THE WATER SOURCE

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Studies Provide Pieces of Edwards Aquifer Puzzle

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While there is a great deal we know about the Edwards Aquifer and how it works, there is much that remains a mystery. The Edwards Underground Water District has conducted a series of hydrologic studies over the past three years that were designed to better define the boundaries of the Edwards aquifer.

The Edwards aquifer is a network of drainage, recharge and artesian/ reservoir areas which encompass 8,000 square miles and 17 south central Texas counties. The movement of water through the aquifer appears to be simple, with the aquifer functioning in a seemingly uncomplicated manner. But a more detailed examination indicates that the flow is very complex.

The aquifer began to form one hundred million years ago when South Texas was covered by a shallow, warm sea. The remains of plants and animals that lived in this area settled to the sea floor and built up thick layers of lime mud. Over millions of years, this mud was buried under more sediment, and was compressed and heated to form [Edwards] limestone. Later, a large portion of Central Texas was pushed upward, causing layers of Edwards limestone to be tilted down towards the southeast and exposed to the atmosphere. As rain water began to filter into the limestone, a chemical reaction caused portions of the limestone to dissolve and be carried away, forming small holes and channels throughout the layers.

This uplift and exposure of the limestone to the atmosphere happened several times and was aided by major periods of faulting which occurred approximately 17 million years ago. The faults and fractures dropped most of the Edwards limestone layers down towards the southeast, creating a zone of highly fractured and faulted rock through which groundwater could flow. These openings were enlarged as the limestone continued to dissolve.

Later, erosion of the tilted layers of Edwards limestone produced the aquifer's recharge zone, where today these layers are exposed at the surface. The cavernous channels, numerous sinkholes and fractured limestone we see in the creekbeds in the recharge zone are evidence of this period of faulting and erosion. Briefly, the recharge zone is the area where rain falling on the surface runs down streams and rivers and eventually filters through the fractures, faults and sinkholes and enters the reservoir portion of the Edwards Aquifer.

"This ...data can be utilized...to more efficiently manage an extremely valuable resource."

The following studies have provided hydrologic data that can be used to model how water moves through the aquifer. The model will assist researchers in determining the optimum plan for providing adequate water to the diverse users of the aquifer while maintaining flow at Comal and San Marcos Springs. A short summary will explain the purpose of these studies, as well as the results and conclusions.

(continued)

Aquifer Puzzle *(continued)*

East/West: Edwards Aquifer Groundwater Divides Study

The Edwards aquifer actually extends northeast past Austin, and west into Mexico. The eastern and western boundaries of the San Antonio portion of the Edwards aquifer are believed to be in Hays and Kinney counties. The boundaries are called groundwater divides and represent imaginary lines that separate groundwater flow in one direction from flow in another. Groundwater divides usually occur along highs in the land surface. The eastern divide, located in Hays County between the cities of Kyle and Buda is believed to isolate flow toward Austin from flow toward San Marcos Springs. The western divide, located in Kinney County near Brackettville, is believed to isolate flow toward Del Rio from flow toward San Antonio. This study examined the geology and hydrology of the two areas so that we could determine the locations of the divides and their hydrogeologic controls.

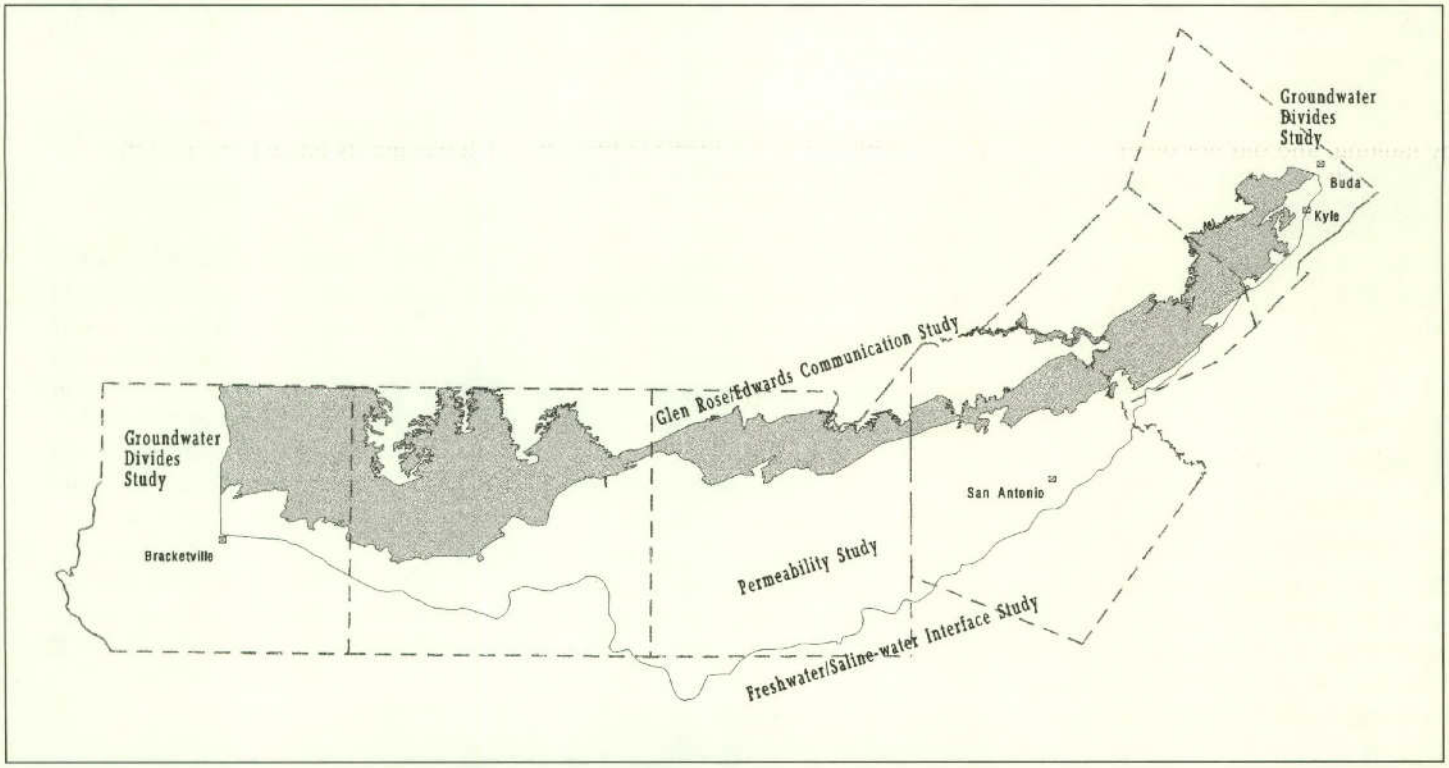
Results of the study indicate that the eastern groundwater divide is located west of Buda, along Onion Creek, in the recharge zone portion of the Edwards aquifer. Previously, scientists thought all the water which filtered into the aquifer through the bottom of Onion Creek flowed towards Buda and Austin. The study indicates that a portion of the recharge in Onion Creek actually flows toward Kyle and San Marcos during normal-to-wet periods.

In the artesian portion of the aquifer, data shows that during times of low water levels, the groundwater flow from the Blanco River and Onion Creek may not be toward San Marcos Springs, but instead moves toward pumping centers near Kyle and Buda, and to Barton Springs near Austin. Proposed tracer research in the Onion Creek area by the Barton Springs/Edwards Aquifer Conservation District will hopefully determine specific flow paths in this area.

Results from the western divide indicate that it should be positioned west of Las Moras Springs, extending northward past Pinto Mountain. A significant finding in this study was that a portion of recharge resulting from stream losses in the West Nueces River flows toward Pinto and Las Moras Springs. The stream losses are currently being used to calculate recharge in the San Antonio region of the aquifer, but the springflow is not being used in calculating discharge. Therefore, discharge from both of these springs should be used when calculating the water balance of the Edwards aquifer.

South: Fresh Water/Saline Water Interface Studies

Beginning in 1992, the District conducted for three studies that would better define the position of the fresh water/saline water interface (or "bad water line") of the Edwards aquifer. This line represents the southern limit of fresh water in the aquifer. The previously mapped position of the interface had been determined in 1978 by the Texas Water Development Board and United States Geological Survey through a study which used a limited number of wells. The District's study used data from geophysical logs



run in oil and gas wells that were drilled through the Edwards aquifer, as well as all available logs from Edwards aquifer water wells. A mathematical relationship between the geophysical log values for water quality and measured water quality from actual well samples was determined, and the resulting data provided water quality values for several hundred new wells. This permitted hydrologists to more accurately locate the position of the interface.

We discovered that the interface between fresh and saline water extended all the way into northwest Frio county in an area previously thought to contain saline water. To confirm the theory, the EUWD drilled and completed a 3,400 foot monitoring well in 1993. The well is approximately four miles southwest of Yancy, Texas in southern Medina County. Analysis of drill cuttings, as well as hydrologic and water quality testing showed that the Edwards aquifer did indeed contain fresh water in a location over four miles south of the previously mapped interface position.

The interface in southeastern Uvalde County was found to be further north than was previously mapped. Between Kyle and San Antonio, we discovered the interface was controlled by faulting, and did not differ substantially from its previously mapped position.

The newly defined position of the fresh water/saline water interface is now the official southern boundary of the aquifer used for current and future EUWD research.

North: Glen Rose / Edwards Aquifer Communication Study

The Edwards aquifer is bounded on its northern edge by the recharge zone. Here, Edwards limestone is deposited on top of another limestone formation called the Glen Rose. In portions of the recharge and artesian zones, the Edwards is faulted and has dropped down to approximately the same elevation as the Glen Rose. In some of these areas, it has been theorized that water in the Glen Rose aquifer can move across the faults and into the Edwards, providing additional recharge. Researchers have previously estimated that this additional recharge from the Glen Rose represents approximately five percent of the total recharge to the Edwards aquifer.

This study analyzed both water-level and water-quality data to determine if water really does move across these faults. It does, but the study confirmed that only small amounts of Glen Rose water enter the Edwards aquifer compared with other recharge sources. Researchers estimate the amount to range between 2,700 to 11,400 acre-feet per year. This represents less than two percent of the total water budget of the Edwards aquifer during average recharge conditions, and is not considered a significant amount that would require annual recharge to be recalculated.

Inside: Regional Distribution of Permeability in the Edwards Aquifer

Permeability is a measurement of the ability of rock to transmit fluid. In terms of the Edwards aquifer, this means how easily water can move through the limestone. This study looked at the aquifer's permeability distribution and where the areas of high flow might be located. A tremendous amount of data was synthesized. Researchers analyzed data concerning the structure and thickness of the aquifer, the affect the limestone's composition had on the flow of water, and permeability data from well tests. Now we have a better picture of how much water can move through the aquifer, and the paths it might take.

The study, completed earlier this year, revealed that the presence of faults and caverns increases permeability by as much as 10 to 100 times more than in non-faulted porous rock. It also revealed that the areas with the highest permeability are adjacent to the aquifer's southern boundary ... the fresh water/saline water interface.

This study compliments a porosity study completed in 1993 which estimated how much water could be stored in the pore spaces of the aquifer. While there may be as much as 215 million acre-feet of total water in the aquifer, it is not known how much of the water is recoverable. The permeability study was the next step in a long process to determine the total retrievable amount of water, and how that water moves through the aquifer.

Data from both studies will be used in developing an interactive, dynamic 3-D model of the Edwards aquifer which will help us better understand the flow patterns water takes when moving through the aquifer. Someday, this will allow us to determine the areas where pumpage from the aquifer has a greater or lesser effect on flow from Comal or San Marcos Springs. This would allow for continued development in our region while lessening its impact on springflow.

Summary

The results of the studies conducted and funded by the EUWD over the past three years have added greatly to understanding the boundaries of the Edwards aquifer. This additional data can be utilized by the region's leaders to more efficiently manage an extremely valuable resource. All the data from these studies has been entered into the District's computer database for use in future research so that we may continue to increase our knowledge of the Edwards aquifer. ■

News Briefs

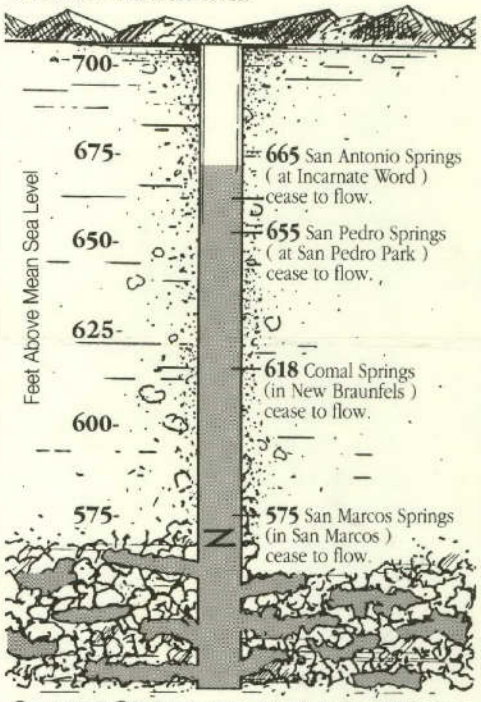
☐ Seven students received special awards from the Edwards Underground Water District at the 1995 Alamo Regional Science Fair. In the senior division, first place was awarded to Amy Coliander from MacArthur High School. She received a limestone plaque and $100 savings bond for her project, "Bacterial Contamination of Zoos." Second place went to Kelly Bendele from LBJ High School for her project entitled "What is Clean Water, Really?" Third went to Shavonne Freeman from Marshall High School for her project, "How Deep is the Well?"

In the junior division, William Verner and Nicholas Hagendorf captured first place for their project, "Water Works." They attend Alamo Heights Junior High. Second place went to Robbie Gonzales and Robbie Klekar from Canyon Middle School for their project entitled, "Water Pollution." All students received a limestone plaque, with first and second place winners also receiving a $100 and $50 savings bond respectively.

☐ For the fourth year, the Edwards Underground Water District is sponsoring a xeriscape contest. First prize in three different categories is a $1,000 gift certificate to your favorite nursery. Entry deadline is May 15, 1995. The three categories are: best existing xeriscape designed by the homeowner; best existing xeriscape designed by a professional (entry must be submitted by the homeowner); and best PLAN for a xeriscape. Second, third and two honorable mentions will also be awarded in each category. Entry forms and guidelines can be found in the WOAI Spring Gardening Almanac. Or call the EUWD at (800) 292-1047 and one will be mailed to you. Other sponsors include the Bexar County Master Gardeners, WOAI radio, San Antonio River Authority and San Antonio Water System.■

The Water Level

This reading reflects the daily high artesian water elevation at the Bexar County Edwards Aquifer Index Well. The bottom of the graph represents the depth of the well which is 143 feet below mean sea level.



Current Status: On April 3rd, 1995 the water elevation was recorded at 671.2. Average for April is 667.2.

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