

Examination of Some Historical Wastewater Irrigation Practices and Effects of the Environment

With Focus on City of Austin and Central Texas Region

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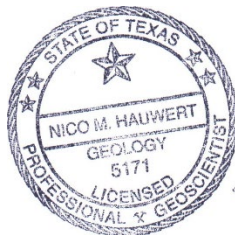
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June 1989 photograph by Danny Brasher of Texas Water Commission of leaking wastewater irrigation line associated with Travis County wastewater disposal system



Geoscientist Stamp

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I. Abstract

Determining the extent that treated or untreated wastewater sources are further treated to safe standards by soil and aquifers is important to public health as well as preservation of future natural heritage, which if not proactively invested in can have severe future economic repercussions. Central Texas water supplies are largely supported by karst limestone aquifers that characteristic contain networks of dissolved conduits and caves, which naturally have rapid groundwater flow that provides little natural attenuation of contaminants. Soils, particularly over karst limestone aquifers, commonly have macropores, that facilitate fast flow of infiltrating water into the underlying bedrock. Environmental Protection Agency guidance manuals and Association of Standard Testing Methods (ASTM) describe methods for evaluating potential contamination sources in karst aquifers using effective dye and other tracing, water-level elevation maps, examination of dip and faulting in aquifer beds, and water quality sampling in association with rain events at monitoring sites directly shown to be downstream (generally by tracing). In the 1980's, practices for the disposal of "treated" wastewater did not include standard protection practices for protecting water supplies in karst areas and was applied fairly widespread on developments over the Edwards Aquifer, leading to thousands of Central Texans becoming ill from pathogenic outbreak and abandonment of some affordable aquifer water-supply sources due to contamination, loss of wildlife, and economic impacts. In this report we will examine several cases where wastewater effluent irrigation may have been associated with local aquifer contamination. Recommended solutions are direct tracing of proposed contaminant sites to locate potential downstream groundwater impacts, regular storm-event monitoring of downgradient sites, and preservation of majority of water source areas since these cannot be built over without effecting drinking water/recreation water sources, wildlife, and future economic sustainability.

II. Introduction and Standard Methods of Examining Karst Areas to Protect Water Supply

While the water supply sources of the City of Austin's water supply is typically viewed in terms of watersheds and surface water, they are actually derived from a combination of watershed runoff captured by artificial reservoirs as well as natural soil storage and limestone aquifers, whose springflow and moisture supplements runoff during wet periods and helps sustain the water supply during drought periods (Veni and Hauwert 2015). The source of springflows that sustain creek baseflow and Central Texas water supplies are primarily generated by karst limestone aquifers (Veni and Hauwert 2015), including the Edwards Aquifer, Trinity Aquifer, Marble Falls Limestone, and Ellenburger Limestone. Significant caves and springs are also found in the Austin Chalk and Buda Limestones. Because the limestone, marls, chalks, and dolomites are soluble, they define karst areas where conduits, caves, sinkholes (skylight entrances into caves), and focused springflow are present, areas underlain by them are called *karst areas*. In contrast, areas underlain by quartz sand, clay or shale located east of Austin do not contain karst features, except in some cases where a thin veneer of clay collapses or washes into shallow, underlying limestone caves. Karst aquifers worldwide tend to have integrated conduits that transmit groundwater with little natural attenuation.

Communities whose water supply relies on karst aquifers have tended to overlook the sensitivity of their water source and fail to invest sufficiently to protect them. In the 1980's through 1990's, scientists believed that groundwater flowed through small pores over years, that nearly all recharge to Barton Springs came from creek recharge, particularly Barton Creek which was the closest source, and that less than 1% of rainfall directly recharged upland areas of the Edwards Aquifer recharge zone (Hauwert, 2016). These beliefs supported intense development over the recharge zone of the Edwards Aquifer in the 1980's and 1990's. Even though standards for understanding karst aquifers was well-established in the 1970's through 2000's in Environmental Protection Agency standards and standard methods and international standards (Atkinson et al 1973; Quinlan and Ray 1981; Thrailkill 1985, ASTM 1995; Quinlan 1989 and 1990; Schindel et al 1996; Aley 1999; Aley 2000; Ginsberg and Palmer 2002, Goldscheider and Drew editors 2007) dye tracing, water-level measurements, and comprehensive sampling following rain events, and detailed mapping of geologic structure were not successfully applied in Austin until the mid-1990's by the Barton Springs/Edwards Aquifer Conservation District (Hauwert and Vickers, 1994; Hauwert et al., 2004) funded primarily through a grant from the Environmental Protection Agency administered through the Texas Commission on Environmental Quality, with dye tracing expertise and analysis of Tom Aley from Protom Missouri and assistance from City of Austin Watershed Protection Dept staff. By 2009 (Hauwert 2009, Hauwert and Sharp 2015), eddy covariance climate tower, coupled with rain gauges, runoff flumes, and soil moisture monitoring demonstrated that over the Edwards and Trinity Aquifers, on average about 28% of rainfall recharged upland areas, as opposed to less than 1% of rainfall that was used to justify irrigation of treated wastewater and direct injection of stormwater into sinkholes. While direct tracing has revealed flow paths and travel times, potential contamination sites that could affect public health and safety are not monitored in recent time per ASTM and EPA standards around Austin, Texas. Sampling of sensitive receptors, such as Barton Springs, are still not sampled

shortly after rain events when the greatest contamination loading is expected. Despite scientific data, the karst nature and rapid groundwater flow of the Edwards Aquifer around Austin, the potential importance of caves in providing recharge and reducing flooding is still not widely recognized.

The 1989 EPA manual for groundwater monitoring in karst areas explains the use of groundwater-level (potentiometric surface) mapping, successful groundwater tracing (where the tracers are recovered at monitored sites), and cave mapping to delineate cave streams as well as where and when to monitor relevant (actually determined downstream) groundwater sites for potential contamination as opposed to random monitor sites assumed to be downgradient. The manual also notes that “*waste-disposal facilities should not be located within a karst terrane unless one is willing to risk sacrificing the use of at least part of the subjacent karst aquifer as a source of potable water. This is a high risk, almost a certainty*” (Quinlan 1989 p. 6).

TxDOT 1989, hypothesized on the potential for roadway runoff to affect Barton Springs from proposed State Highway 45 crossing of Bear Creek and known caves: “*even if unfiltered runoff were allowed to enter the aquifer without mitigation, the distance of flow and the mixing of this recharge with the total volume of transient wedge flowing toward Barton Springs would decrease the concentrations to well within drinking water standards.... This water would move to Barton Springs, probably via a somewhat circuitous route, at a rate of about 51 feet per day (Slade, personal communication, 1988). Assuming that the water flowed directly to the springs, the travel time would be at least 1,035 days.*” Hauwert (2012) tested the no impact and slow flow assessment with five dye traces and found 4 arrived at Barton Springs within 2-4 days (the 5th was a repeat of the prior 4 and wasn’t sufficiently flushed until a rain event and it arrived 17 days after injection). Of the 5 pounds of dye poured into Bear Creek upstream of proposed SH45SW crossing, 45% was measured to arrive at Barton Springs within 5 days of its arrival.

III. Caves as Windows to the Aquifer

Caves as recharge features were filled in widespread across the Central Texas area for various reasons including keeping water at the surface for livestock water ponds, to increase river/creek flow for turning mills, to eliminate fall hazards, to reduce “varmit” habitat, to dispose of trash, and to make sites more marketable for development. Arguments were also successfully made by developer representatives to state regulatory oversight, that filling caves protected the aquifer and protected cave ecosystems. Cave entrances were also used to divert urban stormwater in Central Austin/Tarrytown (Austin Caverns 1963 from Shaw and Hauwert 2013), Shady Hollow (1979), West Lake Hills (1989, Hauwert 2009 p. 225). Many large bowl sinkholes were converted from livestock ponds to water quality ponds, as recently as 2011 (Hauwert and McCaw 2020; Wong et al, 2012). Geologic assessments over the Edwards Aquifer recharge zone most commonly overlooked filled caves. Since the early 1950’s a volunteer group of cave explorers, associated with UT Grotto, began reopening, mapping, and documenting caves across the Austin area, documenting about 200 by 1990, of which 20% had already been refilled.

Hauwert (2009 p. 216 – 218) summarized the early characterization of the Edwards Aquifer around Austin, that was shown accurate with recent scientific data. From travels across Central

Texas in 1846 and 1847, German geologist Ferdinand Roemer (1849) believed that rainfall over the Edwards Aquifer “collects in large subterranean channels and breaks out in large springs.” In 1898 Hill and Vaughan believes cavities, including large underground caverns, predominated the distribution of groundwater in the Edwards Aquifer, as evidenced by the recovery of eyeless salamanders from wells around Austin. In 1922 (Taylor and Schoch), it was measured that Barton Springs flow, which in 1919 was only rarely tested positive of wastewater indicator bacteria, was regularly experiencing wastewater indicator bacteria in every sample in 1922 which was attributed to human wastewater sources relatively far away. Since the 1950’s in Central Texas, most cave excavation, mapping, documentation archive, and preservation of caves was initiated by non-profit and volunteer cave groups including UT Grotto, Bexar Grotto, Texas Speleological Survey, National Speleological Society, and Texas Cave Management Association. By the 1980’s and 1990’s, many scientists and the general public believed that caves were **not** important in aquifer recharge, that groundwater took years to travel through small pores in the aquifer, and that groundwater flow successfully filtered groundwater from contamination (Hauwert 2009 p 216-234).

For example, prior to proposed development, essentially all existing caves on the sites were filled and not recognized as caves by geologists hired by the land owner/developer in assessments submitted for regulatory review (Hauwert et al 2015). A system where a landowner/developer hires an geologist to assess his own property, rather than an independent assessment has a fairly predictable result. As noted, where this type of system was applied in California, nuclear power plants were constructed on known active faults, because regulatory oversight did not adequately evaluate assessments by the landowners representatives (Meehan, 1984; Hauwert 2009 p. 232). Also, since 2000, geologists are licensed by the State of Texas to evaluate proposed development sites for geologic features. However, unless the geologist has extensive experience excavating filled caves, it is unlikely that caves would be recognized. Also, the small scope and expectation in phase I geologic assessments is that the geologist can visually detect filled caves without having to invest time and expense in excavating possible filled caves. Frequently caves overlooked by the owner’s representative are discovered during a limited inspection period (generally 30 days) by regulatory authority such as City of Austin, a groundwater conservation district, Texas Commission on Environmental Quality if the regulatory staff have sufficient experience on caves through excavation to recognize filled caves and resources to sufficiently excavate the fill. The accepted scope for site assessment appears to be fairly small when compared to the effort required to unfill caves. Also, the filling of caves has often been successfully argued after the filling, as an aquifer protection measure. As a consequence of not thoroughly evaluating sites, structures are built over caves which increases runoff and flooding of creeks, reduces aquifer recharge proportional to the natural surface catchment area of the cave, reduce habitat for cave-adapted species in violation of state and federal wildlife protection laws, and can create a potential catastrophic collapse hazard for structures built over the cave.

In 1985, reflecting the existing scientific beliefs of the time, the City of Austin supported the concept of wastewater irrigation:

“Spray irrigation and individual onsite wastewater systems in the upland areas (away from the creeks) where the potential for recharge is much less, may be more effective methods of wastewater disposal. Two independent water budget analyses for this area have been conducted. The first was prepared for the Edwards Underground Water District and the second was done by C.M. Woodruff, Jr. In short, the studies show that the Edwards recharge zone is not an area of high runoff, and that about 85% of the total incident rainfall is either evaporated or is cycled through plants (evapotranspiration).

These facts suggest that alternative systems of (spray irrigation, conventional evapotranspiration systems, pressure dose systems, etc.) that rely on evapotranspiration as the method of treatment should be a more reliable method of maintaining the high quality of ground water in the aquifer. The idea of effluent from septic tanks flushing through fractured bedrock into ground water without undergoing any significant attenuation of bacterial or chemical contaminants has been widely accepted. However, data collected by the U.S. Geological Survey, and by Ann St. Clair, in a University of Texas, Masters thesis suggest that much of the waste may never reach the water table and that the effects of any contamination that does reach the ground water are generally unmeasurable. Reasons for the lack of pollution are due to the thickness of the unsaturated zone above the water table, insoluble clay residue in solution zones which absorb constituents in the effluent much the same way as a soil in a drainfield, the surface area of fractures and bedding planes probably is large enough to account for significant renovation of wastes, and dilution and dispersion in ground water.”

As recently as 2010, for proposed Jeremiah Ventures development with proposed effluent irrigation, Woodruff (2010) assessed that upland areas only receive less than 1% rainfall (as opposed to an average of 28% measured directly through eddy covariance/Bowen Ratio climate towers for average rainfall conditions, which is also consistent with other karst limestone aquifers around the world), that caves are important recharge features only if they have large catchment areas (even if wastewater effluent is piped over the features as was proposed here), that caves are only open features and when they are filled in they are no longer caves or sensitive features underlying proposed effluent irrigation fields:

“Most recharge occurs in the main stream channels, on account of the fact that the streams are where water is concentrated within the recharge zone. Only a modest percentage of total recharge (less than 1%) occurs on all the remaining landscapes, which include all of Hudson Ranch. In short, recharge is constrained at any given locality by a number of natural buffers. “

“A liberal estimate of recharge would allocate about 1% of total rainfall to enter the aquifer on uplands and along tributary watercourses.”

“Clearly, a wide range in recharge potential exists away from the main drainage courses of the six streams that recharge the BSS aquifer. Increased recharge potential at a given site may occur owing to enhanced porosity and permeability of locally exposed bedrock, such as occurs at karst features. But such recharge potential may be lessened by lack of catchment necessary to provide runoff to a karst cavity. Simply put, recharge is ultimately limited by the volume of water available at a site. A cave whose entrance occurs at the highest topographic part of the local

landscape would have recharge limited to the amount of rain falling onto the cave's entrance. Recharge volumes at such a site may be minimal, notwithstanding the fact that the feature could potentially provide direct access to the aquifer below. Moreover, natural aspects of the terrain also might impose limits; these include soil cover, bedrock attributes, and groundwater conditions (such as depth to the water table and the condition of bedrock or sediment within the vadose zone)."

"It would appear that the features most amenable to recharge would be caves, but this is not necessarily true. Caves are open voids (large enough to allow entrance by humans, but too small to be precisely delineated at the area-wide map scale used to present the landform units), and they might accept significant volumes of water, should water be channeled to their mouths. Hence, the sensitivity of the caves depends on their location on the landscape and their position with respect to the surface drainage network.

Certainly, a cave lying along a drainage course would potentially supply the most recharge to the aquifer. Otherwise, extensive caves may not be important recharge features in their unaltered state if they do not receive runoff from an adjacent catchment area. Under natural conditions such a cave without a catchment and drainage path would supply only the volume of rain water that falls directly on (or immediately adjacent to) the cavernous opening. Of course, should water be conveyed to such a cave mouth, recharge would occur; under those conditions, the only probable buffer would be water retained on underground rock surfaces in the vadose zone, or the fraction of water that infiltrates pores within the rock matrix and is thereby retained above the water table. In the vicinity of Hudson Ranch, the vadose zone is approximately 120 ft thick. Thus, the large voids that make up the caves on Hudson Ranch lie approximately 100 ft above the water table, so that some buffering will occur even for water applied directly to these features.

"The only way to prevent rapid recharge when water is conveyed to an upland cave would be to render the cave impermeable, which would mean filling it or covering the cavernous porosity. On a small scale, a similar procedure is applied to water wells. If state water-agency guidelines are followed for well-head protection, the well is isolated from activities (such as spray irrigation) and water-quality in the aquifer is protected."

In addition, caves may also constitute "liabilities" owing to their being "attractive nuisances" that attract unwary adventure seekers. None of the features on Hudson Ranch have biological significance, as this area lies outside the range of endangered karst species. Given the location of these features on the uplands, and the absence of drainage channels intersecting the cave mouths, all may be deemed of but minor importance as recharge features... Given the fact that these catchments constitute the domain of E/T, and not runoff (except during rare high-magnitude rainfall events) these "average" values are overstated. Over the long term little water will flow to the cave mouths. The volume of recharge "lost" from filling these caves is offset by protection of the aquifer's water quality."

"Most of the other features, being small (and mostly related to near-surface weathering) may be covered during the processes of land development. However, before the feature is covered, it

would be prudent to use a backhoe excavate the solution features to ascertain that no cavity extends to depth (thereby providing either a locus of recharge or a site of unstable foundation)."

Following the 1922 appearance of indicator bacteria at Barton Springs, a later occurrence was documented in 1982:

"Recharge during storm runoff resulted in significant increases of bacterial densities in the ground water. Densities of fecal coliform bacteria in samples collected from Barton Springs ranged from less than 1 colony per 100 milliliters during dry weather in November 1981, and January and August 1982, to 6,100 colonies per 100 milliliters during a storm in May 1982. Densities of fecal streptococcal bacteria ranged from 1 colony per 100 milliliters during dry weather in December 1981 to 11,000 colonies per 100 milliliters during a storm in May 1982. During each of three significant storms in October 1981 and April and May 1982, the densities of both groups of bacteria exceeded 1,000 colonies per 100 milliliters. The ratio of fecal coliform bacteria to fecal streptococcal bacteria in most samples was less than 0.7, which generally indicates that the principal sources of fecal pollution in recharge resulting from significant storms and moving rapidly through the aquifer were from domestic and wild animals rather than from humans (Andrews and others, 1984). The use of Barton Springs for recreation is currently denied after periods of significant recharge due to elevated bacteria counts" (City of Austin 1984).

IV. Water and Material Transport through Soil

Particularly in karst areas, soils contain macropores including tree roots, burrows, underlying openings (soil piping), mudcracks that transport water and materials rapidly through the soil to conduits in the underlying karst aquifer (Jennings, 1983; Hillel 1998; National Research Council, 2001; Kiraly, 2002; Hauwert 2009). Erosion of the soil associated with deforestation contributes to the filling of reservoirs and proportion reduction in water supply.

On the J17 Water Quality Protection Land research site, soil moisture increases within 8 hours following rain events down to 37 cm in soil samples dug to calibrate continuous soil moisture sensors (Hauwert 2009 p. 96-99; 124). Chemical tracers, including iron, ammonium carbonate, and potassium bromide can be flushed with rain events to study soil transport to underlying caves or springs (Hauwert and Cowan 2013; Cowan and Hauwert 2023). On nearby Tabor WQPL site, 500 g of potassium bromide poured in a soil-covered depression was detected in underlying drips of Barker Ranch Cave about 100 feet away within 3-7 hours (Hauwert and Cowan 2013).

Trees are particularly important in promoting surface water to infiltrate the soil, reducing surface flooding, reducing soil erosion, and cleaning air and water quality (Hester et al. 1997; Leite et al 2020, Lindley 2005; Bartley et al 2006; Bradshaw et al 2007; Arthur et al 2006; Khanal and Parajuli 2013; Nowak et al 2014.)

V. Cases Where Poor Understanding of Groundwater System Led to Contamination of Water Supply Source

Direct groundwater tracing in injection wells flowed two to three orders of magnitude faster through the limestone Biscayne Aquifer to arrive 100 m away Miami-Dade County wellfield than predicted by a previous groundwater model used to establish time-of-travel protection zones (Renken et al., 2005).

Organic tracers injected within the 2,159-acre City of Tallahassee Florida Southeast Spray Effluent Field showed groundwater primarily flows southwest towards Wakulla Spring, Sally Ward Spring, McBride Slough, Indian Spring, and several intervening wells at flow rates between 0.13-0.185 miles/day (0.2-0.3 km/day, Kincaid et al 2012). Nitrate concentrations in the karstic upper Florida Aquifer increased following operation of the irrigation field from 0.2-0.3 mg/l increasing to around 6 mg/l and as much as 10 mg/l. Wakulla Spring also saw increases in Nitrate to about 0.7-0.8 mg/l which caused significant harm to its ecosystem.

The wellhead protection zone for water supply of Walkersville, Maryland was delineated by the Maryland Dept. of the Environment using a numerical model to identify 5-year and 10-year time-of-travel radii around the well field assuming flow through small pores (porous media). Once directly traced per EPA and ASTM methods for karst aquifers, Aley and Field (1993) measured a 17.5 hour groundwater flow travel time from the erroneously delineated 5-year source travel zone. Fortunately, the direct tracing helped the city prepare for a raw sewage spill of about 900,000 gallons of raw sewage several years later within the previous calculated 8 year groundwater flow radius but dye reinjected at the spill site and fecal coliform concentrations of about 20,000 colonies per 100 ml reached the water supply well in 11 to 13 days (Aley, 2007, personal communication; Hauwert 2009).

The groundwater basin for Dewitt Spring, a Paleozoic carbonate spring near Logan, Utah, was delineated based on the mapped geological framework (Eckoff, Watson, and Preator Engineering, 1996). Darcian calculations (assuming groundwater flow through small pores rather than cave conduits), based on the groundwater gradient, delineated a time-of-travel zone of up to a 15-year time maximum for travel 8 km across the groundwater basin (State of Utah, 1995). Five tracers injected beyond the calculated 3-year time-of-travel arrived within 8 to 31 days (Spangler, 2002). Three of the five tracers arriving at Dewitt Springs were injected beyond the originally delineated groundwater basin (Spangler, 2002).

Pathogenic outbreaks that occur are largely not detected or proven and according to the Center for Disease Protection "the likelihood of an outbreak coming to the attention of health authorities varies considerably from one locale to another depending largely upon consumer awareness, physician interest, and disease surveillance activities of state and local health and environmental agencies. Large interstate-outbreaks and outbreaks of serious illness are more likely to come to the attention of health authorities." (Gerba et al. 1985). Most cases of pathogenic outbreaks occur due to contamination of source water rather than poor treatment of the drinking water (EPA 1999). In part, some pathogens such as *Cryptosporidium* and *Giardia* bacteria, viruses and

protozoa tend to be resistant to chlorine disinfectants. Also soil and groundwater aquifers are frequently over-relied upon for treatment of contaminated waste.

- In June and July 1975 a pathogenic outbreak affected about 200 workers and 2,000 visitors occurred at non-karstic (volcanic and alluvium deposits) Crater Lake National Park from faulty sewage line break or blockage (Rosenberg et al. 1977)
- From 1940 to 1980, 685 cases of pathogenic outbreaks were documented within the United States affecting 150,268 people, of which 44% (295 outbreaks) were attributed to groundwater contamination (Gerba et al. 1985).
- In 1993, in Milwaukee, Wisconsin, wastewater contaminated with *Cryptosporidium* caused illness in an estimated 403,000 people, hospitalized 4,400, and caused the death of 100 people in the largest waterborne disease outbreak in the United States (EPA 1999).
- In May to June 2000, Walkerton, Ontario, Canada an estimated 2,300 people became ill with gastrointestinal disease, with 65 admitted to the hospital, 27 developed a potentially fatal kidney ailment and seven ultimately died (Callan and Sinclair 2001).

Hauwert 2009 Appendix A, and Hernandez 2015 described pathogenic outbreaks that occurred as a result of a poor understanding of the cavernous nature of the Edwards and Trinity Aquifers. Hernandez 2015 summarized some recognized and documented pathogenic outbreaks and spills in Central Texas:

- A major pathogenic outbreak occurred in the City of Georgetown in Williamson County in the summer of 1980. About 8000 of the 10,000 residents on the central four municipal water wells were stricken with gastroenteritis (Hejkal et al., 1982). No cause was officially identified for the outbreak. In a personal communication, former City of Georgetown well operator Ernest Robles explained he suspected a golf course being irrigated with effluent was the cause of contamination, but that the Governor of Texas had disbanded the task force before a source could be officially identified.
- In 1984, an estimated 2,000 people were infected with *cryptosporidium* within the Braun Station subdivision of San Antonio after their wastewater system contaminated their well water.
- In July 1998, 30 Edwards Aquifer wells were contaminated from wastewater spill in Brushy Creek north of Austin. Roughly 2,000 people became ill as a result.
- Muller (1990) noted nitrate and fecal coliform contamination across the City of Dripping Springs was attributed to septic tanks and other wastewater contamination of the Trinity Aquifer.
- Regrading the Pedernales River springs near Pedernales Falls State Park in Blanco County, Brune (1981 p. 78) wrote:

“One point should be kept in mind, however. Many springs, especially those which issue from cavernous limestone, are no longer safe to drink from. The water which flows from this spring originates as surface water flowing from various streams into the Pedernales River in Blanco and Gillespie Counties. As it flows down- stream it picks up much sewage effluent and other

wastes from towns and residences along the river. Some of this effluent is treated and some is not Dye tests have shown that the water which feeds the springs enters the Marble Falls limestone in the Pedernales River bed about four kilometers upstream, near the R W. Robinson ranch house. As the water flows through the channels and caverns in the limestone there is no straining or purification as there would be in sand beds. The water which spouts from the spring is clear and looks pure, but it is not.”

- On 22 March 2012 the Trinity Aquifer water supply of Hazy Hills, west of Austin off Highway 71 toward Spicewood, was found contaminated with *Escherichia coli* (Ingles, 2012).
- On May 9, 2010, one of the larger recorded spills of about 250,000 gallons occurred near Mopac South (Loop 1) and LaCrosse Avenue, sending wastewater over highly cavernous tributary of Slaughter Creek at Lady Bird Johnson Wildflower Center. A previous dye trace conducted April 9, 2007 from Wildflower Cave, intended to predict spill responses, was detected one mile east 240 feet below the surface in an underground stream of Blowing Sink Cave (Hauwert, 2012). On May 12, 2010, three days after the spill, E Coli measured 11 colonies/100 ml and total coliform was 613 colonies/100 ml, which was higher than 1 colony or less of E Coli measured in 9 local wells. The dye traveled 16 km to arrive at Main, Eliza, and Old Mill springs within 2.5 days. A repeat dye injection was conducted after the wastewater spill on May 24, 2010.
- In 2019 seven dogs died after swimming in Lady Bird Lake at Red Bud Isle and Lake Travis that was attributed to toxic algae. The appearance of toxic algae is attributed to increase in nutrients, including phosphorus and nitrates that are typically associated with wastewater, fertilizer, and wildfires.

These are just a few known examples of wastewater contamination of water supplies and are not meant to be comprehensive set of all known cases in Central Texas. The Aquifer Resources Institute (2012) mapped wastewater spills on the Edwards Aquifer Recharge and Contributing Zones from 2007 to 2012, mapping 345 spills over 500 gallons each in Travis County with a net wastewater spill volume of 6,920,728 gallons over the 5 years.

Fisher (2020) and King (2017) summarized the recent impacts of wastewater disposal in the Austin area. Since 2017 across the Texas Hill Country, 81% of effluent discharge plants exceeded at least one pollutant limit, generally high ammonia nitrogen and low dissolved oxygen and high E. coli bacteria. While testing for a limited set of water quality constituents are required, more toxic pathogens may be associated with wastewater that are not tested for.

Clamann et al (2014) sampled four sites where reclaimed water was applied east of the Edwards Aquifer Recharge Zone generally saw increases in electrical conductivity, chloride, sodium, nutrients (Ammonia nitrogen, kjeldahl nitrogen, nitrate + nitrite, phosphorus, orthophosphate), and algae benthic chlorophyll) downstream compared to upstream sites. Significantly higher concentrations than average of wastewater indicators at one upstream site (Roy Kizer Golf Course) led to question whether the upstream site could actually be receiving reclaimed water, since the groundwater flow paths were not directly traced.

VI. Public Benefit of Land Preservation, Proper Assessment, and Application of Standard Methods for Karst Areas

In the 1980's, to support rapid growth in the Austin area, studies **not** using accepted standard methods for evaluating water supply sources and potential effects of contamination sources were used as a basis to suggest that groundwater was naturally treated to high standards and that natural recharge in proposed development areas were insignificant (St. Clair, 1979; Woodruff 1984; Hauwert, 2009 Appendix A; Veni and Hauwert 2015). To support land application of wastewater effluent, assessments frequently did not consider the majority of caves that were filled in advance on ranch and proposed development sites. Only areas within creeks and drainages, which could not be developed for risk of flooding, were considered sensitive for impacts to the water quality of the Edwards Aquifer. As a consequence, many Central Texas municipalities, including Shady Hollow, City of Sunset Valley, City of Westlake Hills, Rollingwood, Georgetown and Brushy Creek have diverted to Colorado River water-supply sources at a higher expense and increasing burden on a limited water source. Also, much of the attraction of the Central Texas area is its natural resources, which have become increasingly degraded through lack of delineation and protection of water sources, and failure to monitor using standard methods for karst areas. Ogden (2008) points out that the City of Austin utilizes considerable public funds to offset water-quality degradation, erosion, and flooding as result of poor land protection and preservation. The City of Austin's management practices for preserving future water supply has been more reactive and less long-term planning. The decision not to regularly invest in water supply source preservation means a heavier financial burden will be applied to future generations, as well as diminished environmental conditions including hotter local summer temperatures, less rainfall, greater siltation of water reservoirs, greater flooding, diminished springflow, diminished native species biodiversity, reduced citizen health, and degraded air and water quality. In 1999 (Loomis and Moore, Ogden 2008) it was estimated that the City of Austin would spend \$875 million through 2039 to partially offset water quality contamination.

While not a recommended practice for protecting water-quality in sensitive karst aquifers, one approach towards reducing contamination complaints of air and water pollution used in the early 1980s and 2017-2018, and 2025 was federal cuts in federal environmental research, sweeping personnel changes including reductions in EPA inspectors, budget cuts, and reductions in regulatory requirements. A different solution administered during the GW Bush administration did not involve budget cuts but used a different strategy to put industry leaders in charge of EPA and hire loyal staff with similar ideology.

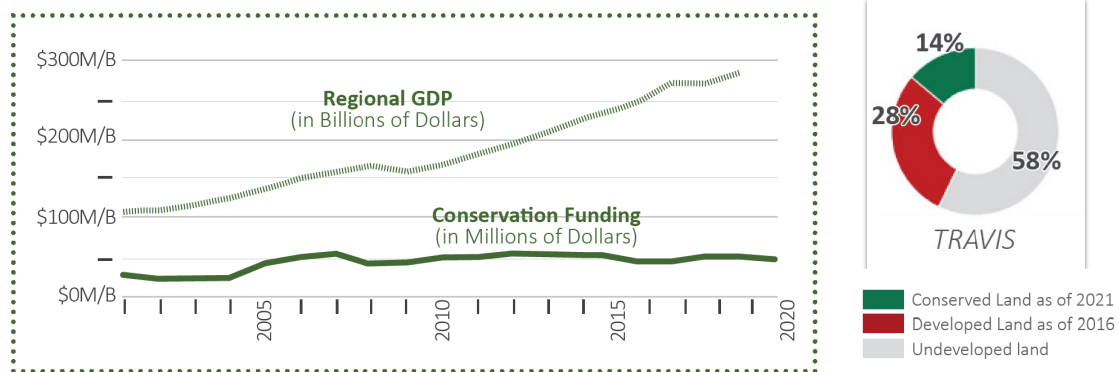
Where government regulatory agencies failed to take necessary protective measures, local residents took action. In 1988, Earth First activists camped out in caves near FM 2222 and FM 620 in northwest Austin to prevent a shopping mall from being built over them. These caves had very rare cave invertebrates identified by cave biologists, that petitioned their listing as endangered in 1985. One month after the heavy media attention of the activists, USFW an emergency listing of 6 cave invertebrates as endangered, and an endangered species permit was issued to the City of Austin and Travis County in 1996. To fund the City of Austin acquisition of

Balcones Canyonlands Preserve, in 1992 a \$22 million bond was approved by voters and another \$20 million bond was approved for acquisition of Barton Creek Wilderness area. While the specified conditions of the permit have not yet been met, about 34,000 acres were protected to some extent to help protect the Colorado River source and Barton Springs. In the late 1990’s Austin City Council labelled preserve lands as “underutilized” since this land were not developed in “greatest and highest use” as generating tax income. Frequently the City of Austin refused free land donations because of maintenance costs. From 1998 to 2018, the average land costs tripled from \$19,500/acre to \$66,600/acre (Siglo, 2022), such that greater tax payer investment becomes necessary to preserve Austin’s water supply. The investment in conserved land has not kept pace with growing population or growing economy (gross domestic product, Siglo 2022). If conservation lands aren’t proportionally conserved as development expands, it is likelier that wastewater and other urban contaminants will affect the water supply, and increasing pumpage and reservoir withdrawal will directly lower spring flows and water supply storage. A 2022 survey found that 85% of respondents would invest public funds for protecting the water supply. In 2025, Texas lost an estimated \$165 billion per year in GDP and economic damages from lack of adequate water-supply infrastructure (Thomas 2025) and the state is in the process of passing a bill and citizen vote to determine if \$1 billion in sales tax each year can be allocated to Texas water infrastructure.

Figure 1. Amount invested over time for conservation land purchase compared to regional economic growth (1 billion net by 2020) from Siglo 2022

10 YEAR AVERAGE CONSERVATION FUNDING VS. REGIONAL GDP

2001-2020



However, by 2024, City of Austin leadership would rather invest \$1.3 billion in replacing a half-used convention center or approving \$7.5 million for Parks & Recreation to clear trees and conduct prescribed burning than purchasing land to protect Austin’s water supply. The strategy of preserving land particularly close to intakes, is briefly mentioned in the 2024 Austin Water Forward Plan “*Conserving land in the Colorado River Basin upstream of Austin helps preserve drinking water quality for the City. Austin Water will begin further community engagement to develop a land conservation program that will expand the utility’s current and ongoing wildland conservation efforts*“, along with wastewater reuse (which can lead to water quality degradation as described in Case III), aquifer storage and recovery, use of Decker Lake reservoir, and

improved water conservation. However, the City of Austin has not invested more than \$1 million in 2 decades to acquire water supply area, but instead reducing environmental regulations to promote development with minimal actual steps to preserve future water supply. The future of Austin's sustainability, economy, and protection of heritage natural sites, wildlife and plants will require that citizens become educated on the issues and take proactive steps for the future of Austin, as they have needed to do in the past.

In 1992, as it became obvious that the existing regulations were not sufficient to protect Barton Springs, a major natural treasure for Austin, the citizens of City of Austin successfully petitioned for a non-degradation Save Our Springs development ordinance. Protection for Barton Springs was supported by 1996 listing of the Barton Springs salamander (*Eurycea sosorum* and later an eyeless *Eurycea waterlooensis* was added). Hauwert and Vickers (1994) showed water quality impacts to Old Mill Springs while testing for a fairly comprehensive list of water-quality constituents shortly after rain events, although were not allowed by the City to include Main Barton and Eliza Springs. Mahler and Massei (2006) were funded in part by the City of Austin and Texas Commission on Environmental Quality to sample Main Barton Springs following three storm events for pesticides and tetrachloroethane and observed peaks of atrazine, simazine, carbaryl, diazinon, and tetrachloroethene generally peak in concentration roughly 48 hours after rainfall and greatly diminish 100-200 hours after rainfall. The City of Austin response to this and other degradation studies was to prohibit regular required sampling of Barton Springs within days of rain events, even though rain event sampling is a standard method of karst aquifer monitoring. About 10% of the Barton Springs Edwards Aquifer Recharge Zone was mapped as natural or artificial internal drainage areas, that were generally large bathtub-like sinkholes which were widespread filled in as rancher practice to keep water at the surface. Very few of these natural upland sinkholes have been unplugged and primarily by volunteers with caving organizations. The City of Austin Watershed Protection Dept funded one project, utilizing roughly \$700,000 Capital Improvement Project that successfully unplugged five large sinkholes from 2013 to 2015 and restoring almost 200 acres of internal drainages which had been artificially diverted to Slaughter Creek. The City of Austin Watershed Protection Dept. had a team of 8 cave specialists from 2013 through 2017 that helped in the intensive task of development application review with excavating filled caves on City land and proposed development sites, while verifying submitted geologic assessments, although this practice was discontinued after a few years. Apparently, finding so many unreported caves on proposed development sites was problematic for the City.

The over 34,000 acres of City of Austin Water Quality Protection Lands preserves 28% of the recharge area and 9% of the contributing zone for Barton Springs and water well supplies for thousands from degradation from development and wastewater irrigation/leakage/spills ([WQPL website](#)) The City of Austin proactively acquired the Hudson Ranch in 2014, rather than allow the cave-covered site be developed into the first major wastewater irrigation development on the Barton Springs segment of the Edwards Aquifer, since the failures of the 1980's and 1990's (Smith 2013; Coppola 2023). The roughly 32,000 acres of Balcones Canyonlands Preserves acquired by the City of Austin, Travis County, Nature Conservancy, Lower Colorado River Authority, Sunset Valley and Texas Cave Management Association were primarily acquired for

endangered species protection but also serve to protect air and water quality for water supply sources along the Colorado River, including the City of Austin.

VII. CASE I. Travis County Utility District Effluent Irrigation

Travis Country Utility District Inc. (CN Number: CN601121668, [RN102916962](#), ID Number cancelled WQ0011294001 and expired WQ0011320001, expired EPA ID TX0068811, Permit No 11294-01, Industry code Sewage Treatment Facility: 221320 NAICS). The wastewater irrigation holding pond is clearly visible in 1988 US Geological Survey topographic maps (Figure 2) and failing irrigation system was operational June 21, July 10, and December 4 of 1989 (appendix A). While it is unclear from records I obtained which wastewater irrigation areas were discontinued at what time. I recall some holding ponds were closed when I inspected proposed Travis County development north of Travis County Circle after a geologic assessment was submitted around 1994. In 1997 when preparing for Williamson Creek phase of dye tracing and utilizing the Travis County park well in the monitoring, I recall a wastewater treatment plant present at Travis County Circle at Sycamore Creek, that may have been closed at the time.

Danny Brasher, who inspected and photographed the Travis Country Utility District Inc. effluent irrigation fields in June 1989 (Appendix A) for the Texas Department of Water Resources (absorbed into the Texas Water Commission in 1985) later wrote:

“I basically spent ten years attempting to protect humanity from the worst aspects of itself by regulating the impacts of the disposal of wastewater and hazardous solid waste. I dealt with the impacts of everything from sewage plants to superfund sites... During my career, I learned that there is a huge disconnect between what the public perceives reality as and what actually is happening at the interface between humanity and the environment. This is true for environmentalists, academia, and capitalists. The climate change problem is the culmination of this disconnect. I learned as an environmental biologist working in some of the most contaminated environments on the planet, that the people living there usually knew more about what was really going on than anyone else did. What I did as a biologist, was to usually find data that proved what they already knew...The problem with adapting technology into society is that it can not be done in a centralized way without creating harm to the environment because it is not adaptive enough to deal with the complexities inherent in the problem.”(Brashear 2023).

Backdoor Springs (state # 58-42-811) is a perennial Edwards Aquifer discharging besides and below Backdoor (Tooth) Cave, within the upper Dolomitic Member of the Edwards Group. It is about 3,000 feet northeast of the Travis Country Wastewater Disposal pond. Photographs of a 1989 sewage bypass from storm sewer into Sycamore Creek (Appendix A), which is about 4,000 feet south of Backdoor Springs and discharges downstream on Barton Creek.

According to Hauwert and Vickers 1995, Backdoor Springs discharges at elevation of 570 ft msl, about 50-60 feet higher than estimated 510-520 ft msl water table elevation for Edwards Aquifer in March 1993 and March 1994 (Figures IIA-2 and IIA-3). According to water level surface maps and recovery of 1 trace in a well within Travis Country, a major groundwater flow path (Cold Springs Groundwater Flow Path conduit) crosses Barton Creek about a half mile downstream of Backdoor Springs with a conduit elevation of around 440-460 feet msl. The

terminal discharge of this flow path is Cold Springs, which has at least 7 orifices on and near the south bank of the Colorado River (water surface elevation of about 425 ft msl). Only 2 to 4 spring orifices of Cold Springs is normally visible above the lake level. One of the discharge springs can be felt as cold uprising water about 4 feet below the lake surface and roughly 20 feet from the bank. Since some of the spring orifices are submerged even when Lake Austin is lowered, and the springflow of all Cold Springs orifices can't be directly measured, but flows at a third to half of Barton Springs flow (Hauwert 2016).

The source of Backdoor Springs constant flow may be the Trinity Aquifer to the southwest. One of the longest caves in Travis County is Cave X on Regents School property that has partially water-filled passages and whose exploration terminates at a large fault near the western edge of the Edwards Aquifer recharge zone about one mile southwest of Backdoor Cave. It is hypothesized that the groundwater in both Cave X and Backdoor Springs may originate as lateral flow from the Trinity Aquifer to the west and both are located a few hundred feet on the downthrown side of the same major fault.

In 1896 USGS topographic maps through at least 1921, a road from Austin to Oak Hill crossed Barton Creek just downstream of Backdoor Springs and a crossing road followed the opposite north side of Barton Creek.

In 2017, endangered Barton Springs salamanders (*Eurycea sosorum*) were discovered at Backdoor Springs (Devitt et al 2018) for the first time, despite frequent visits, perhaps suggesting extirpation and recolonization (Bendik and Dries 2018) may have occurred.

Figure 2. Photograph of Backdoor Springs and cave by Nico Hauwert on June 12, 2005



Backdoor Springs was originally sampled September 19, 1990 by the City of Austin, periodically resampled and sampled April 1, 1993 by Nico Hauwert of the Barton Springs/Edwards Aquifer Conservation District for relatively comprehensive list of parameters.

After sampling 42 wells and springs across the Barton Springs Segment of the Edwards Aquifer, Hauwert and Vickers (1994) assessed:

“Backdoor Springs (58-42-811) contained fecal coliform (2 colonies/ 100 ml) and significant levels of orthophosphorus (0.218 mg/l), indicating impacts from wastewater leakage.” (p. 35)...“Orthophosphorus is commonly found in laundry detergents, and therefore is also a possible indicator of wastewater leaks. Backdoor Springs (58-42-811) and well 58-50-223 both showed relatively high levels of orthophosphorus. Note that Backdoor Springs also measured levels of fecal coliform, indicating that this spring may be impacted by wastewaters.” “Only one well, 58-49-708 and one spring 58-42-821 (Backdoor Springs) sampled in 1994, showed measurable levels of fecal coliform, at 2 colonies per 100 ml each.” (p. 30).

In 1993 an accidental release of 440,000 gallons (1.6 million liters) from Barton Creek Fazio Golf Course about 3 miles west of Backdoor Springs, creating a 3 mile long algal bloom in Barton Creek (City of Austin 1997).

Figure 3. 1988 US Geological Survey Topographic Map Showing Travis County Wastewater Disposal Pond and Backdoor Springs (text and spring location inserted in green) about 4,000 feet northeast.

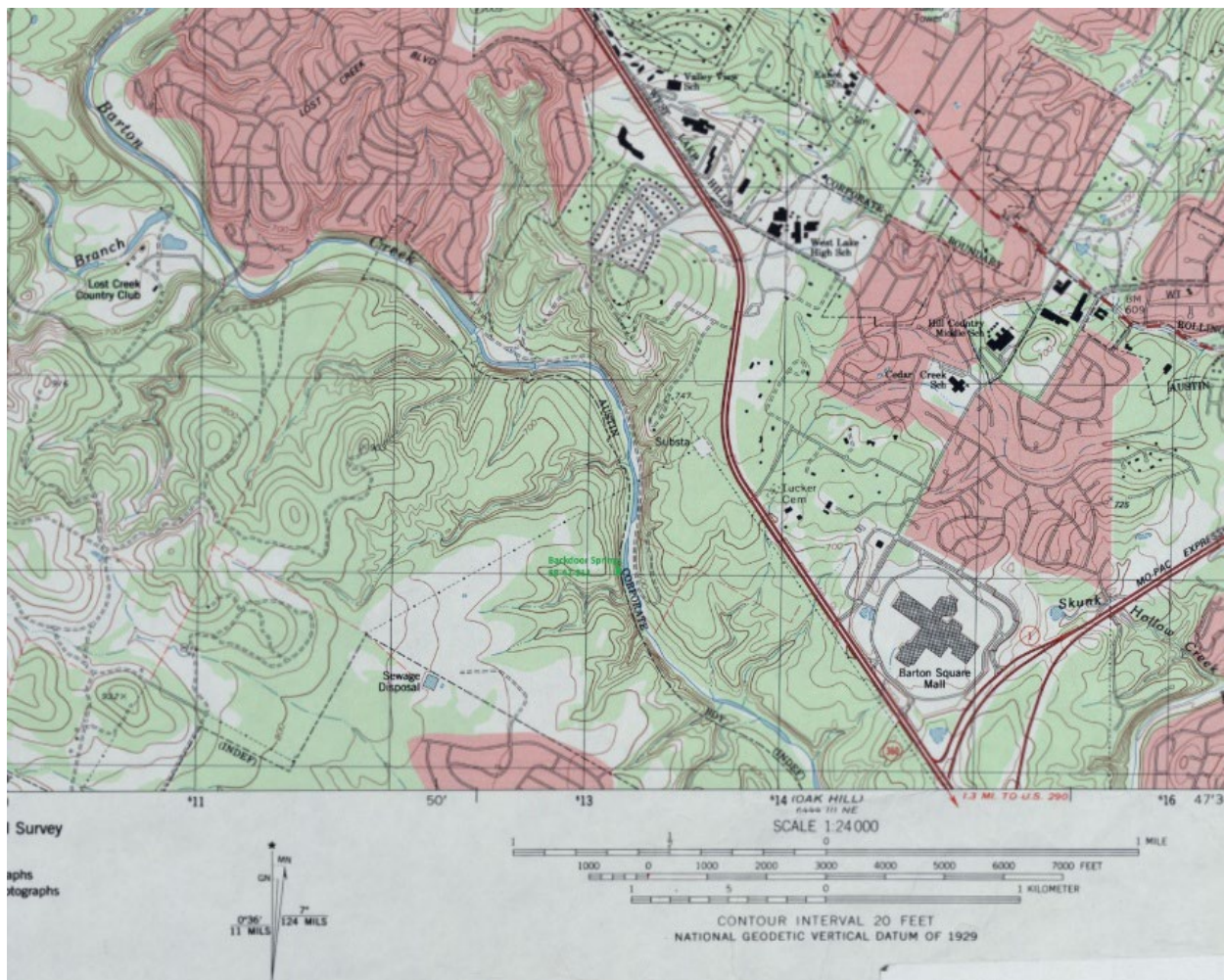
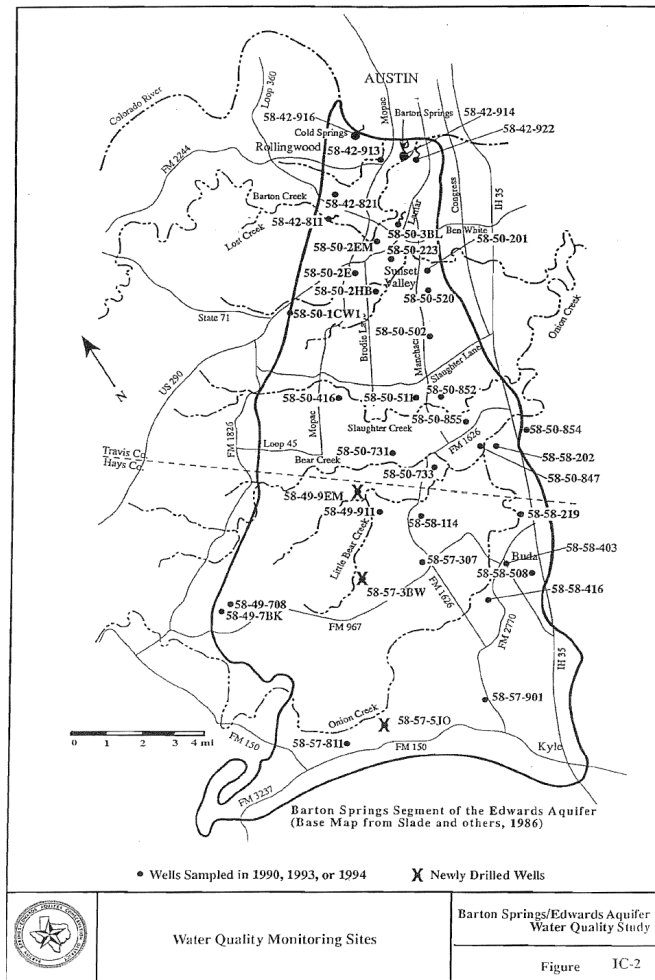
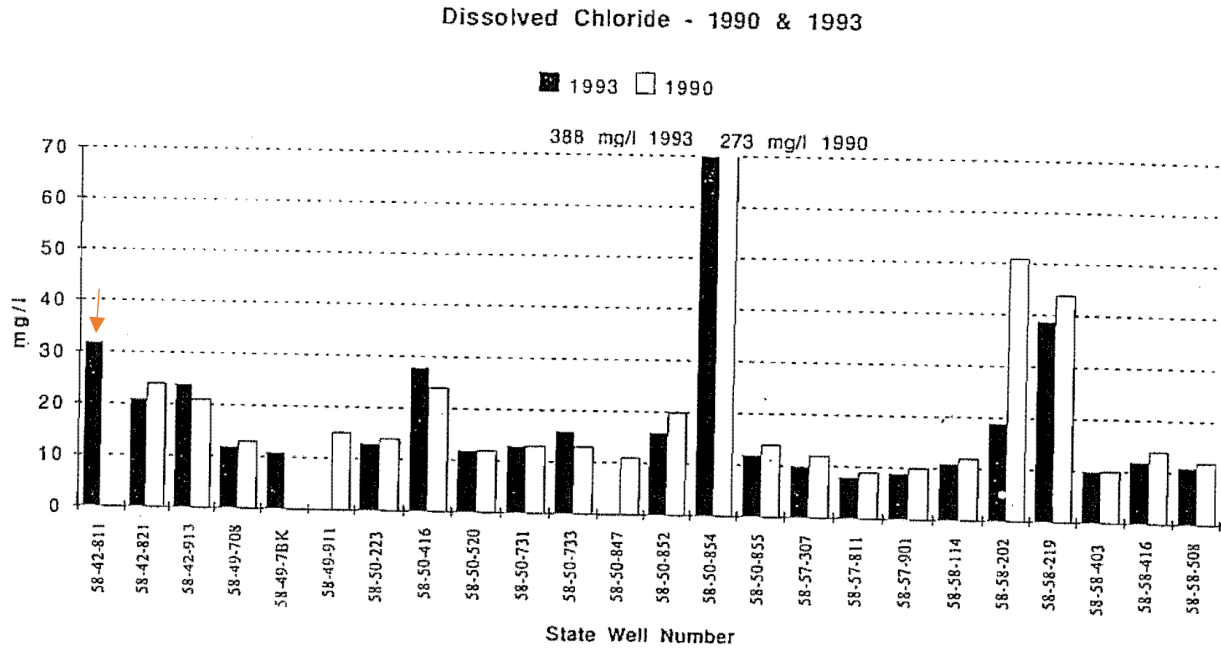


Figure 4. Map of groundwater sampling sites in Hauwert and Vickers 1994 study report showing wide distribution of wells and springs.



Samples taken Sept 19, 1990 revealed anomalously high levels of chloride (127 mg/l) and sulfate (80 mg/l) in Backdoor Springs, that declined to more expected Edwards Aquifer range of 16-30 mg/l by 1995 after plant closure. Some wells sampled, such as 58-50-854, 58-58-202, and 58-58-219, have high chlorine naturally because of their location in the Saline Water Zone.

Figure 5. Chloride concentrations across 24 wells and springs sampled in 1993 and 1994, including Backdoor Springs (58-42-811). From Hauwert and Vickers 1994.



In April 1993 samples, dissolved chloride measured 32 mg/l, significantly higher than typical concentrations of 9-12 mg/l for springs and wells not adjacent to the eastern Saline Water Zone. Kjeldahl nitrogen (0.302 mg/l), ammonia nitrogen (0.02 mg/l), and nitrate nitrogen (1.68 mg/l), orthophosphorus (0.218 mg/l)

Regarding the discharge of recharge from the Cold Springs Groundwater Basin, Hauwert and Vickers 1995 wrote: “*The Rollingwood area generally showed elevated levels of nitrate and trace metals, indicator bacteria, pesticides, and herbicides. Cold Springs, a major discharge point for this area, was found to contain total and dissolved arsenic (at levels of 0.452 mg/l and 0.032 mg/l, respectively), boron at 0.90 mg/l, measurable levels of some pesticides (bromacil, 4-nitrophenol, lindane, endrin ketone, heptachlor, and heptachlor epoxide), and significant levels of coliform and fecal streptococci indicator bacteria. The elevated levels of these parameters are attributed to septic tank leaks, wastewater lift station releases, chemical releases from accidental spills and lawn and golf course runoff, as well as other forms of urban runoff.*”

The City of Austin (1997) also concluded:

“*Irrigation with treated wastewater effluent would, therefore, be expected to increase sodium concentrations in ground water. The large number of samples in the data set from springs in areas that appear to be influenced by effluent irrigation probably skew the concentration averages upward.*”

An analysis of water quality of Backdoor Springs and Cold Springs was reported by Herrington and Hiers 2010, but utilized only limited City of Austin-collected data set of non-storm interval samples collected after 2000.

For this report, further analysis of water quality data collected by the City of Austin Watershed Protection Dept (frequent but limited parameters) combined with sampling by Barton Springs/Edwards Aquifer Conservation District (BS/EACD) staff for more comprehensive analysis funded by Texas Water Development Board. The BS/EACD samples were collected April 1, 1993 (Nico Hauwert), September 3, 1998 (Beckie Morris, Jim Sansom, Mark Mathis), June 21, 2001 (Brian Hunt and Brian Smith), May 7, 2002 (Brian Hunt), and May 7, 2003 (Briant Hunt & Scott Hiers). For comparison, wastewater samples collected by Watershed Protection Dept staff and Austin Water Utility, tap water samples collected by Watershed Protection Dept, runoff on relative unimpacted conservation land by Watershed Protection Dept, Barton Springs samples collected by Watershed Protection Dept., and Edwards and Trinity well water reported by the Texas Water Development Board. Sodium, strontium, chloride, and sulfate are relatively conservative chemical constituents originally used by Senger 1984 to show groundwater source areas.

Figure 6. Sodium versus strontium concentrations, showing a trend of Backdoor Springs to deviate from Edwards Aquifer trends toward tap and wastewater quality.

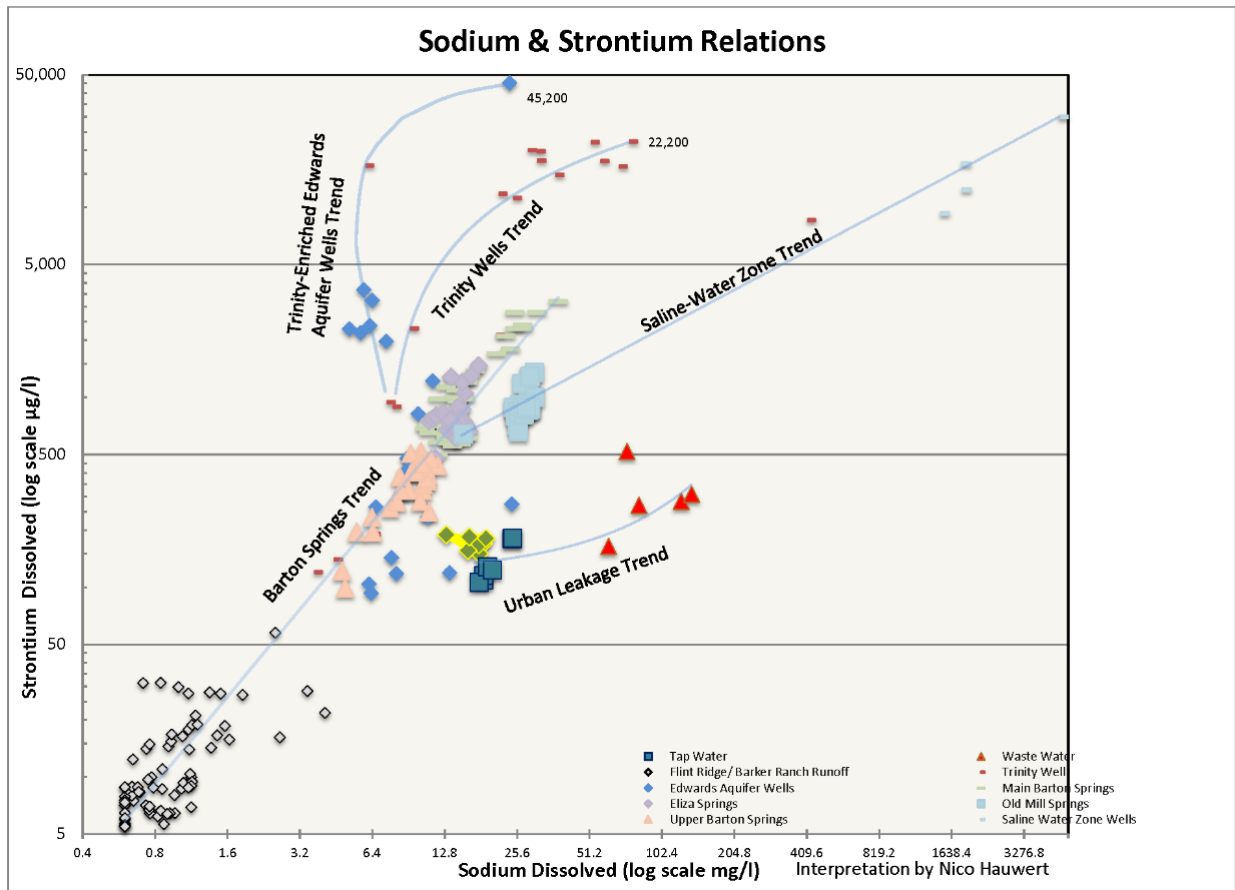


Figure 7. Sulfate versus chloride concentrations for Backdoor Springs in comparison with Edwards Aquifer, Trinity Aquifer, runoff, tap and wastewater samples showing about 100% wastewater contribution to Backdoor Springs at times, following plant closure.

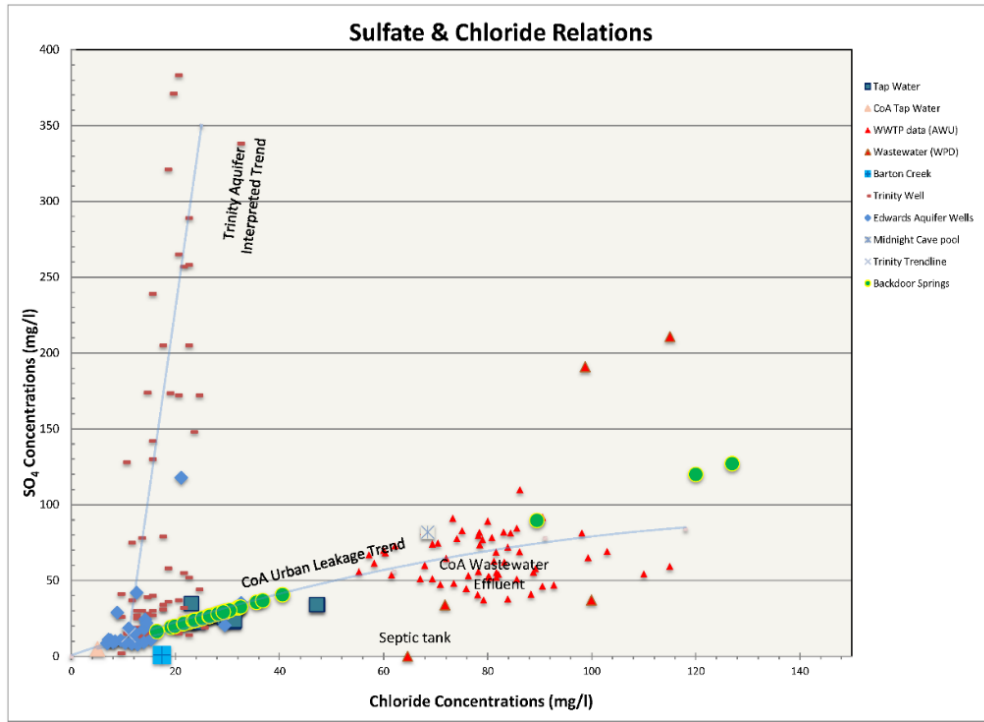
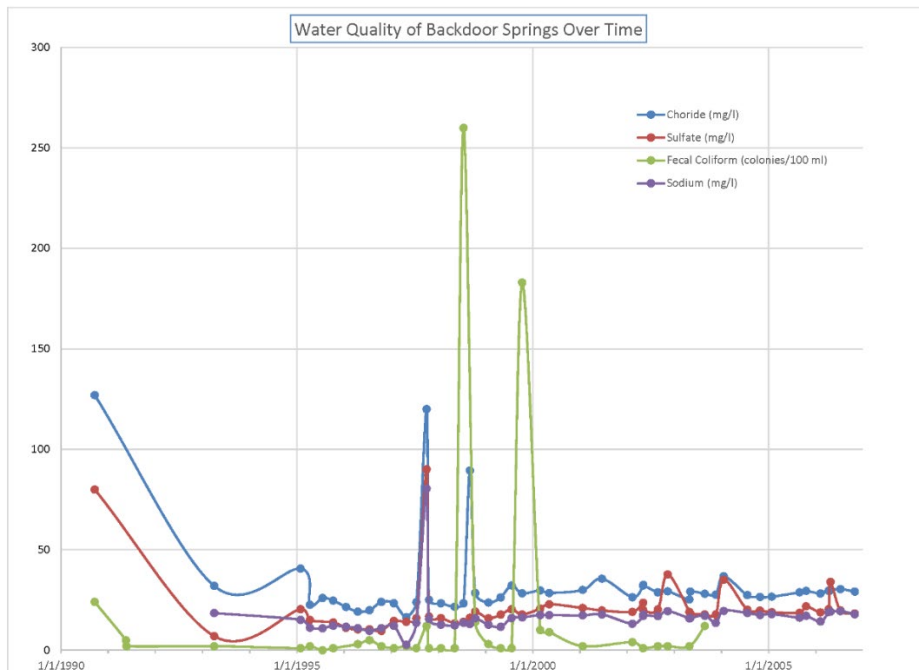


Figure 8. Time Series of Wastewater Indicator Parameters from Backdoor Springs samples. Elevated concentrations of chloride, sulfate, and fecal coliform in 1990, 1993, and January 1995 samples suggest declining wastewater effluent source.

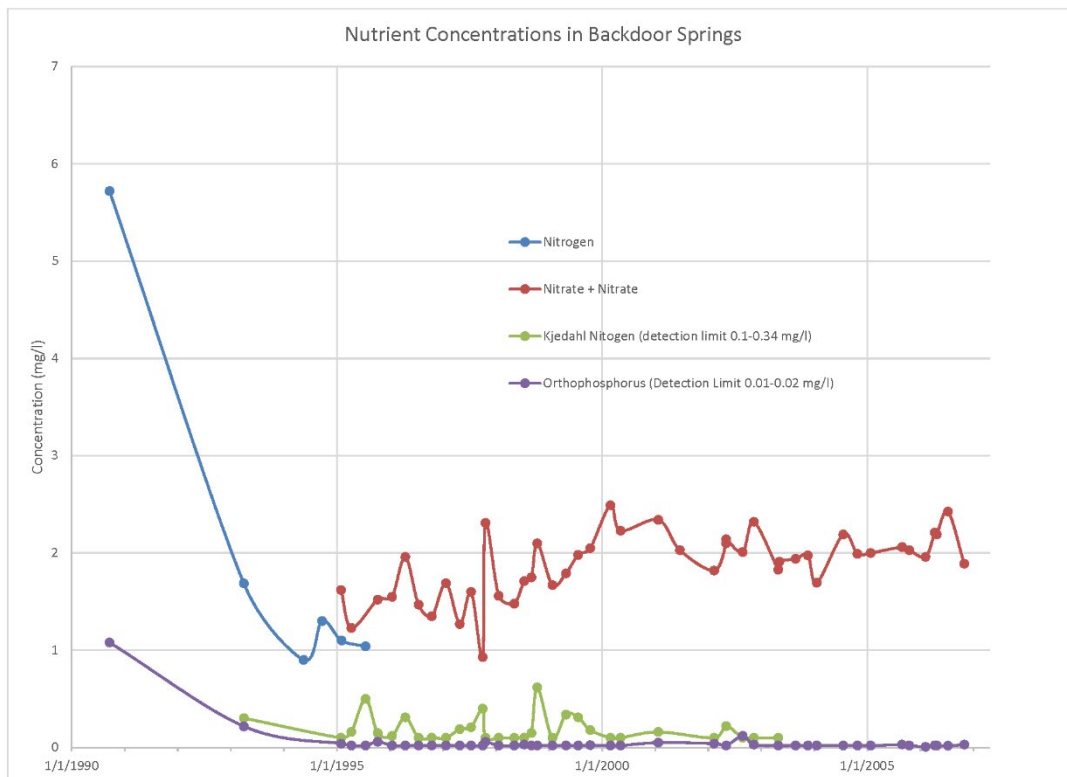


The increased chloride, sulfate, and fecal coliform from Sept 19, 1990, April 1 1993, and Jan 31, 1995 suggested long term wastewater influence that was diminishing to April 12, 1995. Those wastewater indicators, including sodium, suggested additional short term wastewater releases, possibly from other sources, prior to sampling on Oct 2 1997 (between July 15, 1997 and October 21, 1997). High fecal coliform (260 ml/100 ml) on July 15 -October 21 (14 colonies/100 ml), 1998 along chloride 89.5 mg/l on Sept 3, 1998 suggested short term wastewater release. A high fecal coliform level of 183 colonies/100 ml, without elevations in other indicators were measured on Oct 13, 1999.

Relatively high concentrations of dissolve aluminum (150 ug/l) in samples collected by Nico Hauwert on April 1, 1993, while usually less than 4 ug/l in next analysis on Sept 3, 1998 and subsequent analyses.

Backdoor Springs had over ten times more orthophosphorus (0.218 mg/l) than 21 other sites sampled across the Barton Springs Edwards Aquifer within the same one month sampling period (Hauwert and Vickers 1994, p. 189). The relatively high levels of nitrate nitrogen (greater than 1.5 mg/l) and orthophosphorus (greater than 0.1 mg/l) show wastewater impacts to Backdoor Springs prior to 1994.

Figure 9. Nutrient concentration over time at Backdoor Springs



VIII. CASE II. Shady Hollow WWTP (Southwest Travis County Municipal Utility District No. 1

Southwest Travis County Municipal Utility District No. 1 was created on December 15, 1980 and renamed Shady Hollow Municipal Utility District on October 20, 1995

(<https://www.shmud.org/about/>). A water-supply well (state well no. 58-50-731) was drilled in May 1983 (Underground Resource Management 1983). Water supply well (58-50-743) was drilled June 6, 1997. While the Barton Springs Segment of the Edwards Aquifer is an Environmental Protection Agency designated sole source aquifer and was the only source of water for many communities including Shady Hollow, Buda, Manchaca, Sunset Valley, and Rollingwood, Shady Hollow discharged its wastewater using land application.

Permit originally approved December 4, 1984. Texas Water Commission Permit No. 11728-01, WQ11828, NPDES permit TX0069205. Renewed May 8, 1989 for 400,000 gallons per day. The Texas Water Commission noted that monthly discharges from August, Sept and October 1993 were 79%, 94% and 90% of permitted capacity, greater than the required 75% of design capacity criteria (June 24, 1994 correspondence by Jan Sills Appendix B.)

On January 17-18, 1993 and March 18, 1993, Nico Hauwert observed a heavy algal bloom in Slaughter Creek just downstream of IH35, roughly 4 miles downstream of the treatment plant, while conducting a series of dye traces to delineate source areas to Martine Springs. While there is no flow data listed by the USGS for Slaughter Creek downstream of Shady Hollow, based on hand-measured flow loss of about 25 ft³/s between the USGS station at FM 1826 and Menchaca Road (FM 1604) downstream of Shady Hollow, flow conditions of daily averaged flow at FM1826 were sufficient for flow downstream of Shady Hollow to IH35 around Jan 19-21, 1993 (13-21 ft³/s daily average flow), Feb 5-12, 1993 (15-32 ft³/s)

An Agreement for Wholesale Wastewater Service Between City of Austin and Southwest Travis County Municipal Utility District No. 1 was executed on October 9, 1993. Taken off line and wastewater diverted to City of Austin Slaughter Creek Interceptor tunnel on January 13, 1994.

On July 28, 1994, Vanessa Davis of Texas Natural Resource Conservation Commission (TNRCC later Texas Commission on Environmental Quality) notified Southwest Travis County MUD #1 that permit no. 11728-001 expired May 8, 1994 and that any further wastewater disposal on site would be a violation of Texas Water Code (Appendix).

On December 8, 1997 about 10,000 gallons of raw sewage overflowed from a manhole at the Treadsoft lift station after a portion of the sewer line collapsed (Valerie Wheeler letter December 12, 1997 Appendix C). The Austin Fire Department notified Nico Hauwert, Assessment Program Manager of the Barton Springs/Edwards Aquifer Conservation District, that raw sewage was flowing down Slaughter Creek across Bauerle Ranch, but the BS/EACD was unable to obtain access permission to assess the spill to help protect local water wells. Sufficient groundwater tracing to groundwater flow paths and vulnerable wells was initiated in 1996 under an Environmental Protection Agency grant, but wasn't sufficiently completed until 2002 (http://www.austintexas.gov/watershed_protection/publications/document.cfm?id=186140).

IX. Effluent Irrigation of Trees on Circle C at Slaughter Creek Park Near BCP permit cave

The 2020 case of reclaimed wastewater irrigation for watering trees and corresponding high level of wastewater indicators in federal Balcones Canyonlands Conservation Plan (BCCP) federal permit cave Midnight Cave suggests the lack of natural treatment expected by some on soils and Edwards Aquifer.

In 1985, Midnight Cave was mapped by Bill Russell, Peter Sprouse, Mary Standifer, and Pablo Tapie of UT Grotto as being largely trash-filled, with guano as evidence of prior major bat inhabitation. In 1993 Nico Hauwert photographed the cave and trash fill with Jeff Hoese of UT Grotto. A manual cleanup coordinated by Mark Sanders of Austin Parks and Recreation Nature Center Program successfully cleaned trash from the cave from 1993-1999 with dumpster donated by the former ranch heir Ira Yates.

The 1996 BCCP karst land management plan, which applies to Midnight Cave, specifies “*Within 105 m of the entrance of any karst features that support listed invertebrates and/or SOCs, RIFA (red imported fire ant) control must be restricted to the use of boiling water, which ensures protection from pesticides of the entire cave cricket foraging area... Cave areas should be protected from spills or contamination. The cave area is defined as the protection area designated by a hydrogeological investigation, or in the absence of a study, the area within 1/4-mile radius of the cave entrance. Coordination with USFWS is required if there are any possible contamination issues. Pesticides and fertilizers are prohibited from use within the area designated as needed for protection. (p. 33)*”

The 1999 Karst Land Management plan states :

”*There will be baseline monitoring of: Cave species (listed and unlisted), cave crickets, vegetation, environmental conditions (in cave and on surface), fire ants, and mammals (USFW 2003) ... (p.24) Groundwater and drip water samples should be collected to determine the impact of development on groundwater quality.*”

Furthermore the 2016 karst land management plan that includes Midnight Cave specifies: “*Another component of protecting the surface environment around caves involves maintaining high quality and adequate quantity of water to the cave ecosystem, achieved through protection of a cave’s surface and subsurface drainage basins (USFWS 2012). Well protected drainage basins provide necessary moisture and stable temperatures in cave habitats, and ensure these ecosystems are free from contaminants (USFWS 2012).*”

From 2002 to present, coordination of land management around Midnight Cave was not conducted between Parks & Recreation Dept and the Austin Water Balcones Canyonlands Preserve program that administers the federal permit. A 2023 Parks Land Management Plan includes parks containing 1996 federal BCCP permit caves and their cave cricket and water source areas, but the plan does not identify those parks as BCP preserves or limit areas where potentially toxic substances should not be applied. Although the federal permit species that preserve areas would be defined including the water source areas for 62 permit caves where use

of hazardous chemicals such as pesticides would be restricted, but Parks refuses to acknowledge required Balcones Canyonlands Preserve areas in karst preserves including William Russell Karst Preserve, Schroeter Park, Stillhouse Hollow, Circle C at Slaughter Creek Park, Dick Nichols Park, Goat Cave Karst Nature Preserve. City of Austin leadership has supported the lack of federal mandated protection for a few committed caves the last three decades since the public has not demanded cave protection and USFW has not enforced action.

However, even after the BCCP permit administration (with the City's cave biologists was transferred from Parks & Recreation Dept to Austin Water in 2002), the City of Austin assigned Austin Parks & Recreation Department as sole management of Circle C at Slaughter Creek Metro Park that contains Midnight Cave as well as other BCCP-committed permit caves and their specified water-source and cave cricket foraging areas including Goat Cave Karst Nature Preserve, William H. Russell Karst Preserve, Dick Nichols Park, Stillhouse Hollow Preserve, and Schroeter Park and city leadership have never required that these caves have never been protected according to USFW specifications. Parks & Recreation refuses to sign a draft interdepartmental agreement prepared in 2018 by Austin Water that would allow federal BCCP permit protection. With the approval of an interdepartmental agreement, Austin Water offered cost saving support for Parks, including red imported fire ant treatment in designated preserve areas using non-toxic alternatives using boiling water, fencing to reduce camping and camp fires, cave safety including gating, restoration, patrols, and monitoring. Parks has never followed the BCP permit requirements on the parks under their management, nor have they had staff trained in endangered species management. The 2017 Parks Integrated pest management plan does not even mention caves, in violation of the City of Austin Environmental Criteria Manual that prohibits pesticide application in buffer area for caves in the Barton Springs Zone. Other public BCP karst preserves including Whirlpool Cave Preserves, Village at West Oaks Karst Preserve are managed without pesticides, wastewater irrigation or filling in open caves. City Council has supported Parks & Recreation Dept poor land management by approving a land management plan (2023 Recommended Land Management Strategies and Climate Vulnerability Analysis) as recently as September 2023 that focuses on tree clearing, prescribed burning, and pesticide approaches and does not specify these parks as containing BCP preserves, only BCP cave entrances, that states:

*“Several tracts have existing management plans. These plans were considered and incorporated, **where appropriate**. Of note are parklands included in the Balcones Canyonlands Preserve (BCP). These lands are managed under a Federal Incidental Take Permit issued by the U.S. Fish and Wildlife Service. Land management actions on BCP lands must follow Permit requirements to ensure compliance with the Balcones Canyonlands Habitat Conservation Plan (USFWS 1996) and BCP Land Management Plan. PARD will coordinate and collaborate with Austin BCP staff on management for endangered and rare species.”*

Apparently, the application of pesticides, wastewater effluent irrigation, and filling in endangered and rare species caves were not considered “appropriate” to prohibit within specified preserve areas for federal permit caves since Parks customary has never followed these BCCP requirements and City Council/management has never held them accountable for the last two decades.

Cave crickets play an important role in cave ecosystems in that where openings to caves are not filled in, the cave crickets feed on the surface at night and bring into the cave nutrients to sustain other cave invertebrates, some of which are listed as endangered, threatened, or species of concern proactively protected to keep from extinction. Cave cricket counts also provide a general measure of the health of the cave ecosystem in conjunction with direct counts (faunal surveys) of other cave invertebrates in certain repeated survey plots. On August 18, 2020 Mark Sanders and Drew Thompson conducted a bi annual cave faunal survey of Midnight Cave, when Mark observed an unprecedented 50 dead cave crickets within the lower pit (50 feet below the surface). Drew did not observe dead crickets in the upper level room of the cave (10-20 feet below the surface). On August 19, 2020, 6,699 cave crickets were counted during a regular cave cricket exit count outside of the cave. This number was significantly lower than past summer counts.

Despite the BCCP karst land management plan and USFW directives, PARD has had Lonestar Soccer apply pesticides to fire ant mounds that occurs annually, apparently in the spring without notification to cave biologists of AW BCP that have worked to protect Midnight Cave and others since 1993 and administer the federal permit. Prior to 2012, Parks & Recreation Dept used Talstar and Ascend pesticides without notification. In 2012, 1 pound of Extinguish (Hydramethylnon) was applied in Soccer field 7 closest to Midnight Cave around April. 200 lbs of fertilizer are also applied twice annually (mid March and mid September) on field 7 in 2012. On January 29, 2020, Parks and Recreation Dept employees applied Advion on fire ant mounds at Circle C playground, which possibly includes adjacent field 7. Parks has not formally committed to establishing formal preserve areas where contaminants would not be applied, allow the unfilling of federal endangered species caves originally filled by Parks, or even notify City federal permit administrators/biologists.

The use of reclaimed wastewater is increasing encouraged/required by the City of Austin as a water-saving measure. The 2024 Water Forward Plan describes: *“Austin Water began providing reclaimed water in 1974. Reclaimed water is used for non-potable uses including irrigation of golf courses, ballfields, parks, and commercial properties. Other major non-potable uses include cooling towers, manufacturing, and toilet flushing. Austin’s reclaimed water system provides a low-priced source of non-potable water, helps conserve treated potable water, contributes to deferral of treatment plant construction and water contract payments, and provides other environmental benefits... The Reclaimed Water Mandatory Connection Ordinance, adopted by Austin City Council in September 2021, mandates that any development project within 250 feet of a reclaimed water line must connect to the reclaimed water system for irrigation, cooling, toilet flushing, and other significant non-potable water uses.*

The City of Austin has supported irrigation using treated wastewater:

“Austin Water has been promoting onsite water reuse for over a decade, encouraging the utilization of non-potable water sources like rainwater, graywater, reclaimed water, and others for irrigation, cooling, and toilet flushing.

In addition, Austin Water provided comments in support of state legislation in 2015 (HB 1902) and related changes to Texas Commission on Environmental Quality rules contained in 30 Texas

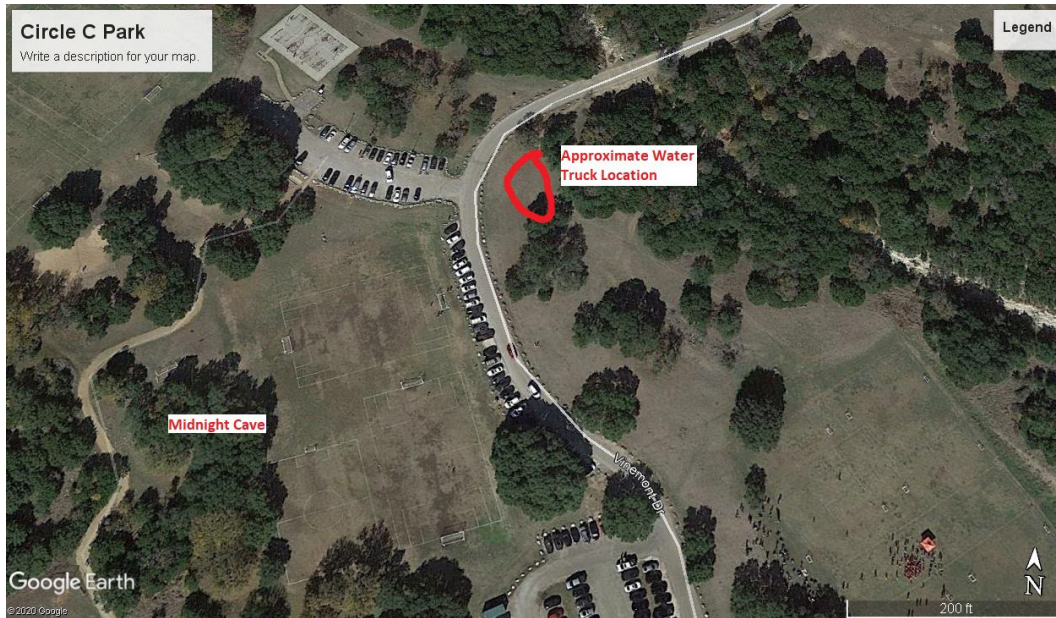
Administrative Code 210 adopted in December of 2016 to further facilitate the use of all auxiliary waters, including industrial reclaimed wastewater.

Beginning in 2015, Austin required new commercial developments and redevelopments within 250 feet of a reclaimed water main to connect for irrigation, cooling, and other significant non-potable water uses. Reclaimed water is treated wastewater and is about 20% of the cost of potable water. Those facilities that are “purple pipe” ready can begin to take advantage of the reduced rates, even before the reclaimed water line has reached their location. The reclaimed water initiative is an integral part of the City’s water conservation program and saves on average about 1.2 billion gallons of drinking water a year.”

“In March of 2024 Austin Water launched a new GoPurple program to increase use of reclaimed water and onsite water reuse systems in and around Austin...Any new commercial or multi-family development that is connecting to the reclaimed water system or installing an onsite water reuse system is eligible to participate in the program and receive financial incentives from Austin Water to reduce the cost of installing water reuse piping or treatment systems.” (City of Austin Water Forward 2024).” However, contrary to recommended monitoring in karst areas to examine potential groundwater impacts, the City of Austin appears to assume there are no water-quality impacts from irrigating reclaimed wastewater over sensitive karst aquifers or near caves.

March 27, 2020 around 9 am contractors on a hydrogeologic study observed a reclaimed effluent water truck watering trees roughly 250 feet northeast and across the park road from Midnight Cave. On October 12, 2020 Parks staff initially denied the use of reclaimed wastewater around Midnight Cave to Austin Water Balcones Canyonlands Preserve staff administering the federal BCCP permit but then admitted doing so, since the truck driver admitted it was treated wastewater. According to Amanda Ross Parks & Recreation Dept. Div Manager, 117 trees are were watered roughly each 2 weeks from March 4, 2020 when they were reportedly planted until before October 26, 2020, when the watering using reclaimed water was reportedly ceased. The 117 trees are were watered 30 gallons each water truck events using one truck with reclaimed water and the other tap water from a hydrant. The location of these trees was not provided. For 15 gallons/tree it was calculated roughly 45,000 gallons of reclaimed water was applied from March through September 2020. It is not known if similar wastewater irrigation has been conducted near Midnight Cave before or after the incident, since Parks as sole manager is not required to disclose this information and invariable discusses it only in cases where the application of a contaminant is observed by cave biologists.

Figure 10. Map of Circle C Park at Slaughter Creek portion with Midnight Cave, and location of reclaimed water truck on March 27, 2020 roughly 300 feet from the entrance of Midnight Cave. The location of other 117 planted and watered trees are not known. Field 7 is immediately east of Midnight Cave and may be annually treated with pesticides for fire ants.



Groundwater samples were collected from the pool about 55 feet below the surface on September 21, 2006, February 20, 2020, August 25, 2020, January 7, 2021, and June 9, 2022 to comply with monitoring requirements for the 1996 Balcones Canyonlands Conservation Plan permit. Regular monitoring, particularly following rain events are recommended, although the sampling collected was random sampling that was not coordinated with applications of treated wastewater, pesticides, and potentially other unreported contaminants Austin Water Balcones Canyonlands Preserves, and its contractors, which did most of the sampling did not have a contract including pesticide analysis and therefore did not collect samples for pesticide analysis.

Figure 11. The moderate strontium and relatively higher sodium concentrations in Midnight Cave Pool trends toward type wastewater samples, rather than trending along type Edwards or Trinity groundwaters.

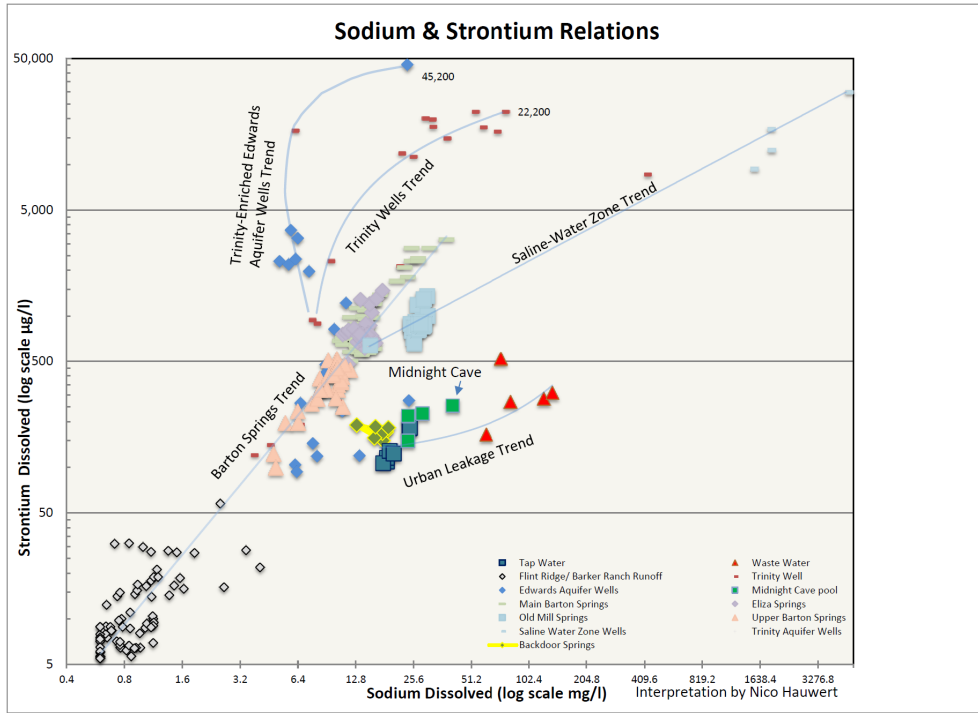


Figure 12. The high chloride concentrations in Midnight Cave pool parallel Old Mill Spring Saline Water trend toward tap water and wastewater sample types by higher in sulfate concentrations. The highest chloride (68.5 mg/l) and sulfate (81.9 mg/l) was sampled in 2006.

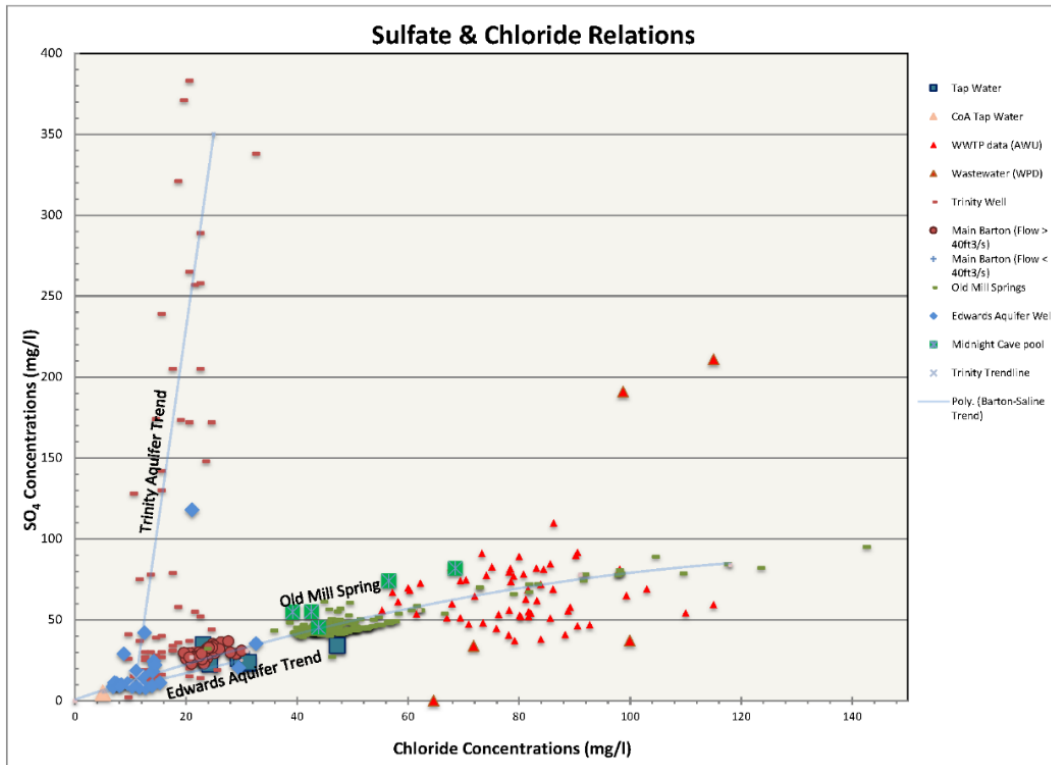
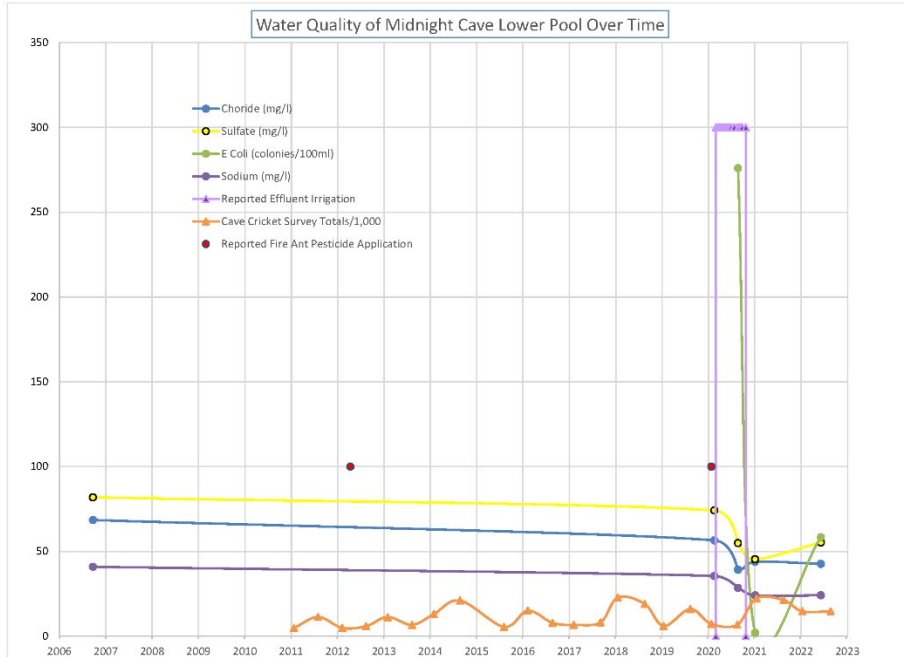


Figure 13. Time series of chloride, sulfate, sodium and E. Coli from sampling of Midnight Cave pool in reference to cave cricket exit counts, observed/reported 2020 interval of tree irrigation using reclaimed wastewater, and two cases where pesticides for red imported fire ants on adjacent field were reported, corresponding to intervals of low cave cricket exit counts.



It is possible and likely that pesticide is applied at least annually and treated wastewater might have been applied at other intervals that were not observed or reported. Based on two samples collected from 2006 to 2020, relatively high and consistent concentrations of chloride, sulfate, and sodium suggest potential wastewater in the pool of Midnight Cave since 2006. An initial *E. Coli* sample collected August 25, 2020, revealed relatively high concentrations of 276 colonies/100 ml during the interval of reported effluent irrigation, dropping to 2 colonies/1000 ml on January 7, 2021 after irrigation was reportedly stopped. While the sampling of Midnight Cave pool and complete reporting of contaminant input is insufficient, low cave cricket exit counts and observed cave cricket deaths appear to be associated with unusually high wastewater and possibly pesticides that were applied but were not sampled for.

X. Conclusions

Because of poorly understood aquifer flow processes and source areas in the 1980's and early 1990's, coupled with lack of standard groundwater monitoring, wastewater effluent irrigation practices and wastewater spills led to groundwater contamination and documented pathogenic outbreaks. The examples provided demonstrate that monitoring using standard methods for karst areas are vital for detecting problems associated with contamination sources including reclaimed wastewater irrigation. The assumption that karst aquifers and overlying soils can attenuate contamination can be tested in advance before placing public health at risk. Without direct dye tracing, the groundwater flow paths and travel times are not confidently known.

Situations where cave underlie or springs connected by tracers to proposed contamination sites provide a great opportunity to objectively test the effectiveness of any believed natural attenuation (Cowan and Hauwert 2013). However, it has not been observed where a party applying potential contaminants monitors the potential effects in an effective way. There are advantages to having an independent objective monitoring, unfortunately discovery of contaminant application has always been a random discovery frequently with limited or no access to the application site. In addition to the lack of reporting of potential “treated” wastewater and other potential groundwater contaminants, access to the application sites are frequently restricted, making assessments by potential groundwater stewards difficult.

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<https://drive.google.com/file/d/1gWCYIKViaCk9-2G2O5EmKI0LyIvJrtP1/view?usp=sharing> or https://www.researchgate.net/publication/361534189_Karst_and_Recharge_in_the_Barton_Springs_Segment_of_the_Edwards_Aquifer_Field_Trip_to_the_City_of_Austin%27s_Water_Quality_Protection_Lands

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Appendices

Appendix A. Photos of Travis Country Municipal District Effluent Irrigation System June 21, 1989 by Danny Brashear of Texas Water Commission.

Travis Country Utility District, Inc.
Permit No. 11294-01
June 21, 1989

1. View of bypass flowing from storm sewer.
2. View of bypass in Sycamore Creek.

Photos taken by Danny Brashear.





Travis Country Utility District, Inc.
Permit No. 11294-01
June 21, 1989

3. Close up of ponding of effluent in Sycamore Creek. Note settled floc.



4. Another close-up of effluent ponding in Sycamore Creek.

Photos taken by Danny Brashear.



Travis Country Utility District, Inc.
Permit No. 11294-01
Photos taken by Danny Brashear, 7-10-89.

1. View of unsecured pumphouse and gate to irrigation area.
2. View of sprinkler showing inadequate spray.



Travis Country Utility District, Inc.
Permit No. 11294-01
Photos taken by Danny Brashear, 7-10-89.

3. View of irrigation area showing ponding.
4. View of ponding showing algal growth.

Views of Travis Co
Permit No. 11294-01
12-4-89



Views of Travis Country
Permit No. 11294
12-4-89



Views of Travis Count
Permit No. 11294-01
12-4-89



Appendix B

Correspondences Between Southwest Travis County Municipal Utility District #1 and Texas Water Commission/Texas Natural Resource Conservation Commission

MUNICIPAL WASTE DISCHARGE

MWD # 11728-001

FILE TYPE: CD

VOL# 1

INCLUSIVE DATES: 89-94

Media Code/Format: M

Microfiche

Roll Microfilm

John Hall, Chairman
Pam Reed, Commissioner
Peggy Garner, Commissioner
Anthony Grigsby, Executive Director



TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

July 28, 1994

Ms. Valerie Wheeler
Southwest Travis County
Municipal Utility District No. 1
3305 Doe Run
Austin, Texas 78748

Re: Expiration of Permit No. 11728-001

Dear Ms. Wheeler:

At your request, Permit No. 11728-001 was allowed to expire as of midnight May 8, 1994. Any continued wastewater disposal activity at the site will be a violation of the Texas Water Code and may be subject to administrative penalties.

Please call the applications team at (512) 239-4440, if you have further questions or comments. Questions concerning outstanding fees may be directed to Sandra Johnson at (512) 239-4553.

Sincerely,

A handwritten signature in cursive script that reads "Vanessa C. Davis".

Vanessa C. Davis, Team Leader
Applications Team
Watershed Management Division

Attachment

cc: TNRCC Region 11

THIS ORDER IS SUPERSEDED
CANCELLED, OR EXPIRED.

SHADY HOLLOW
MUNICIPAL UTILITY DISTRICT

3900 RANCH ROAD 620 S, STE 104
TELEPHONE 512/280-6622

P.O. BOX 150068
AUSTIN, TEXAS 78715

December 12, 1997

Executive Director
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087

Attention: Watershed Management Enforcement Section

Re: Sewage Bypass on December 8, 1997. WQ-11728

Dear Sir:

RECEIVED

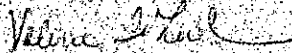
DEC 17 1997

WATER SECTION
ENFORCEMENT DIVISION

This letter is to inform you of a bypass that occurred on Monday, December 8, 1997 at the manhole at the end of Treadsoft Cove, or approximately 100 feet west of the Treadsoft lift station. The office was notified at 8:15 a.m. by a neighbor that the manhole was surging into the dry creek bed that runs by the lift station. The operator responded immediately and two vacuum trucks were called for and responded within the hour. One vacuum truck pumped the line and stopped the flow and stayed on site to continue pumping and discharging into the lift station. The other truck pumped out the creek bed and pumped it back into the lift station. Potable water from the fire hydrant was flushed into the creek and was also removed by the truck to the lift station. Upon completion of the cleanup in the creek bed HHH was put on the spill area. Approximately 10,000 gallons of bypassed sewage was pumped from the creek bed. There were no fish killed as this is a dry creek or drainage area. The sewer line was checked for blockage by camera. It was determined that this incoming line to the lift station was collapsed. Upon gathering all equipment and needed parts the line at the lift station was excavated, removed and repaired that day. The vacuum truck stayed on site and pumped from the nearest manhole back to the lift station all day to prevent any further bypass.

The President of the MUD Board, Gary Black, was present all day as well as myself. William Swanks notified the TNRC by phone that morning of the spill. The Health Department was also notified and sent a representative to check on the area. If you have any further questions please feel free to contact me.

Sincerely,



Valerie Wheeler
General Manager

xc: TNRC Region 14
Gary Black

John Hall, Chairman
Pam Reed, Commissioner
Peggy Garner, Commissioner
Anthony Grigsby, Executive Director



WQ 11728-001

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

SOUTHW TRAVIS CO MUD 001
3305 DOE RUN
AUSTIN, TX 78748

June
Date: JULY 24, 1994

Dear Permittee:

Failure to plan and construct adequate wastewater treatment capacity to meet existing and future needs is a major factor leading to hydraulic and organic overloads affecting wastewater treatment and effluent quality. The Texas Natural Resource Conservation Commission (TNRCC), realizing this to be a major problem affecting permit compliance, promulgated rules which were felt to be necessary in order to preserve and protect the quality of the state water resources.

On June 19, 1986 the Texas Natural Resource Conservation Commission adopted 30 Texas Administrative Code (TAC) Chapter 305 entitled "Consolidated Permits". Section 305.126 states in pertinent part, "Whenever the average daily flow reaches 75 percent of the permitted average daily flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the wastewater treatment and/or collection facilities." Section 305.126 further states, "In the case of a wastewater treatment facility which reaches 75 percent of the permitted average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee will submit an engineering report supporting this claim to the executive director. If in the judgement of the executive director the population to be served will not cause permit noncompliance, then the requirements of this section may be waived. To be effective, any waiver must be in writing and signed by the director of the Watershed Management Division of the Texas Natural Resource Conservation Commission and such waiver of these requirements will be reviewed upon expiration of the existing permit. However, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter."

In order to implement Chapter 305 cited above, a review of your wastewater treatment facility flow records was conducted for the time period Aug 1993 through Oct 1993.

Your self monitoring report records show that the daily average flow reached or exceeded 75% of the design capacity (permitted daily average flow) of the wastewater treatment plant for each of the three months based on the following information:

Permit Number WQ0011728-001	Month	Permitted Flow (MGD)	Reported Flow (MGD)
	Aug 93	0.400000	0.317000
	Sep 93	0.400000	0.375866
	Oct 93	0.400000	0.360000

Please read the following completely and then answer the appropriate questions concerning your wastewater treatment facilities. Should you have any questions, please feel free to contact Ms. Tracy Callen of the Wastewater Enforcement Section at (512) 475-2185.

1. Are you currently under a Court, TNRCC or EPA Order requiring you to expand/upgrade your present treatment facilities? yes/no

If you answered yes, please provide information including projected dates for expanding/upgrading facilities.

2. If you answered no to question #1, are you at this time pursuing engineering and financial planning for expansion and/or upgrading of the wastewater treatment and/or collection facilities? yes/no

If your answer is yes, please explain, providing time schedules for securing funding and schedules for submitting appropriate engineering plans to the TNRCC or other state agencies for approval.

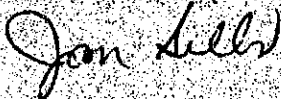
3. If you answered no to question #2, you are required to initiate financial and engineering planning for expansion and/or upgrading of the wastewater treatment and/or collection facilities provided you do not seek a waiver as provided in the rules. Should you not seek such a waiver, please provide a detailed plan with time schedules for complying with this requirement. Should you choose to seek a waiver from the requirements of this rule, you are required to submit an engineering report to the Texas Natural Resource Conservation Commission which supports the claim that the planned population to be served or the quantity of waste produced will not cause permit noncompliance. This report shall include, at a minimum, the following information:

- a. estimated percentages of flow contributed by industrial, commercial, municipal (schools, convention centers, etc.) and residential users;
- b. projected 30-day average influent flow rate to the treatment plant at the permit expiration date. This figure to be based on, but not limited to, the population projection, the anticipated addition and/or withdrawal of any industrial, commercial and/or municipal users to the service area over the duration of the permit;
- c. 30-day average influent 5-day Biochemical Oxygen Demand and Total Suspended Solids concentration for each of the past 12 months;
- d. number of unauthorized discharges (bypasses) from the sewage treatment plant for the past year, their estimated quantity and duration, and the circumstances surrounding each bypass event;
- e. schematic of the treatment plant showing its layout. This should also include the dimensions and design volumetric capacity of each treatment unit;
- f. number of excursions for the past 24 months from the permitted parameters set forth in the permit;

- g. age of the collection system and treatment plant;
- h. any sewer system evaluation surveys (SSES) and/or infiltration and inflow (I/I) studies conducted during the past five years; and
- i. future plans for the expansion/rehabilitation and/or construction of any new facilities, including a timetable.

Please send your written response to the attention of Ms. Tracy Callen, Texas Natural Resource Conservation Commission, Enforcement Section, Watershed Management Division, P.O. Box 13087, Austin, Texas 78711, as well as the appropriate Regional Office, within 90 days after the date of this letter.

Sincerely,



Jan Sills
Enforcement Section
Watershed Management Division

CC: TNRCC Region 11

SCHROEDER ENGINEERING COMPANY

1300 Guadalupe, Ste. 101
Austin, Texas 78701

Ph. (512) 469-7990
FAX (512) 478-0608

March 18, 1994

Mr. Randall Wilburn, P.E.
Wastewater Permitting Section
Watershed Management Division
Texas Natural Resource Conservation Commission
P.O. Box 13087
Austin, Texas 78711-3087

Re: Southwest Travis County MUD No. 1
Wastewater Permit No. 11728-01

Dear Mr. Wilburn:

Southwest Travis County MUD No. 1 has recently completed the construction of a wastewater connection line from the lift station at the wastewater treatment plant site to the City of Austin's Slaughter Creek Interceptor. The District has entered into a Wholesale Wastewater Service Agreement with the City of Austin and will no longer operate the wastewater treatment plant previously serving the District.

The District's Permit No. 11728-01 is scheduled to expire May 8, 1994, and the District does not plan to seek a renewal.

Sincerely,



Ken Schroeder, P.E.
District Engineer

cc: Bert Hooper, Hutcheson & Grundy
Valerie Wheeler

11128-01

**SOUTHWEST TRAVIS COUNTY
MUNICIPAL UTILITY DISTRICT NO. 1**

P.O. Box 43066
Austin, Texas 78745
(512) 280-6622

File

Board of Directors

Gary B. Black
President

Glenn E. Altwein
Vice President

Ron O. Sined, DVM
Secretary

Judy Gulick
Treasurer

Hank Smith, P.E.
Asst. Secy. Treas.

February 14, 1994

FEB 16 1994

Mr. John Young
Texas Water Commission
P.O. Box 13087
Capitol Station
Austin, Texas 78711

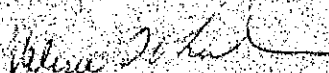
RE: Southwest Travis County MUD No. 1. Permit No.
11728-01

Dear Mr. Young:

Enclosed is the monthly effluent report for the Southwest Travis County MUD for the month of January 1994. Please be advised that the wastewater treatment plant was taken off line and the flow diverted to the City of Austin on January 13, 1994. The MUD is currently cleaning and disinfecting the treatment plant, and will be looking for a buyer.

If you have any questions please feel free to contact me.

Sincerely,



Valerie Wheeler
Southwest Travis County MUD 1



PERMIT NO. 11728-01
(corresponds to
NPDES PERMIT NO. TX0069205)

TEXAS WATER COMMISSION
Stephen F. Austin State Office Building
1700 N. Congress Ave.
Austin, Texas 78711

This amendment supersedes and
replaces Permit No. 11728-01
approved December 4, 1984.

PERMIT TO DISPOSE OF WASTES
under provisions of Chapter 26
of the Texas Water Code

Southwest Travis County Municipal
Utility District No. 1

whose mailing address is

3305 Doe Run
Austin, Texas 78748

is authorized to treat and dispose of wastes from the Shady Hollow Wastewater
Treatment Facilities

located approximately 3200 feet east of Brodie Lane and 5000 feet southwest of Riddle
Road in Travis County, Texas

to Slaughter Creek; thence to Onion Creek in Segment No. 1427 of the Colorado River
Basin

only in accordance with effluent limitations, monitoring requirements and other
conditions set forth herein, as well as the rules of the Texas Water Commission
("Commission"), the laws of the State of Texas, and other orders of the Commission.
The issuance of this permit does not grant to the permittee the right to use private
or public property for conveyance of wastewater along the herein described discharge
route. This includes property belonging to but not limited to any individual,
partnership, corporation or other entity. Neither does this permit authorize any
invasion of personal rights nor any violation of federal, state, or local laws or
regulations. It is the responsibility of the permittee to acquire property rights as
may be necessary to use the herein described discharge route.

This permit and the authorization contained herein shall expire at midnight, five
years after the date of Commission approval.

APPROVED, ISSUED AND EFFECTIVE this 8th day of May
1989

ATTEST

Brenda W. Foster

For the Commission

**THIS ORDER IS SUPERSEDED,
CANCELLED, OR EXPIRED.**

INTERIM EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning upon the date of issuance and lasting through the completion of the 0.5 MGD facility, the permittee is authorized to discharge subject to the following effluent limitations:
The daily average flow of effluent shall not exceed 0.4 million gallons per day (MGD); nor shall the average discharge during any two-hour period (2-hour peak) exceed 833 gallons per minute (gpm).

Effluent Characteristic	Discharge Limitations			Minimum Self-Monitoring Requirements	
	Daily Avg mg/l (lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Max. Single Grab Measurement Frequency Sample Type
Flow, MGD	Report	N/A	Report	N/A	Five/week Instantaneous
Carbonaceous Biochemical Oxygen Demand (5-day)	10 (33)	15	25	35	Once/week Grab
Total Suspended Solids	15 (50)	25	40	60	Once/week Grab
Ammonia Nitrogen	3 (10)	6	10	15	Once/week Grab

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l and shall not exceed a chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes (based on peak flow), and shall be monitored five times per week by grab sample. An equivalent method of disinfection may be substituted only with prior approval of the Commission.
3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per month by grab sample.
4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.
5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit
6. The effluent shall contain a minimum dissolved oxygen concentration of 4.0 mg/l.

FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning upon the completion of the 0.5 MGD facility and lasting through the date of expiration, the permittee is authorized to discharge subject to the following effluent limitations:
The daily average flow of effluent shall not exceed 0.5 million gallons per day (MGD); nor shall the average discharge during any two-hour period (2-hour peak) exceed 1389 gallons per minute (gpm).

Effluent Characteristic	Discharge Limitations			Minimum Self-Monitoring Requirements		
	Daily Avg mg/l (lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Daily Max. Measurement Frequency	Sample Type
Flow, MGD		N/A		N/A	Continuous	Totalizing meter
Carbonaceous Biochemical Oxygen Demand (5-day)	5 (21)	10	20	30	Once/week	Composite
Total Suspended Solids	5 (21)	10	20	30	Once/week	Composite
Ammonia Nitrogen	2 (8.3)	5	10	15	Once/week	Composite

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l and shall not exceed a chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes (based on peak flow); and shall be monitored daily by grab sample. An equivalent method of disinfection may be substituted only with prior approval of the Commission.
3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored twice per month by grab sample.
4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.
5. Effluent monitoring samples shall be taken at the following location(s): following the final treatment unit.
6. The effluent shall contain a minimum dissolved oxygen concentration of 5.0 mg/l.

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Better than an screen

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 11, Texas Administrative Code (TAC) Chapter 305 certain regulations appear as standard conditions in waste discharge permits. All definitions contained in Section 26.001 of the Texas Water Code apply to this permit and are incorporated herein by reference. Additional definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

- Daily average flow** - the arithmetic average of all determinations of the daily discharge within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily discharge, the determination shall be the average of all instantaneous measurements taken during a 24-hour period or during the period of daily discharge if less than 24 hours. Daily average flow determination of intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.
- Instantaneous flow** - the measured flow during the minimum time required to operate the flow measuring device.
- 2-hour peak (domestic wastewater treatment plants)** - the maximum flow sustained for a two-hour period during the period of daily discharge. Multiple measurements of instantaneous maximum flow within a two-hour period may be compared to the permitted 2-hour peak flow.
- Daily maximum flow** - the highest total flow permitted for a 24-hour period.

2. Concentration Measurements

- Daily average concentration** - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar month, consisting of at least four separate representative measurements. (i) For domestic wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values in the previous four consecutive month period consisting of at least four measurements shall be utilized as the daily average concentration. (ii) For all other wastewater treatment plants - When four samples are not available in calendar month, the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.
- 7-day average concentration** - the arithmetic average of all effluent samples, composite or grab within a period of one calendar week, consisting of at least three separate measurements.
- Daily maximum concentration** - the maximum concentration measured on a single day (by composite sample).
- Total Coliform bacteria** - the number of colonies per 100 milliliters effluent.

3. Sample Type

- Composite sample** - a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow collected no closer than two hours; or a sample continuously collected, proportional to flow, on a continuous 24-hour period or during the period of daily discharge if less than 24 hours.
- Grab sample** - an individual sample collected in less than 15 minutes.

4. **Treatment Facility (facility)** - Wastewater facilities used in the conveyance, storage, treatment, recycling, reclamation, and/or disposal of municipal sewage, industrial wastes, agricultural wastes, recreational wastes or other wastes including sludge handling or disposal facilities under the jurisdiction of the Commission.

5. The term "sludge" shall mean the solids and precipitates separated from wastewater by unit processes, which are not regulated as hazardous waste.

MONITORING AND REPORTING

1. Reporting

11 TAC 305.12(17) Monitoring results shall be provided at the intervals specified in the permit.

Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 11 TAC §§319.4-319.7.

Unless otherwise specified, a monthly effluent report must be submitted each month by the 20th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month. Knowingly making any false statement on any such report may result in the imposition of criminal and/or civil penalties as provided by State law.

4. Procedures

4.1. Procedures for the analysis of pollutants shall comply with procedures specified in 31 TAC §305.101(1). Measurements, tests, and calculations shall be accurately accomplished in a representative manner.

5. Frequency of Results

5.1. TAC §305.125(1) Monitoring and reporting requirements are as follows:

- (a) Monitoring samples and measurements shall be taken at times and in a manner so as to be representative of the monitored activity.
- (b) Monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by the permit, and the certification required by 40 Code of Federal Regulations §264.73(b)(9) shall be retained at the facility site for a period of three years from the date of the record or sample, measurement, report, or certification. This period may be extended at the request of the executive director.
- (c) Records of monitoring activities shall include the following:
 - (i.) date, time and place of sample or measurement;
 - (ii.) identity of individual who collected the sample or made the measurement;
 - (iii.) date of analysis;
 - (iv.) identity of the individual and laboratory who performed the analysis;
 - (v.) the technique or method of analysis; and
 - (vi.) the results of the analysis or measurement.

The period during which records are required to be kept shall be automatically extended to and through the final disposition of any administrative or judicial enforcement action that may be instituted against the permittee.

6. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, the results of such monitoring that indicate permit noncompliance shall be included in the calculation and reporting of the value submitted on the required monthly effluent report. The results of such monitoring that indicate permit compliance may also be reported and included in calculations. Increased frequency of sampling shall be indicated on the report.

7. Calibration of Instruments

All automatic flow measuring and/or recording devices and/or totalizing meters required by the permit for measuring permit limited flows shall be accurately calibrated by a trained person at plant startup and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the executive director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be kept at the plant site for at least three years.

8. Compliance Schedule Reports

8.1. TAC §305.125(18) Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date.

9. Noncompliance Notification

- a. 9.1. TAC §305.125(9) Unless specified otherwise, the permittee shall report any noncompliance to the executive director which may endanger human health or safety, or the environment. Report of such information shall be provided orally within 24 hours from the time the permittee becomes aware of the noncompliance. A written submission of such information shall also be provided within five working days of the time the permittee becomes aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.
- b. Any noncompliance which is 40% over the permitted effluent limitation shall be reported orally within 24 hours and in writing to the District Office within 5 working days of becoming aware of the condition.
- c. 9.1. TAC §305.125(12) Any noncompliance other than that specified in this section, or any required information not submitted or submitted incorrectly, shall be reported to the executive director as promptly as possible. (This requirement means to report these types of noncompliances on the monthly self-report form)

10. Signatories To Reports

10.1. TAC §305.125(14) All reports and other information requested by the executive director shall be signed by the person and in the manner required by 31 TAC §305.128 (relating to Signatories to Reports).

6. The permittee is responsible for installing prior to plant startup, and subsequently maintaining, adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures by means of alternate power sources, standby generators, and/or retention of inadequately treated wastewater.
7. Unless otherwise specified, the permittee shall provide a readily accessible sampling point and, where applicable, an effluent flow measuring device or a means by which effluent flow may be determined based upon influent measuring.
8. The permittee shall remit an annual waste treatment inspection fee to the Commission as required by 31 TAC 305 (Subchapter M). Failure to pay this fee may result in revocation of this permit.
9. Documentation
For all written notifications to the Commission required of the permittee by this permit, the permittee shall retain and make available a copy of each such notification, upon the same basis as self-monitoring data are required to be kept and made available.
10. 31 TAC 305.126 whenever flow measurements for any domestic sewage treatment facility reach 75 percent of the permitted average daily flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the domestic wastewater treatment and/or collection facilities. Whenever the average daily flow reaches 80 percent of the permitted average daily flow for three consecutive months, the permittee shall obtain necessary authorization from the Commission to commence construction of the necessary additional treatment facilities. In the case of a domestic wastewater treatment facility which reaches 75 percent of the permitted daily average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee shall submit an engineering report supporting this claim to the Executive Director of the Commission. If in the judgment of the Executive Director the population to be served will not cause permit noncompliance, then the requirement of this section may be waived. To be effective, any waiver must be in writing and signed by the Executive Director or his or her designee, and each waiver of these requirements will be reviewed upon expiration of the existing permit. However, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter.
11. Sewage treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency as defined in 31 TAC 325.1.
12. Plans and Specifications Approval
The plans and specifications for domestic sewage collection and treatment works associated with the discharge authorized by this permit must be approved pursuant to State law, and failure to secure approval before commencing construction of such works or making a discharge therefrom is a violation of this permit and each day of discharge is an additional violation until approval has been secured.

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OTHER REQUIREMENTS

1. The sludge from the treatment process shall be disposed of in accordance with all the applicable rules of the Texas Department of Health. The permittee shall ensure that the disposal of sludge does not cause any contamination of the ground or surface waters in the State. The permittee shall keep records of all sludges removed from the wastewater treatment plant site. These records will include the following information:

- a. Volume of sludge disposed
- b. Date of disposal
- c. Identity of hauler
- d. Location of disposal site
- e. Method of final disposal

The above records shall be maintained on a monthly basis and be available at the plant site for inspection by authorized representatives of the Commission for at least three years.

2. The permittee shall immediately notify the Austin Office, Water Quality Division, Applications Unit and the District 14 Office of the Texas Water Commission in writing 45 days prior to the completion of the new facilities.
3. The permittee is hereby placed on notice that this permit may be reviewed by the Texas Water Commission after the completion of any new intensive water quality survey on Segment No. 1427 of the Colorado River and any subsequent updating of the water quality model for Segment No. 1427, in order to determine if the limitations and conditions contained herein are consistent with any such revised model. The permit may be amended, pursuant to 31 TAC Sections 305.62, as a result of such review.
4. The permittee is hereby placed on notice of the requirements of the Colorado River Watershed Rules 31 TAC Sections 311.41 - 311.44.
5. When the City of Austin has constructed facilities to service the area covered by this permit, the permittee shall divert all wastewater flows to those facilities and this permit shall be cancelled unless the permittee demonstrates to the Commission that it is not timely, economical and/or technically feasible to do so.
6. The permittee is authorized to use the treated effluent from this facility to irrigate the adjacent open space area in accordance with the following provisions:
 - a. Spray fixtures for the irrigation system shall be of such design that they cannot be operated by unauthorized personnel.

- b. Irrigation shall be accomplished only when the area specified is not in use.
- c. Permanent transmission lines shall be installed from the holding pond to each tract of land to be irrigated utilizing effluent from that pond.
- d. Irrigation practices shall be designed and managed so as to prevent contamination of ground and surface waters and to prevent the occurrence of nuisance conditions in the area. Tailwater control facilities shall be provided to prevent the discharge of any wastewater from the irrigated land.
- e. Application rates for the irrigated land shall not exceed 2.5 acre-feet/acre/year. The permittee is responsible for providing equipment to determine application rates and maintaining accurate records of the volume of effluent applied as irrigation water. These records shall be made available for review by the Texas Water Commission and shall be maintained for at least three years.
- f. All irrigation practices shall receive approval from the Texas Water Commission.
- g. Holding ponds shall conform to the Texas Department of Health/Texas Water Commission "Design Criteria for Sewerage Systems" requirements for stabilization ponds with regard to construction and levee design, and a minimum of 2 feet of freeboard shall be maintained.
- h. Annual soil sampling from the root zone of the irrigated site shall be conducted and results shall be reported to the district office and the Austin office of the Commission. Sampling procedures shall employ accepted techniques of soil science for obtaining representative analytical results. Analyses shall be performed for pH, total nitrogen, potassium, phosphorus and conductivity. Prior to commencing irrigation disposal, the permittee shall obtain representative soil samples from the root zones of the irrigation disposal site. The permittee shall submit the result of the soil samples to the Austin and the District Offices of the Commission during the of September of each year.
- i. The effluent shall be chlorinated in a chlorine contact chamber to a residual of 1.0 mg/l with a minimum detention time of 20 minutes. If the effluent is to be transferred to a holding pond or tank, re-chlorination prior to the effluent being delivered into the irrigation system will be required. A trace chlorine residual shall be maintained in the effluent at the point of irrigation application.

- j. Adequate signs shall be erected stating that the irrigation water is from a non-potable water supply. Said signs shall consist of a red slash superimposed over the international symbol for drinking water accompanied by the message "Do not drink the water" in both English and Spanish.
- k. All piping transporting the effluent shall be clearly marked with signs consisting of a red slash superimposed over the international sign for drinking water accompanied by the message "Do not drink the water" both in English and Spanish.