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Groundwater Withdrawals Associated with Oil and Gas Production from Water Supply Aquifers in Texas: Implications for Water Management Practices

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Abstract: The demand for water in Texas is continuing to increase as population and industry grow. The Natural Resources Defense Council has indicated that Texas is at "extreme risk" and will require implementation of sustainable water management practices, particularly since groundwater supplies much of the state's freshwater demands. This study evaluated the occurrence and extent of produced water discharge with low total dissolved solids associated with oil and gas production from the Carrizo-Wilcox formation in Texas. We conducted analyses of produced water discharge permits from the Railroad Commission of Texas, which included limited water quality data of permitted discharges, the groundwater quality in the Carrizo-Wilcox formation from which the producing wells extract, and the potential conflicts between state permitted discharge quantities and ongoing aquifer conservation programs in the area. Our findings show that the Railroad Commission of Texas, the governing agency for Texas oil and gas development, permits produced water to be discharged into surface waters if the discharged water quality meets Texas Surface Water Quality Standards set by the Texas Commission on Environmental Quality for the specific receiving water body. Nearly 5,331,975 cubic meters (4,323 acre-feet) of groundwater each year is discharged as produced water from the Carrizo-Wilcox Aquifer to surface waters through discharge permits designated as "agricultural". Based on an evaluation of the reported Whole Effluent Toxicity test data, 69 discharges of water from the Carrizo-Wilcox formation amount to total dissolved solids levels of less than 1,000 milligrams per liter, 35 of the discharges have total dissolved solids levels of 1,000–1,500 milligrams per liter, and 20 of the discharges have total dissolved solids levels of 1,500–4,000 milligrams per liter. Forty four percent of the referenced discharges exceed the Texas Commission on Environmental Quality's secondary drinking water standard for total dissolved solids (1,000 milligrams per liter), and there is potential that water quality changes are under-reported, as permit values are stagnant but produced water quality generally degrades over time. However, the water quality of the discharges complies with general requirements for several water uses associated with agricultural and industrial practices, although it is understood water quality would need further characterization prior to use. Evidence found in this study suggests that the lack of communication regarding the identified discharges and the associated water quality could lead to conflicting groundwater practices that, at least on a local level, could have negative impacts, such as contributing to aquifer overexploitation. This overextraction in turn is expected to negatively impact existing groundwater conservation efforts and the future of water supply of Texas.

Keywords: low total dissolved solids produced water, shallow oil and gas production, water supply aquifers, Texas

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Terms used in paper

Acronym/Initialism	Descriptive Name
ac-ft	acre-feet
API	American Petroleum Institute
ASR	aquifer storage and recovery
bbl	billion barrels
bgs	below ground surface
BUQW	base of usable quality water
CFR	Code of Federal Regulations
CWA	Clean Water Act
EPA	U.S. Environmental Protection Agency
ft	feet
GCD	groundwater conservation district
m^3	cubic meters
MAL	minimum analytical limit
MDD	maximum daily discharge
mg L^{-1}	milligrams per liter
NPDES	National Pollutant Effluent Discharge System
POTW	publicly owned treatment works
ppm	parts per million
PWA	produced water analysis
RRC	Railroad Commission of Texas
SAWS	San Antonio Water System
SI	supplementary information
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
TOC	total organic carbon
TSWQS	Texas Surface Water Quality Standards
TWDB	Texas Water Development Board
WET	Whole Effluent Toxicity

INTRODUCTION

Increased study of groundwater conservation has become critical as the demand for freshwater is continuing to increase with population and development growth. As engineering technologies have improved over the last 100 years, extraction rates of groundwater, the single largest resource of freshwater in the world, have increased substantially to accommodate the needs of a growing population (USGS 2015). In addition, inconsistent use of the term freshwater since the formation of the Texas Board of Water Engineers in 1913, and later the 1957 Texas Water Development Board (TWDB), has resulted in confusion in characterization of water quality. For example, attributing freshwater as being < 3,000 parts per million (ppm) was common until the formation of the TWDB Groundwater Advisory Unit (GAU), which specified the base of usable quality water (BUQW) as < 3,000 ppm of total dissolved solids (TDS) and superior quality water ("good tasting") as < 1,000 ppm (RRC 2020). Early TWDB data tabulations of produced water generically characterized as freshwater (< 3,000 ppm) led to confusion (RRC 2021). To avoid confusion, in this paper we use the TCEQ water quality standard definition. Further, poor management leads to the overexploitation of freshwater from aquifers and detrimental impacts including but not limited to resource depletion, land subsidence, and water quality degradation (Ponce 2006).

Although water demand across the United States has declined due to conservation efforts in the last decade, based on current trends of population and development growth in Texas, total water demand is projected to increase by 12.3% between 2000 and 2050. Additionally, comparing groundwater extraction to precipitation and aquifer recharge, groundwater overdraft rates are greater than 25%, pointing to our society's current and growing unsustainable use of aquifers (Spencer and Altman 2010). In Texas, while water demand has decreased in the last decade, the water supply is still overextended from both groundwater and surface water (Schwabe et al. 2020). The significant population growth coupled with climate change and other factors contributing to drought, including increased evaporation, present significant challenges to Texas in its efforts to confront water scarcity. Challenges include an estimated water shortage of 8.9 million acre-feet (ac-ft) annually by 2070, caused by current supply allocation problems (Brun et al. 2017).

In 2014, Texas aquifers supplied 62% of the 16.9 billion cubic meters (m^3; 13.7 ac-ft) of water used in the state, making aquifers a critical source of water for Texas (TWDB 2016). In 2010, the Natural Resources Defense Council deemed that Texas and other surrounding states are at "extreme risk" and require implementation of sustainable water management tools, and if extraction rates continue to exceed supply, Texas is likely to experience increasing limitations on water availability in the near future (Spencer and Altman 2010). As though lack of adequate groundwater management is not reason enough for concern, hydrologists and water managers have long recognized that large quantities of water in Texas surface reservoirs are subject to evaporation (Wurbs and Ayala 2014) and seasonal variation due to periods of precipitation and drought, indicating that groundwater is the most reliable source of freshwater available to the state.

Texas has historically been and continues to be the United States' leading state in oil production (Kim and Ruppel 2005; EIA 2020). Additionally, oil and gas production is one of the main driving factors of the Texas economy, which is ranked second largest in the United States, with a value of $1.6 trillion (Forbes 2016). The oil and gas sector produces mainly from source formations, primarily producing non-potable water as a byproduct of oil and gas production (Veil et al. 2004). Produced water from these formations is considered to be a large source of waste that contains relatively elevated levels of hydrocarbons, heavy metals, and other pollutants (Al-Ghouti et al. 2019). Not as common are instances where the produced water may be of low TDS when oil and gas production occurs in shallow geologic strata that host water of low salinities, such as water supply aquifers as discussed in this study. To our knowledge there are two other locations in the United States where water of low TDS is extracted as a product of conventional oil and gas explorations: the Pavilion site in Wyoming (Degenhardt 2012) and California, where conventional extraction of oil and gas has been producing water of lower salinity (Kondash et al. 2020). Although most produced waters are salty (brine), some produced waters can be low TDS as demonstrated in this study (RRC 2016a). In Texas, when produced waters meet the standards set by the Texas Commission on Environmental Quality (TCEQ; RRC 2016b), the operator can discharge the produced water directly into surface waters. Most of the produced water, however, is not of a usable water quality (TDS < 1,000 milligrams per liter [mg L^{-1}]) but is instead salty/brine (TDS > 35,000 mg L^{-1}) and is disposed of via injection wells regulated by the Railroad Commission of Texas (RRC 2016b).

Produced water is generally brine and is disposed of via injection wells (EPA 2012a). However, to our knowledge, no research has addressed the discharge of produced water originating from formations also known to be hosting potable water resources in Texas. An unusual occurrence, the disposal of low-TDS produced water was investigated in this study. More specifically, the aim of this study was to determine the existence and extent of low-TDS produced water discharge associated with oil and gas production practices in an area in Texas that overlaps the Eagle Ford Shale Play. In addition, the quality of permitted produced water discharges was evaluated in the context of potential reuse for different needs in the near area. This information was attained through analyses of produced water discharge permits from RRC, which included the gener-

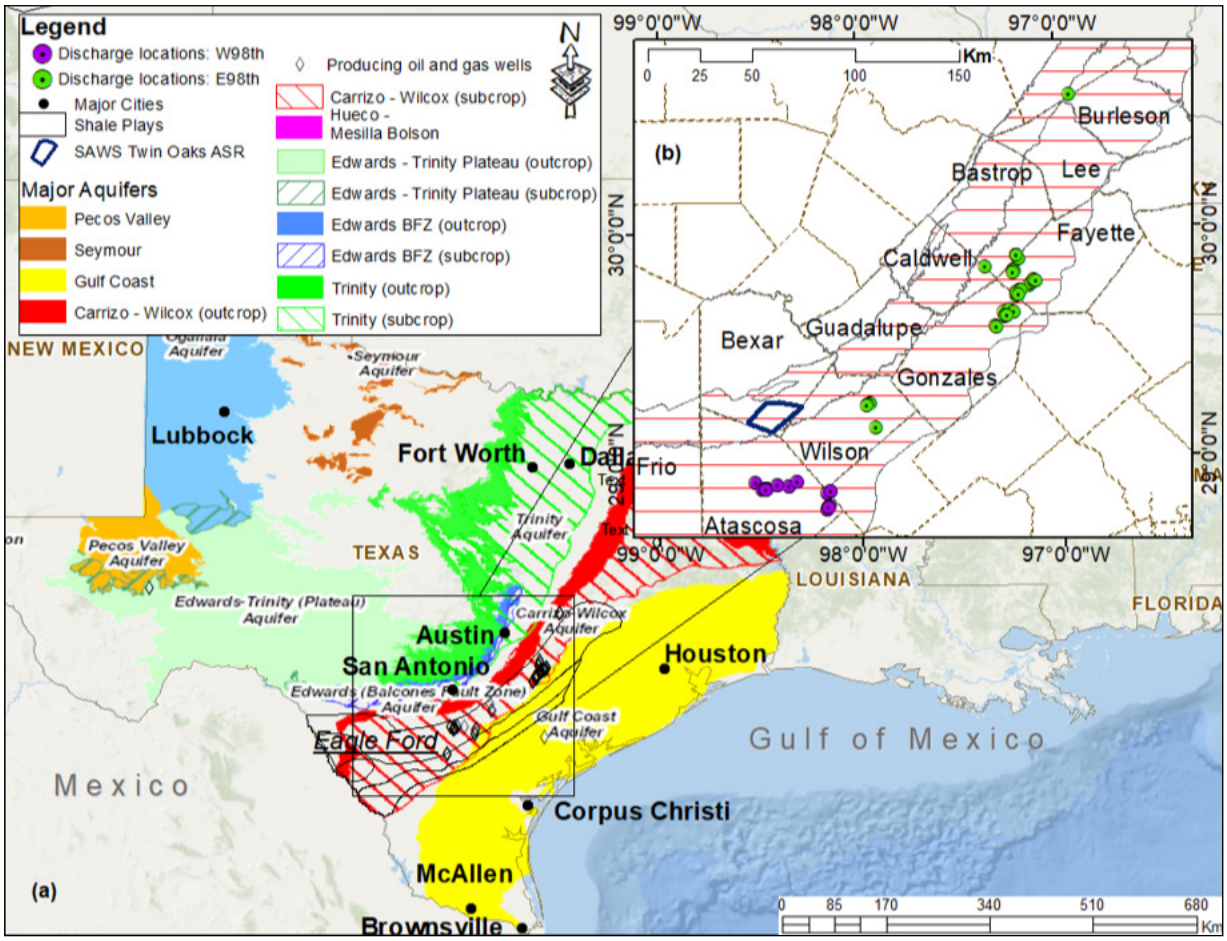

Figure 1. Location map of the study area including location of oil and gas wells (a) associated with surface discharge permits for low total dissolved solids produced water (b). In (b), the location of Carrizo-Wilcox Aquifer outcrop and subcrop are identified by the red line filed region. In (a), the San Antonio Water System aquifer storage and recovery area includes the injection and recovery wellfield.

al information about the water quality of permitted discharges, the groundwater quality in the Carrizo-Wilcox formation from which the producing wells extract, and potential conflicts between state permitted discharge quantities and ongoing aquifer conservation programs in the area. These discharge data were gathered by individual oil and gas companies and submitted to RRC as criteria to maintain operating permits.

MATERIALS AND METHODS

Study area

One of the most extensive water-producing formations in Texas, the Carrizo-Wilcox Aquifer stretches, within the Gulf of Mexico Coastal Plain, from the Rio Grande to the Texas/Louisiana/Arkansas border (Figure 1). Because the Carrizo and Wilcox sands are not easily distinguishable and they are often hydrologically interconnected, the term "Carrizo-Wilcox Aquifer" is frequently used. The massive formation that makes up the Paleocene-age Carrizo Sand is overlaid by the Wilcox Group, a Tertiary-age formation interbedded with sands, clays, silts, and some discontinuous lignite beds. This hydrologically connected area makes up the Carrizo-Wilcox Aquifer that is overlaid by confining shales and clays of the Reklaw and Bigford Formations in East and Central Texas and South Texas, respectively. The thickness of the Carrizo-Wilcox Aquifer varies widely across the state. The saturated thicknesses of the outcrops vary from less than 100 feet (ft) in South Texas to 700 ft in South Central Texas. In down-dip sections, the Carrizo-Wilcox Aquifer reaches only a maximum of 500 ft in South Texas and up to 2,000 ft in South Central Texas. In Central and East Texas, the Carrizo-Wilcox Aquifer thins somewhat, with outcrop saturated thickness of less than 500 ft and down-dip thickness of 1,000 to 1,500 ft and no more than 1,000 ft, respectively (Figure 2). Four general cross sections for the Carrizo-Wilcox Aquifer are shown in Supplementary Information (SI) I.

In South Texas, the Carrizo Sand is the preferred source of groundwater with only minor amounts of water being with-

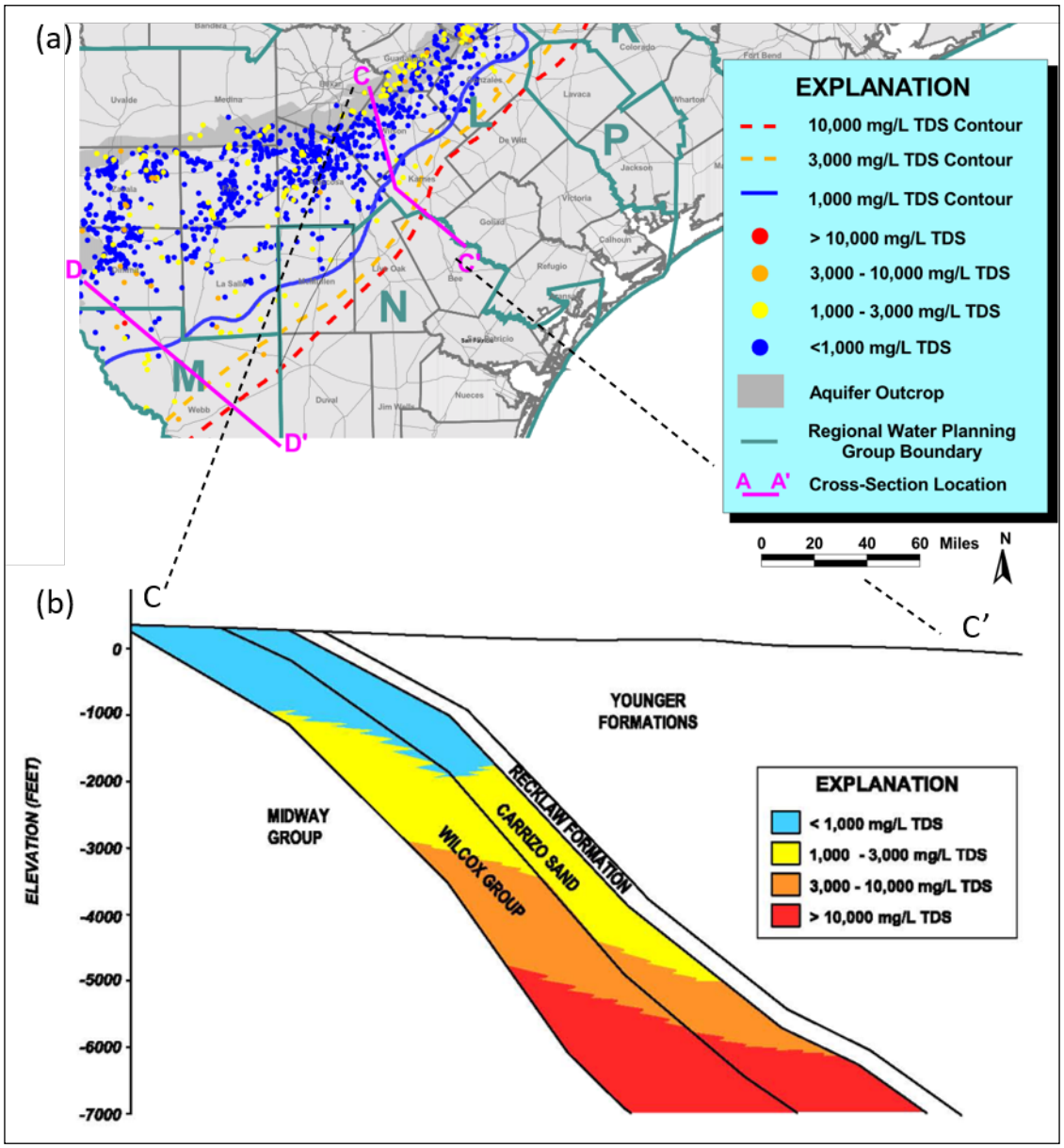

Figure 2. (a) Visual representation of groundwater quality in the Carrizo-Wilcox Aquifer, accompanied by cross section views including formation total dissolved solids (TDS) and depth and (b) simplified cross section C-C′ of the Carrizo-Wilcox Aquifer with generalized water quality ranges (LBG-Guyton Associates 2003).

drawn from the sand and clays of the underlying Wilcox formation. A significant amount of freshwater is withdrawn from the Carrizo-Wilcox Aquifer for irrigation, industrial, and public water supply uses. Low-TDS water is found in the outcrop areas and up to 40 miles down-dip from the outcrop areas throughout much of the extent of Carrizo-Wilcox Aquifer in the state. Only in South Texas is low-TDS water not found in the outcrop areas of Carrizo-Wilcox Aquifer. In general, salinities increase farther down-dip, with low-TDS water generally being found in outcrop areas and at shallow depths, while slightly saline water is found at depths ranging from about 3,000 to 4,000 ft and moderately saline water at depths ranging from about 3,000 to 6,000 ft.

Data types, sources, and analyses

TThe data presented in the results and discussion section of this study was provided by RRC through an open records request between 2017 and 2019. This information was processed, and locations were inputted into ArcMap, along with daily discharge levels, for visual data representation. Upon receipt of the requested information, a thorough analysis of

data was conducted, and permits were separated based on "active" and "inactive" status (see SI III, IV). Discharge quantity levels were only provided by RRC with the active permits; however, some of the values for active permits were not provided despite the status (see SI IV). It is understood that with age of the producing well, the volume of produced water is expected to increase. The permits are named and listed numerically, although there is some confusion based on the indicated information that some permits with higher numbers have earlier initiation dates and others do not. It is possible that the discharge permit records through RRC may not have been maintained, as many of the original permit dates given are not categorized as "new" but rather as "transfer(ed)" or "renew(ed)" (see SI III). Additionally, several discharge permits that were categorized as "discharging" were not listed on the active permit list (see SI IV).

In addition, a search for the oil and gas wells by American Petroleum Institute (API) commission number (API, drilling permit number, oil lease number, and/or gas identification number) associated with the permitted discharges was conducted to determine producing depths and the associated water-bearing formation and water quality. The data were also obtained from RRC via open record requests and the RRC geographic information systems viewer. Depth of production for each well was compared with TWDB groundwater chemistry data for water wells in the immediate area to the identified APIs. The TWDB groundwater chemistry data were compared to that from the reported National Pollutant Effluent Discharge System (NPDES) permit Whole Effluent Toxicity (WET) tests filed with U.S. Environmental Protection Agency (EPA) for those sites where produced water was being discharged under a NPDES permit. An evaluation of existing water resource management programs and potential for produced water reuses in Texas was conducted, and the information was compared to the data findings.

RESULTS AND DISCUSSION

For reporting and discussion, EPA guidelines for water quality were used in this paper (EPA 2020). The 1,000 mg L^{-1} limit is the secondary drinking water standard set by TCEQ (Young and Ronayne 2011). Slightly saline water, with TDS values between 1,000 and 3,000 mg L^{-1}, is generally used for livestock and agriculture, while water with levels above 3,000 mg L^{-1} must be treated to reduce salinity prior to use. Water with TDS exceeding 3,000 mg L^{-1} and less than 10,000 mg L^{-1} is considered moderately saline. Water with more than 10,000 mg L^{-1} to less than or equal to 35,000 mg L^{-1} is very saline. When TDS levels are greater than seawater (approximately 35,000 mg L^{-1}), the water is considered brine (WHO 1996; Young and Ronayne 2011; Godsey 2017).

Permitted discharge process and requirements

An evaluation of surface water discharge permits for the South Texas area presented in this study shows when low-salinity or low-TDS water is produced as a byproduct of oil and gas development, the operator of the producing well can file for a produced water discharge permit. This permit, acquired from RRC, classifies all the low TDS discharges as "agricultural," and the information of discharge quantity and quality is not shared with local groundwater conservation districts (GDCs).

Texas is separated into four NPDES discharge zones: two offshore zones within 9 nautical miles of the shore and two inshore zones, east of the 98th meridian and west of the 98th meridian (Figure 1). The 98th meridian is an arbitrary line established by EPA and followed by RRC to structure monitoring of inland discharge permits (Humberson 2016). All Texas inland discharge locations, regardless of zone, are subject to the RRC application. Discharge permits allow for produced water to be separated and discharged into a creek or other waterway as long as the quality of the discharged water meets the Texas Surface Water Quality Standards (TSWQS) set by TCEQ for the specific receiving body. Along with a produced water analysis (PWA), the permit application must meet several other criteria, including permission from the surface owner of the producing property (see SI II.2).

Based on surface water quality standards set by TCEQ, RRC compares each PWA to the standards of the affected receiving water body, listed as "segments" in the TSWQS. The TSWQS for and location of all segments actively receiving produced water from locations with permits issued by the RRC is provided in SI IV. Maximum allowable TDS levels and the daily discharge in barrels at that maximum TDS level for each segment are depicted in Figure 3. RRC's Statewide Rule 8(d)(6) states that an oil and gas operator may submit a permit application to RRC for authority to operate settling pits. Settling pits function as the last stage of water and oil/grease separation after the standard facility separation process. Along with the permit application, the operator may submit a written letter for request of landfarming or produced water discharge. The operator must notify the surface owner of the land where the pit will be located and submit a written letter of approval by the surface owner to RRC along with the written pit permit application. If the land where the pit will be located is within municipal corporate limits, the operator must also notify the city clerk or other appropriate city official. If water disposal is by discharge into a watercourse, Rule 8(d)(6)(C) requires that an applicant for a discharge permit must give proper notice to the surface owner of each waterfront tract between the discharge point and 0.5 miles downstream of the discharge point. Notification is only necessary during the initial permitting process and not during permit renewal, which occurs every 5 years, per Rule 8(d)(6).

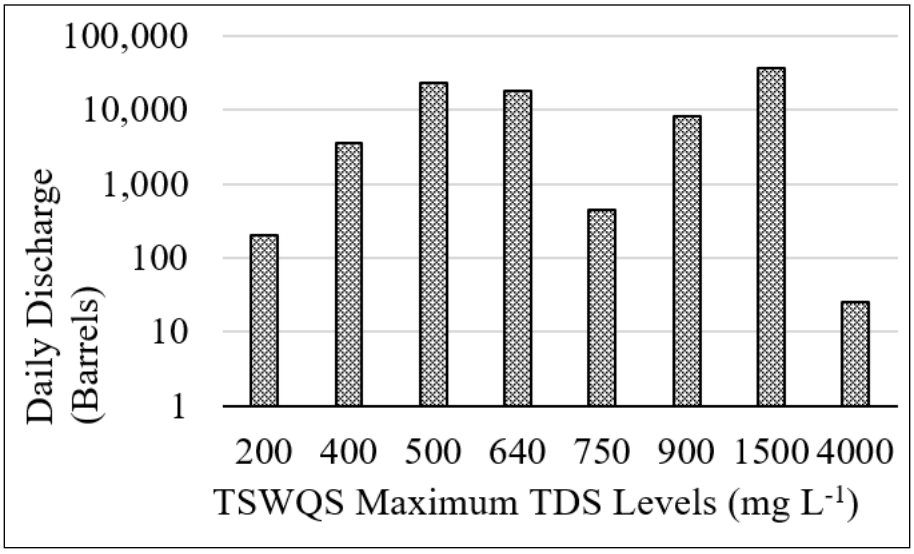

Figure 3. Permitted volumes of water discharged into various segments, as shown in Supplementary Information III by maximum allowable total dissolved solids levels.

Landowners affected by the drilling can oppose the permit and request a hearing. The RRC director of environmental services may also request a hearing if they feel it is in the public's interest. A permit may be modified, suspended, and/or terminated at any point after RRC issues it if a request for hearing is attained for good cause, which constitutes the following six options: (1) Water pollution is occurring or is likely to occur; (2) Waste is occurring or is likely to occur; (3) Permit or rule violation; (4) Factual misrepresentation in application; (5) Failure to give notice; and/or (6) Material change of conditions (RRC 2016a).

When a permit application is approved by RRC, the operator must then apply for a NPDES permit. In the past, the application requirements and permits were slightly different based on the inshore discharge zone in which the applicant was located (separated by the 98th meridian, Figure 1). EPA has drafted a permit, the TXG350000, intended to apply to all inshore produced-water discharge locations regardless of their location. In conclusion, when applying for a produced water discharge permit, an applicant must meet all TSWQS as well as pass the NPDES WET test. According to EPA, the WET test is a vital component to implementing federal water quality standards under the Clean Water Act (CWA) 402. The test is intended to replicate the total effect of environmental exposure of aquatic life to the toxic pollutants in an effluent without requiring a lab analysis and identification of the specific pollutants. If the exposed aquatic life survives the effluent, the test is passed. An applicant or permit holder must submit a WET test to EPA on an annual basis so long as the discharge point is active (EPA 2017).

Through RRC permits, the well operators are only required to notify landowners and EPA of water discharge, and any potential issue with the discharge permits focuses predominantly on water quality and potential toxicity. There is no attention placed on the amount of low-TDS water being removed and discharged under NPDES, and as a result, there is no legal requirement that the relevant GCDs be notified of the discharge locations or quantities. To our knowledge, at the time this study was conducted, there was no communication with GCDs regarding these discharges.

The data obtained from RRC are incomplete in certain permit representations. The daily discharge levels are based on the submitted maximum daily discharge (MDD) segment of each permit, at the discretion of each individual well operator. The water discharged after the separation process must meet TSWQ standards for the respective segment. According to RRC, the MDD levels are supplied every 5 years at the time of permit renewals and are not monitored further, although a well operator is supposed to notify RRC if discharge levels increase (SI II.1). The listed MDD levels are for current permits only. Therefore, any well re-completion that may have occurred in the past such that a permitted well might produce more oil, and therefore more water, has not been considered in the current analysis. This lapse in data recording suggests that the actual amount of low-TDS produced water maybe unknown. It is also important to note that according to an article published by the U.S. Geological Survey, as a well ages, the amount of water produced increases exponentially (Veil et al. 2004). Thus, older conventional oil and gas wells could be abandoned, no longer bringing low-TDS water to the surface. It is also expected that the water quality will degrade with time. Lastly, to highlight the lack of available discharge data, the actual age of many of the discharge permits is unknown, as many of the first records classify a permit as "transfer" or "renew" (see SI IV).

Table 1. Water volumes. The numbers indicated in bold font are numbers taken from researched data. All other numbers are converted through standard conversion rates.

Water practice	Cubic meters	Acre-feet	Gallons	Barrels
Removed through oil and gas shallow formation exploration discharge permits/year	5,331,975	4,323	1,408,547,775	**32,756,925**
Injected into SAWS ASR/year (2004–2011)	17,715,865	14,362	**4,680,000,000**	108,837,209
Injected into SAWS ASR/year (2015–2020)	29,603,520	24,00	**7,820,420,000**	181,870,233
NPDES discharges in Atascosa County	2,152,515	1,745	568,629,850	**13,223,950**
NPDES discharges Atascosa, Wilson, and Karnes counties/year	2,725,845	2,210	720,086,600	**16,746,200**
2014: amount of water used in Texas	**16,900,000,000**	13,700,946	4,464,473,000,000	103,824,953,488

* There may be an option to use low total dissolved solids produced water based on physical location in counties such as Atascosa. Acronyms: San Antonio Water System (SAWS) Aquifer Storage and Recovery (ASR); National Pollutant Discharge Elimination System (NPDES).

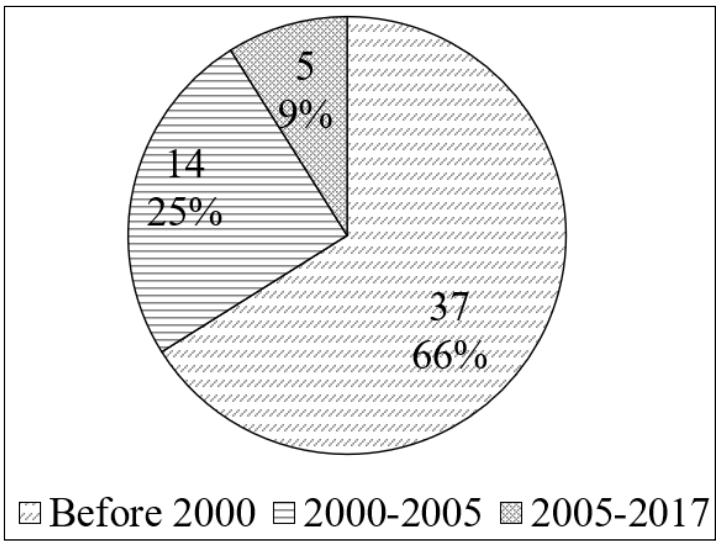

Figure 4. Ages of active discharge permits found in SI IV and the number of active discharge points that have been running since the dates provided by the Railroad Commission of Texas.

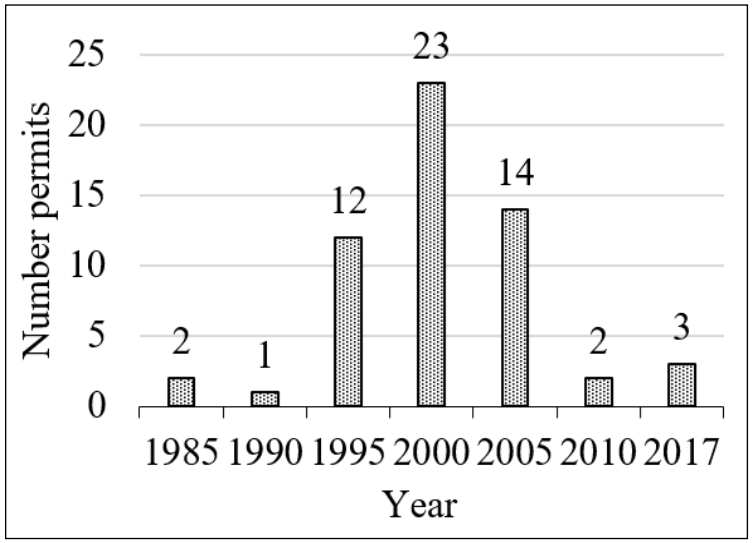

Figure 5. Number of new permits issued between each 5-year sequence.

Occurrence and disposal of low-TDS produced water discharges

According to the data identified in this study from RRC, there are 57 active permits for low-TDS water discharge in the state of Texas (SI IV.2). One of these permits is in northwest Texas, thus not associated with the area of interest. When compared to the data provided on discharge quantity and location, four permits are listed as currently discharging but are not included in the active permit list. Simultaneously, there are seven active permits for which no discharge data were provided (see SI IV). As a result, the following discussion is derived from an assessment of both active and non-active permits. Of the 56 permits, two-thirds (37) of the locations have been discharging low-TDS water since before the year 2000 (Figure 4); some of those locations appear to have been active since 1984. The largest number of new permits (e.g., 49) were in 1995 and 2005 (Figure 5). The number of new permits decreased drastically by 2017. Fifty-three of the discharge locations provided are in proximity to the Carrizo-Wilcox formation (Figure 1). Excluding several of the active permits for which discharge data were not reported, the permitted produced water discharge volume was a significant 5,331,975 m^3 (4,323 ac-ft) per year (Table 1) with TDS ranging from 36 to 3,892 mg L^{-1} (average 960 mg L^{-1}).

Another limitation on the data available from RRC is related to the depth from which the water is removed through the oil and gas extraction process. To fill this gap, API drilling permits were compiled. Available information indicates that roughly 157 oil and gas wells are associated with the 56 permits discharging in proximity to the Carrizo-Wilcox Aquifer (SI IV.1). The well records indicate oil and gas producing depths ranging from 570 to 6,025 ft below ground surface (bgs). Out of the total number of wells, 138 produce from depths ranging from 570 to 2,570 ft bgs (Figure 6a), corresponding to the Carrizo-Wilcox Aquifer. Another 15 wells produce from depths between 2,570 and 4,570 ft bgs and are also associated with this formation, though these depths correspond more with the lower Wilcox formation (SI I.2). Two wells with production depth between 5,570 and 6,570 ft bgs were not clearly correlated with the Wilcox formation.

Data collected from water wells located near these producing wells indicate that 73 of the producing wells extract from aquifer depths ranging from 1,355 to 3,800 ft, where groundwater TDS is less than or close to 500 mg L^{-1}. Another 74 wells produce from aquifer depths ranging between 1,350 to 2,800 ft, where nearby groundwater TDS levels are between 1,000 and 1,500 mg L^{-1}. At most, eight wells produce from aquifer depths between 3,500 and 4,500 ft, where groundwater TDS is around 1,650 mg L^{-1}. Furthermore, two of the wells that produce from aquifer depths between 5,700 and 6,025 ft could not be correlated with any groundwater quality data. These wells, however, were associated with the higher TDS NPDS discharge (average 2,050 mg L^{-1} TDS) for permit 00768 (see SI I.1). Unfortunately, no information was found related to the volumes of produced water by wells associated with each permit.

The groundwater quality assessment shows good agreement with the reported water quality data per permitted discharge as presented in Figure 6b. Based on this evaluation, most NPDES discharges (~83%) do not exceed 1,500 mg L^{-1} TDS. Receiving basins (segments) that have adopted environmental inflow standards (Figures 7 and 8) are Atascosa River (segment 2107), Colorado Cummins Creek (segment 1402), Martinez Creek (segment 1902), Somerville Lake (segment 1212), Frio River (above Choke Canyon Reservoir; segment 2117), Cienegas Creek to Rio Grande (segment 1748), and Guadalupe River below San Marcos River (segment 1803; Figure 8). The average reported TDS concentrations per TSWQS 307 segment criteria (e.g., water quality standards for each water body or segment) was found to exceed the established limit for segments 2304, 1902, and 2117 (Figures 7b, 8). Other parameters such as total organic carbon (TOC) and oil and grease (Figure 6c) were evaluated; however, there is no set maximum limit for the water body by the TSWQS 307 segment criteria for comparison.

The only existing regulation governing oil and grease discharge is related to EPA pretreatment discharge, regulation 40 Code of Federal Regulations (CFR) 403.5(b)(6). These criteria prohibit the discharge of "petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through" when water is distributed to a publicly owned treatment works (POTW; EPA 2004). Most POTWs have adopted 100 mg L^{-1} as their local limit for petroleum-based oil and grease. Nevertheless, recommendations are for concentrations less than or equal to 75 mg L^{-1} and preferably less than 50 mg L^{-1} of oil and grease from mineral or petroleum origin to prevent water quality degradation (Costle et al. 1979). The identified permitted discharges were on average oil and grease concentrations below 20 mg L^{-1} (Figure 6c).

Alternative beneficial use of TDS produced water

With the demand for freshwater increasing rapidly, the need to preserve and reuse water is becoming more urgent. Texas is experiencing declining groundwater levels and intermittent water flows, and the capture and storage of water when it is available is critical to sustainable water management for the state (Nicot et al. 2011). Yet based on this evaluation, thousands of acre-feet of produced low-TDS water have been discharged to surface water bodies in Texas annually. As also indicated in this study, the amount of low-TDS produced water

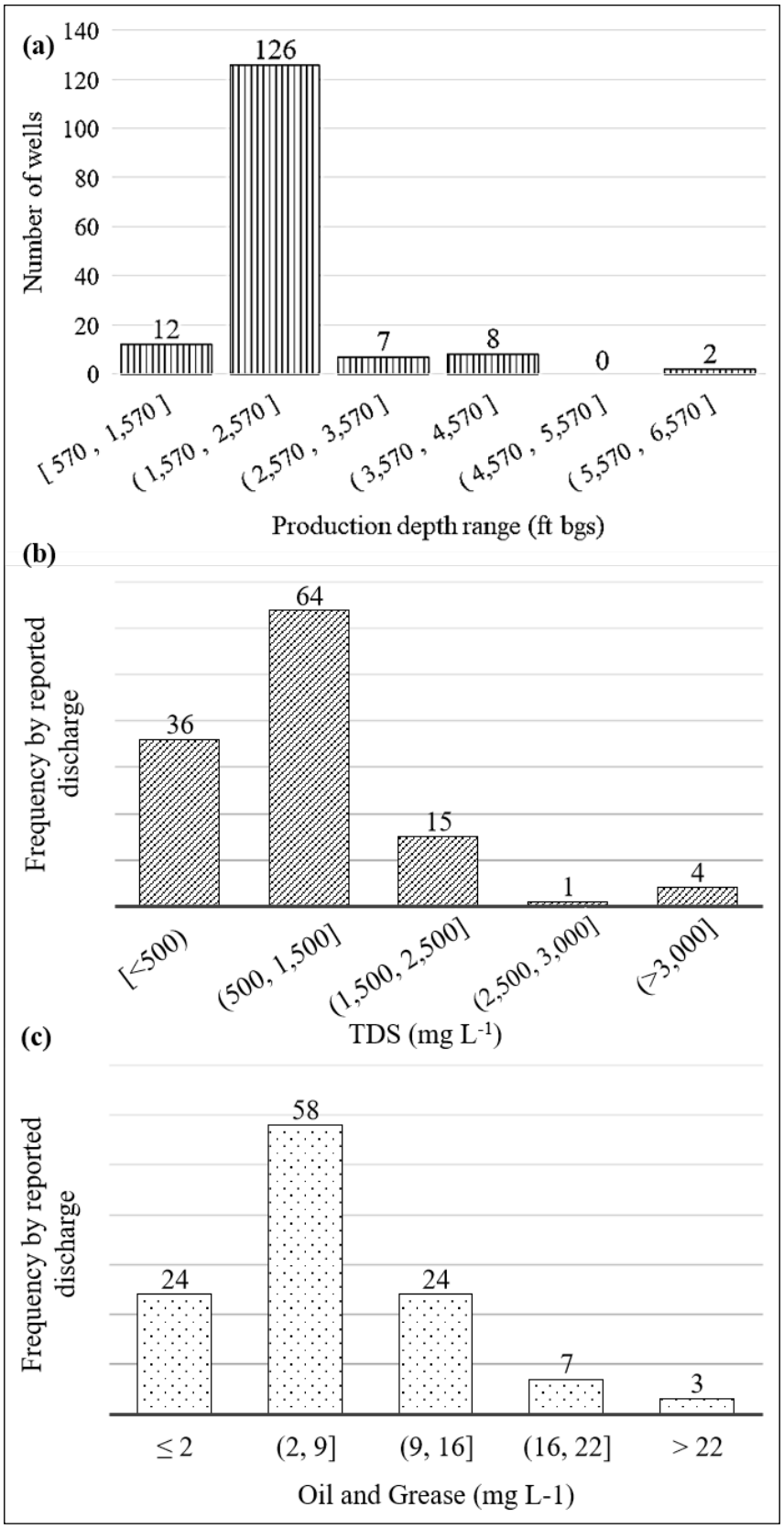

Figure 6. Frequency of occurrence of (a) wells per producing depth range, (b) total dissolved solids (TDS) level distribution based on reported water quality data per year, and (c) oil and grease level distribution based on reported water quality data per year.

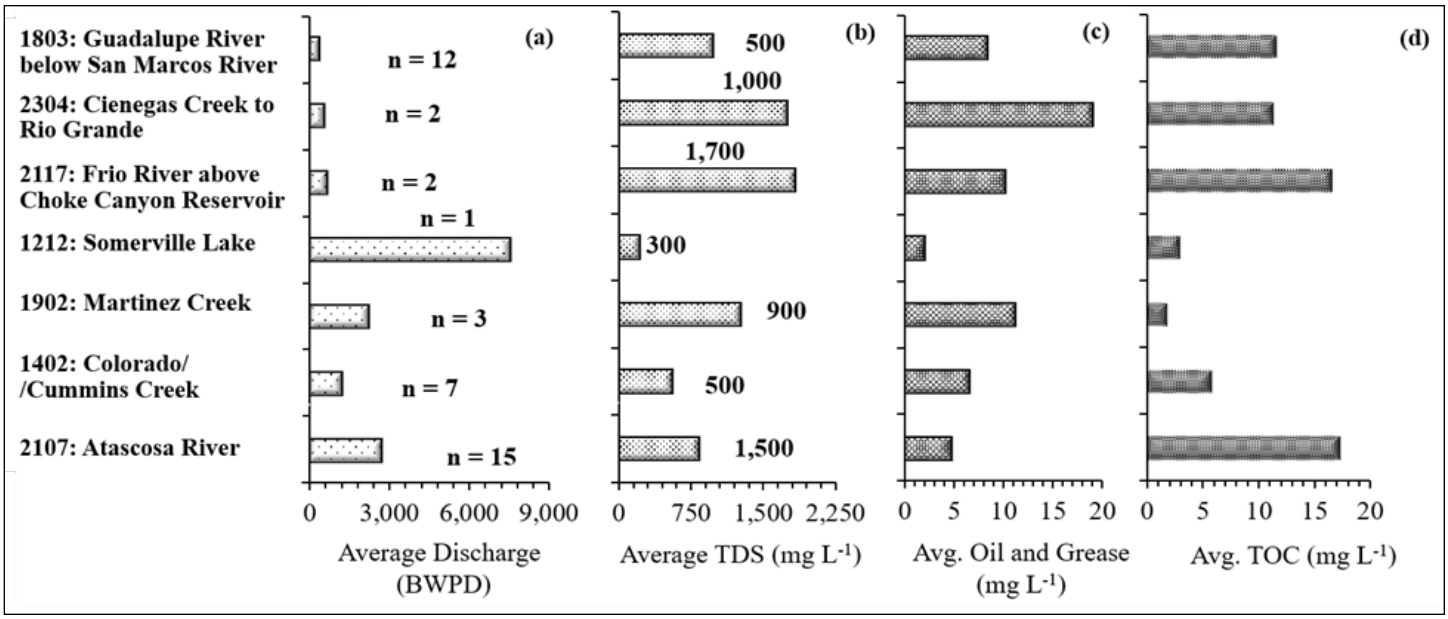

Figure 7. Average reported discharge volumes (a) and laboratory analyses levels of total dissolved solids (TDS) (b), oil and grease (c), and total organic carbon (TOC) (d) by segment. These data are based on the number of permitted discharges (i.e., n in (a)) reporting water quality data and discharge volumes from the Railroad Commission of Texas. The Texas Surface Water Quality Standard 307 segment criteria for TDS (in milligrams per liter [mg L^{-1}]) is included next to the average measured TDS for each segment as shown on Figure 8.

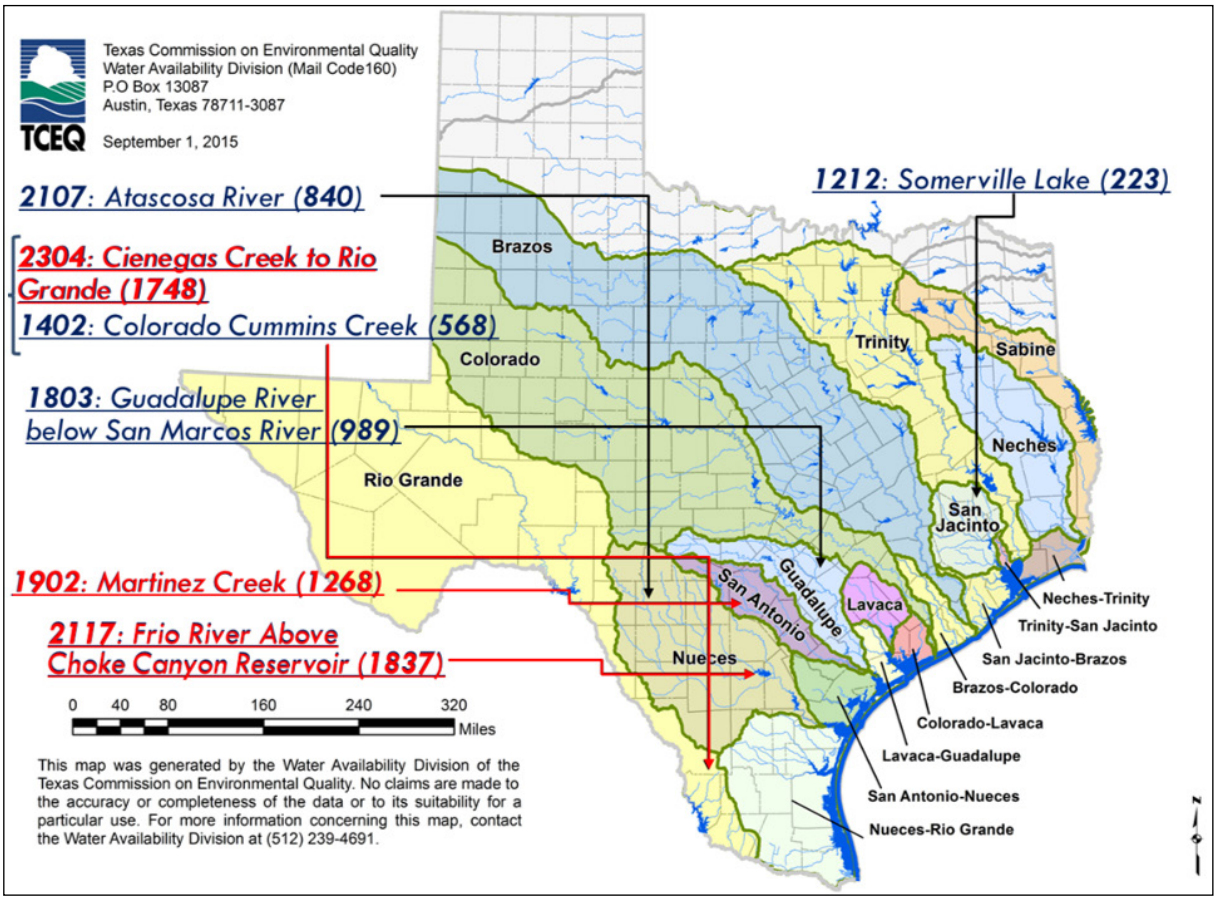

Figure 8. Map showing the produced water receiving basins which have adopted environmental inflow standards. The average reported total dissolved solids concentrations per Texas Surface Water Quality Standard 307 segments is also included with 2304, 1902, and 2117 exceeding the established segment criteria.

through oil and gas production has been inaccurately recorded and documented.

Reported NPDES discharges of produced water from oil and gas operations associated with shallow water-producing formations are filed as agricultural use by landowners surrounding the discharge point. The produced water, once extracted, is discharged to a surface waterway (Figures 7, 8). Once in the watershed, water supplies are exposed to climatic influences and evapotranspiration. It appears, based on the findings of this study (see SI IV), that most of the water discharged from RRC-permitted locations is flowing away from the Carrizo-Wilcox recharge zone.

As presented by Veil (2015), there are a variety of water management technologies and strategies that could optimize beneficial use of the low-TDS produced water. Practices that involve reuse or recycling of produced water for different purposes include reinjection for later use (e.g., aquifer storage and recovery or ASR) and hydrologic maintenance purposes (e.g., preventing land subsidence). Depending on specific water quality, reuse can also benefit agricultural and industrial use as well as treatment for drinking purposes (Veil 2015). In the absence of reuse/recycle options, methods for disposal of produced water include direct discharge (common for offshore production), underground injection (including enhanced recovery and common for onshore production), evaporation, and offsite commercial disposal. Discharge to receiving streams may also benefit stream ecology and in that sense may not be considered disposal. The more common management of produced water is disposal via Class II injection wells into formations that are not connected with underground drinking water sources (EPA 2012a).

In the short term, it is more economical and less labor-intensive for oil and gas operators to discharge low-salinity water into TCEQ segments than to dispose of the produced water via injection wells. As a result, when produced water, such as that in this study, has been determined to be of low TDS overall, water disposal practices such as disposal via deep injection are not discussed.

Aquifer storage and recovery of low-TDS produced water

There are currently three active ASR programs in Texas, among which is the San Antonio Water System (SAWS) program. The SAWS ASR program, located south of San Antonio in Bexar, Atascosa, and Wilson counties (Figure 1), is the third largest in the country. Today it costs SAWS approximately $9.5 million per year to administer and maintain the program, which is funded by SAWS customers through the water supply fee (Eckhardt 2016).

Based on the SAWS 2019 statistics report, the SAWS program annually recharged or injected on average 17,715,865 m³ (14,362 ac-ft) between 2004 and 2011 and 29,603,520 m³ (24,000 ac-ft) between 2015 and 2020 of groundwater into the Carrizo-Wilcox Aquifer. In comparison, based on data collected during this study, at least an annual volume of 2,725,845 m³ (2,210 ac-ft) of low-TDS water may be available for ASR, although costs have not been taken into consideration. In a white paper by the Argonne National Laboratory for the U.S. Department of Energy, Veil et al. (2004) indicated that the cost of managing produced water before disposal can range anywhere from less than $0.01 to at least $7 per barrel. Several examples of costs provided in the study include produced water from different type of oil or gas operations. Produced water from an operation in the Kern River Oil Field, California, has been mixed with treated groundwater and, after filtration, sent to the local water district for use in irrigation and aquifer storage and recharge (Martel-Valles et al. 2016).

Low-TDS produced water could be used to enhance oil and gas recovery in the area, benefiting the operator in the long term. The TDS guidelines for oil and gas injection are lenient. Fluids consisting of brine, freshwater, steam, polymers, or carbon dioxide are injected into oil-bearing formations to recover residual oil and, in limited applications, natural gas (EPA 2012a). Since there is an abundance of oil activity in the area, produced water could also be used in drilling fluids. This practice is allowable in the area under the GCD's rules that allow groundwater export outside of the districts; thus, the produced water from conventional exploration in the Carrizo-Wilcox Aquifer currently discharged to surface water bodies could be exported for use for hydraulic fracturing, even to other areas of the state (Cook et al. 2015). Given that water used as a drilling fluid is normally purchased, reusing the low TDS produced water available nearby may be a proactive way for local oil and gas companies to either save or increase revenue.

Low-TDS produced water may also be used for industrial cooling, agriculture, and/or solution mining of uranium. There are five uranium deposits in South Texas (Sass 2011), with several nearby low-TDS produced water discharge locations. Although little water overall is used by the uranium extraction industry, the mine site reclamation and restoration require more water. Nicot et al. (2011) used an average value of 250 gallons per pound of uranium as an overall representation of water consumption, which is the equivalent of 3,785 m³ or 840 ac-ft of water consumed for all producing uranium mines in Texas. The known annual removal of low-TDS groundwater discussed in this study is five times larger than the total freshwater removed in Texas for uranium mining purposes (i.e., 5,331,975 m³ or 4,323 ac-ft). Thus, given the proximity, use of produced water from water supply formations could help reduce the strain on groundwater sources, both short- and long-term.

Recommendations

A relatively large volume of water (5,331,975 m³ or 4,323 ac-ft), which meets TSWQS, has been removed by the oil and gas sector and filed under agricultural use each year between 1983 and 2017. This practice has been implemented without the knowledge of GCDs in the affected areas, as the wells are oil producing and not primarily water wells." This groundwater removal may not seem significant but may exacerbate groundwater depletion when compounded by other uses. In addition to revealing the existence of low-TDS water extraction associated with oil and gas production and the surface discharge, this study has emphasized the lack of and the need for communication between separate state entities. Efforts should be directed toward a sustainable water management plan for the state of Texas that contains involvement from all state regulatory agencies, including RRC, TCEQ, and GCDs. Better communication and regulation could help prevent unsustainable water practices and increase water security, which could have significant impacts on a local level and which includes beneficial use of low-TDS produced water.

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Conflict of interest

None.

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Supplementary Information

SUPPLEMENTARY INFORMATION (SI) I

SI I.1 Water quality by surface water permit discharge number and the associated oil and gas production wells

County	Segment	Permit number	Year	TDS mg L^{-1}	Chloride mg L^{-1}	Sulfates mg L^{-1}	Selenium mg L^{-1}	pH	Oil and grease mg L^{-1}	Barrels per day	Temperature (°F)	API	Well name	Depth (ft)	Latitude	Longitude
Atascosa	2107	01048	2005	1010	77	<1	<0.003	7.6	19.2	530		013-30391	5	1880	28.903846	-98.425163
			2013	1190	181	80	<0.01	7.6	6.7	-	57.4	013-34644	9	1876	28.904001	-98.430203
		01011	1993	567	80	6	0.004	7.9	2	-		013-31525	6	1575	28.911745	-98.531122
			2004	37.5	77	45	<0.05	7.8	<28.5	1500		013-31367	7	1556	28.916214	-98.525404
												013-32104	9	1575	28.914461	-98.528617
												013-32103	10	1575	28.915603	-98.527040
												013-31076	5	1575	28.916160	-98.526325
		00900	1998	1670	232	8	0.005	7.8	5	3500		013-00729	6	3779	28.803409	-98.166279
			2003	180	89	1	<0.0003	7.7	2.1	5870		013-34241	12	3739	28.804927	-98.163891
			2008	78	19.6	<1	<0.01	6.97	7.3	15700						
		00869	1998	1670	232	8	0.005	7.8	5	1500		013-00748	5	3787	28.795996	-98.172033
			2003	180	89	1	<0.003	7.7	2.1	1500						
			2008	46	11.5	<1	<0.01	7.45	9.1	1500						
		00832	1997	399	36.2	4	<0.002	7	12.2	365		013-03077	1	2161	28.917646	-98.318602
			2003	420	35	20	<0.003	7	<2	500						
		00828	1993	500	16	-	<0.01	8.1	2	-		013-35013	15	1772	28.885391	-98.470848
			2003	390	56	11	<0.003	6.4	2	1347		013-35012	14	1765	28.887384	-98.467885
			2009	390	14.2	7.09	<0.01	7.07	-	1347		013-34148	5R	1790	28.886025	-98.472033
												013-34799	12	1760	28.886291	-98.470880
												013-01185	9	1831	28.879099	-98.480694
Karnes		00759	1998	1504	200	3	<0.002	8.7	2	900		255-31192	1	3450	28.863706	-98.169386
			2004	3892	825	4	0.008	8.5	2	900						
			2009	3230	810	<1	<0.01	8.5	<5	700						
Jefferson	2107	00065	2003	794	7	0	<0.005	7	7	5000						
			2009	802	46	0		7.65	5.4	4000		149-33197	23	2278	29.756021	97.149523
												149-32085	16	2269	29.755369	-97.147785
												149-32087	17	2209	29.753227	-97.150296

County	Segment	Permit number	Year	TDS mg L^{-1}	Chloride mg L^{-1}	Sulfates mg L^{-1}	Selenium mg L^{-1}	pH	Oil and grease mg L^{-1}	Barrels per day	Temperature (°F)	API	Well name	Depth (ft)	Latitude	Longitude
												149-32165	18	2191	29.754102	-97.151369
												149-32194	19	2282	29.754102	-97.151369
												149-00150	9	3508	28.754736	-97.150897
												149-00153	5	2271	29.755127	-97.148493
												149-00367	12	2300	29.755257	-97.149609
												149-00391	11	2270	29.756468	-97.147292
												149-00415	13	2303	29.753003	-97.152914
												149-30039	14	2236	29.753394	-97.152613
												149-32221	12	2352	29.758055	-97.159126
												149-32222	13	2266	29.751908	-97.154684
												149-32225	11	2192	29.747772	-97.155306
												149-00416	2A	2225	29.751405	-97.154405
	1402	00889	1997	618	16	6	<0.002	7	10	200		149-32171	4	2377	29.777557	-97.116468
			2003	561	8	0	<0.005	7.1	1.2	300		149-32168	5	2365	29.778935	-97.113292
			2011	606	23		0.02	7.63	7.6	314						
			2016	189	20		0.002	7.8	1.4	715						
		00808	1997	821	38	2	<0.002	8.51	7	1000		149-32283	1A	2352	29.773590	-97.121918
			2003	776	7	0	<0.005	7.1	6.2	1000		149-32698	3B	2402	29.776812	-97.118463
			2009	632	21	4	<0.02	7.6	3.6			149-32284	2 B	2383	29.776923	-97.117176
		00777	2009	1083	292	263	<0.002	7.1	6.8	650		149-32422	4A	1347	29.817349	-97.222383
			2014	586	162	104		7.5	8							
		00778	2000	760	15	3	<0.005	8.3	<5	1750		149-32795	7	2380	29.773012	-97.122519
			2012	564	157	9		8.5	9.2			149-00197	3	2333	29.772342	-97.123249
		00786	2001	1100	192	44	<0.005	8.3	<5	5000		493-00975	7	1604	29.253140	-97.954010
			2006	980	173	80	<0.05	7.9	12.4	5000						
			2012	1120	269	79	<0.01	8.6	8.8		84.9					
Milam	1212	00823	1996	215	26	11	<0.005	8.4	3.8			331-33473	12	1980	30.582512	-96.921003
			2001	230	27	8	<0.005	8	0.48	7500		331-35005	15	1975	30.583177	-96.924350
												331-35008	16	1980	30.582918	-96.923728
												331-33068	2	2887	30.582364	-96.922676
												331-33289	4	1987	30.583805	-96.920638
												331-33328	5	1902	30.581865	-96.922998
												331-33718	13	2006	30.581404	-96.923535

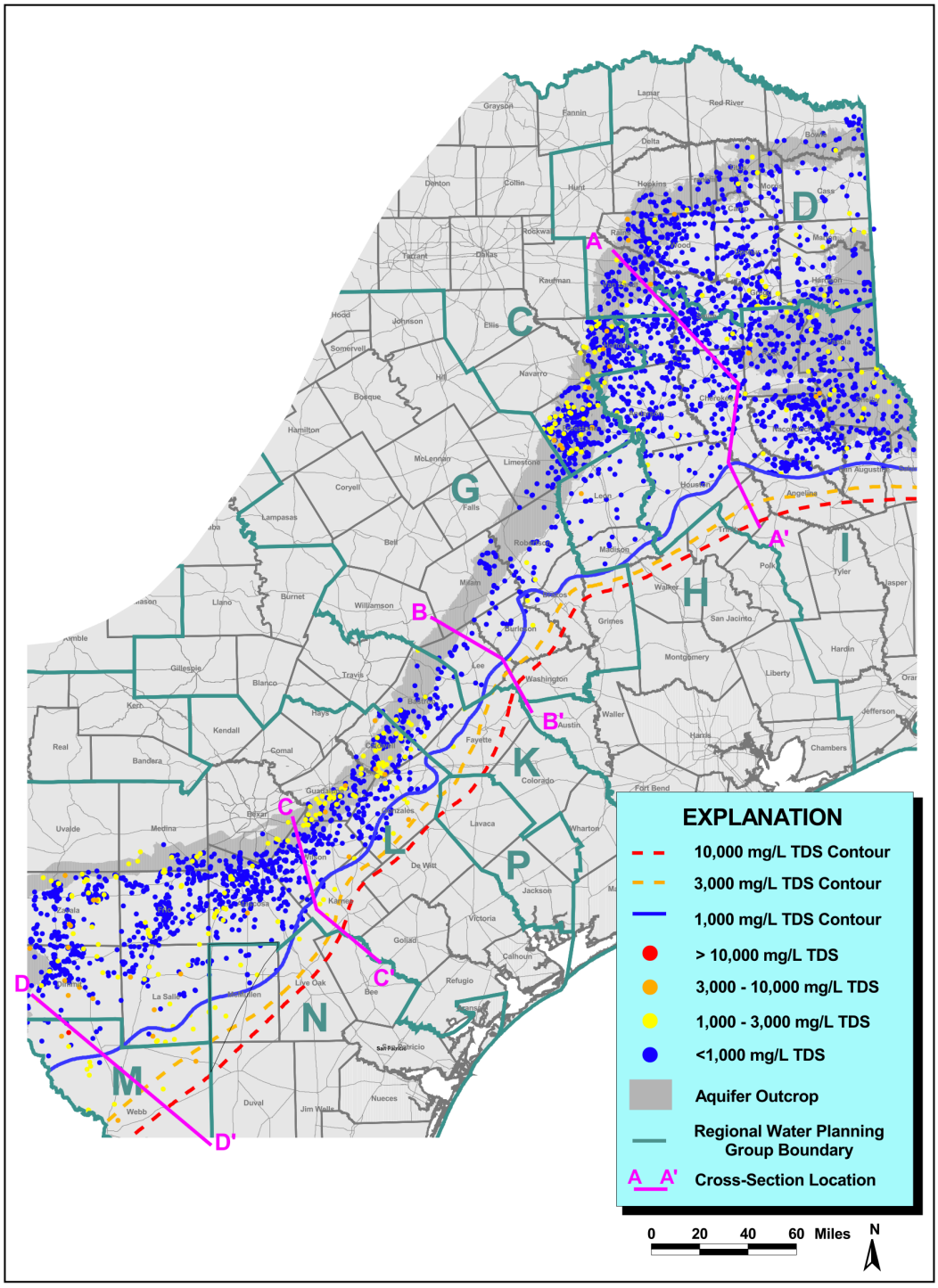
County	Segment	Permit number	Year	TDS mg L^{-1}	Chloride mg L^{-1}	Sulfates mg L^{-1}	Selenium mg L^{-1}	pH	Oil and grease mg L^{-1}	Barrels per day	Temperature (°F)	API	Well name	Depth (ft)	Latitude	Longitude
												331-33409	7	1916	30.581071	-96.923213
												331-33442	8	1932	30.582678	-96.922161
												331-33443	9	1940	30.583306	-96.923320
												331-33474	10	2000	30.582844	-96.924178
												331-33559	11	1980	30.582253	-96.919887
												331-33644	14	2025	30.581810	-96.923470
												331-33344	6	1914	30.581736	-96.921754
												331-34981	7	1998	30.581237	-96.922226
												331-33212	1	2007	30.579686	-96.921711
												331-33326	2	1907	30.580443	-96.922912
												331-33524	6	2021	30.579649	-96.921303
												331-33430	4	1966	30.579538	-96.922440
												331-33449	5	2000	30.581071	-96.920874
												331-33353	3	1965	30.580831	-96.921754
McMullen	2117	00768	1967	3321	122	17						311-00123	2	3720	28.506021	-98.583194
			1997	1506	108	4	<0.002	8	20	1000		311-00127	5	3700	28.509149	-98.588061
			2003	1320	89	1	<0.003	8.3	13.8			311-32925	6	5700	28.507078	-98.586835
												311-00129	7	6025	28.504145	-98.587415
												311-00122	8	3700	28.510029	-98.583033
Gonzales	1803	00995	1997	1084	23	2	0.002	8.5	1	50		177-32008	1	2264	29.626523	-97.262327
			2003	1072	24	7	<0.003	8.2	28	75		177-32025	2	2271	29.627680	-97.260395
			2009	973	21		0.002	8.3	1	75						
		00966	1995	1310	29	<5	<0.005	8.3	<5	400		177-20029	1	2280	29.624378	-97.266939
			2001	1280	85	10	<0.005	8.3	9	500		177-00653	2	2300	29.623277	-97.266939
			2006	1038	288	260	<0.002	6.8	8.6	200		177-31791	4	2200	29.623072	-97.268570
			2012	1621	235	16		8.6	<1	-		177-31848	5	2190	29.622624	-97.268548
												177-31974	6	2215	29.623576	-97.267819
												177-32029	7	2204	29.624940	-97.270007
		00760	2006	837	227	205	<0.002	6.9	3	650		177-32599	107	1985	29.580998	-97.316235
			2012	1126	312		0.002	8.1	24.3	650		177-31578	1	1998	29.579617	-97.316922
												177-32058	2A	1995	29.578479	-97.316857
												177-32055	3	2079	29.577826	-97.317673
												177-32049	2	1998	29.579767	-97.317930

County	Segment	Permit number	Year	TDS mg L^{-1}	Chloride mg L^{-1}	Sulfates mg L^{-1}	Selenium mg L^{-1}	pH	Oil and grease mg L^{-1}	Barrels per day	Temperature (°F)	API	Well name	Depth (ft)	Latitude	Longitude
												177-33974	7A	2050	29.578255	-97.319454
												177-30563	1	8470	29.579468	-97.318381
												177-31323	1A	2130	29.579934	-97.318424
												177-32055	6A	2079	29.577826	-97.317673
												177-31758	3A	2045	29.580812	-97.318252
												177-31986	4A	2050	29.577210	-97.318939
												177-32049	5A	1998	29.579841	-97.317801
												177-31411	2A	2133	29.576538	-97.318445
		00775	1999	1219	14.2	0.74	<0.001	8.07	5.8	100		177-30223	1	2068	29.636164	-97.278809
			2004	1092	18.4	<1	<0.002	8.2	3.7	200		177-30476	2	2138	29.636612	-97.279517
			2014	3650	30	<20		8.75	5.8	-		177-31740	7	2141	29.638626	-97.278466
												177-31733	6	2140	29.638831	-97.278273
												177-31515	5	2155	29.636295	-97.280891
		00782	1988	1555	20	2	0.003	8.4	18	-		177-33841	102	2170	29.647093	-97.255335
			2000	1141	21	<10	<0.01	8.4	10.3	320		177-33987	104	2196	29.650636	-97.243683
			2006	2186	63	5.8	<0.002	8.6	10	350		177-32070	101	2150	29.646291	-97.257137
			2011	315	88	10.7		8.7	8.2	-		177-30099	1	2036	29.652202	-97.245765
Fayette		00965	2006	550	153	138	<0.002	6.6	18.2	800		149-32931	1	1357	29.809213	-97.226996
			2014	441	122		0.002	7.7	5.7	800		149-32944	3	1393	29.808524	-97.228348
												149-32986	6	1390	29.808468	-97.228520
												149-32960	4	1355	29.808990	-97.229679
												149-32989	7	1405	29.807854	-97.229829
		00906	2001	1067	300	25	<0.005	8.15	20	250		149-31473	1A	1975	29.737040	-97.188544
			2006	1108	302	278	<0.002	6.9	4.2	400		149-31472	2B	1981	29.737283	-97.188888
			2009	1108	302	279		6.9	4.2	-						
			2014	377	19	16		8.4	<5	-						
		00891	1997	676	17	2	<0.002	7.4	15	600		149-31473	1A	1975	29.737040	-97.188544
			2003	586	9	0	<0.005	7.2	2.6	800		149-31472	2B	1981	29.737283	-97.188888
			2009	805	26		0.02	7.9	8.6	800						
			2016	213	<20	<20			<1.4	-						
		00890	1997	622	14	5	<0.002	7.1	13	150		149-00401	1	2103	29.721556	-97.208414
			2003	792	8	0	<0.01	7	7.8	200						
			2009	1381	27	<1.0		7.96	6.4	-						

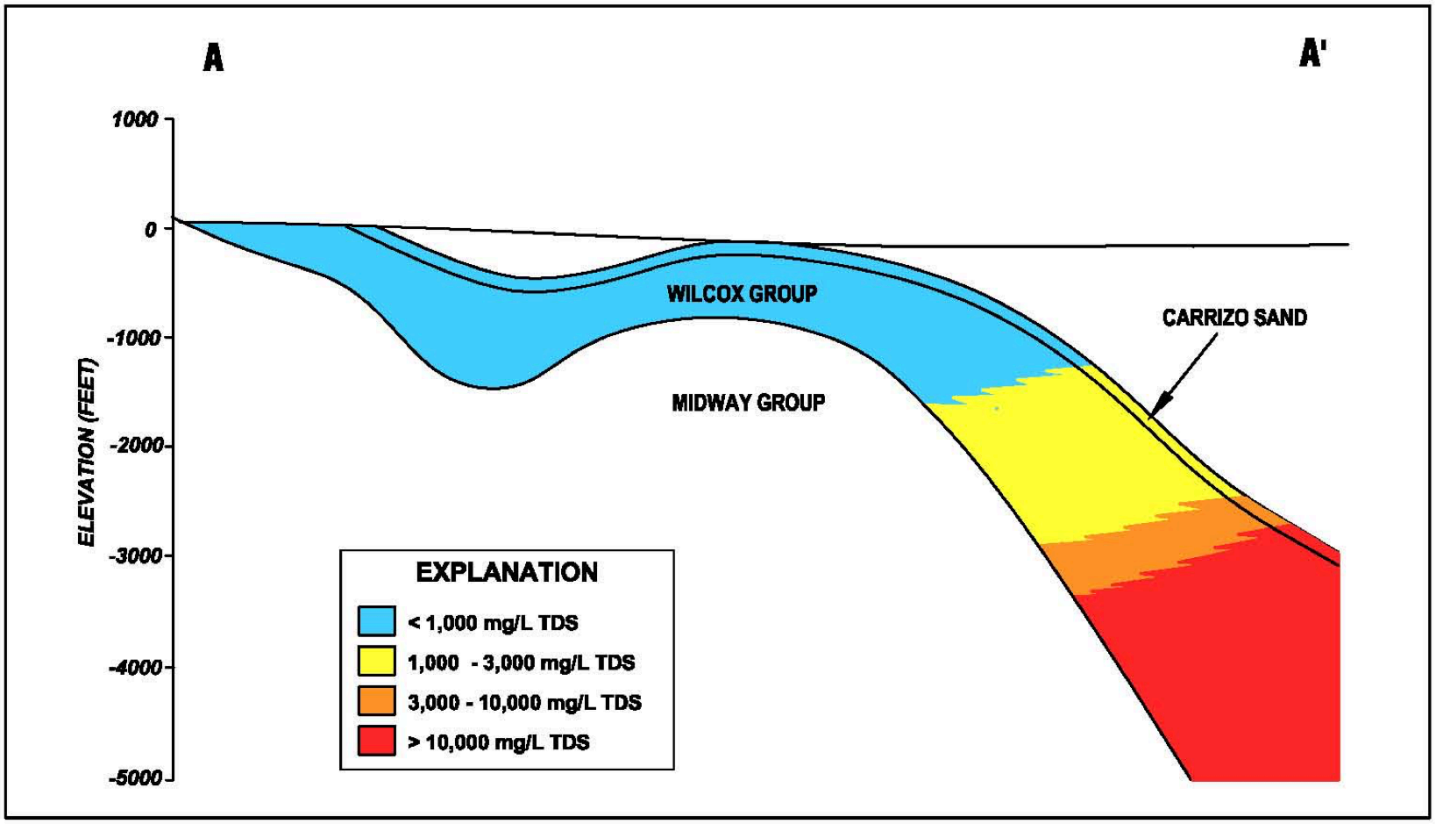
County	Segment	Permit number	Year	TDS mg L^{-1}	Chloride mg L^{-1}	Sulfates mg L^{-1}	Selenium mg L^{-1}	pH	Oil and grease mg L^{-1}	Barrels per day	Temperature (°F)	API	Well name	Depth (ft)	Latitude	Longitude
			2011	1381	27		0.02	7.96	6.4	200						
			2016	370	20		0.002	-	1.4	260						
		00887	1997	701	14	3	<0.002	7.3	11	315		149-33283	5	1967	29.722506	-97.212555
			2003	789	6	0	<0.005	7.1	18.9	315		149-32814	3	1980	29.720270	-97.215517
			2009	1384	21		0.02	8.1	7	215		149-30097	2	2004	29.721426	-97.213650
			2016	130			<0.002			-						
		00859	1997	613	16	<1	<0.002	7.2	12	325		177-31984	2	2135	29.640547	-97.275741
			2009	1015	23		0.02	8.2	3.8	360						
			2016	210	74	<20			<5	-						
		00763	2001	788	90	<1	<0.004	8.98	6	200		149-32549	5	1955	29.732364	-97.196248
			2006	742	137	152	<0.002	7.3	<1	200		149-31319	1	2290	29.733202	-97.194660
			2011	1191	330		0.002	8.2	8.25	200						

*Total dissolved solids (TDS), milligram per liter (mg L-1), API (American Petroleum Institute), Fahrenheit (°F), feet (ft)

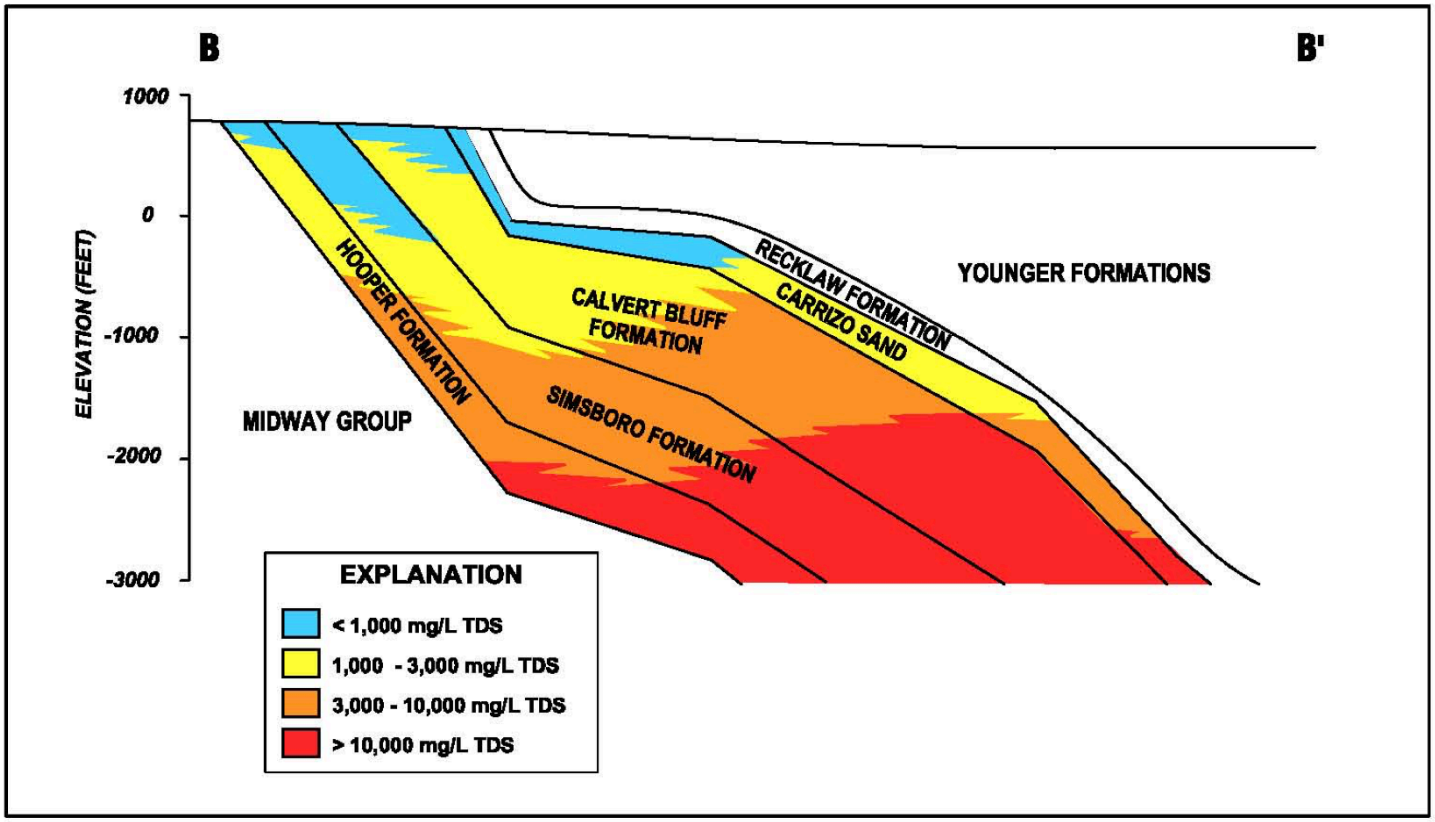
SI I.2 Groundwater quality of the Carrizo-Wilcox Aquifer



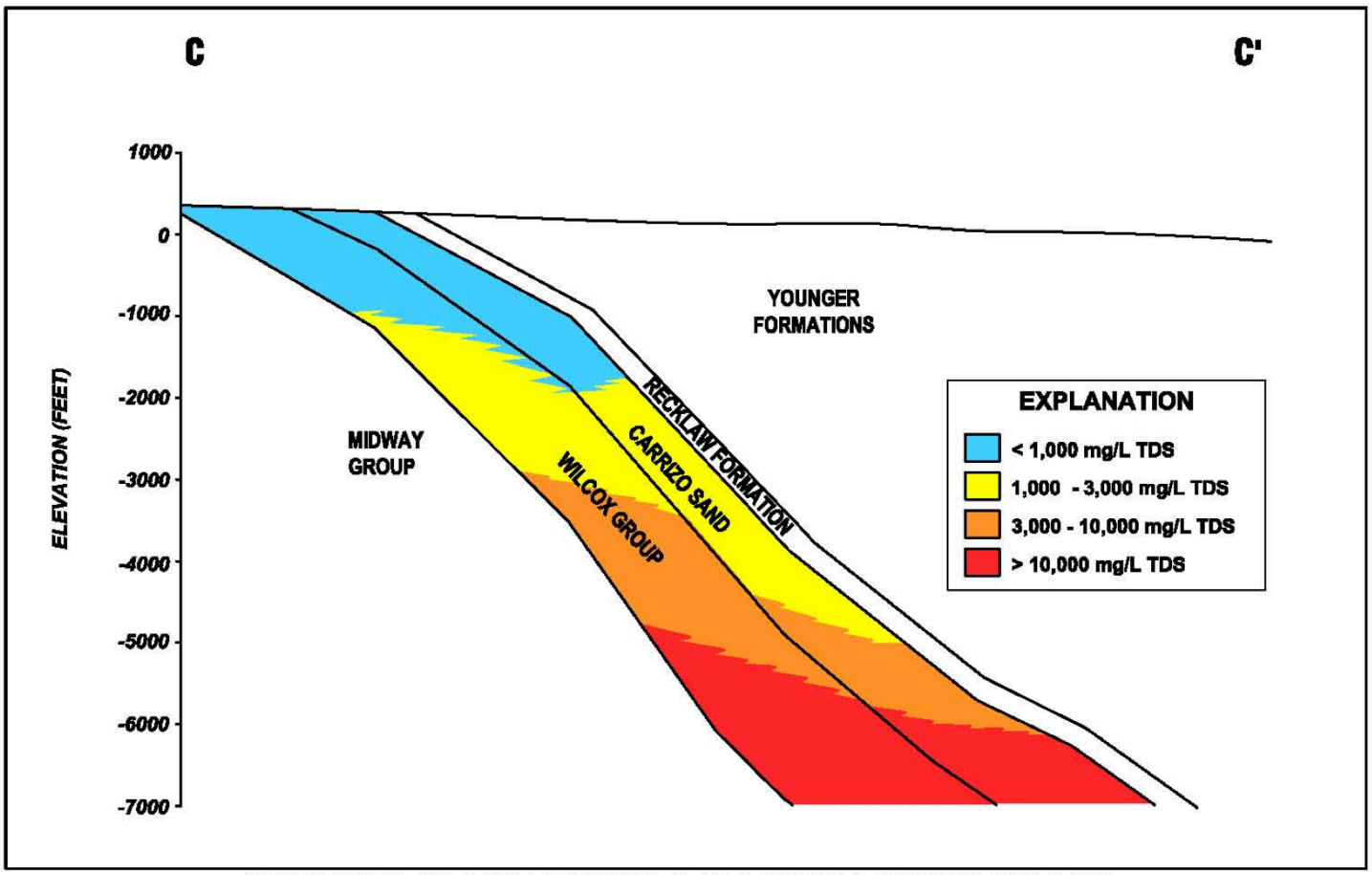
Visual representation of groundwater quality in the Carrizo-Wilcox Aquifer, accompanied by cross section views including formation total dissolved solids (TDS) and depth (LBG-Guyton Associates 2003).



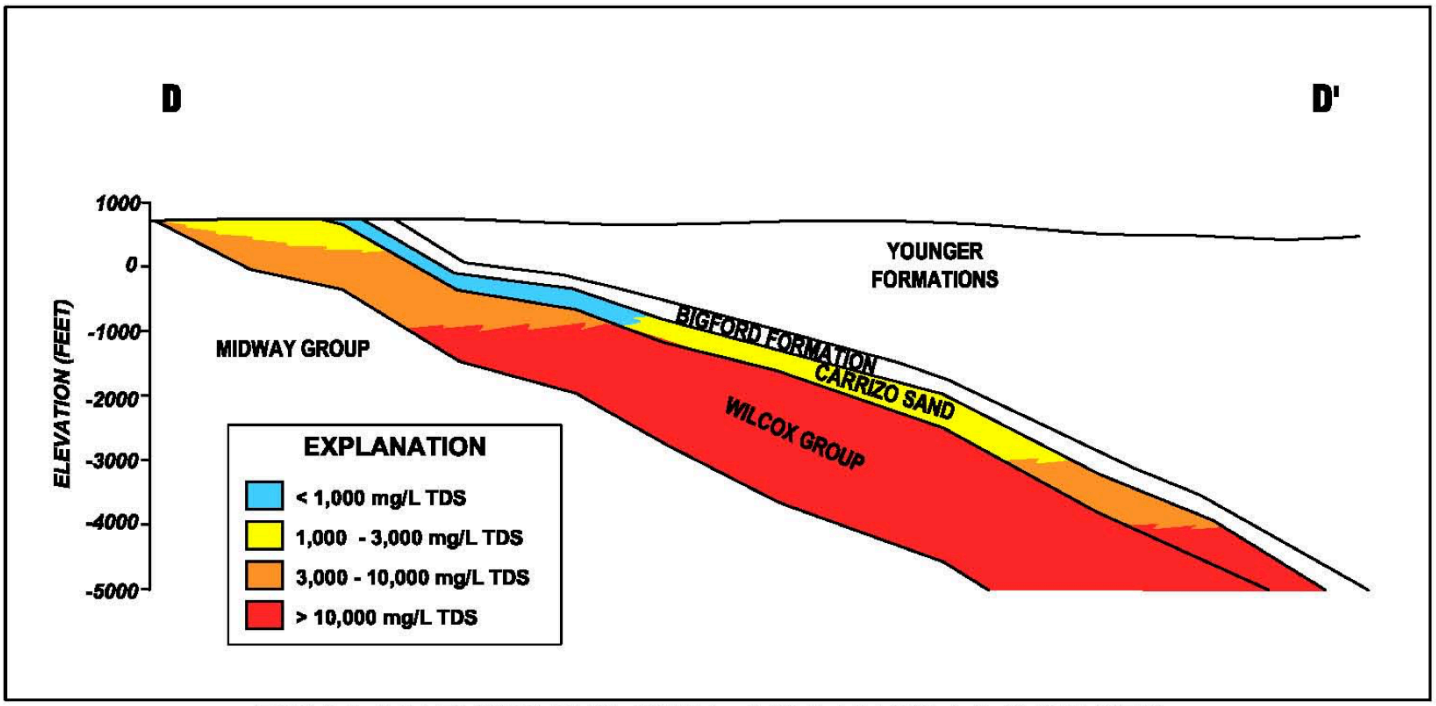
Simplified Cross Section A-A' of the Carrizo-Wilcox Aquifer with generalized water quality ranges (LBG-Guyton Associates 2003).



Simplified Cross Section B-B' of the Carrizo-Wilcox Aquifer with generalized water quality ranges (LBG-Guyton Associates 2003).



Simplified Cross Section C-C' of the Carrizo-Wilcox Aquifer with generalized water quality ranges (LBG-Guyton Associates 2003).



Simplified Cross Section D-D' of the Carrizo-Wilcox Aquifer with generalized water quality ranges (LBG-Guyton Associates 2003).

SI II

SI II.1 Surface waste management manual (RRC 2015)

Application for a permit to discharge produced water to inland waters

Application should be made by letter of request; there is no application form. You may number your responses to correspond to the requests for information outlined below. The application must contain this information before it can be processed.

1. Operator name, address, and telephone number. Note that unless otherwise specified in an application, the permit and correspondence will only be mailed to the operator's P5 address.
2. Identify the county, field(s), lease name(s), lease number(s), and well number(s) producing the water to be discharged. Include any wells that are currently shut in but may contribute to the discharge sometime in the future.
3. Include a list of the average and estimated maximum water production rates (billion barrels/day) on a well-bywell basis. Also indicate whether you believe the maximum produced water rate will increase, and if so, to what rate. Any discharge permit issued may contain a discharge rate restriction.
4. Include a drawing and description of the treatment the produced water will receive before being discharged. Indicate the size of tanks and/or pits and show any special piping, baffles, weirs, etc. inside tanks or pits to minimize turbulence, control oil carry over, control water level, etc. Include a copy of any technical data available from the manufacturer on any equipment used to treat the water.
5. Pits associated with oil and gas activities are required to be permitted unless they are authorized by Statewide Rule 8(d)(4). If any pits are used to treat or contain the water prior to discharge, please advise of the use and size of each pit. Include permit numbers for all permitted pits.
6. List any chemicals that are in use or will be used to treat the water or oil, the purpose for using the chemicals, and the concentrations used. Attach a copy of the manufacturer's brochure and the material safety data sheets for each chemical.
7. A representative sample of the produced water you wish to discharge must be analyzed as outlined in the attached document entitled "Produced Water Analysis." If you have any reason to believe any analyzed contaminant will increase or decrease in concentration during the time you wish to discharge, you must advise us of which contaminant, whether the concentration of the contaminant will increase or decrease, and the extent, if known, of the expected increase or decrease.
8. Please indicate the latitude longitude coordinates to the nearest second for the discharge point, the treatment facility, and each wellhead associated with this discharge. If the latitude longitude coordinates are not readily available, a complete original U.S. Geological Survey 7 1/2-minute quadrangle map of the area may be submitted with the exact location of each well, the treatment facility, and the discharge point clearly marked.
9. Indicate on a county highway map, or include on the USGS map above, the location of the treatment facility, the proposed discharge point, and the route the discharged water will take to the nearest watercourse (creek or river). If the water is to be used for livestock or irrigation, indicate how the water will reach the ultimate point of disposal. A letter from the surface owner must be included stating he wants and has a need for the water or that he does not object to the water being disposed of on his property.
10. If disposal is by discharge into a watercourse, Rule 8(d)(6)(C) requires an applicant for a discharge permit must give proper notice to the surface owner at the point of discharge and to the surface owner of each waterfront tract between the discharge point and 1/2 mile downstream of the discharge point. If any of these waterfront tracts are within an incorporated city, town, or village, then notice shall be given to the city clerk. Notice of the permit application shall consist of a copy of the application together with a statement that any protest to the application should be filed with the Commission within 15 days of the date the application is filed with the Commission. The applicant shall mail or deliver the required notice to the surface owners on or before the date the application is mailed or delivered to the Commission in Austin. After giving the required notice, you must file with the Commission a statement setting out the names and addresses of persons notified and the dates they were notified, and stating the listed persons are all the persons required by Rule 8 to be notified.

11. In the event produced water is delivered into a flood control ditch or similar waterway, written permission must be filed with the Commission from the authority having jurisdiction.
12. There is a $300 nonrefundable application fee for a permit to discharge oil and gas waste to surface waters of the state. EFFCTIVE MAY 1, 2012, A SURCHARGE OF 150% HAS BEEN IMPOSED ON THE APPLICATION FEE to implement the provisions of Senate Bill 1 (82nd Legislature, First Called Session, 2011), which mandated the Commission to impose reasonable surcharges on Commission fees. Accordingly, for applications received on or after May 1, 2012, the total application fee will now be $750. If the discharged water will not reach surface waters of the State or the discharge point is west of the 98th meridian and the water is for agriculture or wildlife use, the fee is not required. If the fee is applicable, checks or money orders should be made payable to "Railroad Commission of Texas." Please do not send cash through the mail. This fee is an application fee and is not refundable even if your application is returned, withdrawn, or denied. If the fee is not applicable, a statement indicating the reason the fee does not apply to your application must be provided.
13. Please provide a statement as to whether the water is for agricultural or wildlife use.
14. You must certify the application as follows:

    "I certify that I am authorized to make this application, that this application was prepared by me or under my supervision and direction, and that the data and facts stated herein are true, correct, and complete to the best of my knowledge."

The application and any attachments should be mailed to:

Railroad Commission of Texas
Oil and Gas Division
Technical Permitting
P. O. Box 12967
Austin, TX 787112967

Send a copy of the application and any attachments to the appropriate District Office.

Before any permit may be issued, the operator must have an Organization (Form P5) on file with the Austin Office of the Commission.

If your facility is east of the 98th meridian, a permit from the U.S. Environmental Protection Agency (EPA) may be required for a discharge to surface waters under the National Pollutant Discharge Elimination System (NPDES). Contact EPA Region 6 (http://www.epa.gov/region6/) in Dallas for more information.

SI II.2 Produced Water Analysis

An application for a permit to discharge produced water must contain an analysis of the water to be discharged. The parameters listed below must be reported. Samples must be representative of the discharged water. Analysis must be performed according to procedures approved by EPA as part of the 40 CFR Part 136 – Guidelines establishing test procedures for the analysis of pollutants (EPA 2021), and, where applicable, samples must be preserved as specified by these procedures. The procedures used to preserve the samples and the analytical methods used must be reported. All parameters should be reported in milligrams per liter unless otherwise specified.

General parameters	Toxic pollutants***	MAL (mg L^{-1})
Temperature (°F)	Aluminum	0.03
pH (standard units)	Arsenic	0.01
Dissolved oxygen	Barium	0.01
Hardness (mg L^{-1} as CaCO3)	Benzene	0.01
Total suspended solids	Cadmium	0.001
Total dissolved solids	Chromium	0.01
Chlorides	Hexavalent Chromium	0.01
Sulfates	Copper	0.01
Sulfides	Cyanide	0.02
Ammonia nitrogen	Lead	0.005
Calcium	Mercury	0.0002
Magnesium	Nickel	0.01
Sodium	Selenium	0.01
Potassium	Silver	0.002
Iron	Zinc	0.005
Manganese		
Oil and grease		
Total organic carbon		
Phenols		
Naphthalene		

***These toxic pollutants have numerical criteria specified in the Texas Surface Water Quality Standards and may be present in some gas plant wastewater. Toxic pollutant concentrations in milligram per liter (mg L^{-1}) above the specified minimum analytical limit (MAL) must be reported. If the laboratory, using acceptable analytical practices, cannot report concentrations down to the specified level due to reasons such as matrix interference, a statement to that effect from the laboratory must be submitted with the results. Also, the MAL achieved by the laboratory for each toxic pollutant must be reported. Temperature is in Fahrenheit (°F).

Last Updated: 3/1/2018

The information above is available from the Railroad Commission of Texas (RRC 2018).

SI III

SI III.1 Discharges west of the 98th meridian

Tiffany Humberson
Environmental Permitting and Support
Texas Railroad Commission

The Agricultural and Wildlife Water Use Subcategory **(40 Code of Federal Regulations [CFR] 435.50)** applies to facilities located in the continental United States west of the 98th meridian for which produced water is clean enough to be used for wildlife and livestock watering or other agricultural uses. The 98th meridian extends from near the eastern edge of the Dakotas through central Nebraska, Kansas, Oklahoma, and Texas. Produced water may be discharged from such sites with limits placed on oil and grease. Note that regulations for reuse of reclaimed water vary from state to state, and not all states have developed water reuse guidelines or regulations (EPA 2012b).

Subpart E—Agricultural and Wildlife Water Use Subcategory

§435.50

Applicability; description of the beneficial use subcategory.

The provisions of this subpart are applicable to those onshore facilities located in the continental United States and west of the 98th meridian for which the produced water has a use in agriculture or wildlife propagation when discharged into navigable waters. These facilities are engaged in the production, drilling, well completion, and well treatment in the oil and gas extraction industry.

§ 435.51

Specialized definitions.

For the purpose of this subpart:

(a) Except as provided below, the general definitions, abbreviations, and methods of analysis set forth in 40 CFR part 401 shall apply to this subpart.

(b) The term "onshore" shall mean all land areas landward of the territorial seas as defined in 40 CFR 125.1(gg).

(c) The term "use in agricultural or wildlife propagation" means that the produced water is of good enough quality to be used for wildlife or livestock watering or other agricultural uses and that the produced water is put to such use during periods of discharge.

Effluent characteristics: Effluent limitation* (mg L^{-1}) *oil and grease: 35

Discharge cannot violate Texas Surface Water Quality Standards (TSWQS). These parameters change depending on the receiving surface water. Some may be impaired, and limits would be strict, or the discharge may be denied.

TSWQS used for permitting can be found at https://www.tceq.texas.gov/assets/public/waterquality/standards/TSWQS2010/TSWQS2010_rule.pdf.

Recommendations for livestock water

TDS less than 1,000 mg L^{-1} is best for all
TDS less than 3,000 mg L^{-1} is still safe to use

Refer to Texas Agricultural Extension Service published paper on water quality found at http://publications.tamu.edu/WATER/PUB_water_Water%20Quality%20Guide%20for%20Livestock%20and%20Poultry.pdf.

All discharges west of the 98th meridian require individual NPDES permits from EPA Region 6 if discharged into navigable surface waters or impaired water bodies.

SI IV

SI IV.1 Water uses and supporting numerical criteria for each of the state's classified segments

The following tables identify the water uses and supporting numerical criteria for each of the state's classified segments. The tables are ordered by segment number correlating with the standards set by the Texas Commission on Environmental Quality. The following descriptions denote how each numerical criterion is used subject to the provisions in §307.7 of the Texas Surface Water Quality Standards title (relating to Site-Specific Uses and Criteria), §307.8 of the title (relating to Application of Standards), and §307.9 of the title (relating to Determination of Standards Attainment).

The criteria for Cl^{-1} (chloride), $SO4^{-2}$ (sulfate), and TDS (total dissolved solids) are listed as maximum annual averages for the segment.

Dissolved oxygen criteria are listed as minimum 24-hour means at any site within the segment. Absolute minima and seasonal criteria are listed in §307.7 of the title.

The pH criteria are listed as minimum and maximum values expressed in standard units at any site within the segment.

The freshwater indicator for bacteria for recreation is *E. coli*.

The criteria for temperature are listed as maximum values at any site within the segment.

Number of segments	Segment number	Cl^{-1} mg L^{-1}	SO_4^{-2} mg L^{-1}	TDS mg L^{-1}	Dissolved oxygen (mg L^{-1})	pH range	Indicator bacteria #/100 ml	Temperature (°F)
1	0604	50	50	200	5.0	6.0-8.5	126	91
1	1211	140	130	640	5.0	6.5-9.0	126	91
30	1803	100	100	500	5.0	6.5-9.0	126	93
3	1902	17	275	900	5.0	6.5-9.0	126	90
1	1911	150	150	750	5.0	6.5-9.0	126	90
16	2107	600	500	1500	5.0	6.5-9.0	126	90
1	2113	50	50	400	5.0	6.5-9.0	126	90
1	2310	1700	1000	4000	5.0	6.5-9.0	126	90

*Miligram per liter (mg L^{-1}), mililiters (ml), Fahrenheit (°F)
Segment 0604 is in the Neches/Trinity River basin and represents a discharge point into the Neches River.
Segment 1211 is in the Brazos River Basin and represents a discharge point into the Yegua Creek.
Segment 1803 is in the Guadalupe River Basin and represents discharge points into the Guadalupe River.
Segment 1902 is in the San Antonio River Basin and represents discharge points into the Cibolo Creek.
Segment 1911 is in the San Antonio River Basin and represents a discharge point into the San Antonio River.
Segment 2107 is in the San Antonio and Nueces river basins and represents discharge points into the Atascosa River.
Segment 2113 is in the Nueces River basin and represents a discharge point into the Frio River.
Segment 2310 is in the Rio Grande basin and represents a discharge point into the Pecos River.

SI IV.2 Active freshwater discharge permits in Texas

Active freshwater discharge permits in Texas, derived from an evaluation of discharge locations and active permits.

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
Renew		Discharge	00005	Approved	6/7/2001	none	960	152.63
Renew	6/14/2006	Discharge	00005	Approved	12/17/2012	12/16/2017		
Transfer	5/10/1993	Discharge	00065	Approved	9/8/1993	9/8/1998	4,975	790.96
Renew	4/19/2000	Discharge	00065	Approved	3/27/2002	3/26/2003		
Transfer	10/16/2003	Discharge	00065	Approved	4/5/2004	4/4/2009		
Renew	8/13/2009	Discharge	00065	Approved	8/3/2012	8/2/2017		
Amend	8/13/2009	Discharge	00065	Approved	8/3/2012	8/2/2017		
Transfer	5/10/1993	Discharge	00066	Approved	9/8/1993	9/8/1998	6,100	969.82
Renew	4/19/2000	Discharge	00066	Approved	3/27/2002	3/26/2003		
Transfer	9/19/2003	Discharge	00066	Approved	4/5/2004	4/4/2009		
Renew	9/19/2003	Discharge	00066	Approved	4/5/2004	4/4/2009		
Renew	8/13/2009	Discharge	00066	Approved	8/3/2012	8/2/2017		
Amend	8/13/2009	Discharge	00066	Approved	8/3/2012	8/2/2017		
Renew	4/12/1996	Discharge	00268	Approved	2/16/2000	2/15/2005	N/A	N/A
Transfer	11/1/2000	Discharge	00268	Approved	11/16/2000	2/15/2005		
Transfer	12/14/2000	Discharge	00268	Approved	1/23/2001	2/15/2005		
Amend	8/7/2002	Discharge	00268	Approved	9/4/2002	2/15/2005		
Amend	7/14/2003	Discharge	00268	Approved	7/29/2003	2/15/2005		
Transfer	7/23/2004	Discharge	00268	Approved	9/20/2004	9/19/2009		
Renew	9/18/2009	Discharge	00268	Approved	11/24/2009	11/23/2014		
Transfer	1/25/2011	Discharge	00268	Approved	3/28/2012	3/27/2017		
Amend		Discharge	00268	Approved				
Renew	5/8/1998	Discharge	00759	Approved	3/23/1999	3/22/2004	700	111.29
Renew	2/17/2004	Discharge	00759	Approved	4/2/2004	4/1/2009		
Renew	4/28/2009	Discharge	00759	Approved	10/30/2009	10/29/2014		
Renew	8/28/2009	Discharge	00759	Approved	10/30/2009			
Renew	10/22/2014	Discharge	00759	Approved	12/16/2016	12/15/2021		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
Transfer	8/7/1995	Discharge	00760	Approved	1/22/1996	1/22/2001	650	103.34
Renew	12/5/2006	Discharge	00760	Approved	4/18/2007	4/17/2012		
Renew	3/27/2012	Discharge	00760	Approved	3/2/2015	3/2/2020		
Amend	7/5/2016	Discharge	00760	Approved	8/25/2016	3/2/2020		
Amend	9/1/2016	Discharge	00760	Approved	9/30/2016	3/2/2020		
Renew	5/4/1987	Discharge	00762	Approved	10/30/2009	10/29/2014	200	31.80
Renew	5/8/1998	Discharge	00762	Approved	3/23/1999	3/22/2004		
Renew	2/17/2004	Discharge	00762	Approved	4/6/2004	4/5/2009		
Renew	10/22/2014	Discharge	00762	Approved	12/16/2016	12/15/2021		
Renew	3/19/2001	Discharge	00763	Approved	5/10/2001	5/9/2006	200	31.80
Transfer	12/9/2002	Discharge	00763	Approved	4/17/2003	5/9/2006		
Renew	5/24/2006	Discharge	00763	Approved	7/11/2006	7/10/2011		
Renew	7/13/2011	Discharge	00763	Approved	7/10/2013	7/10/2018		
Amend	6/23/2014	Discharge	00763	Approved	6/4/2015	7/10/2018		
Transfer	12/9/2002	Discharge	00764	Approved	4/17/2003	5/9/2006	665	105.73
Renew	5/26/2006	Discharge	00764	Approved	7/11/2006	7/10/2011		
Renew	7/15/2011	Discharge	00764	Approved	3/30/2012	7/10/2011		
Amend	9/11/2014	Discharge	00764	Approved	1/5/2015	3/29/2017		
Amend	9/11/2014	Discharge	00764	Approved	1/20/2015	3/29/2017		
Renew	3/16/2017	Discharge	00764	Approved	6/16/2017	6/15/2022		
Renew	8/28/2003	Discharge	00765	Approved	3/9/2004	3/8/2009	1,200	190.79
Renew	3/12/2009	Discharge	00765	Approved	6/19/2009	6/18/2014		
Renew	6/23/2014	Discharge	00765	Approved	7/1/2014	7/1/2019		
Amend	1/20/2015	Discharge	00765	Approved	2/9/2015	7/1/2019		
Renew	8/26/2003	Discharge	00768	Approved	4/2/2004	4/1/2009	3,600	572.36
Renew	5/8/2009	Discharge	00768	Approved	10/2/2009	10/1/2014		
New	2/19/1999	Discharge	00775	Approved	5/24/1999	5/23/2004	200	31.80
Transfer	5/25/2004	Discharge	00775	Approved	7/27/2004	7/26/2009		
Renew	1/16/2009	Discharge	00775	Approved	3/31/2009	3/30/2014		
Renew	10/3/2014	Discharge	00775	Approved	2/24/2015	2/24/2020		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
New	8/30/1983	Discharge	00777	Approved	11/1/1983	none	250	39.75
Amend	5/12/2009	Discharge	00777	Approved	6/4/2009	6/3/2014		
Transfer	5/12/2009	Discharge	00777	Approved	6/4/2009	6/3/2014		
Renew	6/18/2014	Discharge	00777	Approved	6/25/2014	6/25/2019		
Amend	9/11/2014	Discharge	00777	Approved	1/2/2015	6/25/2019		
Amend	9/11/2014	Discharge	00777	Approved	1/5/2015	6/25/2019		
Amend	9/11/2014	Discharge	00777	Approved	1/20/2015	6/25/2019		
Amend	8/16/1993	Discharge	00778	Approved	12/28/1993	7/23/1998	1,500	238.48
Renew	11/17/2000	Discharge	00778	Approved	10/10/2001	10/9/2006		
Renew	6/25/2007	Discharge	00778	Approved	1/10/2013	1/10/2018		
Amend	6/23/2014	Discharge	00778	Approved		1/10/2018		
Amend	9/11/2014	Discharge	00778	Approved	2/3/2015	1/10/2018		
New	8/3/1995	Discharge	00782	Approved	10/31/1995	10/31/2000	665	105.73
Renew	9/11/2000	Discharge	00782	Approved	3/6/2001	3/5/2006		
Renew	3/28/2006	Discharge	00782	Approved	6/26/2006	6/25/2011		
Amend	7/29/2008	Discharge	00782	Approved	11/18/2008	6/25/2011		
Renew	7/6/2011	Discharge	00782	Approved	2/3/2012	2/2/2017		
Amend	9/11/2014	Discharge	00782	Approved	2/3/2015	2/2/2017		
Amend	9/10/2015	Discharge	00782	Approved	2/3/2015	2/2/2017		
Renew	2/24/2017	Discharge	00782	Approved	3/20/2017	3/19/2022		
New	6/2/1983	Discharge	00783	Approved	6/2/1983	none	400	63.60
Amend	9/11/2014	Discharge	00783	Approved	1/2/2015	1/2/2020		
Amend	9/11/2014	Discharge	00783	Approved	1/5/2015	1/2/2020		
Amend	9/11/2014	Discharge	00783	Approved	2/17/2015	1/2/2020		
New	3/1/2001	Discharge	00786	Approved	6/13/2001	6/12/2006	6,850	1,089.06
Renew	7/18/2006	Discharge	00786	Approved	8/22/2006	8/21/2011		
Renew	8/16/2011	Discharge	00786	Approved	7/11/2012	7/11/2017		
Amend	8/16/2011	Discharge	00786	Approved	1/2/2015	7/11/2017		
Amend	8/16/2011	Discharge	00786	Approved	1/5/2015	7/11/2017		
New	1/23/1998	Discharge	00808	Approved	8/24/1998	8/24/2003	1,200	190.79
Renew	9/19/2003	Discharge	00808	Approved	4/5/2004	4/4/2009		
Renew	5/8/2009	Discharge	00808	Approved	8/3/2012	8/2/2017		
Transfer	2/11/1991	Discharge	00814	Approved	3/9/1991		375	59.62
Renew	9/11/2014	Discharge	00814	Approved	7/15/2015	7/15/2020		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
Renew	3/1/2001	Discharge	00821	Approved	6/13/2001	6/12/2006	1,000	158.99
Renew	7/18/2006	Discharge	00821	Approved	8/22/2006	8/21/2011		
Renew	8/16/2011	Discharge	00821	Approved	7/11/2012	7/11/2017		
Amend	5/27/2016	Discharge	00821	Approved	6/17/2016	7/11/2017		
Transfer	12/11/1995	Discharge	00823	Approved	4/3/1996	4/3/2001	18,000	2,861.78
Amend	11/26/2001	Discharge	00823	Approved	3/7/2006	1/17/2007		
Renew	12/4/2009	Discharge	00823	Approved	6/20/2013	6/19/2018		
Amend	6/23/2014	Discharge	00823	Approved	5/21/2015	6/19/2018		
Renew	9/2/2003	Discharge	00828	Approved	3/9/2004	3/8/2009	900	143.09
Renew	3/2/2009	Discharge	00828	Approved	6/19/2009	6/18/2014		
Renew	6/23/2014	Discharge	00828	Approved	9/5/2014	9/4/2019		
Transfer	6/23/2014	Discharge	00828	Approved	9/5/2014	9/4/2019		
Amend	6/23/2014	Discharge	00828	Approved	5/20/2015	9/4/2019		
Renew	8/28/2003	Discharge	00832	Approved	3/9/2004	3/8/2009	500	79.49
Renew	6/23/2014	Discharge	00832	Approved	7/28/2014	7/27/2019		
Renew	6/12/1997	Discharge	00845	Approved	6/25/1997	6/25/2002	100	15.90
Renew	8/18/2003	Discharge	00845	Approved	4/26/2004	4/25/2009		
Renew	5/21/2012	Discharge	00845	Approved	5/25/2012	5/24/2017		
New	4/25/1991	Discharge	00858	Approved	5/7/1991		175	27.82
Amend	9/11/2014	Discharge	00858	Approved	5/1/2015	5/1/2020		
New	1/23/1998	Discharge	00859	Approved	8/24/1998	8/24/2003	350	55.65
Renew	9/19/2003	Discharge	00859	Approved	4/5/2004	4/4/2009		
Renew	5/19/2009	Discharge	00859	Approved	6/13/2011	6/12/2016		
Transfer	4/23/2015	Discharge	00859	Approved	6/17/2015	6/12/2016		
Renew	7/5/2016	Discharge	00859	Approved	9/14/2016	9/13/2021		
Transfer	6/4/1996	Discharge	00869	Approved	2/26/1998	2/26/2003	1,500	238.48
Transfer	4/19/2002	Discharge	00869	Approved	5/15/2002	2/26/2003		
Renew	2/27/2003	Discharge	00869	Approved	5/9/2003	4/24/2008		
Renew	7/9/2009	Discharge	00869	Approved	10/6/2009	10/5/2014		
Renew	9/11/2014	Discharge	00869	Approved	3/23/2015	3/23/2020		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
Transfer	6/4/1996	Discharge	00870	Approved	2/26/1998	2/26/2003	5,000	794.94
Transfer	4/19/2002	Discharge	00870	Approved	5/15/2002	2/26/2003		
Renew	2/27/2003	Discharge	00870	Approved	5/9/2003	4/24/2008		
Renew	7/9/2009	Discharge	00870	Approved	10/6/2009	10/5/2014		
Renew	9/11/2014	Discharge	00870	Approved	3/23/2015	3/23/2020		
Transfer	6/4/1996	Discharge	00871	Approved	2/26/1998	2/26/2003	N/A	N/A
Transfer	4/19/2002	Discharge	00871	Approved	5/15/2002	2/26/2003		
Renew	2/27/2003	Discharge	00871	Approved	5/9/2003	4/24/2008		
Renew	10/20/2008	Discharge	00871	Approved	10/2/2009	10/1/2014		
Renew	9/11/2014	Discharge	00871	Approved	3/23/2015	3/23/2020		
Transfer	6/4/1996	Discharge	00872	Approved	2/26/1998	2/26/2003	N/A	N/A
Transfer	4/19/2002	Discharge	00872	Approved	5/15/2002	2/26/2003		
Renew	2/27/2003	Discharge	00872	Approved	5/9/2003	4/24/2008		
Renew	7/21/2008	Discharge	00872	Approved	5/7/2013	5/6/2018		
Renew	5/29/1997	Discharge	00886	Approved	8/24/1998	8/24/2003	600	95.39
Renew	11/7/2003	Discharge	00886	Approved	4/5/2004	4/4/2009		
Renew	5/19/2009	Discharge	00886	Approved	8/3/2012	8/15/2017		
Amend	5/29/1997	Discharge	00887	Approved	8/24/1998	8/24/2003	225	35.77
Renew	9/19/2003	Discharge	00887	Approved	4/4/2009	4/4/2009		
Amend	9/11/2014	Discharge	00887	Approved	5/1/2015	6/12/2016		
Renew	6/20/2016	Discharge	00887	Approved	8/16/2016	8/17/2021		
Renew		Discharge	00887	Approved	6/13/2011	6/12/2016		
Renew	5/29/1997	Discharge	00889	Approved	8/24/1998	8/24/2003	600	95.39
Renew	8/29/2003	Discharge	00889	Approved	4/5/2004	4/4/2009		
Renew	1/27/2011	Discharge	00889	Approved	6/13/2011	6/12/2016		
Amend	9/11/2014	Discharge	00889	Approved	5/1/2015	6/12/2016		
Renew	6/20/2016	Discharge	00889	Approved	8/2/2016	8/1/2021		
Amend	2/1/2017	Discharge	00889	Approved	2/21/2017	8/1/2021		
Renew	5/29/1997	Discharge	00890	Approved	8/24/1998	8/24/2003	150	23.85
Renew	8/29/2003	Discharge	00890	Approved	4/5/2004	4/4/2009		
Renew	1/27/2011	Discharge	00890	Approved	6/13/2011	6/12/2016		
Amend	9/11/2014	Discharge	00890	Approved	5/1/2015	6/12/2016		
Renew	6/20/2016	Discharge	00890	Approved	8/2/2016	8/1/2021		
Amend	2/1/2017	Discharge	00890	Approved	2/21/2017	8/1/2021		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
Renew	5/29/1997	Discharge	00891	Approved	8/24/1998	8/24/2003	775	123.22
Renew	10/16/2003	Discharge	00891	Approved	4/5/2004	4/4/2009		
Renew	1/27/2011	Discharge	00891	Approved	6/13/2011	6/12/2016		
Amend	9/11/2014	Discharge	00891	Approved	6/1/2015	6/12/2016		
Renew	6/20/2016	Discharge	00891	Approved	8/18/2016	8/17/2021		
Renew	5/29/1997	Discharge	00895	Approved	8/24/1998	8/24/2003	310	49.29
Renew	8/29/2003	Discharge	00895	Approved	4/5/2004	4/4/2009		
Transfer	4/23/2015	Discharge	00895	Approved	12/16/2015	6/12/2016		
Renew	7/5/2016	Discharge	00895	Approved	12/6/2016	12/5/2021		
Renew	1/23/1998	Discharge	00897	Approved	8/24/1998	8/24/2003	250	39.75
Renew	8/29/2003	Discharge	00897	Approved	4/5/2004	4/4/2009		
Renew	5/19/2009	Discharge	00897	Approved	11/17/2009	11/16/2014		
Renew	8/24/2015	Discharge	00897	Approved	4/27/2016	4/26/2021		
Transfer	6/4/1996	Discharge	00899	Approved	2/26/1998	2/26/2003	3,000	476.96
Transfer	4/19/2002	Discharge	00899	Approved	5/15/2002	2/26/2003		
Renew	2/27/2003	Discharge	00899	Approved	5/9/2003	4/24/2008		
Renew	7/9/2009	Discharge	00899	Approved	10/6/2009	10/5/2014		
Transfer	4/30/1996	Discharge	00900	Approved	2/26/1998	2/26/2003	15,700	2,496.10
Transfer	4/19/2002	Discharge	00900	Approved	5/15/2002	2/26/2003		
Renew	2/27/2003	Discharge	00900	Approved	5/9/2003	4/24/2008		
Renew	7/9/2009	Discharge	00900	Approved	10/6/2009	10/5/2014		
New	6/1/2001	Discharge	00906	Approved	8/3/2001	8/2/2006	500	79.49
Renew	5/4/2009	Discharge	00906	Approved	10/27/2009	10/26/2014		
Amend	11/3/2014	Discharge	00906	Approved	8/4/2016	8/3/2021		
New	12/4/2000	Discharge	00907	Approved	3/19/2001	3/18/2006	375	59.62
Renew	3/28/2006	Discharge	00907	Approved	5/1/2006	4/30/2011		
Amend	7/29/2008	Discharge	00907	Approved	11/18/2008	4/30/2011		
Renew	4/26/2011	Discharge	00907	Approved	7/11/2011	7/10/2016		
Amend	6/20/2014	Discharge	00907	Approved	11/7/2014	7/10/2016		
Renew	4/26/2006	Discharge	00936	Approved	10/11/2006	10/10/2011	250	39.75
Renew	10/7/2011	Discharge	00936	Approved	7/10/2013	7/10/2018		
Amend	7/1/2016	Discharge	00936	Approved	7/29/2016	7/10/2018		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
Renew	7/9/1999	Discharge	00943	Approved	8/18/2000	8/17/2005	200	31.80
Transfer	6/7/2004	Discharge	00943	Approved	9/15/2004	9/14/2009		
Renew	12/22/2009	Discharge	00943	Approved	1/19/2012	1/17/2017		
Renew	9/21/1993	Discharge	00944	Approved	7/8/1994	7/8/1999	375	59.62
Renew	3/9/2001	Discharge	00944	Approved	1/15/2002	1/14/2007		
Renew	3/25/2008	Discharge	00944	Approved	6/12/2009	6/11/2014		
Amend	6/11/2014	Discharge	00944	Approved	5/22/2015	5/21/2020		
Renew	6/11/2014	Discharge	00944	Approved	5/22/2015	5/21/2020		
New	3/1/2001	Discharge	00947	Approved	6/13/2001	6/12/2006	450	71.54
Renew	7/18/2006	Discharge	00947	Approved	8/22/2006	8/21/2011		
Renew	8/16/2011	Discharge	00947	Approved	7/11/2012	7/11/2017		
Amend	5/27/2016	Discharge	00947	Approved	6/17/2016	7/11/2017		
New	5/16/1995	Discharge	00965	Approved	6/27/1995	6/27/2000	595	94.60
Renew	4/5/2001	Discharge	00965	Approved	7/26/2001	7/25/2006		
Amend	6/10/2005	Discharge	00965	Approved	7/6/2005	7/25/2006		
Renew	9/5/2006	Discharge	00965	Approved	6/17/2013	6/17/2018		
Amend	6/23/2014	Discharge	00965	Approved	3/19/2015	6/17/2018		
Renew	4/5/2001	Discharge	00966	Approved	7/26/2001	7/25/2006	155	24.64
Renew	11/21/2006	Discharge	00966	Approved	1/11/2013	1/11/2018		
Renew	4/1/2016	Discharge	00966	Approved	4/29/2016	1/11/2018		
New	11/2/1995	Discharge	00973	Approved	1/22/1996	1/22/2001	200	31.80
Renew	4/5/2001	Discharge	00973	Approved	7/26/2001	7/25/2006		
Renew	11/3/2006	Discharge	00973	Approved	1/10/2013	1/10/2018		
Amend	6/23/2014	Discharge	00973	Approved	3/2/2015	1/10/2018		
New	5/20/1997	Discharge	00995	Approved	1/13/1998	1/13/2003	75	11.92
Renew	8/19/2003	Discharge	00995	Approved	3/26/2004	3/25/2009		
Renew	11/18/2009	Discharge	00995	Approved	1/19/2012	1/19/2017		
Amend	9/11/2014	Discharge	00995	Approved	8/28/2015	1/19/2017		
Renew	1/19/2017	Discharge	00995	Approved	3/31/2017	3/30/2022		
New	8/11/1998	Discharge	01004	Approved	9/11/1998	9/11/2003	N/A	N/A
Renew	8/12/2003	Discharge	01004	Approved	7/1/2004	6/30/2009		
Renew	10/27/2009	Discharge	01004	Approved	11/14/2012	11/15/2017		

Type	Date received	Permit designation	Permit/application number	Action status	Final action date	Permit expire date	bbls day^{-1}	m^3 day^{-1}
New	6/25/1999	Discharge	01011	Approved	11/12/1999	11/11/2004	1,500	238.48
Renew	11/8/2004	Discharge	01011	Approved	1/20/2005	1/19/2010		
Renew	4/13/2010	Discharge	01011	Approved	12/14/2012	12/14/2017		
Amend	10/12/2015	Discharge	01011	Approved	1/22/2016	1/21/2021		
New	10/30/2002	Discharge	01031	Approved	1/15/2003	1/14/2008	N/A	N/A
Transfer	4/16/2004	Discharge	01031	Approved	9/14/2004	1/14/2008		
Renew	3/19/2008	Discharge	01031	Approved	5/23/2008	5/22/2013		
Renew	5/4/2009	Discharge	01031	Approved	8/13/2013	8/12/2018		
New	10/30/2002	Discharge	01032	Approved	1/15/2003	1/14/2008	N/A	N/A
Transfer	5/24/2004	Discharge	01032	Approved	8/25/2004	1/14/2008		
Amend	3/6/2007	Discharge	01032	Approved	2/19/2008	1/14/2008		
Renew	5/6/2008	Discharge	01032	Approved	8/13/2013	8/12/2018		
New	7/25/2005	Discharge	01048	Approved	9/21/2005	9/20/2010	4,770	758.37
Amend	9/28/2005	Discharge	01048	Approved	10/4/2005	9/20/2010		
Renew	12/1/2008	Discharge	01048	Approved	6/28/2013	6/27/2018		
New	1/7/2013	Discharge	01107	Approved	7/18/2013	7/17/2018	450	71.54
Amend	9/11/2014	Discharge	01107	Approved	7/6/2015	7/17/2018		
New	8/15/2016	Discharge	01120	Approved	9/26/2016	9/25/2021	25	3.97
New	9/6/2016	Discharge	01121	Approved	5/19/2017	5/18/2022	N/A	N/A
						Total	**9,745**	**14,268**

Billion barrels per day (bbls day^{-1}) represents the number of barrels of water permitted to discharge per day, m^3 day^{-1} represents the quantity in cubic meters, and N/A represents information not available. These data do not include the four discharge locations that were not displayed as "active" in the open records request. For the complete list of data received, including all permits both active and inactive, as well as renewal dates and locations, please see SI IV.5.

SI IV.3 Permit status information

The following information is based off data provided by a Railroad Commission of Texas open records request. Permits in red indicate inactive permits; permits in grey indicate the first registered date for the respective active permit.

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
Renew		**00005**	Bay Rock Operating Company	Approved	6/7/2001	none
Renew	6/14/2006	**00005**	Bay Rock Operating Company	Approved	12/17/2012	12/16/2017
Renew	6/23/1998	**00006**	Bay Rock Corp.	Approved	4/27/2000	
Renew	1/4/2001	**00009**	Bay Rock Operating Company	Approved	6/7/2001	6/6/2006
Transfer		**00014**	Duke Energy Field Services, Inc.	Approved	2/18/1999	2/17/2004
Transfer	11/20/2000	**00017**	Pueblo Midstream Gas Corporation	Approved	5/8/2002	5/7/2007
Renew	2/19/2004	**00030**	Ray Jr. Co., Inc.	Approved	8/23/2004	8/22/2009
Renew	12/15/2009	**00030**	Ray Jr. Co., Inc.	Approved	10/5/2010	9/29/2015
Renew		**00053**	Vastar Resources, Inc.	Approved	3/13/1998	3/13/2003
Renew		**00054**	Vastar Resources, Inc.	Approved	3/13/1998	3/13/2003
Transfer	5/10/1993	**00065**	Enex Resources Corp.	Approved	9/8/1993	9/8/1998
Renew	4/19/2000	**00065**	3TEC Energy Corp.	Approved	3/27/2002	3/26/2003
Transfer	10/16/2003	**00065**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	8/13/2009	**00065**	MCA Petroleum Corporation	Approved	8/3/2012	8/2/2017
Amend	8/13/2009	**00065**	MCA Petroleum Corporation	Approved	8/3/2012	8/2/2017
Transfer	5/10/1993	**00066**	Enex Resources Corp.	Approved	9/8/1993	9/8/1998
Renew	4/19/2000	**00066**	3TEC Energy Corp.	Approved	3/27/2002	3/26/2003
Transfer	9/19/2003	**00066**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	9/19/2003	**00066**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	8/13/2009	**00066**	MCA Petroleum Corporation	Approved	8/3/2012	8/2/2017
Amend	8/13/2009	**00066**	MCA Petroleum Corporation	Approved	8/3/2012	8/2/2017
Transfer	11/7/1996	**00116**	Bellwether Exploration Company	Approved	8/13/1997	8/13/2002
Transfer	4/3/2001	**00116**	RSEC II, LLC	Approved	5/14/2001	8/13/2002
Renew	8/14/2002	**00116**	RSEC II, LLC	Approved	9/10/2002	9/9/2007
Transfer	10/20/1997	**00130**	Louis Dreyfus Natural Gas Corp.	Approved	6/20/2000	6/19/2005
Renew	2/25/1999	**00190**	GPM Gas Corporation	Approved	4/30/1999	4/30/2004
Transfer	2/25/2000	**00190**	GPM Gas Company LLC	Approved	8/18/2000	4/30/2004
Renew	2/25/1999	**00206**	GPM Gas Corporation	Approved	4/30/1999	4/30/2004
Transfer	2/25/2000	**00206**	GPM Gas Company LLC	Approved	8/18/2000	4/30/2004
Renew	8/20/2003	**00236**	Sabco Operating Company	Approved	5/7/2004	5/6/2009

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
Renew	9/17/2007	**00236**	Sabco Operating Company	Approved	10/27/2009	10/26/2014
Amend	2/29/2012	**00236**	Sabco Operating Company	Approved	5/8/2012	10/26/2014
Renew	4/12/1996	**00268**	National Energy Group, Inc.	Approved	2/16/2000	2/15/2005
Transfer	11/1/2000	**00268**	Orient Petroleum Offshore, LLC	Approved	11/16/2000	2/15/2005
Transfer	12/14/2000	**00268**	Osprey Petroleum Company, Inc.	Approved	1/23/2001	2/15/2005
Amend	8/7/2002	**00268**	Osprey Petroleum Company, Inc.	Approved	9/4/2002	2/15/2005
Amend	7/14/2003	**00268**	Osprey Petroleum Company, Inc.	Approved	7/29/2003	2/15/2005
Transfer	7/23/2004	**00268**	Sterling Energy, Inc.	Approved	9/20/2004	9/19/2009
Renew	9/18/2009	**00268**	Sterling Energy, Inc.	Approved	11/24/2009	11/23/2014
Transfer	1/25/2011	**00268**	Atinum Energy, Inc.	Approved	3/28/2012	3/27/2017
Amend		**00268**	Sterling Energy, Inc.	Approved		
Renew	2/25/1999	**00269**	GPM Gas Company LLC	Approved	11/6/2000	11/6/2005
Transfer	10/29/1997	**00687**	Sharpe Energy Company	Approved	1/7/2000	1/6/2005
Transfer	7/19/2001	**00687**	Vamos Oil & Gas, LLC	Approved	8/30/2001	1/6/2005
Amend	1/28/1999	**00692**	Tri-Union Development Corp.	Approved	1/29/1999	9/30/2003
Transfer	12/16/1997	**00695**	Xplor Energy Operating Co.	Approved	7/31/1998	8/4/2003
Transfer	12/5/2001	**00695**	Enfield Operating, L.L.C.	Approved	1/4/2002	8/4/2003
New	3/8/1999	**00697**	Whiting Petroleum Corporation	Approved	6/18/1999	6/17/2004
Amend	3/9/2001	**00697**	Whiting Petroleum Corporation	Approved	3/26/2001	6/17/2004
Transfer	2/20/2004	**00697**	Whiting Oil and Gas Corporation	Approved	6/8/2004	6/7/2009
Transfer	4/9/1998	**00707**	Forcenergy, Inc.	Approved	5/21/1999	6/22/2000
Renew	5/23/2000	**00707**	Forcenergy, Inc.	Approved	10/24/2000	10/23/2005
Transfer	1/16/2001	**00707**	Forest Oil Corp.	Approved	1/30/2001	10/23/2005
Renew	3/5/1997	**00731**	Rutherford Oil Corporation	Approved	10/13/1998	10/13/2003
New	8/14/1986	**00732**	Rutherford Oil Corporation	Approved	8/26/1986	
Amend	1/7/1991	**00733**	Rutherford Oil Corporation	Approved	2/11/1991	none
Transfer	8/3/1995	**00741**	National Energy Group, Inc.	Approved	8/18/1995	8/18/2000
Transfer	4/11/2006	**00741**	Chaparral Energy, L.L.C.	Approved	5/9/2006	5/8/2011
Renew	5/8/1998	**00759**	Delray Oil, Inc.	Approved	3/23/1999	3/22/2004
Renew	2/17/2004	**00759**	Delray Oil, Inc.	Approved	4/2/2004	4/1/2009
Renew	4/28/2009	**00759**	Delray Oil, Inc.	Approved	10/30/2009	10/29/2014
Renew	8/28/2009	**00759**	Delray Oil, Inc.	Approved	10/30/2009	
Renew	10/22/2014	**00759**	Delray Oil, Inc.	Approved	12/16/2016	12/15/2021
Transfer	8/7/1995	**00760**	Sellers Lease Service, Inc.	Approved	1/22/1996	1/22/2001

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Renew	12/5/2006	**00760**	Sellers Lease Service, Inc.	Approved	4/18/2007	4/17/2012
Renew	3/27/2012	**00760**	Sellers Lease Service, Inc.	Approved	3/2/2015	3/2/2020
Amend	7/5/2016	**00760**	Sellers Lease Service, Inc.	Approved	8/25/2016	3/2/2020
Amend	9/1/2016	**00760**	Sellers Lease Service, Inc.	Approved	9/30/2016	3/2/2020
Renew	5/4/1987	**00762**	Delray Oil, Inc.	Approved	10/30/2009	10/29/2014
Renew	5/8/1998	**00762**	Delray Oil, Inc.	Approved	3/23/1999	3/22/2004
Renew	2/17/2004	**00762**	Delray Oil, Inc.	Approved	4/6/2004	4/5/2009
Renew	10/22/2014	**00762**	Delray Oil, Inc.	Approved	12/16/2016	12/15/2021
Renew	3/19/2001	**00763**	Vomela Resources, Inc.	Approved	5/10/2001	5/9/2006
Transfer	12/9/2002	**00763**	Sellers Lease Service, Inc.	Approved	4/17/2003	5/9/2006
Renew	5/24/2006	**00763**	Sellers Lease Service, Inc.	Approved	7/11/2006	7/10/2011
Renew	7/13/2011	**00763**	Sellers Lease Service, Inc.	Approved	7/10/2013	7/10/2018
Amend	6/23/2014	**00763**	Sellers Lease Service, Inc.	Approved	6/4/2015	7/10/2018
Transfer	12/9/2002	**00764**	Sellers Lease Service, Inc.	Approved	4/17/2003	5/9/2006
Renew	5/26/2006	**00764**	Sellers Lease Service, Inc.	Approved	7/11/2006	7/10/2011
Renew	7/15/2011	**00764**	Sellers Lease Service, Inc.	Approved	3/30/2012	7/10/2011
Amend	9/11/2014	**00764**	Sellers Lease Service, Inc.	Approved	1/5/2015	3/29/2017
Amend	9/11/2014	**00764**	Sellers Lease Service, Inc.	Approved	1/20/2015	3/29/2017
Renew	3/16/2017	**00764**	Sellers Lease Service, Inc.	Approved	6/16/2017	6/15/2022
Renew	8/28/2003	**00765**	Guinn Operating Company	Approved	3/9/2004	3/8/2009
Renew	3/12/2009	**00765**	Guinn Operating Company	Approved	6/19/2009	6/18/2014
Renew	6/23/2014	**00765**	Guinn Operating Company	Approved	7/1/2014	7/1/2019
Amend	1/20/2015	**00765**	Guinn Operating Company	Approved	2/9/2015	7/1/2019
Renew	8/26/2003	**00768**	Acock/Anaqua Operating Co., LC	Approved	4/2/2004	4/1/2009
Renew	5/8/2009	**00768**	Acock/Anaqua Operating Co., LC	Approved	10/2/2009	10/1/2014
New	2/19/1999	**00775**	B J P Operating	Approved	5/24/1999	5/23/2004
Transfer	5/25/2004	**00775**	Harrier Holdings, LTD	Approved	7/27/2004	7/26/2009
Renew	1/16/2009	**00775**	Harrier Holdings, LTD	Approved	3/31/2009	3/30/2014
Renew	10/3/2014	**00775**	Harrier Holdings, LTD	Approved	2/24/2015	2/24/2020
New	8/30/1983	**00777**	Hardin Oil Enterprises	Approved	11/1/1983	none
Amend	5/12/2009	**00777**	Sellers Lease Service, Inc.	Approved	6/4/2009	6/3/2014
Transfer	5/12/2009	**00777**	Sellers Lease Service, Inc.	Approved	6/4/2009	6/3/2014
Renew	6/18/2014	**00777**	Sellers Lease Service, Inc.	Approved	6/25/2014	6/25/2019
Amend	9/11/2014	**00777**	Sellers Lease Service, Inc.	Approved	1/2/2015	6/25/2019

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Amend	9/11/2014	**00777**	Sellers Lease Service, Inc.	Approved	1/5/2015	6/25/2019
Amend	9/11/2014	**00777**	Sellers Lease Service, Inc.	Approved	1/20/2015	6/25/2019
Amend	8/16/1993	**00778**	Sellers Lease Service, Inc.	Approved	12/28/1993	7/23/1998
Renew	11/17/2000	**00778**	Sellers Lease Service, Inc.	Approved	10/10/2001	10/9/2006
Renew	6/25/2007	**00778**	Sellers Lease Service, Inc.	Approved	1/10/2013	1/10/2018
Amend	6/23/2014	**00778**	Sellers Lease Service, Inc.	Approved		1/10/2018
Amend	9/11/2014	**00778**	Sellers Lease Service, Inc.	Approved	2/3/2015	1/10/2018
New	8/3/1995	**00782**	O. Neathery III	Approved	10/31/1995	10/31/2000
Renew	9/11/2000	**00782**	O. Neathery III	Approved	3/6/2001	3/5/2006
Renew	3/28/2006	**00782**	Sellers Lease Service, Inc.	Approved	6/26/2006	6/25/2011
Amend	7/29/2008	**00782**	Sellers Lease Service, Inc.	Approved	11/18/2008	6/25/2011
Renew	7/6/2011	**00782**	Sellers Lease Service, Inc.	Approved	2/3/2012	2/2/2017
Amend	9/11/2014	**00782**	Sellers Lease Service, Inc.	Approved	2/3/2015	2/2/2017
Amend	9/10/2015	**00782**	Sellers Lease Service, Inc.	Approved	2/3/2015	2/2/2017
Renew	2/24/2017	**00782**	Sellers Lease Service, Inc.	Approved	3/20/2017	3/19/2022
New	6/2/1983	**00783**	Somont Oil Co Inc	Approved	6/2/1983	none
Amend	9/11/2014	**00783**	Somont Oil Co Inc	Approved	1/2/2015	1/2/2020
Amend	9/11/2014	**00783**	Somont Oil Co Inc	Approved	1/5/2015	1/2/2020
Amend	9/11/2014	**00783**	Somont Oil Co Inc	Approved	2/17/2015	1/2/2020
New	3/1/2001	**00786**	REC Well Service, Inc.	Approved	6/13/2001	6/12/2006
Renew	7/18/2006	**00786**	REC Well Service, Inc.	Approved	8/22/2006	8/21/2011
Renew	8/16/2011	**00786**	Rickaway Energy, Corp.	Approved	7/11/2012	7/11/2017
Amend	8/16/2011	**00786**	Rickaway Energy, Corp.	Approved	1/2/2015	7/11/2017
Amend	8/16/2011	**00786**	Rickaway Energy, Corp.	Approved	1/5/2015	7/11/2017
New	5/22/1997	**00787**	Guinn Operating Company	Approved	2/17/1998	2/17/2003
Renew	8/28/2003	**00787**	Guinn Operating Company	Approved	7/20/2004	3/8/2009
Renew	3/2/2009	**00787**	Guinn Operating Company	Approved	6/19/2009	6/18/2014
Transfer	10/26/1995	**00791**	Wen-Be	Approved	11/8/1995	11/8/2000
Renew	9/8/2003	**00791**	Wen-Be	Approved	6/8/2004	6/7/2009
Renew	11/3/1997	**00805**	Brymer Contracting Incorporated	Approved	4/10/1998	4/10/2003
Renew	7/31/2002	**00805**	Brymer Contracting Incorporated	Approved	10/16/2002	10/15/2007
Renew	3/25/2009	**00805**	Brymer Contracting Incorporated	Approved	9/29/2009	9/28/2014
New	1/23/1998	**00808**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	9/19/2003	**00808**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009

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Renew	5/8/2009	**00808**	MCA Petroleum Corporation	Approved	8/3/2012	8/2/2017
New	5/10/1988	**00809**	Davenport Oil Company	Approved	1/23/1989	1/23/1994
Renew	9/8/1994	**00809**	Davenport Oil Company	Approved	5/23/1995	5/23/2000
Transfer	2/5/1997	**00809**	JAD Oil, Inc.	Approved	7/23/1999	5/23/2000
Renew	11/29/1995	**00811**	Ray Jr. Co., Inc.	Approved	1/22/1996	1/22/2001
Renew	2/19/2004	**00811**	Ray Jr. Co., Inc.	Approved	4/7/2004	4/6/2009
Transfer	2/11/1991	**00814**	MCA Petroleum Corporation	Approved	3/9/1991	
Renew	9/11/2014	**00814**	MCA Petroleum Corporation	Approved	7/15/2015	7/15/2020
Transfer		**00817**	W. C. Miller Operating Company	Approved	4/17/1989	
Renew	3/1/2001	**00821**	REC Well Service, Inc.	Approved	6/13/2001	6/12/2006
Renew	7/18/2006	**00821**	REC Well Service, Inc.	Approved	8/22/2006	8/21/2011
Renew	8/16/2011	**00821**	Rickaway Energy, Corp.	Approved	7/11/2012	7/11/2017
Amend	5/27/2016	**00821**	Rickaway Energy, Corp.	Approved	6/17/2016	7/11/2017
Transfer	12/11/1995	**00823**	Heartland Resources, Inc.	Approved	4/3/1996	4/3/2001
Amend	11/26/2001	**00823**	Heartland Resources, Inc.	Approved	3/7/2006	1/17/2007
Renew	12/4/2009	**00823**	Three Forks Operating Co LLC	Approved	6/20/2013	6/19/2018
Amend	6/23/2014	**00823**	Three Forks Operating Co LLC	Approved	5/21/2015	6/19/2018
Renew	9/2/2003	**00828**	Guinn Operating Company	Approved	3/9/2004	3/8/2009
Renew	3/2/2009	**00828**	Guinn Operating Company	Approved	6/19/2009	6/18/2014
Renew	6/23/2014	**00828**	Guinn Operating Company	Approved	9/5/2014	9/4/2019
Transfer	6/23/2014	**00828**	Guinn Operating Company LLC	Approved	9/5/2014	9/4/2019
Amend	6/23/2014	**00828**	Guinn Operating Company LLC	Approved	5/20/2015	9/4/2019
Renew	8/28/2003	**00832**	Guinn Operating Company	Approved	3/9/2004	3/8/2009
Renew	6/23/2014	**00832**	Guinn Operating Company	Approved	7/28/2014	7/27/2019
Renew	6/30/2004	**00835**	Bay Rock Operating Company	Approved	9/20/2004	9/19/2009
Renew	6/12/1997	**00845**	Warrior Resources, Inc.	Approved	6/25/1997	6/25/2002
Renew	8/18/2003	**00845**	Warrior Resources, Inc.	Approved	4/26/2004	4/25/2009
Renew	5/21/2012	**00845**	Warrior Resources, Inc.	Approved	5/25/2012	5/24/2017
New	3/27/1995	**00849**	LMN Oil & Gas, Inc.	Approved	6/27/1995	6/27/2000
Renew	1/11/2001	**00849**	Wen-Be	Approved	5/16/2001	5/15/2006
New	1/15/1990	**00850**	Energy Development Corp.	Approved	5/24/1990	none
New	5/4/1998	**00852**	Santos USA Corp.	Approved	7/13/1998	7/13/2003
Transfer	2/14/2001	**00852**	Sterling Exploration & Production Co, LLC	Approved	2/28/2001	7/13/2003
New	4/25/1991	**00858**	MCA Petroleum Corporation	Approved	5/7/1991	

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Amend	9/11/2014	**00858**	MCA Petroleum Corporation	Approved	5/1/2015	5/1/2020
New	1/23/1998	**00859**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	9/19/2003	**00859**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	5/19/2009	**00859**	MCA Petroleum Corporation	Approved	6/13/2011	6/12/2016
Transfer	4/23/2015	**00859**	Sellers Lease Service, Inc.	Approved	6/17/2015	6/12/2016
Renew	7/5/2016	**00859**	Sellers Lease Service, Inc.	Approved	9/14/2016	9/13/2021
Transfer	6/4/1996	**00869**	Somex Energy Company	Approved	2/26/1998	2/26/2003
Transfer	4/19/2002	**00869**	Acock Engineering & Assoc., Inc.	Approved	5/15/2002	2/26/2003
Renew	2/27/2003	**00869**	Acock/Anaqua Operating Co., LC	Approved	5/9/2003	4/24/2008
Renew	7/9/2009	**00869**	Acock/Anaqua Operating Co., LC	Approved	10/6/2009	10/5/2014
Renew	9/11/2014	**00869**	Acock/Anaqua Operating Co., LC	Approved	3/23/2015	3/23/2020
Transfer	6/4/1996	**00870**	Somex Energy Company	Approved	2/26/1998	2/26/2003
Transfer	4/19/2002	**00870**	Acock Engineering & Assoc., Inc.	Approved	5/15/2002	2/26/2003
Renew	2/27/2003	**00870**	Acock/Anaqua Operating Co., LC	Approved	5/9/2003	4/24/2008
Renew	7/9/2009	**00870**	Acock/Anaqua Operating Co., LC	Approved	10/6/2009	10/5/2014
Renew	9/11/2014	**00870**	Acock/Anaqua Operating Co., LC	Approved	3/23/2015	3/23/2020
Transfer	6/4/1996	**00871**	Somex Energy Company	Approved	2/26/1998	2/26/2003
Transfer	4/19/2002	**00871**	Acock Engineering & Assoc., Inc.	Approved	5/15/2002	2/26/2003
Renew	2/27/2003	**00871**	Acock/Anaqua Operating Co., LC	Approved	5/9/2003	4/24/2008
Renew	10/20/2008	**00871**	Acock/Anaqua Operating Co., LC	Approved	10/2/2009	10/1/2014
Renew	9/11/2014	**00871**	Acock/Anaqua Operating Co., LC	Approved	3/23/2015	3/23/2020
Transfer	6/4/1996	**00872**	Somex Energy Company	Approved	2/26/1998	2/26/2003
Transfer	4/19/2002	**00872**	Acock Engineering & Assoc., Inc.	Approved	5/15/2002	2/26/2003
Renew	2/27/2003	**00872**	Acock/Anaqua Operating Co., LC	Approved	5/9/2003	4/24/2008
Renew	7/21/2008	**00872**	Acock/Anaqua Operating Co., LC	Approved	5/7/2013	5/6/2018
Transfer	2/2/1998	**00885**	Seagull Energy E&P, Inc.	Approved	4/28/1999	4/27/2004
Renew	5/29/1997	**00886**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	11/7/2003	**00886**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	5/19/2009	**00886**	MCA Petroleum Corporation	Approved	8/3/2012	8/15/2017
Amend	5/29/1997	**00887**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	9/19/2003	**00887**	MCA Petroleum Corporation	Approved	4/4/2009	4/4/2009
Amend	9/11/2014	**00887**	MCA Petroleum Corporation	Approved	5/1/2015	6/12/2016
Renew	6/20/2016	**00887**	MCA Petroleum Corporation	Approved	8/16/2016	8/17/2021
Renew		**00887**	MCA Petroleum Corporation	Approved	6/13/2011	6/12/2016

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Renew	5/29/1997	**00889**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	8/29/2003	**00889**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	1/27/2011	**00889**	MCA Petroleum Corporation	Approved	6/13/2011	6/12/2016
Amend	9/11/2014	**00889**	MCA Petroleum Corporation	Approved	5/1/2015	6/12/2016
Renew	6/20/2016	**00889**	MCA Petroleum Corporation	Approved	8/2/2016	8/1/2021
Amend	2/1/2017	**00889**	MCA Petroleum Corporation	Approved	2/21/2017	8/1/2021
Renew	5/29/1997	**00890**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	8/29/2003	**00890**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	1/27/2011	**00890**	MCA Petroleum Corporation	Approved	6/13/2011	6/12/2016
Amend	9/11/2014	**00890**	MCA Petroleum Corporation	Approved	5/1/2015	6/12/2016
Renew	6/20/2016	**00890**	MCA Petroleum Corporation	Approved	8/2/2016	8/1/2021
Amend	2/1/2017	**00890**	MCA Petroleum Corporation	Approved	2/21/2017	8/1/2021
Renew	5/29/1997	**00891**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	10/16/2003	**00891**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	1/27/2011	**00891**	MCA Petroleum Corporation	Approved	6/13/2011	6/12/2016
Amend	9/11/2014	**00891**	MCA Petroleum Corporation	Approved	6/1/2015	6/12/2016
Renew	6/20/2016	**00891**	MCA Petroleum Corporation	Approved	8/18/2016	8/17/2021
Renew	5/29/1997	**00892**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	11/7/2003	**00892**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Transfer	9/16/2004	**00892**	Sellers Lease Service, Inc.	Approved	12/23/2004	12/22/2009
Renew	11/8/2010	**00892**	MCA Petroleum Corporation	Approved	1/9/2012	1/9/2017
Renew	5/15/1998	**00893**	Sellers Lease Service, Inc.	Approved	3/22/1999	3/21/2004
Renew	5/29/1997	**00894**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	5/29/1997	**00895**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	8/29/2003	**00895**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Transfer	4/23/2015	**00895**	Sellers Lease Service, Inc.	Approved	12/16/2015	6/12/2016
Renew	7/5/2016	**00895**	Sellers Lease Service, Inc.	Approved	12/6/2016	12/5/2021
Renew	1/23/1998	**00897**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	8/29/2003	**00897**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Renew	5/19/2009	**00897**	MCA Petroleum Corporation	Approved	11/17/2009	11/16/2014
Renew	8/24/2015	**00897**	MCA Petroleum Corporation	Approved	4/27/2016	4/26/2021
Renew	3/9/1998	**00898**	Amoco Production Company	Approved	3/17/1999	3/16/2004
Transfer	6/4/1996	**00899**	Somex Energy Company	Approved	2/26/1998	2/26/2003
Transfer	4/19/2002	**00899**	Acock Engineering & Assoc., Inc.	Approved	5/15/2002	2/26/2003

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Renew	2/27/2003	**00899**	Acock/Anaqua Operating Co., LC	Approved	5/9/2003	4/24/2008
Renew	7/9/2009	**00899**	Acock/Anaqua Operating Co., LC	Approved	10/6/2009	10/5/2014
Transfer	4/30/1996	**00900**	Somex Energy Company	Approved	2/26/1998	2/26/2003
Transfer	4/19/2002	**00900**	Acock Engineering & Assoc., Inc.	Approved	5/15/2002	2/26/2003
Renew	2/27/2003	**00900**	Acock/Anaqua Operating Co., LC	Approved	5/9/2003	4/24/2008
Renew	7/9/2009	**00900**	Acock/Anaqua Operating Co., LC	Approved	10/6/2009	10/5/2014
Renew	1/23/1998	**00902**	MCA Petroleum Corporation	Approved	8/24/1998	8/24/2003
Renew	9/19/2003	**00902**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
Transfer	9/14/2011	**00902**	Acock Operating Limited	Approved	1/19/2012	4/14/2016
New	6/1/2001	**00906**	C. R. Devine, Inc.	Approved	8/3/2001	8/2/2006
Renew	5/4/2009	**00906**	C. R. Devine, Inc.	Approved	10/27/2009	10/26/2014
Amend	11/3/2014	**00906**	C. R. Devine, Inc.	Approved	8/4/2016	8/3/2021
New	12/4/2000	**00907**	Sellers Lease Service, Inc.	Approved	3/19/2001	3/18/2006
Renew	3/28/2006	**00907**	Sellers Lease Service, Inc.	Approved	5/1/2006	4/30/2011
Amend	7/29/2008	**00907**	Sellers Lease Service, Inc.	Approved	11/18/2008	4/30/2011
Renew	4/26/2011	**00907**	Sellers Lease Service, Inc.	Approved	7/11/2011	7/10/2016
Amend	6/20/2014	**00907**	Sellers Lease Service, Inc.	Approved	11/7/2014	7/10/2016
Transfer	10/20/1997	**00910**	Louis Dreyfus Natural Gas Corp.	Approved	6/20/2000	6/19/2005
Transfer	9/14/1995	**00916**	R. K. Bledsoe Trust Oil Operator	Approved	2/14/1996	2/14/2001
Transfer	8/30/1996	**00930**	Tenex Corporation	Approved	2/17/1998	2/17/2003
Renew	4/26/1993	**00935**	W. C. Miller Operating Company	Approved	8/25/1993	8/25/1998
Amend	5/23/1995	**00935**	W. C. Miller Operating Company	Approved	6/27/1995	8/25/1998
Renew	4/26/2006	**00936**	Warrior Resources, Inc.	Approved	10/11/2006	10/10/2011
Renew	10/7/2011	**00936**	Warrior Resources, Inc.	Approved	7/10/2013	7/10/2018
Amend	7/1/2016	**00936**	Warrior Resources, Inc.	Approved	7/29/2016	7/10/2018
Renew	7/9/1999	**00943**	Means Oil Co.	Approved	8/18/2000	8/17/2005
Transfer	6/7/2004	**00943**	EES Oil Company, LLC	Approved	9/15/2004	9/14/2009
Renew	12/22/2009	**00943**	EES Oil Company, LLC	Approved	1/19/2012	1/17/2017
Renew	9/21/1993	**00944**	Warrior Resources, Inc.	Approved	7/8/1994	7/8/1999
Renew	3/9/2001	**00944**	Warrior Resources, Inc.	Approved	1/15/2002	1/14/2007
Renew	3/25/2008	**00944**	Warrior Resources, Inc.	Approved	6/12/2009	6/11/2014
Amend	6/11/2014	**00944**	Warrior Resources, Inc.	Approved	5/22/2015	5/21/2020
Renew	6/11/2014	**00944**	Warrior Resources, Inc.	Approved	5/22/2015	5/21/2020
Transfer	12/23/1996	**00945**	J. W. Lacey, Jr.	Approved	10/2/1998	10/2/2003

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
New	3/1/2001	**00947**	REC Well Service, Inc.	Approved	6/13/2001	6/12/2006
Renew	7/18/2006	**00947**	REC Well Service, Inc.	Approved	8/22/2006	8/21/2011
Renew	8/16/2011	**00947**	Rickaway Energy, Corp.	Approved	7/11/2012	7/11/2017
Amend	5/27/2016	**00947**	Rickaway Energy, Corp.	Approved	6/17/2016	7/11/2017
Transfer	2/4/1997	**00955**	Forcenergy, Inc.	Approved	6/9/1997	2/8/2000
Renew	5/16/2000	**00955**	Forcenergy, Inc.	Approved	10/24/2000	10/23/2005
Transfer	1/16/2001	**00955**	Forest Oil Corp.	Approved	1/30/2001	10/23/2005
Transfer	2/4/1997	**00956**	Forcenergy, Inc.	Approved	6/9/1997	2/8/2000
Renew	4/9/1998	**00959**	Forcenergy, Inc.	Approved	1/20/2000	1/19/2005
Renew	4/9/1998	**00960**	Forcenergy, Inc.	Approved	1/20/2000	1/19/2005
Amend	10/14/1999	**00960**	Forcenergy, Inc.	Approved	1/20/2000	1/19/2005
New	5/16/1995	**00965**	Sellers Lease Service, Inc.	Approved	6/27/1995	6/27/2000
Renew	4/5/2001	**00965**	Sellers Lease Service, Inc.	Approved	7/26/2001	7/25/2006
Amend	6/10/2005	**00965**	Sellers Lease Service, Inc.	Approved	7/6/2005	7/25/2006
Renew	9/5/2006	**00965**	Sellers Lease Service, Inc.	Approved	6/17/2013	6/17/2018
Amend	6/23/2014	**00965**	Sellers Lease Service, Inc.	Approved	3/19/2015	6/17/2018
Renew	4/5/2001	**00966**	Sellers Lease Service, Inc.	Approved	7/26/2001	7/25/2006
Renew	11/21/2006	**00966**	Sellers Lease Service, Inc.	Approved	1/11/2013	1/11/2018
Renew	4/1/2016	**00966**	Sellers Lease Service, Inc.	Approved	4/29/2016	1/11/2018
New	10/23/1995	**00971**	The Rollert Co., Inc.	Approved	12/19/1995	12/19/2000
Transfer	8/4/2003	**00971**	RBR Operating, Inc.	Approved	2/26/2004	2/25/2009
Renew	1/21/2009	**00971**	RBR Operating, Inc.	Approved	3/20/009	3/20/2014
New	11/2/1995	**00973**	Sellers Lease Service, Inc.	Approved	1/22/1996	1/22/2001
Renew	4/5/2001	**00973**	Sellers Lease Service, Inc.	Approved	7/26/2001	7/25/2006
Renew	11/3/2006	**00973**	Sellers Lease Service, Inc.	Approved	1/10/2013	1/10/2018
Amend	6/23/2014	**00973**	Sellers Lease Service, Inc.	Approved	3/2/2015	1/10/2018
Renew	11/12/1998	**00976**	Koch Gateway Pipeline Co.	Approved	9/5/2000	9/4/2005
Renew	3/10/1997	**00979**	Mid-Gulf, Inc.	Approved	11/18/1998	11/17/2003
New	9/23/1996	**00989**	Swift Energy Company	Approved	1/27/1998	1/27/2003
New	9/23/1996	**00990**	Swift Energy Company	Approved	1/27/1998	1/27/2003
Renew	2/2/2004	**00990**	Whiting Oil and Gas Corporation	Approved	6/8/2004	5/26/2009
Renew	10/5/2009	**00990**	Whiting Oil and Gas Corporation	Approved	3/9/2012	8/24/2015
Amend	10/5/2009	**00990**	Whiting Oil and Gas Corporation	Approved	3/9/2012	8/24/2015
Renew	9/23/1996	**00991**	Swift Energy Company	Approved	1/29/1998	1/29/2003

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
New	1/27/1997	**00993**	Maple Energy Inc.	Approved	10/15/1997	10/15/2002
New	5/20/1997	**00995**	Bastrop Energy Group	Approved	1/13/1998	1/13/2003
Renew	8/19/2003	**00995**	Bastrop Energy Group	Approved	3/26/2004	3/25/2009
Renew	11/18/2009	**00995**	Bastrop Energy Group	Approved	1/19/2012	1/19/2017
Amend	9/11/2014	**00995**	Bastrop Energy Group	Approved	8/28/2015	1/19/2017
Renew	1/19/2017	**00995**	Bastrop Energy Group	Approved	3/31/2017	3/30/2022
New	10/20/1997	**00997**	Louis Dreyfus Natural Gas Corp.	Approved	2/10/1999	2/10/2004
New	3/27/1998	**01001**	MCA Petroleum Corporation	Approved	6/5/1998	6/5/2003
Renew	8/29/2003	**01001**	MCA Petroleum Corporation	Approved	4/5/2004	4/4/2009
New	8/11/1998	**01004**	Dan A. Hughes Company	Approved	9/11/1998	9/11/2003
Renew	8/12/2003	**01004**	Dan A. Hughes Company	Approved	7/1/2004	6/30/2009
Renew	10/27/2009	**01004**	Dan A. Hughes Company	Approved	11/14/2012	11/15/2017
New	8/12/1998	**01005**	Samedan Oil Corp. - Offshore Div.	Approved	2/10/1999	2/10/2004
Amend	3/22/2000	**01005**	Samedan Oil Corp. - Offshore Div.	Approved	4/21/2000	2/10/2004
Renew	7/16/1998	**01006**	Sellers Lease Service, Inc.	Approved	3/17/1999	3/16/2004
New	7/6/1998	**01007**	Louis Dreyfus Natural Gas Corp.	Approved	4/14/2000	4/13/2005
New	3/27/1998	**01009**	MCA Petroleum Corporation	Approved	4/23/1999	4/22/2004
New	1/26/1999	**01010**	Transwestern Pipeline Company	Approved	9/7/1999	9/6/2000
Renew	11/14/2000	**01010**	Transwestern Pipeline Company	Approved	5/9/2001	5/8/2006
New	6/25/1999	**01011**	Pressly Oil Interest, Inc.	Approved	11/12/1999	11/11/2004
Renew	11/8/2004	**01011**	Pressly Oil Interest, Inc.	Approved	1/20/2005	1/19/2010
Renew	4/13/2010	**01011**	Pressly Oil Interest, Inc.	Approved	12/14/2012	12/14/2017
Amend	10/12/2015	**01011**	Pressly Oil Interest, Inc.	Approved	1/22/2016	1/21/2021
New	7/18/2001	**01012**	Amerada Hess Corporation	Approved	2/6/2002	2/5/2007
Transfer	6/30/2003	**01012**	Anadarko Petroleum Corp.	Approved	7/21/2003	2/5/2007
Transfer	12/7/2004	**01012**	Apache Corporation	Approved	12/30/2004	2/5/2007
Transfer	7/25/2000	**01013**	Coastal Field Services Company	Approved	10/27/2000	10/26/2005
Transfer	2/10/2004	**01013**	El Paso Field Services, L.P.	Approved	8/9/2004	8/8/2009
Transfer	11/8/2004	**01013**	Enterprise Products Operating, L.P.	Approved	1/28/2005	8/8/2009
New	8/7/2000	**01016**	Duke Energy Field Services, LLC	Approved	10/23/2000	10/22/2001
Renew	11/26/2001	**01016**	Duke Energy Field Services, LP	Approved	12/5/2001	12/4/2002
New	9/11/2000	**01017**	Spinnaker Exploration Co., LLC	Approved	11/26/2001	11/25/2006
New	8/30/2001	**01018**	Osprey Petroleum Company, Inc.	Approved	2/6/2002	2/5/2007
New	1/23/2002	**01021**	Amerada Hess Corporation	Approved	3/7/2002	3/6/2007

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
Transfer	6/30/2003	**01021**	Anadarko Petroleum Corp.	Approved	7/21/2003	3/6/2007
Transfer	10/11/2004	**01021**	Maritech Resources, Inc	Approved	11/1/2004	3/6/2007
New	7/31/2002	**01024**	Brymer Contracting Incorporated	Approved	10/16/2002	10/15/2007
Renew	3/25/2009	**01024**	Brymer Contracting Incorporated	Approved	9/26/2009	9/28/2014
Amend	3/25/2009	**01024**	Brymer Contracting Incorporated	Approved	3/9/2012	9/28/2014
New	7/31/2002	**01025**	Brymer Contracting Incorporated	Approved	10/16/2002	10/15/2007
Renew	3/25/2009	**01025**	Brymer Contracting Incorporated	Approved	9/29/2009	9/28/2014
New	7/31/2002	**01026**	Brymer Contracting Incorporated	Approved	10/16/2002	10/15/2007
Renew	3/25/2009	**01026**	Brymer Contracting Incorporated	Approved	9/29/2009	9/28/2014
New	7/31/2002	**01027**	Brymer Contracting Incorporated	Approved	10/16/2002	10/15/2007
Renew	3/25/2009	**01027**	Brymer Contracting Incorporated	Approved	9/29/2009	9/28/2014
New	9/4/2002	**01028**	LLOG Exploration Offshore, Inc.	Approved	11/8/2002	11/7/2007
New	10/30/2002	**01031**	Saxet Energy, LTD	Approved	1/15/2003	1/14/2008
Transfer	4/16/2004	**01031**	CMR Energy, LP	Approved	9/14/2004	1/14/2008
Renew	3/19/2008	**01031**	CMR Energy, LP	Approved	5/23/2008	5/22/2013
Renew	5/4/2009	**01031**	CMR Energy, LP	Approved	8/13/2013	8/12/2018
New	10/30/2002	**01032**	Saxet Energy, LTD	Approved	1/15/2003	1/14/2008
Transfer	5/24/2004	**01032**	CMR Energy, LP	Approved	8/25/2004	1/14/2008
Amend	3/6/2007	**01032**	CMR Energy, LP	Approved	2/19/2008	1/14/2008
Renew	5/6/2008	**01032**	CMR Energy, LP	Approved	8/13/2013	8/12/2018
New-Amend	7/16/2003	**01033**	Saxet Energy, LTD	Approved	10/2/2003	10/2/2008
Transfer	8/17/2004	**01033**	CMR Energy, LP	Approved	9/15/2004	10/2/2008
Amend	5/17/2006	**01033**	CMR Energy, LP	Approved	9/7/2006	10/2/2008
Renew	5/12/2009	**01033**	CMR Energy, LP	Approved	11/24/2009	11/23/2014
Amend	10/30/2002	**01034**	Saxet Energy, LTD	Approved	1/15/2003	1/14/2008
Renew		**01034**	CMR Energy, LP	Approved	5/23/2008	5/22/2013
Amend	7/16/2003	**01036**	Saxet Energy, LTD	Approved	10/2/2003	10/2/2008
Transfer	8/17/2004	**01036**	CMR Energy, LP	Approved	9/15/2004	10/2/2008
New-Amend	9/12/2005	**01037**	Roma Oil & Gas, Inc	Approved	10/11/2005	10/10/2010
Transfer	7/25/2011	**01037**	Atascosa Exploration, LLC	Approved	8/15/2011	8/14/2016
New	3/18/2004	**01040**	CMR Energy, LP	Approved	9/15/2004	9/14/2009
Renew	7/31/2009	**01040**	CMR Energy, LP	Approved	10/27/2009	10/26/2014
New	3/18/2004	**01041**	CMR Energy, LP	Approved	8/25/2004	8/24/2009
Renew	6/16/2009	**01041**	CMR Energy, LP	Approved	12/31/2009	12/31/2014

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
New	5/20/2004	**01043**	CMR Energy, LP	Approved	9/14/2004	9/13/2009
Renew	6/15/2009	**01043**	CMR Energy, LP	Approved	2/24/2012	2/23/2017
New	3/16/2004	**01044**	CMR Energy, LP	Approved	8/25/2004	8/24/2009
Amend	5/25/2006	**01044**	CMR Energy, LP	Approved	9/7/2006	8/24/2009
Renew	6/15/2009	**01044**	CMR Energy, LP	Approved	1/4/2010	1/3/2015
New	7/25/2005	**01048**	REC Well Service, Inc.	Approved	9/21/2005	9/20/2010
Amend	9/28/2005	**01048**	REC Well Service, Inc.	Approved	10/4/2005	9/20/2010
Renew	12/1/2008	**01048**	Rickaway Energy, Corp.	Approved	6/28/2013	6/27/2018
Amend	3/22/2006	**01051**	CMR Energy, LP	Approved	6/3/2009	8/15/2011
Renew	1/21/2011	**01051**	CMR Energy, LP	Approved	2/3/2011	2/2/2017
Renew	5/10/2006	**01052**	Genesis Gas & Oil, LLC	Approved	3/2/2012	3/1/2017
New	5/8/2006	**01053**	CMR Energy, LP	Approved	6/26/2006	6/25/2011
New	11/13/2006	**01054**	Apex Oil & Gas Inc.	Approved	12/6/2006	12/5/2011
New	12/13/2006	**01056**	Black Pool Energy, LP	Approved	3/14/2007	3/13/2012
New	12/20/2006	**01057**	REC Well Service, Inc.	Approved	3/7/2007	3/6/2012
Transfer	12/1/2008	**01057**	Rickaway Energy, Corp.	Approved	12/15/2008	3/6/2012
New	2/6/2007	**01058**	The Exploration Company	Approved	5/23/2007	5/22/2012
Transfer	5/31/2007	**01058**	TXCO Resources, Inc.	Approved	7/11/2007	5/22/2012
Amend	4/24/2008	**01058**	TXCO Resources, Inc.	Approved	12/19/2008	5/22/2012
Renew	1/22/2009	**01058**	TXCO Resources, Inc.	Approved	3/24/2009	5/22/2012
New	3/5/2007	**01059**	CMR Energy, LP	Approved	5/22/2007	5/22/2012
Renew	3/5/2007	**01059**	CMR Energy, LP	Approved	6/7/2013	6/6/2018
New	9/24/2008	**01063**	Rio-Tex, Inc	Approved	6/1/2009	5/31/2014
New	12/8/2008	**01064**	Magellan E&P Holdings, Inc	Approved	3/28/2012	3/29/2017
New	1/16/2009	**01066**	Hawthorn Energy Partners	Approved	3/16/2009	3/16/2014
New	8/6/2009	**01072**	CMR Energy, LP	Approved	2/24/2012	2/23/2017
New	8/10/2009	**01073**	CMR Energy, LP	Approved	11/13/2009	11/12/2014
New	8/12/2009	**01074**	CMR Energy, LP	Approved	1/5/2010	1/4/2015
New	8/12/2009	**01075**	CMR Energy, LP	Approved	2/3/2012	2/2/2017
Amend	8/13/2009	**01076**	CMR Energy, LP	Approved	6/7/2013	11/12/2014
New	8/13/2009	**01077**	CMR Energy, LP	Approved	12/1/2009	11/30/2014
New	8/24/2009	**01078**	CMR Energy, LP	Approved	7/11/2011	7/10/2016

Type	Date received	Permit/app number	Operator	Action status	Final action date	Permit expire date
Type	Date received	**Permit/app number**	Operator	Action status	Final action date	Permit expire date
New	8/31/2009	**01079**	CMR Energy, LP	Approved	2/3/2012	2/2/2017
Amend	8/31/2009	**01080**	CMR Energy, LP	Approved	6/7/2013	11/12/2014
New	8/31/2009	**01081**	CMR Energy, LP	Approved	12/1/2009	11/30/2014
New	11/9/2009	**01083**	CMR Energy, LP	Approved	1/4/2010	1/3/2015
New	11/13/2009	**01084**	Anloc LLC	Approved	12/15/2009	12/14/2014
Transfer	10/26/2010	**01090**	Patterson Energy Corporation	Approved	7/1/2013	2/17/2016
New	1/13/2012	**01097**	Hall Houston Exploration	Approved	3/9/2012	3/8/2017
New	2/27/2012	**01099**	Rickaway Energy, Corp.	Approved	11/20/2012	11/19/2017
New	1/7/2013	**01107**	Rickaway Energy, Corp.	Approved	7/18/2013	7/17/2018
Amend	9/11/2014	**01107**	Rickaway Energy, Corp.	Approved	7/6/2015	7/17/2018
New	8/15/2016	**01120**	Cimarex Energy Co.	Approved	9/26/2016	9/25/2021
New	9/6/2016	**01121**	Enbridge G & P (East Texas) L.P.	Approved	5/19/2017	5/18/2022

SI IV.4 Discharge coordinates and values per permit number

The following are the discharge coordinates and values per permit number provided by the Railroad Commission of Texas via the Open records Requests. The coordinates of the below listed permits are displayed in SI II.

Latitude	Longitude	Permit number	Statue	Quantity	Discharge	Segment
29.754917	-97.148783	**00065**	E98th	4975	Unnamed tributary to West Brook Creek to Big Fivemile Creek to Peach Creek	1803
29.7614	-97.137183	**00066**	E98th	6100	Unnamed tributary to Pin Oak Creek to Buckners Creek	1803
29.581188	-97.318022	**00760**	E98th	650	Unnamed tributary to Sandy Fork Creek to Peach Creek	1803
29.73294	-97.19422	**00763**	E98th	200	Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.820924	-97.220394	**00764**	E98th	665	Stock Pond to unnamed tributary to Live Oak Creek to Buckners Creek	1803
29.63783	-97.27832	**00775**	E98th	200	Pin Oak Creek to Peach Creek	1803
29.814537	-97.221743	**00777**	E98th	250	Surface to unnamed tributary to Live Oak Creek to Buckners Creek	1803
29.77315	-97.12133	**00778**	E98th	1500	Unnamed tributary to Live Oak Creek to Buckners Creek	1803
29.651685	-97.24666	**00782**	E98th	665	Unnamed tributary to Baldridge Creek to Peach Creek	1803
29.821394	-97.224442	**00783**	E98th	400	Tributary of Live Oak Creek/Buckners Creek	1803
29.254241	-97.953046	**00786**	E98th	6850	Stock Pond to Clifton Branch of Cibolo Creek	1902
29.778611	-97.121944	**00808**	E98th	1200	unnamed tributary to Live Oak Creek to Buckners Creek	1803
29.8705964	-97.196096	**00814**	E98th	375	Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.247264	-97.964041	**00821**	E98th	1000	Clifton Branch of Cibolo Creek	1902
30.581997	-96.921988	**00823**	E98th	18000	Stockpond to unnamed tributary of Hills Branch to East Yegua Creek	1211
29.88676	-97.20735	**00845**	E98th	100	Stock pond to Buckners Creek	1803
29.710124	-97.211913	**00858**	E98th	175	Surface to Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.63823	-97.227828	**00859**	E98th	350	Surface to Pin Oak Creek to Peach Creek	1803
29.728232	-97.195378	**00886**	E98th	600	Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.720336	-97.212819	**00887**	E98th	225	Stock pond to Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.773783	-97.108933	**00889**	E98th	600	Stock pond to Live Oak Creek to Buck-ners Creek	1803
29.725185	-97.209147	**00890**	E98th	150	Stock pond to Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.73627	-97.18936	**00891**	E98th	775	Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.887912	-97.208301	**00895**	E98th	310	Buckners Creek	1803
29.84028	-97.36667	**00897**	E98th	250	Unnamed tributary to Peach Creek	1803
29.71254	-97.20256	**00906**	E98th	500	Surface to Little Fivemile Creek to Big Fivemile Creek to Peach Creek	1803
29.62057	-97.27102	**00907**	E98th	375	Pin Oak Creek to Peach Creek	1803
29.886384	-97.209444	**00936**	E98th	250	East Fork of Live Oak Creek to Buckners Creek	1803
31.62638	-95.47916	**00943**	E98th	200	Surface to unnamed tributary to Squirrel Creek to Ioni Creek to Neches River	0604
29.886384	-97.20944	**00944**	E98th	375	Buckners Creek	1803

Latitude	Longitude	Permit number	Statue	Quantity	Discharge	Segment
29.244476	-97.966051	**00947**	E98th	450	Stock pond to Clifton Branch of Cibolo Creek	1902
29.810139	-97.226944	**00965**	E98th	595	Unnamed tributary Peach Creek	1803
29.624442	-97.267285	**00966**	E98th	150	Pin Oak Creek	1803
29.5775	-97.31527	**00973**	E98th	200	Unnamed tributary to Sandy Fork Creek to Peach Creek	1803
29.626162	-97.261365	**00995**	E98th	75	Unnamed tributary to Baldridge Creek to Peach Creek	1803
29.1459159	-97.9250013	**01107**	E98th	450	Cibola Creek, thence to San Antonio River (Water Body Segement No. 1901)	1911
28.897778	98.364722	**00005**	W98th	960	Atascosa River	2107
28.8645	-98.169806	**00759**	W98th	700	Stock Pond to Tordilla Creek to Borrego Creek	2107
28.872667	-98.15225	**00762**	W98th	200	Tordilla Creek to Borrego Creek	2107
28.898099	-98.36304	**00765**	W98th	1200	Atascosa River	2107
28.50875	-98.584167	**00768**	W98th	3600	Unnamed tributary to Leoncita Creek	2113
28.88689	-98.472111	**00828**	W98th	900	Unnamed tributary to East Metate Creek to Atascosa River	2107
28.91732	-98.31886	**00832**	W98th	500	Unnamed creek to Atascosa River	2107
28.794705	-98.171535	**00869**	W98th	1500	Tordillo Creek to Lipan Creek	2107
28.806944	-98.1625	**00870**	W98th	5000	Tordillo Creek to Lipan Creek	2107
28.799722	-98.165	**00899**	W98th	3000	Tordillo Creek to Lipan Creek	2107
28.802516	-98.166469	**00900**	W98th	15700	Tordillo Creek to Lipan Creek	2107
28.911389	-98.526667	**01011**	W98th	1500	Natural drainage to stock pond to tribu-tary to La Parita Creek to Atascosa River	2107
28.88156	-98.49078	**01024**	W98th	600	Unnamed tributary to East Metate Creek	2107
28.88279	-98.47969	**01025**	W98th	100	Unnamed tributary to East Metate Creek	2107
28.88595	-98.47391	**01026**	W98th	100	Unnamed tributary to East Metate Creek	2107
28.88317	-98.47417	**01027**	W98th	400	Unnamed tributary to East Metate Creek	2107
28.9	-98.416667	**01048**	W98th	4770	Unnamed tributary of East Metate Creek	2107
30.96424	-102.97500	**01120**	W98th	25		2310

SI IV.5 Listed active discharge permits

The following information is an evaluation of the permits provided by the Railroad Commission of Texas. It is a comparison of permits that were listed as "active" and the permits for which discharge locations were provided.

Active permits	Listed discharges	Listed discharge but not dated active
00005	00005	01024
00065	00065	01025
00066	00066	01026
00268	N/A	01027
00759	00759	
00760	00760	
00762	00762	
00763	00763	
00764	00764	
00765	00765	
00768	00768	
00775	00775	
00777	00777	
00778	00778	
00782	00782	
00783	00783	
00786	00786	
00808	00808	
00814	00814	
00821	00821	
00823	00823	
00828	00828	
00832	00832	
00845	00845	
00858	00858	
00859	00859	
00869	00869	
00870	00870	
00871	N/A	

Active permits	Listed discharges	Listed discharge but not dated active
00872	N/A	
00886	00886	
00887	00887	
00889	00889	
00890	00890	
00891	00891	
00895	00895	
00897	00897	
00899	00899	
00900	00900	
00906	00906	
00907	00907	
00936	00936	
00943	00943	
00944	00944	
00947	00947	
00965	00965	
00966	00966	
00973	00973	
00995	00995	
01004	N/A	
01011	01011	
01031	N/A	
01032	N/A	
01048	01048	
01107	01107	
01120	01120	
01121	N/A	