used to assess temporal changes in the characteristics of key "functional flow" elements (Chapter 2, Section 2.2.1.6), particularly the acceleration or delay in spring recess flow timing and the delay or acceleration in the onset of the fall pulse flow in any given year.
- The two simulations can also be used to assess the changes in the length of dry stream sections within the stream network resulting from PMAs, e.g., as a function of water year type.
- SVIHM currently uses monthly "stress periods" (time-varying model inputs such as precipitation are provided month-by-month, reflecting the average condition over each month), but computes daily flows (and groundwater level changes). Flows can be aggregated by month, season, year, or water-year type. Future versions of SVIHM may use daily stress periods.
- Numerous statistics can be obtained from the model with respect to
  - absolute flow differences between two scenarios,
  - relative flow differences (a PMA scenario change relative to a No Pumping Reference Model change),
  - changes in the timing of flows,
  - and other characteristics.

4. **Business as Usual Model (BAU Model)** scenario: SVIHM is used to compute daily streamflow at the same times and locations as the PMA model, explicitly excluding all PMA implementation over the entire simulation period. This simulation represents the "Business as Usual Model (BAU)", a scenario in which no PMAs are implemented that would make water use more sustainable than during the baseline period (1991-2018). This version includes representative land use and land management conditions without PMAs.
5. **Project and Management Action (PMA Model)** scenario: SVIHM is used to compute daily streamflow at the Fort Jones gauge (and other locations) under assumed (future) conditions with a static implementation of a specific PMA of interest, a PMA portfolio of interest (see Chapter 4), or the specific PMA portfolio representing current (post-2021) conditions. The latter is the **"Current PMA Portfolio Model"**. The PMA models are simulated as if the set of PMAs, as is, were to continue throughout the simulation period. The PMA Model allows for evaluation of desired or current PMA effects over a variety of climate conditions. The Current PMA Portfolio Model is the model used for compliance purposes and to "measure" the stream depletion reversal (and remaining stream depletion) under the current portfolio of PMAs.
6. **No Pumping Reference (NP Model)** scenario: For the NP Model, SVIHM is used to compute daily streamflow at the same times and locations as the PMA Model, but for conditions of no pumping outside the Adjudicated Zone and no implementation of PMAs. Various no pumping scenarios have been and can be constructed (see Appendix 4-A)
7. The total surface water depletion due to groundwater use outside of the Adjudicated Zone (**"Total Depletion"**) is calculated by taking the difference in simulated streamflow at the Fort Jones gauge between the BAU Model and the NP Reference Model. The total depletion is a time-series with daily values over the simulation period. It is measured in the same units as average daily streamflow (cubic-feet per second, cfs), but can be summed as a cumulative volume over a month, season, or water-year (thousand acre-feet, TAF), and it can be averaged over the entire simulation period, by water-year type, and for specific seasons.
8. The surface water depletion that was avoided by the implementation of PMAs (**"PMA Depletion Reversal"**) is calculated by taking the difference in simulated streamflow at the Fort Jones gauge between the PMA Model and the Business as Usual Model, and comparing that difference to Total Depletion:

$$Total\ Depletion\ [cfs] = NP – BAU$$

$$PMA\ Depletion\ Reversal\ [cfs] = PMA - BAU$$

$$Relative\ PMA\ Depletion\ Reversal\ [\%] = 100 * \frac{PMA\ Depletion\ Reversal}{Total\ Depletion}$$

A visual schematic of this framework is included as Figure 5.

With this framework, the GSA can estimate streamflow changes (including numerous statistics of those changes for any period of interest) caused by the implementation of PMAs over the range of observed, actual climate conditions. It can assess the changes relative to a scenario in which no management actions were taken and calculate the fraction of total depletion due to pumping outside the Adjudicated Zone that was reversed by PMAs. All of this can be calculated under the specific weather conditions experienced. The amount [cfs] and fraction [%] of total depletion reversed for the Current PMA Portfolio Model will be reported in annual GSA reports.

This is designed to be an adaptive management process that evolves as new knowledge is gained. The monitoring network assessment section below (Section 3.3.5.2) describes in more detail the relationship between the numerous data collection efforts and the updating process of SVIHM as a measurement tool of stream depletion due to groundwater pumping outside of the Adjudicated Zone.

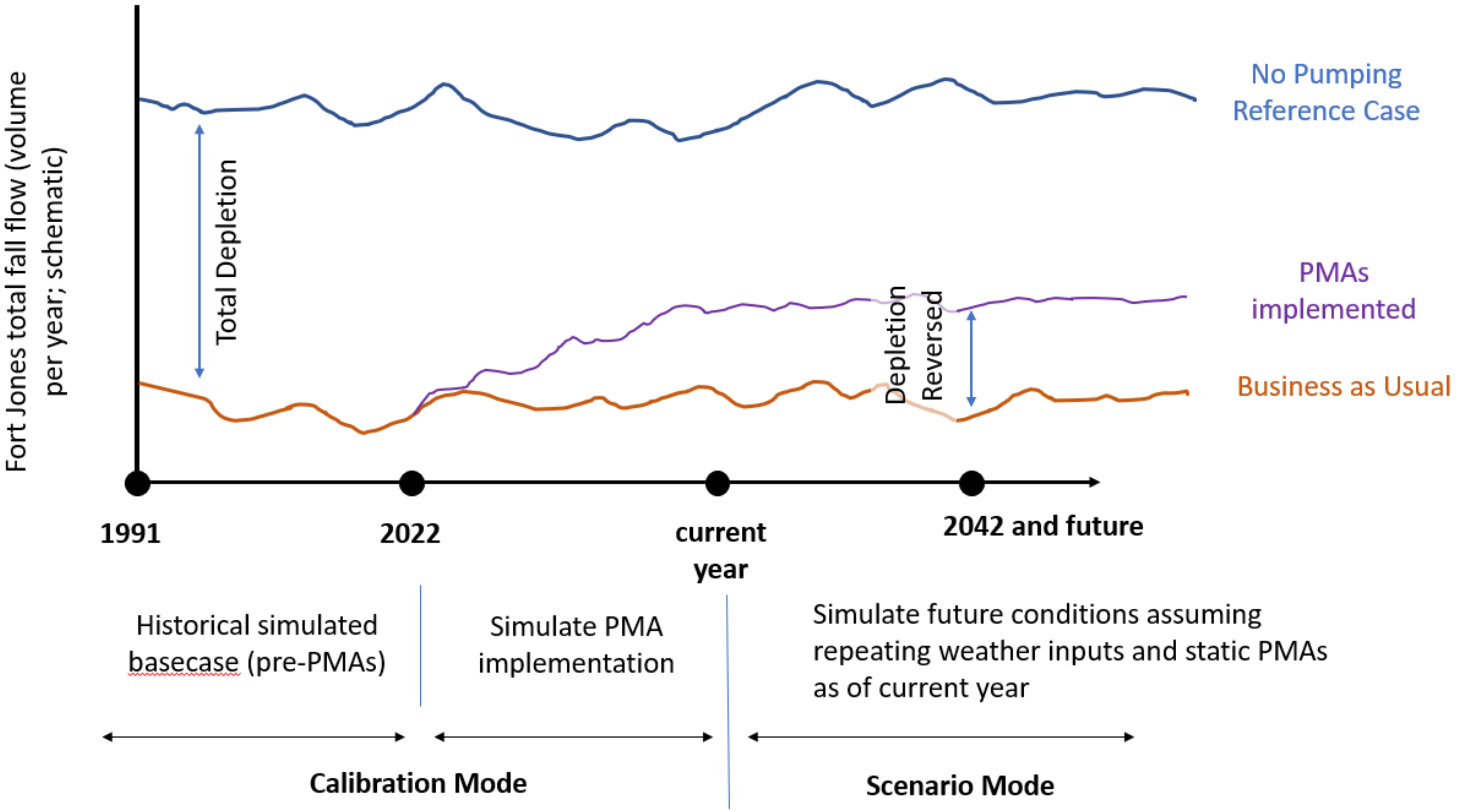


Figure 5: Visual schematic of simulations used to calculate Relative Depletion Reversal in future sustainable groundwater management reports.

Additional Monitoring Related to Interconnected Surface Water

To monitor for sustainable rates of surface flow depletion, the GSA will also rely on existing monitoring programs. The GSA plans to collaborate with other entities to add verified data and additional monitoring locations to fill data gaps.

Surface water monitoring

The GSA will continue to rely on the longstanding flow record of the Scott River monitored at the Fort Jones Gauge (USGS; Station ID 11519500).

The flows in tributary streams to the Scott River constitute a data gap. Currently, records of flowrates in tributary streams are limited, and for the SVIHM simulations, the temporal gaps in tributary records are filled using statistical correlations between each tributary's record and the record at the USGS Fort Jones gauge (Chapter 2). Additional monitoring on tributaries would provide more information on specific water year type conditions and inflows to interconnected stream reaches. Such tributary data would generate critical target data (see Section 3.3.3.2) to improve the reliability of SVIHM.

Biological monitoring

Existing biological monitoring that will be used to assess the condition of aquatic and other groundwater-dependent ecosystems includes the CDFW camera trap program and biological surveys conducted by the Siskiyou County RCD (RCD), and juvenile salmonid outmigrant monitoring conducted by CDFW.

Since 2008, CDFW has operated a camera trap on the Scott River, near the bottom of the Scott Valley stream system. It is located downstream of the Fort Jones gauge at river mile 18.2 (041° 38' 10.93" N; 123° 04' 3.08"W). The camera trap records the passage of migrating salmonids (Knechtle and Giudice 2021).

Since 2001, the RCD has collected data on the location and abundance of salmon redds (gravel nests where eggs are laid) in the late fall and early winter. These surveys include recording of redd locations, occurrence of adult spawning salmon (both live and as carcasses), and stream connectivity and flow conditions.

Annual juvenile salmonid monitoring has been occurring since 2001, following the installation of the Scott River rotary trap; the Scott River Juvenile Salmonid Outmigrant study 2020 monitored emigrating Chinook salmon, coho salmon and steelhead trout (Massie and Morrow 2020). Annual monitoring of juvenile salmonids is part of work conducted by CDFW and the Shasta Valley Resource Conservation District on Shasta and Scott Rivers.

Additional biological monitoring data may be used as it becomes available through other organizations and agencies. For GSP and groundwater sustainability monitoring purposes, no data gaps in biological monitoring have been identified at this time.

3.3.5.2. Assessment and Improvement of Monitoring Network

Assessing and Improving SVIHM

The SVIHM, as a "monitoring" instrument of surface water depletion due to groundwater pumping, will be assessed and updated every 5 to 10 years, utilizing the data and knowledge used for the original/previous model development update plus any additional monitoring data collected since the last model update. New data that will be considered in the assessment and update of SVIHM fall into three general categories:

- *Validation and re-calibration data ("target" data).* These are independently collected field data, typically collected on a daily, monthly, or seasonal basis, that are also simulation outcomes by SVIHM: groundwater level monitoring data and streamflow measurements within Scott Valley and at the Fort Jones gauge. They are commonly used as calibration targets during model (re-)calibration. In other words, real monitoring data are used to compare model simulation results to reality and to adjust the model (within the limits of the conceptual model) to closely simulate measured and monitored real hydrologic outcomes (groundwater levels, streamflow).

- *Conceptual model data – hydrologic and hydrogeologic conditions (concept and "input" data).* These are data that the model uses as input and data that are used to parameterize or conceptually design the model. These types of data include, but are not limited to precipitation data, tributary inflow data to the basin, hydrogeologic data obtained from well logs and pump tests, and research insights obtained from projects to further understand any hydrologic sub-systems within Scott Valley (e.g., groundwater-surface water interaction measured with distributed temperature sensing tools or a local network of piezometers, see Groundwater Study Plan 2008).
- *Data about projects and management action implementation ("PMA" data).* These are (monitoring) data collected specifically to characterize the implementation of PMAs to inform the GSA, stakeholders, and the design of future model scenario updates. The specific datasets collected are a function of the PMA and are described in Chapter 4. Examples include monthly volume and location of water recharged (MAR PMA), acreage, location, and irrigation efficiency of improved irrigation systems (irrigation efficiency PMA), acreage, crop/land use, and pumping/diversion restriction conditions associated with conservation easements (voluntary land repurposing PMA).

The data collected will be used to update the calibrated timeline mode of SVIHM in three ways:

1. *Conceptual Data* to update SVIHM simulation period: Precipitation and streamflow data measured at weather stations and the USGS Fort Jones gauge (from which tributary inflows are estimated using an existing statistical regression model) will be used to extend the simulation time horizon of SVIHM without any parameter, boundary condition, or scenario adjustments to the original time horizon of the model. This is a relatively inexpensive SVIHM application that allows for updated comparison of SVIHM water level and streamflow predictions against measured data under baseline and (existing) scenario conditions through the most current time period for which data are available. This type of SVIHM application is anticipated to occur at least once in every five-year reporting period, or possibly annually.
2. *PMA Data* to update SVIHM simulation period: In addition to (1), data about PMA implementation will be used to update the model to include new, actual PMA implementation on the correct timeline within SVIHM. This provides a model update that appropriately represents recent changes in PMA implementation. This allows for a more consistent evaluation of simulated versus measured water level and streamflow data. This type of SVIHM application is anticipated to occur at least once in every five-year reporting period.
3. *Conceptual, PMA, and Target Data* to update SVIHM and re-calibrate: In addition to (1) and (2), conceptual model data are used to update model parameters and model boundary conditions unrelated to PMAs to improve the conceptual model underlying SVIHM based on new insights and data. This will typically (but not automatically) require a re-calibration of the model against measured validation and re-calibration target data. After the re-calibration, all scenarios of interest and the timeline of stream depletion reversal associated with each scenario of interest and any new scenario of interest will be updated using the re-calibrated model to allow for consistent comparison of stream depletion and depletion reversal that has resulted or will result from PMAs. This type of SVIHM application is anticipated to occur at least every ten years.

For example, the version of SVIHM used in Chapter 2 was calibrated for the period 1991-2011 (step 3 above), then extended using step 1 above to cover the period 1991-2018.

The above protocol ensures tight integration between monitoring programs, projects and management action implementation, and SVIHM as a monitoring tool for surface water depletion due to groundwater use. It provides the most accurate estimation not only of stream depletion, but also numerous associated information about water level dynamics, streamflow dynamics and their spatial, seasonal, inter-annual, and water-year-type-dependent behavior. Examples of future field monitoring data used to assess and improve SVIHM are listed below:

- Validation and re-calibration data ("target" data):
    - Water level in the water level monitoring network.
    - Daily streamflow measured at the Fort Jones gauge of the Scott River.
    - Data documenting dates and locations of dry sections in the stream network.
    - Last date on which certain low flow triggers are exceeded in the spring recession (e.g., date at which flow at the Fort Jones gauge falls below 20, 30, 40 or 60 cfs (1.1 cms)).
    - First date on which certain low flow triggers are reached as flow increases in the fall (e.g., date at which flow at the Fort Jones gauge exceeds 20, 30, 40 or 60 cfs (1.1 cms)).
- Hydrologic and hydrogeologic conditions (concept and "input" data):
    - Precipitation data from existing climate stations.
    - Potential ET data computed form existing climate stations.
    - Daily streamflow measured at locations near tributary stream inflow to Scott Valley (e.g., French Creek gauge at Hwy. 3).
    - Pump test data that contain information about hydrogeologic properties in the vicinity of a well.
    - Geologic information obtained from new well drilling logs.
    - Data collected in conjunction with research and pilot projects characterizing hydrologic and hydrogeologic conditions in Scott Valley.
    - Improved estimates of unimpaired tributary inflows from the upper watershed to the Basin accounting, e.g., for the location of existing/historic gauges relative to diversion locations.
    - Assess the need to incorporate fall/winter stockwater diversions
    - Refine stress-period setup in MODFLOW (e.g., daily instead of monthly)
- Data about projects and management actions ("PMA" data); see Chapter 4:
    - Date when certain PMA phases begin.
    - Location of PMA implementation:
        * The location of all fields participating in MAR activities during a given water year.
        * The location of conservation easements with altered diversion or pumping patterns during a given water year.
        * The location of improved irrigation systems with higher irrigation efficiencies.
    - Timing and volumes of water associated with PMA implementation:
        * The total volume of water recharged in MAR activities during a given month of a given water year.
        * The amount of streamflow diversion dedicated to instream flow in a given month of a given water year.
        * The amount of pumping curtailment implemented in a given month of a given water year.
        * The reduction in ET over the total growing season in a conservation easement.
        * First installation date of improved irrigation systems with higher irrigation efficiencies and estimated improvements in irrigation efficiency.
        * Perform additional sensitivity analysis on conceptual model inputs and PMA data inputs.

Assessing and Improving Related Monitoring Networks

As discussed above, one major data gap identified is flows in tributary streams. Though some active gauges exist on tributary streams (notably on Sugar Creek, French Creek and Shackleford; see table in Chapter 2 Section 2.2.1.6), other major tributaries do not appear to be actively gauged based on publicly available data. Data gaps in tributary flows will be addressed through prioritization of streams for measurement and GSA coordination with other agencies for addition of stream gauges. Repeated evaluations of the network will occur on a five-year basis. Additional stream gauges may be implemented throughout GSP implementation period. Streams should be prioritized according to how much flow each stream contributes to the Basin. According to estimated flow volumes in SVIHM, the five highest-priority tributaries for installation of flow gauges would be East and South Fork Scott River (possibly immediately below their confluence) and Kidder, Etna, and Shackleford Creeks (Table 4). French Creek is also a priority location for installation of a flow gauge due to its value as habitat for coho salmon, a priority GDE in the Basin. If possible, these gauges should be located near the Basin boundary to capture flow conditions before streams interact with the alluvial aquifer underlying the flat valley floor.

Tributary Name	Proportion of total inflow to SVIHM
East Fork	18%
Kidder Creek	18%
Etna Creek	15%
Shackleford Creek	12%
South Fork	11%
French Creek	8%
Patterson Creek	5%
Sugar Creek	4%
Mill Creek	4%
Moffett Creek	3%
Johnson Creek	1%
Crystal Creek	1%

Table 4: Major tributary streams to the Scott River and the proportion of total flow inputs to the model domain simulated in SVIHM. The source for this data is the available tributary inflow records, with missing daily values interpolated using a streamflow regression model (see Chapter 2, Section 2.2.1.6, and Appendix 2-F for more information).

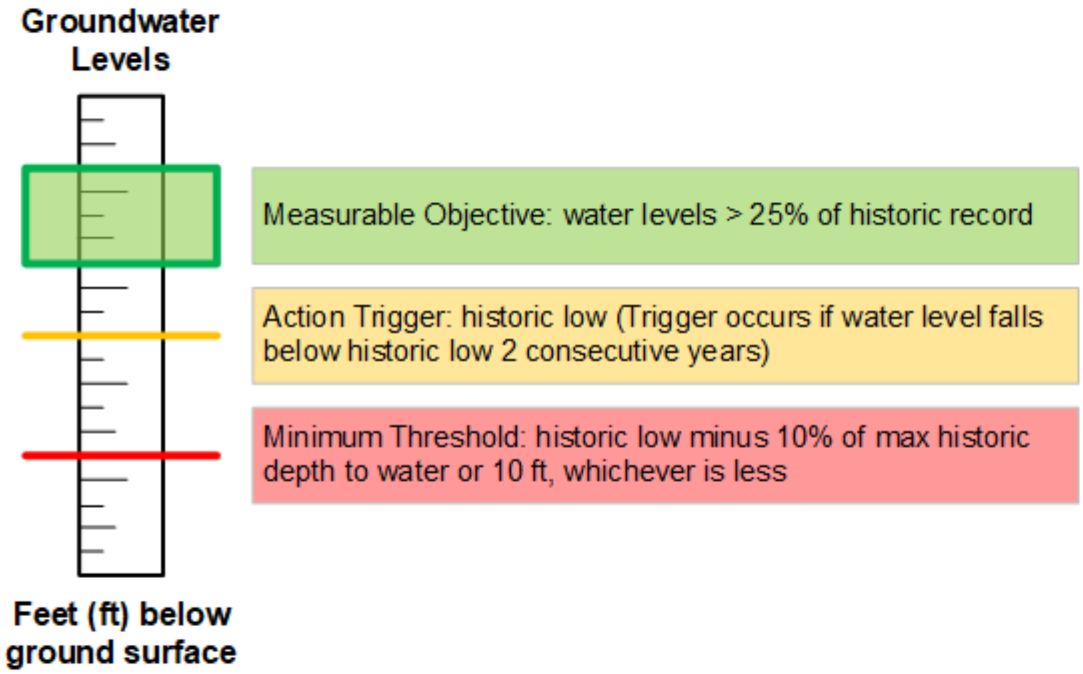
3.4 Sustainable Management Criteria

3.4.1 Groundwater Elevation

SMC for groundwater levels are visualized in Figure 6, and in example hydrograph form in Figure 7.

3.4.1.1 Undesirable Results

Chronic lowering of groundwater levels is considered significant and unreasonable when a significant number of private, agricultural, industrial, or municipal production wells can no longer pump enough groundwater to supply beneficial uses, or when lower groundwater levels adversely affect environmental uses and users of interconnected surface water and groundwater-dependent ecosystems. SGMA defines undesirable results related to groundwater levels as chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. The lowering of water levels during a period of drought is not the same as (i.e., does not constitute) “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.



Measurable Objective: water levels > 25% of historic record

Action Trigger: historic low (Trigger occurs if water level falls below historic low 2 consecutive years)

Minimum Threshold: historic low minus 10% of max historic depth to water or 10 ft, whichever is less

Figure 6: Thermometer visualization of SMC definitions for groundwater levels (WL).

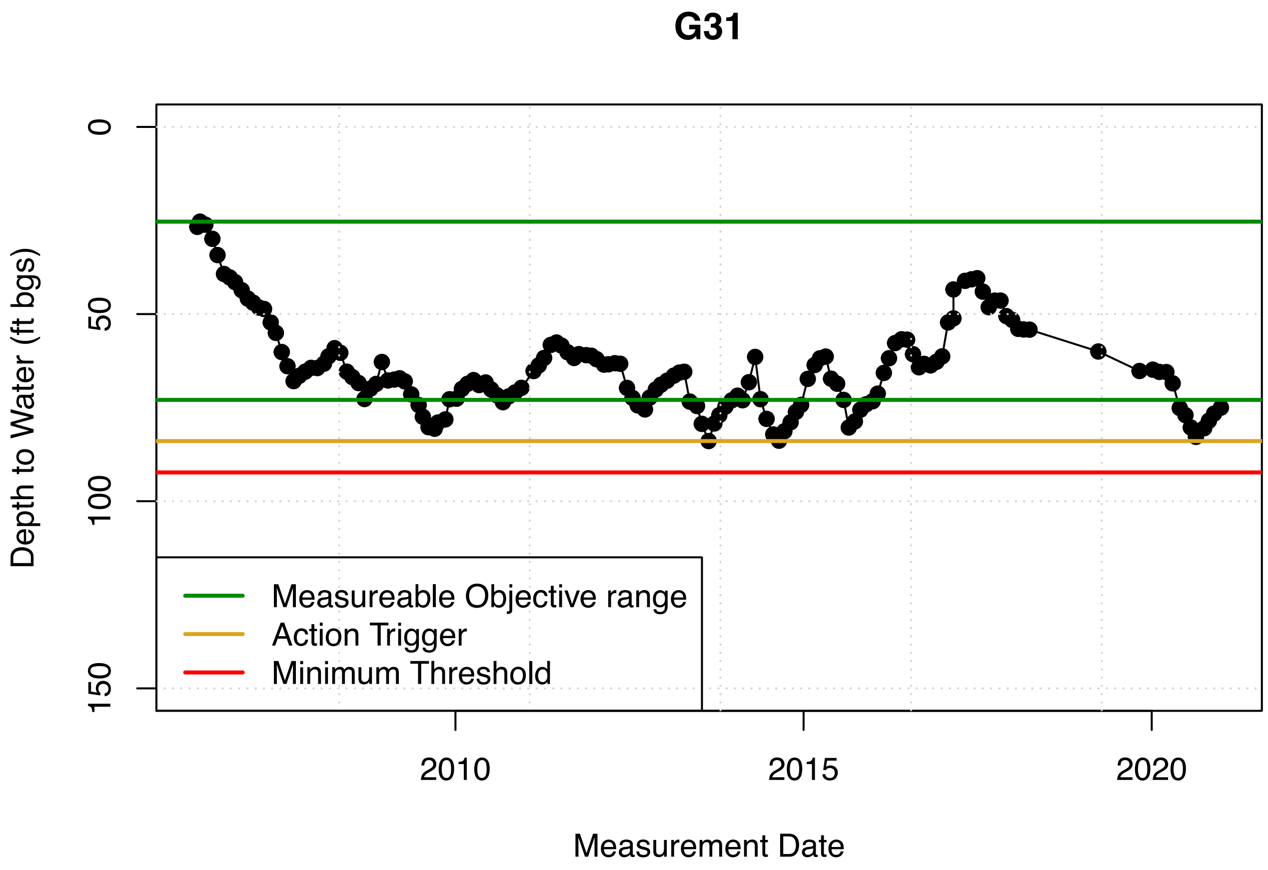


Figure 7: Example hydrograph visualization of SMC definitions for groundwater levels.

Potential impacts and the extent to which they are considered significant and unreasonable were determined by the GSA with input by technical advisors and members of the public. During development of the GSP, the GSA identified potential significant and unreasonable depletion of supply, including:

- Excessive number of domestic, public, or agricultural wells going dry.
- Excessive reduction in the pumping capacity of existing wells.
- Excessive increase in pumping costs due to greater lift.
- Excessive need for deeper well installations or lowering of pumps.
- Excessive financial burden to local agricultural interests.
- Adverse impacts to environmental uses and users, including interconnected surface water and groundwater-dependent ecosystems (GDEs) (also see Section 3.4.5).

With some caveats, none of the above conditions have occurred, either historically or since 2015. The primary exception is that interconnected surface water has been impacted by groundwater pumping and, hence, by resulting changes in water levels (Chapter 2). This undesirable result is addressed explicitly in section 3.4.5.

The dry well condition is also worth expanding on. Available data suggests that this undesirable result is not occurring, though data gaps limit the ability to analyze it directly.

The data gap is a mismatch in two key data resources:

1) a database of well perforations and depths, collected from Well Completion Reports (WCRs) by UC Davis researchers during development of the SVIHM model (194 total wells, 61 with perforation interval data); and
2) a database of groundwater elevation measurements (in 85 total wells). Though these datasets provide two necessary pieces of information, the vast majority of WCRs are only geo-located to the level of a PLSS section (with an area of one square mile), and the WCRs have not been associated with groundwater elevation records. This mismatch makes it impossible to systematically evaluate the risk of groundwater elevations falling below the relevant well screens.

Despite this data gap, indirect evidence suggests that this undesirable result is not taking place. Recently, only two dry wells have been reported in Scott Valley (California Department of Water Resources (DWR) 2021). Additionally, a comparison between the distribution of depths of wells in Scott Valley (212 wells with depth data) and the distribution of observed groundwater depths in the past 10 years indicate that, while water levels falling below well depths certainly may have happened in the last 10 years, the aggregate observed groundwater levels are well above known well depths (Figure 8).

Operationally, an undesirable result for water level would occur if the low water level observation in the fall (i.e., the minimum elevation in any given water year) in any of the representative monitoring sites in the Basin drop below their respective minimum thresholds in two consecutive years. No further federal, state, or local standards exist for chronic lowering of groundwater elevations.

Potential Causes Undesirable Results

Basin groundwater pumping currently does not exceed the sustainable yield of the Basin (as discussed in Chapter 2). Future decline in water levels in the Basin may occur due to several possible causes, even absent conditions of overdraft (see Chapter 2.2.3.3):

- Change in Basin pumping distribution and/or volumes.
- Reduction in natural recharge as a result of climate change, or other sources that reduce recharge or increase groundwater pumping.

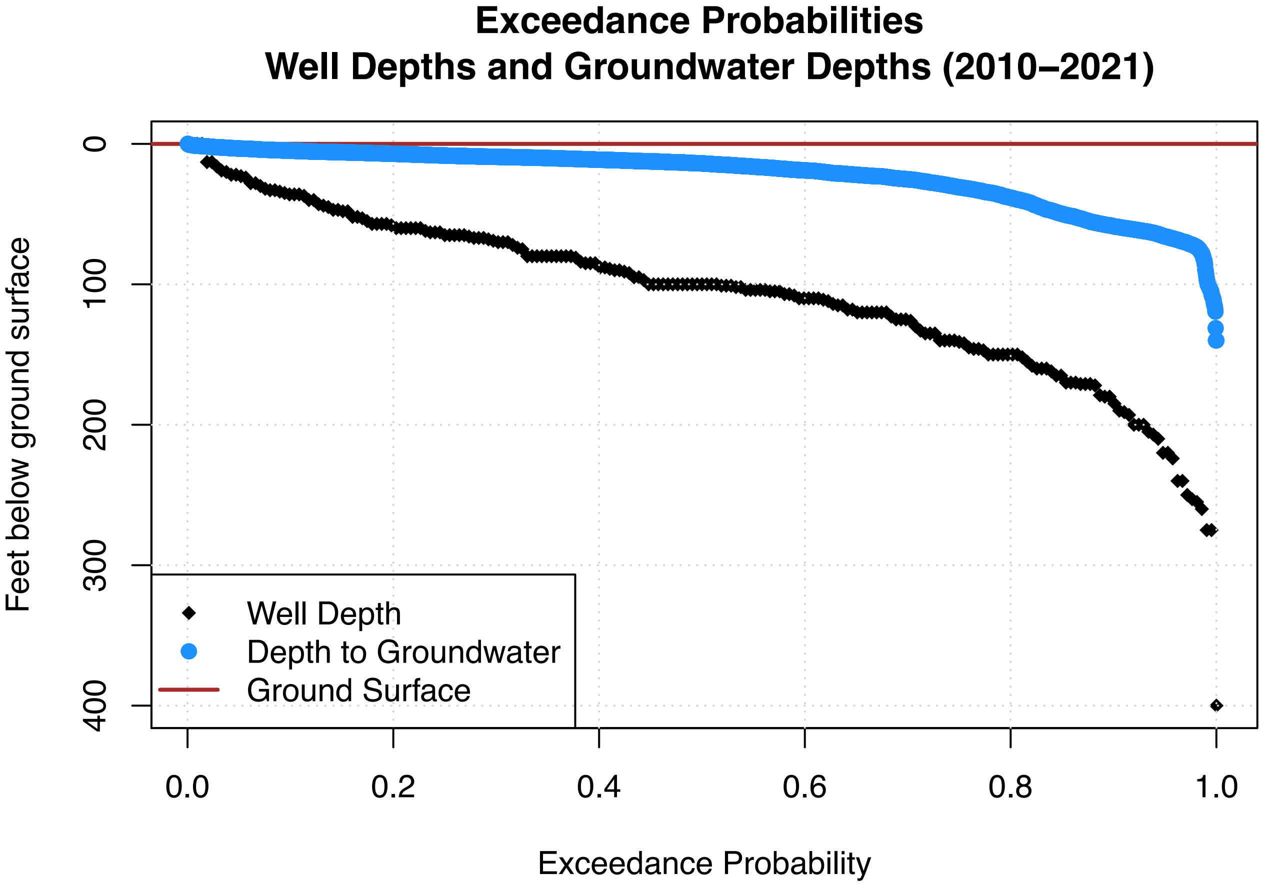


Figure 8: The probability, on the x-axis, of well depths (n = 212 wells) and groundwater depths (n = 4,414 measurements) exceeding the depth below ground surface listed on the y-axis. Displays the overall distribution of known well depths and groundwater depths measured 2010-2021.

Changes in pumping distribution and volume may occur due to significant rural residential, agricultural, and urban growth that depend on groundwater as a water supply. Climate change is expected to raise average annual temperatures, decrease the winter snow-pack, shorten the snow-melt season, and intensify rainfall periods while extending dry periods (DWR CCTAG 2015). Together with resulting vegetation changes in surrounding uplands, climate change may significantly increase or decrease recharge compared to historical conditions. To the degree that climate change may lead to reduced recharge in and runoff from surrounding uplands, stream recharge to the Basin (especially on the upper alluvial fans) will be lower and thus reduce the dynamic equilibrium water level in the Basin (Chapter 2, Section 2.2.3.3). On the other hand, future increased recharge and runoff in the surrounding uplands may have the opposite effects and thus raise water levels in the Basin.

The GSA will coordinate with relevant agencies and stakeholders within the Basin and the larger watershed to implement management actions and projects to sustainably manage groundwater levels in the Basin.

Effects of Undesirable Results on Beneficial Uses and Users

Undesirable results would prevent an unknown number of private, agricultural, industrial, or municipal production wells from supplying groundwater to meet their water demands. Some wells may even go dry temporarily. Chronic well outages are not expected in Scott Valley due to the lack of long-term overdraft and seasonal variation in water levels. Temporary well outages may initially affect the shallowest wells, which tend to be located in the valley bottom and in some locations, tend to be domestic wells.

The following provides greater detail regarding the potential impact of temporary well outages on several major classes of beneficial users:

- **Municipal Drinking Water Users** – Undesirable results due to declining groundwater levels can adversely affect current and projected municipal users, causing increased costs for potable water supplies.
- **Rural and/or Agricultural Residential Drinking Water Users** – Seasonal low groundwater levels can cause shallow domestic and stock wells to go dry, which may cause seasonal well outages and restrict water access during periods of highest crop or pasture water demand. Additionally, the lowering of the water table may lead to decreased groundwater quality drinking water wells.
- **Agricultural Users** – Excessive seasonal lowering of groundwater levels could necessitate changes in irrigation practices and crops grown and could cause adverse effects to property values and the regional economy.
- **Environmental Uses** – Deep groundwater levels may result in significant and unreasonable reduction of groundwater flow toward streams and groundwater dependent ecosystems. This would adversely affect ecosystem functions related to baseflow and stream temperature, as well as resident species.

3.4.1.2. Minimum Thresholds

At each individual water level RMP, the minimum threshold (MinT) is set at the RMP's historic maximum depth to water measurement prior 2015 (i.e., the historic low measured groundwater elevation prior to 2015), plus a buffer to allow for operational flexibility against the measurable objective under extreme climate conditions and to accommodate practicable triggers. The buffer is either 10% of the historic maximum depth to water measurement, or 10 feet, whichever is smaller (Table 5). The proposed representative monitoring points for groundwater levels and associated MinT depths to water are shown in Figure 9.

Additional analysis, suggesting that the number of wells affected by groundwater elevations at the MinT is probably very small, is included in Appendix 3-C (Scott Dry Well Risk Analysis). Limitations in available data resources introduce some uncertainty into this assessment that can be addressed once data gaps are filled.

Triggers

The primary trigger for management actions is if the water level falls below the historic low in any individual well for more than two consecutive years (“action trigger”). A secondary trigger for management actions will be if a significant number of well outage reports are received. The latter trigger is not water-level-specific but instead is informed by impacts to well users. If either of these triggers occurs, the GSA will conduct an investigation and may use management actions to proactively avoid the occurrence of (further) undesirable results.

3.4.1.3. Measurable Objective

The MO is defined as the desired operating range for groundwater levels, with a minimum and maximum value for the MO. The MO range is defined individually for each RMP. The goal for this SMC is to keep water levels above their historic lows. For this reason, the minimum MO elevation is set at the 75th percentile lowest water elevation measured in each well (i.e., the observed elevation at which 25% of other observed elevations fall below it). The maximum MO is the highest observed water level at each RMP.

Minimum measurable objectives are shown in Table 5 and an example MO graph is shown in Figure 6.

The difference in groundwater levels between the minimum measurable objective and primary trigger gives a margin of operational flexibility, or margin of safety, for variation in groundwater levels due to seasonal, annual, or drought variations. Groundwater levels might drop in drought years but rise in wet years that recharge the aquifer and offset drought years.

3.4.1.4. Path to Achieve Measurable Objectives

The GSA will support achievement of the measurable objectives by monitoring groundwater levels and co-ordinating with agencies and stakeholders within the Basin to implement projects and management actions (PMAs). The GSA will review and analyze groundwater level data to evaluate any changes in groundwater levels resulting from groundwater pumping or recharge projects in the Basin. Using monitoring data collected as part of GSP implementation, the GSA will develop information (e.g., hydrograph plots) to demonstrate that projects and management actions are operating to maintain or improve groundwater level conditions in the Basin and to avoid unreasonable groundwater levels. Should groundwater levels drop to a trigger or minimum threshold as the result of GSA project implementation, the GSA will implement measures to address this occurrence as illustrated in Figure 10 that depicts the high-level decision making that goes into developing SMC, the monitoring to determine if criteria are met, and actions to be taken based on monitoring results.

To manage groundwater levels, the GSA will partner with local agencies and stakeholders to implement PMAs. PMAs are presented in further detail in Chapter 4. Implementation timelines and approximate costs are discussed in Chapter 5. Examples of possible GSA actions include stakeholder education and outreach and support for impacted stakeholders.

Where the cause of groundwater level decline is unknown, the GSA will conduct additional or more frequent monitoring or initiate additional modeling. The need for additional studies on groundwater levels will be assessed throughout GSP implementation. The GSA may identify knowledge requirements, seek funding, and help to implement additional studies.

Interim Milestones

Because undesirable results are not currently occurring, the management objective of the GSA will be to maintain groundwater levels above historic lows and defined MTs. Interim milestones are therefore not needed for this sustainability indicator.

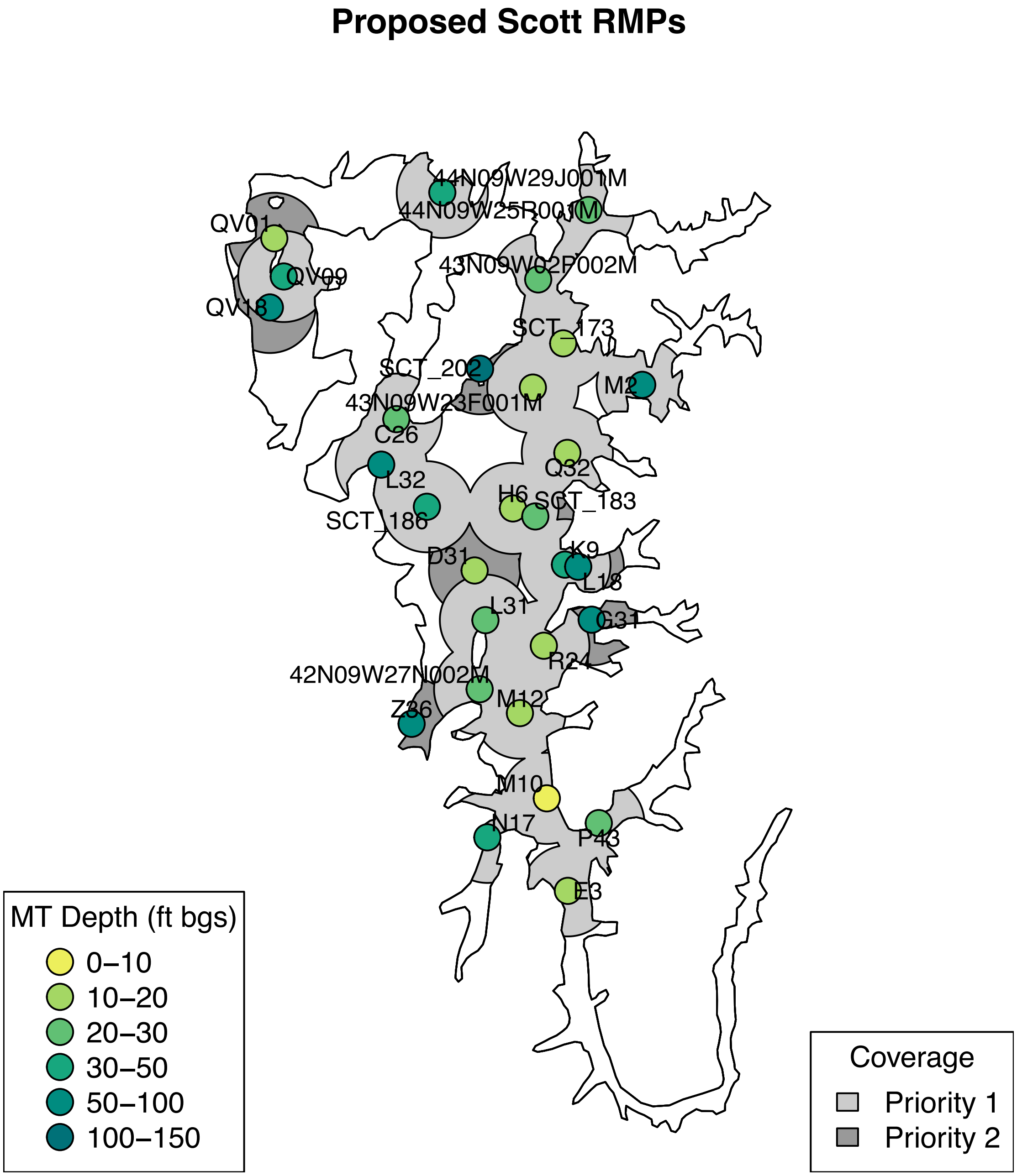


Figure 9: Minimum thresholds for the groundwater levels and storage monitoring network.

3.4.1.5. Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

Historical water levels indicate that there is no overdraft and no long-term decline in water levels. Where water levels have been observed since the 1960s, declines in fall water levels occurred in the 1970s, but have remained steady over the past 40 years. However, below average water year types have occurred more frequently over the past two decades. Average precipitation over the past 20 years (2000–2020) has been lower (19.7 inches/year (50 cm/year)) than the average precipitation during the measured record in the 20th century (20.7 inches/year (52.6 cm/year), see Chapter 2). Yet, water levels have been relatively steady over the past 20 years with seasonal fluctuations that are relatively small near the trough of the Valley and largest on upper alluvial fans (westside, eastside gulches, see Figure 22 in Chapter 2, Section 2.2.2.1). A few wells have seen declines in fall water levels but no declines in spring water level over the 2000–2020 period. No significant trend is visible across the Basin over the detailed observation period from 2006 to 2018 (see Figure 22 in Section 2.2.2.1 and hydrographs all other wells in Appendix 2-A). The years 2001, 2014, and 2020 were exceptionally dry in Scott Valley, with the lowest water levels in most wells observed in 2014 and with lowest levels in some wells observed in 2020. Over the past two decades, due to climate conditions, low summer and fall water levels have likely occurred more often than in the second half of the 20th century, although very few water level data are available for that period.

The minimum thresholds were selected based on historical groundwater level data and stakeholder input. Historically, well outages have not been an issue in the Basin and maintaining groundwater levels at or above historical levels should avoid future outages. Groundwater level trends and current conditions are discussed in Section 2.2.2.1. In establishing minimum thresholds for groundwater levels, the following information was considered:

- Feedback about groundwater level concerns from stakeholders.
- An assessment of available historical and current groundwater level data from wells in the Basin.
- A collection of well information regarding water bearing formation, depth, and screen characteristics, as well as an assessment of data to inform a well outage analysis (insufficient data were available to complete this analysis).
- Results of the completed numerical groundwater model, indicating groundwater flow direction and seasonal changes in elevation.
- Input from stakeholders resulting from the consideration of the above information in the form of recommendations regarding minimum thresholds and associated management actions.

3.4.1.6. Relationship to Other Sustainability Indicators

Minimum thresholds are selected to avoid undesirable results for other sustainability indicators. In the Basin, groundwater levels are directly related to groundwater storage and groundwater-dependent ecosystems outside of streams. The relationship between groundwater level minimum thresholds and minimum thresholds for other sustainability indicators are discussed below.

- **Groundwater Storage** – Groundwater levels are closely tied to groundwater storage, with high groundwater levels associated with high groundwater storage. The undesirable result for groundwater storage is measured and thus defined as the occurrence of an undesirable result for groundwater elevations.
- Depletion of Interconnected Surface Water – Though groundwater elevations are related to the depletion of interconnected surface water, groundwater elevations are not a suitable proxy for surface water depletion in Scott Valley (see Section 3.3.5). Consequently, this GSP proposes to monitor stream depletion by simulating stream-aquifer fluxes, not measured groundwater elevations. Additional analysis during a future GSP update will be used to determine if the current groundwater level minimum thresholds would have a negative impact on depletion of interconnected surface water.

- **Seawater Intrusion** – This sustainability indicator is not applicable in this Basin.
- **Groundwater Quality** – A significant and unreasonable condition for degraded water quality is exceeding drinking water standards for COCs in supply wells due to projects and management actions proposed in the GSP. Groundwater quality could potentially be affected by projects and management action-induced changes in groundwater elevations and gradients. These changes could potentially cause poor quality groundwater to flow towards supply wells that would not have otherwise been impacted.
- **Subsidence** – Subsidence has not historically been a problem in Scott Valley. The groundwater level SMC will ensure that there is no onset of subsidence in the future. The minimum threshold for water level is sufficiently close to historic water levels that, under the hydrogeologic conditions prevalent in Scott Valley, no significant subsidence can occur due to lowering of water levels within the limits set by the minimum threshold.

Well ID	Well Depth (ft bgs)	Fall Range (ft bgs)	MO (ft bgs)	PT (ft bgs)	MT (ft bgs)
42N09W27N002M	60	10.9-23.5	> 18.2	23.50	25.90
43N09W23F001M	60	4.6-13.2	> 8.5	13.20	14.50
43N09W02P002M	80	15.1-27.0	> 20.1	27.00	29.70
44N09W25R001M	140	11.5-22.2	> 17.8	22.20	24.40
44N09W29J001M	60	35.2-44.7	> 40.6	44.70	49.20
C26	80	12.7-20.2	> 14.3	20.20	22.20
E3	60	5.1-10.3	> 7.4	10.30	11.40
H6	–	3.0-9.8	> 6.9	9.80	10.70
K9	60	23.8-41.2	> 37.1	41.20	45.30
L31	–	10.3-23.6	> 19.6	23.60	26.00
L32	203	33.8-62.2	> 48.7	62.20	68.40
M10	43	4.6-7.4	> 6.5	7.40	8.20
M12	–	13.1-17.0	> 16.6	17.00	18.70
M2	140	33.2-75.8	> 67.4	75.80	83.30
N17	179	20.3-36.7	> 24.2	36.70	40.40
P43	75	4.2-19.4	> 14.1	19.40	21.30
Q32	57	4.0-13.1	> 9.7	13.10	14.40
R24	100	10.6-16.2	> 13.8	16.20	17.80
SCT_173	70	13.2-16.9	> 16.3	16.90	18.50
SCT_186	48	31.9-35.0	> 34.5	35.00	38.50
QV09	40	28.2-41.0	> 39.8	41.00	45.10
D31	81	4.1-10.5	> 7.8	10.50	11.60
G31	236	39.3-81.3	> 77.0	81.30	89.40
L18	170	44.9-71.4	> 67.3	71.40	78.60
Z36	197	21.2-45.5	> 33.9	45.50	50.10
SCT_202	184	67.0-140.0	> 140.0	140.00	150.00
QV18	140	53.2-68.1	> 65.4	68.10	74.90
QV01	82	6.1-16.2	> 14.7	16.20	17.80
SCT_183	100	15.4-19.0	> 18.7	19.00	20.90

Table 5: Objectives, triggers and thresholds for proposed Scott Valley RMPs for groundwater elevation. Fall Range refers to the maximum and minimum of measurements collected at each well during September–November. The minimum Measurable Objective (MO) is set as the 75th percentile of the fall measurement range - i.e., the measurement at which 25 percent of groundwater elevation measurements fall below it. The primary trigger (PT) is set at the historic low groundwater elevation measurement. The Minimum Threshold (MT) is set at the historic low plus a buffer. The buffer is either 10 percent of the historic low, or 10 feet, whichever is smaller.

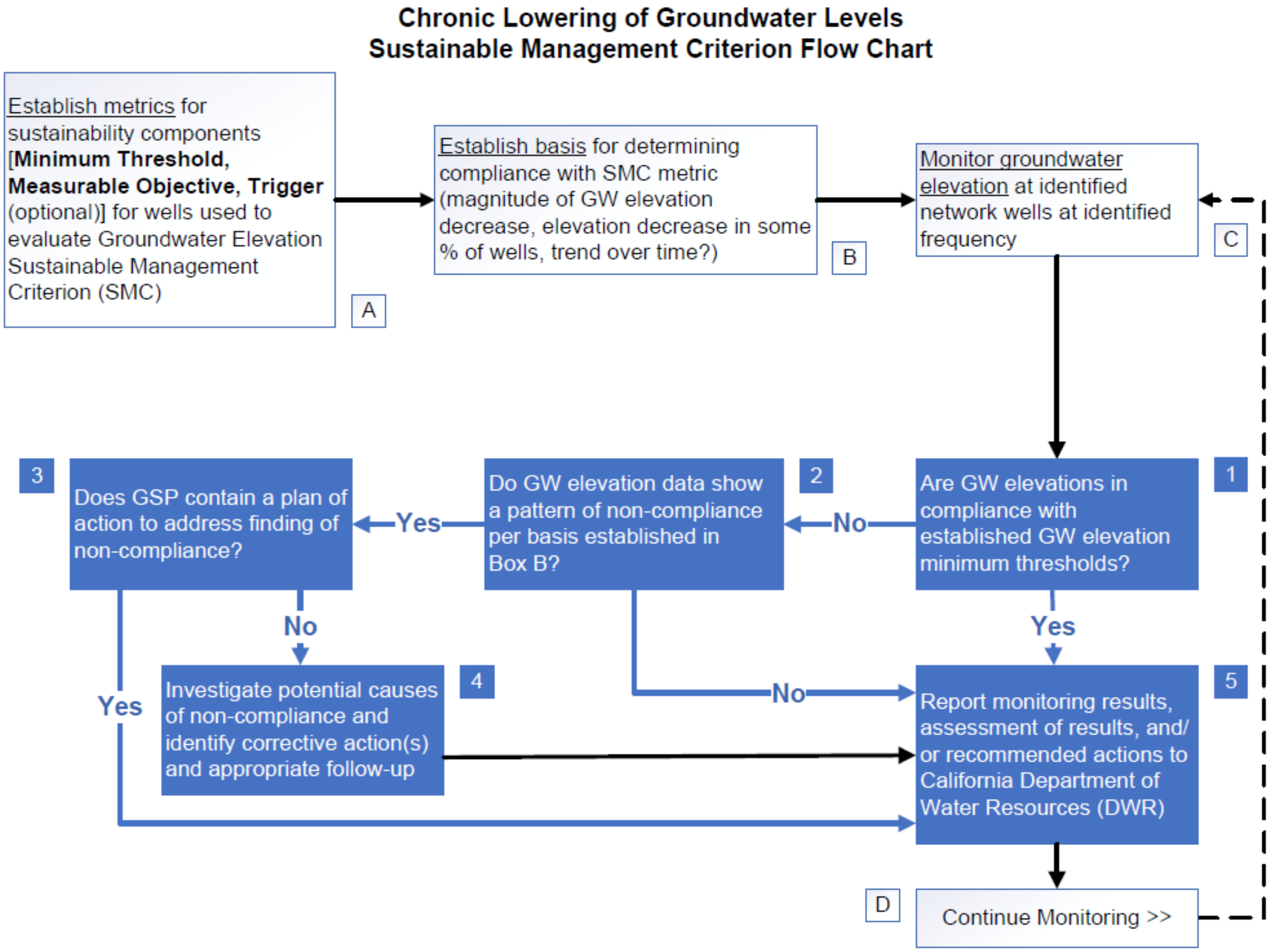


Figure 10: Groundwater level sustainable management criteria flow chart. The flow chart depicts the high-level decision making that goes into developing sustainable management criteria (SMC), monitoring to determine if criteria are met, and actions to be taken based on monitoring results.

3.4.2 Groundwater Storage

Groundwater levels are selected as the proxy for groundwater storage. Hence, the SMC are identical. According to the United States Geologic Survey, estimates of groundwater storage rely on groundwater level data and sufficiently accurate knowledge of hydrogeologic properties of the aquifer. Direct measurements of groundwater levels can be used to estimate changes in groundwater storage (United States Geologic Survey - California Water Science Center 2020). As groundwater levels fall or rise, the volume of groundwater storage changes accordingly, where unacceptable groundwater level decline indicates unacceptable storage loss. The hydrogeologic model outlined in Chapter 2 provides the needed hydrogeologic properties of the aquifer.

Protecting against chronic lowering of groundwater levels will directly protect against the chronic reduction of groundwater storage because the lowering of groundwater levels would directly lead to predictable reduction of groundwater storage. There cannot be a reduction in groundwater storage without a commensurate, observable reduction in water levels. There are currently no other state, federal, or local standards that relate to this sustainability indicator in the Basin.

An undesirable result from the reduction of groundwater in storage occurs when reduction of groundwater in storage interferes with beneficial uses of groundwater in the Basin. Since groundwater levels are being used as a proxy, the undesirable result for this sustainability indicator occurs when groundwater levels drop below the extended minimum threshold (Table 5), as defined by the undesirable result for the chronic lowering of groundwater levels. This should avoid significant and unreasonable changes to groundwater storage, including long-term reduction in groundwater storage or interference with the other sustainability indicators. Possible causes of undesirable reductions in groundwater storage are increases in well density or groundwater extraction or increases in frequency or duration of drought conditions.

The minimum threshold for groundwater storage for this GSP is the minimum threshold for groundwater levels. Information used to establish minimum thresholds and measurable objectives for groundwater levels can be found in Section 3.4.1. Since groundwater storage is defined in terms of water level, Section 3.4.1.2 for the water level indicator equally applies to define the relationship of the groundwater storage SMC to other sustainability indicators.

The measurable objective for groundwater storage is the measurable objective for groundwater levels as detailed in Section 3.4.1.3. The path to achieve measurable objectives and interim milestones for the reduction in groundwater storage sustainability indicator are the same measurable objectives and interim milestones as for the chronic lowering of groundwater levels sustainability indicator detailed in Section 3.4.1.4.

3.4.3 Water Quality

Groundwater quality in the Basin is generally well-suited for the municipal, domestic, agricultural, and other existing and potential beneficial uses designated for groundwater in the Water Quality Control Plan for the North Coast Region (Basin Plan), as discussed in Section 2.2.3 and in the water quality assessment in Appendix 2-D.

SMC are defined for two constituents: specific conductivity and nitrate. These identified COCs are consistent with the threats to groundwater quality highlighted in the *Staff Report for the North Coast Hydrologic Region Salt and Nutrient Management Planning Groundwater Basin Evaluation and Prioritization* (NCRWQCB 2020). Although benzene is identified as a potential constituent of concern in Section 2.2.3, no SMC is defined for benzene as current benzene data are associated with leaking underground storage tanks (LUST) where the source of benzene is known and monitoring and remediation are in progress. These sites will be taken into consideration with PMAs undertaken by the GSA, as applicable. As part of the sustainability goal for the Basin, the specific objective for groundwater quality is to maintain a groundwater resource that meets the water quality needs of beneficial uses and users in the Basin, as regulated by federal and state water quality standards and regional water quality objectives. Avoiding significant degradation of groundwater quality is central to protecting uses that rely on groundwater. Categories of beneficial uses of groundwater in the North Coast Region, as listed in the Basin Plan, include municipal and domestic supply, agricultural and stock water supply, industrial service supply, industrial process supply, aquaculture, and Native American culture. Specific uses of groundwater in Scott Valley include groundwater use for irrigation in agriculture, a significant part of the local economy, as stock water, and as a municipal and domestic water source. Importantly, beneficial uses also include groundwater-dependent ecosystems and instream habitat where and when groundwater contributes to streamflow.

The role of the GSA is to provide additional local oversight of groundwater quality, collaborate with appropriate parties to implement water quality PMAs, and to evaluate and monitor, as needed, water quality effects of PMAs implemented to meet the requirements of other SMC. All future PMAs implemented by the GSA will be evaluated and designed to avoid causing undesirable groundwater quality outcomes. Federal and state standards for water quality, water quality objectives defined in the Basin Plan, and the management of known and suspected contaminated sites within the Basin will continue to be managed by the relevant agency. Groundwater in the Basin is used for a variety of beneficial uses which are protected by NCRWQCB through the water quality objectives adopted in the Basin Plan.

Available historical and current groundwater quality monitoring data and reporting efforts have been used to establish and document conditions in the Basin, as discussed in Section 2.2.3. These conditions provide a baseline upon which to compare future groundwater quality and identify any changes observed, including those due to GSP implementation. Groundwater quality monitoring in the Basin in support of the GSP will rely on the existing and planned wells in the monitoring network, as described in Section 3.3.3. Groundwater quality samples will be collected and analyzed in accordance with the monitoring protocols outlined in Appendix 3-B. The monitoring network will use information from existing programs in the Basin that already monitor for the COCs and programs where these constituents could be added as part of routine monitoring efforts in support of the GSP. New wells will be incorporated into the network as necessary to obtain information to fill spatial gaps in data or to gather data that cannot be collected at existing wells. Because water quality degradation is typically associated with increasing rather than decreasing concentration of constituents, the GSA uses the term “maximum threshold” (MaxT) in the context of water quality instead of “minimum threshold”. The use of the term “maximum threshold” in this GSP is equivalent to the use of the term “minimum threshold” in other SMC or in the SGMA regulations.

3.4.3.1 Undesirable Results

Significant and unreasonable degradation of groundwater quality is the degradation of water quality that would impair beneficial uses of groundwater within the Basin or result in failure to comply with groundwater regulatory thresholds. Degraded groundwater quality is considered an undesirable result if concentrations of COCs exceed defined maximum thresholds or if a significant trend of groundwater quality degradation is observed for the identified COCs. Groundwater quality changes that occur independent of SGMA activities do not constitute an undesirable result. Based on the State’s 1968 Antidegradation Policy[3], water quality degradation that is not consistent with the provisions of Resolution No. 68-16 is degradation that is determined to be significant and unreasonable. NCRWQCB and the State Water Board are the two entities that determine if water quality degradation is inconsistent with Resolution No. 68-16.

For purposes of quantifying and evaluating the occurrence of an undesirable result, the concentration data are aggregated by statistical analysis to obtain spatial distributions and temporal trends. Specifically, statistical analysis is performed to determine the ten-year linear trend in concentration at each well. This trend is expressed unitless as percent relative concentration change per year. From the cumulative distribution of all

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[3] State Water Resources Control Board. “Resolution No. 68-16: Statement of Policy with Respect to Maintaining High Quality of Waters in California”, California, October 28, 1968.

ten-year trends observed across the monitoring network, the 75th percentile, $trend75_{10year}$, is obtained. Similarly, the moving two-year average concentrations are computed at each well, and from their cumulative distribution the 75th percentile, $conc75_{2year}$, is obtained. Concentrations are expressed in their respective concentration units (µg/L, mg/L, or micromhos). For purposes of this GSP, a "water quality value" is defined by combining the measures of trend and concentration.

$$Water\ quality\ value = \mathrm{max}(trend75_{10year} - 15\%,\ conc75_{2year}–MaxT)$$

The undesirable result is quantitatively defined as:

$$Water\ quality\ value\ is > 0$$

This quantitative measure assures that water quality remains constant and does not increase by more than 15% per year, on average over ten years, in more than 25% of wells in the monitoring network. Mathematically this can be expressed by the following equation:

$$trend75_{10year}[\%] - 15\% \leq 0$$

It also assures that water quality does not exceed maximum thresholds for concentration, MT, in more than 25% of wells in the monitoring network. Values for maximum thresholds are defined in Section 3.4.3.4. Mathematically, this second condition can be expressed by the following equation:

$$conc75_{2year}–MaxT \leq 0$$

The water quality value is the maximum of the two terms on the left-hand side of the above two equations. If either of them exceeds zero, that is, if either of them does not meet the desired condition, then the water quality value is larger than zero and quantitatively indicates an undesirable result.

Potential Causes of Undesirable Results

Future GSA activities with potential to affect water quality may include changes in location and magnitude of Basin pumping, declining groundwater levels, and groundwater recharge projects. Altering the location or rate of groundwater pumping could change the direction of groundwater flow which may result in a change in the overall direction in which existing or future contaminant plumes move and thus potentially compromise ongoing remediation efforts. Similarly, recharge activities could alter hydraulic gradients and result in the downward movement of contaminants into groundwater or move groundwater contaminant plumes towards supply wells.

Land use activities not associated with the GSA that may lead to undesirable groundwater quality include future contamination from urban and industrial sources, the application of fertilizers, certain agricultural practices, and/or waste discharges that may result in exceedances of constituents in groundwater. Existing leaks from underground storage tanks (USTs) in the Basin are currently monitored and managed, and though additional degradation is not anticipated from these known sources, new leaks may cause undesirable results depending on the contents of an UST, which may include petroleum hydrocarbons, solvents, or other contaminants. Groundwater quality degradation associated with known sources primarily will be managed by the entity currently overseeing these sites, NCRWQCB. Agricultural activities in the Basin are dominated by alfalfa and pasture production. The risk for fertilizer-associated nitrate leaching from these activities is considered low (Harter et al. 2017). Grain production is rotated with alfalfa production usually for one year after seven years of alfalfa production. Grain production also does not pose a significant nitrate-leaching risk. Animal farming, a common source of nitrate pollution in large, confined animal farming operations, is also present in the Valley, but not at stocking densities of major concern (Harter et al. 2017). However, NCRWQCB (2020) listed the Basin as "high" priority for the threat of water quality degradation from salts and nutrients.

Effects on Beneficial Uses and Users

Concerns over potential or actual non-attainment of the beneficial uses designated for groundwater in the Basin are and will continue to be related to certain constituents measured at elevated or increasing concentrations, and the potential local or regional effects that degraded water quality can have on such beneficial uses.

The following provides greater detail regarding the potential impact of poor groundwater quality on several major classes of beneficial users:

- **Municipal Drinking Water Users** – Under California law, agencies that provide drinking water are required to routinely sample groundwater from their wells and compare the results to state and federal drinking water standards for individual chemicals. Groundwater quality that does not meet state drinking water standards may render the water unusable or may cause increased costs for treatment. For municipal suppliers, impacted wells potentially may be taken offline until a solution is found, depending on the configuration of the municipal system in question. Where this temporary solution is feasible, it will add stress to and decrease the reliability of the overall system.
- **Rural and/or Agricultural Residential Drinking Water Users** – Residential structures not located within the service areas of the local municipal water agency will typically have private domestic groundwater wells. Such wells may not be monitored routinely and groundwater quality from those wells may be unknown unless the landowner has initiated testing and shared the data with other entities. Degraded water quality in such wells can lead to rural residential use of groundwater that does not meet potable water standards and results in the need for installation of new or modified domestic wells and/or well-head treatment that will provide groundwater of acceptable quality.
- **Agricultural Users** – Irrigation water quality is an important factor in crop production and has a variable impact on agriculture due to different crop sensitivities. Impacts from poor water quality may include declines in crop yields, crop damage, changes in the crops that can be grown in an area, and other effects. For example, irrigation with water containing moderate to high levels of nitrate may increase nitrate concentrations in the underlying groundwater.
- **Environmental Uses** – Poor quality groundwater may result in the migration of contaminants that could affect groundwater dependent ecosystems or instream environments and their resident species. Poor quality groundwater may also add nutrients to water bodies that produce adverse ecological effects, including eutrophication.

3.4.3.2. Maximum Thresholds

Maximum thresholds for groundwater quality in the Basin were defined using existing groundwater quality data, groundwater beneficial uses designated in the Basin, existing regulations, including water quality objectives included the Basin Plan, Title 22 Primary and Secondary MCLs, and consultation with the GSA advisory committee and stakeholders (see Section 2.2.3). Resulting from this process, SMC were developed for two of the COCs in the Basin, nitrate and specific conductivity.

The selected maximum thresholds for the concentration of each of the two COCs and their associated regulatory thresholds are shown in Table 6.

Triggers

The GSA will use concentrations of the identified COCs (nitrate and specific conductivity) as triggers for preventative action to proactively avoid the occurrence of undesirable results. Trigger values are identified for both nitrate as nitrogen and specific conductivity, as shown in Table 6. The trigger value and associated definition for specific conductivity is the 90% upper limit, or 90 percentile values for a calendar year, as specified in the Basin Plan. The Title 22 water quality objective for nitrate is incorporated by reference into the Basin Plan and the triggers provided in Table 6 correspond to 90% of the Title 22 MCL.

Method for Quantitative Measurement of Maximum Thresholds

Groundwater quality will be measured in wells in the monitoring network, as discussed in Section 3.3.3. Statistical evaluation of groundwater quality data obtained from the monitoring network will be performed

Constituent	Maximum Threshold	Regulatory Threshold
Nitrate as Nitrogen	5 mg/L as N, trigger only; 9 mg/L as N, trigger only; 10 mg/L as N, MaxT	10 mg/L as N (Title 22)
Specific Conductivity	500 micromhos, trigger only; 900 micromhos, MT	500 micromhos (Basin Plan Upper Limit for the EC value not exceeded by 90% of wells); 900 micromhos (Title 22)

Table 6: Constituents of concern and their associated maximum thresholds. Maximum thresholds also include a 15 percent average increase per year over ten years in no more than 25 percent of wells, and no more than 25 percent of wells exceeding the maximum threshold for concentration listed here.

using the equations described above. The maximum thresholds for concentration values are shown in Figure 11. This figure shows “rulers” for the two identified COCs in the Scott Valley Groundwater Basin with the associated maximum thresholds, range of measurable objectives, and triggers.

3.4.3.3. Measurable Objectives

Within the Basin, the measurable objectives for water quality are established to provide an indication of desired water quality at levels that are sufficiently protective of beneficial uses and users. Measurable objectives are defined on a well-specific basis, with consideration for historical water quality data. Concentrations of some naturally occurring contaminants may not be possible to change through implementation of PMAs.

Description of Measurable Objectives The groundwater quality measurable objective for wells within the GSA’s monitoring network (either existing or future wells), where the concentrations of COCs historically have been below the maximum thresholds for water quality in recent years, is to continue to maintain concentrations within the current range, as measured by long-term trends.

Specifically, for the two identified COCs, the action taken to meet the measurable objective will be to maintain groundwater quality at a minimum of 90% of wells monitored for water quality within the range of the water quality levels measured over the past 30 years (1990-2020). In addition, no significant increase in long-term trends should be observed in COC concentrations as another mechanism for meeting MOs.

3.4.3.4. Path to Achieve Measurable Objectives

The GSA will support the protection of groundwater quality by monitoring groundwater quality conditions and coordinating with other regulatory agencies that work to maintain and improve the groundwater quality in the Basin. All future PMAs implemented by the GSA will comply with state and federal water quality standards and Basin Plan water quality objectives and will be designed to maintain groundwater quality for all uses and users and avoid causing unreasonable groundwater quality degradation. The GSA will review and analyze groundwater monitoring data as part of GSP implementation in order to evaluate any changes in groundwater quality, including those changes resulting from groundwater pumping or recharge projects in the Basin. The need for additional studies on groundwater quality will be assessed throughout GSP implementation. The GSA may identify knowledge requirements, seek funding, and help to implement additional studies.

Using monitoring data collected as part of project implementation, the GSA will develop information (e.g., time-series plots of water quality constituents) to demonstrate that PMAs are operating to maintain or improve groundwater quality conditions in the Basin and to avoid unreasonable groundwater quality degrada-

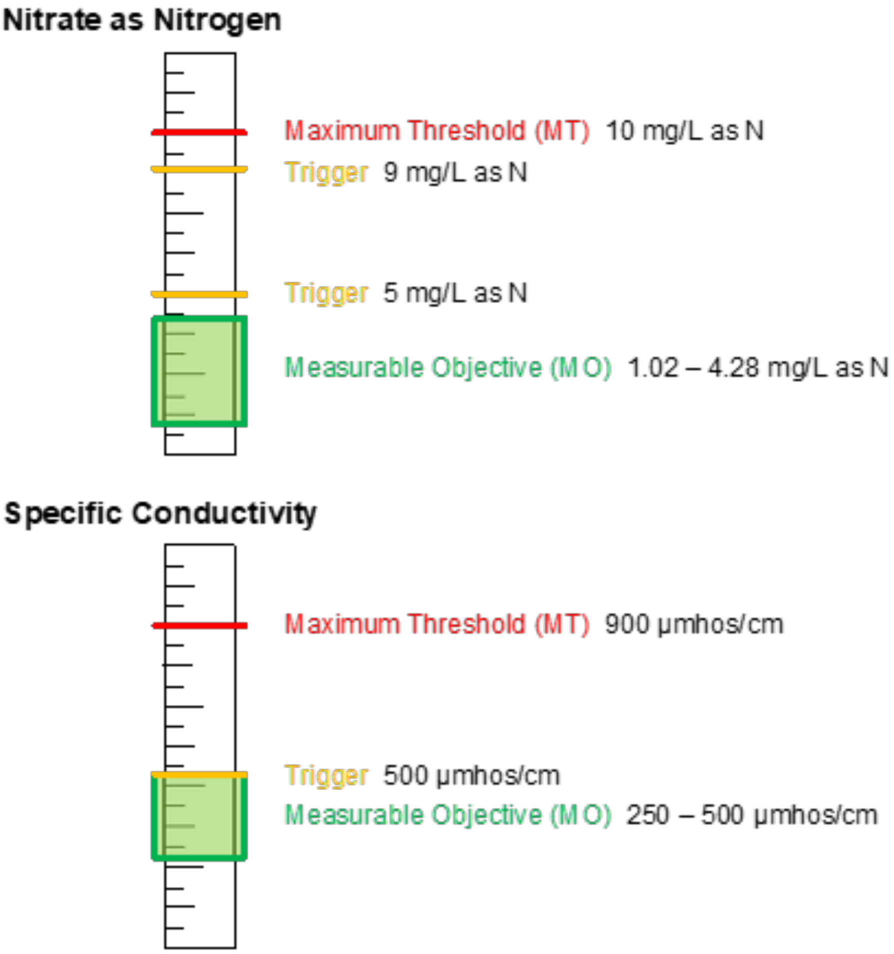


Figure 11: Degraded water quality thermometers for the constituents of concern in Scott River Valley.

tion. Should the concentration of a constituent of interest increase to its maximum threshold (or a trigger value below that threshold specifically designated by occurrence), the GSA will determine an appropriate response based on the process illustrated in Figure 12. This process depicts the high-level decision making that goes into developing SMC, the monitoring to determine if criteria are met, and actions to be taken based on monitoring results. Exceedances of nitrate and specific conductivity water quality objectives will also be referred to NCRWQCB. Where the cause of an exceedance is unknown, the GSA may choose to conduct additional or more frequent monitoring.

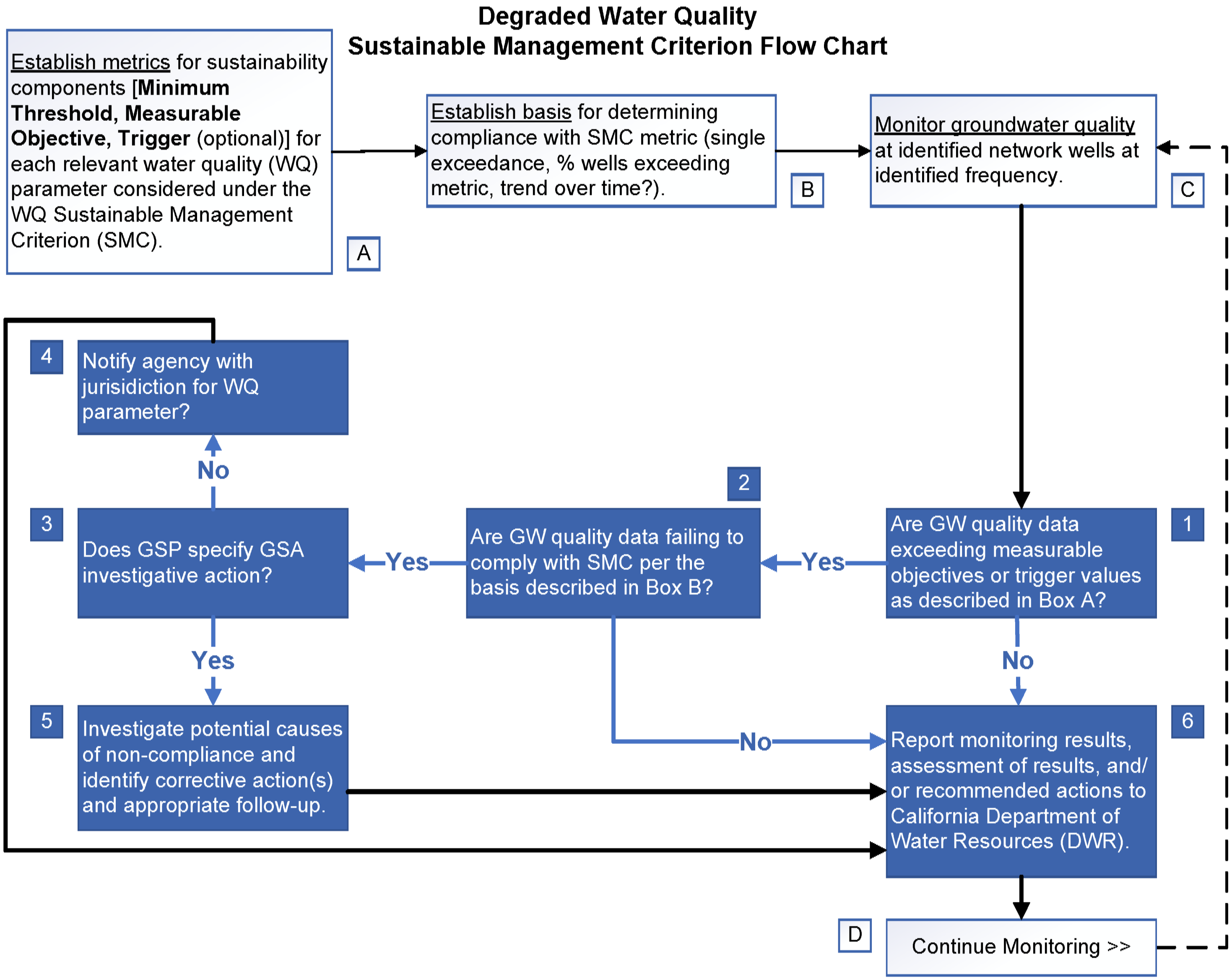


Figure 12: Degraded water quality sustainable management criteria flow chart. The flow chart depicts the high-level decision making that goes into developing sustainable management criteria (SMC), monitoring to determine if criteria are met, and actions to be taken based on monitoring results.

Interim Milestones

As existing groundwater quality data indicate that groundwater in the Basin generally meets applicable state and federal water quality standards, the objective is to maintain existing groundwater quality. Interim milestones are therefore set equivalent to the measurable objectives with the goal of maintaining water quality within the historical range of values.

3.4.3.5 Information and Methodology Used to Establish Maximum Thresholds and Measurable Objectives

A detailed discussion of the concerns associated with elevated levels of each constituent of interest is described in Section 2.2.3. As the COCs were identified using current and historical groundwater quality data, this list may be reevaluated during future GSP updates. In establishing maximum thresholds for groundwater quality, the following information was considered:

- Feedback about water quality concerns from stakeholders.
- An assessment of available historical and current groundwater quality data from production and monitoring wells in the Basin.
- An assessment of historical compliance with federal and state drinking water quality standards and water quality objectives.
- An assessment of trends in groundwater quality at selected wells with adequate data to perform the assessment.
- Information regarding sources, control options, and regulatory jurisdiction pertaining to COCs.
- Input from stakeholders resulting from the consideration of the above information in the form of recommendations regarding maximum thresholds and associated management actions.

The historical and current groundwater quality data used in the effort to establish groundwater quality maximum thresholds are discussed in Section 2.2.3. Based on a review of these data, applicable water quality regulations, Basin water quality needs, and information from stakeholders, the GSA reached a determination that the State drinking water standards (MCLs and WQOs) are appropriate to define maximum thresholds for groundwater quality. The established maximum thresholds for groundwater quality protect and maintain groundwater quality for existing or potential beneficial uses and users. Maximum thresholds align with State drinking water standards, which are derived from the maximum contaminant levels (MCLs) in Title 22 of the California Code of Regulations. The more stringent water quality objectives for specific conductivity, specified in the Basin Plan, are reflected in the trigger values defined for this constituent. New COCs may be added with changing conditions and as new information becomes available.

3.4.3.6. Relationship to Other Sustainability Indicators

Groundwater quality cannot typically be used to predict responses of other sustainability indicators. However, groundwater quality may be affected by groundwater levels and reductions in groundwater storage. In addition, certain implementation actions may be limited by the need to achieve minimum thresholds for other sustainability indicators.

- **Groundwater Levels** – Declining water levels can potentially lead to increased concentrations of COCs in groundwater, may alter the existing hydraulic gradient, and may result in movement of contaminated groundwater plumes. Changes in water levels also may mobilize contaminants that may be present in unsaturated soils. The maximum thresholds established for groundwater quality may influence groundwater level minimum thresholds by affecting the location or number of projects, such as groundwater recharge, in order to avoid degradation of groundwater quality.

- **Groundwater Storage** – Groundwater quality that is at or near maximum thresholds is not likely to influence pumping.
- **Depletion of Interconnected Surface Waters** – Groundwater quality that is at or near maximum thresholds may affect stream water quality.

- **Seawater Intrusion** – This sustainability indicator is not applicable in this Basin.

3.4.4 Subsidence

3.4.4.1 Undesirable Results

An undesirable result occurs when subsidence substantially interferes with beneficial uses of groundwater and land uses. Subsidence occurs as a result of compaction of (typically) fine-grained aquifer materials (i.e., clay) due to the overdraft of groundwater. As there has not been any historical documentation of subsidence in the Basin, and the aquifer materials are unlikely to present such a risk, it is reasonable to conclude that any land subsidence caused by the chronic lowering of groundwater levels occurring in the Basin would be considered significant and unreasonable. This is quantified as pumping induced subsidence greater than the minimum threshold of 0.1 ft (0.03 m) in any single year; essentially zero subsidence accounting for measurement error.

Effects of Undesirable Results on Beneficial Uses and Users

Subsidence can result in substantial interference with land use including significant damage to critical infrastructure such as canals, pipes, or other water conveyance facilities. Flooding of land, including residential and commercial properties, can lead to financial losses.

3.4.4.2 Minimum Thresholds

The minimum threshold for land subsidence in the Basin is set at no more than 0.1 ft (0.03 m) in any single year, resulting in no long-term permanent subsidence. This is set at the same magnitude as the estimated error in the InSAR data (+/- 0.1 ft [0.03 m]), which is currently the only tool available for measuring basin-wide land subsidence consistently each year in the Basin.

The minimum thresholds for land subsidence in the Basin were selected as a preventative measure to ensure maintenance of current ground surface elevations and as an added safety measure for potential future impacts not currently present in the Basin and nearby basins. This avoids significant and unreasonable rates of land subsidence in the Basin, which are those that would lead to a permanent subsidence of land surface elevations that would impact infrastructure and agricultural production in the Scott Valley and neighboring groundwater basins. There are currently no other state, federal, or local standards that relate to this sustainability indicator in the Basin.

3.4.4.3 Measurable Objectives

Land subsidence is not known to be significant in the Scott Valley. There is no historical record of inelastic subsidence in the Basin resulting in permanent land subsidence. Recent InSAR data provided by DWR (TRE Altamira) show no significant subsidence occurring during the period of mid-June 2015 to mid-September 2019. Small fluctuations observed in these datasets are likely due to seasonal variations in the local hydrologic cycle and agricultural practices and are not significant or unreasonable. Additionally, the specific geology of the aquifer materials comprising the Basin is not known to contain the thicker clay confining units that typically exhibit inelastic subsidence due to excessive groundwater pumping (i.e., overdraft conditions).

The guiding measurable objective of this GSP for land subsidence in the Basin is the maintenance of current ground surface elevations. This measurable objective avoids significant and unreasonable rates of land subsidence in the Basin, which are those that would lead to a permanent subsidence of land surface elevations that impact infrastructure and agricultural production. As this subsidence measurable objective is essentially already met, the specific goal is to maintain this level of land subsidence (i.e., essentially zero) throughout the GSP implementation period. Land subsidence in the Basin is expected to be maintained throughout the implementation period via the sustainable management of groundwater pumping through the groundwater level measurable objectives, minimum thresholds, and interim milestones, as well as the fact that the aquifer geology is not very likely to be susceptible to significant and unreasonable subsidence, even under groundwater overdraft conditions.

The margin of safety for the subsidence measurable objective was established by setting a measurable objective to maintain current surface elevations and opting to monitor subsidence throughout the implementation period, even though there is no historical record of subsidence, and the aquifer is not deemed to be likely to succumb to inelastic subsidence. This is a reasonable margin of safety based on the past and current aquifer conditions and more conservative than the alternative of simply setting the subsidence indicator as 'not applicable' in the Basin due to current and documented historical evidence. As the current measurable objective is set to maintain the present land surface elevations of the Basin, the interim milestones are set as check-in opportunities to review year-to-year subsidence rates from the previous five-year period to assess whether there are longer-period subsidence trends than may be observed in the annual reviews.

3.4.4.4 Path to Achieve Measurable Objectives

Land subsidence in the Basin will be quantitatively measured by use of InSAR data (DWR-funded TRE Altamira or other similar data products). If there are areas of concern for inelastic subsidence in the Basin (i.e., exceedance of minimal thresholds) observed using the InSAR data, then ground-truthing studies could be conducted to determine if the signal is potentially related to changes in land use or agricultural practices or from groundwater extraction. If the subsidence is determined to result from groundwater extraction and is significant and unreasonable, then ground-based elevation surveys might be needed to monitor the situation more closely.

3.4.4.5 Relationship to Other Sustainability Indicators

By managing groundwater pumping to avoid the undesirable result of chronic lowering of groundwater levels, the possibility of land subsidence, already unlikely due to aquifer geology, will be mitigated. Avoiding or limiting land subsidence through sustainably managed groundwater levels in the Basin will also lessen impacts due to declines in groundwater storage and/or impacts to the sensitive, and relatively shallow, interconnected surface water/groundwater system that defines much of the Basin.

3.4.5. Depletion of Interconnected Surface Water

3.4.5.1. Undesirable Results

Undesirable Results in the Context of Interconnected Surface Water

As described in Section 2, groundwater throughout the Basin is interconnected with the Scott River stream network including its tributaries. As also described in Section 2, the Scott River stream network is ecologically stressed due, in part, to periodically insufficient baseflow conditions during the summer and fall. Summer baseflow levels are, in part, related to groundwater levels and storage which determine the net groundwater contributions to streamflow. Excessive stream temperatures are also related to earlier completion of the snow melt/spring flow recession, and due to later onset of the fall flush flow from the first significant precipitation event of the season. These adverse conditions impact, among others, two species of native anadromous fish, coho and Chinook salmon. Adverse stream flow conditions have occurred primarily since the 1970s, exacerbated by the large frequency of dry years that have occurred over the past 20 years. Low streamflow conditions are similar in dry years since the 1970s. Lowest streamflow conditions in dry years between the 1940s (when the Scott River stream gauge near Fort Jones was established) and the 1970s were about four times larger than more recently: 40 cfs (1.1 cms) instead of 10 cfs (0.28 cms). There exists no long-term trend in water-year-type-dependent streamflow minima. However, the frequency of low precipitation years has been higher over the past 20 years than in the second part of the 20th century. Ecosystem stresses in the Scott River stream network also include geomorphic conditions unrelated to flow (channel straightening and incision, sediment deposition).

Potential Causes of Undesirable Results

Causes of the overall low flow challenges in the Scott River stream system include consumptive use of surface water and groundwater and climate variability (which must be accounted for in the GSP). Some consumptive uses of groundwater may have a more immediate impact on streamflow than others; for example, a well that begins pumping groundwater 66 ft (20 m) from the river bank may cause stream depletion hours or days later, while a well that begins pumping two miles (3 km) west of the river bank may not influence streamflow for months or even a year. Possible causes of undesirable results include increasing frequency or duration of drought conditions, increased groundwater extraction, and continued surface water diversions.

Effects of Undesirable Results on Beneficial Uses and Users

Agricultural Land Uses and Users – depletion of interconnected surface water due to groundwater pumping can reduce the surface flow available to downstream diverters.

Some of the PMAs considered in the GSP development process, which are designed to reduce or reverse stream depletion, can make less water available for consumptive use, which would negatively impact some agricultural operations. However, the PMAs prioritized in this GSP do not use mandatory restrictions on water available for consumptive use on currently active agricultural land.

Domestic and Municipal Water Uses and Users – depletion of interconnected surface water can negatively affect municipalities, including the City of Etna, that are reliant on surface water as a drinking water source.

None of the PMAs considered in the GSP development process would change operations for domestic water users pumping less than 2 AFY (2,467 m3/year), as these are *de minimis* groundwater users who are not regulated under SGMA. Similarly, none of the PMAs prioritized in the GSP development process would negatively affect municipal water users.

Recreation – depletion of interconnected surface water can affect the ability of users to partake in recreational activities on surface water bodies in the Basin.

Environmental Land Uses and Land Users – depletion of interconnected surface water may negatively affect the following: near-stream habitats for plant and animal species; instream ecosystems, including habitat necessary for reproduction, development, and migration of fish and other aquatic organisms; terrestrial ecosystems reliant on surface water; and wildlife that rely on surface waters as a food or water source. Additionally, low flow conditions can result in increased stream temperature that can be inhospitable to aquatic organisms, including anadromous fish. Low streamflow can also lead to increased concentrations of nutrients which can result in eutrophication.

Addressing Undesirable Results That Existed During the Baseline Period (prior to 2015)

SGMA requires that a GSP design SMCs to avoid undesirable results that did not already exist prior to 2015. Optionally, the plan may address undesirable results that occurred before January 1, 2015 (California Water Code 10727.2(b)(4)). In Scott Valley, undesirable results associated with depletion of interconnected surface water that have occurred since January 1, 2015, had already existed for 24 years as of 2015. No additional undesirable results have occurred since January 1, 2015 (Section 2.2.1.6 and Table 7). Table 7 shows that stream depletion since 2014 (30 cfs or less) has not exceeded the highest stream depletion observed in the 24-year period prior to 2015 (over 40 cfs).

SGMA also requires that the design of the SMC is consistent with existing water rights and regulations (23 CCR § 354.28(b)(5)). With respect to the interconnected surface water SMC in the Basin, relevant rights and regulations include (Cantor et al. 2018): the 1980 Scott River Adjudication, Porter-Cologne Water Quality Control Act (NCRWQCB Basin Plan and TMDL), Endangered Species Act (ESA), and Public Trust Doctrine (PTD). These programs are described in Chapter 2 and briefly summarized here as they relate to the SMC development.

Adjudication. The 1980 adjudication decree defined all groundwater within approximately 1,000 ft (305 m) from the mainstem Scott River as interconnected to surface water and assigned a water right to groundwater pumpers. The GSP is not allowed to alter water rights, including the 1980 adjudication in the Basin, which allows landowners within the Adjudicated Zone to pump groundwater (Superior Court of Siskiyou County 1980). SGMA's definition of "basin" for the Scott Valley Groundwater Basin is limited by Water Code sections 10720.8(a) and (e), which provide that the portion of the Scott Valley Basin within the area included in the Scott River Stream System is not subject to SGMA.

ESA. Under the ESA, coho salmon occurring in the Scott Valley are listed as a threatened species. CDFW has proposed minimum instream flow recommendations for the fish; however, the SWRCB has not set instream flow requirements for the Scott River to date.

Porter-Cologne. For the Scott River, the NCRWQCB's Basin Plan has established fish and wildlife beneficial uses, and set water quality objectives and an implementation plan to protect these uses (Scott River TMDL Action Plan, NCRWQCB, (2018)).

The Scott River TMDL Action Plan establishes a framework to support meeting water quality objectives. Permitting authority is established under the NCRWQB's Basin Plan and Porter-Cologne. The TMDL Action plan establishes voluntary and regulatory programs related to water quality management actions that would, among others, expand riparian shading and control irrigation return-flows to streams to protect stream temperature (currently regulated under the 2018 Scott River TMDL Conditional Waiver of Waste Discharge Requirements). The TMDL staff report has identified groundwater discharge to streams as a factor controlling stream temperature and a groundwater study plan has been completed.

Porter-Cologne (through NCRWQCB's Basin Plan and using the TMDL Action Plan) encourages water users to develop and implement water conservation practices (surface water and groundwater, Table 4-10 of the TMDL Action plan). However, the TMDL Action Plan does not include legal requirements for groundwater management actions that would increase baseflow as a tool to maintain or improve cold streamflow temperature conditions (NCRWQCB 2010).

Public Trust Doctrine. A recent court decision on the public trust doctrine (PTD) identifies the County of Siskiyou as an extension of the SWRCB with administrative responsibilities for protecting public trust resources when issuing groundwater well permits; specifically, the Scott River. The court decision identifies groundwater pumping that leads to surface water depletion as subject to public trust considerations, specifically, balancing public trust resource needs against the public interest.

Given the history of stream depletion associated with groundwater pumping outside the adjudicated zone, SGMA does not require the GSA to address undesirable results associated with depletion of interconnected surface water. However, current Basin conditions indicate a need to improve conditions for fish. The GSP furthers that goal. Reversal of stream depletion is one action that can help achieve that goal. Neither the ESA, TMDL, or PTD specify mandatory targets, minimum thresholds, or specific project requirements. They do not use, as SGMA does, the concept of "significant and unreasonable undesirable results" as an absolute legal measure. Instead, targets, projects, and management actions to address surface water depletion are developed as part of a program implementation and depend on environmental outcomes, scientific studies, public interest concerns about PMAs, and best available technology.

The GSA designed this interconnected surface water SMC to be consistent with the requirements of SGMA and the programmatic structures of the NCRWQCB Basin Plan (including the TMDL Action Plan), ESA, and PTD.

Undesirable Results to Define a Minimum Threshold and Measurable Objectives for ISWs versus the aspirational "Watershed Goal"

According to SGMA regulations, "Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin" (23 CCR § 354.26). For the interconnected surface water sustainability indicator, undesirable results commonly arise from habitat conditions that are affected by the amount of streamflow, as described above. However, reductions in streamflow – even during periods of baseflow – are not identical to "stream depletion due to groundwater pumping". Rather, streamflow and streamflow changes are subject to several contributing factors as described above and in Section 3.3.5.1 (monitoring of surface water depletion). For improving streamflow conditions, various agencies and NGOs managing watersheds typically target one or several aspirational "watershed goals". The SGMA undesirable result is only one of several contributing mechanisms impairing these watershed goals. **The undesirable result that is relevant to SGMA is the stream depletion that can be attributed to groundwater pumping outside of the adjudicated zone to the degree it leads to significant and unreasonable impacts on beneficial uses of surface water.**

In assessing how stream depletion reversal less than the MTs and MO would result in significant and unreasonable effects on beneficial uses of surface water, it is helpful to consider the following standards for "significant" and "unreasonable". Case law concerning the California Environmental Quality Act (CEQA) defines a "Significant effect on the environment" as "a substantial, or potentially substantial, adverse change in the environment." (Pub. Resources Code, § 21068.)

There is considerable case law interpreting the concept of an "unreasonable" use of water under Article 10, Section 2 of the California Constitution that is instructive when evaluating the reasonableness of competing uses of water. (See e.g., *Gin Chow v. Santa Barbara* (1933) 217 Cal. 673, 705-706; *Peabody v. City of Vallejo* (1929) 2 Cal.2d351, 367; *City of Lodi v. East Bay Mun. Utility Dist.* (1936) 7 Cal.2d 316, 339-341; *Joslin v. Marin Municipal Water Dist.* (1967) 67 Cal.2d 132, 141; *Erickson v. Queen Valley Ranch Co.* (1971) 22 Cal.App.3d578, 585-586). These cases essentially say that whether a water use is reasonable depends on the circumstances, and these circumstances can change over time. The reasonableness of groundwater use that may contribute to stream depletion could depend on a number of circumstances, including the benefits of pumping groundwater and the resource impacts of pumping groundwater.

Furthermore, in the Scott Valley, the definition of surface water depletion due to groundwater pumping must account for the jurisdictional boundary of the 1980 adjudication, as SGMA only allows regulation of those wells outside of the Adjudicated Zone (Wat. Code, § 10720.8(a)(20).). In the SGMA context, the GSA's enforcement responsibilities are limited to stream depletion due to groundwater pumping outside of the Adjudicated Zone. This is reflected in the design of the quantification of stream depletion (Section 3.3.5.1): the "no pumping reference scenario" refers to no pumping outside of the Adjudicated Zone. No pumping inside of the Adjudicated Zone would be a (voluntary) PMA and has also been evaluated as a "bookend" PMA scenario (Appendix 4-A).

In the context of assessing MTs for the ISW SMC, the GSA has determined that it is reasonable to hold groundwater producers outside the adjudicated zone (regulated by the GSP) to a modest percentage of stream depletion reversal.

While its enforcement responsibilities are narrowly focused on groundwater extraction outside of the Adjudicated Zone, the GSA's collaborative goals are broader than its enforcement responsibilities and include support toward meeting aspirational watershed goals. The GSP seeks to reflect these efforts in the design of the measurable objective for interconnected surface water.

Consequently, for the sustainability indicator of Interconnected Surface Water (ISW), this GSP makes a distinction between the Undesirable Result (which must consider the impacts on surface water beneficial uses attributable to groundwater use outside of the Adjudicated Zone) and overall challenges related to surface water beneficial uses throughout the watershed. This distinction reflects the fact that SGMA can address only a portion of the water supply challenges of the entire Scott Valley.

The objective of securing sufficiently functional environmental flows has been referred to as an aspirational "watershed goal" indicating that action by all water users in the watershed may be necessary to achieve it. Quantification of the MO for the ISW sustainability indicator supports achievement of the aspirational watershed goal.

Choosing the aspirational watershed goal itself as the MO would not meet regulations. DWR requires that the metrics used to quantify and measure stream depletion and to establish the minimum threshold, Section 3.3.5.1, must also be used to quantify the MO (23 CCR § 354.30): "(b) measurable objectives shall be established for each sustainability indicator, based on quantitative values using the same metrics and monitoring sites as are used to define the minimum thresholds".

The GSA seeks to elevate its priority for being an active partner in an integrated watershed management process involving many collaborations and partnerships by emphasizing that the MO helps support this aspirational, *integrated* watershed management goal. As discussed below in Section 3.4.5.3, the GSA's MO for interconnected surface water sustainability accounts for Porter-Cologne, the TMDL, the Public Trust Doctrine, and the Endangered Species Act, by targeting substantial stream depletion reversal in order to benefit Scott River fish and wildlife beneficial uses.

To summarize, the ISW Undesirable Result is narrower in scope than the overall low flow challenges in the Scott River stream network and is defined as "stream depletion due to groundwater extraction from wells subject to SGMA (i.e., outside of the Adjudicated Zone) to the degree it leads to significant and unreasonable impacts on beneficial uses of surface water." It is protected by the MT and the MO. However, GSP implementation is part of a broader, integrated effort across multiple partners and partnerships to address overall low flow challenges in the Basin. Hence, the minimum MO is only the lowest end of a broader range of desirable stream depletion reversal (green-shaded area in Figure 13) that is inclusive of the aspirational watershed goal.

Identifying Undesirable Results for Purposes of Setting a Minimum Threshold

The GSA decided that quantification of stream depletion that constitutes the Undesirable Result depends on the results of a balancing test between public trust needs (environmental improvements) and the public interests.

In public meetings, the Scott GSA Advisory Committee (AC) evaluated the flow benefits and the public interest impacts of various PMAs. The AC determined that, based on the diverse array of PMAs that could be implemented in the Scott Valley, it would be reasonable to undertake some combination of PMAs to reduce stream depletion while exposing stakeholders to reasonable economic costs.

The committee considered both, information provided on protecting environmental beneficial uses and users; and information provided on the public interests of the Basin:

- *Environmental Beneficial Uses and Users:* Detailed biological assessments relating specific instream flows, functional flow elements, or habitat to specific biological outcomes are not available (Chapter 2). However, the advisory committee considered the minimum instream flow requirements proposed by CDFW (2017) and the drought instream flow requirements proposed by CDFW in 2021 (2021).
    - The economic value of the environmental benefits achieved specifically from Scott River flows recommended by CDFW is currently unknown. Kruse and Scholz (2006) provide an analysis of environmental economic benefits from Klamath River dam removal (for a summary, see Appendix 5-D, Section 4.3).
    - The Advisory Committee considered a wide range of PMA scenarios and hypothetical scenarios to assess their environmental outcome. Among the scenarios considered, none consistently achieve the proposed CDFW instream flows (Appendix 4-A). Among the simulated scenarios, scenarios with an outcome that would come closest to the proposed minimum instream flow requirements include those that either abandon all groundwater pumping inside and outside the adjudicated zone

(Appendix 4-A, page 75) or completely abandon both groundwater and surface water irrigation in the Basin (Appendix 4-A, page 75).

- *Public Interests in the Basin and Siskiyou County.* The economic impact of various degrees of permanent irrigation curtailment have been evaluated through an economic analysis and presented to the Advisory Committee (Appendix 5-D).
  - Of the economic scenarios considered, Scenario 1c ("All alfalfa and pasture are fallowed by 60%, with no ability to re-operationalize land and water use reductions with other crops.") most closely represents the permanent curtailments of all Basin groundwater use or all Basin groundwater and surface water use that would be needed to achieve CDFW recommended instream flow. The economic impact of scenario 1c for the Scott Valley Basin is $20 million in total annual lost output and $15 million in total annual lost 'value added', leading to an estimated 140 lost jobs (Table 17 in Appendix 5-D).
  - The economic impact of scenario 5 ("Total agricultural water use cutback by 15%, and model given flexibility to optimize distribution of cutbacks across individual crops.") for the Scott Valley Basin is $5 million in total annual lost output and $3.8 million in total annual lost 'value added', leading to an estimated 35 lost jobs (Table 17 in Appendix 5-D).

Considering this analysis and the presence of multiple Disadvantaged Communities in the Basin, the AC and GSA found that the instream flows identified by CDFW to protect environmental uses and users did not reasonably balance public interest and environmental considerations. It would also be outside the GSA's legal authority to implement to the degree achievement of those flows would require curtailments from adjudicated users or surface water diverters.

Nonetheless, based on this assessment of reasonableness by the AC, the GSA decided to implement PMAs to reduce current rates of stream depletion due to groundwater use in wells within the GSA's jurisdiction. This would address Undesirable Results existing in 2014 and continuing to exist today.

Quantitative Metric for Purposes of Setting a Minimum Threshold and Measurable Objective

The reduction in stream depletion is referred to as "stream depletion reversal". "Current rates" of stream depletion are "measured" using SVIHM (see Section 3.3.5.1) as the stream depletion rates due to groundwater pumping outside of the Adjudicated Zone. These rates cannot be directly measured with field instruments for the reasons discussed in Section 3.3.5.1.

Section 3.3.5.1 describes how stream depletion reversal due to a PMA is measured by comparing a PMA scenario against a BAU scenario. That section also explains that the comparison includes several metrics, readily available from the SVIHM simulations. Metrics that the AC has considered in its deliberations include:

- dates of the spring flow recession (date when simulated Scott River flows at the Fort Jones gauge fall below, 40 cfs, 30 cfs, 20 cfs, or 10 cfs)
- simulated monthly baseflow at the Fort Jones gauge [in cfs] during the summer and fall
- dates of the fall flush flow (dates after which simulated Scott River flows at the Fort Jones gauge reach at least 10 cfs, 20 cfs, 30 cfs, or 40 cfs)

Differences between PMA scenarios and the BAU scenario for the above three metrics have been compiled in Appendix 4-A (with electronic versions of detailed spreadsheet tables available in Digital Appendices 2-A-1 and 2-A-2). The documents provide in some detail year- and month-specific stream depletion reversal for a specific PMA for the 28-year period from 1991 - 2018. For purposes of quantitatively communicating each PMA's complex stream depletion reversal, it is here represented by a single representative number that focuses on the critical low-flow period of September–November: the 28-year average "Relative PMA Depletion Reversal" (measured in percent), as defined in Section 3.3.5.1, with respect to simulated monthly Scott River flow at the Fort Jones gauge in September, October, and November.

In summary, the minimum threshold (and measurable objective) is set as the amount of stream depletion reversal achieved by one or an equivalent set of multiple minimum required PMAs to meet the intent of SGMA (no additional undesirable results) and to further Porter-Cologne and the PTD (some reversal of existing undesirable results). The stream depletion reversal effects of PMAs and combinations of PMAs were evaluated using the SVIHM and the full portfolio of results is discussed in Chapter 4 and Appendix 4-A. This framework for the minimum threshold is consistent with 23 CCR 354.28(c)(6), which (A) specifies the use of models to measure stream depletion, (B) implies that consideration of impacts on beneficial uses and users of interconnected surface water necessary, but (C) does not require that streamflow itself is used to set the minimum threshold, triggers, or interim targets.

3.4.5.2. Minimum Thresholds

Based on deliberations of the AC, a combination of Managed Aquifer Recharge (MAR) in the winter (January through March) and In-Lieu Recharge (ILR) in the spring (April until June), on days when streamflow, above CDFW interim instream flow criteria is available after meeting surface water deliveries on 6,250 combined acres of active alfalfa and pasture was considered to be a "guiding" scenario to define the minimum amount of stream depletion reversal set as the minimum threshold.

The MAR-ILR scenarios, once fully implemented, provide a relative stream depletion reversal that averages **19%** during September–November under 1991–2018 climate conditions, as measured by the SVIHM monitoring tool. In other words, stream depletion is reduced, on average, to **81%** of stream depletion under business-as-usual. Appendix 4-A provides detailed monthly data for all months in 1991–2018, including relative and absolute stream depletion reversal and relative and absolute remaining stream depletion. It also provides information on the change in timing of spring recess and fall pulse flows each year.

Advisory Committee discussions further lead to the conclusion that the implementation of multiple PMAs is desired over implementation of a single PMA. Implementation of the MAR-ILR scenario, without consideration of other actions to increase instream flows, was considered ambitious. The Advisory Committee agreed that a portfolio of PMAs that includes some MAR, some ILR, increased irrigation efficiencies, conservation easements, habitat improvements (e.g., beaver dam analogs), crop changes, and other PMAs (see Chapter 4) represents a preferable and more realistic approach to meeting the minimum threshold set for this sustainability indicator. With these considerations, the Advisory Committee chose to set an operationally flexible minimum threshold.

The minimum threshold is **any portfolio of PMAs** that achieves an individual monthly stream depletion reversal **similar to, but not necessarily identical to, the stream depletion reversal achieved by the specific MAR-ILR scenario** presented to the Advisory Committee (Table 7). The **average stream depletion reversal** of the implemented PMAs during September–November must **exceed 15% of the depletion caused by groundwater pumping from outside the adjudicated zone in 2042 and thereafter**, where depletion is defined by the SVIHM "no-pumping outside the adjudicated zone scenario 1" described in the appendix. The average remaining stream depletion during September–November therefore must not exceed 85% of that achieved under the BAU scenario.

The average (relative) stream depletion reversal, the average remaining stream depletion, and all other "measurable" outcomes to be expected from PMA implementation are obtained through long-term SVIHM simulations encompassing at least 28 years of actual climate conditions (see Section 3.3.5.1). Because SVIHM is the "measurement tool", the expected outcome of a PMA or combination of PMAs can be obtained from simulation, without waiting for the actual implementation of PMAs and subsequent observation over a long time period. For the simulation "measurement", the time series of recent climate conditions that have actually occurred in the Scott Valley (a wide range of climate conditions), and the design of the PMA provide the required model input. The assessment and improvement process for SVIHM "measurements", also described in Section 3.3.5.1, ensures that SVIHM remains the appropriate tool for determining PMA outcomes, even under future climate and Basin conditions.

Since the minimum threshold reflects a reversal of an existing undesirable result, the management "glide-path" (sometimes considered for the gradual elimination of water level decline in basins in overdraft) is instead a "climbing-path" for this interconnected surface water SMC: a gradual increase in the minimum required stream depletion reversal (and gradual decrease in the maximum allowable remaining stream depletion) over time. **Due to the climbing-path, the minimum threshold of 15% stream depletion reversal only becomes enforceable under SGMA in 2042 and thereafter, when sustainable conditions must be achieved.**

Along the "climbing-path" of the interim twenty-year period, the GSP sets milestones that ensure that the GSA can meet and exceed MT conditions by 2042. **The milestones toward the final MT implementation in 2042 and thereafter are:**

- 2027: PMAs have been implemented that yield average relative stream depletion reversal of at least 5% (remaining stream depletion: no more than 95% of BAU).
- 2032: PMAs have been implemented that yield average relative stream depletion reversal of at least 10% (remaining stream depletion: no more than 90% of BAU).
- 2037: PMAs have been implemented that yield average relative stream depletion reversal of at least 15% (the 2042 MT; remaining stream depletion: no more than 85% of BAU).
- 2042: PMAs have been implemented that exceed the 2042 MT and show progress toward meeting the measurable objective.

By setting a milestone to achieve MT conditions no later than 2037, five years prior to the date set for the MT deemed to reflect sustainable groundwater conditions, the GSP provides a reasonable "climbing-path" toward a measurable objective that exceeds the MT and achieves the sustainability goal. **During the interim period, the GSA will use milestones to demonstrate that the GSA is on a path to compliance with the 2042 Minimum Threshold** (23 CCR Section 355.6(c)(1)).

Year	Depletion (cfs)
1991	36
1992	43
1993	40
1994	33
1995	35
1996	27
1997	17
1998	25
1999	45
2000	25
2001	36
2002	32
2003	34
2004	30
2005	13
2006	30
2007	33
2008	33
2009	35
2010	29
2011	27
2012	29
2013	32
2014	31
2015	22
2016	28
2017	28
2018	30

Table 7: Average of daily simulated stream depletion (cfs) due to groundwater pumping outside of the adjudicated zone, by calendar year. Stream depletion was computed using SVIHM, by comparing the base case scenario (calibrated historic model) against a scenario, for the same simulation period, in which no groundwater pumping occurred outside the adjudicated zone. Daily stream depletion [cfs] is the difference in simulated streamflow at the Fort Jones gauge between the no-groundwater pumping scenario (generally more flow) and the base scenario (generally less flow). Stream depletion due to groundwater pumping is currently not available for periods after 2018. SVIHM will be regularly updated during the GSP implementation to reflect more current conditions.

Water Year Type	Years	2042 Minimum Threshold for Total Depletion Reversed, Sep 1-Nov 30 (cfs)	Average Depletion Reversed, Sep-Nov (cfs)	IM for 2022	IM for 2027	IM for 2032	IM for 2037	IM for 2042
Dry	1991, 1992, 1994, 2001, 2009, 2013, 2014, 2018	20.60%	4.10	0	7%	14%	21%	21%
Below Avg	2002, 2004, 2005, 2007, 2008, 2010, 2012, 2015	11.20%	3.50	0	3%	7%	11%	11%
Above Avg	1993, 2000, 2003, 2011, 2016	9.50%	3.00	0	3%	7%	10%	10%
Wet	1995, 1996, 1997, 1998, 1999, 2006, 2017	18.60%	5.00	0	6%	12%	19%	19%

Table 8: Percent and average flowrate (cfs) of Total Stream Depletion (due to groundwater pumping in wells outside of the Adjudicated Zone), from Sep 1 to Nov 30, reversed by the “guiding” minimum PMA, Managed Aquifer Recharge and In-Lieu Recharge (MAR and ILR), categorized by water year type, and adjusted to the final 2042 minimum threshold of 15 percent. Water year type is based on quartiles of total flow recorded at the Fort Jones USGS flow gauge, water years 1977-2018 (where water years start Oct 1). IM indicates Interim Milestone, in units of Percent Depletion Reversed by PMAs, by water year type.

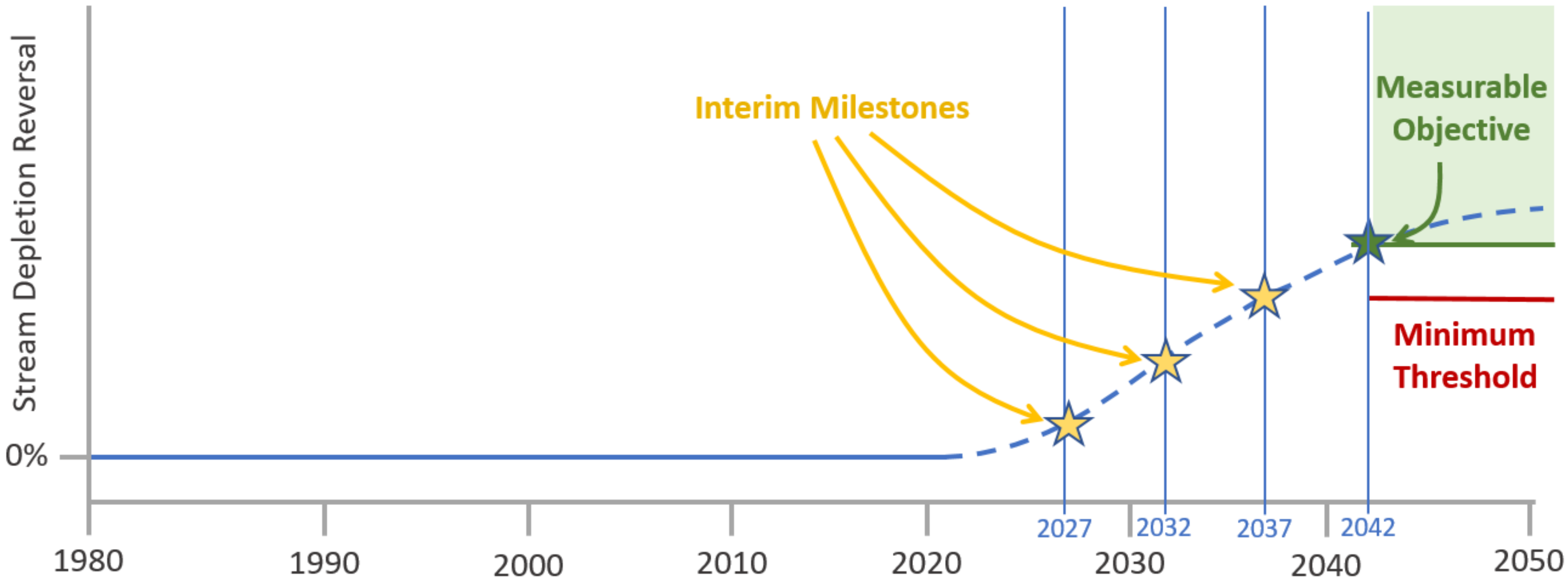


Figure 13: Conceptual outline of the sustainable management criteria for interconnected surface water (reversal of stream depletion due to groundwater pumping). Current Basin conditions indicate a need to improve conditions for fish and the GSP furthers that goal. Reversal of stream depletion is one action that can help achieve that goal. The minimum threshold for stream depletion reversal is higher than current or recent historic conditions. The minimum threshold deemed to reflect sustainable conditions will be effective from 2042 onward. Prior to 2042, interim milestones are set for 2027, 2032, and 2037. The interim milestone for 2037 is equal to the 2042 minimum threshold. The measurable objective represents a percentage of stream depletion reversal that exceeds the reasonable margin of operational flexibility for improving overall conditions in the basin. Graphic modified from California DWR, Draft Sustainable Management Criteria BMP, November 2017, Figure 15B.

3.4.5.3. Measurable Objectives

More than any other sustainable management criteria besides water quality, the interconnected surface water SMC is tightly linked to the water management efforts outside direct groundwater management. Managing the interconnected surface water SMC is part of a broader watershed portfolio of projects and management actions that engages multiple federal, state, and local agencies, NGOs, and volunteer groups. To be successful, implementation of the GSP for interconnected surface water must be closely integrated with these broader, collaborative water management efforts. To articulate the integrated water management characteristic of this SMC, the Measurable Objective is considered to be part of the overall, aspirational "watershed goal". The watershed goal constitutes a management objective covering all consumptive water uses as well as land management in the Scott Valley Basin and its surrounding watershed. Because the GSA has no legal authority over some of these uses, collaboration with surface water users in the Basin, with upland land managers, and with groundwater users in the Adjudicated Zone, as well as with local organizations and state and federal agencies will be necessary to work towards the aspirational watershed goal.

It is worth noting that the GSP regulations allow the GSA to consider using the MO as an aspirational goal by setting a MO that exceeds the reasonable margin of operational flexibility for improving overall conditions in the basin (23 CCR 354.30(g).), but this is not required. Nothing in SGMA otherwise precludes discussion of "aspirational" goals.

Consistent with the metrics for the minimum threshold, the measurable objective is defined as **any portfolio of PMAs** that achieves an individual monthly relative stream depletion reversal **similar to, but not necessarily identical to, the relative stream depletion reversal achieved by the specific MAR-ILR scenario** presented to the AC. The measurable objective is achieved when **average relative stream depletion reversal** of the implemented PMAs during September–November is **20% or above in 2042 and thereafter**, where depletion is defined by the SVIHM "no-pumping outside the adjudicated zone scenario 1" described in the appendix. The average remaining stream depletion during September–November, under the measurable objective, is 80% or less of that achieved under the BAU scenario. The difference between measurable objective (20% or above) and the minimum threshold (15%) provides for necessary operational flexibility in the implementation of PMAs. The range of the measurable objective (20% or above) is consistent with the aspirational watershed goal.

This measurable objective meets the legal requirement that the measurable objective must use the same metrics and monitoring tools as that used for setting the minimum threshold (23 CCR Section 354.30(b)). Implementation of the SMC is closely tied to the broader water management in the Basin and its surrounding watershed. To emphasize the desire to integrate the efforts of the GSA with other agencies' and groups' water management efforts, achieving the measurable objective will be part of a broader, albeit aspirational, integrated water management goal to establish appropriate, healthy stream and stream flow conditions. The implementation of the Plan contributes, in collaboration with other agencies and groups, to improving water temperatures and protecting public trust resources. This explicit linkage between the measurable objective with the aspirational watershed goal also provides flexibility for compliance with potential future regulations or actions, in an integrated water management approach.

3.4.5.4. Path to Achieve Measurable Objectives

The GSA will support achievement of the measurable objective by conducting monitoring related to interconnected surface water, including streamflow monitoring and collaboration with entities that conduct biological monitoring for the environmental beneficial uses and users of interconnected surface water in the Basin. PMAs to reverse surface water depletion and ensure compliance with the minimum threshold will be undertaken by the GSA, either as the lead agency, or as a project partner. The GSA will review and analyze data, and update the model to evaluate any changes in depletion of surface water due to groundwater pumping or

PMA implemented in the Basin. Using monitoring data collected as part of GSP implementation, the GSA will develop information to demonstrate that PMAs are operating to maintain or improve conditions related to the depletion of interconnected surface water in the Basin and to avoid undesirable results. Should the minimum threshold be exceeded, the GSA will implement measures to address this occurrence.

To manage depletion of interconnected surface water, the GSA will partner with local agencies and stakeholders to implement PMAs. PMAs are presented in further detail in Chapter 4. Implementation timelines and approximate costs are discussed in Chapter 5.

The GSA may choose to conduct additional or more frequent monitoring. The need for additional studies on depletion of interconnected surface water will be assessed throughout GSP implementation. The GSA may identify knowledge requirements, seek funding, and help to implement additional studies.

3.4.5.5. Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

The minimum threshold is defined in terms of modeled monthly stream depletion reversal for climate period 1991-2018 conditions under proposed PMAs. This is measured with the SVIHM, simultaneously in percent of Total Depletion reversed, in cubic-feet-per-second (cfs), and in year-specific number of days gained in the spring recess flow and fall pulse flow for specific flow thresholds (e.g., 10 cfs, 20 cfs, 30 cfs, or 40 cfs) at the simulated Fort Jones gauge. A detailed discussion of interconnected surface water and groundwater dependent ecosystems in the Basin is described in Section 2.2.1.7. In establishing minimum thresholds for depletion of interconnected surface water, the following information was considered:

- Feedback on concerns about depletion of interconnected surface water and feasibility of PMAs from stakeholders.
- An assessment of interconnected surface water in the Basin.
- Results of the numerical groundwater model, which was used to calculate surface water depletion under a variety of scenarios.
- Input from stakeholders resulting from the consideration of the above information in the form of recommendations regarding minimum thresholds and associated management actions.

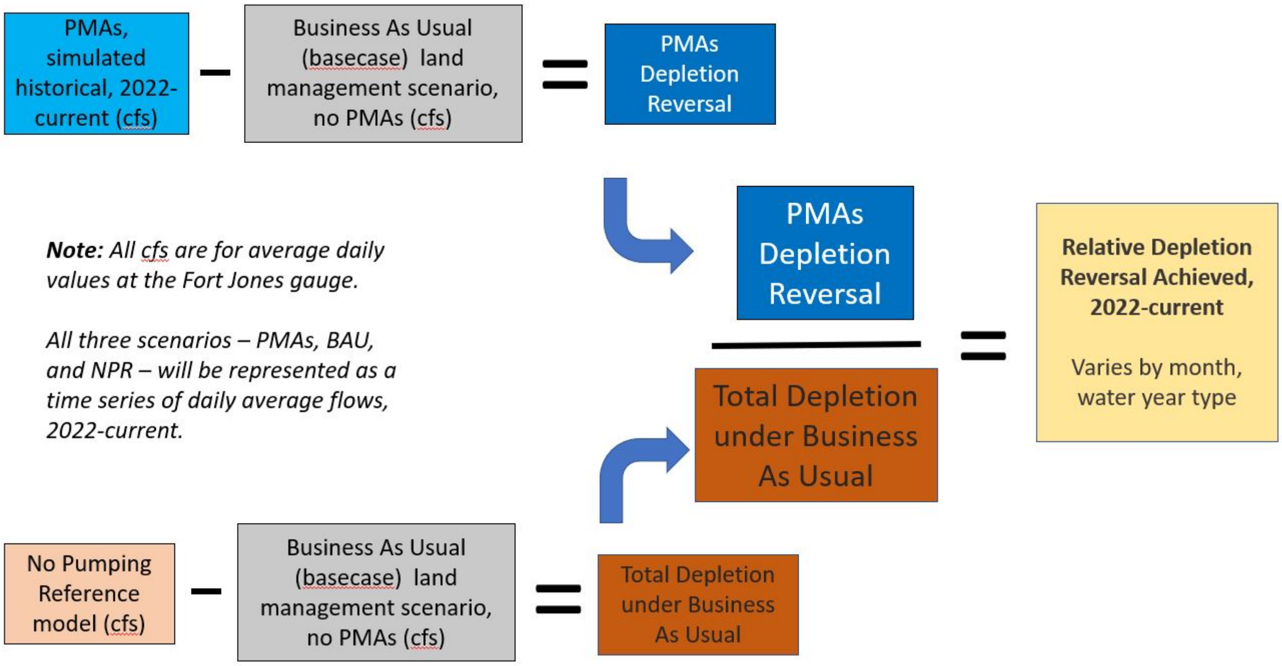
The minimum thresholds were selected based on results of scenarios, modeled using SVIHM, used to identify a realistic and reasonable amount of surface water depletion that can be achieved through the proposed PMAs. The proposed PMAs included in the scenarios to improve the decline in spring flow recession, summer and fall baseflow conditions, and the onset of the fall flush flow in dry and some average years, individually and in combination were:

- Winter and spring managed aquifer recharge.
- Beaver dam analogues and other fish-friendly structures.
- Changes in irrigation technology or crop type.
- Surface water storage.
- Seasonal pumping restrictions in the non-Adjudicated Zone.
- Voluntary pumping restrictions in the Adjudicated Zone.
- Conservation easements that would limit irrigation in some or all water years.
- An expanded surface water leasing program.

Along with Depletion Reversal for specific scenarios of PMAs, other output of SVIHM was also used to compute and present other relevant project outcome metrics important to understanding and assessing the project and management action benefits to streamflow. Information considered by the Advisory Committee include:

- The ratio of Depletion Reversal and Total Depletion, which is the **“Relative Depletion Reversal”**, measured in percent. The computation of this value is shown in Figure 14.
- Streamflow on any given day and location, a metric relevant to measure environmental outcomes.
- The number of days gained in stream connectivity in dry and some average years, both in the summer after the end of the spring flow recession, and in the fall when streamflow increases for the fall flush.
- Other relevant metrics including the timeseries of relative streamflow increase and simulated streamflow.
- Evaluation under Future Climate Conditions: The Total Depletion under future climate conditions, as well as the Depletion Reversal under future climate conditions, can be modeled in the same way as for the 1991-2018 models, using future climate data and DWR’s protocol for simulating climate change conditions.
- Uncertainty Analysis: SVIHM also allows for uncertainty analysis in predicting Total Depletion, as well as Depletion Reversal for specific projects and management actions under current or future climate conditions.
- For each group of projects and management actions that are implemented, the Depletion Reversal is a measure of the amount of surface water depletion that is reversed relative to business as usual (BAU) conditions. PMAs are therefore – through SVIHM – inextricably, deterministically, and directly linked to specific “measured” outcomes: streamflow, streamflow gains, Depletion Reversal, Relative Depletion Reversal, number of days gained in stream connectivity, etc.

A full portfolio of the scenarios and results are included in Appendix 4-A.



Note: *All cfs are for average daily values at the Fort Jones gauge.*

All three scenarios – PMAs, BAU, and NPR – will be represented as a time series of daily average flows, 2022-current.

Figure 14: Computation of the Relative Depletion Reversal as the ratio of Depletion Reversal (due to PMAs) and Total Depletion. The graphic also shows the computation of the Total Depletion and the Depletion Reversal as defined above. The Relative Depletion Reversal is a unitless fraction. Multiplied by 100, it has units of percent. PMAs may lead to less than 100 percent Relative Depletion Reversal, or even more than 100 percent Relative Depletion Reversal. Just like Total Depletion and project or management action-specific Depletion Reversal, the Relative Depletion Reversal varies from day to day.

3.4.5.6. Relationship to Other Sustainability Indicators

Minimum thresholds are selected to avoid undesirable results for other sustainability indicators. Depletion of interconnected surface water is a complex function of groundwater storage and groundwater level dynamics that are in turn the result of groundwater pumping patterns. The relationship between depletion of interconnected surface water minimum thresholds and minimum thresholds for other sustainability indicators are discussed below.

- **Groundwater Level** – depletion of interconnected surface water occur in conjunction with decreases in groundwater levels measured in shallow groundwater wells, relative to the (unmeasured) conditions under no-pumping or less-pumping. Minimum thresholds for groundwater levels may serve to avoid significant additional stream depletion due to groundwater pumping but are insufficient as a tool to manage the interconnected surface water sustainability indicator. Vice versa, the minimum threshold for interconnected surface water is protective of groundwater levels and supports achievement of the groundwater level SMC.
- **Groundwater Storage** – depletion of interconnected surface water are related to groundwater storage in a similar way as they are related to water level changes.

- **Seawater Intrusion** – This sustainability indicator is not applicable in this Basin.
- **Groundwater Quality** – groundwater quality is not directly related to depletion of interconnected surface water.
- **Subsidence** – depletion of interconnected surface water are related to subsidence in a similar way as they are related to water level changes. The minimum threshold for interconnected surface water will avoid significant lowering of water levels and thus also avoid subsidence.

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