Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act
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This factsheet is intended to be a resource for community water decision makers who are engaged in the implementation of the Sustainable Groundwater Management Act (SGMA) and are interested in learning about best management practices for addressing drinking water concerns.

Why is Protecting Groundwater Quality Important?
Groundwater is an important resource that we depend on to drink, bathe, grow food, and more. In the Southern San Joaquin Valley, over 95% of drinking water users depend on groundwater, at least in part, and many communities depend on it entirely (Balazs et.al, 2011). Groundwater can become contaminated through the use of man-made chemicals, fertilizers, or improperly managed waste facilities as well as naturally-occurring elements in soils and sediments. Contaminated drinking water can cause both acute and long-term health impacts and affect the long-term viability of the impacted regions. Some of the most common drinking water contaminants found in the San Joaquin Valley are nitrate, arsenic, chrom-6, uranium, 1,2,3-TCP (1,2,3-Trichloropropane), DBCP (1,2-Dibromo-3-chloropropane), and bacteria. For more information on the human health impacts of each of these contaminants, visit: www.communitywatercenter.org/guides_and_factsheets.

How Does the Sustainable Groundwater Management Act (SGMA) Protect Drinking Water?
Through the implementation of SGMA, local groups called Groundwater Sustainability Agencies (GSAs) are developing Groundwater Sustainability Plans (GSPs or Plans) that specify how they will sustainably manage groundwater in their areas. Plans must avoid six undesirable results within the basin: chronic lowering of groundwater levels; degraded water quality; depletion of interconnected surface water; reduction of

1 Note: Community Water Center periodically updates our factsheets based upon information provided by the State Water Resources Control Board and the Office of Environmental Health Hazard Assessment (OEHHA). See https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.html or visit https://oehha.ca.gov/water/public-health-goals-phgs
groundwater storage; seawater intrusion; and land subsidence. For each of these six undesirable results, GSAs are required to set minimum thresholds and measurable objectives for how their GSP will avoid the undesirable results and for how they will measure progress towards their goals. See section on Planning and Setting Sustainable Criteria for more information. GSAs in basins that are identified as high or medium priority critically overdrafted will be submitting their GSPs to the Department of Water Resources (DWR) by January 31, 2020.

GSPs must identify groundwater quality issues including known groundwater contamination locations and must also collect data from each aquifer to determine groundwater quality trends. Data gaps must be identified and addressed. When developing minimum thresholds and measurable objectives for degraded water quality, GSAs must consider existing drinking water standards and identify drinking water supply wells in order to monitor for degradation of drinking water sources. See Box 1 for a selection of provisions required by DWR GSP regulations regarding drinking water quality.

How can Groundwater Pumping or Recharge Affect Groundwater Quality?

Groundwater pumping can change the movement of groundwater and cause contaminant plumes to move toward or away from drinking water wells (See Figure 1). Over-pumping can also cause subsidence which in turn can result in the release of some naturally-occurring contaminants such as arsenic and uranium.

While groundwater recharge can have positive water quality impacts by diluting contaminants (See Box 3), if not properly designed, recharge projects may mobilize pesticides and fertilizers, resulting in negative water quality impacts. As a basin is recharged, the recharged water can push contaminants in the vadose zone or shallow groundwater, deeper into the aquifer, impacting drinking water supplies.

For more information on how naturally-occurring contaminants such as arsenic, uranium, and chromium enter groundwater from soils and sediments and what actions can be taken to prevent, limit, or reverse these impacts, consult the factsheet, Groundwater Quality in the Sustainable Groundwater Management Act (SGMA) Scientific Factsheet, developed with Stanford University.

Box 1: Key Groundwater Sustainability Plan Regulations Related to Drinking Water Quality

SGMA requires that groundwater be managed in a way that avoids undesirable results including “significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water quality.” (Water Code Section 10721(x)(4)). Below are requirements for GSPs to address water quality.

Groundwater Conditions:
“Each Plan shall provide a description of current and historical groundwater conditions in the basin, including... groundwater quality issues that may affect the supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes.” (23 CCR 354.16(d)).

Monitoring Network:
“Each monitoring network shall be designed to accomplish the following for each sustainability indicator: ...Degraded Water Quality: Collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues.” (23 CCR 354.34(c)(4)).

“Monitoring network objectives shall be implemented to accomplish the following: (1) Demonstrate progress toward achieving measurable objectives described in the Plan. (2) Monitor impacts to the beneficial uses or users of groundwater. (3) Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds. (4) Quantify annual changes in water budget components.”(23 CCR 354.34(c)(4)).

Minimum Threshold:
“The minimum threshold for degraded water quality shall be the degradation of water quality, including the migration of contaminant plumes that impair water supplies or other indicators of water quality as determined by the Agency that may lead to undesirable results. The minimum threshold shall be based on the number of supply wells, a volume of water, or a location of an isocontour that exceeds concentrations of constituents determined by the Agency to be of concern for the basin. In setting minimum thresholds for degraded water quality, the Agency shall consider local, state, and federal water quality standards applicable to the basin.” (23 CCR 354.28(c)(4))
Recommendations for Groundwater Sustainability Plans (GSPs) to Protect Drinking Water Supplies

Understanding Baseline Conditions and Developing Monitoring Networks

GSAs are required to document current baseline conditions in their basins including the location of groundwater contamination sites and plumes. SGMA also requires GSAs to develop and implement a monitoring network to determine if management is impacting beneficial uses, including drinking water.

Baseline Conditions

GSAs must identify and map all available spatial and temporal data on drinking water sources and contaminants in the basin. At a minimum, the following drinking water datasets need to be included:

- All individual private domestic well information from US Geological Survey (USGS), Regional Water Quality Control Board data including on-farm domestic well results from the Irrigated Lands Regulatory Program (ILRP) if location information is available, and Groundwater Ambient Monitoring and Assessment Program (GAMA). GAMA now has groundwater quality data that can be filtered by GSA boundaries;
- All data collected by local county health departments for state or local small water systems and private domestic wells;
- Public water system data from the State Water Resources Control Board (SWRCB or State Water Board).

Monitoring Networks

- GSAs must monitor all contaminants found in public water systems or private wells in concentrations above the public health goals as established by the Office of Environmental Health Hazard Assessment (OEHHA) to establish whether there is a trend of increasing concentration over time.²

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³ Note: See OEHHA website for more information on public health goals (PHGs) https://oehha.ca.gov/water/public-health-goals-phgs.
• Identify data gaps and develop a plan for additional monitoring to fill in gaps. Common data gaps for drinking water include:
  > Location, number, and the average depth of private domestic wells;
  > Water quality of private domestic wells;
  > Water quality of state and local small water systems (only bacteria and occasional nitrate levels available in some counties);
  > Unregulated contaminants in drinking water;
  > Depth-specific water quality data.

• Develop a groundwater quality monitoring program that is fully integrated with other regulatory programs and agencies (Irrigated Lands Regulatory Program (IRLP), Integrated Regional Water Management (IRWM), and Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS)). Develop data sharing agreements with all entities that monitor drinking water sources as well as threats to drinking water (e.g. Superfund and other hazardous waste sites). This will facilitate regular updates to the monitoring network.

• Develop transparent data management protocols to inform all stakeholders of water quality trends in the basin.

Planning and Setting Sustainable Criteria
GSAs need to establish sustainable management criteria that indicate what values they will use to measure progress. These indicators include: undesirable results, minimum thresholds, measurable objectives, and establishing triggers.

Undesirable Results
In developing GSPs, GSAs must establish what are significant and unreasonable impacts for each of the six undesirable results and how those impacts are related to the minimum thresholds that GSAs establish. Groundwater quality impacts are undesirable when they harm any beneficial use of the groundwater. A groundwater condition is considered an undesirable result if X amount of minimum thresholds have been exceeded. GSAs must consider impacts to all drinking water supply wells including private domestic wells, municipal wells, and small community wells. An example of a possible approach for this undesirable result is:

• X% of wells have exceeded the minimum threshold for groundwater quality with increased contamination and degradation of groundwater caused either as a result of the movement of contaminant plumes, through impacts of recharge projects, or through the lowering of groundwater levels.

Minimum Thresholds
A minimum threshold is a quantifiable number that indicates the lowest possible degree of impact, or failure point, that the GSA will allow to occur for each undesirable result. In determining the minimum threshold for groundwater quality, GSAs will need to consider information about existing drinking water conditions in the area and choose a threshold that is protective of drinking water sources. Once current groundwater quality conditions are identified for the key contaminants in the area, GSAs should compare baseline conditions to the maximum contaminant levels (MCLs) for key contaminants such as nitrate,

Note: The SWRCB issues health-based advisory levels and monitoring requirements for some unregulated contaminants in drinking water. More about unregulated contaminants here: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.html
arsenic, uranium, 1,2,3-TCP, and DBCP. MCLs are the legal limit for a contaminant in drinking water adopted by the State Water Board. Below are recommendations for groundwater quality minimum thresholds:

- If baseline groundwater quality conditions are significantly below (less than 75%) the MCL for the known contaminants, GSAs could utilize the baseline groundwater quality conditions to establish a minimum threshold at that current level or could set the minimum threshold at 75% of the MCL. Setting the minimum threshold at 75% of the MCL is helpful because it allows the GSA an opportunity to implement strategies to address the degradation of groundwater before the exceedance of the MCL occurs. Acting earlier is helpful because it could help avoid the high costs of providing safe drinking water to drinking water users whose wells have exceeded the MCL as a result of groundwater management actions.

- If baseline groundwater quality conditions are near, or exceed, existing MCLs for known contaminants, GSAs could consider aligning their monitoring and management actions to allow them to be able to meet a minimum threshold at 75% the MCL over the 50-year horizon. GSAs would monitor groundwater quality trends to ensure that naturally occurring contaminants, like arsenic and uranium, are not exacerbated through groundwater management practices. For man-made contaminants, like nitrate and 1,2,3-TCP, the local Regional Water Quality Control Board (RWQCB) has the authority to indicate how the MCL exceedances of those contaminants will be remediated. In this situation, GSAs could also consider working with local and regional water agencies or the county to implement groundwater quality remediation projects that could improve both groundwater quality as well as groundwater levels.

- In developing minimum thresholds, GSAs could also consider developing drinking water management zones (see Box 2) to implement more stringent minimum thresholds for drinking water contaminants near cities, smaller communities, and clusters of domestic well reliant households.

- Though GSAs are allowed to use groundwater elevation as a proxy for the minimum thresholds of all undesirable results, SGMA requires that the GSA demonstrate that the value being used is a “reasonable proxy” for minimum thresholds and is “supported by adequate evidence” (23 CCR 354.28(d)). If the relationship between groundwater elevation and groundwater quality is not supported by scientific evidence, DWR may consider the GSP incomplete. CWC recommends that GSAs establish a minimum threshold for groundwater quality using actual contaminant levels and MCLs of known key contaminants. Using MCLs allows for more accurate monitoring, measuring, and quantifying of groundwater quality trends and helps facilitate more effective collaboration and data sharing between different groundwater quality programs and groundwater quality monitoring networks.

**Measurable Objectives**

Measurable objectives are success goals that the GSA will work towards through projects and management actions. Measurable objectives are related to the sustainable yield, which is the maximum amount of groundwater that can be withdrawn without causing undesirable results. By 2040 (or 2042), groundwater basins are required to reach a sustainable yield and measurable objectives are useful indicators for GSAs to measure progress towards achieving sustainable yield. For more guidance on setting measurable objectives, visit the Union of Concerned Scientists’ *Measuring What Matters: Setting Measurable Objectives to Achieve Sustainable Management*. 

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Setting Protective Triggers

SGMA regulations do not require GSAs to establish triggers but they are a very useful warning system that can help the GSA avoid exceeding their minimum thresholds. When setting protective triggers, GSAs can utilize adaptive management strategies by collecting data and adjusting their management actions and projects to prevent or address possible concerns before surpassing the minimum threshold. Taking action to address concerns early on can ensure drinking water is protected and that costly remediation measures are avoided.

- GSAs should monitor contaminant levels over time to establish the rate of increase or decrease of a contaminant in order to predict future water quality. GSAs could then consider using degradation (or the rate of increase in a contaminant) as a trigger. If a constituent shows a pattern of increasing concentration that could lead to an exceedance of a trigger level in the 50-year planning horizon, the GSP should identify measures to avoid that impact.

- An example of a trigger could be: 50% of monitoring wells in a management zone have exceeded the minimum threshold for arsenic.

Management Actions and Projects

In order for GSAs to achieve sustainability and avoid undesirable results, they will need to implement management actions and projects. Below are some recommendations:

When implementing preventative measures:

- Consider working with counties to develop well ordinances that prevent drinking water wells from being drilled in areas with known contaminants or are drilled deep enough or screened at levels to avoid contaminant plumes. Encourage counties to collect better well-drilling information to improve GSA’s characterization of the basin.

When implementing projects:

- Prior to implementing any recharge project, collect soil and groundwater quality data to identify the level of residual nitrate, pesticides, and fertilizers that may be present in the earth below the land surface and above the groundwater aquifer (upper vadose zone). Also, collect information about naturally occurring contaminants, bicarbonate, and oxygen present in the potential recharge zone. If there are known contaminants in the potential recharge area, the project should be implemented to prevent adverse results or possibly improve the groundwater quality conditions. See Box 3 of this factsheet as well as Stanford’s Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium for more information.

When addressing current groundwater quality challenges:

- GSAs can work actively with local drinking water agencies as well as regional and state regulatory agencies to address water quality problems. In situations where groundwater management actions have affected groundwater quality, GSAs can consider mitigation strategies such as: drinking water treatment, consolidating nearby drinking water systems, or financially supporting the extension of drinking water services to domestic well owners near drinking water systems. For an example of mitigation strategies, see Box 2.
Box 2: Developing Management Zones to Protect Community Drinking Water Supplies

In GSPs, GSAs are able to determine areas where there is particular sensitivity to one or more undesirable result(s) and develop a management zone to address this sensitivity. Depending on the available data, size, and the geography of vulnerable drinking water communities, a management zone could be a beneficial tool.

- Management zones can have separate minimum thresholds and measurable objectives that are protective of vulnerable community drinking water supplies. By customizing sustainability criteria near communities, GSAs are able to implement triggers below or at 75% the known maximum contaminant levels (MCL) for existing contaminants in order to better monitor and reduce the risk of impacts to human health.

- Management zones can be used to designate areas vulnerable to groundwater depletion as well. In areas where groundwater elevation is significantly lower than other areas in the GSA's planning area, where there are significant differences in hydrogeologic properties, or where there is a higher concentration of domestic well households, implementing higher minimum thresholds and enacting stricter pumping rules could help the GSA reach sustainability in the long term.

Box 3: Recommendations for Recharge Projects to Limit Impacts on Drinking Water Supplies

Water Quality Considerations

Groundwater recharge projects can have multiple benefits such as increasing groundwater storage and levels, as well as diluting contaminant plumes and improving groundwater quality. However, if not properly designed, recharge projects may mobilize nitrates, pesticides, and fertilizers, as well as naturally occurring contaminants, and can lead to the further degradation of groundwater quality, impacting drinking water wells.

In order to address the possibility of worsening groundwater quality conditions, fertilizers and pesticides need to be managed appropriately to ensure that residual levels in soils are low at the time of recharge. It is also worth noting that certain crops require more fertilizers and pesticides than others and this should be taken into account when considering potential recharge areas. Below are some key recommendations to ensure that recharge projects are generating multiple benefits, including protecting or improving drinking water conditions.

Recommendations for Recharge Projects

1. When selecting sites for on-farm recharge projects, GSAs can work with growers who are implementing some or all of the following in order to minimize the mobilization of pesticides and fertilizers:
   - Using best management practices that optimize chemical use so residuals do not enter recharge water;
   - Growing crops that require fewer fertilizers (e.g. legumes);
   - Recharging during winter months (when less/no fertilizer is being used);
   - Minimizing fall applications of fertilizers and pesticides;
   - Not surrounded by dairy operations.

1. When implementing on-farm recharge projects, recharge on the same plot of land annually for a consecutive number of years in order to most effectively flush out and dilute residual contaminants (especially nitrate) left behind from previous applications. Continued flushing will also help reduce bicarbonate, calcium, and organic carbon transport which will limit their impact on the dissolution and release of uranium and/or arsenic.

2. Prior to implementing any recharge project, identify all nearby drinking water wells (both public supply and private wells). Additional monitoring wells that collect groundwater quality samples may need to be installed in key areas to protect public health.

3. Prior to implementing any recharge project, collect data to characterize the upper soil zone and groundwater quality, including the amount of fertilizer applied and any naturally occurring contaminants present in the soil. Monitor and adjust the quality of water being recharged in order to limit the mobilization of naturally occurring contaminants (e.g. monitoring oxygen, pH, electrical conductivity, and nitrate levels).

4. Consider recharging through excavated points, ditches/canals, and other designated recharge basins in order to bypass soil layers with naturally occurring contaminants, pesticides, and/or nitrate.
Box 4: Multi-Benefit Recharge Project to Improve Community Drinking Water Supplies

Agencies involved: Tulare Irrigation District, Okieville-Highland Acres Community Services District, and Self-Help Enterprises

The agencies listed above are currently undertaking steps to develop and implement a recharge basin near Okieville to improve the community’s water quality and increase groundwater recharge in the basin. This idea began when Self-Help Enterprises discovered high nitrate levels in the northern part of the community of Okieville. The southern part of the community had good water quality conditions due, in part, to an existing groundwater recharge project implemented by Tulare Irrigation District and the Kaweah Delta Water Conservation District. After discovering this, Tulare Irrigation District, the Okieville community, and Self-Help Enterprises began to develop a groundwater recharge project northeast, and upgradient, of the community that would aim to provide an improved sustainable water supply for the community.

The project is anticipated to be a 20-acre recharge basin that will include a monitoring network and a study that will look at both water supply and water quality impacts in an attempt to develop a strategy for implementing recharge basins in, and around, communities to provide groundwater quantity and quality benefits. This project is an example of how multi-benefit projects can be developed and implemented to reach sustainability. When developing potential projects, GSAs must consider whether the projects could be strategically placed to improve groundwater quality for nearby communities.

How Will my GSA Fund These Projects?

GSAs will be developing their own individual approach for funding both the administrative costs of maintaining the GSA, as well as costs associated with implementing management actions and projects. Some GSAs will be asking their member agencies to contribute a certain fee; other GSAs will be implementing land-based fee assessments using Proposition 26; others will be using different combinations of fee structures. In addition to the fees GSAs collect, there are a number of funding sources available to provide financial assistance for implementing multi-benefit projects that could improve both groundwater quality and supply conditions. Some potential sources:

- The SWRCB has several programs that can fund management and treatment of nitrate and other contamination problems; some of those programs are specifically for disadvantaged communities. A few example programs include: Proposition 1 Groundwater Grant Program and Prop 68 Groundwater Treatment and Remediation Grant Program.
- DWR also has funding for groundwater projects and technical assistance programs to aid SGMA implementation.
- Implementation of a new proposed Central Valley basin plan amendment on salts and nitrates may result in additional funding sources for nitrate contaminated aquifers. Where appropriate, GSAs should coordinate with nitrate dischargers forming a Management Zone under CV-SALTS in order to streamline administrative costs and leverage resources.

5 Note: Proposition 26 expands the definition of taxes to include fees and charges for health, environmental, social, and economic concerns. For more information: http://www.cacities.org/Prop218andProp26
6 Note: For more information on the SWRCB funding program visit: www.waterboards.ca.gov. For specific funding programs: Proposition 1 Groundwater Grant Program: www.waterboards.ca.gov/water_issues/programs/grants_loans/proposition1/groundwater_sustainability Prop 68 Groundwater Treatment and Remediation Grant Program: www.waterboards.ca.gov/water_issues/programs/grants_loans/propositions/prop68
7 Ibid.
8 Note: For more information about CV-SALTS and the CV Basin Plan Amendment, see CWC’s CV-SALTS factsheet at https://bit.ly/2FMSC5Z
ACRONYMS:

1,2,3-TCP: 1,2,3-Trichloropropane
DBCP: 1,2-Dibromo-3-chloropropane
CWC: Community Water Center
CV-SALTS: Central Valley Salinity Alternatives for Long-Term Sustainability
DWR: Department of Water Resources
GAMA: Groundwater Ambient Monitoring and Assessment Program
GSA: Groundwater Sustainability Agency
GSP: Groundwater Sustainability Plan
ILRP: Irrigated Lands Regulatory Program
IRWM: Integrated Regional Water Management Program
MCL: Maximum Contaminant Level
OEHHA: Office of Environmental Health Hazard Assessment
RWQCB: Regional Water Quality Control Board
SGMA: Sustainable Groundwater Management Act
SWRCB or SWB: State Water Resources Control Board or also referred as State Water Board
USGS: US Geological Survey

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REFERENCES and ADDITIONAL RESOURCES:


Community Water Center’s Drinking Water Vulnerability Tool — To be released Winter 2019


Groundwater Exchange: https://groundwaterexchange.org


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