

History of water well completions and uses at the State Capitol, 1857 to 1997

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Introduction

The purpose of this paper is to provide a perspective on the history of water well development and use for the Texas Capitol building and grounds in Austin, Texas. Historically, eight wells have been completed and used on the Capitol grounds since 1857 when the drilling of the first well was begun. These wells include four wells used for water supply purposes and four wells used for monitoring purposes. The water supply wells include the 1859 Well, the 1874 Well, the 1889 Well, and the 1890 Well. The four monitor wells were drilled and cored and cased with steel casing in 1989 and used for measuring shallow water levels in conjunction with the possible dewatering of the Austin Chalk during the recent construction of the Capitol extension. The occurrence, availability, and quality of the ground-water resources of the Capitol grounds and adjacent area in Travis County is adequately presented for review in Brune and Duffin (1983).

Preparation of this report is based on over 40 references reviewed and researched in the Texas State Library Archives, The University of Texas' Center of American History Library, The University of Texas' Architecture Library, the U.S. Geological Survey's Water Resources Library in Austin, the library of the Bureau of Economic Geology, the State Preservation Board Library, the author's personal ground-water resources library and files, and the files of the State Preservation Board, Texas Water Development Board, and the Texas Natural Resource Conservation Commission (now the Texas Commission on Environmental Quality).

The 1859 Capitol Water Well

The first permanent State Capitol building in Austin was completed in 1852–1853 at a location between the current Capitol building which was completed in 1888 and the south entrance to the Capitol grounds at the north end of Congress Avenue (LOC on Figure 1). On August 26, 1856, the Sixth Texas Legislature appropriated \$10,000 for the drilling of an artesian well and the purchase of trees and shrubbery for the Capitol grounds.

The first Capitol water well (State Well Number YE 53-43-707) which was started at a location “north” and “to the rear” of the 1852–1853 Capitol building (Well Location 1 on Figure 1) was drilled from April 1857 to July 1859 and was completed at a depth of 471 feet in the Edwards aquifer. At about 323 feet the drill struck “a vein of mineral water”, and the water rose up the wellbore to within 40 feet of the surface. Once the 471-foot depth was reached the well produced

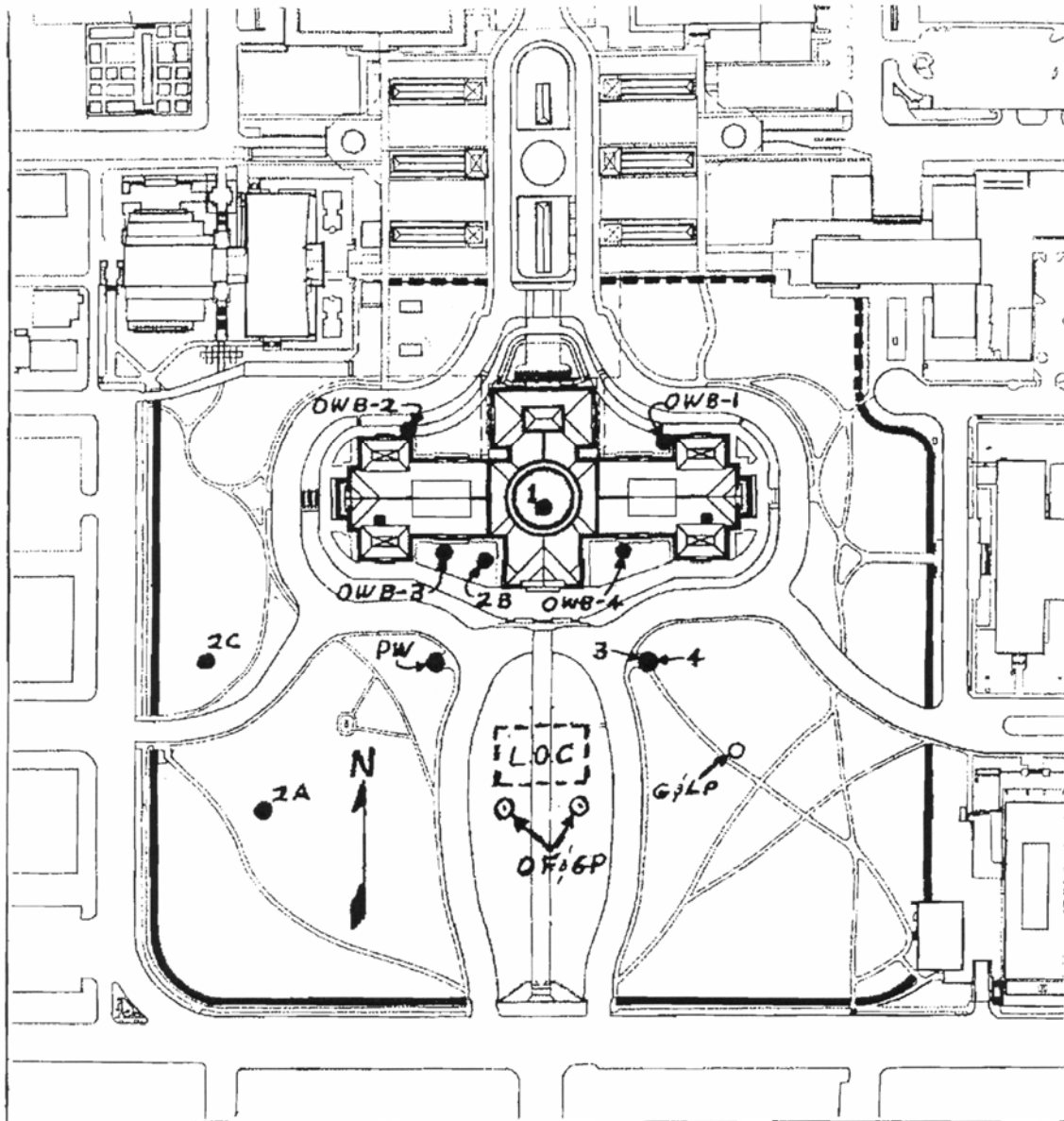


Figure 1. Location of the Capitol buildings and wells, since 1852–1853, Austin, Texas. (LOC is the approximate location of the 1852–1853 capitol building 1; 1 is the approximate location of the 1859 Capitol Water Well [YD 58-43-707]; 2A, 2B, and 2C are the possible locations of the 1874 Capitol Water Well; 3 is the location of the 1889 Capitol Water Well; 4 is the location of the 1890 Capitol Water Well [YD 58-43-702]; OWB-1, OWB-2, OWB-3, and OWB-4 are the locations of the 1989 water-level observation wells; and PW is the location of the proposed artesian well by Dibrell [1900]).

a surface flow of highly mineralized water containing abundant hydrogen sulfide. The geologic units encountered by the wellbore include from the surface to the total depth of 471 feet: the Capitol Terrace (alluvial) deposits down to 5 feet, the Austin Chalk and Eagle Ford Shale from 5 to 131 feet, the Buda Limestone from 131 to 162 feet, the Del Rio Clay from 162 to 232 feet, and the Georgetown Kiamichi and Edwards Formations from 232 to 471 feet.

The 1859 well was probably the first deep artesian well drilled in Texas and is known as the “Old State Capitol Well” and the “Austin Artesian Well”. The diameter of the borehole and the contents, diameter, and amount of casing set in the borehole is unknown. However, to assure that the wellbore would not be filled with the heaving clay of the Del Rio, some type of metal casing was probably set to a depth of about 235 feet. The approximate surface elevation of the wellhead when completed in July 1859 was about 545 feet.

The 1859 Capitol well was drilled by a Mr. Peterson by first using drilling equipment driven by a horse walking in a circular path around the wellhead. Later, due to the lack of penetration of “hard rock”, it was completed to a depth of 471 feet using steam-powered drilling equipment. In the early 1860s, the 1859 well was reportedly deepened to a depth of about 1,000 feet in an attempt to obtain better quality water believed to exist in the deeper “Trinity sands”. The Trinity water-bearing sands were never reached.

In 1870 another deepening of the well was attempted. Apparently during this attempt a depth between 1,160 and 1,200 feet was reached when part of the drilling tools were lodged and left in the hole. The “Trinity sands” again were not reached. However, the well continued to have the surface flow of highly mineralized, “smelly” water from the Edwards aquifer.

In March 1872, Messrs. Millican and Steele attempted to remove the obstruction (lodged drilling tools) from the wellbore and planned to drill the well deeper to “obtain a good supply of water”. They were unable to remove the obstruction and drill the well deeper. It may be at this time or at sometime later that the well was reported to be plugged back to the original depth of 471 feet.

Water from the well was used for medicinal purposes; that is, it was found to possess tonic and laxative properties. Early on the water was reported “to contain the following constituents named in order of their relative abundance: Chloride of Sodium, Bicarbonate of Lime, Sulphate of Lime, Sulphate of Soda, Sulphate of Alumina and Potassa, Sulphate of Magnesia, Sulphate of Iron (a trace), Sulphuretted Hydrogen”. The water was reported to have “a saline taste, and is strongly impregnated with Sulphuretted Hydrogen Gas”. Also, it was reported to be “too impregnated with lime to taste well” and was determined to be injurious to plants and could not be used to irrigate the Capitol grounds. A “modern”, more detailed, chemical analyses of the water produced by the well was never made or reported. Other Edwards aquifer wells nearby at the Austin Public Library and The University of Texas produced water high in hydrogen sulfide gas with total dissolved solids of about 3,500 and 6,200 milligrams per liter.

The wellhead of the 1859 well apparently was sealed soon after the 1852–1853 Capitol building (LOC on Figure 1) was destroyed by fire in November 1881. It remained capped during the construction of the new Capitol building from 1882 to 1888 and never was uncapped again for further use. The capped or sealed wellhead is under the 1888 (current) Capitol building and was reported to be “located within and beneath the basement rotunda of the dome walls some distance from their foundation” (location 1 on Figure 1). It is very probable that the productivity of the 1859 Capitol Water Well was adversely affected by caving, because in 1882 the burned

remains of the 1852–1853 Capitol building were “being demolished using dynamite, so preparations for the construction of the present Capitol can begin.”

In their November 1, 1886, report, the Capitol Building Commissioners suggested to the Governor, “...and as the State has in the past spent a very large sum of money upon this well, we think the expenditure of a nominal sum now in opening it again will prove a benefit to the new capitol, for this well could supply much of the water used in the building, and more than pay for its being opened by lessening the cost to the State of procuring water from other sources.” Apparently those Commissioners were not aware of the highly mineralized water and abundant hydrogen sulfide that the well produced, the reported plugging of the well up to 471 feet, the obstruction in the wellbore which prevented previous deepening of the well, and the probable caving of the well caused by the 1882 dynamiting of the burnt remains of the 1852–1853 Capitol building.

Information for the 1859 Capitol water well is found in: Shumard (1860), Wood (1861), Texas Almanac (1865–1867), Brown (circa 1875), Myers (1881–1882), Lee and Norton (1883), Lee and McLaurin (1886), Hill and Vaughan (1898), Dibrell (1900), Hill (1901), George and others (1941), White and Livingston (1941), Arnow (1957), Connors and others (1970), Brune and Duffin (1983), Hamblett (1986), Zapalac (1994), Broussard Group/EDAW (1995), and TWDB (1997).

The 1874 Capitol Water Well

In 1874, because of the lack of water for irrigation of the Capitol grounds, the Superintendent of Public Buildings and Grounds reported that “...much labor was required in supplying the trees and plants with water; and to keep the grounds in good order generally, labor had to be employed, and paid for from private sources. The digging of a well also incurred a considerable expense; but this enterprise was deemed essential in order to test the practicability of sinking wells within the Capitol Grounds with success, as the scarcity of water is the most serious obstacle to the success of beautifying these grounds. I am able to report that at a depth of forty-five feet (blasted out of solid rock), a supply of water was found, which already has proven of great value and convenience”

The location of the well, the diameter of the wellbore, and the diameter and amount of casing (if any) placed in this well are unknown. However, it is apparent (considering the depth of 45 feet and the geologic units that occur beneath the Capitol grounds) that this well provided some unknown amount and unknown quality of ground-water from the Austin Chalk.

The 1874 well might have been located at a low place reported to be on the grounds southwest of the Capitol building. This location was reported to have a “wet weather spring” which could have been the remnant of the 1874 dug well (location 2A on Figure 1).

Also, in the mid-1930s, a subsurface vault for the State Treasury was completed just south of the southwest edge of the current Capitol building basement. A “natural spring” was reported to be under this vault that “makes the internal atmosphere (of the vault) dank.” This “spring” might be the remnant of the 1874 dug well (location 2B on Figure 1).

There have been several reports of another low place which had a pond and was located on the west edge of the Capitol grounds. This other low place, which was eventually filled-in, may have been the remnant of the 1874 dug well (See location 2C on Figure 1).

Information related to the 1874 Capitol Water Well may be found in Voigt (1874), Dibrell (1900), Jones (1980), Hamblett (1986), and Broussard Group/EDAW (1995).

The 1889 and 1890 Capitol Water Wells

Planning, Drilling, Construction, Geology, and Cost of the Wells

In the late 1880s, the Legislature apparently appropriated \$10,000 to obtain a water supply for the new Capitol building (completed in 1888) and for watering the Capitol grounds. In their 1890 report, the Board for Improving the Capitol Grounds reported that options for developing an “adequate water supply” had been considered. The Board, which included Governor L.S. Ross, Attorney General J.S. Hogg, and W.M. Hardeman, Superintendent of Public Buildings and Grounds, decided that the least expensive option was to drill a deep artesian well which was expected to provide a sustained, natural flow of good quality water from the deep, Trinity water-bearing sands.

As part of the selected option, the Board had the State of Texas purchase a drilling “outfit” (rig, related equipment, and supplies) and hire a drilling crew. This was done rather than have a commercial drilling contractor drill and complete a well at what apparently was estimated to be a much higher total cost. The drilling “outfit” purchased apparently was the very first drilling rig and related equipment used by an agency of the State of Texas. Mr. Hugh McGillvray and/or the Pierce Artesian Well Company may have been the driller hired to operate the new State rig to complete the Capitol well. Mr. McGillvray was definitely reported as the driller who operated the same State drilling rig when it was used in 1895 to drill the deep artesian well at the North Austin State Hospital.

From the fall of 1889 to March 1890, two wells were drilled about seven feet apart at a location southeast of the south entrance to the Capitol building (locations 3 and 4 on Figure 1). The first well (the 1889 Capitol Water Well, location 3 on Figure 1) was drilled to 1,023 feet which was the depth where some part of the drilling tools became lodged in the borehole. During the drilling of the 8-inch diameter borehole at the 370 to 374-foot level, a “water-bearing sand” was encountered in the Edwards Limestone which had water “strongly impregnated with sulphuretted hydrogen (hydrogen sulfide gas), and had a salty taste.” In December 1889, the lodged drilling tools could not be removed. An unknown amount of 6-inch diameter, metal casing was set in the wellbore. However, since the well was uncapped and used later in 1903–1904 (See discussion below), the 6-inch diameter casing may have been set to about 240 to 250 feet to keep the Del Rio Clay from heaving and filling the borehole.

In January 1890, the drilling rig was moved about 7 feet southeast of the 1889 Well, and the drilling of a second borehole was started. On February 6, 1890, the 1,023-foot depth (total depth of the nearby 1889 Well) was reached in the second well. Drilling in the second well encountered the saline, “sulphur water” in the Edwards Limestone from 370 to 502 feet, which essentially was the same level such water was encountered in the nearby 1889 Well. Soon after

the “sand” from 1,427 to 1,437 feet was penetrated by the drill bit, a “solid stream” of water began to flow out of the wellbore at the surface. On March 8, 1890, the second well (the 1890 Capitol Water Well 58-43-702) was completed at a total depth of 1,554 feet and had a natural flow at the surface of 60 gallons per minute from the Hensell Sand and Cow Creek Limestone (“first Trinity water-bearing sand”) encountered from 1,427 to 1,505 feet. The elevation of the land surface at the site of the 1890 Well is about 543 feet.

The saline, “smelly sulphur water” found in the Edwards Limestone was prevented from entering the 1890 Capitol Water Well by setting a string of 6-inch diameter metal casing in the 8-inch diameter borehole from the surface to a depth of about 525 feet. The well apparently was completed open hole from the bottom of the 6-inch casing at 525 feet to the total depth of 1,554 feet (Figure 2).

The first “modern” chemical analyses of the water from the 1890 Well was made in 1905 and resulted in total dissolved solids of about 1,460 milligrams per liter. The results of the 1905 analyses is a reliable indication that initially the saline Edwards water was successfully prevented from entering the well by the setting of the 6-inch metal casing to 525 feet. As previously stated, groundwater produced from the Edwards aquifer wells near the Capitol have total dissolved solids ranging from about 3,500 to 6,200 milligrams per liter. The 1905 analysis also indicates that the water produced by the 1890 Well is characteristic of the Trinity aquifer, represented in the wellbore by the water-bearing units of the Hensell Sand and Cow Creek Limestone, which are members of the Travis Peak Formation.

The geologic units encountered by the 1890 Capitol Water Well to the total depth of 1,554 feet are as follows: Capitol Terrace (alluvial) deposits from surface to 7 feet; Austin Chalk from 7 to 106 feet; Eagle Ford Shale from 106 to 148 feet; Buda Limestone from 148 to 180 feet; Del Rio Clay from 180 to 239 feet; Georgetown and Kiamichi Formations and Edwards Limestone from 239 to 510 feet; Walnut and Glen Rose Formations from 510 to 1,427 feet; Hensell Sand from 1,427 to 1,460 feet; Cow Creek Limestone from 1,460 to 1,507 feet; and Hammett Shale from 1,507 to 1,554 feet. The Hensell Sand, Cow Creek Limestone, and Hammett Shale are members of the Travis Peak Formation of the Trinity Group, Comanche Series, Cretaceous System. All of these geologic units and their water-bearing properties are described in Brune and Duffin (1983, Table 1, p. 14). After the 1889 and 1890 Capitol Water Wells were completed, the total cost of completing the wells was \$9,702.61, which included cost of the drilling equipment, pipe, engineers’ salary, crew salaries, freight charges, telegraph charges, and coal for steam power to run the drilling “outfit”. Since the drilling rig (which cost about \$4,722.76) was still on hand and of use, the net cost for the well was estimated to be about \$4,979.85. The rig was used later in 1895 to complete the artesian well (State Well No. YD 58-43-401) at the North Austin State Hospital to a total depth of 1,975 feet.

History of use and nonuse of the 1889 and 1890 Capitol Wells

The slightly saline water from the 1890 Capitol Well was used in the 1890s to supply a boiler that provided steam for heating the Capitol building and for the operation of a generator for lighting the Capitol building and running hydraulic elevators. The well water was used to irrigate the grass, shrubbery, and trees on the Capitol grounds. The water was reported to be good for drinking for medicinal purposes and was reported to be “popular with invalids”. In April 1900

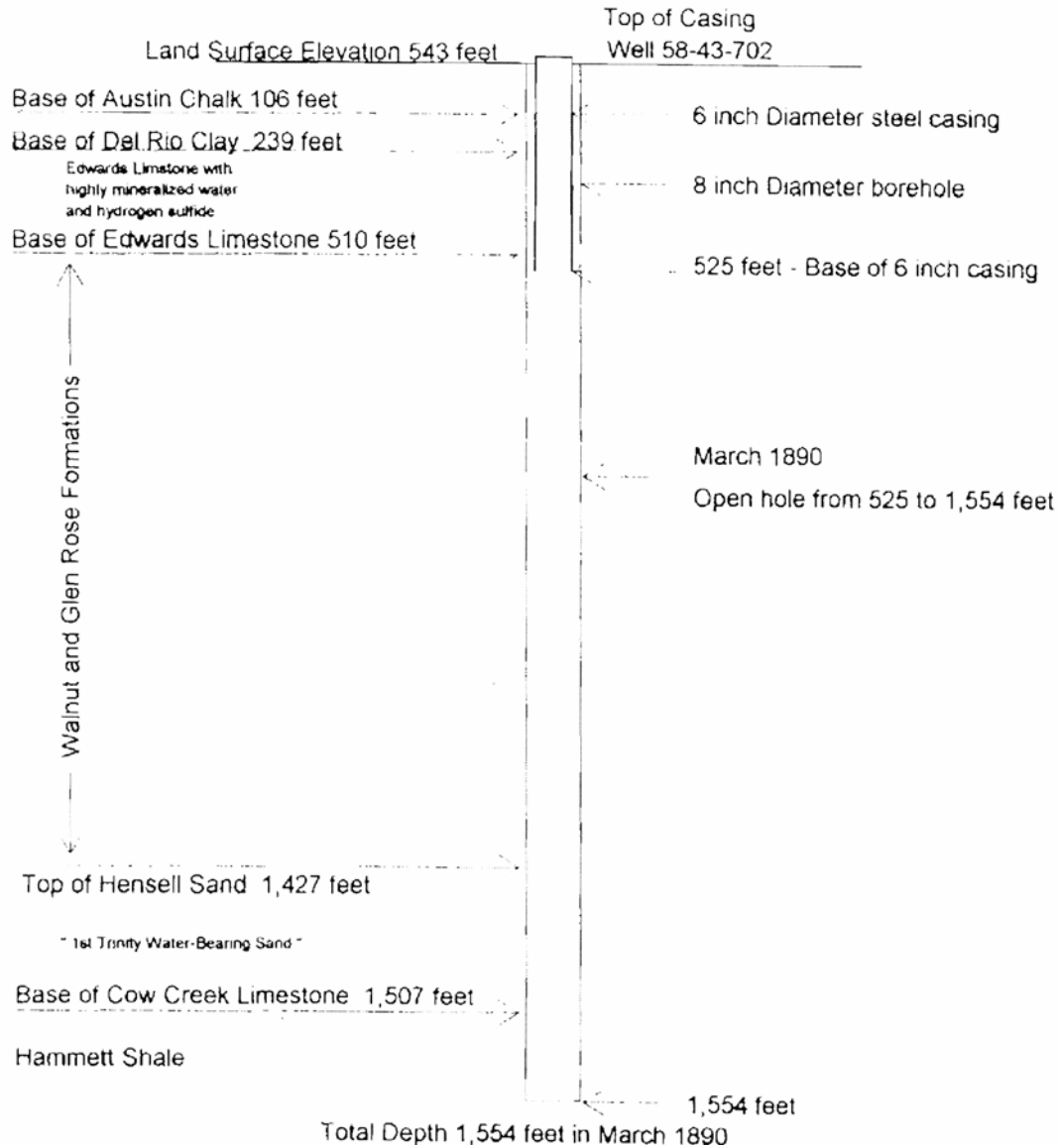


Figure 2. Diagrammatic cross section of the 1890 Capitol Water Well 58-43-702, as approximately completed in March 1890. The well flowed approximately 60 gallons per minute of water with total dissolved solids of about 1,460 milligrams per liter.

the Austin Dam on the Colorado River broke which caused considerable flooding of the city and disruption of the city's electric power and water systems. During this catastrophe, water from the well was used for drinking and other purposes by many Austinites, including the high school and the Capitol complex.

During the 1890s, the water from the 1890 Well was determined to be injurious to plant growth. The well was probably not used for any of its intended uses by 1900, because there were documentations that another, deeper artesian well should be drilled or that the Capitol building and grounds be supplied water by the City of Austin water system. Also in the early 1900s, there was an earnest judgment by the Superintendent of Public Buildings and Grounds "...for the State to build a pumping station on the banks of the Colorado river, lay a large main and supply the

capitol yard with water for sprinkling purposes...” Eventually, in about 1914, an adequate network of water distribution facilities were installed, and the Capitol building and grounds were provided a reliable supply of better quality water from the city water system, which obtained water from the Colorado River.

In 1903–1904, the wellhead of the 1889 Well (location 3 on Figure 1) was uncovered while installing sidewalks. The Superintendent of Public Buildings and Grounds uncapped the well and connected it to an elaborate, lighted drinking fountain which was placed west of the great walk and southwest of the south entrance to the Capitol building (location PW on Figure 1). Being Edwards water, the flow from the faucet on the fountain was cool, highly mineralized, and smelly from hydrogen sulfide. The water was reported good for medicinal purposes. In about 1907, the 1889 Well was no longer used for any purposes. In May 1996 the wellhead of the 1889 Well was again uncovered, and was found to be located about seven feet northwest of the uncovered and opened wellhead of the 1890 Well (Figures 3 through 7).

Also, in 1903–1904, the 1890 Well (location 4 on Figure 1) was refurbished with new plumbing and was connected to a new elaborate, lighted, cast iron drinking fountain which was placed at a site immediately adjacent to the wellhead. The well supplied the new fountain with warm water that had a temperature of about 93 degrees Fahrenheit, was slightly mineralized, but did not have the “rotten egg” smell associated with hydrogen sulfide.

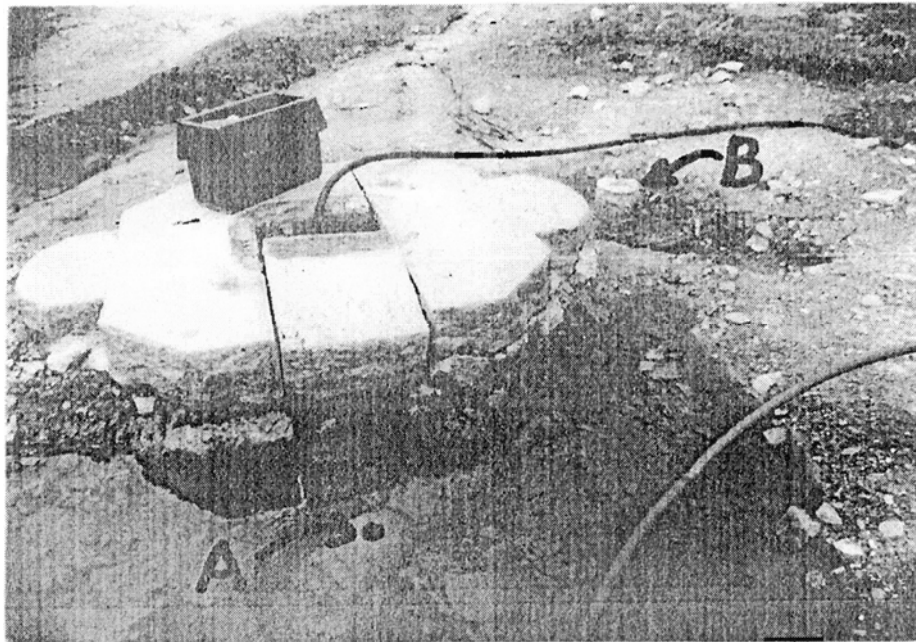
In 1904, the 1890 Well was connected to and the water used by two ornamental fountains which had water ponds that supported goldfish (OF and GP on Figure 1). Also in the early 1900s, the 1890 Well was connected to and supplied artesian water to a grotto and lagoon which supported tropical plants in a low-lying area of the southeast Capitol grounds (just north of G and LP on Figure 1).

In the mid-1920s, the cast iron drinking fountain at the 1890 Capitol Water Well (location 4 on Figure 1) was removed due to corrosion and replaced with a granite drinking fountain. The 1890 (Trinity) Well was connected to a faucet(s) on this new granite fountain and was used by the public as a “drinking water” supply. It may be at this time that the 1889 (Edwards) Well was also connected to a faucet(s) on this new granite fountain and also used as a “drinking water” supply. However, in about May 1996 when the granite fountain was removed for restoration, there were not any pipe or pipes evident that may have been used to connect the 1889 (Edwards) Well to the nearby granite fountain. At that time there was only a system of pipes which previously were used to connect the 1890 (Trinity) Well to the granite fountain. This information is hearsay and is not based on any written documentation.

In 1978, the water from the 1890 (Trinity) Well was chemically analyzed by the Texas Department of Health (TDH). The analyses helped determine that the 1890 Well water had “four times the fluoride content allowed by the TDH for a community public water supply” and that “this fluoride level may cause mottling of teeth in children 14 years of age and younger who use this water regularly.” The analyses also indicated that the water was high in sulfate content and dissolved solids. The high sulfate content may cause a laxative effect if the water was consumed by humans. However, the well was determined by the TDH to be a “non-community public water supply”. The results of the 1978 chemical analyses were posted at the well/fountain site, and the water from the well was allowed to be used by visitors to the granite drinking fountain.



(a)



(b)

Figure 3. . Photographs (looking northwest) taken on May 27, 1996, showing the wellheads of the 1890 and 1889 Capitol. The wellheads were uncovered by the State Preservation Board's activities to restore the southeast Capitol grounds. (a) "A" is the location of the 1890 Capitol Water Well 58-43-702. "B" is the location of the 1889 Capitol Water Well. Notice the pool of water which had accumulated from the artesian flow through the opening in the 1890 Well (A). The flow was estimated to be 5 to 10 gallons per minute. Notice that the 1889 Well (B) is capped (sealed) with a plug having a 3/4-inch nipple. Notice the granite base which was used to support the granite drinking fountain installed in 1928. (b) "A" is location of the 1890 Capitol Water Well 58-43-702. "B" is the location of the 1889 Capitol Water Well.



(a)



(b)

Figure 4. Photographs Taken on September 23, 1996, Showing of the 1890 Capitol Water Well 58-43-702 and the Location of the 1889 Capitol Water Well (Buried). (a) Looking west. “A” is the 1890 Capitol Water Well 58-43-702 which has been capped and has a 20inch diameter PVC pipe which is discharging flow to a sanitary sewer to the east-northeast. The leaking wellhead has caused a pool of water around the well. Notice the granite base used to support the granite drinking fountain installed in 1928. The water outlet from the 1890 Well is under the manhole cover in the center of the granite base. Location “B” is the approximate location of the 1889 Well covered with alluvial soil and gravel. (b) “A” is the 1890 Capitol Water Well 58-43-702 which has been capped with flow diverted to a sanitary sewer to the east-northeast. Notice the pool of water caused by a small leak in the capped wellhead.

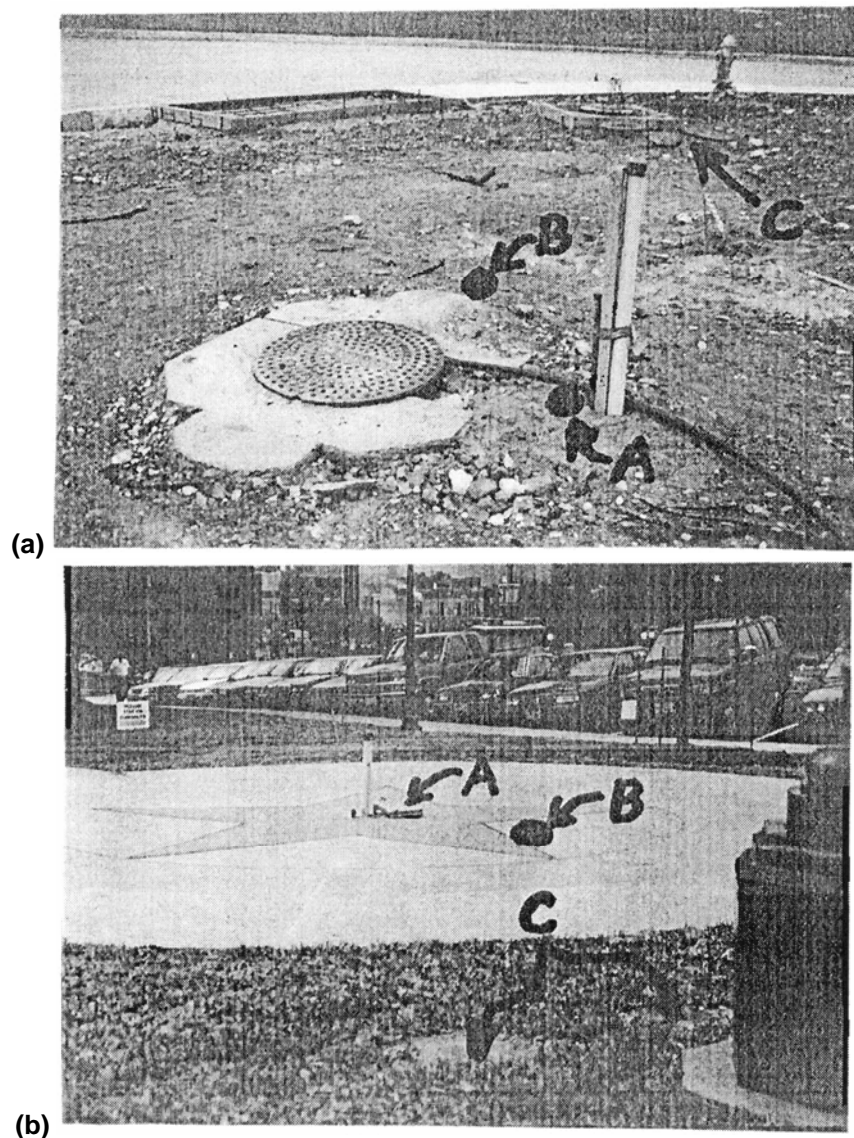


Figure 5. Photographs taken on October 29, 1996, and January 27, 1997, of the sites of the 1890 and 1889 Capitol Water Wells. (a) October 29, 1996, photograph with “A” at location of 1890 Well 58-43-702 (pipes are city water and electrical conduits for new fountain and light); “B” at location of 1889 Well; and “C” at manhole covers with water-pressure release outlets for the 1890 Capitol Water Well. (b) January 27, 1997, photograph showing 18-foot diameter concrete base over “A” location of 1890 Well 58-43-702 under folder; and “B” approximate location of the 1889 Well. Location “C” marks the locations of manhole covers with water pressure release outlets for the 1890 Capitol Water Well.

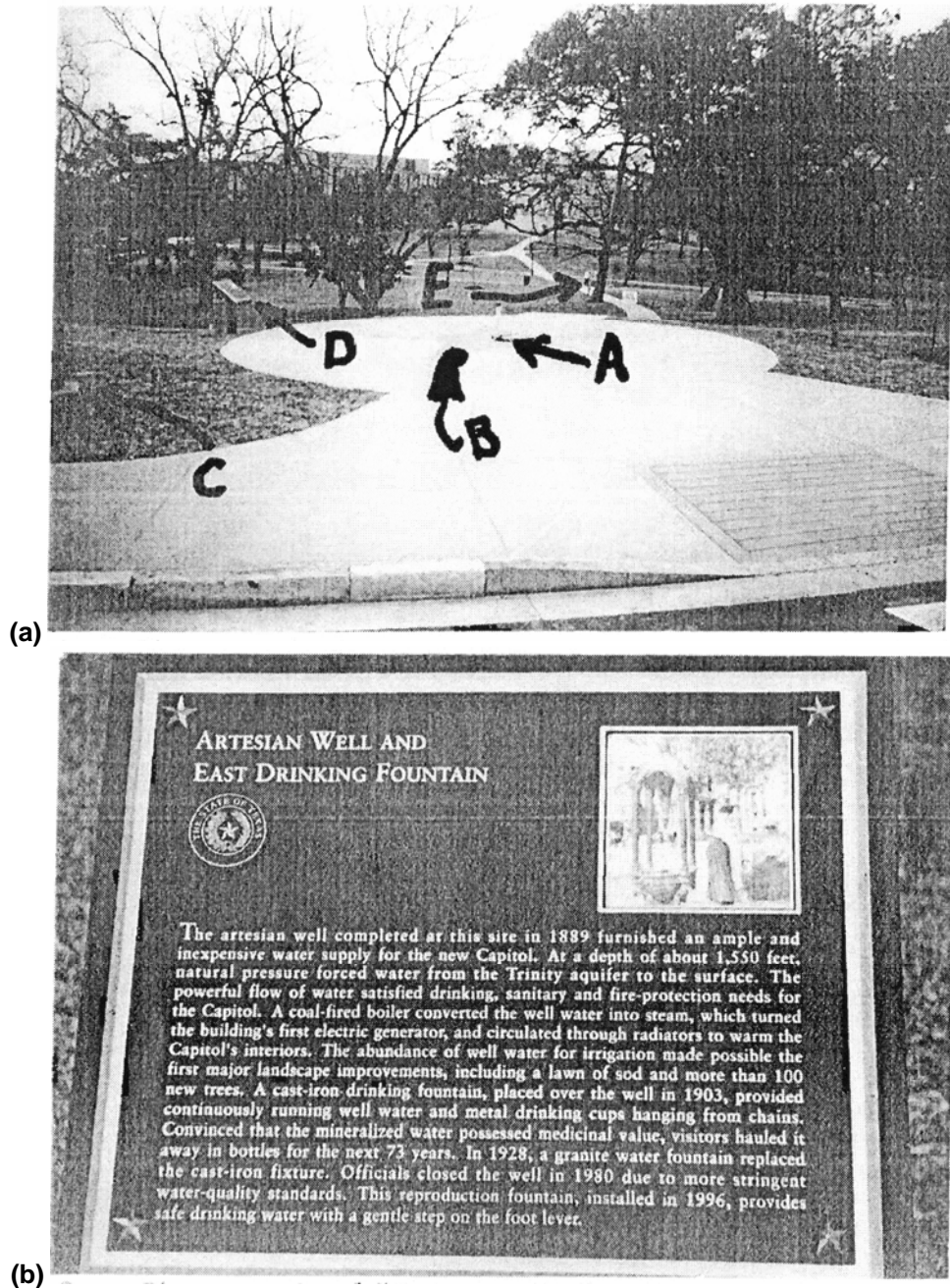


Figure 6. . Photographs taken on January 27, 1997, of the sites of the 1890 and 1889 capitol water wells and marker-plaques. (a) Photograph showing approximate locations of “A” the 1890 Well 58-43-702, “B” the 1889 Well, “C” the water-pressure release outlets from the 1890 Well 58-43-702, “D” the “Artesian Well and East Drinking Fountain” marker-plaque (See Figure 8-2), and “E” the “Grotto and Lagoon” marker-plaque (See Figure 9-2 and location “C & L P” on Figure 1). (b) Photograph of “Artesian Well and East Drinking Fountain” marker-plaque (See “D” on Figure 8-1).

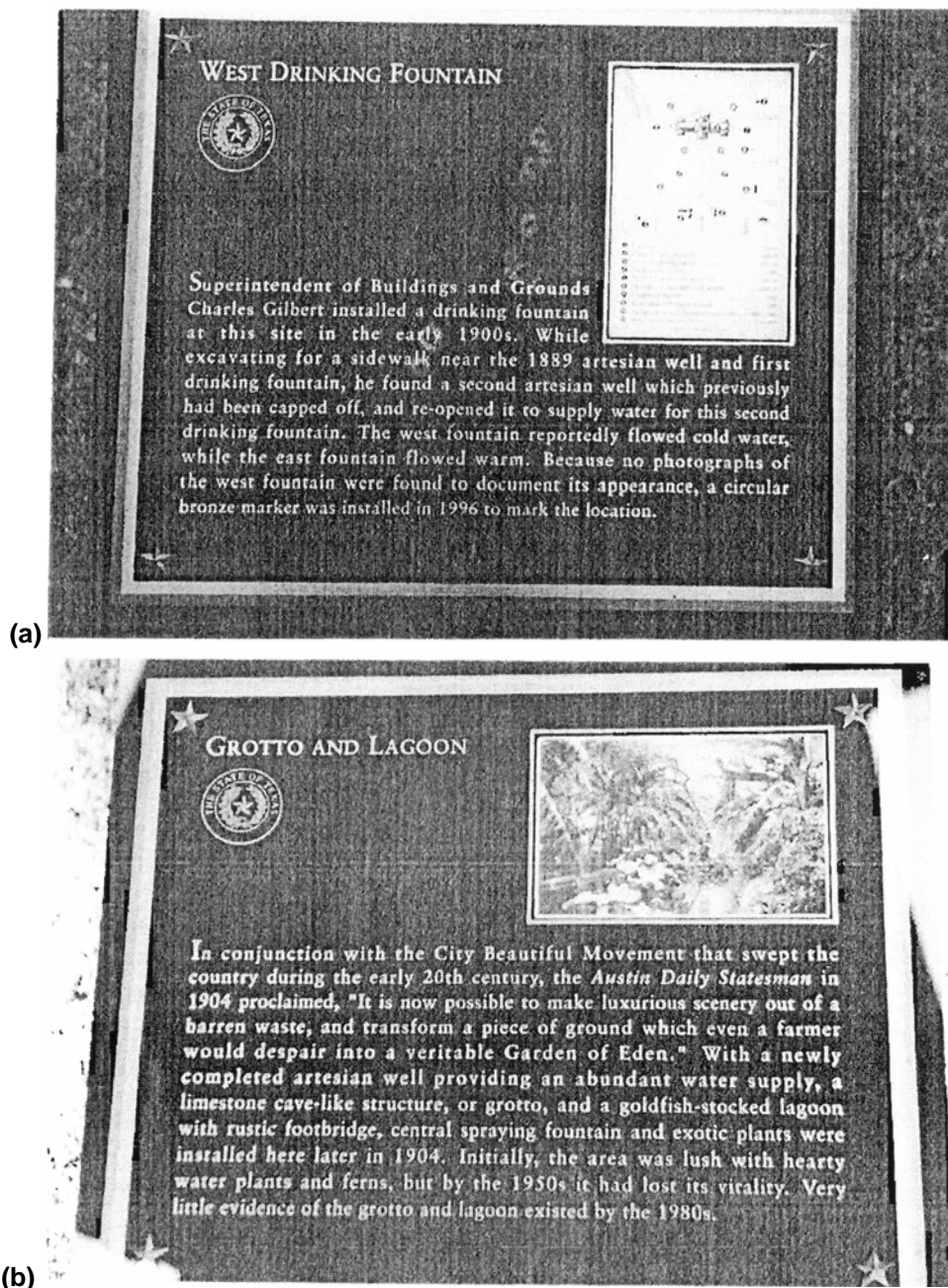


Figure 7. Photographs taken January 27 and 29, 1997, of "West Drinking Fountain" and "Grotto and Lagoon" marker-plaques. (a) Photograph taken on January 27, 1997, of the "West Drinking Fountain" marker-plaque which is at location "PW" on Figure 1. (b) Photograph taken on January 29, 1997, of the "Grotto Lagoon" marker-plaque which is "E" on Figure 8-1 and is at location P on Figure 1.

In 1980, another chemical analysis was made of the water from the 1890 Capitol Water Well. This analysis also determined that the water from the well had high concentrations of fluoride, sulfate, and total dissolved solids. Finally the well was capped and abandoned and the fountain outlets were closed. These actions were taken because the TDH required that the State agency responsible for the use and maintenance of the fountain/well be required to (1) collect and submit monthly water samples for analyses by the TDH, (2) to install and operate mechanical chlorination facilities to treat the water for drinking purposes, and (3) to post a copy of the chemical analyses of the water periodically collected from the fountain/well. Apparently, the State decided to shut-off the fountain/well, not because of the quality of the water, but because of the high cost of having to meet TDH requirements to have the water properly available for drinking by visitors to the Capitol grounds.

In May 1996, the wellheads of the 1889 and the 1890 Capitol Water Wells were uncovered by the State Preservation Board when the granite drinking fountain was removed for restoration and relocation. The fountain was removed as part of the restoration of the Capitol grounds. After restoration, the granite fountain was reinstalled near the Sam Houston State Office Building northeast of the Capitol. A replica of the cast iron, ornamental drinking fountain originally placed over and connected to the 1890 Well was installed at the site of the capped wells. This replica drinking fountain uses water from the City of Austin water system.

The uncovered 1890 Well was logged with the State logging unit in May 1996. These logs were used to determine and describe the current conditions of the well as shown in Figure 8. During this time of logging the well had a flow of water at the surface of 5 to 10 gallons per minute with a total dissolved solids content of 1,574 milligrams per liter.

The site having the uncovered wells and the foundation of the removed granite fountain (locations 3 and 4 on Figure 1) was documented in a series of photographs taken from May 1996 to January 1997 (Figures 5 through 9).

Information related to the 1889 and 1890 Capitol Water Wells can be found in Arnow (1957), Bluntzer (1996a, 1996b), Broussard Group/EDAW (1995), Brune and Duffin (1983), Connors and others (1970), Dibrell (1900), George and others (1941), Gilbert (1905, 1906), Green (circa 1988), Hamblett (1986), Hardeman (1892), Harlan (1900, 1902), Hill (1901), Hill and Vaughan (1898), Klemm and others (1976), Lower and others (1996), Phillips (1914), Ross and others (1890), Sellards (1930), TWDB (1996a, 1996b, 1997), Young (1990), and Zapalac (1994).

The 1989 capitol water-level observation wells

In June 1989, four shallow wells were completed around the Capitol building (locations OWB-1 through OWB-4 on Figure 1). These wells were drilled and cored to depths ranging from 20 to 23 feet to provide information on the subsurface geologic and hydrologic conditions at the Capitol. This information was used in the planning for a possible dewatering program during the construction of the Capitol building extension. The four wells were permanently completed with 4-inch diameter steel casing and used as water-level observation wells during the summer of 1989. Additional water-level measurements may have been taken during the construction of the Capitol extension. The wells currently exist and probably are available for future use as observation wells. Each well has a keyed locked cap which apparently can be unlocked so that

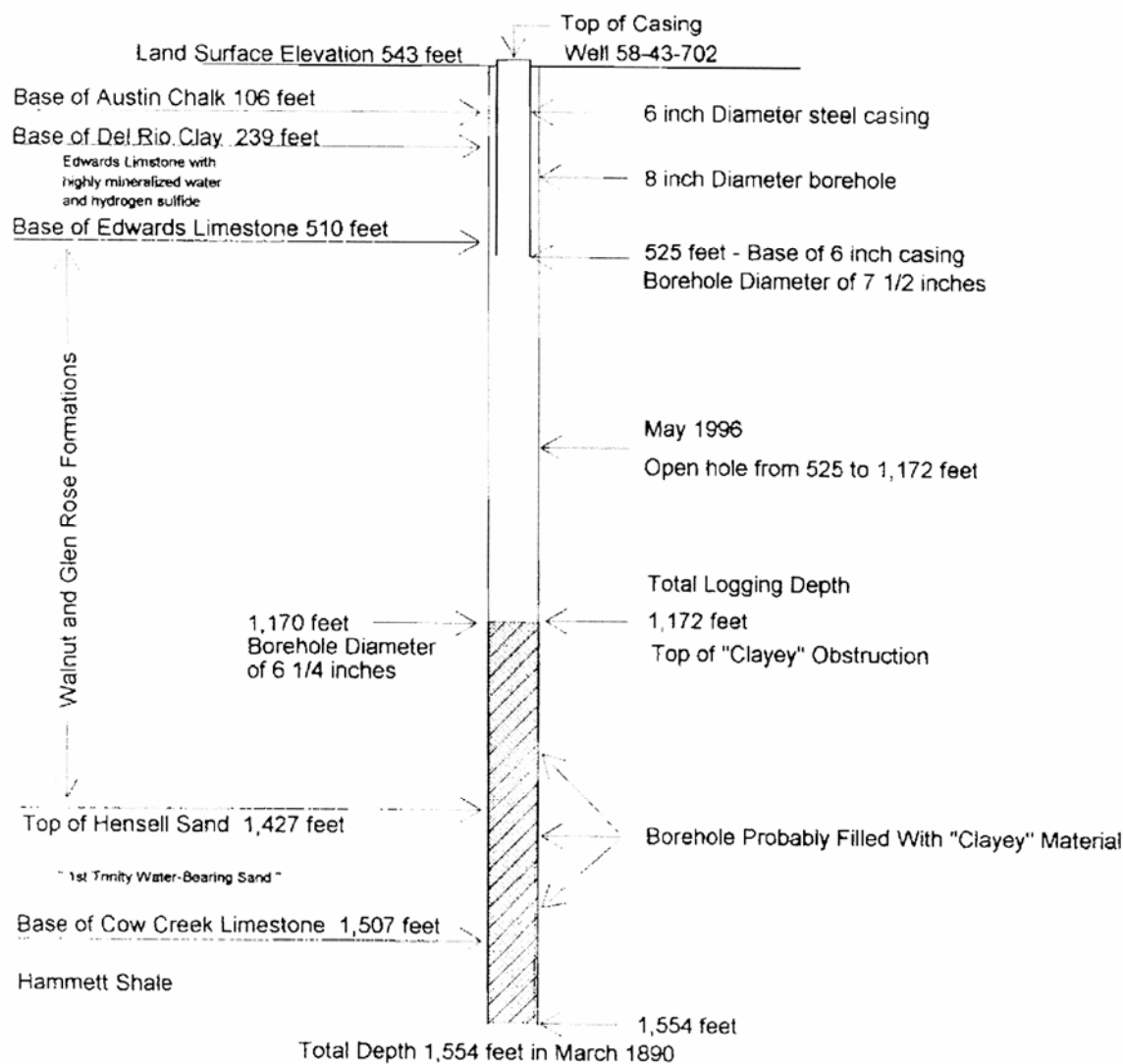


Figure 8. Diagrammatic cross-section of the 1890 Capitol Water Well 58-43-702, as determined from geophysical logs obtained in May 1996. The well flowed approximately 5 gallons per minute with total dissolved solids about 1,574 milligrams per liter.

the well can be used for future monitoring of water levels and perhaps water quality of the shallow water-bearing unit of the Austin Chalk beneath and adjacent to the Capitol building.

Proposed restoration of the 1890 Capitol Water Well

During the period from March 1890 to October 1980, water from the 1890 Capitol Water Well was used (1) as a drinking water supply for the Capitol building, (2) as a water supply for a boiler to provide steam to power an electric generator (dynamo) for lighting the Capitol building

and grounds, and for radiators to heat the Capitol building, (3) as a water supply for the operation of hydraulic elevators in the Capitol building, (4) as a water supply for irrigating the grass, shrubbery, and trees on the Capitol grounds, and (5) as a water supply for drinking and ornamental fountains and a grotto and lagoon on the Capitol grounds. Groundwater data collected from the 1890 Capitol Water Well has been used in State and Federal ground-water investigations and reports to help characterize the occurrence, availability, and quality of water from the Trinity aquifer in central Texas.

The master plan for the restoration of the Capitol grounds indicates "...that the specific restoration period for the grounds is 1888–1915 and that fundamental improvements must occur to provide a safe, functional, and appropriate setting for the Capitol..." As indicated in the previous sections addressing the 1890 Capitol Water Well and as summarized in the previous paragraph, the 1890 Capitol Water Well had a very meaningful and significant historical period of use within the 1888–1915 restoration period indicated in the master plan. Under these conditions, it is justifiable to meet the challenge and make a serious effort to restore and reuse the 1890 Capitol Well.

Therefore, the author recommends that the 1890 Capitol Water Well be restored (See Figure 9) using a well reconstruction plan and proper well rehabilitation methods and procedures to assure that the well will provide a safe and reliable supply of water from the Trinity aquifer to use for an ornamental (non-drinking) water-spraying fountain on the Capitol grounds. Also, since historical water-level and water-quality data from the well have been used to help characterize the Trinity aquifer in State and Federal ground-water investigations, the well, when restored, should be used by the appropriate State water agency as a Trinity aquifer water-level and water-quality monitoring well.

Other investigators and observers have recommended that the 1890 Capitol Well should not be restored, because (1) the well produces "smelly water" impregnated with hydrogen sulfide, (2) the flow and artesian head have deteriorated to such an extent that the well has been rendered useless for operation of a fountain and for use as a monitor well, and (3) the well very likely has unremoveable obstructions that make it impossible to restore the wellbore to the base of the water-bearing units of the Trinity aquifer. Also, doubt has been indicated that even if the well were successfully completed in the Trinity aquifer, it probably would not be an effective and useful State monitor well, because its location and subsurface position places it out of the area of concentrated development of ground water from the Trinity aquifer.

The detection of hydrogen sulfide gas from the wellhead when it was first uncovered and opened in May 1996 is accurate. Also, the deterioration of flow from the well since it was first completed, and very recently since the well was uncovered and opened, is accurate. When the wellbore was logged in May 1996, a "clayey" obstruction was encountered at 1,172 feet which made it impossible to log the well deeper. The explanation for these conditions is undoubtedly due to the deterioration of the 6-inch diameter metal casing which was installed in the well over 100 years ago.

The caliper log run in the wellbore by the Texas Water Development Board in May 1996 indicates that there are separations in the old metal casing at depths opposite the Austin Chalk, the Eagle Ford Shale, the Del Rio Clay, and the Edwards aquifer. These separations in the old casing have allowed the hydrogen sulfide gas in the Edwards aquifer to seep into the wellbore

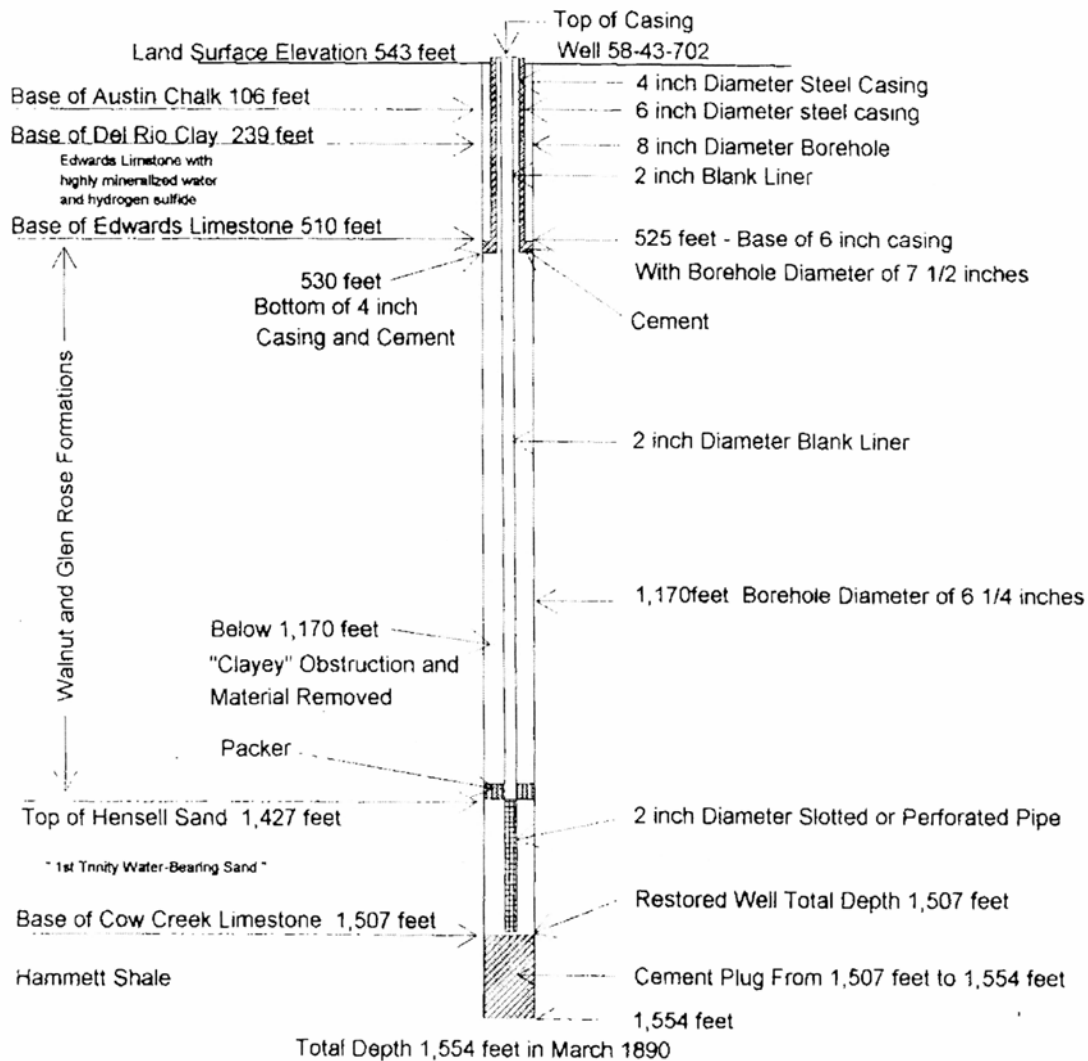


Figure 4. Diagrammatic cross-section of the 1890 Capitol Water Well 58-43-702, after restoration. Flow expected of up to 60 gallons per minute with total dissolved solids about 1,500 milligrams per liter.

and accumulate at the wellhead while the well is capped. Consequently, when the well was opened in May 1996, a slug of hydrogen sulfide gas was released and detected. When the author and others visited the well several times while it was open, no hydrogen sulfide gas was evident.

Since the artesian head of the Trinity aquifer is higher than the artesian head of the Edwards aquifer, part of the flow up the wellbore from the Trinity aquifer is escaping through the separations in the casing and entering the saline water-bearing units of the Edwards aquifer. This is one of the conditions causing the deterioration of flow at the wellhead of the 1890 Capitol Well.

The other cause for the deterioration of flow at the wellhead is the presence of the "clayey" obstruction found at a depth of 1,172 feet. Additional obstructions are likely to exist below 1,172

feet. The shallowest obstructions below 1,172 feet are probably caused by the Eagle Ford Shale and Del Rio Clay heaving through the separations in the old casing and falling down the wellbore. Also, the wellbore below the 1,172-foot level probably has other deeper “clayey” obstructions caused by the Hammett Shale which is known to heave up the borehole of wells with open hole completion. This condition of an obstructed borehole is shown on Figure 3. These ‘clayey’ obstructions have not prevented the flow of water from the Trinity aquifer at the surface and can be readily removed during the restoration of the well by the conventional rotary drilling method using the proper drilling fluid.

When the 1890 Capitol Well is restored as illustrated in Figure 9, it will make a very meaningful Trinity aquifer water-level and water-quality monitor well. The Trinity aquifer is used extensively as a domestic water supply in the rural areas on the upthrown side of the Balcones Fault Zone in northwestern Travis, Hays, and Williamson counties. The 1890 Capitol Well is located in the Balcones Fault Zone on the downthrown side of the main Mount Bonnel Fault. It is very possible that a very significant thickness of the Glen Rose Formation does not occur in the well due to a fault through the wellbore. Due to this fault and related fracturing which has been observed in the subsurface of the Capitol area, the Trinity aquifer and the Edwards aquifer in the area of the well as well as the Balcones Fault Zone in Travis and Williamson counties are probably hydrologically connected. Therefore, it is important that the restored 1890 Capitol well be used as a monitor well to detect effects of the Trinity aquifer development to the northwest and how the Balcones Fault Zone acts as a hydrologic boundary between relatively good quality Trinity groundwater to the northwest and poorer quality Trinity groundwater in the fault zone. Also the well should be used to monitor the interaction between the bad water in the Edwards aquifer and the relatively good water in the Trinity aquifer.

A diagrammatic presentation of the proposed reconstruction of the 1890 Well is provided in Figure 9. To achieve well restoration as diagramed in Figure 9, the following general methods and procedures are recommended.

- Preparation of the well site (See location 4 in Figure 1) to expose and open the wellhead (See ‘A’ in Figures 5 through 8), so the well can be re-logged with electric, gamma ray, and caliper logging surveys.
- Further preparation of the well site for the operation of a drilling rig over the wellhead. The drilling rig should be equipped to use the conventional mud rotary method of drilling and well workover.
- The well should be entered with appropriate rotary tools and cautiously clean-out to a depth below the base of the old metal casing. This procedure should be immediately followed by setting and cementing a string of 4-inch diameter, steel casing from surface to a depth of about 530 feet (at a point below the base of the old 6-inch diameter casing at about 525 feet). Installation and pressure cementing of the 4-inch casing will help assure that the Eagle Ford Shale and the Del Rio Clay will no longer enter the wellbore, and the wellbore can be cleaned-out further without the old casing collapsing and obstructing the wellbore. Also, the drilling operations will not lose circulation through the old separated 6-inch casing if the 4-inch casing is properly set and cemented.
- After the cementing of the 4-inch casing has set-up, enter the well with appropriate rotary drilling tools and clean-out the wellbore to its original total depth of 1,554 feet.

- Re-log the well to its total depth. A borehole deviation survey should be run in the wellbore and then followed by running appropriately scaled caliper, electric, and gamma ray logs to total depth.
- Using the hydrogeologic and borehole information provided by the logging, set a cement plug opposite the Hammett Shale estimated to occur in the well below a depth of 1,505 feet. This will permanently prevent the bentonitic clays of the Hammett Shale from heaving up the wellbore and affecting the productivity of the water-bearing units of the Hensell Sand and Cow Creek Limestone estimated to occur from 1,427 to 1,505 feet.
- Once the cement plug below 1,505 feet has set-up, install and set into the wellbore to the top of the cement plug, a 2-inch diameter perforated steel liner attached to the end of a sufficient length of blank 2-inch diameter steel liner. The top of the blank liner should be at the surface and the perforated liner should be positioned in the wellbore opposite the water-bearing units between 1,427 and 1,505 feet. Consequently, the total length of the blank and perforated liner would be about 1,505 feet. The top of the perforated, 2-inch diameter steel liner should have a downhole packer (sealer) of sufficient size to prevent ground water in the annulus above the perforated liner from entering the perforated interval opposite the Trinity water-bearing units from 1,427 to 1,505 feet.
- Once the well has been reconstructed as described above, the well should be developed to obtain a maximum flow of water at the surface. Such developed flow should approach about 60 gallons per minute (flow of the well observed in March 1890).
- A representative sample of water from the well should be collected and comprehensive chemical and radioactive analyses should be made.
- The well should then be equipped with appropriate facilities for connection to an ornamental water-spraying fountain and also have appropriate outlets for use of the well as a State monitor well for measuring the water level (head) and collecting water samples for future water-quality analyses.
- The well site should then be returned to the condition of the site before restoration of the well was started.

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The drinking water fountain that is located over the 1890 Capital water well (photo by Robert E. Mace)