# San Antonio Water System Source Water/Wellhead Protection Program


**Note: This report is currently being revised and will be updated in late 2002.**

**San Antonio Water System Wellhead/Source Water Protection Initiatives**

**Introduction**

Over 1.5 million people in south central Texas and San Antonio rely on the Edwards Aquifer for their drinking water. This was the first aquifer in the United States to receive a sole source designation by the Environmental Protection Agency in 1975 under the Safe Drinking Water Act. The amendments to the Safe Drinking Water Act of 1986 provide for ground-water protection. One of the amendments provides for the Wellhead Protection Program. Additionally, the amendments to the Safe Drinking Water Act of 1996 establish a new charter for the nation's public water systems, in protecting the safety of drinking water. The amendments include, among other things, approaches to prevention, and a source water protection assessment program. According to the Act, "a State assessment program is required to: (1) delineate the boundaries of the areas providing source waters for public water systems, and (2) identify (to the extent practicable) the origins of regulated and certain unregulated contaminants in the delineated area to determine the susceptibility of public water systems to such contaminants".

The San Antonio Water System (SAWS) has developed and is continuing to expand the scope of its Source Water / Wellhead Protection Program. This program received an EPA Environmental Excellence Award in 1999.

The project tasks incorporate the study of the general geology in the San Antonio area, occurrence of ground water, land use, inventory of historical and present potential contamination sources within the area of each public supply water well, and a public education campaign. Land use activities on the Edwards Aquifer recharge zone will be

noted, since it has the potential of being one of the largest areas in which contaminants can enter the water supply in the San Antonio region.

**Geology \ Hydrology of the Edwards Aquifer and Associated Limestone**

The Edwards Aquifer is an intensely faulted and fractured carbonate limestone formation that lies within the Balcones fault zone. The storage capacity, flow characteristics, water producing capabilities and efficient recharging ability make this geologic anomaly one of the most wondrous aquifers in the nation. The San Antonio portion of the Edwards Aquifer extends approximately 180 miles from the Brackettville area in the west to Kyle in the east (See Map Fig.1). The small hydraulic gradients and the large discharge volume at the springs and many high-capacity yielding wells demonstrate the immense transmissivity of the Edwards Aquifer. The recharge zone is its outcrop area in the Balcones fault zone. Average groundwater recharge to the Edwards Aquifer in the San Antonio area from 1934 through 1997 was 676,000 acre-feet annually (Walthour and others 1997).

In the San Antonio region, the Edwards Limestone attains a thickness of approximately 450 to 500 feet, about 450 feet of which make up the Edwards Aquifer. Other rock properties, which make up the Edwards limestone, but at lesser quantities, are chert, dolomite and evaporites. The major lithostratigraphic units of the Edwards Aquifer are the Kainer, Person and Georgetown formations. (Maclay and Small, 1976). The Person and Kainer formation are subdivided into seven members. The Person formation members are the Cyclic and Marine member, Leached and Collapsed member, and the Regional Dense member. The Kainer formation members are the Grainstone, Kirschberg Evaporite, Dolomitic, and the Basal Nodular. (Rose, 1972). (See table 1) The porosity

and permeability of the confined freshwater part of the Edwards Aquifer results primarily from the dedolomitization (calcification) of dolomitic rocks by circulating calcium rich ground water. In the unconfined portion of the aquifer the permeability is characterized by dissolution of limestone by circulating ground water, which led to the development of a cavernous network along fractures associated with the Edwards formation (Maclay 1995).

Regional flow of water within the aquifer is generally from west to east. (Fig. 1) Approximately 70% of the recharge into the Edwards Aquifer occurs in the western counties (Kinney, Uvalde and Medina). Barriers to flow on the southern edge of the artesian zone direct the flow towards the east.

The downdip boundary of the Edwards Aquifer is marked by the freshwater/ saline-water interface. It divides the Edwards into the updip freshwater zone containing potable water and the downdip saline-water zone with a concentration of total dissolved solids of greater than 1,000 mg/L (Schultz 1992). This boundary is sometimes referred to as the “bad-water line”. Most of the meteoric water entering the aquifer from the recharge zone moves through the freshwater zone before being discharged. Low permeability in the saline confined portion of the aquifer is attributed to limited interconnection between pores in the rock matrix and to the lack of substantial dissolution along fractures (Maclay 1995). However, due to the hydraulic gradient declines toward the saline zone some of the freshwater moves into the saline zone.

Table 3. Hydrogeologic subdivision form Maclay and Small (1976).

| Hydrogeologic subdivision | | | Group, formation, member | Thickness (Feet) | Porosity / permeability type |
|---|---|---|---|---|---|
| UPPER CRETACEOUS | UPPER UNITS | | Navarro Group, Upper Taylor Marl undivided and Escondido Formation | 200 - 580 | Low porosity / low permeability |
| | | | Anacacho Limestone and Pecan Gap Chalk | 300 - 500 | Southern Bexar Co. has some water bearing strata |
| | | | Austin Chalk | 200 - 350 | Minor aquifer that is locally interconnected with the Edwards Aquifer |
| | UPPER CONFINING UNITS | | Eagle Ford Group | 30 - 50 | Low permeability |
| | | | Buda Limestone | 40 - 50 | Low porosity / low permeability |
| | | | Del Rio Clay | 40 - 50 | None / primary upper confining unit |
| LOWER CRETACEOUS | EDWARDS AQUIFER | | Georgetown Formation | 2 - 20 | Low porosity / low permeability |
| | | EDWARDS GROUP | PERSON FORMATION: Cyclic and marine members, undivided | 80 - 90 | Laterally extensive; secondary porosity/ water - yielding |
| | | | PERSON FORMATION: Leached and collapsed members, undivided | 70 - 90 | Porosity developed along fractures or faults, permeable beds of collapse breccia, burrow biomicrities, honeycombed and laterally extensive, one of the most permeable |
| | | | PERSON FORMATION: Regional dense member | 20 - 24 | Negligible porosity and low permeability; vertical barrier |
| | | | KAINER FORMATION: Grainstone member | 50 - 60 | Cavernous, honeycombed layer and interparticle porosity |
| | | | KAINER FORMATION: Kirschberg evaporite member | 50 - 60 | One of the most permeable. Boxwork porosity in breccia or by burrowed zones |
| | | | KAINER FORMATION: Dolomitic member | 110 - 130 | Porosity developed along fractures or faults, honeycombed and laterally extensive, and water yielding |
| | | | KAINER FORMATION: Basal nodular member | 50 - 60 | No permeability in subsurface |
| | Lower confining unit | | Upper member of the Glen Rose Limestone | 350 - 500 | Relatively impermeable |

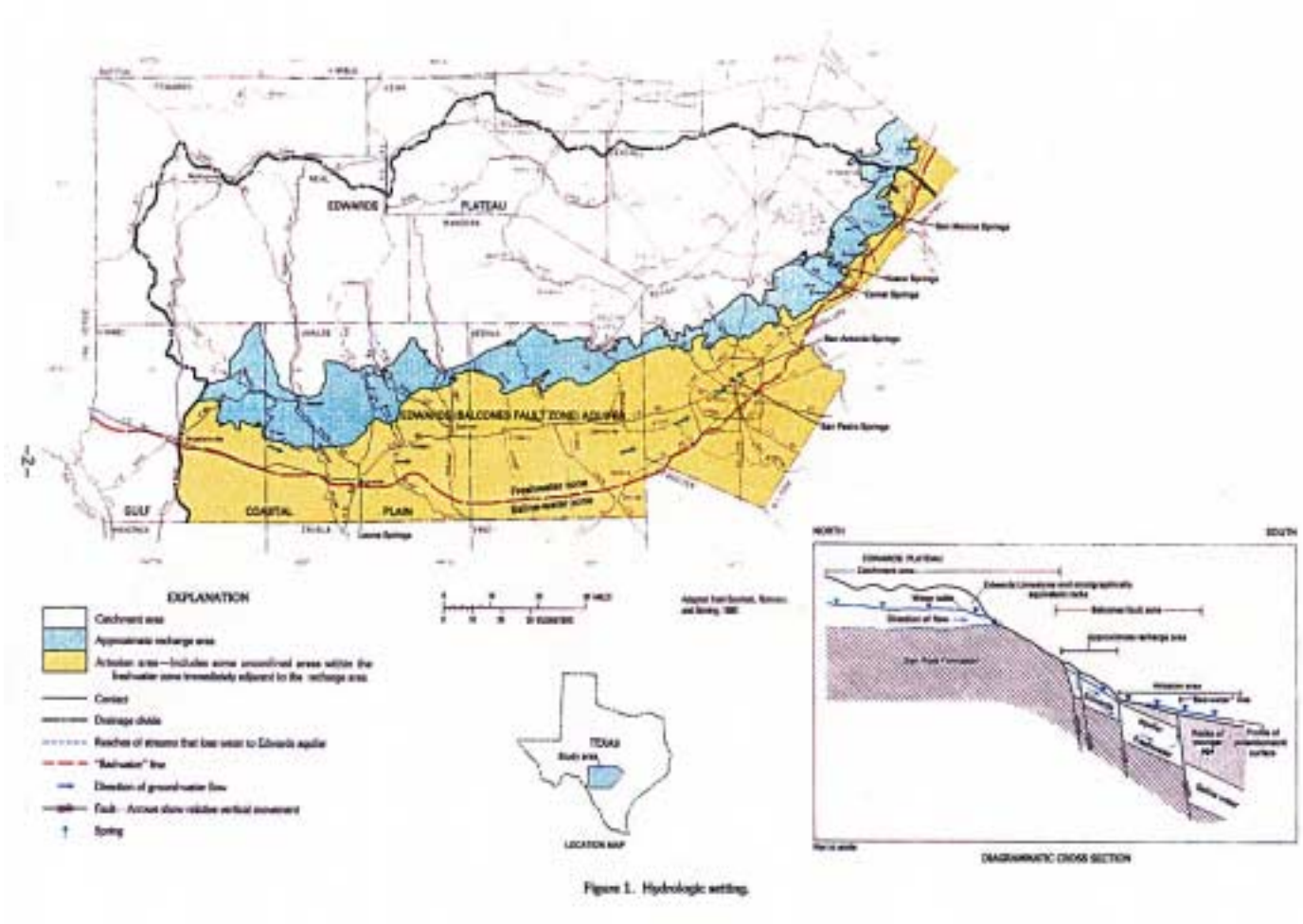


Figure 1. Hydrologic setting.

**Delineation**

The delineation of Wellhead Protection Areas (WHPAs) is an important means for directly safeguarding the public water supply. As defined in the 1986 Safe Drinking Water Act Amendments, a WHPA is "the surface and subsurface area surrounding a water well or well-field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or well-field." An initial delineation of one-quarter mile around each SAWS public supply well was completed for SAWS WHP program. However due to the complex geologic structure of the Edward

Aquifer, the large distance between the recharge zone and SAWS public supply wells, a more scientifically based methodology of delineation is required. A good aquifer model is necessary to properly design and plan an aquifer protection program that recognizes the extent of the aquifer and its overlying and upgradient region. SAWS staff has been trained on software programs that will enable the development of a model that can be used to better delineate the Source Water Protection areas. Utilizing this model in conjunction with those that other agencies, such as the U.S.G.S. and the Texas Water Development Board (TWDB), will allow a better understanding of the impact of potential contaminates within the contributing area. Conditions of both surface and groundwater flow patterns must be factored into the delineation of aquifer contributing areas. The goal is to develop a model that will provide a more accurate definition of SAWS WHPAs.

**Inventory**

The Groundwater Resource Protection Section purchased a Trimble Global Position Satellite (GPS) unit system for use in the Abandoned Well and Wellhead Protection program. All locations regarding the SAWS public supply water wells, all inventoried potential sources of contamination, abandoned wells and known karst features associated with the recharge zone were accurately located using the Trimble GPS. Once the GPS data is obtained it is plotted and incorporated into SAWS' database. Table 1 lists the potential sources to groundwater degradation that were looked for around each SAWS public supply well. Below are two examples of the delineation that were done for all of SAWS public supply wells.

**Table 1.**

| POTENTIAL SOURCES OF GROUND WATER DEGRADATION | |
|---|---|
| **WELLS:** | **Abandoned wells**<br>**Geothermal wells**<br>**Active private wells**<br>**Mineral Exploration wells** |
| **TRANSPORTATION:** | **Highways**<br>**Railroads** |
| **CHEMICAL STORAGE:** | **Underground Storage Tanks**<br>**Above Ground Storage Tanks** |
| **DISPOSAL OF WASTE:** | **Municipal Solid Waste Landfills**<br>**Industrial and Hazardous Waste**<br>**Abandoned Landfills** |
| **AGRICULTURAL CHEMICALS:** | **Fertilizers**<br>**Pesticides** |

**Well Pump Station Geology**

SAWS is currently studying the geology of each pump station. This study provides comprehensive look at the subsurface geology and is being conducted through the collection of subsurface information via geophysical log data, well reports and state well schedules. This information is a vital part of the SAWS Wellhead Protection Program, as it will address any potential avenue through which contaminates could enter the aquifer.

**SAWS Abandoned Well Program**

Abandoned wells are an environmental concern since they are direct conduits for contaminants to enter a water supply. The Groundwater Resource Protection Section is proactive in the pursuit of identifying and seeking the closure of abandoned wells. Abandoned wells are identified through the inspection of platted or replatted properties, property inspections performed when SAWS receives an application for water service and the Search and Abatement Program which is the inspection of approximately 1,500 accumulated active well files. SAWS issues permits for approximately 70 well closures per year.

In 1997, a geophysical logging program was initiated to ensure the proper closure of abandoned wells. Additionally, this program provides the technical and scientific information to promote subsurface research, and ensure proper well construction.

**Public Outreach and Education**

SAWS has made great strides in public awareness and education in the past few years. SAWS has orchestrated public information fairs and is involved with public education regarding water-related issues. Information fairs are presented by a

combination of various SAWS departments. The goal of stressing the importance of conservation, stormwater runoff, water quality, reuse, aquifer studies, recycling and wellhead protection has been, and will continue to be, presented through these efforts. In addition to the information fairs, SAWS has programs aimed at homeowner associations, schools and community gatherings. Through these programs people learn how to identify potential hazards that could threaten the water supply. SAWS also sponsors and participates in many educational efforts involving state, federal and local agencies.

There are many rural residents in the San Antonio area that rely on private wells for their household water supply. These people are being encouraged to practice wellhead protection for their private domestic wells. SAWS Groundwater Resource Protection Division assists homeowners in four basic wellhead protection practices: (1) proper well construction; (2) proper well siting; (3) backflow prevention; and (4) plugging abandoned wells. The Groundwater Resource Protection Division also helps well owners by answering inquiries regarding water quality.

The Commutation and Community Education conducts workshops and presentations to inform the public about Watershed Protection, Conservation, Water Quality and Source Water Protection. Through a series of programs the Section interacts with the public conveying the importance of these programs. Presentations to kindergarten students through adults of the general public have been successful avenues to increase citizen's knowledge of protecting their water source. Training workshops for the professional trades are coordinated on a regular basis to address local, state and federal regulations associated with construction and industrial activities. Specific water quality efforts implemented to achieve the goals and objectives of the federal stormwater

program (NPDES), include Kindergarden-2nd grade curriculum, a 3-D walk through aquifer, Watershed Olympics festival, Adopt-A-Creek, Texas Watch Monitoring, Storm Drain Stenciling, a Student Water Advisory Committee, and wide range of printed materials and promotional items.

**Aquifer Protection Areas - The Edwards Aquifer Recharge Zone**

The possibility of contaminates from spills, leakage from hazardous materials or runoff from the rapidly developing urban areas that are on or near the recharge zone are greatly increased (Stein and Ozuna, 1995). Therefore, safeguarding public water supplies in the San Antonio region must focus on protection of the Edwards Aquifer Recharge Zone. The Edwards Aquifer Recharge Zone crosses Kinney, Uvalde, Medina, Bexar, Comal and Hays Counties. Bexar County contains the smallest share having only 8% of the Recharge Zone, with less than 3% located within the city limits of San Antonio. However, of the six Counties, San Antonio has the strictest regulations for development over the Recharge Zone. Development in Bexar County of residential and commercial property on the recharge zone is increasing.

In 1994 the City Council of San Antonio met as a Committee Whole to review concerns about water quality. The mandate report adopted by City Council identified 33 measures needed to strengthen regulations to further protect the Edwards Aquifer. Of these 33 mandates, six were addressed by the Mayor and assigned to the Water Quality Task Force to revise. They were buffers along floodplains, buffers around significant recharge features, density limits, greenspace requirements, and two issues dealing with underground storage tanks. This Water Quality Task Force consisted of various

representatives of different groups, developers, Zoning and Planning Commission members, neighborhood groups, and engineers. The outcome was the Water Quality Ordinance No. 81491 adopted on January 12, 1995 by San Antonio City Council. The remaining 27 mandates have either been adopted by the ordinance, or approved as administrative or policy directives.

Enforcement and implementation responsibilities were assigned to SAWS to ensure compliance and increase public awareness on watershed quality and management issues.

**SAWS Plans for it's Source Water Protection Program**

The Source Water Protection Program is not static, but continuing in nature. SAWS will strive to achieve a more accurate delineation of its WHPAs, continue research to increase our knowledge of our water source and continue educating the public. Further, SAWS is developing a contingency plan in the event of contamination. In addition to protecting our current water source SAWS will implement new Wellhead/Source Water Protection Programs for new water sources as they are acquired.

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