

1432 **APPENDIX 8c**

1433 **Groundwater Trading System**

1434 **INTRODUCTION**

1435 The Solano Collaborative received input on groundwater markets at a series of meetings over the  
1436 Groundwater Sustainability Plan (GSP) development period. A groundwater market was considered to  
1437 improve flexibility for a potential demand management program and was also considered as a potential  
1438 way to facilitate exchanges in specific areas of the Solano Irrigation District to reduce pumping in these  
1439 areas (effectively and in-lieu recharge program).

1440 The GSP does not include plans to immediately develop and implement demand management or a  
1441 groundwater market in the Solano Subbasin. The GSAs will continue to monitor Subbasin conditions,  
1442 assess the need for a market, and engage stakeholders, the public, and technical experts in market  
1443 design if needed in the future. Therefore, this appendix should be viewed as a high-level overview of  
1444 options to increase flexibility and reduce costs associated with potential future demand management in  
1445 the Solano Subbasin. The Collaborative, or other lead agency as appropriate, may initiate a study in the  
1446 future to better define some of the concepts for application in the Solano Subbasin.

1447 This appendix describes a groundwater market (sometimes called groundwater trading), components  
1448 for market design, and considerations for implementation in the Solano Subbasin.

1449 **GROUNDWATER TRADING INSTITUTION**

1450 A market—for groundwater or any other good—is an economic institution that enables willing buyers  
1451 and sellers to meet and transact business, trade goods and services in exchange for other goods and  
1452 services or the exchange of money.

1453 Groundwater markets can provide benefits for the participants, and they can help direct economic  
1454 resources in a way that improves the economy as a whole. However, market transactions can also affect  
1455 third parties - others not directly involved in the transaction, which is especially important when the  
1456 market involves a natural resource like groundwater that affects lives and livelihoods in the Solano  
1457 Subbasin in many ways. For a groundwater market to work well in the Solano Subbasin, participants  
1458 must know what they have to trade and under what conditions or restrictions.

1459 A groundwater market is an institution that specifies, enforces, and manages rules that:

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- Ensure trading is consistent with the Solano Subbasin GSP, sustainability objectives, and desired  
1461 outcomes.
  - Define who can participate and the quantity that they can trade.
  - Are consistent with the Solano Subbasin water budget and other projects being implemented.
- 1462
- 1463

- 1464 • Assure the participants of what they are buying or receiving and that their transactions will be  
 1465 honored.
- 1466 • Protect third parties from unintentional, significant harm, that would cause undesirable results  
 1467 in the subbasin.
- 1468 • Allow the flow of information needed to conduct business (engage in transfers) and allow trades  
 1469 to be executed at relatively low cost.

1470 A groundwater market is more than a storefront, accounting system, or online system for posting trades  
 1471 and should be tailored to conditions in the Solano Subbasin. An effective groundwater market would  
 1472 consider physical, legal, regulatory, economic, and political conditions, and be tailored to those  
 1473 conditions. Importantly, this process would include the sustainable management criteria for  
 1474 groundwater as defined in the GSP. **Figure Appendix 8c-1** illustrates and provides a brief description of  
 1475 the seven different components of a groundwater market institution, including subbasin conditions,  
 1476 allocation, trading structure, market rules, monitoring and enforcement, market administration, and  
 1477 market reporting. These components are described below.



1478  
 1479 *Figure Appendix 8c-1: Groundwater Market Components*

1480 Substantial overlap occurs between many of the components. For example, monitoring and  
 1481 enforcement and reporting are linked because the ability to monitor the market depends on  
 1482 information that is reported to the market administrator. Modern software for trading structures (smart  
 1483 market electronic clearing houses) can integrate market rules, match trades, and report market  
 1484 information in real time to participants, thereby integrating three components of the groundwater  
 1485 market simultaneously.

1486 **Basin Conditions.** An effective groundwater market must be appropriate for and tailored to local  
 1487 conditions, which encompass the physical, legal, economic, and social characteristics of the Subbasin.  
 1488 For example, hydrogeologic conditions affect minimum thresholds and measurable objectives and the

1489 checkerboard pattern of districts and other entities across the Subbasin. Political considerations would  
1490 define the desired outcomes of a groundwater market, addressing localized areas with sustainability  
1491 concerns and defining potential impacts to third parties so that those can be mitigated in the market.  
1492 The legal institutions under which a water market operates includes California’s system of water rights,  
1493 requirements and authorities related to water trading under SGMA and other parts of the Water Code,  
1494 and many other related issues, including California contract law and environmental law.

1495 **Allocation.** A groundwater allocation specifies the quantities of available groundwater, and is essential  
1496 for an effective groundwater market so that potential traders know what they have to sell or need to  
1497 buy. Without an allocation, pumpers face no effective scarcity of groundwater so they would have no  
1498 motive to create or participate in a market. Fundamentally, an allocation and market rely on rights that  
1499 are well enough defined that potential traders know what they can legally trade (buy or sell) and not be  
1500 at risk for the time and expense of legal challenge. Therefore, an allocation must by its nature be built  
1501 on top of the underlying water rights of the participants.

1502 **Trading Structure.** Trading structures are the ways in which buyers and sellers of water connect with  
1503 one another and execute a transaction. It is one component of a groundwater market institution, but it  
1504 does not constitute the entire market (this is a common source of confusion). A trading structure can be  
1505 thought of as the “marketplace” where buyers and sellers go to gather information and conduct trading  
1506 business. Structures range from informal, such as bilateral negotiations, to water brokers and more  
1507 formal exchanges, such as electronic clearinghouses. The selection of the trading structure affects the  
1508 cost to participate in the market and how participants gather information about the market. For  
1509 example, an electronic clearinghouse can automatically match buyers and sellers, whereas informal  
1510 bilateral trades require individuals to locate, negotiate, and execute trades with one another. The search  
1511 and transaction costs for the different types of trading structures can vary in important ways. This, in  
1512 turn, affects access to the market, which emphasizes the importance of developing a trading structure  
1513 concurrent with other market elements.

1514 **Market Rules.** Market rules are restrictions on groundwater trade quantities, timing, or location that are  
1515 derived from groundwater allocation decisions, Subbasin hydrology, GSP sustainability criteria, and  
1516 other legal, social, or political concerns. For example, a trading rule might limit the quantity of  
1517 groundwater traded out of an area within the Subbasin (or impose trading ratios) with sustainability  
1518 concerns (e.g., falling groundwater levels). Another trading rule might define the volume of an allocation  
1519 that can be carried over across years to limit market “speculators” and encourage greater trading in the  
1520 market. Regardless of trading structure, the market rules should be clear and specific so that  
1521 participants can determine whether the trade would be approved or denied before the transfer  
1522 application is submitted. Clear and specific criteria for approval improve the quality of transfer  
1523 applications and also expedite the review process, with defensible reasons for the application decision.  
1524 Market rules are important for ensuring that the market does not negatively affect third parties, but  
1525 market rules also may “thin” the market, making fewer parties eligible to trade with one another. Rules  
1526 should be developed to balance market participation and prevent unintended outcomes of the market.

1527 **Monitoring and Enforcement.** The three primary methods of measuring groundwater use include using  
1528 crop coefficients and irrigated area, satellite remote sensing, and well metering. The monitoring  
1529 methods are not necessarily mutually exclusive, and multiple methods may be implemented within the  
1530 same market. The core requirement is that the market participants understand and accept the  
1531 monitoring method so that they know what quantities are being bought and sold in the market.  
1532 Enforcement follows from monitoring and is typically the responsibility of the market administrator,  
1533 which would be the GSA. **Appendix 8f** includes a summary of a generalized groundwater credit  
1534 accounting framework that describes an application of a monitoring/tracking approach for the Subbasin.

1535 **Market Administration.** The role of a market administrator is to incorporate rules and regulations, as  
1536 well as relevant updates, into how parties are matched; to match parties based on eligibility to trade  
1537 and on price point; and to finalize the transaction through contracting, recording, and exchanging  
1538 monies. Market administrators can be any number of entities, public or private, but would typically  
1539 involve the GSA (or GSAs) for some components of administration. Many administrators are private, for-  
1540 profit organizations, as are Mammoth Water, Waterfind, and Western Water Market. The selection of a  
1541 market administrator typically considers how certain private data, such as price information, are  
1542 handled, whether there is a real or perceived conflict of interest or bias in the market structure, the cost  
1543 structure, and other basic qualifying criteria (e.g., experience, domain expertise).

1544 **Market Reporting.** Market reporting includes tracking the characteristics of trading activity, including  
1545 the quantity of water traded, parties and wells involved in the trade, and the timing and duration of the  
1546 trade. These characteristics must be known for proper completion of each transaction and must be  
1547 provide to the GSA Collaborative for inclusion in the Annual Report and the 5-year update of the GSP.  
1548 Permanent transfers may require additional reporting, such as recording the deed transfer at the county  
1549 clerk's office. It is important to note that market reporting can be handled within the market trading  
1550 structure. For example, electronic clearinghouse smart markets automatically match buyers and sellers,  
1551 approve trades, and report specified market outcomes.

## 1552 **SUMMARY**

1553 This appendix provided a general overview of a groundwater market institution. The Solano GSAs may  
1554 consider a groundwater market to support GSP implementation in the future. The components of a  
1555 groundwater market described here provide an initial summary of the requirements for setting up a  
1556 functioning groundwater market that provides benefits to Subbasin participants. If initiated, market  
1557 development would involve the GSAs, technical experts, and a substantial stakeholder and public  
1558 outreach effort in the Subbasin. Future funding opportunities to support groundwater market  
1559 development include potential state grants, US Bureau of Reclamation Water Smart grants, and local  
1560 funding through GSA fees. A groundwater market is one way to increase flexibility and reduce costs  
1561 associated with any future demand management (or other limits on groundwater pumping in specific  
1562 areas) in the Subbasin. The concepts described in this appendix would need to be more fully developed  
1563 under a future study for a potential Solano Subbasin groundwater market.

1564 Potential next steps would be completed under GSP implementation, concurrent with the development  
1565 of planned projects and management actions, and would include:

- 1566 • Develop a planning study to evaluate the willingness and ability to pay for groundwater in the  
1567 Solano Subbasin. The study would serve dual purposes of: (i) evaluating potential trading  
1568 outcomes under a market and impacts to third-parties and (ii) establishing willingness to pay for  
1569 additional water supply, which would support planned project feasibility studies.
- 1570 • Pursue potential funding options and partners for a groundwater marketing study, which may  
1571 include USBR WaterSmart grants (which require a cost-share) or other funding opportunities  
1572 with partners. The study would expand on the groundwater market components and define  
1573 specific options for the Solano Subbasin.
- 1574 • Preliminary groundwater market study design could be targeted to individual market  
1575 components, each of which are related to other aspects of the GSP. For example, a planning  
1576 study of potential groundwater allocation concepts could be developed as one component of  
1577 groundwater market design. However, it is also related to Subbasin funding and financing  
1578 mechanisms (cost allocation) as well as implementation of other recharge projects (if any  
1579 benefits are associated with recharge projects). Developing targeted studies (rather than a full  
1580 groundwater market design) may be a cost-effective way to introduce and explore concepts  
1581 without committing to a full groundwater market.