

09.2022

# NEWSDROP

**WAITING ON THE RAIN**





EDWARDS AQUIFER  
AUTHORITY

MANAGE • ENHANCE • PROTECT

Edwards Aquifer Authority

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# 1950

## DROUGHT OF RECORD

The drought by which all droughts are measured in Texas is the one of the 1950s, the historic drought of record. It was a multi-year drought with devastating impacts that shaped thinking about drought preparation in the years and decades after.

Historical photograph of farmer in San Antonio, by Harvey H Belgin (1951).

Source: Austin American-Statesman <https://www.statesman.com/story/news/history/2022/07/18/texas-drought-a-look-at-the-dust-bowl-and-other-times-with-no-rain/65369863007>. Accessed: 9/2/2022.







**ROLAND RUIZ**

EAA GENERAL MANAGER

***“THE FOUNDATIONAL TOOL FOR THE EDWARDS IS A LEGISLATIVELY MANDATED REGULATORY PROGRAM THAT LIMITS PUMPING FROM THE AQUIFER TO 572,000 ACRE-FEET ANNUALLY AND WHICH REQUIRES ALL WITHDRAWALS FOR MUNICIPAL, INDUSTRIAL AND AGRICULTURAL USES TO BE METERED AND PERMITTED FOR BENEFICIAL AND LAWFUL USES. THIS PERMITTING SYSTEM PROVIDES US THE LEGAL MEANS TO MONITOR AND MANAGE USE OF THE AQUIFER IN BOTH NORMAL AND DRY TIMES.”***

In the throes of a drought, like we’ve experienced this year, historical context helps frame our work. The drought by which all droughts are measured in Texas is the one of the 1950s, the historic drought of record. It was a multi-year drought with devastating impacts that shaped thinking about drought preparation in the years and decades after.

What we now know is that managing a resource through drought begins long before the rain stops. Today, thanks in large part to the Edwards Aquifer Authority Act, we have far more water resource management tools at our disposal than we did in the mid-twentieth century to help us withstand drought’s effects, protect the Aquifer, and help ensure its continued sustainability as a water supply for all users and uses.

*During drought years*, this permitting regime enables us to require curtailment of pumping when Aquifer conditions and/or springflows from the two major spring systems – Comal and San Marcos – drop below certain critical levels. These limitations help the region comply with federal law that requires protections of threatened and endangered aquatic species in the two spring environments in the event we experience a drought like that of the 1950s.

*These cutbacks are part of* a greater diversity of conservation and protective measures the region agreed to implement more than 10 years ago through the Edwards Aquifer Habitat Conservation Plan. This EAHCP enables us in the Edwards region to continue to use the Aquifer legally as a sustainable water supply, albeit with pumping reductions during droughts, but without worry of further limitations beyond that to which we’ve agreed.

*This demonstrates that* the hard work in drought management happens long before drought comes. For us, much of this work centers around educating our permit holders, stakeholders and the public at large about our three-pronged mission to manage, enhance and protect the Edwards Aquifer system, and why a sustainable Edwards should be important to all of us. This education process never ends; it is continual and will remain essential as we move into the future. That’s why our new Education Outreach Center that opened this year on the Recharge Zone is the right venue at the right time to reinvigorate our mission and, in some ways, reframe it for people across the entire Edwards region. It communicates an invitation to join us as partners in ensuring the sustainability of the Edwards Aquifer for the “Next Generation and beyond;” ***not just in drought, but always.*** ■





# HIGHLIGHTING

THE EAA'S WOMEN IN AQUIFER SCIENCE  
& RESEARCH

Series

Photo: EAA Aquifer  
Sustainability Supervisor, Jesse  
Chadwick.





EAA Aquifer Sustainability  
Supervisor, Jesse Chadwick.

## WOMEN IN AQUIFER SCIENCE & RESEARCH

Jesse Chadwick, Aquifer Sustainability Supervisor, joined the EAA in 2019. Her STEM career began after she graduated from Princeton University with a bachelor's degree in geosciences. After graduation, Jesse was unsure of her next step, so she sought advice from her undergraduate advisor and mentor. "My mentor enlisted me to work on a three-year project to curate and digitally catalogue thousands of specimens for (Princeton's) gem and mineral collection.

This project was challenging, requiring mastery of new skills at every step, and I was able to lead it from concept to implementation. What began as uncatalogued boxes and trays of rocks became digital records with historical data, photographs, and geographic information. Princeton continues to make this digital catalogue publicly available.

This project was my first professional milestone and confirmed my vocation in the earth sciences."

Once her project concluded, Jesse decided to pursue her master's degree in geology at Montana State University. Her thesis in metamorphic petrology examined how western North America was transformed through multiple ancient mountain-building events.

"This was another project that I was able to see through to the end. One of its most challenging aspects was connecting small-scale field observations of discrete moments in geological time to construct a geologic history over several billion years. Mapping rock exposures above the treeline often seemed worlds away from analyzing mineral chemistry, but I was able to synthesize field studies with laboratory and computer techniques to develop this tectonic history.

The skills that I learned from collecting and interpreting data for my thesis, as well as writing it, have been essential to my STEM career."

After completing her master's degree, Jesse wanted to enter the oil and gas industry. "Unfortunately, when I graduated, the price of crude oil crashed, and no one was hiring. I decided to change my focus to environmental consulting but discovered that the newly laid-off oil and gas geologists had the same idea." Instead of giving up, Jesse tried a new direction. She worked as an early childhood educator for two years, bringing STEM concepts to the curriculum wherever possible. "My classroom was a lively place, where we read aloud books on dinosaurs, rocks, plants, machines, and more.

Then, we connected these ideas to the world around us – growing beans, taking a field trip to see fossils in limestone, and asking many, many questions. The curiosity and observational abilities of young children is the perfect starting point to foster STEM.

With their wonderful questions and ideas, my young students reminded me of my own early calling to science."

Jesse then decided to return to her STEM career, working as an air quality analyst at the Alamo Area Council of Governments. While employed there, she also learned how local governments operated. In her free time, she explored the wild spaces in and around San Antonio. "I discovered that this city and its history depended on a karst aquifer. That is when I realized I wanted to work at the EAA, the agency tasked with protecting and studying the Edwards Aquifer. I knew I wanted to be a part of that."

It took several applications, but Jesse was determined to join the EAA and became part of the Aquifer Science & Research team. "My degrees are not in hydrogeology, but I brought transferable skills from my masters' research and previous work like data analysis, geospatial thinking, and an understanding of how local governments operate."





As part of the Aquifer Science and Research team, Jesse sampled wells and springs to measure water quality, and uses the data in support of ongoing research projects (like the PFAS study).

When not in the field, Jesse conducted quality control review on water quality data collected by EAA staff. "Conducting quality control on laboratory data is important because we need to ensure that our data represents the best possible information on the Edwards Aquifer's water quality. The public and future generations depend on our accuracy."

This spring, Jesse joined the Aquifer Sustainability team as Supervisor. She now oversees the conservation easement monitoring of properties enrolled in the City of San Antonio's Edwards Aquifer Protection Program (EAPP) and leads geologic evaluations of properties seeking to join the EAPP. "Conservation easements are a valuable tool to protect the Edwards Aquifer. My team and I visit properties to observe how well they are following the covenants of the easement agreement. We want to ensure that the quality and quantity of the water recharging the Aquifer remains high. Geologic evaluations are an essential first step in determining a property's suitability for the goals of the EAPP. We visit these properties and characterize their local geology and hydrogeology through field observations. It's exciting to develop a hydrogeologic understanding of a property and then see it become part of the EAPP."

One of Jesse's career highlights occurred in the fall of 2020, when she successfully passed the National Association of State Boards of Geology (ASBOG) exams to become a licensed Professional Geoscientist (PG) in the state of Texas.

"One thing to remember is that I took the ASBOG exams several years after completing my master's, so I needed to revisit concepts that I had learned years ago. To prepare for both parts of the ASBOG, I spent hours in self-study, reading an array of geoscience texts to develop the broad base of geoscience knowledge required for a PG.

The fieldwork that I conduct at the EAA gave me hands-on experience with field techniques, which is also essential for a PG. Earning this license was a major professional accomplishment."

A recent career highlight occurred this October when Jesse presented at the Geological Society of America's (GSA) annual meeting. There, Jesse presented results from Aquifer Science & Research team's ongoing study on low levels of per- and polyfluoroalkyl substances (PFAS) in the Edwards Aquifer. "This study investigates how low-level PFAS concentrations can act as tracers to better understand flow paths in the Edwards Aquifer and how different sources may contribute to the Edwards Aquifer. (Presenting at) GSA was a career milestone for me because I gave a technical presentation to a knowledgeable audience and received valuable feedback. I was also able to connect with experts in related fields and have informative discussions that generated new ideas."

While attending the GSA conference, Jesse also participated in a hydrology career panel to share her education and experience with an audience of



JESSE'S ADVICE TO FUTURE WOMEN IN STEM IS TO CONNECT WITH SOMEONE WHO WORKS IN THE FIELD IN WHICH YOU ARE INTERESTED. "MENTORS AND INSPIRATION CAN BE IN OUR COMMUNITIES. YOU MAY ALREADY BE CONNECTED TO SOMEONE - A NEIGHBOR, A PARENTS' COWORKER, OR A TEACHER WHO WORKS IN YOUR FIELD OF INTEREST. CHANCES ARE, THEY WILL BE MORE THAN WILLING TO SHARE THEIR KNOWLEDGE AND EXPERIENCE. FOR THOSE OF YOU WHO ARE IN COLLEGE, VISIT WITH YOUR PROFESSORS DURING THEIR OFFICE HOURS. THIS IS A UNIQUE OPPORTUNITY TO LEARN ONE-ON-ONE FROM AN EXPERT."

undergraduate and graduate students who were interested in hydrology studies and careers.

"The audience had great questions for us about choosing careers and academic programs, finding mentors, and building their networks. It was a privilege to share my own experiences and to hear how seriously these students were thinking about their future studies and careers." ■





# CLIMATECHANGE

Now on Groundwater Modelers' Radar





## CLIMATE CHANGE.

THOSE TWO WORDS HAVE SPARKED MANY PASSIONATE DEBATES AMONG THE GENERAL PUBLIC AND SCIENTISTS ALIKE OVER THE PAST SEVERAL YEARS. HOWEVER, WHEN YOU SPEAK WITH THOSE RESPONSIBLE FOR ADDRESSING THE ISSUE IN A FEDERAL PERMIT SETTING LIKE THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN (EAHCP), THE DISCUSSION BECOMES A LITTLE MORE PALATABLE, A LOT MORE COMPLEX AND TRULY FASCINATING.

## EAHCP TO STUDY REGIONAL CLIMATE CHANGE AS PART OF ITS PERMIT RENEWAL PROCESS

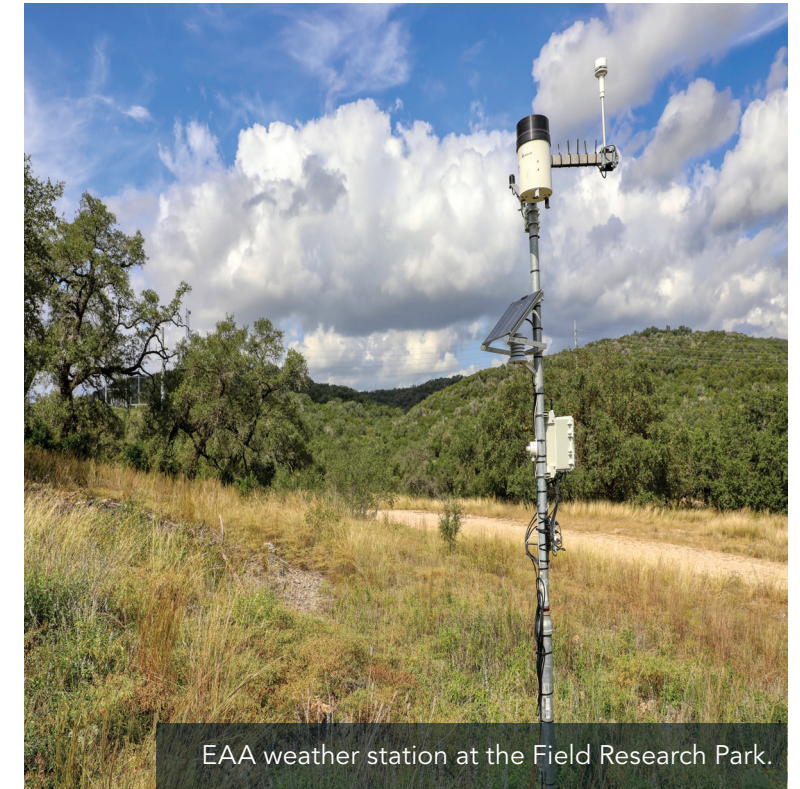
“Those who know some background on the EAHCP understand that the bottom line goal is to protect the endangered species in the Edwards [Aquifer] Region by implementing measures to maintain springflows at the Comal Springs and San Marcos Springs, even during a drought of record,” said Paul Bertetti, who leads the hydrological modeling team at the Edwards Aquifer Authority (EAA). “As we’re coming up on the EAHCP federal permit renewal, the U.S. Fish and Wildlife Service will be examining how we address climate change in our application. At this point, the agency’s guidelines are fairly general, so it will be up to us to define a scientific approach that we think is the best way to move forward.”

Bertetti explained that the challenge in defining a method of addressing climate change is that the effects of climate change and scientists’ understanding of those changes evolve over time. Given that fact, it is a wise thing that rigid federal standards are not set in stone and that each HCP applicant can consider their own circumstances and address those accordingly using the best science available at the time. “Another key point of understanding is that the Edwards Aquifer Authority does not employ climate scientists and our job is not to model the climate,” Bertetti explained.

“What we are doing is relying on the hard work and research of other climate scientists worldwide to help us make some assumptions about what could happen in our region over time. What the current data is telling us is it is generally expected to be a little warmer in this area of the country over the next few decades. However, the prospects for precipitation are uncertain. Some indications are that there could be more rain but that it could come in large storm events. That could play a part in how the Edwards Aquifer takes in that precipitation as recharge. For example, if the ground is drier more often and we are receiving larger rain events, then will the aquifer be less efficient in its water intake? We are not completely certain about those impacts, and that affects how we address the overall climate change issue.”

Another difficult data point to measure is the fact that the Edwards Aquifer Region’s own climate boundaries vary from semi-arid in the west to a wetter climate in the east. Consequently, EAA computer modelers will have to find a way to apply relatively uncertain broader climate predictions across a diverse regional climate situation. That task will be complex in many ways.

One of the initial steps EAA hydrological modelers will take is to convert projected climate data points such as temperature, precipitation, amounts of sunlight, rates of evapotranspiration and others into data inputs that relate to Edwards Aquifer recharge. Currently, recharge is calculated by the U.S. Geological Survey which uses many stream flow gauges across the recharge zone to determine recharge data.

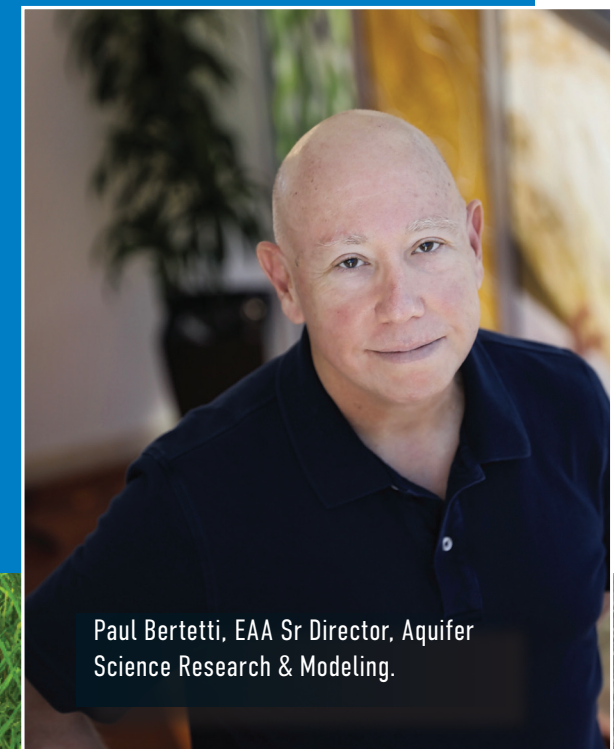


EAA weather station at the Field Research Park.

The next step would be to do some mathematical correlations between the new and traditional data. Bertetti also cited that the EAA has continued to improve its weather data collection in recent years, but his hydrological modeling team must also account for some data that goes back several decades.

“There are many parameters out there that can go into our work, but at some point you have to do your best to produce sound information that decision makers can use in this relatively small geographic area,” Bertetti noted. “We are plugged into climate science gathering groups both on a national and regional level. Our focus over the next 18 months will be to take their most recent data and apply it to the Edwards [Aquifer] Region.”

Paul Bertetti, EAA Sr Director, Aquifer Science Research & Modeling.







“SUFFICE TO SAY, THIS WORK IS COMPLICATED AND SOMEWHAT UNCERTAIN AT THE SAME TIME.”

We might have to develop scenarios that apply differently in the western and eastern parts of the region as well as how those scenarios play out over time.”

While that effort might seem like an impossible task to most, Bertetti said they would be leveraging some current artificial intelligence (AI) applications to help them sort through the mountains of data. This type of sophisticated technique creates some efficiencies in the number of calculations needed to compare a set of inputs to what the team is looking at in the final outputs.

One example could be that modelers would input current information on precipitation, temperature and water levels in the aquifer to produce a representation of how aquifer levels would be affected by changes in temperature and rainfall over time.

The results from those model runs would provide insights the EAHCP team could use in recommending adjustments to existing springflow protection measures or new measures altogether. “One of the problems with some AI applications is that they are somewhat like a black box because you can’t really see the calculations being made,” Bertetti acknowledged.

“So, it is our intent to use what’s called explainable AI that allows us to better understand the complex calculations being made which in turn helps us be more transparent to all stakeholders. But the big advantage here is that we can process large amounts of data, sometimes seemingly unrelated data, and produce sound results that can enhance our overall understanding of this complex hydrological system.

“Suffice to say, this work is complicated and somewhat uncertain at the same time. However, we are confident that we can provide valuable insights to the EAHCP team and the consultant they will be using for the federal permit renewal. We have an excellent, experienced team of hydrological modelers on staff, but in the end, we understand that we can’t predict how the climate will change over the next several decades. But, we can provide a scientifically sound set of scenarios the applicants can feel good about in choosing the best way forward in renewing the federal permit.” ■



LOOKING  
BACK

TO MOVE  
FORWARD



These are the times for which the Edwards Aquifer Habitat Conservation Plan's (EAHCP) group of springflow protection measures were designed.



Fountain Darter.

Over the last decade the entire Edwards Region has pitched in to develop and maintain the springflow protection measures which are designed to ensure the springs in New Braunfels and San Marcos continue to flow, even in another drought of record. That's no easy feat to accomplish but our incidental take permit with the U.S. Fish and Wildlife Service depends on these programs working. And the good news is that so far we've accomplished that goal," said EAA Special Projects Liaison, Javier Hernandez.

He manages the Aquifer Storage and Recovery (ASR) and Voluntary Irrigation Suspension Program Option (VISPO) programs for the Edwards Aquifer Authority (EAA). The other two components of the springflow protection measures include the Regional Water Conservation Program (RWCP) and Stage V Critical Period Management Plan (CPM). The CPM is divided into five stages in which percentages of pumping reductions

become more restrictive as water levels in the Edwards Aquifer decline. The J-17 index well in San Antonio, the United States Geological Survey (USGS) San Marcos springflow gauge, the USGS Comal springflow gauge and the J-27 index well in Uvalde provide water level data which trigger the implementation of the CPM. There are two monitoring wells because scientists determined that there are distinctive "pools" in the Edwards Aquifer.

The Uvalde pool supports Uvalde County while the San Antonio pool supports Medina, Bexar, Comal and Hays and parts of Guadalupe, Atascosa and Caldwell Counties. In Uvalde, Stage 1 of the CPM is triggered when that index well averages a reading of 850 feet at mean sea level (MSL) or less for 10 days. Stage 1 in the San Antonio pool is triggered when averages are 660 feet MSL or lower for 10 days.





“THIS YEAR THE EAHCP IS CELEBRATING 10 YEARS OF SUCCESSFUL HABITAT CONSERVATION AND IT COMES AT A TIME WHEN THE REGION IS GOING THROUGH A VERY DRY PERIOD RIGHT NOW,” SAID JAVIER HERNANDEZ, EAA SPECIAL PROJECTS LIAISON, “BUT THAT’S THE WAY IT IS IN SOUTH TEXAS, AND WE’RE PREPARED NOW MORE THAN EVER.”

The springflow gauges at San Marcos and Comal Springs can also trigger Stage I when the 10-day average at the San Marcos Springs falls below 96 cubic feet per second (cfs) and at Comal Springs, below 225 cfs. Getting out of the various stages also includes the consideration of a 10- day average.

“Originally, the Critical Period Management Plan was developed with four stages of pumping reductions based on Edwards Aquifer trigger levels,” Hernandez explained. “However, as part of the EAHCP, the region added Stage V to the CPM which calls for a 44 percent reduction in Edwards Aquifer water use. While the San Antonio pool has not reached its 625’ trigger level over the last 10 years, the Uvalde pool hit Stage V in 2013 and stayed there for almost two years before we began to get enough rainfall to get us out of trouble. Many people remember that during the drought of the 1950s, the Edwards Aquifer level got to its lowest reading of 612’ at J-17 and the Comal Springs went dry for six months.”

The RWCP is also one of four springflow protection measures in the EAHCP intended to reduce aquifer withdrawals to protect endangered species in the Comal Springs and San Marcos Springs during a drought of record. The RWCP’s goal in the EAHCP was to conserve 20,000 acre-feet of Edwards water. The RWCP started out with traditional conservation programs like toilet and other water fixture retrofits in cities around the region. However, the program took a giant leap forward in 2016 as the EAHCP and San Antonio Water System (SAWS) reached an agreement for SAWS to invest an additional \$18 million in its water leak detection and repair program through 2028. That one program alone will help preserve 20,000 acre-feet of Edwards water.

“While it takes all four of the springflow protection measures to make sure the Comal Springs do not dry up during another drought of record, the ASR and VISPO programs are by far the most critical,” Hernandez stated. “In fact, The EAA’s updated computer model verified that the ASR and VISPO programs were the most effective in helping the Comal and San Marcos Springs continue to flow even under drought of record conditions.”

**The RWCP is also one of four springflow protection measures in the EAHCP intended to reduce aquifer withdrawals to protect endangered species in the Comal Springs and San Marcos Springs during a drought of record. The RWCP’s goal in the EAHCP was to conserve 20,000 acre-feet of Edwards water.**

VISPO was launched in 2014 and had an overall program goal of 40,000 acre-feet, which later was increased to 41,795 acre-feet (13.6 billion gallons).



It has always been a forbearance type of program meaning that if water levels at the J-17 index well in San Antonio were at or below 635 feet on October 1, the VISPO participants would be required to suspend the use of the amount of water enrolled in the program for the following year. Participants in VISPO are paid a stand-by fee each year, even if the program does not trigger. If the program triggers, participants receive an additional compensation for not using water enrolled in the program the following year.



ASR Facility.

As for the ASR program, the EAHCP requires that 126,000 acre-feet of water (41 billion gallons) be stored in the SAWS ASR facility in South Bexar County, with the EAA controlling an additional 50,000 acre-feet (16.2 billion gallons) accrued through forbearance agreements. The 126,000 acre-foot goal was achieved by allowing water permit holders to lease their water over defined periods of time. The smallest lease was for less than one acre-foot and the largest agreement contains thousands of acre-feet. All of that water was pumped by SAWS from its wells and stored in its ASR facility.

That water will remain there until the region faces another drought of record. Within the last two years, forbearance agreements have reached the 50,000 acre-foot goal (16.3 billion gallons). There are a few ASR leases that will expire in the next couple of years, but the majority of the agreements will run through 2028 when the EAHCP incidental take permit will be renewed.

"While the participants in ASR and VISPO programs are being paid to enroll their (groundwater) rights in the programs, they are also helping the entire Edwards Region protect its main source of water during times of extreme drought," Hernandez concluded. "And that benefit accrues not only to the endangered species in the Edwards Aquifer spring systems, but to approximately two-and-one-half-million and thousands of businesses throughout the region as well."

**"All of these springflow protection measures make us much more prepared for another drought of record."**

"No one knows what the future holds, but we can be very confident in knowing that all of these springflow protection measures make us much more prepared for another drought of record than the region was the first time around. And in South Texas with strings of 100-plus degree temperatures and no rain in sight, that could happen at any time." ■

Agricultural field.





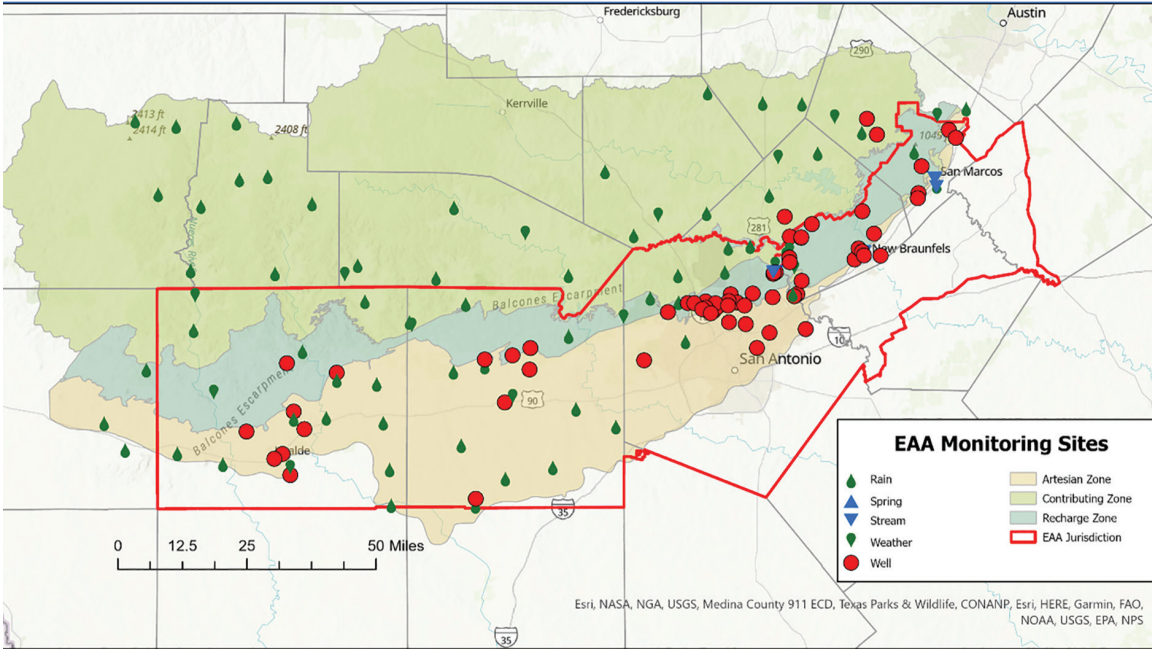
Clients

# What's the scoop?

Data collection at the EAA



**EAA data collection sites include groundwater wells, rain gauges, weather stations, streams, and springs.**



Map of current EAA environmental monitoring sites.

The EAA has collected millions of data sets since the agency began operating and has continued to amass significant amount of data each year. Providing real-time data to stakeholders, scientists, educators, members of the community, etc. helps people understand and become stewards of the aquifer. EAA data collection sites include groundwater wells, rain gauges, weather stations, streams, and springs. These data are used in research and modeling to help us better understand the Edwards Aquifer system.

Groundwater Wells and Springs	Streams	Weather Stations	Rain Gauges
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Groundwater discharges from the Edwards Aquifer either as springflow or as pumping from wells. Comal and San Marcos springs, the largest and second-largest springs in Texas, respectively, are fed by the Edwards Aquifer. This springflow greatly benefits the recreational economies in New Braunfels and San Marcos, and both springs provide habitat for threatened and endangered species. Wells drilled into the Edwards Aquifer throughout the region provide water for many diverse uses, including irrigation, municipal water supplies, industrial applications, and domestic/livestock consumption. Keeping track of water levels in groundwater wells and flow from the springs are vital to the management of this precious resource.

All EAA rain gauge and weather station data are available on the state-wide TexMesonet website at [www.texmesonet.org](http://www.texmesonet.org)



Bryan Anderson, EAA Director of Data Management in front of weather station at the Field Research Park.



Groundwater Wells and Springs	Streams	Weather Stations	Rain Gauges
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The EAA maintains a joint funding agreement with the U.S. Geological Survey (USGS) to provide surface recharge estimates for eight of the nine major drainage basins with streams that flow on to the Edwards Aquifer Recharge Zone. Recharge is estimated using a water-balance method that relies on precipitation and streamflow measurements across the region.

RECHARGE TO THE EDWARDS AQUIFER ORIGINATES AS PRECIPITATION OVER THE CONTRIBUTING AND RECHARGE ZONES OF THE AQUIFER, OR AS INTER-FORMATIONAL FLOW FROM ADJACENT AQUIFERS.



Texas ranch storm.

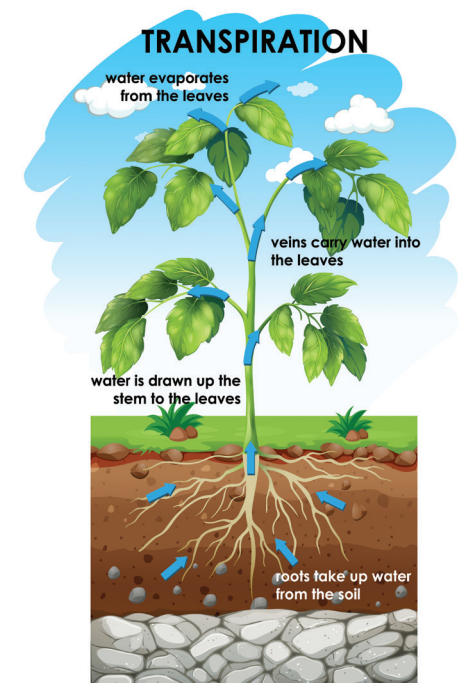
Groundwater Wells and Springs	Streams	Weather Stations	Rain Gauges
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The EAA, with its partners (including Barton Springs Edwards Aquifer Conservation District, Bandera River Authority and Groundwater District, the Nueces River Authority, Cibolo Nature Center, Bat Conservation International), and private landowners, have developed a network of weather stations in our shared region. Since some water loss is due to evapo-transpiration (ET) after precipitation events, as such, ET is a valuable tool for improving recharge estimates and managing groundwater resources.



This shared network of weather stations collects climatic and soil moisture data that can be applied to calculate ET values at numerous locations throughout the Edwards Aquifer Recharge Zone and Contributing Zone. These data are collected every 5 minutes, and transmitted hourly through a telemetry network, available to the public through the EAA website. Parameters collected at the weather stations include:

- Air Temperature
- Relative Humidity
- Barometric Pressure
- Precipitation
- Solar Radiation
- Dew Point
- Wind Direction
- Wind Speed
- Soil Moisture



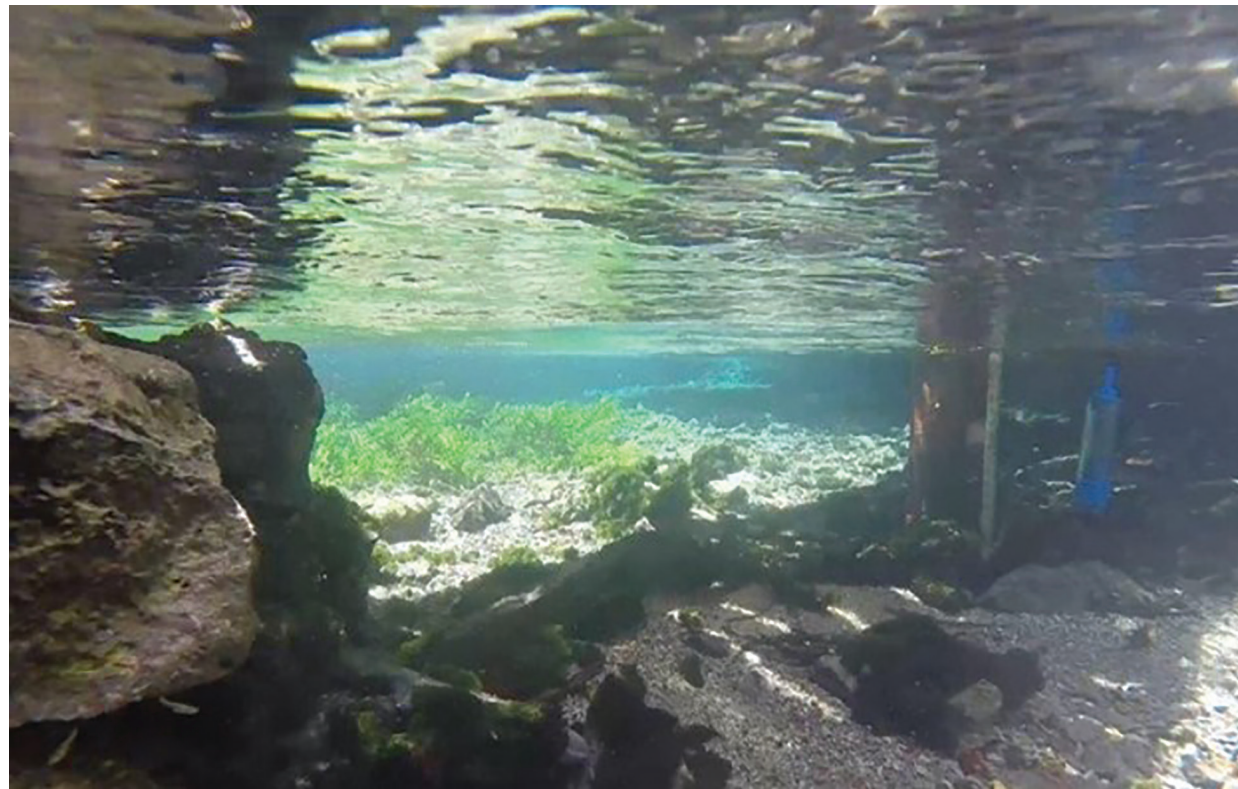
Evapotranspiration and soil moisture.



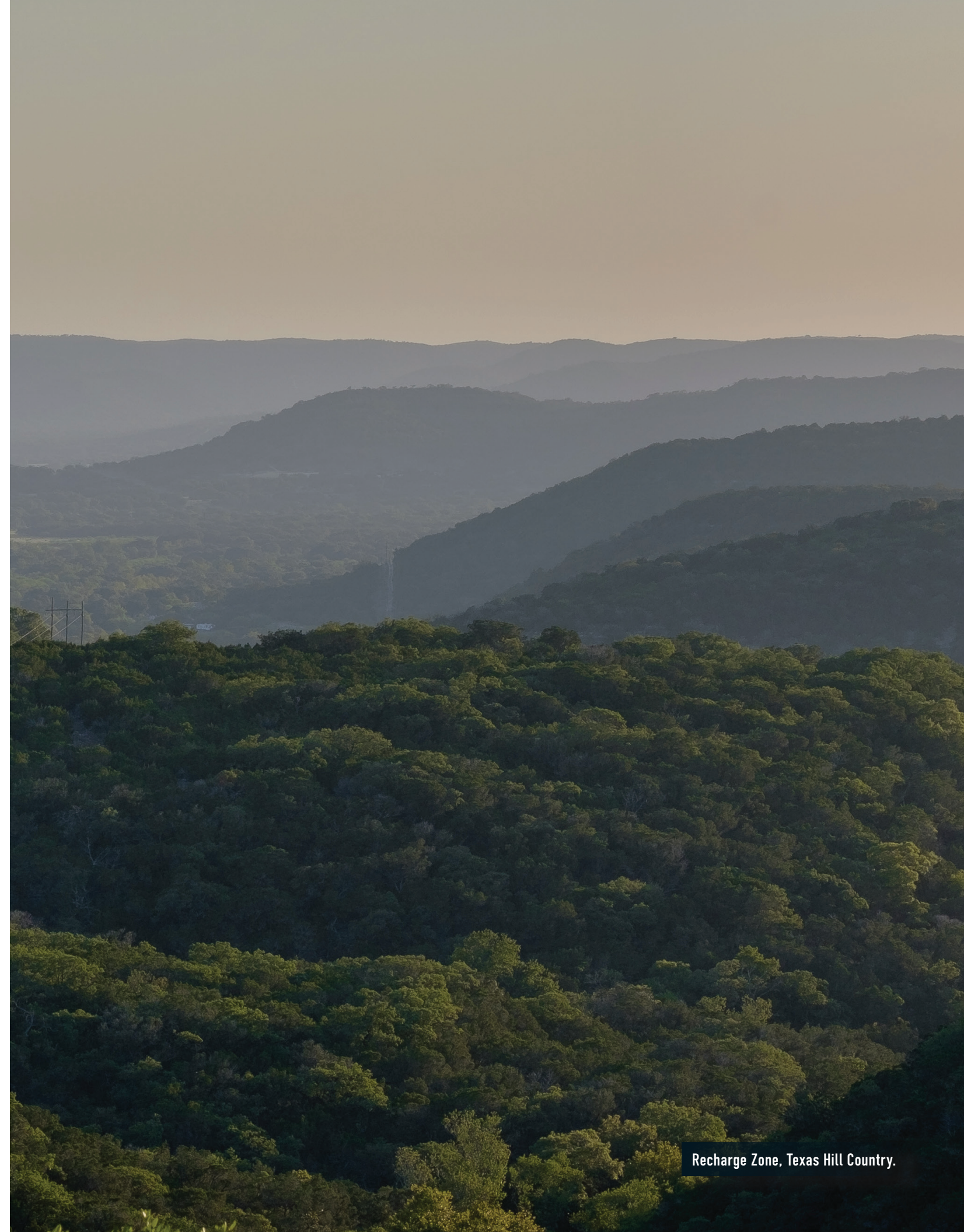
Groundwater Wells and Springs	Streams	Weather Stations	Rain Gauges
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The Edwards Aquifer Authority (EAA) monitors precipitation throughout the region using a network of over 70 real-time rain gauges. Rainfall data is used as input for watershed data models that can provide estimates of monthly recharge to the aquifer. Collected over several years or decades, the extensive database of rainfall information can also be useful for monitoring climate trends, evaluating relationships between rainfall and aquifer levels, or understanding how global scale phenomena such as “El Niño” (term referencing above-average sea surface temperatures in the equatorial region of the Pacific Ocean) may affect rainfall in Central Texas. All EAA rain gauge and weather station data are available on the state-wide TexMesonet website at [www.texmesonet.org](http://www.texmesonet.org). ■

For more information about our data collection programs, check out our website at: [www.edwardsaquifer.org](http://www.edwardsaquifer.org). For custom data requests, send an email to: [data@edwardsaquifer.org](mailto:data@edwardsaquifer.org).




Monitoring water.



Recharge Zone, Texas Hill Country.





# Irrigation Efficiency Improvement is a Water Saving Champ

PROGRAM PROVIDES FINANCIAL ASSISTANCE

Center pivot sprinkler.



**IRRIGATION EFFICIENCY IMPROVEMENT IS A WATER SAVING CHAMP**

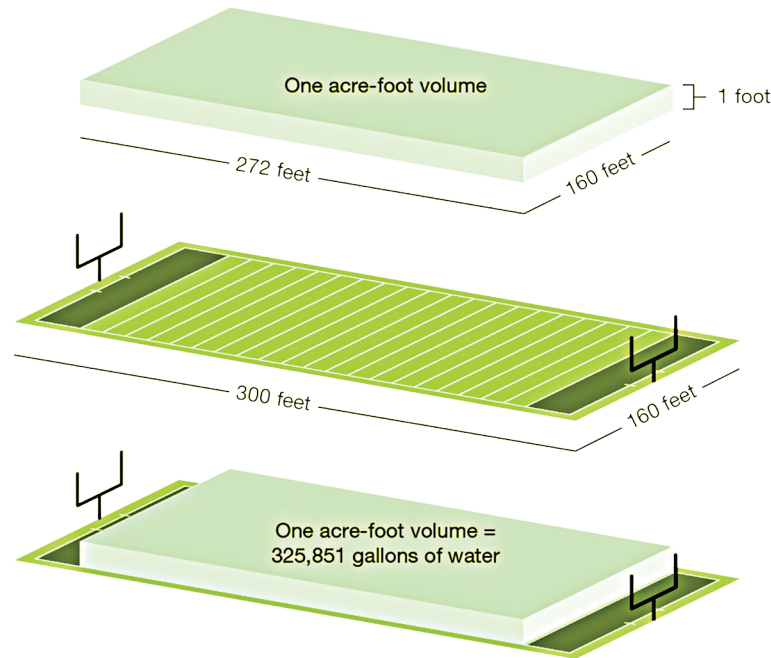
Our agency recognizes that regional and individual groundwater conservation planning is essential in managing regional water resources and demonstrates such stewardship through the administration of the EAA Groundwater Conservation Grant Program.

This program provides financial assistance for projects that enhance water conservation of the Edwards Aquifer by focusing on the implementation of water conserving practices that are recommended in the EAA Groundwater Conservation Plan (GCP). It is through the Conservation Grant program and the EAA GCP that water from the Edwards Aquifer continues to be the primary water source in south central Texas for over 150 utilities region wide and a population of approximately two-and-one-half-million people.

**EAA'S IRRIGATION EFFICIENCY IMPROVEMENT PROGRAM**

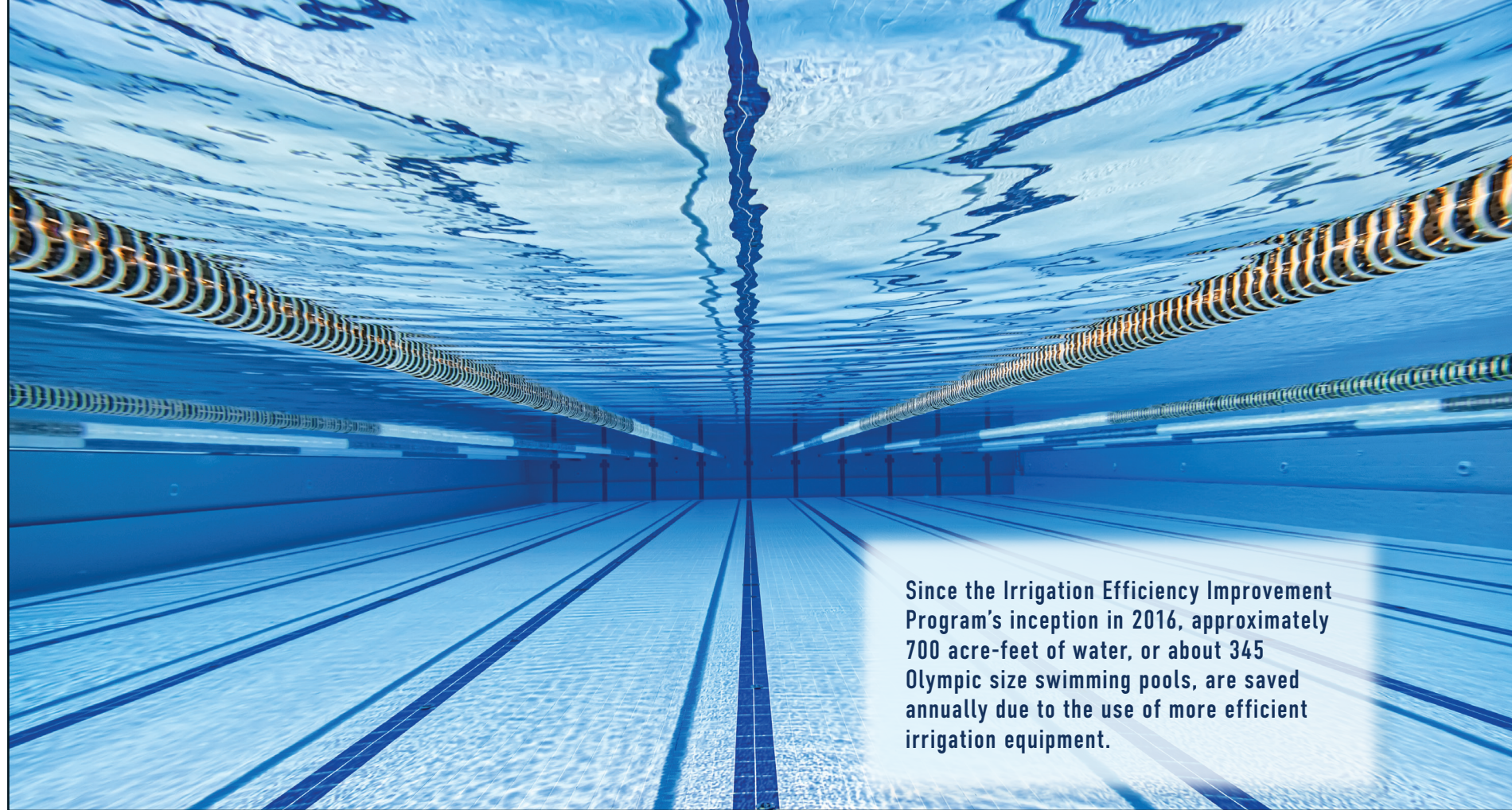
The EAA Groundwater Conservation Grant Program focuses on improving water efficiency among permitted Edwards Aquifer users. Grant funding has been awarded to permit holders for innovative water conservation projects allowing for continued water use and preservation of the aquifer and its aquatic habitats that support several endangered species.

The EAA has recently focused the funding of projects that support the implementation of specific agricultural Best Management Practices (BMPs) and created the EAA's Irrigation Efficiency Improvement Program, which supports the implementation of the sprinkler and micro-irrigation system BMP for irrigation users. Irrigation permit holders are encouraged to apply for assistance to transition to more efficient irrigation practices such as the installation of linear sprinkler, center pivot sprinkler, and subsurface drip irrigation systems.



1 acre-foot volume = 325,851 gallons of water

Illustration: <https://nmwd.com/what-is-an-acre-foot/>



Project applications are evaluated on the amount of water saved, following Request for Applications requirements, amount of money being requested, and the likelihood of project completion by a set deadline. The success and high interest of the Irrigation Efficiency Improvement Program allowed the EAA to secure grant monies from the Texas Water Development Board (TWDB) Agriculture Water Conservation Grant Fund for multiple years. ■



Isabel Martinez Senior Permit & Conservation Coordinator (center) with the 2019 Water Conservation and Reuse Award.

“In 2019 the EAA's Groundwater Conservation Grant Program was awarded the “Water Conservation and Reuse Award” by the American Water Works Association, an international nonprofit society focused on the conservation and reuse best practices of water.”





# MANAGING THE AQUIFER

THE FIRST STEP TO SUSTAINABILITY





The Edwards Aquifer is unique in the State of Texas in the way that it is managed. It is the only groundwater system in the state with firm limits on how much water can be withdrawn per year. The withdrawals are based on the EAA's permitting system and total 572,000-acre feet. In total, about 1,200 total groundwater withdrawal permits have been issued, which serve about two-and-one-half million users. The effect of drought on the Comal Springs is seen in the picture to the left, dry in August 2022.

The annual maximum withdrawal amount, however, is subject to restriction during times of drought. These restrictions or Critical Period Management (CPM) are part of a well-developed management plan that is designed to ensure springflows at Comal and San Marcos springs remain viable during severe drought. These CPM measures can be triggered by both water levels and springflows as measured at the Bexar County index well, and Comal and San Marcos springs for the San Antonio Pool. The Uvalde Pool CPM process is triggered by Uvalde County index well J-27.

The CPM measures are summarized in the figures to the right for the San Antonio and Uvalde pools. The CPM reductions are the product of decades of data collection for many aquifer metrics. For example, ground water levels, spring flows, recharge estimates, and rainfall data are all vital components used to model and manage the aquifer. These data, some dating back to the 1930s, are vital to groundwater model development and subsequent model improvements. The model is the primary management tool for predicting aquifer

Right: J17 San Antonio Pool top; J27 Uvalde Pool, below.

Critical Period Stage	J-17 Index Well Level above mean sea level (amsl)	San Marcos Springs Flow cubic feet per second (cfs)	Comal Springs Flow cubic feet per second (cfs)	% of Water Reduction
No Stage indicates stable levels	660 feet or above	96 or above	225 or above	0%
Stage 1	less than 660 feet	less than 96	less than 225	20%
Stage 2	Less than 650 feet	less than 80	Less than 200	30%
Stage 3	Less than 640 feet	Not Applicable	Less than 150	35%
Stage 4	Less than 630 feet	Not Applicable	Less than 100	40%
Stage 5	Less than 625 feet	Not Applicable	Less than 45/40*	44%

Critical Period Stage	J-27 Index Well Level above mean sea level (amsl)	% of Water Reduction
No Stage indicates stable levels	850 feet or above	0%
Stage 1	N/A	0%
Stage 2	Less than 850 feet	5%
Stage 3	Less than 845 feet	20%
Stage 4	Less than 842 feet	35%
Stage 5	Less than 840 feet	44%





Above, Comal Springs. Our ever-increasing population, coupled with extreme and exceptional periods of drought require imaginative, inclusive, and innovative solutions to protect and sustain the Edwards Aquifer now and for future generations. The EAA and regional stakeholders continue this mission, as we strive to manage, enhance, and protect the Edwards Aquifer.



In addition to these important alternative water sources and conservation measures, steps are being taken to protect and sustain aquifer recharge at its source. Above, EAA contractor at Comal Springs.

behavior in a repeat of the drought of record (1950's drought, when Comal Springs ceased flowing for a period of approximately six-months). Based on many years of model development and subsequent modeling scenarios, CPM tools are designed to maintain water levels and springflows, to benefit all users that rely on the aquifer.

However, critical period reductions are not the only management tools in use for keeping the aquifer healthy and sustainable. Other programs play a vital role in maintaining aquifer levels and contributing to sustainability.

Conservation programs that facilitate more efficient irrigation methods, resulting in less evaporative loss have been incentivized by the EAA for many years. Groundwater forbearance programs such the Voluntary

Irrigation Suspension Program (VISPO) are in place and funded by the EAA to pay agricultural irrigators not to pump water during severe drought scenarios. San Antonio Water Systems (SAWS) developed an Aquifer Storage and Recovery (ASR) in the Carrizo Aquifer, where Edwards Aquifer water can be stored in wet years and used during drought years to reduce demand on the Edwards.

These tools are all accounted for in the modeling efforts and considered when developing the CPM reductions shown earlier

As population and subsequent demand grows, other water purveyors are exploring alternative management strategies to contribute to a more sustainable Edwards Aquifer supply.

The City of San Antonio has invested over 300 million dollars through a self-imposed tax to conserve environmentally sensitive lands that contribute recharge to the Edwards Aquifer, now totaling more than 165,000 acres of conserved land.

Furthermore, the EAA has recently developed a Next Generation component to its mission wherein staff will facilitate

the acquisition of additional conservation easements in areas critical to recharge and water quality sustainability.

Most recently as part of the Next Generation initiative, EAA staff (photos above and below) are working to quantify how improved management of land and soils impact recharge and water quality as a new tool for sustainability of the system. ■



Gizelle Luevano, EAA Sr Geoscientist, and Jennifer Adkins-Schudrowitz, EAA Aquifer Science Research Supervisor.



Quinn Rusu, EAA Regulatory Inspector II.



Matthew Rogers, EAA GIS Analyst II.



Taylor Bruecher, EAA Geoscientist II.



**GLOBAL PERSPECTIVE DISPLAY**

From an astronaut's point of view, watch as weather patterns work their way across the face of the globe!

**WHERE WATER LEARNING**

# Takes Place



**MICRO EYE**  
View species and specimens under the eye of the EOC Microscope!



**CLOUD CASTER**

The journey through the Edwards Aquifer begins with a drop of water – actually, billions and trillions of drops!

**EXPLORE THE AQUIFER**

The Edwards Aquifer holds treasures for you, just waiting to be found. All you have to do is dive right in to the Education Outreach Center and learn what they are. Over time, you will acquire enough knowledge and insights about the waters of the Edwards Aquifer – and you just might become a certified EAA Aquinaut!

**AN ADVENTURE AWAITS YOU**

With its mission of managing, enhancing, and protecting the Edwards Aquifer, The Edwards Aquifer Authority (EAA) is committed to educating the community about this wonderful and precious resource.

The EAA Education Outreach Center (EAAEOC) is a quantum leap in this regard. Free and open to all, The EAAEOC offers a number of interactive exhibits and displays, including a Cave theater, endangered species aquaria, a one-of-a-kind Global Perspective Display, a Cloud Caster, a Demonstration Garden, and many more treats for visitors. Situated on the EAA Recharge Zone, on the grounds of Morgan's Wonderland Camp, the EAAEOC is an adventure awaiting you!



23400 Cibolo Vista  
San Antonio, TX 78259  
Monday – Friday  
8am – 5pm  
(210)-547-2222  
[www.eaaeoc.org](http://www.eaaeoc.org)



Sarah Cervera, summer intern for EAA Communications & Development at the EOC.

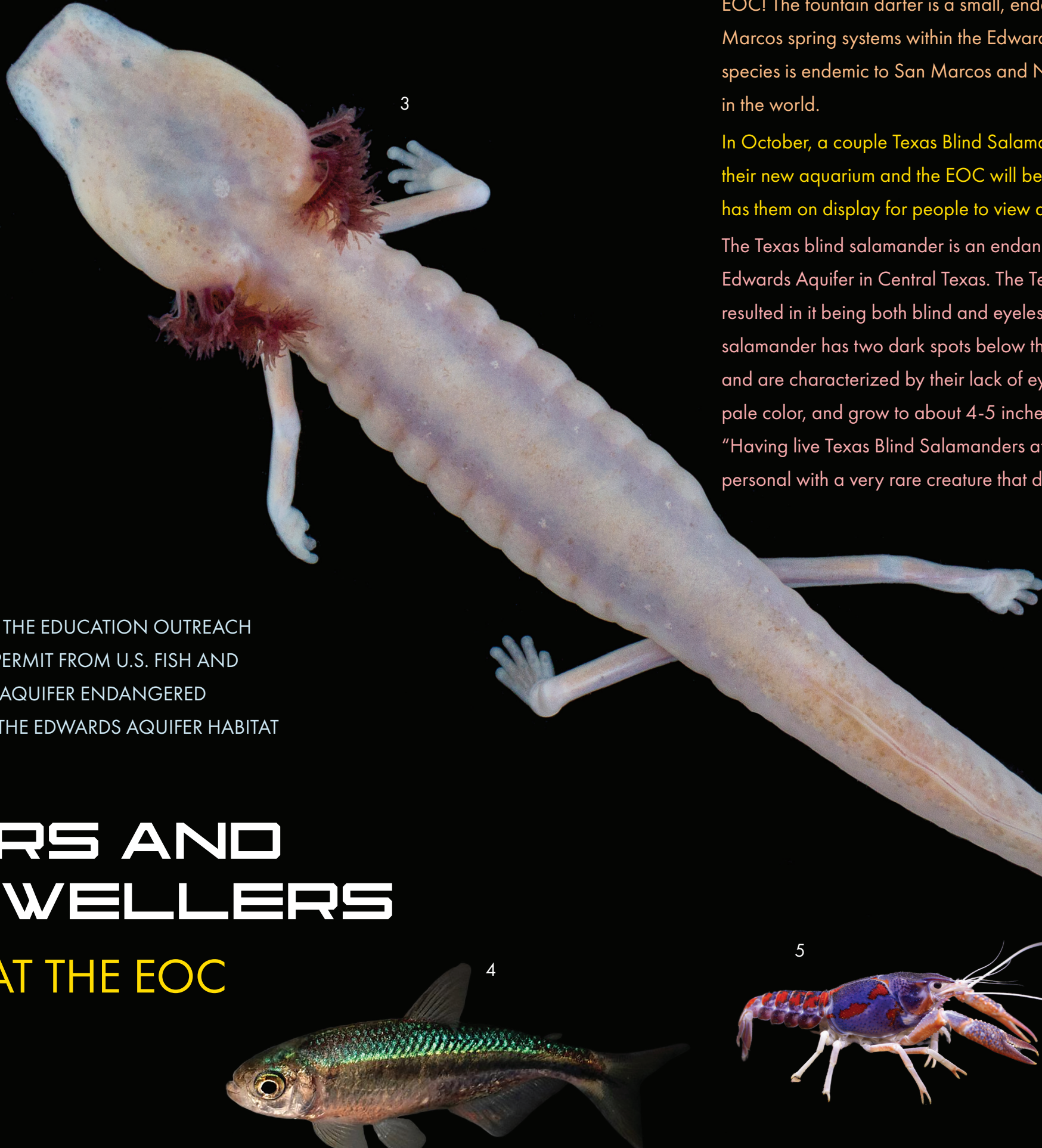




1



2



3



6



4



5

This just in! The endangered Fountain Darters have moved on into their aquarium at the EOC! The fountain darter is a small, endangered fish found only in the Comal and San Marcos spring systems within the Edwards Aquifer region of Central Texas. This fish species is endemic to San Marcos and New Braunfels and is not found anywhere else in the world.

In October, a couple Texas Blind Salamanders will call the Center home in their new aquarium and the EOC will be the only location in San Antonio that has them on display for people to view and learn more about!

The Texas blind salamander is an endangered species of aquatic salamander found only within the Edwards Aquifer in Central Texas. The Texas blind salamander is troglobitic, or cave dwelling, which has resulted in it being both blind and eyeless. Where most other salamanders have eyes, the Texas blind salamander has two dark spots below the skin. These lungless salamanders breathe through their gills and are characterized by their lack of eyes, external red gills, slender limbs, a broad head, transparent-pale color, and grow to about 4-5 inches as adults.

"Having live Texas Blind Salamanders at the EOC gives the public a chance to get up close and personal with a very rare creature that depends on the Edwards Aquifer.

It is one thing to see it in pictures but a whole other experience to watch it move, eat and swim right in front of your eyes. We hope that when people come in to see these Endangered Species, they will better understand what an amazing resource the Edwards Aquifer is and how much diversity of life it supports," said Sarah Valdez, EAA/EOC Senior STEAM Outreach Educator.

1. Sailfin Molly 2. Fountain Darter 3. Texas Blind Salamander 4. Mexican Tetra 5. Crayfish 6. Goldfish

THIS PAST SUMMER IN AUGUST, THE EDUCATION OUTREACH CENTER (EOC) RECEIVED THEIR PERMIT FROM U.S. FISH AND WILDLIFE TO DISPLAY EDWARDS AQUIFER ENDANGERED SPECIES PROTECTED THROUGH THE EDWARDS AQUIFER HABITAT CONSERVATION PLAN.

# DARTERS AND CAVE DWELLERS

## ON DISPLAY AT THE EOC





# ET NOT THE ALIEN

ET, in this case evapotranspiration, is the elusive process by which water moves from earth's surface into the atmosphere, and hosts Brent and Ann-Margaret discuss this with EAA's Principal Geoscientist Marcus Gary. Learn about eddy covariance towers, and how they play an important role in understanding a myriad of observations occurring in the atmosphere and from the soil.

ET, Not the Alien  
Season 3, Episode 8  
Scan to listen:





# AQUIFER

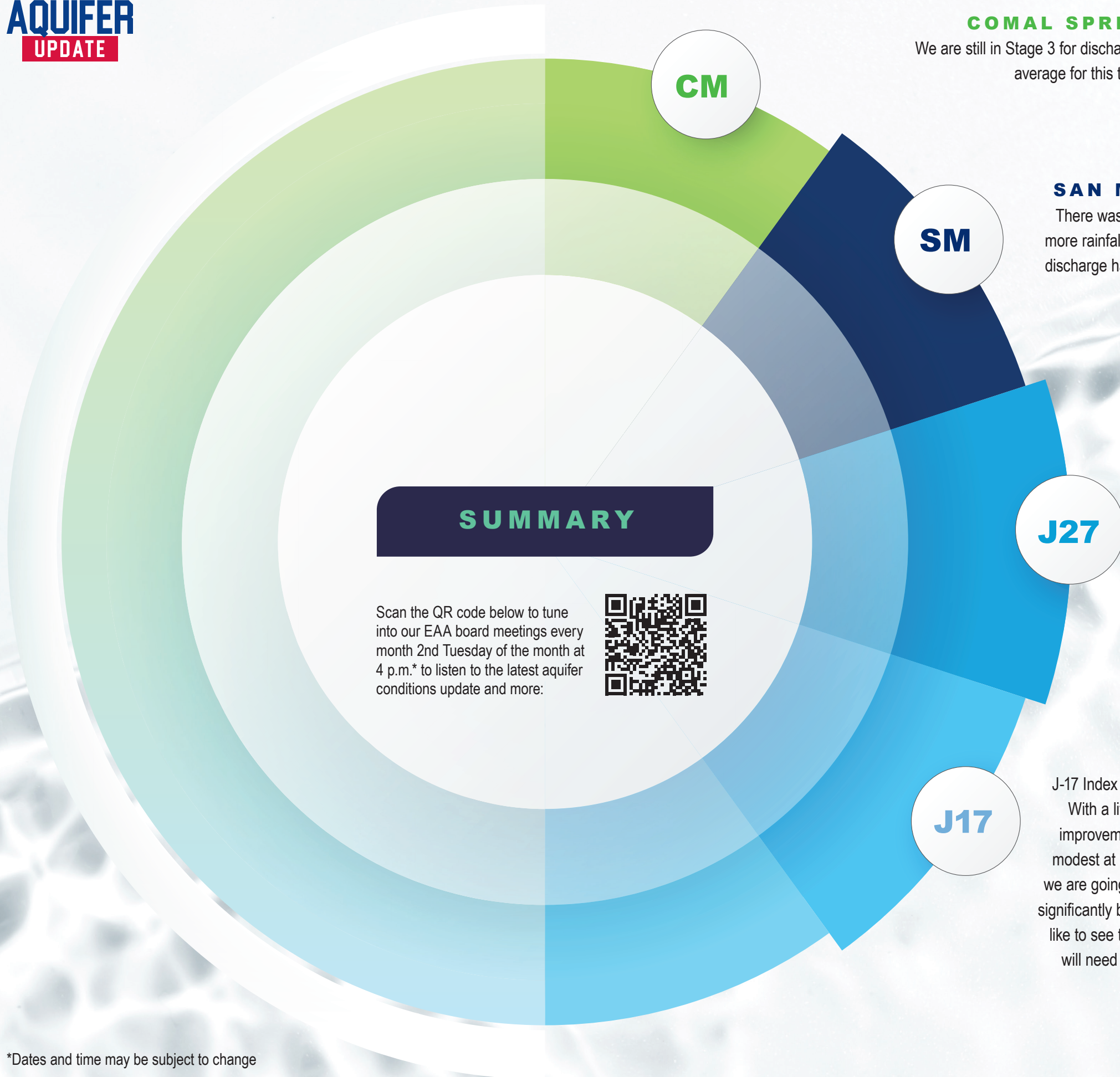
## UPDATE

CONDITIONS CURRENT AT TIME OF PUBLICATION

An aquifer conditions update is reported every month at the EAA board meeting to inform board members and the public about the status of the J-17 Index Well, J-27 Index Well, the Comal Springs and the San Marcos Springs springflows. These index wells and springs are indicators of the health of the aquifer and critical to drought management.

Significant rainfall in Uvalde helped the J-27 Index Well transition from Stage 3 to Stage 2 earlier this month (September 10, 2022). Water levels at J-27 have been relatively low over the last year or two. Significant rain out in Uvalde and north of Uvalde provided some recharge and an increase in water levels. It's hard to say how long this trend will continue but it's a good trend.





**CM**

**COMAL SPRINGS (CM)**

We are still in Stage 3 for discharge, and significantly below average for this time of year.

**SM**

**SAN MARCOS SPRINGS (SM)**

There was some rainfall out in Hays County with a little more rainfall in some of its recharge areas, but the springs discharge has been flat. We will see if that trend continues over the next few weeks.

**J27**

**J27 INDEX WELL**

Significant rainfall in Uvalde helped the J-27 Index Well transition from Stage 3 to Stage 2 earlier this month (September 10, 2022). Water levels at J-27 have been relatively low over the last year or two. Significant rain out in Uvalde and north of Uvalde provided some recharge and an increase in water levels. It's hard to say how long this trend will continue but it's a good trend.

**J17**

**J17 INDEX WELL**

J-17 Index Well water levels have been increasing lately. With a little rain fall in the region there has been an improvement (increase in levels), but these have been modest at best. We will need significantly more rainfall if we are going to continue this trend through the fall. We are significantly below average for this time of the year, and we'd like to see these levels come up closer to normal. But we will need significantly more rainfall for that to happen.

**SUMMARY**

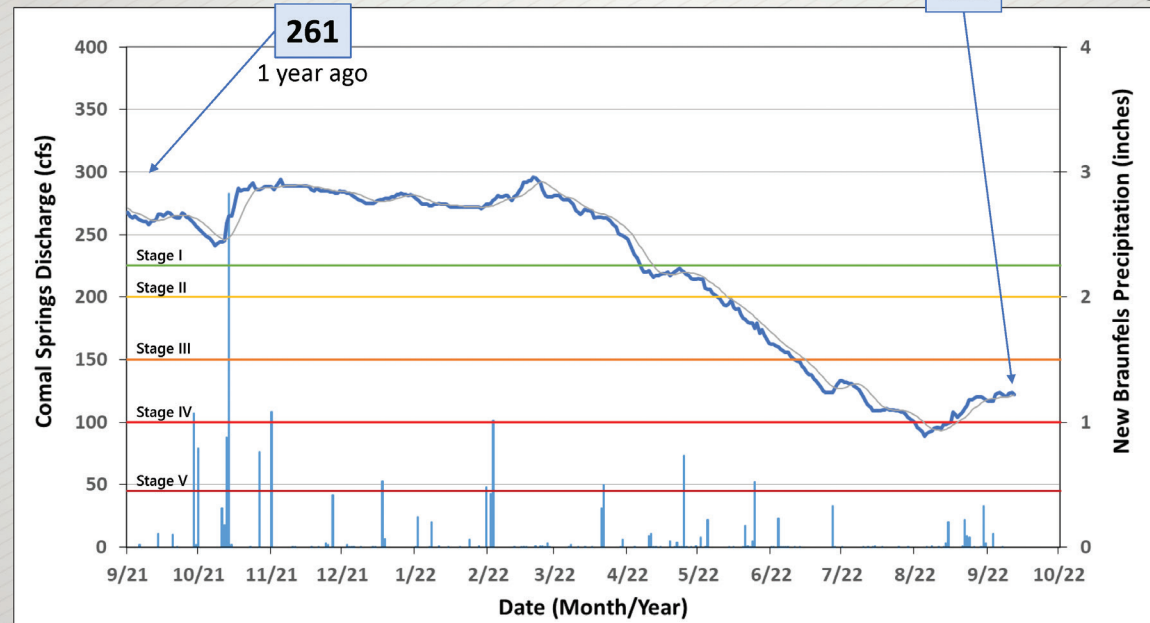
Scan the QR code below to tune into our EAA board meetings every month 2nd Tuesday of the month at 4 p.m.\* to listen to the latest aquifer conditions update and more:



\*Dates and time may be subject to change



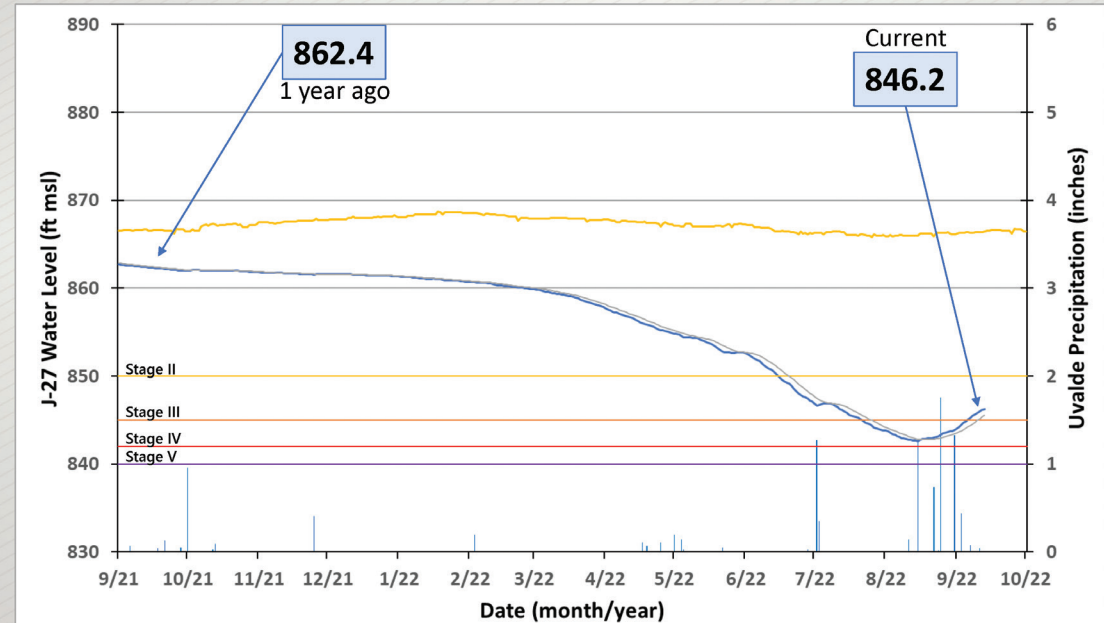
### Comal Springs Discharge to Date



September monthly historical average: 263 cfs

10-day average Sep 12: **122**  
Stage III

### Uvalde Well J-27 Water Level to Date



Historical Average Sep 13: **866.4**

10-day average Sep 13: **845.5**  
Stage II

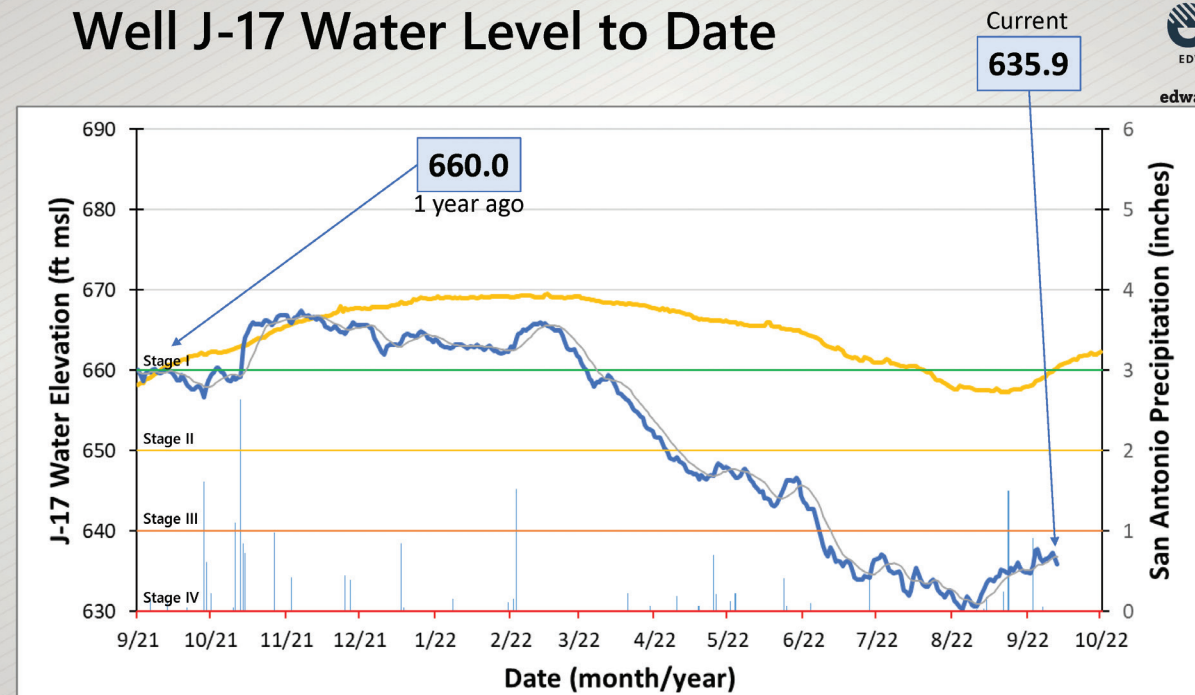
### San Marcos Springs Discharge to Date



September monthly historical average: 163 cfs

10-day average Sep 12: **92**

### Well J-17 Water Level to Date



Historical Average Sep 13: **660.4**

10-day average Sep 13: **636.8**  
Stage III





The Edwards Aquifer Conservancy (EAC) gets a

# RECHARGE

Established in 2014, The Edwards Aquifer Conservancy (EAC) is a 501(c)3 nonprofit organization with the sole purpose of supporting the mission of the Edwards Aquifer Authority (EAA). The EAC does this by raising funds to carry out EAA-authorized programs, projects, and special initiatives.



Same great mission, new exciting

## OPPORTUNITIES

The EAC Board of Directors is the nonprofit's governing body and is composed of members of the EAA Board of Directors who have been appointed by the EAA to serve in this capacity. As a nonprofit, the EAC accepts cash and non-cash gifts, such as land parcels, to fulfill its legal purpose.

Presently, the EAC is housed within the EAA where it is operated by EAA staff. The EAC maintains its own bank account and files its own tax returns, as required by law. It currently leases to the EAA an approximately 150-acre parcel of land acquired through donation, which the EAA now uses as its Field Research Park (FRP) for aquifer sustainability research and demonstration purposes.

EAA staff assigned to the Conservancy are reestablishing contacts with major corporate funders who initially expressed interest in the progress of the Education Outreach Center (EOC) and the FRP, prior to the onset of the pandemic.

Understandably, these organizations' focus of support moved from projects such as ours, to more pressing and immediate food and medical needs. Now, as the pandemic slowly recedes, businesses are returning to normal routines.

To leverage these support opportunities, the EAC will produce several signature friend raising/fundraising events in 2023, including an evening Gala, a luncheon, a 5k walk/run and family-friendly country fairs in counties the EAA serves. ■



"A Night of a Thousand Drops" an annual gala that will allow philanthropic and civic business leaders to come together for an evening filled with fine dining, entertainment, inspirational and innovative stories of water conservation, awards, and more.





**EDWARDS AQUIFER  
AUTHORITY**

MANAGE • ENHANCE • PROTECT

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