



California 
WATER COMMISSION

**A State Role in Supporting Groundwater Trading
with Safeguards for Vulnerable Users:
Findings and Next Steps**

May 2022

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Executive Summary

In those parts of California where groundwater pumping has long exceeded replenishment, people are striving to bring groundwater basins into sustainable conditions within 20 years, between 2040 and 2042, as the Sustainable Groundwater Management Act (SGMA) requires. In some areas, groundwater sustainability agencies (GSAs) – the local agencies tasked with sustainable groundwater management – are beginning to work with other entities and stakeholders to discuss and experiment with the idea of giving groundwater pumpers allocations – allowances to remove a certain amount of water from a groundwater basin – and allowing them to either use their allocation individually or trade allocations between specified parties. Ideally, groundwater trading could ease the economic disruption of cutting back the overall amount of water pumped from a groundwater basin; growers who have less need for pumping could sell their allocation to others willing to pay for it, helping buyers keep their operations functional while compensating sellers. But the concept of groundwater trading raises many questions: How would wetlands, streams, and other ecosystems fed by aquifers be treated in a groundwater trading program? Would operators of farms who lack the resources of larger neighbors be able to benefit from trading? How might trading affect people who depend upon a household well or communities that need reliable groundwater supplies for homes and businesses? How can GSAs work with local stakeholders to develop, implement, and oversee trading programs that help with sustainable groundwater management? There is a State interest behind all of these questions – and a clear need for a focused discussion about groundwater trading.

The Water Resilience Portfolio, finalized in July 2020 by the Newsom Administration, acknowledges that need by calling on State agencies to create flexibility for groundwater sustainability agencies to trade water within basins by enabling and incentivizing transactional approaches, including groundwater markets, with rules that safeguard natural resources, small- and medium-size farms, and water supply and quality for disadvantaged communities. In March 2021, State water leaders asked the California Water Commission (Commission) to utilize its public forum to gather expert and public input and investigate what role California agencies should take to support the local agencies that are turning to groundwater trading as a flexible tool to help them bring basins into sustainable conditions.

Through extensive outreach and input that involved learning from the experience of others around the state, country, and world, the Commission has framed the basic elements of well-functioning, protective groundwater trading programs. Those elements start with trust, access to accurate data, and a sound, well-implemented groundwater sustainability plan that has fully considered all beneficial groundwater users when setting sustainable conditions. Groundwater trading will only help achieve sustainable groundwater management in areas that have capped groundwater use; that have a system for tracking and accounting for groundwater levels, quality, and use; and that have allocated how much groundwater can be used by individual pumpers to reach a sustainable groundwater condition while avoiding undesirable results. Not all GSAs will opt to develop groundwater trading programs.

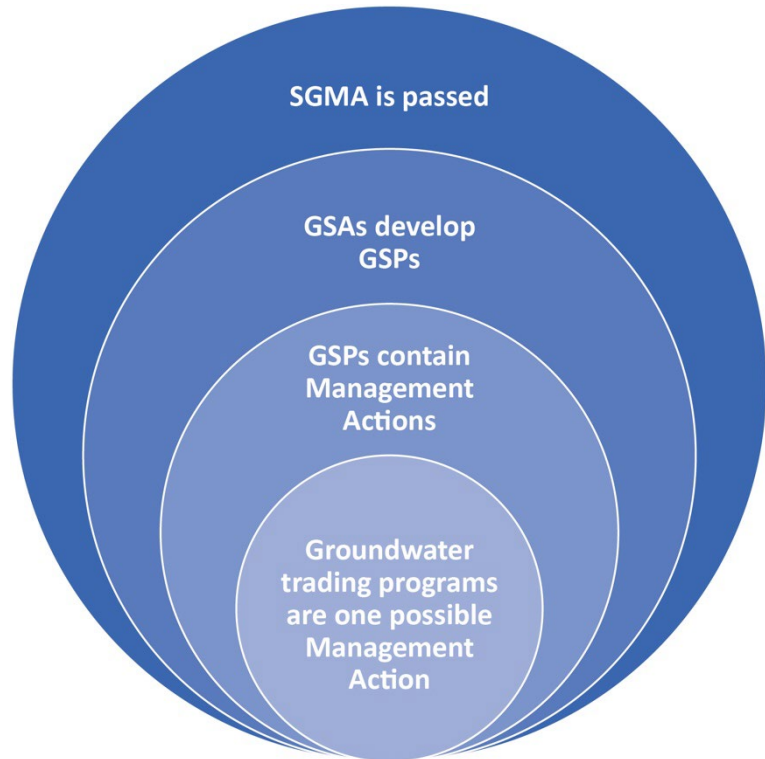
Without good governance in place and a careful, thoughtful approach to groundwater trading, trading programs run the risk of not meeting their goals and creating negative, third-party impacts. To protect natural resources, small- and medium-sized farms, and disadvantaged communities (taken together, “vulnerable users”), GSAs that decide to develop groundwater trading programs should incorporate specific, locally relevant mechanisms and trading rules, such as buffer zones or special management areas, that direct how and when trading occurs to avoid negative impacts. These mechanisms must be informed through inclusive stakeholder engagement, selected and evaluated through an iterative and

transparent process, modified as needed, and effectively enforced. No trading system will be instantly perfect – it will take time and vigilance for a GSA to develop a program that meets local needs, includes necessary protections, ensures compliance, and advances relevant State policies. The endeavor initially may be uncomfortable for many stakeholders. By starting with small-scale trading programs, GSAs can more easily adapt their efforts, modifying programs to ensure that they are functioning efficiently without causing harm.

Locally driven groundwater trading programs have the potential to be an important tool for managing reduced groundwater pumping – and implementing SGMA – in California. If done well, groundwater trading can provide a voluntary, flexible tool to help alleviate the economic burden of using less groundwater. Local entities, including community members and local water agencies, are, with the support of experienced advisors, best positioned to establish trading programs that work for their communities and local conditions. State authority to develop rules or oversee trading programs within basins is limited, but the Commission suggests that State agencies can play an important role in promoting groundwater trading with appropriate safeguards for vulnerable users. A State role could include disseminating information about where groundwater trading is being considered or used in California, developing best management practices, providing technical and financial assistance, creating incentive programs, hosting forums to further understanding, and engaging stakeholders to better recognize their concerns and fill information gaps. State agencies should also stand ready to administer additional authorities if the State Legislature finds stronger oversight is needed. It is the Commission’s hope that this white paper will provide implementers and stakeholders a broad overview of the potential promises and pitfalls of groundwater trading and chart possible next steps for State agencies. By moving forward carefully and deliberately and in partnership with local implementers and stakeholders, the State can help foster groundwater trading that builds water resilience for all Californians.

Introduction

In 2014, halfway through California’s 2012 to 2016 drought cycle, the California Legislature passed the Sustainable Groundwater Management Act (SGMA), laying out a means of stewarding the state’s groundwater resources in perpetuity. SGMA gives local groundwater sustainability agencies (GSAs) the authority and responsibility to manage and allocate groundwater resources within a basin. SGMA requires that GSAs develop, submit to the Department of Water Resources (DWR), and follow groundwater sustainability plans (GSPs) that describe the groundwater basin setting, determine a groundwater budget, create management criteria for monitoring and evaluating sustainability, and outline projects and management actions that will bring the basin into sustainability. Under SGMA, GSAs must achieve their sustainability goals, operating to a sustainable yield while avoiding undesirable results, within 20 years (by 2040 or 2042, depending on the basin).



Groundwater trading is one voluntary management action that a GSA could decide to employ to aid in the management of groundwater. There is potential for groundwater trading to be used broadly by GSAs. Of the 46 GSPs submitted by the 2020 SGMA deadline, approximately 19 note that the submitting GSAs will be or are considering setting up a groundwater trading program. To date, several GSAs are already developing trading programs and the current drought may be hastening their timelines (see Appendix 1: Status of SGMA Groundwater Trading Programs in California). Sixty-three of the non-critically overdrafted high- and medium-priority groundwater basins submitted GSPs to DWR in January of 2022; some number of these basins could also include in their GSPs the intent to use groundwater trading. The decision to design and implement a groundwater trading program rests solely with GSAs.

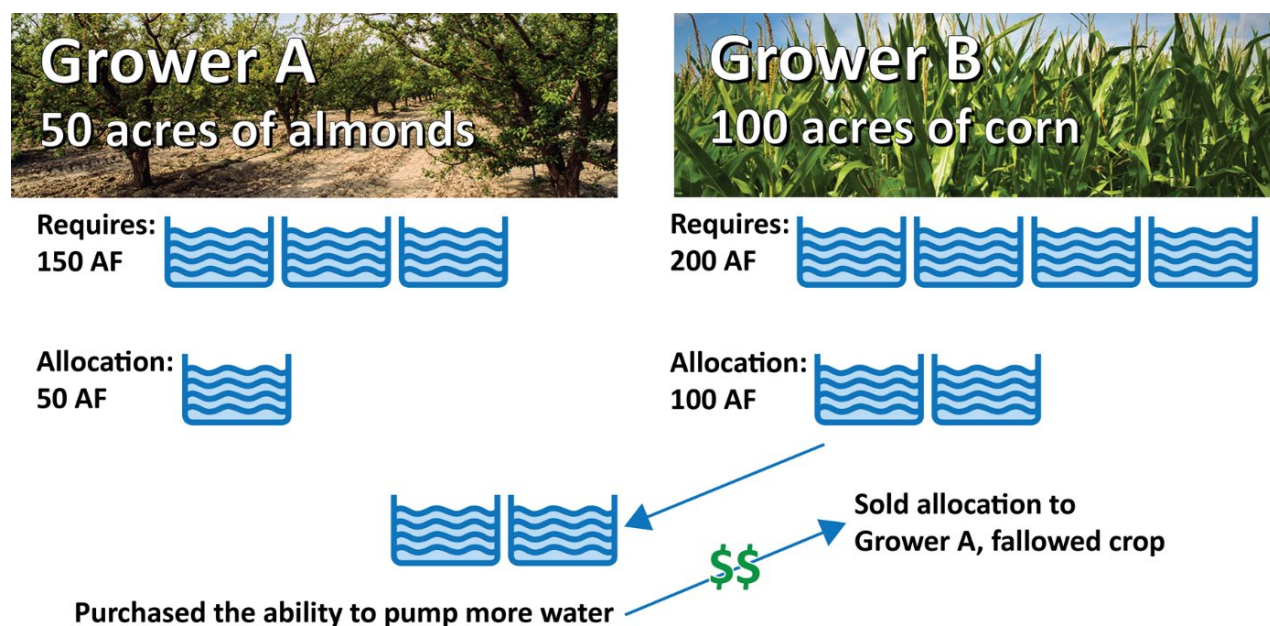
The Water Resilience Portfolio¹ (Portfolio), Governor Newsom’s blueprint for California’s water policy, includes Action 3.6, which calls on the DWR, the State Water Resources Control Board (Water Board), the California Department of Fish and Wildlife (CDFW), and the California Department of Food and Agriculture (CDFA) (taken together, “implementing agencies”) to:

“Create flexibility for groundwater sustainability agencies to trade water within basins by enabling and incentivizing transactional approaches, including groundwater markets, with rules that safeguard natural resources, small- and medium-size farms, and water supply and quality for disadvantaged communities.”

¹ Link: [California Water Resilience Portfolio 2020](#)

In March 2021, the Commission received a letter² from the Secretaries for Natural Resources, Environmental Protection, and Food and Agriculture asking the Commission to take some initial steps on Portfolio Action 3.6 by using its public forum to better understand the concerns and opportunities around groundwater trading and to explore how the State can help support well-managed, locally designed, and locally led trading programs that provide safeguards for natural resources, small- and medium-sized farm operators, and disadvantaged communities. (For more information on the Commission’s process and the topics considered, see Appendix 2: The Commission’s Role and Approach.) The information captured in this white paper is distilled from conversations with experts, stakeholders, and the public and is intended to guide State agencies in their support of locally led groundwater trading programs. It may also serve to educate implementers and stakeholders about how to proceed with well-managed groundwater trading that safeguards natural resources, small- and medium-sized farms, and disadvantaged communities (taken together, “vulnerable users”).

Localized, within-basin groundwater trading occurs when one entity sells its groundwater allocation to another entity to use within the same basin. Water is not typically being physically moved: participants in groundwater trading programs are trading their pumping allocation, moving the place where pumping is occurring, but not necessarily conveying water through a pipe or trucking water from one area to another. A simplified example of how groundwater trading works is illustrated in the graphic below³.



Groundwater allocations, or allowances to pump a specific amount of groundwater, are the basis of groundwater trading and are generally presumed to be a specified volume of water per year. Most domestic well users will fall within the SGMA definition of a de minimis extractor: “a person who

² Link: [Letter from the Secretaries for Natural Resources, Environmental Protection, and Food and Agriculture](#)

³ In the graphic, “AF” stands for acre-feet, which is a volumetric measurement of water. One acre-foot is enough water to cover an acre of land one-foot deep.

extracts, for domestic purposes, two acre-feet or less (of groundwater) per year,” meaning they will not need an allocation to be allowed to pump and use groundwater (note that domestic users served by a community water system do not fall within the definition of a de minimis extractor). GSAs have authority to establish groundwater allocations. Because SGMA authority to require measurement devices does not apply de minimis extractors, however, it may not be practical to set allocations for de minimis extractors. GSAs can set and administer allocations for those who exceed de minimis usage, including community water systems, and should consider many factors when setting allocations, including basin hydrology, water rights, different beneficial uses and classes of users, and the goals of SGMA. Groundwater allocations by a GSA are not a final determination or modification of groundwater rights. Allocations, along with trading rules and other policies, may specify how much water may be pumped, when it can be pumped, and from where it may be pumped. In this way, groundwater allocations are similar to land use regulations: while land ownership entitles the landowner to a bundle of rights, the ability to utilize those rights is restricted by zoning, building codes, and other regulations put in place to manage land responsibly. The creation and modification of allocations is critical to groundwater trading, however it is not the primary focus of this paper, which looks instead at major public policy issues that can arise when allocations are traded. For more information about allocations, see Appendix 3: Allocations.

Groundwater trading is intended to reduce the economic hardships caused by water scarcity by giving water users flexible, voluntary mechanisms to shift available water to where it is needed most: to the crops that cannot be fallowed, to the livestock that need reliable water to survive, or to the crops whose value make a local grower willing and able to pay for supplemental water. Groundwater trading programs may create opportunities for water users in groundwater-constrained areas to purchase groundwater allocations to keep their operations functional, or to be compensated for foregoing pumping when selling their allocations. To participate in trading, some water users may implement water-saving behaviors or technologies in order to free up allocation which can be sold to other users. With sufficient price transparency, groundwater trading can also help guide efficient capital investments for water supply infrastructure. In its optimal form, groundwater trading will avoid negative impacts and complement other sustainable groundwater management tools, reducing the burden of using less groundwater and helping preserve the long-term viability of California, where, statewide, groundwater provides for 40 to 60 percent of the water used each year. Ease of use and efficiency will be critical for trading programs to meet their potential.

Developing a groundwater trading program is a voluntary, locally driven action. GSAs have the authority to establish trading programs and, with the support of experienced advisors and the involvement of diverse stakeholders, are best positioned to develop programs that work within their local context. GSAs also have the responsibility to consider beneficial users of groundwater and to run trading programs that avoid harming third parties. Not all GSAs will develop groundwater trading programs; GSPs without a trading component may not need to trade to achieve sustainable groundwater management. Where trading is being considered, GSAs will be responsible for exploring local authorities, such as local ordinances that prohibit trading groundwater outside of county boundaries, and incorporating locally-relevant issues into trading programs, such as surface water use and trading, and groundwater substitution, banking, and recharge efforts. GSAs that set up groundwater trading programs will have many questions to answer:

- Who are the stakeholders that use groundwater in the basin? What are the different uses of groundwater?
- What do different groups of stakeholders hope to accomplish with groundwater trading? What do they hope to avoid?
- Who stands to benefit from trading?
- What are the potential unintended consequences of trading?
- Which stakeholders are most at risk?
- Who develops, implements, and oversees a basin's groundwater trading program?
- What will the role of water stakeholders be in that process?

But GSAs are not starting from scratch: Through the process of developing a GSP, GSAs will be assembling the foundation for supporting groundwater trading, should a GSA choose to pursue it as a management action. The GSP's water budget and estimated sustainable yield of the basin are the basis for groundwater allocations, providing a capped amount of water that can be divvied up among users. Careful analysis of impacts to groundwater users is already required as part of the development of a GSP: SGMA calls for GSAs to consider interests of all beneficial uses and users of groundwater in the development of a GSP. Beneficial uses and users include, but are not limited to, agricultural users, environmental users, and disadvantaged communities. GSAs have the responsibility to ensure that the management actions proposed in a GSP, including a groundwater trading program, protect the environment and disadvantaged communities from groundwater overdraft and SGMA's undesirable results, which are chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, land subsidence, water quality degradation, and depletions of interconnected surface water. Given these requirements, a GSP, if done well, will provide a solid basis for launching a groundwater trading program that considers vulnerable users. Even with a sound GSP, however, GSAs will need to carefully consider the ramifications of a groundwater trading program. Because GSPs consider impacts to beneficial users at a basin scale and over a 20-year time horizon, the localized, immediate impacts of trading may not be appropriately covered in a GSP. If groundwater trading programs are not thoughtfully designed and well-managed, they could negatively impact vulnerable users at a very localized scale and in a short timeframe.

It is in the State's interest to help local entities explore the potential of groundwater trading while ensuring that vulnerable users are safeguarded and that diverse types of water users have the opportunity to benefit from trading, with the overall intent of locals reaching their basin sustainability goal. The State's interest in supporting groundwater trading is shaped by SGMA's clear intent to have all beneficial uses and users of groundwater considered in sustainable groundwater management and the State policy that domestic water use is the highest use of water (California Water Code section 106). The State interest includes advancing the Human Right to Water, codified in section 106.3 of the California Water Code, which specifies that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes," and protecting and preserving the statewide benefits of intact ecosystems.

Under SGMA, sustainable management of groundwater is the responsibility of local GSAs, but the State plays a critical role in overseeing local progress (for more information, see Appendix 4: Current State Engagement). The State must act within the confines of its existing authorities when enabling well-managed groundwater trading and supporting protections for vulnerable water users. The State lacks the regulatory authority to direct a GSA to develop or not develop a groundwater trading program, nor

can the State dictate how a GSA structures an in-basin trading program. Neither can the State implement a statewide groundwater trading program on an inter-basin (between basins) scale, moving water from water-rich areas to water-poor areas. However, the State can use its resources to support well-managed groundwater trading, helping local water managers and users attain good outcomes. Working in partnership with local implementers and stakeholders, the State can help advance groundwater trading programs that are thoughtfully designed and governed, that are inclusive and incorporate robust stakeholder input, and that achieve multi-benefit outcomes, prevent harm to vulnerable users, and avoid other negative consequences.

With SGMA as a catalyst, groundwater trading in California is entering a period of expansion and experimentation. California's groundwater basins will provide a laboratory for testing and refining the practice of trading groundwater to promote sustainability. The actions taken by early adopters will generate lessons to be heeded by others; California may serve as an example for other parts of the country and the world.

Box 1: Glossary of Terms

Beneficial users: As defined by California Water Code section 10723.2, beneficial users of groundwater that must be considered by GSAs include agricultural users and domestic well owners who hold overlying groundwater rights, municipalities with groundwater rights, environmental users, Tribes, and disadvantaged communities, among others.

De minimis users: SGMA defines a de minimis groundwater user as “a person who extracts, for domestic purposes, two acre-feet or less (of groundwater) per year.” De minimis users may be defined otherwise in other circumstances, but generally are considered to be users with individually negligible impacts on overall water use due to the small amount of water they each consume.

Disadvantaged community: Disadvantaged communities refers to the areas throughout California that most suffer from a combination of economic, health, and environmental burdens; these communities, among other groundwater users, are to be considered in groundwater sustainability planning under SGMA.

Groundwater rights: Groundwater rights are rules applied to the extraction and use of groundwater and are held by groundwater users. Unlike surface water, California does not have a permit process for acquiring groundwater rights. Most of the law governing groundwater rights is established through case law. In several basins, groundwater rights have been determined by court decrees adjudicating the groundwater rights within the basins. Case law precedent can be used to estimate and take into account users' groundwater rights, but a legally binding determination of groundwater rights can only be achieved through judicial decree.

Groundwater sustainability agency: SGMA authorizes people to form groundwater sustainability agencies (GSAs) to develop, implement, and enforce a basin's groundwater sustainability plan.

Groundwater sustainability plan: A groundwater sustainability plan (GSP) is a plan developed by a groundwater sustainability agency for the sustainable use of groundwater within a groundwater basin.

Market power: Market power refers to an individual's or entity's relative ability to influence the price of an item in the marketplace by manipulating the level of supply, demand, or both.

Box 1: Glossary of Terms continued

Regulatory capture: Regulatory capture is an economic theory that regulatory agencies may come to be dominated by the interests they regulate and not by the public interest.

Small- and medium-sized farms: USDA defines small farms as having gross cash farm income (GCFI) of less than \$350,000. Mid-sized farms are defined as operations having GCFI of \$350,000 to \$999,999. The California Department of Food and Agriculture recognizes that the USDA definitions do not appropriately take into account the wide diversity of crops grown in California that are not grown in other states and the array of farm sizes and inputs and is working with stakeholders and academic institutions to develop a more relevant description of small- and medium-sized farms. For the purposes of groundwater trading programs, small- and medium-sized farms may be best defined by GSAs and stakeholders, using locally relevant parameters.

Socially disadvantaged farmers and ranchers: Under the Farmer Equity Act, a socially disadvantaged farmer or rancher is defined as a farmer or rancher who is a member of a group whose members have been subjected to racial, ethnic, or gender prejudice because of their identity as members of a group without regard to their individual qualities.

Sustainable yield: Under SGMA, sustainable yield means the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result.

Undesirable results: Sustainable groundwater management under SGMA singles out six “undesirable results” to be avoided: chronic lowering of groundwater levels, reduction of groundwater storage, seawater intrusion, land subsidence, water quality degradation, and depletions of interconnected surface water.

Cross-Cutting Themes: Context for Groundwater Trading Discussions

From the Commission’s conversations on groundwater trading, generally agreed-upon, high-level concepts emerged that provide context for consideration of the opportunities and challenges surrounding groundwater trading in California. The cross-cutting themes identified below touch on and impact groundwater trading, but also extend beyond the specific focus of Action 3.6, offering some understanding of the ways in which groundwater trading is connected to other aspects of groundwater management.

Trust is critical. Groundwater management involves community members coming together to manage a shared resource collaboratively with the intention of counteracting a history of institutions and individuals acting in their own interest, in some cases at the expense of others or of the greater good. To manage groundwater successfully – and, more specifically, to trade groundwater – starts and ends with building trust. In some instances, trust is lacking due to long-standing historical issues related to control over resources. To move toward well-managed groundwater trading will require building trust in institutions as well as person-to-person trust, a process that should begin during GSP development. Trust-building is not a short endeavor. It requires engaging stakeholders and ensuring that all

groundwater users or their chosen representatives are included in conversations about groundwater management and, ideally, that stakeholder groups are represented in management decisions. It involves educating stakeholders so that they can understand the hydrogeology of the basin and how decisions may impact them, which will help establish trust that GSAs are being forthright about how trading programs are accounting for specific users. GSAs – which are governed by a collection of local individuals – must endeavor to uphold good governance structures that are transparent and accessible and responsive to stakeholders; with groundwater trading, they must create clear rules and enforce them consistently. Without trust in institutions’ ability to govern effectively and enforce rules, those participating in groundwater trading programs may not feel that they or others need to abide by rules and vulnerable stakeholders may not believe that they are being properly protected. Because of the localized nature of trading, trust in individuals is also important, and this can be pursued through respectful interactions and inclusivity, as modeled by GSAs. Without trust between individuals, skepticism and fear that others might “game the system” could undermine the buy-in and participation necessary for a successful trading program. Building trust will increase participation in trading programs, increasing their effectiveness. The Final Groundwater Management Principles and Strategies to Monitor, Analyze, and Minimize Impacts to Drinking Water Wells document referenced in Appendix 4, Box 4: Related State Actions notes that building trust will “create opportunities for effective coordination, communication, and decision-making” and outlines six actions for building trusted relationships, many of which are applicable to groundwater trading and should be pursued by GSAs.

Implementing sustainable groundwater management takes time and information. Correcting decades of unsustainable groundwater management will not happen overnight, and neither will the development and implementation of a robust, well-managed groundwater trading program. It is imperative that GSAs and local communities understand their basin context, both in terms of hydrology – the way water moves into, out of, and through the aquifer – and the consumptive context – how much groundwater is used, where, and at what time. It is also important that they know where vulnerable water users are located and how they might be impacted by groundwater management actions. The process of building trust, alone, may take years. Educating and engaging stakeholders, establishing governance systems, developing a trading program that is responsive to the local context and does not have negative consequences, gradually reducing groundwater use, and waiting for management actions to result in basin-wide changes will likely take decades. In its conversations with representatives from other states that have been managing groundwater for much longer than California, the Commission learned of examples of groundwater management that have been ongoing for 40 or more years and are still working towards sustainability. In parts of Nebraska, groundwater management began in the 1980s and users are still working on gradually reducing their individual use. In Arizona, groundwater regulation occurred in the 1980s and many areas may not meet their 2025 sustainability goals.

Groundwater trading is built upon a sound GSP and accurate data. Sustainable groundwater management generally – and well-managed groundwater trading more specifically – requires a sound GSP that appropriately considers agricultural, environmental, and community water use. To be properly considered in GSPs, GSAs must first understand where these water uses take place: where agricultural water use may create undesirable results, where groundwater-dependent ecosystems are located, and where communities with drinking water wells are located. GSPs should contain an accurate water budget that identifies adequate water for human consumption and the environment (including wetlands and groundwater-dependent ecosystems). GSPs also should reflect best available data, clearly defined

sustainable groundwater management conditions, and a limit on the amount of groundwater that can be pumped to achieve sustainable conditions. The steps that GSAs take to develop a GSP, including conducting stakeholder outreach, collecting and analyzing data to develop a description of the basin, and determining sustainable yield, provide the foundation for developing a groundwater trading program. From these efforts stem the stakeholder buy-in, understanding of potential negative impacts, and allocations that are needed for groundwater trading. But a GSP must be done well to be effective. Of the first tranche of 42 GSPs submitted for review, DWR deemed 12 out of 20 basins incomplete, sending 34 GSPs back to GSAs to correct the deficiencies in their plans, including key issues related to impacts on drinking water, land subsidence, and interconnected surface water and groundwater. Addressing these deficiencies will be critical for developing a sound GSP that considers all groundwater users, and a sound GSP is an essential precursor to developing a groundwater trading program. If a GSP contains impactful data gaps or if it has not been informed by thorough and inclusive stakeholder engagement, then it is missing the foundational information needed to develop a well-managed groundwater trading program. Good data is imperative for understanding the likely impacts of trading and for ensuring that a trading program is meeting its goals. Participants in the Commission’s workshops stressed the need to take time to verify newly developed GSPs and to close relevant knowledge gaps before thoughtfully designing groundwater trading programs.

Groundwater trading is just one tool in the sustainable management toolbox and may not be appropriate in all instances. Groundwater trading is not a silver bullet that will “solve” over-pumping, it is an optional part of a larger groundwater management effort that will involve a diverse suite of management actions to bring basins into sustainability. Trading programs are only applicable to address groundwater demands within a basin. Inter-basin water trading has not been contemplated and would in most instances run counter to the goals of respective GSPs, to water rights, and to community interests. Trading programs cannot be successful in areas that do not have limitations on groundwater use and established groundwater allocations. To be a useful tool, groundwater trading needs sufficient interest and activity from trading parties. Trading may not be appropriate if there are few entities interested in trading or if allocations are concentrated in the hands of a few. Trading programs are not appropriate if they create unavoidable third-party impacts, or if the risks associated with those third-party impacts are high or cannot be mitigated. Further, groundwater trading program development and oversight are costly endeavors and require specialized expertise. A cost-benefit analysis may indicate that trading is too costly. Finally, groundwater trading is not necessary to achieve sustainable groundwater management: It is likely that many GSAs will work toward sustainability without developing a trading program.

The State has a role to play. Although groundwater management and groundwater trading is governed by local agencies, the State has a role to play in ensuring that groundwater management broadly, and groundwater trading more specifically, complies with the intent of SGMA, supports the Human Right to Water, and protects and enhances the public trust resources, such as fish and wildlife, for which the State is responsible.

Box 2: Points of Divergence

During its conversations with small groups, the Commission identified three areas where there was not general agreement about how to approach groundwater trading programs.

1. Local control vs. State oversight
2. Customization vs. standardization
3. Transparency vs. confidentiality

These points of divergence represent a continuum of options for which there is no inherently right or wrong approach. Instead, the choices are dynamic and highly contextual. Navigating conflicting viewpoints must be nuanced and adaptive and may consist of “and/both” rather than “either/or” options. The Commission explored these continuums at its public workshops, as described below.

Local Control vs. State Oversight. Overall, those providing feedback to the Commission expressed interest in the State providing some form of support or oversight for groundwater trading. Many indicated a potential benefit in having the State articulate best practices and provide safeguards against trading systems that could create disproportionate impacts to some segments of the community. Participants proposed that the State could serve as a final arbiter of disputes associated with trading systems. Conversely, others felt it would be impossible for the State to provide more than high-level support, given the wide diversity of hydrologic, economic, and demographic conditions in individual groundwater basins. These individuals explained that the issuance of best practices could hinder the innovation and adaptation that will be necessary as people managing groundwater basins work to find trading options most suitable for their situation. Further, some questioned the State’s authority to exercise any oversight over trading programs.

Customization vs. Standardization. As a group, those providing feedback on this subject generally believed there would be a need for customization of groundwater trading approaches in different areas. They suggested that groundwater trading programs need to be tailored to address local conditions and that new accounting platforms should be designed with input from local groundwater users. Many of the same group also saw benefits to standardization for activities like data monitoring and tracking. They believed the use of standardized tools within basins would facilitate better information sharing and potentially reduce costs as development costs and innovations could be shared across GSAs and subbasins. Even so, participants recognized that standardized software or other tools may still need some customization to accommodate local conditions. Some also noted that standardized practices would better facilitate evaluation of a trading program’s performance.

Transparency vs. Confidentiality. Feedback on this topic tended to support transparency. Those arguing for transparency in groundwater trading programs cited the need for accountability. They believed that access to trading information would increase fairness by highlighting both the beneficiaries of the trading program and the degree to which impacts may occur to program participants and non-participants. Conversely, other stakeholders suggested that some level of confidentiality would be necessary to maintain privacy, security, and proprietary information. For instance, sharing information about who traded water to whom and the price and timing of that specific trade could give a business advantage to competitors. Publishing aggregated numbers of trades or average prices, however, would be less sensitive. Some also argued that blind trades were inherently fairer as they precluded groundwater trading program participants from only selling to certain entities or individuals or otherwise discriminating against buyers.

Considerations for Safeguarding Vulnerable Users: Concerns and Risks

As groundwater allocations are traded to the places of highest demand or the highest cost of reducing water use, it is possible that a groundwater trading program will lead to or exacerbate concentrations of pumping in certain areas. Concentrated pumping could draw down groundwater levels, creating localized groundwater declines that cause shallower wells to go dry or that deplete interconnected surface water. Concentrated pumping could also influence contaminant or seawater migration, which degrades water quality, and land subsidence, which could decrease groundwater storage capacity. In addition to physical risks, vulnerable users are also at risk of being overlooked during the design and implementation of trading programs. In its consideration of groundwater trading, the Commission has looked closely at the concerns of and risks posed to vulnerable water users.

Natural Resources. The groundwater-dependent ecosystems (GDEs) of California are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface (California Code of Regulations, Title 23, section 351(m)). Examples include rivers, streams, and wetlands, all of which have been greatly diminished in size, extent, and/or quality due to land use changes and degradation over the last century. A small fraction of California's once-immense aquatic habitat remains and, as a result, the state has lost biodiversity and valuable ecosystem services like filtration of water and attenuation of peak flood flows.

Stakeholders who seek to protect, enhance, and restore groundwater-dependent ecosystems include environmental groups and environmental advocacy groups, land trusts, habitat managers, natural resource agencies at the federal, state, and local level, resource conservation districts, philanthropic foundations, and Tribes. These stakeholders stressed the need for groundwater trading programs to be developed from GSPs and water budgets that reflect the needs of GDEs and to consider and operate within the constraints of various regulations governing species and habitat protection. Stakeholders also expressed frustration that wetlands could face a disproportionate impact from SGMA implementation and from trading programs, particularly given the negligible contribution of managed wetland water use to existing groundwater problems.

Groundwater trading programs pose the following risks to natural resources.

- Concentrated pumping in portions of the basin could deplete groundwater, leaving GDEs without enough water to remain viable.
- Concentrated pumping in portions of the basin could deplete interconnected surface water, leaving surface water streams without enough water to remain viable.
- Pumping patterns could shift the water quality (such as temperature, salinity, or pH), timing, and/or reliability of groundwater, threatening GDEs and interconnected surface water.
- For managed wetlands that depend upon pumped groundwater and need more water than they are allocated to keep wetlands viable, wetland managers may not have sufficient capacity and financial resources to buy additional allocations to keep wetlands viable.

Small- and Medium-Sized Farm Operators. California is home to a diverse agricultural community, with farms ranging in size from fractions of an acre to many thousands of acres. Small- and medium-sized farms represent approximately 90 percent of farm operations in California. Farmers with smaller land holdings have less flexibility to aggregate their own groundwater allocations or shift their cropping

practices to accommodate pumping restrictions and less operational capacity to participate in trading programs. Because SGMA does not specify consideration of small- and medium-sized farm operators as beneficial users of groundwater (instead referring to agricultural users more broadly), GSAs will be responsible for identifying variability within the spectrum of agricultural users in order to understand any special considerations needed to accommodate small- and medium-sized farm operators.

Stakeholders representing small- and medium-sized farm operators include farmers, farm advocates and advocacy groups, agricultural land trusts and non-governmental organizations (NGOs), the University of California Cooperative Extension, county Farm Bureaus, resource conservation districts, county governments, and Tribes. These stakeholders expressed concerns that groundwater trading programs could drive small- and medium-sized farms and lower-value crops out of production, reducing the economic diversity of the area. Further, if excessive speculation, including possible outside speculation and investment, is allowed, water prices could outstrip agricultural commodity prices, making farming of some agricultural commodities, or even agricultural production itself, uneconomic. Stakeholders also expressed frustration that SGMA contains no protections for smaller-sized farm operators, such as a requirement to ensure that they are represented on a GSA board.

Groundwater trading programs pose the following risks to small- and medium-sized farm operators.

- Small- and medium-sized farm operators may not have the capacity to engage in or stay informed about the process of developing and participating in a trading program, which may lead to trading programs that do not serve them or that they do not understand well enough to participate in ways that serve their interests. Socially disadvantaged farmers may face additional challenges, such as language, cultural, and socioeconomic barriers to participation in groundwater trading, as well as in the development and governance of trading programs.
- Small- and medium-sized farm operators who need more water than they have been allocated to make a profit may not have sufficient capacity and financial resources to buy additional allocations to remain viable.
- Small- and medium-sized farm operators may not wield sufficient market power, allowing more powerful entities to dominate the trading program and control how allocations are used.
- Tenant farmers may not be able to continue leasing parcels of land if the value of water is higher than the value of leasing land and the landowner decides to sell all or part of the allocation from a leased parcel.
- Concentrated pumping in adjacent areas could create localized groundwater declines, causing shallower irrigation wells to go dry.
- Concentrated pumping could influence contaminant plume migration or seawater intrusion, degrading water quality.

Disadvantaged Communities. Throughout California, and particularly in the San Joaquin Valley, falling groundwater levels are causing drinking water wells to go dry, disproportionately impacting low-income communities and communities of color that rely on groundwater for domestic purposes. Drought exacerbates this problem, creating a water crisis for many vulnerable communities and well owners.

Stakeholders representing disadvantaged communities include community members, community-based organizations, county governments, community services districts, small water system operators, and

Tribes. These stakeholders expressed concerns that GSAs setting up trading programs or individuals participating in groundwater trading programs may not consider the needs of communities or protect their drinking water resources and may not respond swiftly to any negative consequences of trading. Stakeholders fear that local decision makers lack information about where shallow wells and other vulnerable resources are located, making it difficult to carefully design a trading program. Stakeholders also expressed frustration with the rapidity of well-deepening occurring around communities and with declining water quality on the cusp of failing to meet water quality standards.

Groundwater trading programs pose the following risks to disadvantaged communities.

- Communities and community members may not have the capacity to engage in or stay informed about the process of developing and participating in a trading program, which may lead to trading programs that do not have adequate protections for communities or that they do not understand well enough to participate in ways that serve their interests.
- Concentrated pumping in adjacent areas could create localized groundwater declines, causing shallower drinking water wells to go dry.
- Concentrated pumping could influence contaminant plume migration or seawater intrusion, degrading drinking water quality.
- Community water systems may not have sufficient allocations nor sufficient resources to buy additional allocations to meet basic human health and safety needs.

Findings

The following findings are distilled from conversations with experts, stakeholders, and the public and are intended to guide State agencies in their support of locally led groundwater trading programs and to educate implementers and stakeholders on how to proceed with well-managed groundwater trading that safeguards natural resources, small- and medium-sized farms, and disadvantaged communities.

1. **Safeguards for vulnerable users.** The Commission finds that ensuring safeguards for vulnerable water users, namely natural resources, small- and medium-sized farms, and disadvantaged communities, is a critical component of well-managed groundwater trading programs and that GSAs and local stakeholders will have the best understanding of the potential vulnerabilities at the local level. The Commission further finds that it is critical for GSAs and local trading entities to design programs that do not harm vulnerable users and to monitor implementation of programs to prevent and mitigate any unintended negative consequences; and that groundwater trading programs are not an appropriate tool for sustainably managing groundwater resources where harm to vulnerable users is likely or unavoidable and cannot be mitigated effectively and sufficiently.
2. **Identification and involvement of small- and medium-sized farms.** Although small- and medium-sized farms are not specifically called out as a beneficial user of groundwater in SGMA legislation, the Commission finds that it is incumbent upon GSAs that are developing trading programs to use locally applicable parameters to identify small- and medium-sized farm operators within their area, and to then engage and consider these users in the design of the program, especially those farmers – such as socially-disadvantaged farmers – who are most vulnerable to the impacts of trading programs.

3. **Identification and involvement of disadvantaged communities.** The Commission finds that localized, near-term impacts of groundwater trading programs could cause impacts to drinking water wells, and that, in accordance with section 106 of the California Water Code, which states that it is the “established policy of this State that the use of water for domestic purposes is the highest use of water,” it is incumbent upon GSAs to identify and engage community members and representatives and protect these users especially in the design and implementation of groundwater trading programs to prevent trades that could have negative impacts to these vulnerable users’ drinking water supply.
4. **Characteristics of well-managed local groundwater trading.** The Commission finds that the characteristics enumerated below describe well-managed groundwater trading, and that the State may help enable groundwater trading that safeguards natural resources, small- and medium-size farms, and water supply and quality for disadvantaged communities by supporting GSAs in developing trading programs that have these characteristics. Expert guidance, in the form of economists or other experienced market advisors, may be needed to help GSAs design a well-managed groundwater trading program.

Precursors that need to be in place prior to designing a well-managed groundwater trading program include the following.

- 1) A sound GSP, without critical data gaps that are relevant to starting a groundwater trading program, that includes:
 - a) A water budget that accounts for water needs for human health and safety, the environment, and all other users in the basin.
 - b) Clearly defined sustainable groundwater management conditions and a limit on the amount of groundwater that can be pumped to achieve sustainable conditions.
 - c) A means of monitoring how much water is coming into and going out of the system.
 - d) A means of measuring water use that provides verifiable, accurate data.
 - e) A groundwater accounting system that tracks how much water is being used and by whom.
- 2) Groundwater allocations that limit the amount of groundwater that an individual pumper can use and provide a consistent unit of trade.
- 3) The flexibility to design a locally relevant program with rules that respond to the local context and that accommodate local needs.
- 4) A sound governance system with transparent and robust decision-making mechanisms and leadership, and with program oversight and enforcement experience.

The designing of a well-managed groundwater trading program involves the following.

- 5) An articulated program goal that is aligned with achieving sustainable conditions and avoiding undesirable results.
- 6) Fully engaged stakeholders who represent all beneficial users.
- 7) A transparent and accessible process for designing the program.
- 8) An understanding of vulnerable users and resources, including the location of groundwater dependent ecosystems, and how they might be impacted by a trading program.

- 9) Clear trading rules – including quantities, timing/schedule, and uses of groundwater – that have broad support from stakeholders and are designed to prevent impacts to vulnerable resources, vulnerable users, and other third parties.
- 10) Clearly articulated roles, responsibilities, and expectations for trading participants, program administrators, and GSAs.
- 11) A process for assessing and refining the program to ensure that safeguards are working properly, that any unintended consequences are minimized, and that adaptive management can occur.

The implementation of a well-managed groundwater trading program involves the following.

- 1) Accessible processes for eligible participants to participate in the trading program.
 - 2) Sufficient participation for the program to meet its goals.
 - 3) Sufficient funding, capacity, and expertise to run the program efficiently and to enforce market rules.
 - 4) Transparent, accurate, and timely data used to monitor the success and impact of the program.
 - 5) A transparent process for monitoring and reporting on the progress and impacts of the program.
 - 6) Clearly identified triggers for stopping or changing the program before it leads to harmful impacts.
 - 7) A mitigation plan in place for swiftly addressing and effectively correcting unintended negative consequences, including abuses of market power⁴.
 - 8) Consistent enforcement with clear consequences for breaking the rules.
5. **Proactive management.** The Commission finds that developing a well-managed groundwater trading program may take a significant amount of time – possibly years – in order to bring together the science, data, and stakeholders needed to ensure safeguards for vulnerable users, and that, to ensure adequate time to respond to drought conditions and water restrictions, GSAs should proactively plan for the development of trading programs to allow for sufficient time to ensure protections for vulnerable users.
6. **Stakeholder engagement.** The Commission finds that stakeholder engagement is a critical component of developing and implementing a well-managed groundwater trading program, and that GSAs and local entities bear the responsibility for engaging all beneficial users or for considering all beneficial users should those users be unable to engage in their processes. The Commission finds that GSAs and local entities should: provide sufficient information to stakeholders for them to understand the potential risks and benefits of a trading program, provide information in layperson terms, provide information in the languages commonly spoken in the area, provide adequate notice via a variety of distribution methods for public meetings, hold public meetings at times and venues when stakeholders are able to attend, and convene a stakeholder advisory group with diverse representation to guide and inform decision-making. When engaged, stakeholders can contribute to design decisions, enhance understanding of where vulnerable resources are located, and share views on how vulnerable users may be impacted by a trading program. Stakeholder engagement

⁴ Note that, under SGMA, GSAs have broad discretion when identifying what, if any, mitigation measures are needed.

builds trust in GSAs and between individuals and facilitates coming to agreement on the rules governing the trading program. A trading program should not proceed without broad stakeholder support for the rules.

7. **Accurate, reliable data.** The Commission finds that, to design a well-managed groundwater trading program, local entities need accurate, reliable data to understand how trading could impact water levels and flows, where wells might go dry, where interconnected surface water or groundwater-dependent ecosystems might suffer, and where subsidence or sea water intrusion might occur if pumping increases in certain locations. The Commission further finds that accurate and reliable data is necessary for monitoring a groundwater trading program and tracking its impacts on groundwater users and resources.

Box 3: Measuring Water Use

Measuring water use is foundational to groundwater trading. Without reliable water usage measurements, trading programs could exacerbate overpumping, erode trust, and fail to function properly. Meters and satellite-based estimates of evapotranspiration (ET; water that evaporates off land and is transpired by plants) provide two different water measurements. Some GSAs have or are pursuing mandatory metering on all wells to implement water trading. Meters measure the volume of water pumped or diverted and are accurate when they are well-maintained and functioning properly. In some instances, GSAs are using or would like to use telemetric monitoring that feeds pumping data into an online accounting system. Meters, however, can be expensive, and some people shared concerns about the ability of bad actors to tamper with meters to game the system. Other GSAs are measuring net water consumed from irrigation by estimating ET through satellite imagery. Using satellite-based ET data is less expensive than installing meters, but since well meters and ET data are measuring different quantities, it is important to carefully consider the local setting to determine what measurement techniques are necessary to appropriately characterize use. Using satellite-based ET data may be the best option for GSAs in remote, rural areas or GSAs that are struggling with well registration. For groundwater trading programs, ET data and meters can be used in tandem. Some regions have used remote sensing to prevent cheating by manipulating water meters. If the meter reading is lower than the satellite data suggests it should be, the meter is inspected.

8. **Mechanisms for safeguarding vulnerable users.** The Commission finds that incorporating the following mechanisms, as applicable, into the design of a well-managed groundwater trading program may improve safeguards for vulnerable water users. The list below is not comprehensive; it is based on examples provided and discussed during the Commission’s public conversations. The suggested mechanisms described below would need to be selected and implemented based on local needs and context, agreed upon by groundwater users and other stakeholders, and combined with other tools for managing groundwater sustainably. In selecting safeguarding mechanisms, GSAs will need to ensure that the mechanism itself is not creating undue impacts to other beneficial users.
 - 8.1. Scenario Planning. Groundwater models can be used to better understand potential implications from management actions, such as groundwater trading, to identify how changes in groundwater levels may impact or benefit other water users.

8.2. Trading Rules. Trading rules can be used to restrict how and when groundwater trading occurs.

- Directional trading occurs when groundwater users in a restricted area can only sell groundwater allocations but not buy them, thus limiting pumping in the areas where buying is restricted, and may be particularly helpful when there is a need to direct trading away from areas of subsidence or seawater intrusion, or where shallow wells and groundwater-dependent ecosystems need to be protected
- Proportional trading occurs when groundwater users can trade a portion of their allocation but not all of it. The proportion that may be traded may fluctuate across a variant based on the distance of the trade site from a vulnerable resource.
- Spatial concentration limits or well-spacing requires a certain amount of space between operational wells.
- Pumping schedules limit the time when groundwater may be pumped and could be used, for instance, to manage pumping near interconnected surface waters during ecologically sensitive time periods.
- Notice requirements occur when trading parties or the governing body must notify the public of proposed trades. While this mechanism may provide a disincentive to trade by slowing trades down, it may also increase transparency and help identify cause-and-effect impacts of pumping.
- Anonymous trading can be used to protect the identity of the buyers and sellers to prevent selective trading or other market manipulations. However, a buyer and seller need to be independent from one another. A trading program manager usually knows who is behind each trade and knows what the relationship is between parties and can prevent buying and selling between related entities.

8.3. Special Management Areas. Special Management Areas can create special rules, such as directional trading, within designated sensitive areas, such as those areas prone to seawater intrusion, along streams and rivers, near important infrastructure that is at risk of damage due to subsidence, near shallow wells, and near communities.

8.4. Buffer Zones. Buffer zones create an area around vulnerable users or resources, such as areas with shallow wells, where trading in is not allowed.

8.5. Mitigation Plans. Mitigation and compensation requirements occur when trading parties or the governing body must mitigate potential impacts, such as by paying to deepen shallow wells or by providing water to habitat areas that could be impacted, or to compensate third parties for any damages caused by the program, such as providing potable water should wells go dry or be contaminated.

8.6. Program Operation.

- Anonymous, algorithmic trading occurs when parties submit their willingness to sell allocations or desire to buy allocations to a system that anonymously matches sellers and buyers, factoring in any applicable trading rules before approving the trade. Instead of a party-to-party negotiation of the amount and price of the allocation to be traded, trading

parties do not know with whom they are trading, which helps ensure equal access to the trading program for vulnerable users, especially small- and medium-sized farm operators. Algorithmic matching helps ensure that trading rules are followed.

- Confined trading programs that limit trading to entities of the same size (e.g., bifurcating a program to keep trading between small farm operators or between large farm operators) may allow those entities to better access the trading program while guarding against power differentials that disadvantage certain participants.
- Third party intermediaries that absorb transaction costs and aggregate small allocations into larger blocks for sale or divide large allocations into smaller blocks for sale may help small- and medium-sized farm operators participate in a trading program. An intermediary could be the GSA itself, a cooperative, or a different, neutral third party.
- A neutral third-party administrator of the groundwater trading program may help avoid conflicts of interest, ensure all users have access to groundwater trading, and more objectively evaluate the impacts on vulnerable groundwater users in the region.

8.7. Careful Well Aggregation. Well aggregation rules allow a groundwater user to move allocations between wells that are owned or operated by the same user. Aggregations can produce the same negative impacts as groundwater trading. Generally, users must apply for well aggregation and be approved by the GSA. Well aggregation rules can allow powerful entities the ability to aggregate large numbers of wells, outside of the intention of the rule, giving such users the ability to move the location of pumping without oversight or application of trading rules and an unfair advantage over other traders in the basin. Careful well aggregation limits how wells can be aggregated and enforces aggregation rules, closing loopholes if they are exploited.

8.8. Annual Program Renewal. Annual renewal of a groundwater trading program allows for the regular evaluation of the program and its impacts, creating an opportunity to improve the design of the trading program and avoid unintended consequences to vulnerable groundwater users.

9. **Applying safeguards to protect vulnerable users.** The Commission finds that the safeguarding mechanisms noted above might be applied to protect vulnerable users, where agreed upon by groundwater users and other stakeholders, as follows.

9.1. Natural Resources. Local GSAs may seek to protect groundwater-dependent ecosystems, interconnected surface water, wetlands, and other natural resources through scenario planning to understand the potential impacts of trades; through the creation of special management areas and/or the use of directional trading, proportional trading, spatial concentration limits, pumping schedules, temporary trades, and buffer zones; through the use of protective mitigation plans that halt pumping when water levels drop or other habitat impacts are noted; and through annual program renewal. Natural resources may also benefit from financial support to help acquire water for species and habitat or a no net loss of wetlands policy.

9.2. Small- and Medium-Sized Farms. Local GSAs may seek to protect small- and medium-sized farms through notice requirements to alert farm operators of proposed trades; through anonymous and/or algorithmic trading; through confined trading programs; through use of

third-party intermediaries; through the use of a neutral third-party administrator; through careful well aggregation; and through annual program renewal.

- 9.3. Disadvantaged Communities. Local GSAs may seek to protect communities through the creation of special management areas and/or the use of directional trading, proportional trading, spatial concentration limits, pumping schedules, temporary trades, and buffer zones; through the use of protective mitigation plans that halt pumping when water levels drop or water quality impacts are noted; through careful well aggregation; and through annual program renewal.
10. **Market power**. The Commission finds that issues related to market power can show up during the design of the trading program, such as with rules that restrict access to the program, and during implementation of the trading program, such as when powerful entities coerce others to trade or refrain from trading. Market power also may manifest outside of trading, operating as a work-around to thwart the rules of the program. For example, well aggregation could happen outside of a trading program, allowing certain parties to control and trade groundwater outside of the formal groundwater trading program. The implications of out-of-program trades may warrant additional conversation. Many people across sectors expressed concern to the Commission about trading program participants using their market power to escalate prices or to create user blocs that dictate where water goes. Unbalanced market power could impact many of the other important factors involved in trading programs, such as trust, engagement, access, and compliance, posing a risk to groundwater trading programs and to SGMA implementation overall.
11. **Oversight and enforcement**. The Commission finds that consistent, active enforcement is a critical function of the GSA, that it is essential to running a well-managed groundwater trading program, that those participating in trading programs should agree to enforcement mechanisms, and that penalties must be sufficient to deter non-compliance. The Commission heard concerns about intentional non-compliance with program rules, such as intentionally misreporting water use or manipulating monitoring equipment, and about regulatory capture. In other states, local groundwater management entities enforce rules by levying fines, revoking pumping allocations, and pursuing criminal penalties. In these instances, local participants were eager to see rules enforced: They voted on the rules and report those not following rules, understanding that lax compliance works against those who are following rules. Enforcing pumping limits and trading program rules demonstrates to stakeholders and participants that parties are being treated equally and fairly, which builds trust in the institutions overseeing trading and ensures that the trading program meets its intent. Enforcement requires an on-the-ground presence to develop relationships with groundwater users and other stakeholders and to verify that rules are being followed. Enforcement is built on good governance, stakeholder engagement, and clear trading rules and necessitates proper capacity and resources for the enforcing entity.
12. **Start small**. The Commission finds that starting with a small, geographically and temporally confined program will allow local entities to test and refine their programs to minimize negative impacts and maximize the chances of success. Trading programs may be conscribed to small geographic areas and short-term, temporary trades at the outset or over the long term. Small programs may be the easiest means of securing stakeholder support and managing adverse trading impacts. Short-term, temporary trades may help avoid land use impacts.

13. **Scaling up.** The Commission finds that, as groundwater trading programs grow within basins, they will require additional oversight, including locally identified measures and controls, to ensure that trades do not have negative consequences and that compatible systems are developed to foster greater efficiency across entities. The implementation or consideration of the previous findings will advance viable groundwater trading programs that minimize unintended consequences.

Potential Next Steps for State Engagement

At this time, groundwater trading programs in California are under consideration or development or in the early stages of implementation. This is a period of learning, experimentation, and gathering information through observation and experience. GSAs and local entities are in the process of building trust and navigating a pioneering effort that may, at times, be uncomfortable in its unfamiliarity and unpredictability. The State, too, must position itself to navigate these early stages of groundwater trading by continuing to engage with GSAs and stakeholders to build trust. Because groundwater trading programs associated with SGMA are starting to be developed now, because they are forming in response to State policies, and because there may be many of them, the State has an opportunity to act now to help GSAs establish well-managed groundwater trading programs, avoiding foreseeable harms to disadvantaged communities, the environment, and other State interests. Doing so will be complex, it will require proper resourcing and the development of new skills and expertise, but timeliness matters. Over time, as groundwater trading becomes more established, the State role may need to change, adapting as programs develop.

The Commission proposes that the State take an iterative, multi-pronged approach to enabling and incentivizing well-managed groundwater trading where local entities and users propose and decide to adopt it. State agencies will need to fulfill their fundamental roles, described in Appendix 4: Current State Engagement, and meet their obligations under SGMA to ensure that GSPs are sound and being followed. Other potential actions for State engagement are enumerated below. DWR, the Water Board, CDFW, and CDFA will need to continue working together in a complementary and collaborative fashion. For each action listed below, the Action 3.6 implementing agencies will need to identify an appropriate lead and team for moving forward. The Commission encourages the implementing agencies to act with some urgency to implement Action 3.6 and offers its continued engagement in the effort at the request of the implementing agencies. The Commission also encourages the implementing agencies to engage other departments and agencies to ensure that State priorities are being implemented consistently, especially as applied to permitting and existing financial assistance and incentive programs. The implementing agencies may also look to work with federal agencies to better incorporate federal priorities and leverage federal funds.

Group 1 Actions. The Commission suggests that the State operate within its existing authorities to target immediate needs by engaging in the following actions. These actions may require additional resources for implementing agencies.

1. **Develop a workplan for implementation.** Upon release of this white paper, with DWR as the lead and working together across all implementing agencies, develop a workplan for implementing Action 3.6 to create flexibility for GSAs to trade water within basins by enabling and incentivizing transactional approaches, including the perspectives included in this groundwater trading white paper.

- 1.1. Consider creating an external advisory board with diverse representation to provide ongoing input on the State's workplan.
2. **Conduct SGMA related oversight.** Ensure that GSPs adequately address all groundwater uses and users when designing and implementing groundwater trading programs, if identified as a management action in an area's GSP.
3. **Convene stakeholders to share information.** Bring together GSAs, stakeholders, and experts on a regular basis, such as through an annual conference or quarterly forums, to share ideas, resources, and lessons learned with one another.
4. **Identify and assess resources for GSAs.** Engage GSAs in areas where trading programs may be developed in ongoing dialog about their resource requests and identify how implementing agencies can use technical and financial assistance to meet these requests while making sure that relevant, appropriate data and information are made available to the public. Some of the places where State resources could be deployed include:
 - Augmenting technology developments to optimize groundwater trading.
 - Providing an open-source water accounting platform with a scenario planning component that helps guide trading.
 - Providing statewide data sets to inform decision-making linked to designing trading programs.
 - Collecting and providing improved hydrogeologic data.
 - Providing information on different approaches to water measurement and a public forum for the discussion of water measurement standards.
 - Incentivizing the installation of meters and telemetric monitoring on wells in order to track water use.
 - Incentivizing and providing direct technical support for installing monitoring wells that will track impacts of trading programs.
 - Providing guidance or best management practices for data collection and measurement so that trading programs can be easily tracked and compared.
 - Supporting stakeholder engagement in trading programs by funding outreach to disadvantaged communities, environmental stakeholders and natural resource managers, and small- and medium-sized farm operators.
 - Offering facilitation services as needed to establish trading programs.
5. **Engage and support vulnerable users.** Engage community stakeholders, environmental stakeholders, small- and medium-size farm stakeholders, and GSAs in areas where trading programs may be developed to discuss how GSAs can identify stakeholders and how stakeholders can engage with GSAs on groundwater trading, and to develop processes at the State level for accepting, cataloging, and sharing feedback from stakeholders about their specific groundwater trading concerns.
 - 5.1. For community stakeholders, directly support community-based organizations and communities to promote engagement in the development of groundwater trading programs and ensure drinking water is a priority consideration, and work cross-programmatically to apply departmental Human Right to Water policies to groundwater trading outreach efforts.

- 5.2. For environmental stakeholders, consider working with environmental groups and other stakeholders to clarify the potential impacts and benefits to wetlands and interconnected surface water from trading programs.
- 5.3. For small- and medium-sized farm stakeholders, directly support community-based organizations and technical assistance providers who have existing relationships with farmers, particularly socially disadvantaged farmers and ranchers who could be more vulnerable in groundwater markets, to facilitate engagement in the development of groundwater trading programs and ensure that access to groundwater for small- and medium-sized farms is a priority consideration; work cross-programmatically to apply the Farmer Equity Act to groundwater trading outreach efforts; provide informational services to the agricultural community and GSAs about available technical assistance and State and federal programs related to SGMA, drought, water-use efficiency, and soil health; and, in coordination with the U.S. Department of Agriculture National Agricultural Statistics Service, County Agricultural Commissions and Sealers, and UC Agriculture and Natural Resources, make available to GSAs the most recent U.S. Census of Agriculture data that provides information related to the number of farms by size and by value of sales for each county so that GSAs may consider this data and possible unique characteristics of a particular local agricultural economy when developing groundwater trading.
6. **Create digital resources and catalog available trading information.** Establish, populate, and promote the use of a website for sharing groundwater trading information that includes a repository of GSA- and stakeholder-identified resources as well as information available in GSPs and annual reports about SGMA-related groundwater trading programs. Consider creating a digital map to display where programs are being developed and the status of development using designations such as pre-development, design phase, testing phase, and implementation phase.
7. **Develop best management practices.** Using the list of characteristics of well-managed local groundwater trading (Finding 4), develop a best management practices guidance document for GSAs to use when establishing groundwater trading programs that includes guidance on data transparency that balances anonymity and private information. Consider providing guidance on common trading program attributes that will make it easier to trade across GSA and/or political boundaries, where such trades are appropriate and without triggering negative impacts.
8. **Incentivize well-managed groundwater trading.** Using the best management practices described above as a means of evaluating programs, create a funding program for GSAs that incentivizes well-managed groundwater trading that safeguards natural resources, small- and medium-sized farms, and disadvantaged communities.
9. **Evaluate incentives for wetlands.** Explore how to work within trading programs established by local GSAs to incentivize the provisioning of supplemental water for wetlands in areas where wetlands require groundwater in excess of their allocation.
10. **Support groundwater technical assistance programs for small- and medium-sized farm operators.** Work with GSAs, UC Cooperative Extension, NGOs, and resource conservation districts to expand technical assistance programs and to create new opportunities to help small- and medium-sized farm operators access groundwater trading programs.

Group 2 Actions. The Commission suggests that the State monitor, evaluate, and report on groundwater trading efforts to identify additional ways in which the State can enable well-managed groundwater trading with protections for vulnerable water users. The actions suggested below will need to be reviewed and refined as trading programs are developed; however, it behooves the State not to delay until the issues these actions seek to remedy have intensified. The suggested actions stem from the public dialog hosted by the Commission. The Commission received significant public feedback stressing the need to formally incorporate equity issues into groundwater management in order to enforce outreach and engagement efforts or representative governance structures, and to hold entities accountable for the impacts of overpumping. The actions below may extend beyond the State’s current authorities and implementation of these actions may require the State to be given new authorities by the Legislature. Expanded State authority is not likely to be universally welcome and should be pursued thoughtfully and with prudence.

11. **Examine existing authorities.** Examine existing State authorities to determine where the State may need new authorities to assist with the oversight of groundwater trading programs, including whether authority is needed for setting up an oversight mechanism to ensure programs are run openly and fairly, and that established rules are enforced.
12. **Create standard principles and rules.** Create standardized principles and rules related to the treatment of natural resources, small- and medium-sized farms, and disadvantaged communities and apply those principles and rules to trading programs. Consider using standardized principles and rules as criteria for reviewing GSP updates, as a requirement for securing financial and technical assistance from the State, and/or as the basis of a groundwater trading program certification process, akin to land trust accreditation.
13. **Create oversight mechanisms.** Develop a committee with stakeholder representation to advise the State on its review and oversight of local groundwater trading programs; request additional information about trading programs in annual reports and/or GSP updates sufficient to conduct an annual review of trading efforts to ensure that they are advancing the goal of sustainability and avoiding undesirable results; and establish a State process for reviewing programs that repeatedly violate standard principles or rules.

Appendix 1: Status of SGMA Groundwater Trading Programs in California

Currently, California is home to several nascent groundwater trading programs linked to SGMA. The most established is the Fox Canyon groundwater market, located in the Oxnard Basin in Ventura County. Fox Canyon began trading in 2020 and was the first groundwater trading program to begin trading under SGMA. Under the Fox Canyon GSP, both urban and agricultural water users receive an allocation, with approximately 60% going to agriculture and 40% going to urban users. Agricultural producers in the Oxnard basin are largely groundwater dependent and groundwater itself is in short supply: The basin is critically-overdrafted and growers face pumping cuts of at least 40 percent to bring their basin into sustainable conditions under SGMA. Growers in the basin called for the development of the program and were integral to developing groundwater allocations and market rules during the design phase. Urban and environmental stakeholders also participated in the process. The design of the Fox Canyon program was stakeholder-driven, facilitated by a non-profit third party, and authorized via ordinances passed by the GSA. Groundwater flows within the basin are well understood. The Fox Canyon groundwater market is an anonymous market that features algorithmic matching and a third-party exchange administrator, a design intended to thwart market power concerns by protecting participants' identities. Transfers of allocations are pre-approved by the GSA, conditional on the rules of the market, which reduces uncertainty and transaction costs. The program features special management areas with directional trading rules put in place to limit increased pumping in areas at risk of seawater intrusion and declining water levels. Initially, the program limited trading to agricultural water users, but the GSA will soon consider allowing municipal users to participate as well. All program participants are required to have meters on their wells with telemetric monitoring. The market is reviewed yearly by the GSA and requires annual reauthorization, allowing for the regular evaluation of its functionality and impacts, and allowing for changes to its design.

The Eastern Tule GSA, located in the Tule subbasin in Tulare County, established groundwater allocations in 2021 and allows landowners to transfer their allocations so long as they are in good standing with the GSA. Eastern Tule is home to many agricultural and domestic users who are not supplied by a water district and do not have access to surface water; many landowners are not irrigating and are presumed by the GSA to have dormant groundwater rights. While there are some large agricultural operations, the area also includes small and medium-sized operations; water use can vary from heavy to very light or domestic use only. Agricultural landowners receive a groundwater allocation from the GSA and may participate in the Eastern Tule trading program. Pumpers must arrange for trades themselves, using a bulletin board within their landowner account software that allows parties to specify if they are looking to sell or purchase groundwater allocations. This initial bulletin board does not include GSA management of actual trades, nor does it require disclosure of purchase amounts: All transactions remain anonymous throughout the process. Once a trade is negotiated, the pumpers submit a form to the GSA and the GSA then reviews the trade for approval. Pumpers located outside of a water district are likely to be buyers of groundwater allocations, while sellers are likely to be those with access to surface water or who have large operations that they are not irrigating. Eastern Tule measures groundwater pumping using remote sensing and evapotranspiration calculations and allows for a carry-over period of five years (meaning unused groundwater allocations created in one year can be stored and used or traded for up to five years). Flows within the basin are fairly well understood and understanding is increasing as the GSA expands its groundwater monitoring. Eastern Tule GSA is monitoring the impacts of its program on subsidence levels around the Friant-Kern Canal and on

groundwater wells in the nearby disadvantaged community of Ducor and will impose rules to restrict pumping in these areas should additional impacts occur. Ducor is represented by a County Supervisor on the GSA Board and a Ducor Community Services District (CSD) Board Member on the stakeholder committee. The General Manager of the GSA will occasionally attend Ducor CSD Board Meetings to provide updates or serve as a resource. An independent consultant designed the trading program.

The Lower Tule and Pixley GSAs, also located in the Tule subbasin in Tulare County, have implemented a trading program similar to the Eastern Tule program and expect that trades will occur across GSAs within the Tule subbasin. Use of the same groundwater accounting platform in the three GSAs will make this easier. Land ownership within the GSAs is not concentrated. The area is home to many landowners, with the largest owning only a small percentage of the agency's lands. Groundwater is used predominantly by agriculture and these water users all have similar water rights and water needs because the GSA boundaries match with the water district boundaries. By 2040, the GSAs need to reduce groundwater use by approximately one acre-foot per acre per year. Groundwater flows are fairly well understood; the GSA's flow model is improving with time and additional data. This area is home to disadvantaged communities whose needs are well known; the communities are incorporated into the GSP through a memorandum of understanding. The GSAs designed the policies and programs that allow groundwater users to trade allocations.

In Madera County, the county GSA, which represents those landowners not covered by another GSA, worked with other GSAs in the county to solicit stakeholder input to create a water trading program framework and then, in 2021, to run a simulation of the program. Approximately 60 people registered for the simulation, with 30 participating regularly. The simulation did not yield many trades. Because 95 to 97 percent of water use in Madera County serves agricultural demand, trading could increase as allocations decrease. The Madera County GSA anticipates agricultural demand reduction between 30 to 50 percent in the Madera, Chowchilla, and Delta-Mendota subbasins. The biggest challenge to the process came from landowners who had not recently pumped groundwater and were not given an allocation but felt they should receive a groundwater allocation based on their land ownership in the basin. Instead, groundwater allocations were divided equally among existing beneficial groundwater users. Another consideration centered around the ability to move allocations among parcels with the same owner or manager. As a tool for flexibility, Madera County GSA included multi-parcel farm units that allow owners and managers within the same hydrogeologic zone to move an allocation among multiple parcels that they own or manage. Residential water users have been heavily involved in the Madera County GSA and receive regular updates at monthly meetings held around the county; their needs have been articulated and will be incorporated into the design of the trading program. An independent consultant designed the trading program simulation and received input at three large, public meetings that included irrigated agricultural users, ranchers who do not irrigate, homeowners who do not farm, and disadvantaged community advocacy groups. This work is being funded, in part, by a grant from the U.S. Bureau of Reclamation.

The Kaweah subbasin, in Tulare County, is currently conducting a stakeholder-informed process that is projected to produce a water marketing strategy framework by 2022. The Kaweah subbasin is a mixed agricultural landscape with large urban areas, several small, disadvantaged communities, and rural homes, and has calculated that it is in overdraft of approximately 80,000 acre-feet annually on average. With the recent drought conditions, this number may be higher. Those without access to surface water will likely be interested in buying groundwater allocations. Beneficial users in the basin

have a representative seat at the table for discussions and decisions. Meetings are held regularly to share information and solicit public input. An advisory committee, called the Kaweah Subbasin Water Marketing Strategy Committee, made up of 11 members representing all beneficial users (agriculture, environmental stakeholders, disadvantaged communities, urban water users, industrial users, and the GSAs in the subbasin), serves as a workgroup for the development of the trading program. The member GSAs receive regular updates on the progress of the Water Marketing Strategy Committee from GSA representatives that participate on the committee. The Kaweah subbasin committee has discussed ideas like confining trading to those who own land in the Kaweah subbasin and imposing restrictions on trading around disadvantaged communities to protect shallow drinking water wells. Local GSAs are continuing to explore the needs of the communities and resources within the subbasin. The development of the trading program is being supported by a consultant. This work is being funded, in part, by a grant from the U.S. Bureau of Reclamation.

The McMullin Area GSA, located in the Kings subbasin in Fresno County, is dominated by agriculture, 75 percent of which is permanent crops. Ninety-five percent of agricultural production is utilizing groundwater as its only source of water. Users will need to reduce groundwater use by three-quarters of an acre-foot per acre to achieve sustainability. Subsurface flows within the basin are well understood. The McMullin Area GSA is considering developing a groundwater trading program based on per-acre groundwater allocations where pumping is tracked using meters and telemetric monitoring. The GSA is working to install meters. Allocations will be voluntary at first and will be monitored to see if pumping reductions are being successfully implemented. It may take 10 years to get to a firm allocation. Landowners may test a trading program while allocations are still voluntary. The GSA is considering starting with the ability to carry over water for one year with pumpers arranging for trades themselves, although there is potential to move to using a platform that matches sellers and buyers. The McMullin Area GSA anticipates that all landowners are likely participants in the program. The GSA has formed a stakeholder advisory group and is planning to convene an ad hoc group of stakeholders to assist with developing the trading program. The group will advise on the development of local groundwater trading rules, regulations, and methodologies. The GSA works with a data management company for collecting and maintaining its data for multiple purposes and expects that this company will serve the function of the trading platform.

The Rosedale-Rio Bravo Water Storage District (District) has established the Rosedale-Rio Bravo Management Area (RRBMA), which is included in the Kern GSA, located in the Kern County subbasin in Kern County. The RRBMA contains 25,000 acres of land in production in farms of varying sizes. Beginning in 2018, the District and Environmental Defense Fund collaborated to co-create an open-source Water Accounting and Trading Platform designed to facilitate effective accounting and management of available water resources in a user-friendly format. Iterative workshops with landowners and water managers informed development and refinement of the platform. The accounting section of the platform was launched in March 2020. The trading module has not been launched to date because the District is working to build a strong foundation of sustainable groundwater management before pursuing a water trading program, although the District anticipates that a water trading program could be a future tool for landowners to manage their water supplies. District stakeholders are engaged through bimonthly meetings.

Appendix 2: The Commission’s Role and Approach

The Commission has led a thorough and inclusive public dialog, described below, to frame State considerations around how to shape and support well-managed groundwater trading programs. The Commission acknowledges the complexity of groundwater trading. It takes time and resources to develop and implement a trading program that advances sustainable groundwater management, avoids undesirable results, and does not create negative impacts, because the foundation to such a program requires building trust, collecting information, utilizing accurate groundwater data, and evaluating alternatives and trade-offs. Considering how groundwater trading programs will interact with surface water use and trading, groundwater substitution, banking, and recharge, and how they will affect land use increases the complexity of this topic. These considerations will need to be taken up by GSAs and local stakeholders who are designing and implementing markets. For this endeavor, the Commission has focused its discussions on groundwater trading using the topics specified in the Water Resilience Portfolio: a State role in supporting in-basin trading that protects vulnerable users. Transboundary transactions – trading between two groundwater basins or basin-to-basin trading – were not considered. Additionally, the scope of the Commission’s discussions covers groundwater, but not surface water stored underground, which is subject to Water Board permitting authority.

Step 1: Frame the Issue. To better understand the issues at play, Commission staff conducted interviews with small groups of stakeholders, spoke with out-of-state representatives about their groundwater trading efforts, and invited expert panels to address the Commission at its standing meetings. Staff organized 13 small group discussions with academics, agriculture representatives, associations, community-based organizations and community leaders, federal government representatives and wetland managers, environmental groups, northern GSAs, San Joaquin Valley GSAs and representatives, Central Coast GSAs, Tribal members, and economists. These discussions explored the status of groundwater trading; the bookends that should be placed on groundwater trading to protect communities, the environment, and small- to medium-sized farm operators; and perspectives about the State’s role in groundwater trading to safeguard vulnerable water users. To gain an understanding of lessons learned about groundwater management and trading strategies outside of California, staff met with 22 people from Arizona, Colorado, Florida, Nebraska, Texas, and Australia (See Appendix 5: Synthesis of Out-of-State Conversations). Syntheses of small group and out-of-state discussions were brought to the public at the following Commission meetings:

- [Groundwater Trading: Small Group Discussion Synthesis - September 2021, Item 12](#)
- [Groundwater Trading: Overview of Out-of-State Discussions and Emerging Themes - October](#)

The Commission hosted the following expert panels and presentations at its monthly meetings:

- [Water Trading: Panel Discussion on Markets and Groundwater Trading - June 2021, Item 13](#)
- [Groundwater Trading: Presentation on Groundwater Rights Law - July 2021, Item 10](#)
- [Groundwater Trading: Panel Discussion on Exploring Groundwater Trading - August 2021, Item](#)
- [Groundwater Trading: Panel Discussion on the Future of Groundwater Trading - September](#)

Step 2: Hold Public Discussions. To further explore the information gathered in Step 1, Commission staff conducted localized outreach by attending stakeholder meetings; the Commission also hosted public

workshops, and collected information via an online survey. By holding these public discussions, the Commission sought to collect feedback from diverse participants about how groundwater trading could impact or benefit them and to gather information and test assumptions around opportunities and concerns; potential impacts to ecosystems, farms, and communities; and a State role in enabling groundwater trading with safeguards for vulnerable users. Commission staff made 14 presentations to stakeholder groups, including GSAs, habitat managers, farmers, county representatives, environmental and community nonprofit organizations, and community members. The Commission hosted two online public workshops, presented via Zoom. A total of 229 participants attended the workshops. The workbook used for the workshops is posted on the Commission’s website: https://cwc.ca.gov/-/media/CWC-Website/Files/Documents/2021/GWTrading_Workbook_FINAL.pdf. Recordings for all workshops are posted to the Commission’s website: <https://www.water-ca.com/ground-water-trading-workshops.html>. Results of the Commission’s survey are discussed in Appendix 6: Stakeholder Survey. A discussion of workshop and survey results was brought to the public at the following Commission meeting:

- [Groundwater Trading: Workshop Results - November 2021, Item 9](#)

Throughout this process, Commission staff worked closely with a stakeholder advisory group to inform its approach and guide its discussions (see Appendix 7: Groundwater Trading Stakeholder Advisory Group Members). Commission staff also met regularly with representatives from the implementing agencies to share information and to keep them apprised of the status of the Commission’s work.

Drawing on its public discussions, the Commission developed this white paper to guide the continued work on Action 3.6 by DWR, the Water Board, CDFW, and CDFA. The white paper includes a set of findings around how to shape well-managed groundwater trading programs with appropriate safeguards for natural resources, small- and medium-sized farms, and disadvantaged communities, and addresses what role the State could play in supporting groundwater trading.

Appendix 3: Allocations

Groundwater allocations are particularly important to groundwater trading. Without groundwater allocations, trading has no basis: allocations provide a limit on the amount of groundwater that can be pumped by an individual user and a consistent unit to trade. For this reason, establishing allocations is a necessary precursor to developing a groundwater trading program. If groundwater is allocated thoughtfully and inclusively, it can support trading that does not undermine a community's access to safe, clean, affordable water adequate for human consumption, cooking, and sanitary purposes, and does not overlook groundwater-dependent ecosystems and smaller farms. In particular, GSAs will need to consider how allocations to community water systems will ensure and support the Human Right to Water.

Because allocations are critical to groundwater trading, the topic of allocations came up repeatedly in the Commission's conversations with experts and stakeholders. Some stakeholders and some GSAs in the process of developing groundwater trading programs expressed a desire for more information to help with the complex process of determining allocations. These parties suggested that there would be some value in the State convening GSAs, stakeholders, and experts to discuss issues related to water rights and to groundwater allocations and that it would be helpful to share information about which allocations methods are being pursued and under which situation a particular allocation method may be a good practice.

While allocations are relevant to groundwater trading, the specifics of allocations, complex water rights issues, and other matters will depend on the area and uniquely complex issues relevant to each local setting. Further, the creation and modification of allocations is complicated and involves the potential for litigation that could lead to adjudications or intervention into groundwater management by the Water Board. SGMA—by its express terms—does not represent any final determination of the underlying groundwater rights in the basin. GSAs have no authority to determine water rights. Allocations may, for good reason, take water rights into account, but do not have to follow groundwater rights precisely. Short of an adjudication, GSAs and stakeholders cannot know what individuals' groundwater rights are. Further, no groundwater adjudication to date has precisely followed an individualized determination of water rights based on the legal principles governing groundwater rights. Most groundwater rights are overlying rights, which are not fixed but change as relative need changes. An overlying right holder can divert more as its reasonable needs increase, assuming there is enough water for all overlying needs. If there is not enough water, then each overlying right holder's right is reduced as necessary to meet the reasonable needs of the others. Other considerations, including claims of prescription, further complicate allocations. Even if allocations approximate water rights, they should not be thought of as water rights but instead be thought of as a regulatory overlay.

Below, the Commission captures some of the ways in which allocations may be designed to protect vulnerable water users. This information is based on the feedback the Commission received; the list is not exhaustive. GSAs will need to determine allocation methods based on local conditions and in line with their authority.

- GSAs could create special rules appropriate for local conditions for disadvantaged communities, small- and medium-sized farms, and environmental water uses, allowing these users to pump all or some proportionately tiered amount they need to be viable.

- GSAs could create a progressive allocation system that permits less pumping on larger landholdings (e.g., three acre-feet per acre on the first 100 acres and then a gradually reduced allocation for every 100 or more acres thereafter);
- GSAs could create a tiered system to protect one or more beneficial use that specifies that a certain portion of an allocation can only be used for agricultural purposes, for example, or another protected beneficial use, thereafter placing no restriction on the remainder of the allocation, which could be used for any other beneficial use (for example, municipal use); or
- GSAs could create carry-over rules allowing groundwater users to hold onto unused allocations for more than a single year, promoting conservation and flexibility.

Appendix 4: Current State Engagement

Defining how the implementing agencies are already engaged in SGMA and other groundwater-related efforts – as well as how other authorities, policies, and programs may relate to groundwater trading – provides context for understanding potential State engagement on groundwater trading, specifically. While the implementing agencies of Water Resilience Portfolio Action 3.6 are already active in supporting SGMA implementation, SGMA legislation only describes a specific oversight role for DWR and specific triggers for the Water Board’s enforcement actions. Per California Water Code section 10720.1(h), one of the primary goals of SGMA is to “manage groundwater basins through the actions of local government agencies to the greatest extent feasible, while minimizing state intervention to only when necessary to ensure that local agencies manage groundwater in a sustainable manner.” Aligned with the intent of SGMA, groundwater trading, as noted above, is a local, voluntary action selected, designed, and implemented by GSAs and other water rights holders.

Department of Water Resources (DWR). The Department of Water Resources has two primary roles in SGMA: regulator and provider of assistance. DWR’s major regulatory oversight role is to review and assess GSP compliance at the basin or subbasin level and work with GSAs to revise their GSPs where there are deficiencies. GSAs must prepare and submit GSPs for review and assessment by DWR at least every five years beginning in 2020 for critically overdrafted basins and 2022 for all other high- or medium-priority basins. DWR is required to make local GSPs publicly available through the DWR SGMA Portal⁵. GSPs deemed unacceptable by DWR will result in Water Board intervention until the GSA adequately addresses the deficiencies found in the GSP and the Water Board returns control to the local GSAs. While DWR does not oversee the implementation of actions within a GSP, DWR assesses whether GSPs consider all groundwater uses and users when addressing and avoiding undesirable results, among other regulatory criteria. DWR incorporated the state’s Human Right to Water policy into its GSP Regulations as part of the General Principles section (California Code of Regulations section 350.4(g)), making an early decision to incorporate the human right to water as a central principle⁶. For those GSPs that include groundwater trading programs as a management action, DWR will assess whether the program appears reasonable and feasible as described in the GSP and whether it will help achieve the basin’s sustainability goal.

In addition to GSP oversight, DWR offers technical, planning, and financial assistance programs to support and guide GSAs toward reaching their sustainability goals. The technical assistance program provides various groundwater-related technical data, modeling, and tools to help GSAs in addressing undesirable results during the development and implementation of their GSPs. Financial assistance provides planning and implementation grants that support GSP development and local projects or programs, and planning assistance includes facilitation and written translations services to assist with stakeholder engagement. These resources could help with starting a new groundwater trading program.

State Water Resources Control Board (Water Board). The State Water Resources Control Board serves as a SGMA backstop and enforcement agency. If DWR determines that GSAs are not sustainably managing their basin, the Water Board can step in to manage the basin in a process called “State

⁵ Link: [SGMA Groundwater Management \(SGMA\) Portal - Department of Water Resources \(ca.gov\)](https://www.water.ca.gov/SGMA/SGMA-Portal).

⁶ In April of 2021, DWR codified in the Department Administrative Manual a Human Right to Water policy that guides departmental operations, projects, and programs (section 1100.01). Link: <https://water.ca.gov/Programs/All-Programs/Human-Right-to-Water>

intervention.” Lack of plans, lack of coordination, inadequate plans, or inadequate implementation can trigger the State intervention process. After a triggering condition, the Water Board may designate a basin probationary after providing notice and holding a public hearing. Once a basin has been designated probationary, the Water Board may require groundwater extractors to install meters, measure and report all groundwater extractions, and pay fees to cover the cost of Water Board activities. The Water Board may also conduct investigations and gather data necessary for sustainable groundwater management. The Water Board may develop and implement an interim plan for a probationary basin if the Water Board determines that a local agency has not fixed the deficiencies that resulted in the probationary designation. An interim plan is intended to be a temporary measure to protect groundwater until effective local management is in place. An interim plan would likely focus on reducing groundwater use in the basin to sustainable levels as soon as practical.

To date, the Water Board has not initiated State intervention in any basins. The Water Board’s focus has been on working with local agencies and interested parties to respond to questions and concerns about SGMA implementation. Additionally, Water Board staff commented on several GSPs submitted to DWR. Comments drew from the Water Board’s expertise and regulatory experience in certain topic areas, including water quality, drinking water, and water rights. The goal of the Water Board’s GSP review was to highlight concerns now, so that issues can be addressed and implementation succeeds.

In addition to its enforcement role under SGMA, the Water Board also is responsible generally for the administration and enforcement of surface water rights. The California Water Code requires that the Water Board, in its role as administrator of surface water rights, consult with CDFW on the amounts of water needed for fish and wildlife. The Water Board, and all political subdivisions of the state, are charged with the protection of public trust resources, such as fisheries, wildlife, aesthetics, and navigation, which it must consider in the balancing of all beneficial uses of water, protecting public trust uses whenever feasible.

The Water Board has passed a Human Right to Water Resolution⁷ and a Resolution on racial equity⁸, both of which speak to the Water Board’s commitment to safeguarding water supplies for communities, particularly vulnerable communities.

California Department of Fish and Wildlife (CDFW). As trustee for the State’s fish and wildlife resources, the California Department of Fish and Wildlife has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish and Game Code sections 711.7 and 1802). CDFW supports groundwater planning that carefully considers and protects groundwater-dependent ecosystems. In response to SGMA, CDFW developed a Groundwater Program to ensure fish and wildlife resources reliant on groundwater are addressed in GSPs and to support compliance with regulatory requirements on CDFW-owned lands and facilities in groundwater basins subject to SGMA.

⁷ February 16, 2016, State Water Resources Control Board Resolution No. 2016-0010, Adopting the Human Right to Water as a Core Value and Directing its Implementation in Water Board Programs and Activities: [remediated resolution 2016-0010 \(ca.gov\)](https://www.waterboards.ca.gov/water_issues/programs/gsp/docs/2016-0010_resolution_2016-0010_ca.gov)

⁸ November 21, 2021, State Water Resources Control Board Resolution No. 2021-0050, Condemning Racism, Xenophobia, Bigotry, and Racial Injustice and Strengthening Commitment to Racial Equity, Diversity, Inclusion, Access, and Anti-Racism: [rs2021-0050 \(ca.gov\)](https://www.waterboards.ca.gov/water_issues/programs/gsp/docs/2021-0050_resolution_2021-0050_ca.gov)

CDFW is also responsible for implementation and enforcement of the California Endangered Species Act (CESA; Fish and Game Code section 2050 et seq.), a California environmental law that conserves and protects plant and animal species at risk of extinction, and oversees the Native Plant Protection Act (Fish and Game Code section 1900 et seq.), which is designed to preserve, protect, and enhance endangered or rare native plants. These responsibilities shape CDFW's interest in ensuring that groundwater management and trading do not harm listed species, although CDFW's interest in ensuring proper groundwater management extends to non-listed species.

When considering the appropriation of surface water, CDFW engages in the State Water Board's water right process via review, analysis, and comment on new water rights applications, development of conditions for water right permits and licenses, as well as any proposed changes to existing water rights. For surface water transfer change petitions, CDFW identifies studies, surveys, and data required to evaluate conditions necessary to protect fish and wildlife resources and develops terms and conditions to protect public trust resources.

The Wetlands Conservation Policy (Executive Order W-59-3), also known as the state's "No Net Loss" policy, is an executive order issued in 1993 providing for the coordination of statewide activities for the preservation and protection of wetland habitats, which is potentially meaningful for any SGMA-related impacts to wetland habitat. CDFW implements No Net Loss through its "Retention of Wetland Acreage and Habitat Values" policy, which governs wetlands owned by CDFW. For wetlands not owned by CDFW, CDFW's role is advisory, related to the application of applicable state and federal laws and regulations.

California Department of Food and Agriculture (CDFA). The California Department of Food and Agriculture supports the ongoing vitality of the state's agricultural industry. In relation to SGMA, CDFA provides informational resources to support farmers and ranchers in accessing technical assistance and federal and state funding related to water-use efficiency and soil health. CDFA's Office of Environmental Farming and Innovation provides financial assistance for on-farm management practices and technologies that help farmers and ranchers prepare for and adapt to the implementation of SGMA. The State Water Efficiency and Enhancement Program (SWEET) provides grants for irrigation system improvements that conserve water while the Healthy Soils Program funds soil management practices that promote water retention and infiltration. Both programs are supported by technical assistance providers, funded through CDFA, that help farmers apply for funding and implement projects. In 2021, CDFA received one-time funding for the Water Efficiency Technical Assistance (WETA) program. This program will support on-farm water efficiency technical assistance more broadly and support the development of training curriculum and resources for farmers related to irrigation water management and efficient irrigation systems.

CDFA is also home to the Office of Farm Equity, which runs the California Underserved and Small Producers Grant Program, designed to facilitate direct assistance to individual small- and mid-scale and socially disadvantaged farmers and ranchers who need support applying for economic relief grant programs and assistance with business planning and marketing strategies. Passed in 2017, the Farmer Equity Act requires the CDFA "to ensure the inclusion of socially disadvantaged farmers and ranchers...in the development, adoption, implementation, and enforcement of food and agriculture laws, regulations, and policies and programs."⁹

⁹ Link: [Bill Text - AB-1348 Farmer Equity Act of 2017. \(ca.gov\)](#)

Box 4: Related State Actions

Groundwater Management and Drinking Water Well Principles and Strategies. Called for in Governor [Executive Drought Proclamation in April 2021](#), [the Groundwater Management and Drinking Water Well Principles and Strategies \(Principles and Strategies\)](#) are intended to help ensure that potential drought impacts on communities that rely on groundwater for drinking water are anticipated and proactively addressed. DWR and the Water Board have developed these Principles and Strategies to monitor, analyze, and minimize the impacts of groundwater management on drinking water wells. The information contained in the Principles and Strategies document provides a complementary framework for considering how to protect some of the vulnerable water users considered in this white paper.

Voluntary Open-source Groundwater Accounting Platform. DWR, the Water Board, the California Water Data Consortium (Consortium), and Environmental Defense Fund (EDF) are collaborating to enhance and scale a voluntary open-source groundwater accounting [platform](#) that will be freely available to help GSAs manage the transition to sustainable supplies. The open-source platform enables water managers and landowners to securely track water supplies and use, create water budgets, model scenarios, and trade allocations of water within a district or basin. DWR and the Water Board are working with EDF and the Consortium to ensure that the platform is compatible with the online electronic portals that local agencies use to submit public data required by the State, such as DWR's SGMA Portal and the Water Board's Groundwater Extraction Annual Reporting System (GEARS). Groundwater trading is one of many tools that local agencies are considering for managing groundwater sustainably, and an accounting system is the first step for such programs.

Appendix 5: Synthesis of Out-of-State Conversations

Commission staff talked to 22 people total from the states of Arizona, Colorado, Florida, Nebraska, and Texas, and from Australia about the role of their states in trading programs, about their experience with considering vulnerable water users in groundwater trading, and about any salient issues and considerations they could share with the Commission. Out-of-state representatives discussed groundwater management generally as well as groundwater trading. The information they shared complements what staff heard from its small-group participants. Representatives stressed that sustainable groundwater management takes time – decades or more – and that local control is important, but that the State can serve as a catalyst for sustainable management and provide removed but important oversight. The need to engage stakeholders and the community came up repeatedly, with representatives stressing the need for groundwater managers to embed in the community, to understand it, to educate pumpers, and to take the time to build trust.

Through its conversations, the Commission learned of many ways of allocating groundwater: by permitting acres with unlimited pumping, which works best in areas with the same cropping patterns; by well and by year; by acre (based either on desired future conditions or historic use); and with restricted usage, with a certain portion specified for agricultural use and the rest unrestricted. In many cases, household wells and de minimis users are exempted from the allocation process. Some representatives explained that allowing for multiple-year allocations helps combat a “use it or lose it” mentality, leading to increased conservation and lower overall groundwater use. Groundwater managers stressed the overarching importance of enforcing allocation limits and the need for compliance with groundwater management rules. In general, out-of-state representatives explained that locals embrace rules and want to see them enforced consistently; they do not see the rules as an imposition or a burden, but as a necessity for fairness.

Representatives noted that groundwater trading is complicated and generally happens later in the process of managing groundwater. In Australia, groundwater trading is growing, but is significantly less in volume than surface water trading. There are two types of groundwater transfers: temporary transfers (called allocation transfers) and permanent groundwater transfers (called groundwater license entitlement transfers, which are less common). Trading between different groundwater sources is not permitted. In Arizona, there is not a huge volume of trades nor a specific interest in safeguarding disadvantaged communities or small- and medium-sized farm operators. Two local groundwater trading programs – the Edwards Aquifer in Texas and the Twin Platte in Nebraska – instituted groundwater management to protect surface water resources (streams, springs, and species) due to laws related to endangered species and depletion of interstate surface water. The Edwards Aquifer Authority uses directional trading to restrict trading near surface waters. The Twin Platte Natural Resources District, which uses irrigated acres as its unit of trade, uses a stream depletion factor (SDF) to calculate proportional trading, where the SDF determines the number of acres that can be irrigated based on the possible impact to the stream. Fewer acres can be irrigated as proximity to the stream increases.

Appendix 6: Stakeholder Survey

To explore and validate themes identified during Step 1 conversations, the Commission conducted an online stakeholder survey, distributed through Commission communication lists and social media, stakeholder advisory group members' associated networks, and the DWR Sustainable Groundwater Management Office e-mail distribution list. The survey asked respondents to rank the importance of including various characteristics of well-managed groundwater trading in future policy recommendations and of possible State roles in supporting groundwater trading. It also asked respondents to share thoughts on how best to guide groundwater trading with safeguards for vulnerable water users. Over the course of four weeks, 135 people responded to the survey. Of the 135 responses, 35 percent indicated they were affiliated with or represented a GSA. Respondents were from across the state and included farm operators, representatives of county and regional groups, environmental groups, state and federal agencies, private utilities, consultants, and Tribes. Although the results are not statistically robust because respondents were not equally representative of the entire stakeholder population, responses indicate support for the themes identified by the Commission and offer areas for further exploration¹⁰.

- **Characteristics of well-managed trading programs.** Respondents indicated that clear trading rules, measurement of water use, and water accounting and allocations are important characteristics of well-managed groundwater trading that should be incorporated into future policy recommendations. Responses show that stakeholder engagement has the least support for inclusion in future policy recommendations. This may be an area where some additional inquiry would be useful.
- **State role in supporting a well-managed groundwater trading program.** Respondents indicated that they would like to see the State provide guidance and minimum standards around how to establish well-managed groundwater trading programs and ensure that programs have metrics and monitoring. Responses show that a State role in enforcing protections for vulnerable users and ensuring the human right to water have the least support from the totality of respondents. Given the State's interest in having safeguards for vulnerable users, it may be useful to learn more about perceived concerns about these State roles
- **Guidance on how to establish a groundwater trading program with safeguards for vulnerable users.** Respondents indicated a preference for the State issuing best management practices and/or establishing standards that would need to be met to qualify for State funding or other assistance.

¹⁰ Survey results were presented to the public and the Commission at the November 2021 Commission meeting. More information is available here: [Groundwater Trading: Workshop Results - November 2021, Item 9.](#)

Appendix 7: Groundwater Trading Stakeholder Advisory Group Members

	Agency	Member (Name, Title)	Alternate (Name, Title)
1	Environmental Defense Fund	Dr. Christina Babbitt , Director, Climate Resilient Water Systems	Ann Hayden , Associate Vice President, Climate Resilient Water Systems
2	The Nature Conservancy	Sarah Heard , Director of Conservation Economics & Finance	
3	Mid-Kaweah Subbasin GSA	Aaron Fukuda , interim General Manager	
4	Madera County	Stephanie Anagnoson , Director of Water and Natural Resources	
5	Self-Help Enterprises	Eddie Ocampo , Director of Community Sustainability	Angela Islas , Community Development Specialist
6	Leadership Counsel for Justice and Accountability ¹¹	Nataly Escobedo Garcia , Policy Coordinator	
7	University of California Cooperative Extension	Dr. Ruth Dahlquist-Willard , Small Farms and Specialty Crops Farm Advisor	
8	Community Alliance with Family Farmers	David Runsten , Policy Director	

¹¹ Leadership Council for Justice and Accountability is opposed to groundwater trading.