Edwards Underground Water District

Created to conserve,
and recharge...
to prevent waste and pollution...
to preserve and protect...
the groundwaters of the
Edwards Aquifer

Established 1959

When the well is dry
we all know the wealth
of water.

—Ben Franklin

The Edwards Aquifer:

A Texas Treasure

Extending 176 miles from Brackettville in Kinney County to Kyle in Hays County, the Edwards Aquifer is one of the nation's most productive groundwater resources. In many respects, the Edwards Aquifer has shaped this area of south central Texas. The lives and livelihoods of more than 1.3 million people living in the region depend on the high quality, replenishable water found in the Edwards Aquifer. Cities, towns, rural communities, farms and ranchlands alike rely on the aquifer's water for municipal, domestic, agricultural, industrial, and recreational purposes.

The Edwards Aquifer is a complex network of drainage, recharge and artesian/ reservoir areas, underlying 8,000 square miles and thirteen counties. The Edwards Aquifer, one of the largest aquifers in the south-western United States, is the primary source of water for the people it serves. In 1977, the Edwards Aquifer was designated the first Sole Source Aquifer by the Environmental Protection Agency. San Antonio, the third largest metropolitan area in the state and the tenth largest in the nation, currently is the most populated city in the U. S. that obtains its entire water supply from a single aquifer. The Edwards Aquifer also supports a unique system of plant and animal life, some of which exist nowhere else in the world.

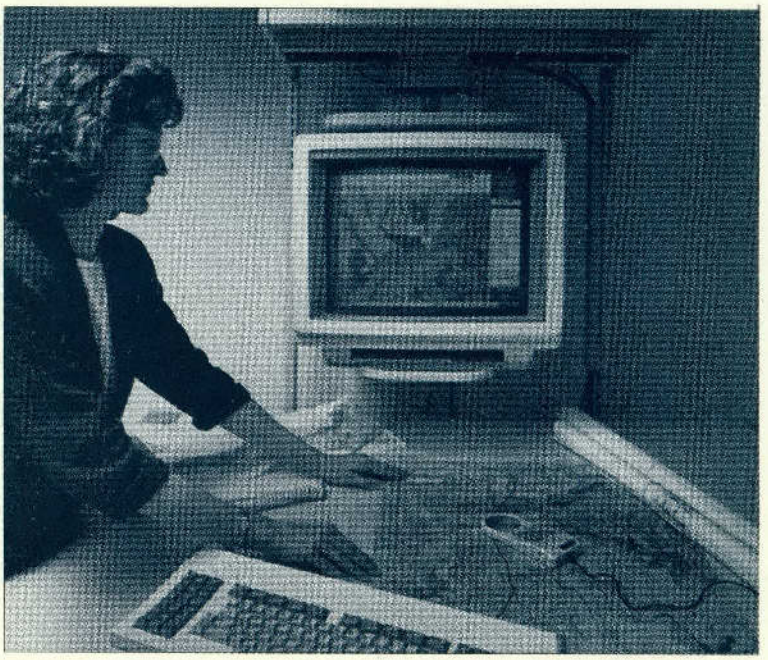
For centuries, people have settled in the Edwards Aquifer region because of the abundance of springwater.

The need for planning and protection is continuous. If the long term average annual pumpage exceeds the long term average annual recharge, water levels in the aquifer will drop and springflow will cease. To the people of this region, the protection and proper management of the Edwards Aquifer means economic stability, environmental integrity, preservation of a unique system of plant and animal life, and a continued high quality of life.

The Edwards Underground Water District:

A Mission of Stewardship

Groundwater is one of Texas' most valuable resources. About 70 percent of the water currently used in the state is groundwater. In south central Texas, groundwater is particularly important to the 1.3 million people who rely upon the Edwards Aquifer as their primary source of water.



Following the drought of the 1950's, concerned citizens worked with state and local leaders to provide for local protection of the Edwards Aquifer through the creation of an underground water district. The Edwards Underground Water District, created by the State Legislature in 1959, is the manifestation of the region's commitment to protect and preserve this unique and precious resource.

Since its creation, the Edwards Underground Water District has initiated much of the groundwater resource planning for the Edwards Aquifer region.

The District's boundaries currently lie within the counties of Bexar, Comal, and Hays and its affairs are governed by a 12-member board, elected by popular vote. The *Edwards Aquifer*, however, cannot be divided according to political boundaries. For this reason, the Edwards Underground Water District is committed to continuing its programs throughout the aquifer region so that residents can continue to receive the benefits of an indispensable resource.

At the present time, the quality of water in the Edwards Aquifer surpasses recognized water quality standards. To ensure both the quality and the quantity of water in the aquifer, holistic and coordinated management is critical.

The District's mission of stewardship extends throughout the Edwards Aquifer region so that residents can continue to enjoy the benefits of an indispensable resource.

Photo courtesy of San Antonio Convention and Visitor's Bureau

The Edwards Aquifer Provides A Valuable Resource to South Central Texas

To Early Settlers Springs Were Like Paradise

The history of this area is rich with accounts of people and their dependence upon the springs and rivers of this area. Archaeological digs at San Marcos Springs reveal that man lived there as early as 13,000 years ago.

The "Camino Real," or King's Highway, which was completed in 1697 by the Spanish, passed by the San Marcos, Comal, and San Antonio Springs. In San Antonio, the first acequia, or water ditch, was finished in 1730 and provided an elaborate system of springwater dispersal for cooking, drinking, and irrigation. In 1845, German settlers led by Prince Carl Solms of Braunfels arrived and established the settlement known as New Braunfels along the Comal River.

Through the late 1800's, springs provided the primary source of water for people living in the area. The first well was drilled into the Edwards Aquifer in 1865. By 1900, wells had become the major suppliers of water.

Because of the renewable nature of this precious resource, the Edwards Aquifer continues to be the basic building block of life for everyone who lives and works in the region.

Downstream Users Also Rely on the Edwards Aquifer

People living in the Edwards Aquifer region are not the only ones who rely on its waters. In San Marcos and New Braunfels, the springs support a thriving recreation and tourism economy. The water then flows downstream where thousands of people depend on it for domestic use, irrigation, industry and recreation.

Under normal conditions, the Comal and San Marcos Springs supply approximately 30 percent of the base flow of the Guadalupe River. In times of drought, the springs provide up to 70 percent of the base flow. Farmers along the Guadalupe River rely on this flow to irrigate their orchards and row crops, to water their livestock, and for domestic needs.

Aquifer Sustains A Unique System of Plant and Animal Life

Just as the aquifer is our sole source of water, it is also the life-source for an abundance of wildlife that live in the aquifer region.

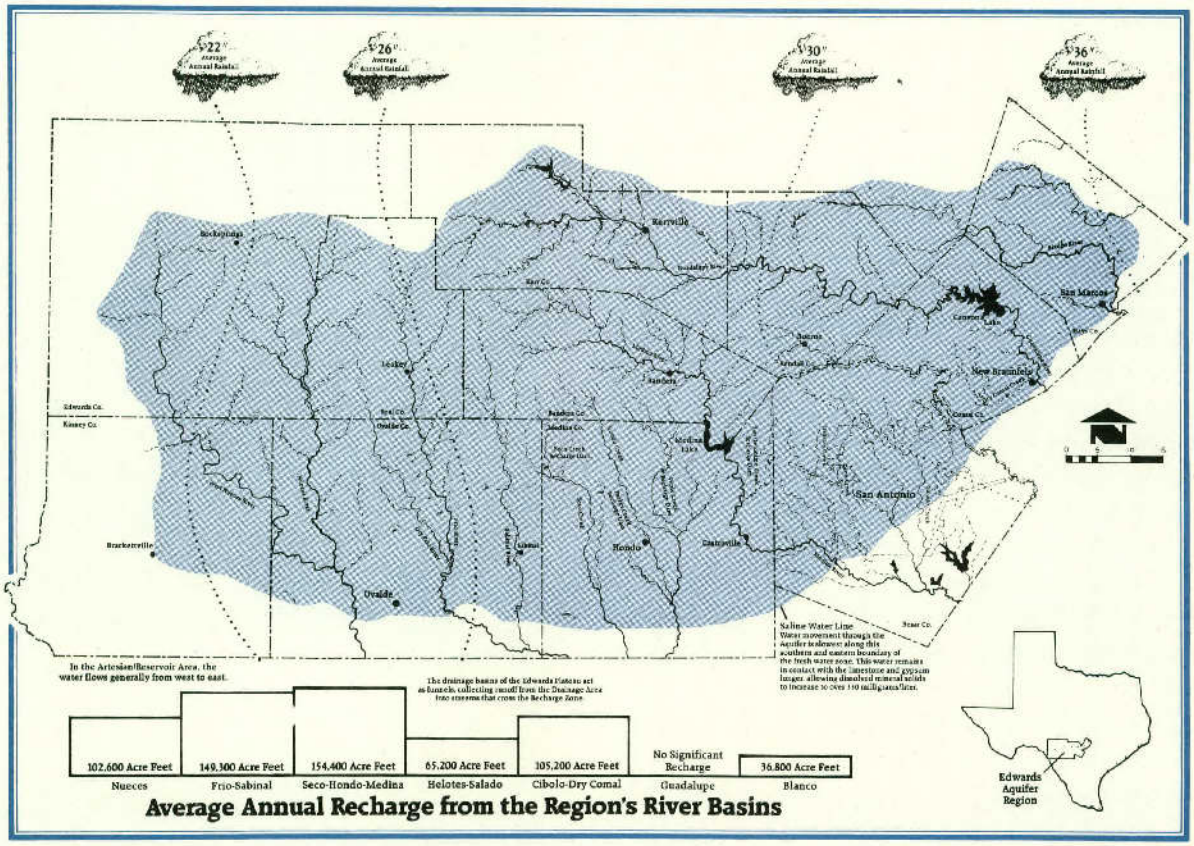
In addition to the familiar species of wildlife which flourish in the hills and grasslands of south central Texas, the waters and underground caverns of the aquifer provide a natural habitat for a number of endangered plant and animal species. There are three known endangered animal species living in the springs, either in or near the mouths of Comal and San Marcos springs: the Texas Blind Salamander, the Fountain Darter, and the San Marcos Gambusia. The San Marcos Salamander, listed as threatened, is restricted to the headwaters of the San Marcos and Comal Rivers. Texas Wildrice, also endangered, is an aquatic grass that is indigenous to the San Marcos River. Species such as the Widemouth Blindcat, the Toothless Blindcat, and blind shrimp can be found deep beneath the earth's surface, living in the pore spaces of the Edwards Limestone.

Continued Economic Vitality Depends on Clean, Fresh Water

Water from the Edwards Aquifer has supported civilization in south central Texas for thousands of years, and it continues to be the primary source of water for the area.

Maintaining the clean and plentiful supply of water that is stored by nature in the Edwards Aquifer is, and always will be, essential to the growth and prosperity of the Edwards region.

The Edwards Aquifer and its Drainage Area Includes All or Parts of 13 Counties



Average Annual Recharge from the Region's River Basins

From a regional perspective, the movement of water through the Edwards Aquifer appears to be simple.

The primary geologic component of the Edwards Aquifer is Edwards Limestone, which occurs in three major and distinct segments: the Edwards Plateau, the Balcones Fault Zone, and the Gulf Coastal Plain.

There are also three hydrologic components in the Edwards Aquifer system: a Drainage Area, a Recharge Area, and an Artesian/ Reservoir Area.

Precipitation falling on the drainage area is transported by streams to the Balcones Fault Zone, where it penetrates the ground and recharges the aquifer. The groundwater then moves by gravity through the pore spaces in the limestone from areas where the water levels are at higher elevations to areas where the water levels are at lower elevations (toward the major springs). Water is withdrawn by wells or discharged at the springs.

From this generalized explanation, the aquifer functions in a seemingly uncomplicated manner. A more detailed examination of the Edwards Aquifer, however, indicates that the flow is very complex.

Complex Aquifer System Has Three Major Components

The Edwards Aquifer is a network of drainage, recharge and artesian/ reservoir areas, which underlie 8,000 square miles and thirteen south central Texas counties.

Drainage Area

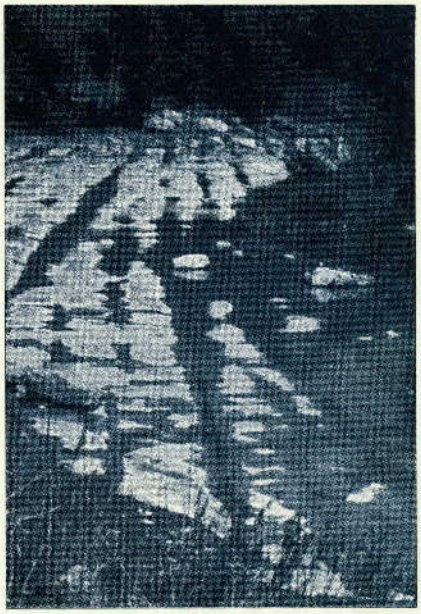
The Edwards Plateau

The first and largest component of the aquifer system, with an area of about 4,400 square miles, is the Drainage Area, also known as the Edwards Plateau.

Land surface on the Edwards Plateau ranges in altitude from 2,300 feet above mean sea level in the west to about 1,000 feet above mean sea level in the east. Vegetation on the plateau is primarily woodlands comprised of various species of oak, mesquite, and juniper. Large areas of woodlands on the plateau have been cleared to provide increased rangeland for grazing livestock.

The Drainage basins on the Edwards Plateau funnel stormwater runoff into streams that flow across the recharge area. Since most recharge to the aquifer occurs through streambeds, the funneling effect is an important function of the Drainage Area.

The Edwards Plateau is composed of Edwards and Glen Rose Limestones and receives recharge directly from rainfall and runoff. Edwards Limestone is porous and some of the water is stored after the rainfall stops. Streams that originate from the

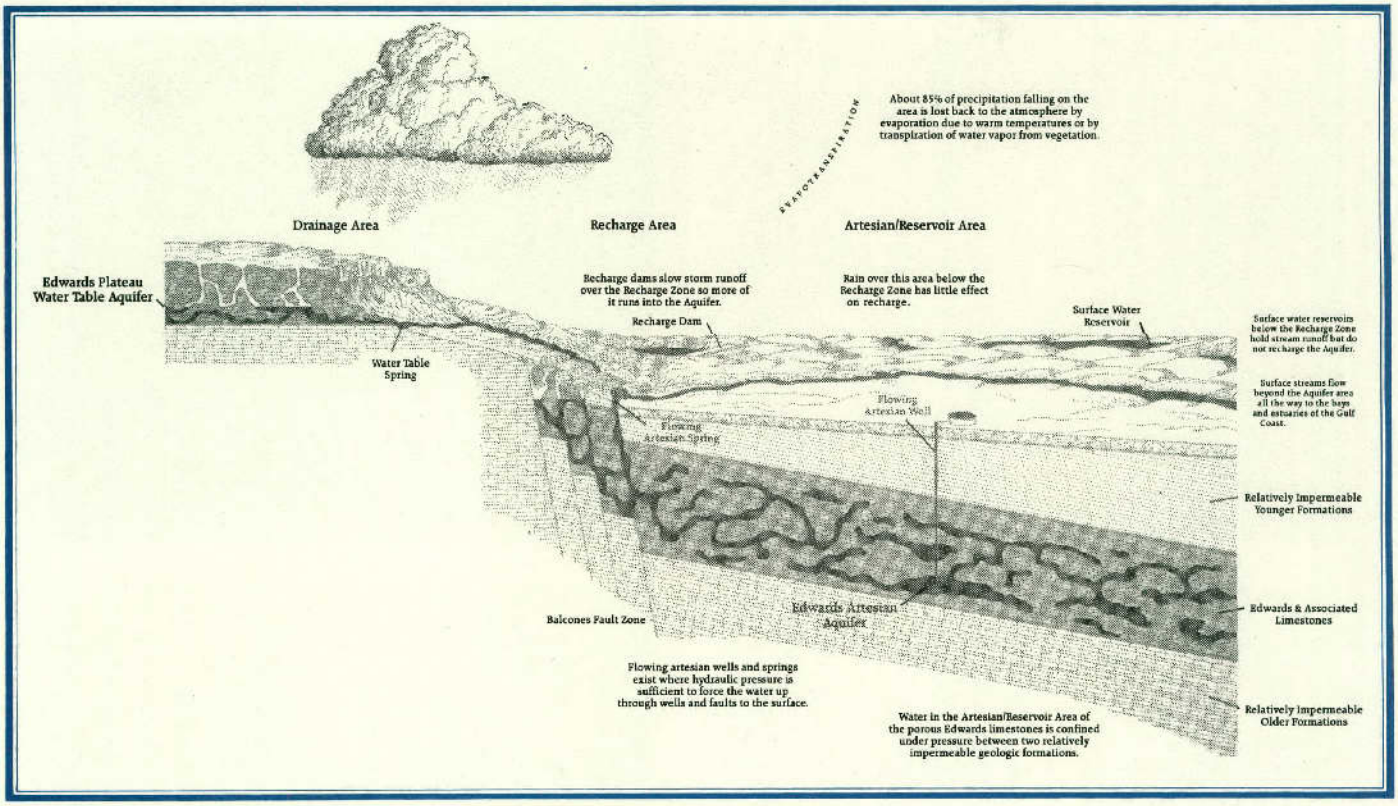


Drainage Area continue to flow for long periods after storms cease because the water stored in porous limestone slowly migrates out of the rock and sustains the base flow of the streams.

Recharge Area

The Balcones Fault Zone

The second component of the aquifer system is the Edwards Limestone's exposure along the Balcones Fault Zone, also known as the Recharge Area. This portion of the aquifer has



an area of about 1,500 square miles.

Many closely spaced, nearly vertical faults occur along the relatively narrow Balcones Fault Zone, exposing the fractured Edwards Limestone at land surface. Recharge features such as caverns and sinkholes are common in this area. Live Oak and juniper trees are also a part of the native landscape.

As the streams cross the fault zone, much of the flow percolates through the streambeds into the aquifer. During low-flow periods, virtually all streamflow is recharged to the aquifer. Except during floods, the streams flowing from the western part of the plateau lose most of their water through recharge to the Edwards Aquifer and generally are dry when they reach the Gulf Coastal Plain. During higher flow periods, streamflow commonly exceeds the recharge rate and much of the water flows across the recharge area to the Coastal Plain.

Artesian/ Reservoir Area

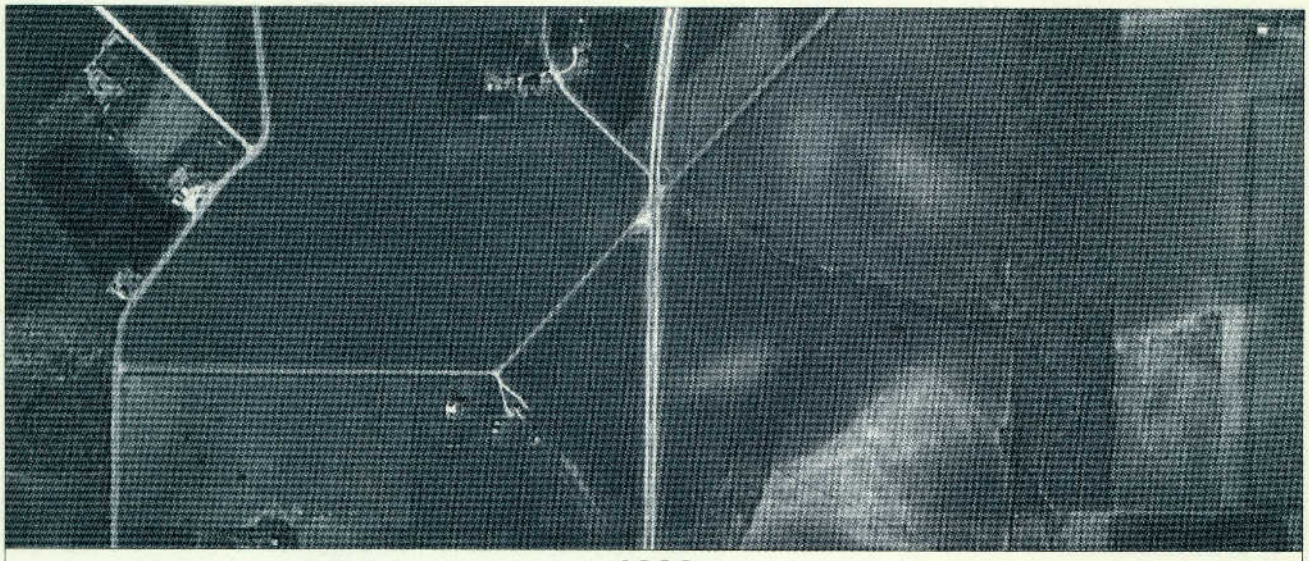
The Gulf Coastal Plain

The final component of the aquifer system lies deep beneath the Gulf Coastal Plain. The Del Rio Clay and other overlying, confining formations make this part of the Edwards Limestone the Artesian/ Reservoir Area. The Gulf Coastal Plain is a gently rolling landscape and altitudes vary from about 1,200 feet in the western part of the area to about 600 feet in the eastern part. This portion of the aquifer system has a surface area of about 2,100 square miles.

The Artesian/ Reservoir Area, with its many pore spaces and complex network of solution openings, has a great capacity for storing and moving water. In this area, the groundwater moves east—northeast. The southern and eastern boundary of the Edwards Aquifer is known as the Fresh/Saline Water Interface. Water south and east of this interface is highly mineralized and not potable. On the fresh water side of this line, flow is deflected northeastward toward the major springs in New Braunfels and San Marcos.

The direction and rate of movement of water in the aquifer are affected by the extremely complicated physical characteristics of the Edwards Limestone such as faulting and transmissivity, or the capability of water to move through the aquifer.

The part of the aquifer with the greatest pore space and the highest yielding wells is a relatively narrow band from near San Antonio northeastward through the vicinity of the two largest springs. Wells in this band commonly yield water at rates of 6,000 to 7,000 gallons per minute. Wells in the northern and western parts of the aquifer produce much less water, with wells that produce only several gallons per minute being common in northern Bexar County.



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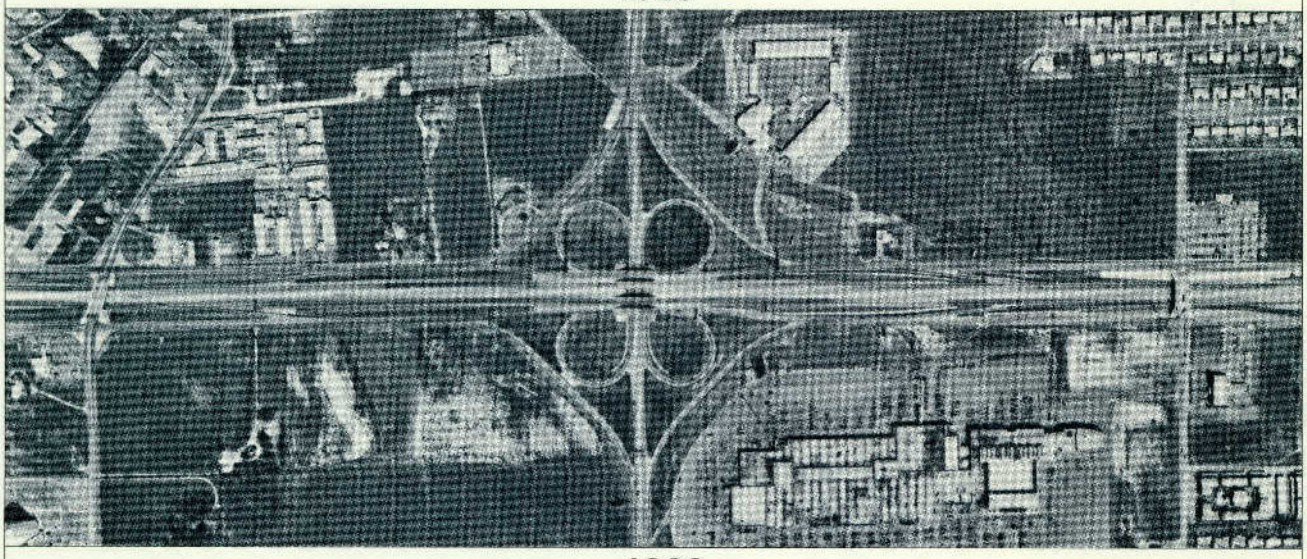

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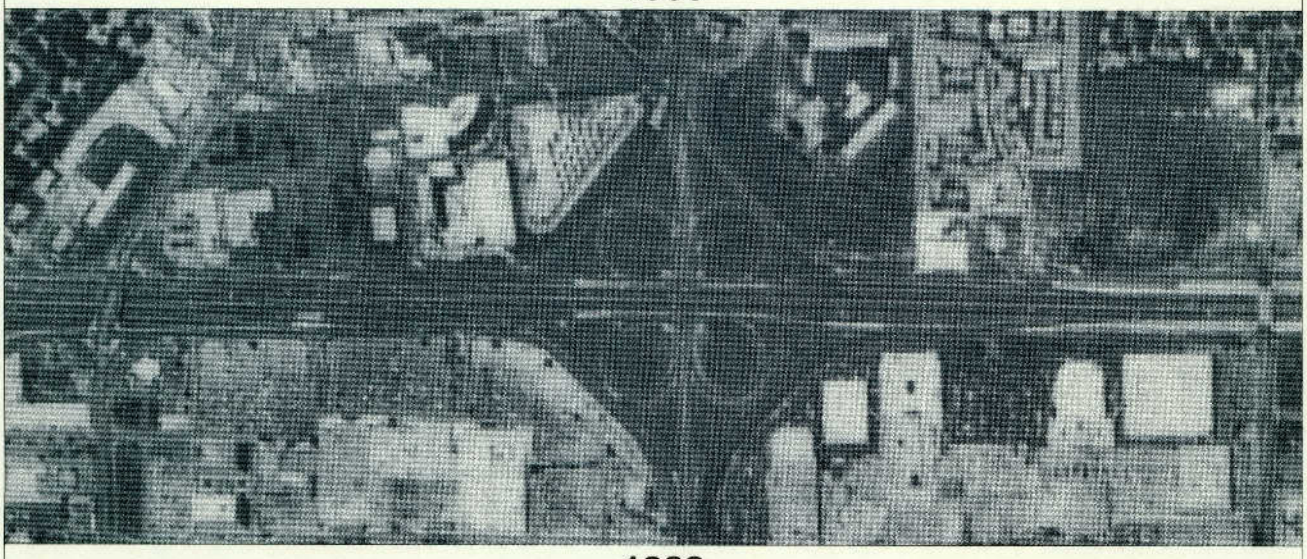


1988

Intersection of Interstate Highway 410 and San Pedro Avenue, San Antonio, Texas illustrates population growth in Bexar County

Increasing Demands Threaten Water Supply

Photo courtesy of San Antonio Convention and Visitor's Bureau

Growing Population Causes Changes in Water Use

The first settlements in the area were located near natural spring outlets. Until the first well was drilled into the Edwards Aquifer in 1865, water from the aquifer was obtained only from springs. In the 18th and 19th centuries, only a small part of the springflow was needed to sustain the area's sparse population.

Wells became the major suppliers of water after 1900 when the area population reached 100,000. Since 1940, the population in the Edwards Aquifer region has increased at a rate of about 20,000 people per year.

Bexar County, where San Antonio is located, represents most of the area's population. This city has increased in population from about 200,000 in 1940 to over 1,100,000 in 1990. Rapid development of light industry and service companies have accompanied the population increases.

The trend toward growth is consistent throughout the Edwards Aquifer region. Between 1940 and 1990, the population of Uvalde increased from 6,679 to 14,729; the population of Hondo increased from about 3,500 to 6,012; and San Marcos has increased from about 6,000 to 28,743. Furthermore, during the past 50 years, many areas within the region have changed from a predominantly rural to a more urban environment.

In response to population increases, industrial growth, agricultural expansion, and demographic changes, water withdrawals through wells from the Edwards Aquifer have also increased. Since 1940, total annual pumpage in the region has increased by more than 300 percent, from 120,100 acre feet to 489,000 acre feet in 1990. (An acre foot equals the amount of water needed to cover one acre of surface area to a depth of one foot, or 325,851 gallons.)

Demands Expected to Increase

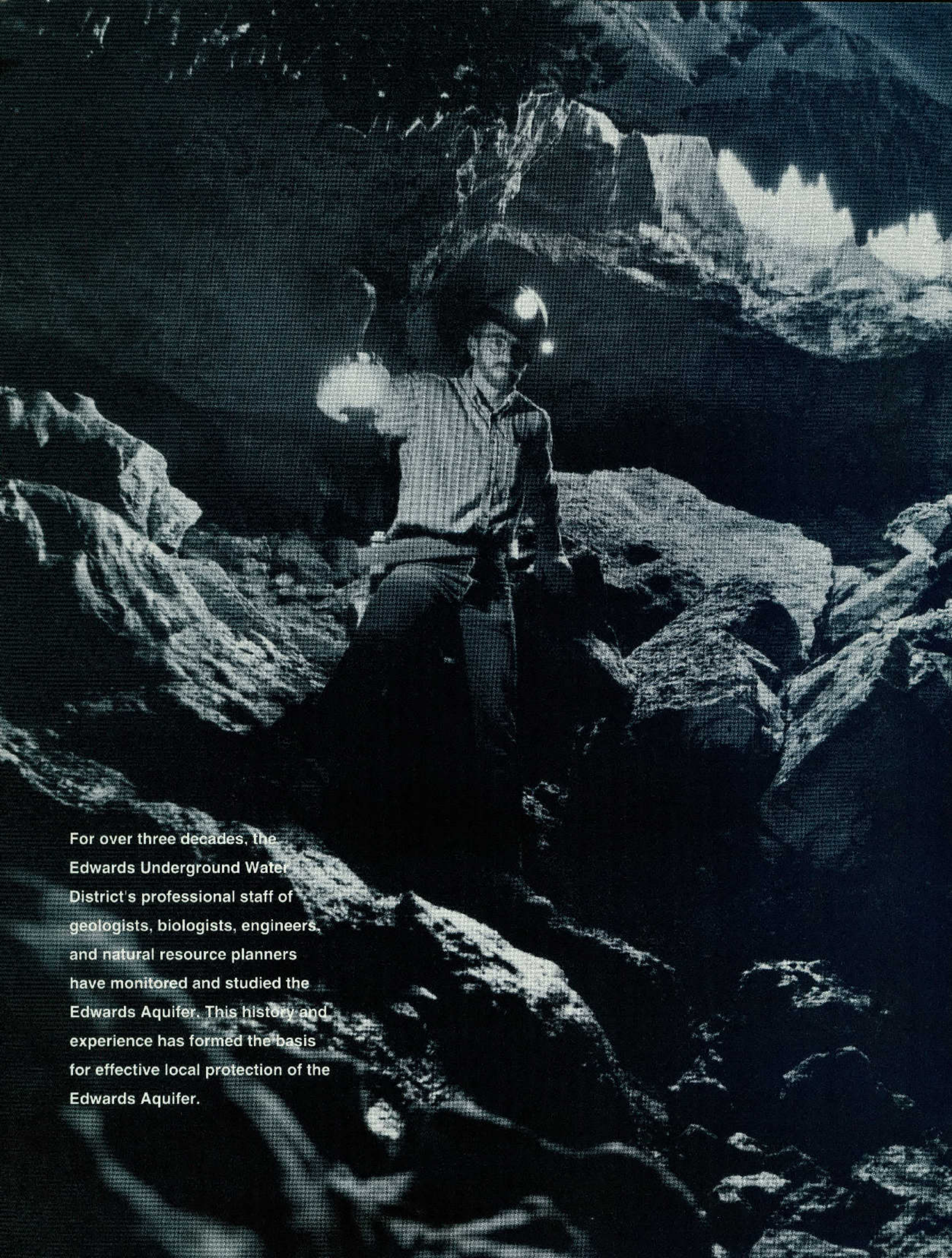
Historically, the availability of water from the Edwards Aquifer has been sufficient to meet the demands in the area. Continued urban and industrial development, however, will result in increased demands on the aquifer.

Water resource planners project that by the year 2020, demand for water in the Edwards Aquifer region could exceed 850,000 acre feet per year and that "mining" of the aquifer could begin as soon as the year 2000.

Average annual recharge to the Edwards Aquifer equals 640,000 acre-feet, with an historical range from 43,000 to over 2 million acre feet. Increasing demands on the Edwards Aquifer, coupled with wide ranging recharge amounts has resulted in large fluctuations in water levels. This, at times, has resulted in depleted wells and dry springs. With a regional population predicted to surpass 2.3 million by the year 2020, increased reliance on the Edwards Aquifer will cause wells and springs to dry up more frequently and for longer periods. A limited resource necessitates limiting demands upon it.

Per Capita Use Slowing

Through the late 1980's, per capita water use in the urban areas of the region continued to increase, reflecting the changing lifestyles and industrial expansion that had occurred. However, current events over the last few years have prompted a gradual reversal of that trend. Since 1980, attention has increasingly focused on the water resources of this region. Federal lawsuits, state actions, local ordinances and intensive water conservation education efforts have created an increased public awareness of the need to conserve the region's principal source of water.



For over three decades, the Edwards Underground Water District's professional staff of geologists, biologists, engineers, and natural resource planners have monitored and studied the Edwards Aquifer. This history and experience has formed the basis for effective local protection of the Edwards Aquifer.

The Edwards Underground Water District is a regional unit of government created in 1959 by the Texas Legislature for the purpose of conserving, protecting, and recharging the groundwater in the Edwards Aquifer.

To accomplish this purpose, the District is empowered through its enabling legislation.

As citizens in the region become more aware of their water supply and the critical importance of planning for future water needs, it is more important than ever to understand the limitations and capabilities of this complex resource.

Under the leadership of the Board of Directors, the Edwards Underground Water District will continue its mission of stewardship of the Edwards Aquifer. . . to conserve. . . to preserve and protect. . .to prevent waste and pollution. . . to develop comprehensive plans. . . to publish plans and information. . . to increase recharge. . . for present and future generations.

"...TO PREVENT WASTE AND POLLUTION..."

Water Quality

According to the U. S. Environmental Protection Agency, water in the Edwards Aquifer surpasses all federal drinking water standards. Many of the District's programs focus on maintaining these high water quality standards for the people who rely on the Edwards Aquifer as their principal source of water.

Due to the faulting and fracturing associated with Edwards Limestone, the Edwards Aquifer is extremely vulnerable to surface and subsurface pollution. In September of 1986, the District's Board of Directors adopted a non-degradation policy concerning the Edwards Aquifer.

In response to that mandate, and in accordance with its enabling statute, the District carries out a number of programs aimed at identifying and abating potential threats to both the quality and quantity of water in the Edwards Aquifer. These programs include:

- monitoring development on the Recharge Zone
- monitoring and inspecting hazardous material storage facilities
- responding to leaks and other sources of contamination
- working to upgrade the existing Edwards Rules
- conducting groundwater contamination investigations
- conducting hydrocarbon storage facility compliance inspections
- development of an Emergency Spill Response Plan
- protecting sensitive areas such as sinkholes and caves from contamination and maintaining them as natural recharge points
- closing abandoned wells.

Water Conservation

Water conservation represents an additional source of water. Resource planners estimate that common-sense conservation efforts can result in at least a 10-15% reduction in water use.

Water quantity is affected both by the amount of water that is added to the aquifer and the amount of water that is withdrawn. The District carries out a number of innovative programs to eliminate waste and develop additional sources of water.

One major source of wasted water comes from leaks in underground distribution systems. Nationwide, unseen leaks account for an estimated 40 percent water loss rate. In the Edwards region, however, District leak detection specialists are helping area municipalities locate these hidden water wasters.

Outdated plumbing fixtures are also substantial wasters of water. Design improvements in toilets, showerheads, and faucet fixtures allow appliances to use less than half of the water used by their older counterparts. The District has been active in encouraging the adoption of municipal ordinances requiring the use of ultra-low-flow (ULF) plumbing fixtures in new construction. Since this effort began, seven cities within the Edwards Aquifer region have adopted ULF ordinances.

Information and Education

One of the most important factors affecting how people use water from the Edwards Aquifer is how well they understand the nature and characteristics of the resource itself. The District believes that a well informed citizenry will be more responsive and better equipped to meet the challenges facing them with respect to resource

"...TO CAUSE INVESTIGATIONS TO BE MADE TO DETERMINE THE MOVEMENT OF UNDERGROUND WATER AND THE QUANTITY THEREOF..."

management. Because of this belief, the District conducts a comprehensive public information and education program targeting children, adults, and a variety of other groups and organizations. Fostering a water conservation ethic among present and future water users is the cornerstone of the District's overall conservation effort.

The District's education program is a multi-level, multi-faceted, in-school effort which targets the special needs of teachers and students alike. The education program includes teacher workshops, in-service education, high quality audio-visual materials, multi-level curricula and resource materials, and theatrical presentations.

Information programs include a speakers' bureau, field trips, free standing displays for use in libraries, banks, malls and other public spaces, a seasonally-intensive conservation effort, water conservation materials, a variety of community outreach programs, and a quarterly newsletter distributed to citizens upon request. For more information on these programs call the District's Public Information Office at 222-2204 or 1-(800)-292-1047.

Data Collection and Management

Despite years of study, scientists still are not certain how much water is in the Edwards Aquifer. Although the U. S. Geological Survey estimates between 25 and 50 million acre feet, it is difficult to measure precisely how much water is in the aquifer because of the limestone's porosity and the interconnected configurations of open caverns and microscopic pores. The Edwards Underground Water District conducts several programs aimed at providing answers to some of the unknown factors.

Geologists understand that continuous monitoring of the water supply is key to its protection. The District maintains one of the most comprehensive data collection programs in Texas for an underground water supply. A network of over 100 monitoring wells, located throughout the Edwards Aquifer region, enables District geologists to maintain constant watch over water quality and quantity.

In its effort to uncover the mysteries of the Edwards Aquifer, the District has collected a large body of physical data. Due to the sheer volume of data and the aquifer's sizable geographic area, computer processing is required. In 1989, the District began developing a geographic information system (GIS) capable of storing, analyzing, and managing the wide variety of information required to monitor the impact of human activities on the quantity and quality of water in the Edwards Aquifer. Data sets have been compiled on significant recharge features, geology, drainage areas over the recharge zone in Bexar County, and other information which supports District objectives and programs.

At any given time, the District has underway a variety of long- and short-term investigations into the nature and characteristics of the Edwards Aquifer. Examples of such studies include: an investigation into the storage trends in the Edwards and Glen Rose Aquifers; the potential for saline water intrusion into the fresh water zone of the Edwards Aquifer; and the potential for increasing recharge to the Edwards Aquifer.

Regional Water Supply Planning

"...TO DEVELOP COMPREHENSIVE PLANS... "

Achieving regional solutions to water problems through consensus is a primary goal of the Edwards Underground Water District.

As early as 1983, the District joined with the City of San Antonio and other interested parties from across the region to develop the 1988 Regional Water Plan. This Plan contained four major components and continues to represent the region's best attempt at forging a consensus-based water management plan. The components of the Regional Water Plan were: the construction of surface water reservoirs, the development of water reuse programs, conservation, and allocation. Although the enabling legislation for the Regional Water Plan failed in the 1989 legislative session, the guiding principles behind that Plan still represent the best approach for effective management of the Edwards Aquifer.

The failure of the legislative effort left the people of this region with no plan in place to protect their future water interests. Nor is there an effective regionwide mechanism for resolving the critical and complex issues which face them.

The nature and characteristics of this very special resource require careful planning and equitable management. The issues are not purely technical, but are political and economical as well. The key to building a sound consensus is through preparation and participation—posing the right questions, collecting and analyzing data, interpreting the information, delineating the alternatives, deciding on a course of action and doing these activities through a collaborative process that is open, equitable, and fair.

The Future of the Edwards Aquifer

Elected state and local officials, professional water managers, and interested citizens from across the Edwards Aquifer region have different but important concerns relative to alternatives for future water management. Because of the interconnectedness of the aquifer system, and competing interests for limited supplies, each diverse group must be consulted and their input carefully considered before management decisions are finalized.

Alston and Freeman (1975) describe decision makers as sociopolitical people "who must bargain with diverse clients, knowing that the public good is defined in many conflicting ways by intensely competitive and self-interested groups. Such decision makers know that goals are fluid, multiple, and inconsistent, multidimensional and incommensurable. They also know that no fixed solutions are possible, regardless of their technical or economic elegance."

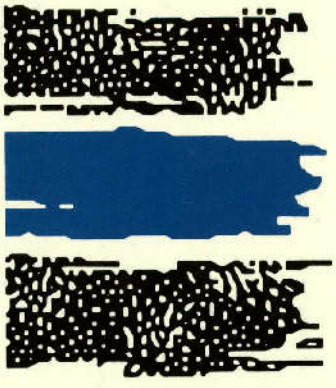
In an expanding economy with increasing population, water use will increase and the Edwards Aquifer will continue to provide the primary source of water for the region. State and local water managers as well as decision makers need the best information available to make decisions concerning the water needs of the area and how these needs are to be met. Information needs include data for determining the maximum recharge potential and the maximum that can safely be withdrawn from the aquifer during periods of various climatic conditions. All of this must be accomplished without endangering the quality of the resource and without causing severe hardship for the various water users.

Long and continuous study efforts, with well defined objectives and well organized study approaches must be pursued. The Edwards Underground Water District is committed to long- and short-term groundwater investigations aimed at addressing these issues.

Considerable work has been undertaken by various groups and entities in the Edwards Aquifer region to address present and future water needs. But much work remains to be done. The need for planning is ongoing. The need for management is critical. The need for stewardship is essential. To protect both the quality and quantity of water, the resource must be managed as a whole. The responsibilty rests with all those who rely upon the Edwards Aquifer.

Photo opposite page
Recharge to Seco Sinkhole (December 1991)

Photo courtesy of San Antonio Light/ Tommy Hultgren



EDWARDS UNDERGROUND
WATER DISTRICT

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