BOARD OF SUPERVISORS AGENDA ITEM REPORT
AWARDS / CONTRACTS / GRANTS

○ Award ◉ Contract ○ Grant

Requested Board Meeting Date: July 2, 2024

** = Mandatory, information must be provided*

or Procurement Director Award: ☐

***Contractor/Vendor Name/Grantor (DBA):**

Department of Interior US Geological Survey

***Project Title/Description:**

Joint Funding Agreement (JFA) Water Resource Investigations Agreement 24ZFJFA0800

***Purpose:**

The purpose of this JFA (Intergovernmental Agreement (IGA) between the Department of Interior US Geological Survey (USGS) and Regional Flood Control District (District) is to monitor changes in water stored in the Tucson Active Management Area (TAMA) aquifers and evaluate land surface change, which may impact infrastructure, cause subsidence and land fissures.

***Procurement Method:**

This IGA is a non-Procurement contract and not subject to Procurement rules.

***Program Goals/Predicted Outcomes:**

Improve our knowledge of existing water resources and threats to infrastructure from loss of water in the TAMA aquifers and subsequent land-surface elevation change.

***Public Benefit:**

Obtain a better capacity to estimate risks from land-surface changes to roads, sewer lines, and foundations, as well as knowledge of changes in water resource volume availability and physical location.

***Metrics Available to Measure Performance:**

The USGS will provide the District with interpretive maps, a presentation on the updated data, and periodic technical reports on an annual basis.

***Retroactive:**

Yes. The USGS returned the signed agreement on June 4, 2024, which did not allow the District sufficient time to route for Pima County signatures and submit documents to the Clerk of the Board prior to the June 5, 2024 deadline to be placed on the Board of Supervisors Agenda for the June 18, 2024 meeting.

To: COB 6-13-24(1)
Vers: 1
Pgs: 12

THE APPLICABLE SECTION(S) BELOW MUST BE COMPLETED

Click or tap the boxes to enter text. If not applicable, indicate "N/A". Make sure to complete mandatory (*) fields

Contract / Award Information

Document Type: CT Department Code: FC Contract Number (i.e., 15-123): 24*483

Commencement Date: 7/1/24 Termination Date: 06/30/2028 Prior Contract Number (Synergen/CMS): _____

☒ Expense Amount $ 69,800 * ☐ Revenue Amount: $ _____

***Funding Source(s) required:** Flood Control Tax Levy

Funding from General Fund? ○ Yes ◉ No If Yes $ _____ % _____

Contract is fully or partially funded with Federal Funds? ○ Yes ◉ No

If Yes, is the Contract to a vendor or subrecipient? _____

Were insurance or indemnity clauses modified? ○ Yes ◉ No

If Yes, attach Risk's approval.

Vendor is using a Social Security Number? ○ Yes ◉ No

If Yes, attach the required form per Administrative Procedure 22-10.

Amendment / Revised Award Information

Document Type: _____ Department Code: _____ Contract Number (i.e., 15-123): _____

Amendment No.: _____ AMS Version No.: _____

Commencement Date: _____ New Termination Date: _____

Prior Contract No. (Synergen/CMS): _____

○ Expense ○ Revenue ○ Increase ○ Decrease Amount This Amendment: $ _____

Is there revenue included? ○ Yes ○ No If Yes $ _____

***Funding Source(s) required:** _____

Funding from General Fund? ○ Yes ○ No If Yes $ _____ % _____

Grant/Amendment Information (for grants acceptance and awards)

○ Award ○ Amendment

Document Type: _____ Department Code: _____ Grant Number (i.e., 15-123): _____

Commencement Date: _____ Termination Date: _____ Amendment Number: _____

☐ Match Amount: $ _____ ☐ Revenue Amount: $ _____

***All Funding Source(s) required:** _____

***Match funding from General Fund?** ○ Yes ○ No If Yes $ _____ % _____

***Match funding from other sources?** ○ Yes ○ No If Yes $ _____ % _____

***Funding Source:** _____

***If Federal funds are received, is funding coming directly from the Federal government or passed through other organization(s)?**

_____

Contact: David Scalero (M. Guzman 4-4611 for P/U)

Department: Regional Flood Control District Telephone: (520) 724-4600

Department Director Signature: _____ Date: 6-11-2024

Deputy County Administrator Signature: _____ Date: 6/11/2024

County Administrator Signature: _____ Date: 6/11/2024

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000000793
Agreement #: 24ZFJFA0800
Project #:
TIN #: 86-6000543

Fixed Cost Agreement YES[X] NO[ ]

THIS AGREEMENT is entered into as of the July 1, 2024, by the U.S. GEOLOGICAL SURVEY, Arizona Water Science Center, UNITED STATES DEPARTMENT OF THE INTERIOR, party of the first part, and the Pima County party of the second part.

1. The parties hereto agree that subject to the availability of appropriations and in accordance with their respective authorities there shall be maintained in cooperation for negotiated deliverables (see attached), herein called the program. The USGS legal authority is 43 USC 36C; 43 USC 50, and 43 USC 50b.

2. The following amounts shall be contributed to cover all of the cost of the necessary field and analytical work directly related to this program. 2(b) include In-Kind-Services in the amount of $0.00

(a) $50,100 by the party of the first part during the period July 1, 2024 to June 30, 2028

(b) $69,800 by the party of the second part during the period July 1, 2024 to June 30, 2028

(c) Contributions are provided by the party of the first part through other USGS regional or national programs, in the amount of: $0

Description of the USGS regional/national program:

(d) Additional or reduced amounts by each party during the above period or succeeding periods as may be determined by mutual agreement and set forth in an exchange of letters between the parties.

(e) The performance period may be changed by mutual agreement and set forth in an exchange of letters between the parties.

3. The costs of this program may be paid by either party in conformity with the laws and regulations respectively governing each party.

4. The field and analytical work pertaining to this program shall be under the direction of or subject to periodic review by an authorized representative of the party of the first part.

5. The areas to be included in the program shall be determined by mutual agreement between the parties hereto or their authorized representatives. The methods employed in the field and office shall be those adopted by the party of the first part to insure the required standards of accuracy subject to modification by mutual agreement.

6. During the course of this program, all field and analytical work of either party pertaining to this program shall be open to the inspection of the other party, and if the work is not being carried on in a mutually satisfactory manner, either party may terminate this agreement upon 60 days written notice to the other party.

7. The original records resulting from this program will be deposited in the office of origin of those records. Upon request, copies of the original records will be provided to the office of the other party.

8. The maps, records or reports resulting from this program shall be made available to the public as promptly as possible. The maps, records or reports normally will be published by the party of the first part. However, the party of the second part reserves the right to publish the results of this program, and if already published by the party of the first part shall, upon request, be furnished by the party of the first part, at cost, impressions suitable for purposes of reproduction similar to that for which the original copy was prepared. The maps, records or reports published by either party shall contain a statement of the cooperative relations between the parties. The Parties acknowledge that scientific information and data developed as a result of the Scope of Work (SOW) are subject to applicable USGS review, approval, and release requirements, which are available on the USGS Fundamental Science Practices website (https://www.usgs.gov/office-of-science-quality-and-integrity/fundamental-science-practices).

Form 9-1366
(May 2018)

U.S. Department of the Interior
U.S. Geological Survey
Joint Funding Agreement
FOR
Water Resource Investigations

Customer #: 6000000793
Agreement #: 24ZFJFA0800
Project #:
TIN #: 86-6000543

9. Billing for this agreement will be rendered **quarterly**. Invoices not paid within 60 days from the billing date will bear Interest, Penalties, and Administrative cost at the annual rate pursuant the Debt Collection Act of 1982, (codified at 31 U.S.C. § 3717) established by the U.S. Treasury.

USGS Technical Point of Contact

Name:	Jamie Macy Supervisory Hydrologist/Associate Director for Studies
Address:	2255 North Gemini Drive Flagstaff, AZ 86001
Telephone:	(928) 556-7276
Fax:	(928) 556-7112
Email:	jpmacy@usgs.gov

Customer Technical Point of Contact

Name:	David Scalero
Address:	Pima County Regional Flood Control District 201 N. Stone Ave. Tucson, AZ 85701
Telephone:	(520) 724-4600
Fax:	(n/a)
Email:	david.scalero@pima.gov

USGS Billing Point of Contact

Name:	Rudolph (Rudy) Richard Administrative Officer
Address:	520 N. Park Ave Tucson, AZ 85719
Telephone:	(520) 670-3302
Fax:	(n/a)
Email:	rrichard@usgs.gov

Customer Billing Point of Contact

Name:	David Scalero
Address:	Pima County Regional Flood Control District 201 N. Stone Ave. Tucson, AZ 85701
Telephone:	(520) 724-4600
Fax:	(n/a)
Email:	david.scalero@pima.gov

U.S. Geological Survey
United States
Department of Interior

Signature

By JAMES LEENHOUTS Digitally signed by JAMES LEENHOUTS Date: 2024.06.04 08:56:46 -07'00' **Date:**

Name: James M Leenhouts

Title: Director of Arizona Water Science Center

Pima County

Signatures

By Brian Jones 2024.06.05 15:27:20-07'00' **Date:** 6/5/24

Name: Brian Jones

Title: Deputy Director

PIMA COUNTY FLOOD CONTROL DISTRICT

_____

Chair, Board of Directors

_____

Date

ATTEST

_____

Clerk of the Board

_____

Date

APPROVED AS TO FORM

_____

Deputy County Attorney

Sarah Meadows

6-10-2024

_____

Date

Aquifer-Storage Change and Land-Surface Elevation Change Monitoring in the Tucson Active Management Area, July 1, 2024, to June 30, 2028

Introduction

The U.S. Geological Survey (USGS), in cooperation with local state and city agencies, have been monitoring aquifer-storage change within the Tucson Active Management Area, here referred to as TAMA, since the 1990's. The main method utilized is the repeat microgravity for storage change and Interferometric satellite aperture radar (InSAR) for land surface elevation change. Over the decades, the spatial extent of the monitoring has grown and expanded to now include over 140 active stations within TAMA. The most recent report was from the period of 2003-2016 (Carruth and others, 2018), but data collection has continued biannually with data releases being produced for the public.

The continued artificial recharge in the area, in addition to ephemeral streamflow and groundwater pumping, allows for continued interest in aquifer-storage monitoring of the area. In 2020, the project included the maintenance and installation of new sites to replace monument sites that have been lost or destroyed over the years. While no new sites are proposed to be installed or replaced, an updated GPS survey is needed to archive and document all current measurement sites within the area. Since gravity change is highly spatially variable, an accurate GPS location and elevation of the sites is vital for repeat measurements at the same location.

This project relies on the use of two ZLS Burris relative gravity meters and two Micro-g LaCoste A-10 absolute gravimeters for gravity monitoring, and iGage iG9 Global Navigation Satellite System (GNSS) receivers for GPS surveying. Relative gravity meters are used to measure the relative difference in gravity between two stations, but this method alone generally cannot detect the slow scale of storage change that occurs over a multi-month or year timeframe. Relative gravimeters are best utilized when paired with an absolute gravity measurement that acts as a datum in which all changes can then be referred to. The absolute gravity meters provide a measurement of the acceleration due to gravity at any location at any time, so the timing of relative measurements is then required to be made in conjunction with absolute measurements in order to achieve the best precision and accuracy of the gravity field at that time (Kennedy and others, 2020). The GNSS survey is used to provide highly precise location and elevation data. Data from the GNSS survey will be used in the final processing of the absolute data to account for changes in elevation that could have been caused by land subsidence.

The most recent data collection has included a full survey in odd years and a partial survey every even year. The full survey utilized all 140 stations in the network to provide maps of storage change over most of the basin and the partial survey only included 40-60 sites. The purpose of interceding full and partial surveys allows for storage change maps over the area to be created biannually, and in the years in between select focus areas are surveyed to gain an in-depth view of areas that show changes to previous trends. In FY28 year, a web-based visualization method, known as a geo-narrative, will be created and made available to the public. The geo-narrative will allow for visualization and conceptualization of the aquifer storage change from the collected data.

The USGS proposes to continue working with Arizona Department of Water Resources (ADWR), Pima County Regional Flood Control District, City of Tucson-Tucson Water, and the Town of Marana, to collect relative and absolute gravity data, along with using InSAR data provided by ADWR. The gravity data in conjunction with updated measuring station GPS data will provide estimates of aquifer storage change through June 30th, 2028.

Problem

The volume of water artificially recharged or pumped from an aquifer is easily measured. Estimations based on indirect methods must be used for other groundwater-budget components, including withdrawals by small capacity (<35 gallon per minute) wells, evapotranspiration, groundwater underflow from adjacent basins, incidental recharge from effluent recharge and other sources, and natural recharge from many sources including mountain fronts and ephemeral streams. This estimation of several groundwater-budget components results in large uncertainty in the groundwater budget. The greatest uncertainty can be attributed to a lack of information about natural recharge and groundwater-storage change. Estimates of the natural recharge rates are highly uncertain and depend on accurate measurements of annual precipitation and streamflow, which have high interannual variation (Pool, 2005). Estimates of groundwater storage change are also highly uncertain when computed as residuals in the water budget equations because the storage term includes the cumulative uncertainty of all other components.

Water levels in wells have been monitored to estimate aquifer-storage changes. However, use of water-level variations entails significant assumptions about the hydraulic properties of the aquifer system. One difficulty is the heterogeneity of hydrologic properties of the aquifer; the alluvial sediments of the aquifer vary in lithology and texture, both laterally and with depth. Thus, hydraulic properties estimated from water levels in individual wells may not adequately represent aquifer characteristics at distances away from the well. A second difficulty is monitor-well design; particularly when water levels are measured in deep wells that tap multiple aquifers, most of which are confined and have accordingly low storage properties. Water levels in these deep wells open to multiple aquifers represent a composite of water levels from several aquifer units. When these composite water levels are used to estimate storage changes, the hydrologic properties used in the calculation typically do not reflect the range of aquifer materials over which the well is screened. Water-level responses also depend on the geometry and lithology of the hydrogeologic units that constitute the aquifer system that wells sample. This information often is incomplete, or uncertain. Because of these complexities and requisite assumptions, use of water-level variations as the only indicators of storage change can be uncertain and cannot be reliably extrapolated beyond the well location.

Aquifer-storage can be monitored by measuring changes in gravity alone. As water is added or removed from the aquifer, there is a change in mass and a corresponding measurable change in gravity. The repeat microgravity method is an established method for monitoring aquifer-storage changes in alluvial basins (Kennedy and others, 2021). Monitoring of gravity and groundwater levels in the Tucson Basin has shown that large changes in groundwater storage, as much as several feet of water, have occurred that were not reflected in comparable water-level changes (Carruth and others, 2018).

The City of Tucson's water utility, Tucson Water, manages many artificial recharge projects in the project area. Two of importance are the Central Avra Valley Storage and Recovery

Project (CAVSARP) and Southern Avra Valley Storage and Recovery Project (SAVSARP). These two facilities, located in the eastern part of Tucson, have seen reduced volumes of recharge into the subsurface since 2021. The response to the variable recharge rates of these areas will be of particular interest to the city of Tucson as the observed aquifer storage is thus affected.

Permanent land subsidence can occur in alluvial basins when water is removed from aquifer systems (Galloway and others, 1999). Aquifer systems in unconsolidated rocks such as those in the Tucson AMA are supported by the granular skeleton and the pore-fluid pressure. When groundwater is withdrawn and the pore-fluid pressure is reduced, the granular skeleton is compressed, causing some lowering of the land surface. Both the aquifers (sand and gravel) and aquitards (clay and silt) of aquifer systems are deformed as a result of changes to the pore-fluid pressure and skeleton, but to different degrees. Continued monitoring of areas having the greatest potential for subsidence will provide information that resource managers can use in the development and implementation of mitigation efforts.

Objectives

The objective of this project is to monitor the aquifer-storage change and land-surface elevation change in the Tucson AMA using microgravity monitoring techniques. In full survey years, gravity measurements will be conducted at all established gravity stations (approximately 140 stations), see figure 1. Every other year, in the off years, data collection will consist of a subset of locations where gravity will be measured in order to access areas of interest. In Fiscal Year 2026, a GPS survey will be conducted at all sites to update the total list and site descriptions of every site.

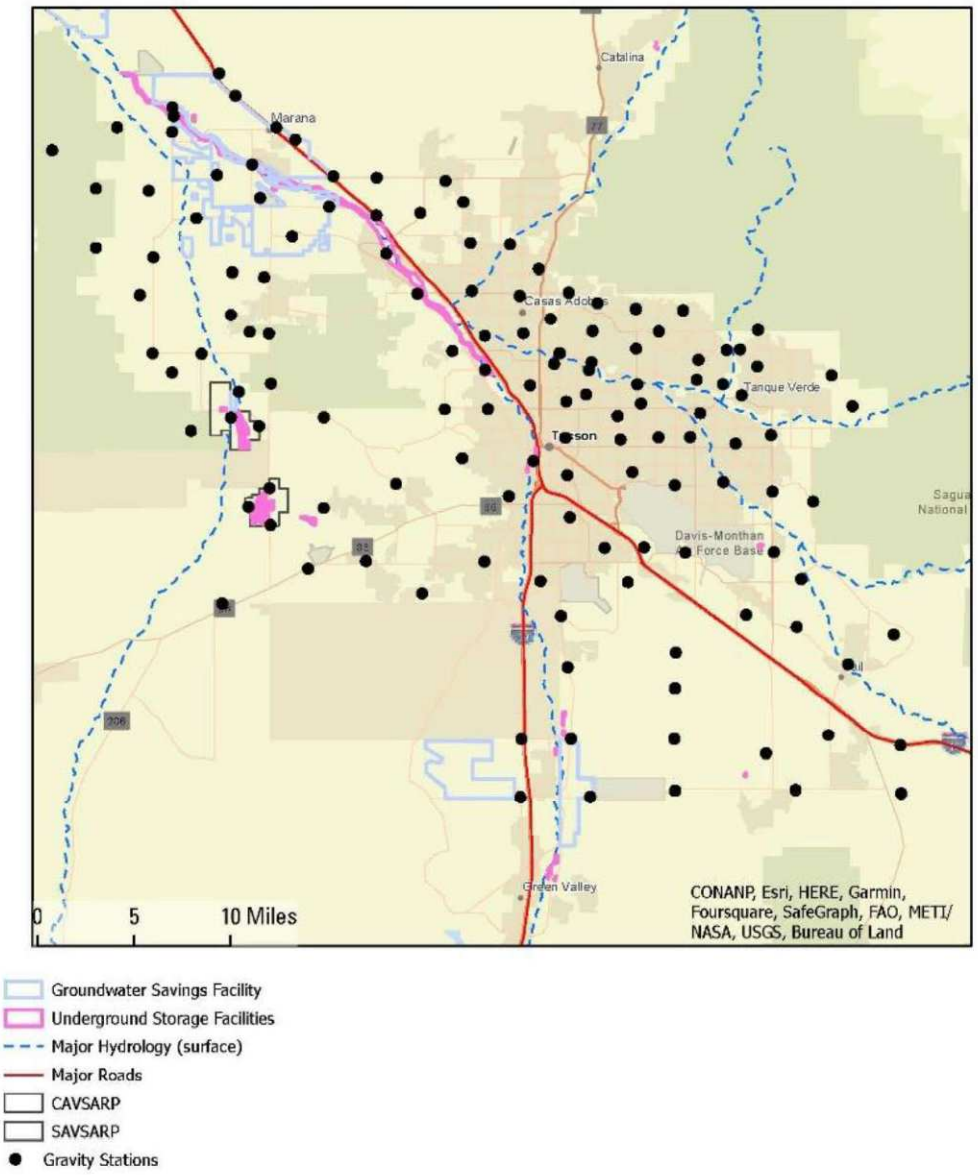

Figure 1: Map of current relative and absolute gravity site locations across the Tucson Active Management Area (TAMA). The distribution of sites allows for coverage of almost the entire active management area.

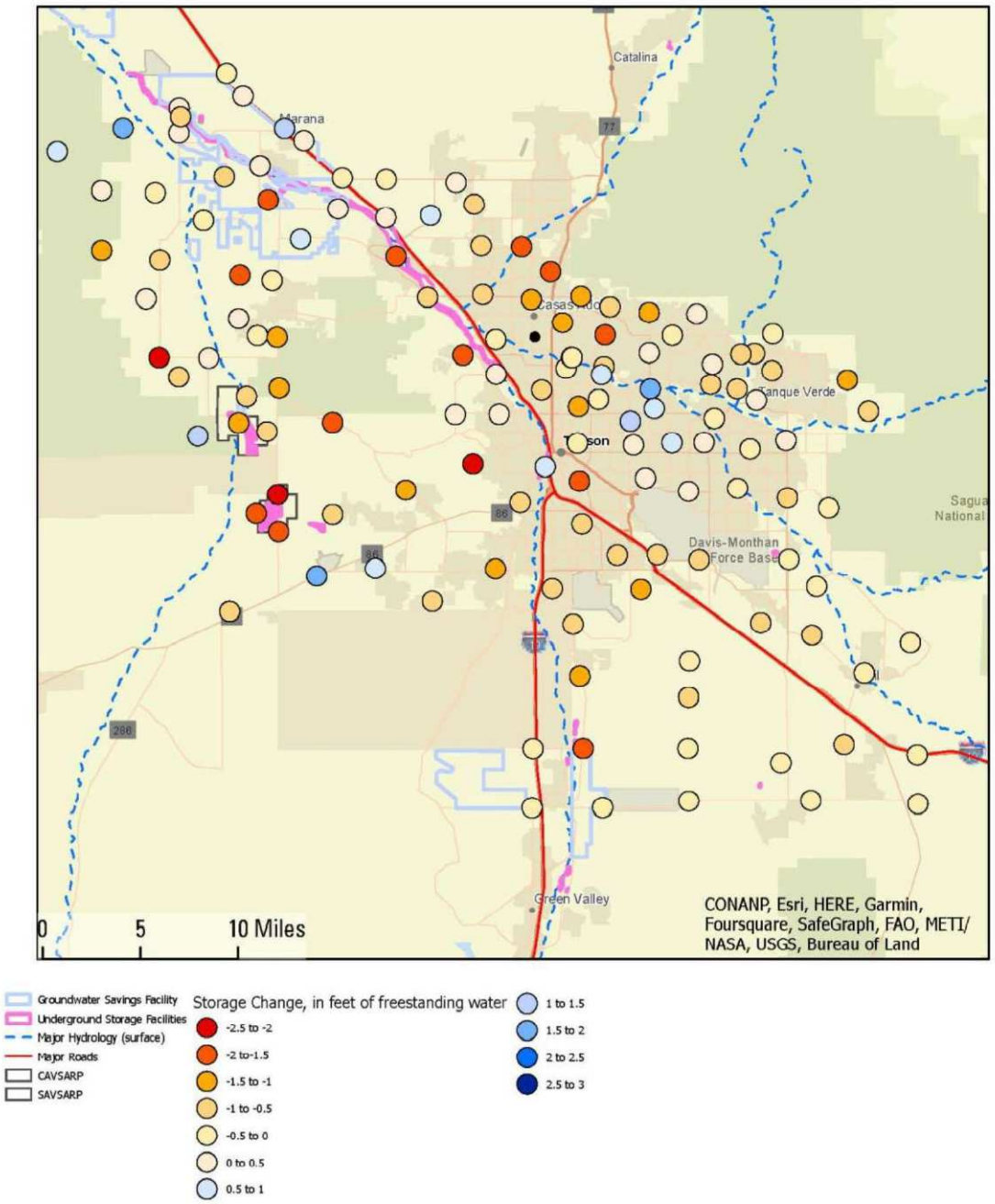

Figure 2: Storage change map from 2021-2023 of the Tucson AMA area. Storage losses continued in the south and central areas of the study while storage increases were seen to the northwest and in localized areas in central Tucson.

Approach

Gravity data will be collected using both absolute and relative gravity meters over the period of 2 to 6 weeks depending on yearly scope of each survey. Data collection can occur anytime with November-January of each fiscal year, as long as all data is collected within a fairly continuous timeframe. This reduces the likelihood of large pumping or natural recharge events to alter the accuracy of storage change in the subsurface. In years of a full survey, all 140 site locations will be measured. In years of partial surveys, roughly 40-60 sites will be measured in specific areas of interest will be decided with input from all cooperators to focus on unique water-level trends of the year. Since all station locations are previously established, no additional locations are required to be constructed.

Land-surface elevation change is monitored across the Tucson AMA by measuring changes in land surface elevation over time (approximately annually) with Interferometric Synthetic Aperture Radar (InSAR). These data come from the Arizona Department of Water Resources (ADWR), which has an InSAR program in the Tucson AMA. InSAR is a technique that utilizes interferometric processing to compare the amplitude and phase signals received during one pass of the satellite-based SAR platform over the AMA with the amplitude and phase signals received during a second pass of the platform over the same area but at a different time.

Relevance and Benefits

The repeat microgravity method is an efficient, noninvasive technique to determine changes in groundwater from the surface without needing to drill into the ground (Pool, 2008). The method allows for quick data collection over a large geographic area while providing a quantitative value of storage change. This will benefit ADWR's goal of monitoring the groundwater basins and understanding the hydrologic system within the Tucson AMA. ADWR's additional goal for the Tucson AMA is to achieve safe yield in the basin which requires the maintaining of a long-term balance between the amount of groundwater withdrawn in an Active Management Area and the annual amount of natural and artificial recharge. This also will benefit Pima County, the Town of Marana, and Tucson Water by better understanding the water budget and groundwater storage of the basin their water-users are reliant on. This work is consistent with and supports the USGS water science strategy outlined in Evenson and others, (2013) by advancing the hydrologic monitoring networks and techniques by enhancing the available information including the aquifer storage.

Regional subsidence in response to groundwater pumping is unlikely to end in the near future. It will continue until the aquifer system reaches pressure equilibrium. Observation of the timing and magnitude of aquifer responses will further improve the understanding of land subsidence and of how the aquifer systems function. Monitoring data also will contribute to a better understanding of the responses of the aquifer systems to withdrawals and will provide additional insight for future plans for well site selection, recharge efforts, and water-management programs.

Data Management Plan

All gravity data will be collected by trained personnel using techniques consistent with published methodologies for using microgravity to investigate and monitor aquifer-storage change and land subsidence (Kennedy and others, 2021). Data will be archived in the Arizona Water Science Center gravity data archive. All data will be published as one or more formal data releases at the USGS Southwest Gravity Program ScienceBase website (USGS Southwest Gravity Program - ScienceBase-Catalog).

Data collected during each year of a full survey will be published online within five months of final data collection. All gravity data for the project will be processed, reviewed, approved, and published following QA/QC protocols established by the USGS Southwest Gravity Program (Kennedy and others, 2021). Gravity data will be processed by USGS personnel in the office within 3 months of data collection. An experienced reviewer will review and check the data for accuracy. Data releases will be peer-reviewed and include complete metadata. Once published, data will be publicly accessible.

GPS data of station positions will be archived at the Arizona Water Science Center. Data will be processed using the National Geodetic Survey Online Positioning User Service or Project Networks and (or) OPUS projects service.

Deliverables and Timeline

Data releases will be made available after each full survey year. Cooperator meetings will be held in the summer to provide updates on the produced storage change maps and allow for the discussion of what areas to focus on during the partial survey. After partial surveys, data releases will not be made but cooperator meetings can occur, if requested.

In the fourth year, a publicly available web-based product, called a geo-narrative, will be created. The geo-narrative will allow for a unique way to visualize and conceptualize the data collected and be suitable for a general audience to better understand the changes to the local groundwater supply.

The table below summarized the cost breakdown per year and per agency for the entire project. Fiscal years 2025 and 2027 will be full surveys with the cost adjusted to the additional field work. Fiscal year 2026 is a partial survey but also includes the additional GPS survey to inventory all active sites. Finally, fiscal year 2028 will include a partial survey and the associated geo-narrative of all data.

Fiscal Year	FY2025		FY2026		FY2027		FY2028	
	Cooperators	USGS	Cooperators	USGS	Cooperators	USGS	Cooperators	USGS
ADWR	$ 24,800	$17,800	$ 25,500	$ 18,300	$ 26,200	$ 18,800	$ 20,200	$ 14,500
Pima County	$ 17,900	$ 12,800	$ 18,400	$ 13,200	$ 18,900	$ 13,600	$ 14,600	$ 10,500
City of Marana	$ 4,800	$ 3,500	$ 5,000	$ 3,600	$ 5,100	$ 3,700	$ 3,900	$ 2,800
Tucson Water	$ 6,200	$4,400	$ 6,400	$ 4,600	$ 6,600	$ 4,700	$ 5,100	$ 3,600
Totals	$ 53,700	$38,500	$ 55,300	$ 39,700	$ 56,800	$ 40,800	$ 43,800	$ 31,400

Table 1: Project budget by state fiscal year (FY). FY 2025 is July 1, 2024 to June 30, 2025, but work, and therefore billing, would not begin until October 2024.

References

ADWR Geophysics & Surveying Unit, undated, https://new.azwater.gov/sites/default/files/GSU_FactSheet_006.pdf

Carruth, R.L., Kahler, L.M., and Conway, B.D., 2018, Groundwater-storage change and land-surface elevation change in Tucson Basin and Avra Valley, south-central Arizona—2003–2016: U.S. Geological Survey Scientific Investigations Report 2018–5154, 34 p., https://doi.org/10.3133/sir20185154.

Conway, B., 2014, Land Subsidence Monitoring Report No. 2, Arizona Department of Water Resources, https://www.azwater.gov/sites/default/files/2022-08/ADWRLandSubsidenceMonitoringReport_Number2_Final.pdf

Evenson, E.J., Orndorff, R.C., Blome, C.D., Böhlke, J.K., Hershberger, P.K., Langenheim, V.E., McCabe, G.J., Morlock, S.E., Reeves, H.W., Verdin, J.P., Weyers, H.S., and Wood, T.M., 2013, U.S. Geological Survey water science strategy—Observing, understanding, predicting, and delivering water science to the Nation: U.S. Geological Survey Circular 1383–G, 49 p.

Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., 1999, Land subsidence in the United States: U.S. Geological Survey Circular 1182, 175 p.

Kennedy, J.R., Pool, D.R., and Carruth, R.L., 2021, Procedures for field data collection, processing, quality assurance and quality control, and archiving of relative- and absolute gravity surveys: U.S. Geological Survey Techniques and Methods, book 2, chap. D4, 50 p., https://doi.org/10.3133/tm2D4.

Landrum, M.T., 2021, Repeat microgravity data from Tucson Basin and Avra Valley, Arizona, 2021: U.S. Geological Survey data release, https://doi.org/10.5066/P952D0WL.

Pool, D. R., 2008, The utility of gravity and water-level monitoring at alluvial aquifer wells in southern Arizona: GEOPHYSICS, 73(6), WA49-WA59. https://doi.org/10.1190/1.2980395

U.S. Geological Survey, 2021, Southwest Gravity Program Absolute-Gravity Database (updated 2022-12-18): U.S. Geological Survey data release, https://doi.org/10.5066/P984HN6J