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An online, peer-reviewed journal
published in cooperation with the
Texas Water Resources Institute

Texas Water Journal

Volume 9 Number 1 | 2018

Texas Water Journal

Volume 9, Number 1
2018
ISSN 2160-5319

texaswaterjournal.org

THE TEXAS WATER JOURNAL is an online, peer-reviewed journal devoted to the timely consideration of Texas water resources management, research, and policy issues. The journal provides in-depth analysis of Texas water resources management and policies from a multidisciplinary perspective that integrates science, engineering, law, planning, and other disciplines. It also provides updates on key state legislation and policy changes by Texas administrative agencies.

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Texas Water Resources Institute
Texas Water Journal
Volume 9, Number 1, October 24, 2018
Pages 108-119

Texas' water quality challenge and the need for better communication in an era of increasing water quality contamination events

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Abstract: As Texas cities experience an increase in incidents associated with water quality contamination, the need for public education and engagement increases. The discussion in this paper identifies, based on publicly available data, three of the most common incidents in Texas related to drinking water and environmental contamination: boil water notices (BWNs), sanitary sewer overflows (SSOs), and lead in drinking water. Trends observed from 2011 to 2016 indicate a sharp upward increase in the incidents of such events. Increased frequency of incidents that threaten water quality often erodes public trust in the city and utility, thus making it more difficult in the long term to get public support for increased investment in water and wastewater infrastructure. The recommendations in this study focus on how to manage communications when events associated with water quality create a public relations challenge for city and utility leaders.

Keywords: Safe Drinking Water Act, Environmental Protection Agency, MCLs, Maximum Contaminant Levels, Texas Commission on Environmental Quality, Texas Water Development Board

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Citation: Mulki S, Rubinstein C, Saletta J. 2018. Texas' water quality challenge and the need for better communication in an era of increasing water quality contamination events. Texas Water Journal. 9(1):108-119. Available from: https://doi.org/10.21423/twj.v9i1.7059.

Terms used in paper

Acronyms	Descriptive name
TWDB	Texas Water Development Board
TCEQ	Texas Commission on Environmental Quality
MCLs	Maximum Contaminant Levels
SDWA	Safe Drinking Water Act
EPA	U.S. Environmental Protection Agency
BWNs	boil water notices
SSOs	sanitary sewage overflows
LCPE(s)	Lead Contamination Public Education

INTRODUCTION

When Texans experience a threat to their water quality, it erodes public trust in city and utility leaders. That trust can take years to rebuild. The frequency of incidents threatening drinking water quality in Texas has increased over the past six years. In particular, incidents of boil water notices (BWNs), sanitary sewer overflows (SSOs), and Lead Contamination Public Education (LCPE) increased by 73%, 983%, and 1,300%, respectively, from January 2011 to December 2016.

The above-mentioned trend forewarns of how relationships between utilities and customers will deteriorate if these events persist and city and utility leaders cannot effectively communicate and reassure their users. To be sure, cities and utilities are actively implementing corrective measures to address these types of incidents; how these measures are communicated also impacts customers' views. Trust and dependability are values city and utility leaders need to engender in their customers, especially since infrastructure financing is heavily dependent on taxpayers' contributions, and thus their perceptions.

Public relations will increasingly become a critical part of the city and utility leaders' jobs because Texas' water and wastewater infrastructures are aging and in desperate need of repair and replacement. According to the Texas Section of the American Society of Civil Engineers (2012), Texas requires $33.9 billion to address water infrastructure issues over the next 20 years.

The need for increased investment will ultimately lead to higher water rates. Rates are the only low-cost means cities and utilities have at their disposal to raise the needed funds within a short amount of time. Therefore, it is necessary that customers understand the true cost of delivering water. Water quality crises and the mismanagement of rate increases, along with other situations, will only create obstacles to changing customer's minds on the ability of utilities to perform their job adequately.

To demonstrate the extent of the water quality issues in Texas, the authors analyzed the data on three types of incidents between 2011 and 2016 most commonly associated with threats to drinking water quality: BWNs, SSOs, and LCPE. The frequency of the incidents is correlated with other variables: duration, population density, and water regions as defined by the Texas Water Development Board (TWDB) regional water planning groups (See Figure 1).

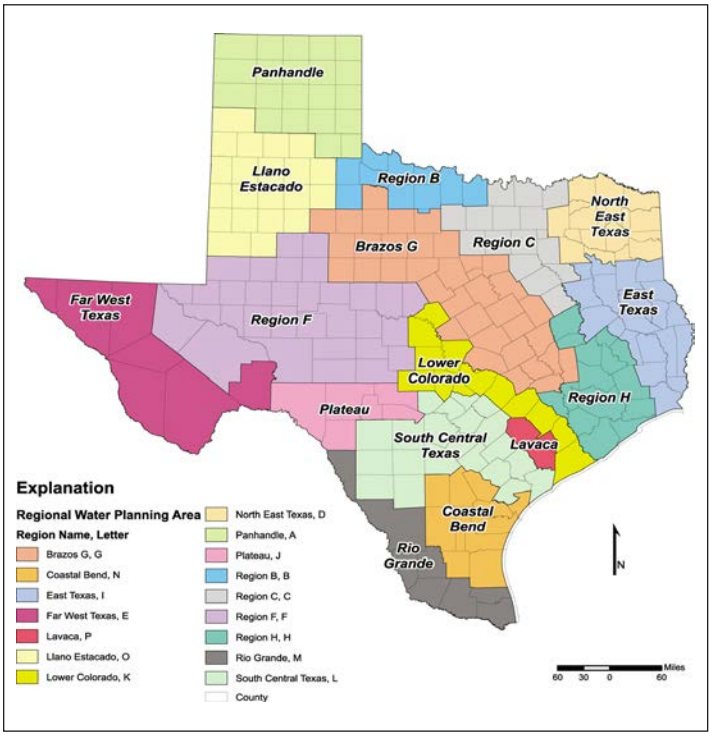

Figure 1: Regional water planning areas. Source: Texas Water Development Board.

BWNs are issued when a utility suspects harmful levels of bacteria and other pathogens are in the drinking water supply. During such incidents, consumers are advised to boil and then cool the water prior to consumption. "Common reasons for a boil water notice include loss of pressure in the distribution system and loss of disinfection. BWNs often result from other events such as waterline breaks, treatment disruptions, power outages, and floods (NY.GOV 2016)."

SSOs occur when raw sewage spills out of a collection system and into the environment—whether into a basement, out of manholes, onto a street, or into a waterway—before reaching a treatment plant. In a report to Congress, the U.S. Environmental Protection Agency (EPA) estimated up to 75,000 SSO events occur per year (EPA 2004), often during extreme wet weather patterns, such as floods, blocking sewage systems. Coastal cities are especially vulnerable due to extreme weather flooding, such as hurricanes. This is true particularly for Texas cities along the Gulf Coast.

Frequent SSO occurrences are indicative of failing infrastructure, lack of maintenance, ineffective operational procedures, and inadequate flow capacity (US EPA 2016a). The Texas Commission on Environmental Quality (TCEQ) recognizes the increase in SSO incidents and in 2004 established a compliance agreement coupled with a discretion-driven enforcement program called the SSO Initiative. This find-it-and-fix-it approach incentivizes corrective action by cities and utilities. The initiative addresses "an increase in SSOs due to aging collection systems throughout the state and encourage(s) corrective action before there is harm to human health and safety or the environment (TCEQ c2002-2018)."

Lead contamination in drinking water is considered detrimental to humans if sample results indicate a value of 15 parts per billion, according to TCEQ (following EPA guidance). Under Title 30 of the Texas Administrative Code and per the federal Lead and Copper Rule, public water systems are required to issue LCPE notices if they exceed this lead action level.

Lead in drinking water generally occurs because of corrosion of water pipes installed over 30 years ago or due to chemical reactions. Lead contamination is a silent threat as it does not give a unique taste or color to water; lead in pipes can only be detected through the testing of drinking water or by blood tests of those who drink the water. Lead also has long-lasting health impacts, including lifelong learning disabilities in children.

METHODOLOGY

In fall 2016, data sets on the total number of BWNs, SSOs, and LCPEs reported in Texas between January 2011 and December 2016 were acquired from TCEQ via a public information request. Data on BWNs were organized by entity (i.e., public and private utilities), date the event began, and a tracking number. In the case of SSOs, the data sets included the date of the SSO, water region, city, total units spilled, source of incident when available, and the water bodies impacted when applicable. Finally, LCPEs were organized by public water systems that delivered such notices and the date that notices were issued to the public.

To create uniformity among the data sets, each of the spreadsheets was reorganized by the total number of incidents by year and by water region. The regions are identified alphabetically starting from Region A all the way to P. Based on the tabulated data, line charts (See Figures 2, 3, 4, and 5 and Tables 1, 2, and 3) were generated to display the trends in the total number of incidents in each region over a six-year period. The data were also organized by population in each region to determine the correlation between population and the frequency of incidents associated with SSOs, BWNs, and LCPEs.

RESULTS

Between 2011 and 2016, the number of reported incidents associated with SSOs, BWNs and LCPEs increased significantly. Regions observed to have higher rates of incidents also have a high population density and are located close to or by the Gulf Coast. Increased awareness, visibility, and concern of water quality impacts from such incidents in densely populated

Table 1. Total number of boil water notices by region from January 2011 to December 2016.

	2011	2012	2013	2014	2015	2016	Total
Region A	2	5	5	6	11	9	**38**
Region B	7	16	12	5	11	5	**56**
Region C	29	71	73	77	126	86	**462**
Region D	29	38	55	57	68	47	**294**
Region E	2	3	9	4	3	3	**24**
Region F	21	32	22	26	30	20	**151**
Region G	66	148	159	181	247	191	**992**
Region H	109	181	186	253	249	145	**1,123**
Region I	193	332	308	282	311	214	**1,640**
Region J	2	5	9	5	11	2	**34**
Region K	57	66	96	118	144	85	**566**
Region L	12	27	24	52	101	84	**300**
Region M	3	14	7	5	7	9	**45**
Region N	6	24	29	15	7	4	**85**
Region O	6	27	27	25	20	34	**139**
Region P	0	1	1	3	2	1	**8**
Total	**544**	**990**	**1,022**	**1,114**	**1,348**	**939**	**5,957**

urbanized areas may drive increased reporting. Detailed results and trends for each type of incident are discussed below.

Boil Water Notices (BWNs)

The total number of BWNs recorded in the six-year period observed was 5,957 incidents. The annual number of incidents increased generally during the six-year period in all 16 regions. The overall increase—from 544 incidents reported in 2011 to 939 by the end of 2016—represents a 73% increase in the number of BWNs reported in Texas (See Table 1 and Figure 2).

Four regions—G, H, I, and K—recorded a higher than average number of incidents. Although the number of BWNs reported decreased in 2016, this is not an anomaly and could be attributed, in part, to reporting and recording inconsistencies, as well as a decrease in extreme weather events.

Regions G, H, I, and K are also high population centers, representing approximately 42% of the total Texas population. In addition to Houston-based Region H, Region G includes Abilene, Bryan, College Station, Killeen, Round Rock, Temple, and Waco; Region I includes Beaumont, Tyler, Port Arthur, Nacogdoches, and Lufkin; and Region K includes Austin, Bay City, Pflugerville, and Fredericksburg.

A notable spike can be seen between 2011 and 2012 where incidents increased by 82% from 544 to 990, respectively. The spike is most likely attributed to the regional impacts noted from the severe drought that began in 2009 and peaked in 2011. Severe droughts and resulting soil moisture loss can damage infrastructure, resulting in line leaks, water main breaks, and overall system pressure loss.

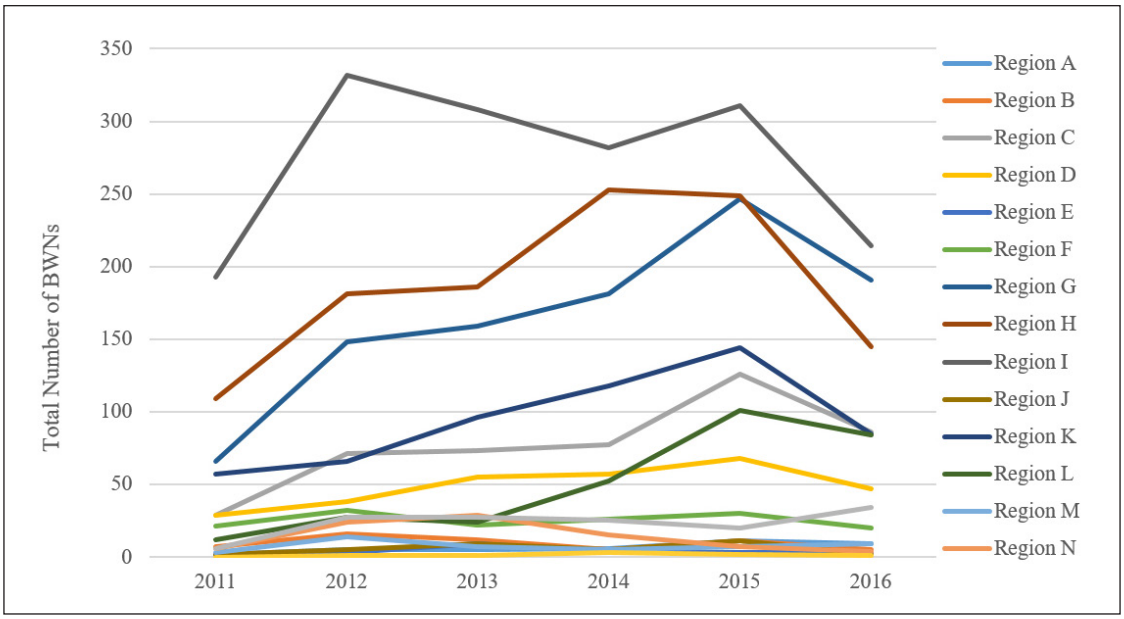

Figure 2. Total number of boil water notices by region from January 2011 to December 2016.

Sanitary Sewer Overflows (SSOs)

In the six-year period examined, there were 7,982 SSO incidents; the total rose by 983% over this period with approximately 424 incidents in 2011 and 4,594 in 2016 across all 16 regions (See Table 2 and Figure 3). Five of the regions—F, G, H, K, and L—recorded a higher-than-average number of SSOs over the six-year period; Regions H and L recorded the highest total number of SSOs at 2,468 and 1,916, respectively. These regions are also high population centers, representing approximately 50% of the total Texas population.

The largest cities in Region H are Houston and Galveston, while the largest cities in Region L are San Antonio, Victoria, San Marcos, and New Braunfels. Both Region H and L include segments of the Gulf Coast, making them more susceptible to extreme wet weather conditions, often causing flooding. Floods can overwhelm aging wastewater systems and result in SSOs.

There were two notable spikes observed in the SSO data. The first spike occurred between 2014 and 2015, during which the number of reported statewide SSO incidents increased by 79%, which was likely caused by the heavy rainfall and resulting flooding at the end of the 2010–2014 Texas drought. The second spike was specific to Region H, where the number of SSOs rose from 75 in 2015 to 2,364 in 2016. This spike was driven mainly by Region H and the history of SSO incidents and response to the same by the Greater Houston area in particular.

The Houston region is known for subsidence issues. Periods of drought followed by flooding can cause significant soil movement, particularly in clay soil areas. This movement can wreak havoc on infrastructure and cause flooding events that increase infiltration to sewer systems, which can then quickly overtake their design capacity, resulting in SSOs.

The city of Houston, recognizing the need to remedy these SSO trends, has undertaken a multiyear infrastructure replacement program. A report from the Houston Chronicle claims that "ramping up maintenance and educating the public on how to avoid clogging Houston's 6,700 miles will cost up to $5 billion (Morris 2016)."

Table 2. Total number of sanitary sewer overflows by region from January 2011 to December 2016.

	2011	2012	2013	2014	2015	2016	Total
Region A	0	0	0	59	27	33	**119**
Region B	0	0	0	0	9	38	**47**
Region C	2	30	5	4	46	399	**486**
Region D	0	1	7	3	26	33	**70**
Region E	16	7	3	6	0	19	**51**
Region F	95	74	60	91	97	91	**508**
Region G	106	310	1	4	21	375	**817**
Region H	1	14	9	5	75	2,364	**2,468**
Region I	2	2	0	3	82	415	**504**
Region J	0	0	0	0	4	25	**29**
Region K	0	1	1	153	266	279	**700**
Region L	201	269	436	267	384	359	**1,916**
Region M	0	1	0	0	0	2	**3**
Region N	1	5	7	6	2	113	**134**
Region O	0	0	0	16	65	49	**130**
Region P	0	0	0	0	0	0	**0**
Total	**424**	**714**	**529**	**617**	**1,104**	**4,594**	**7,982**

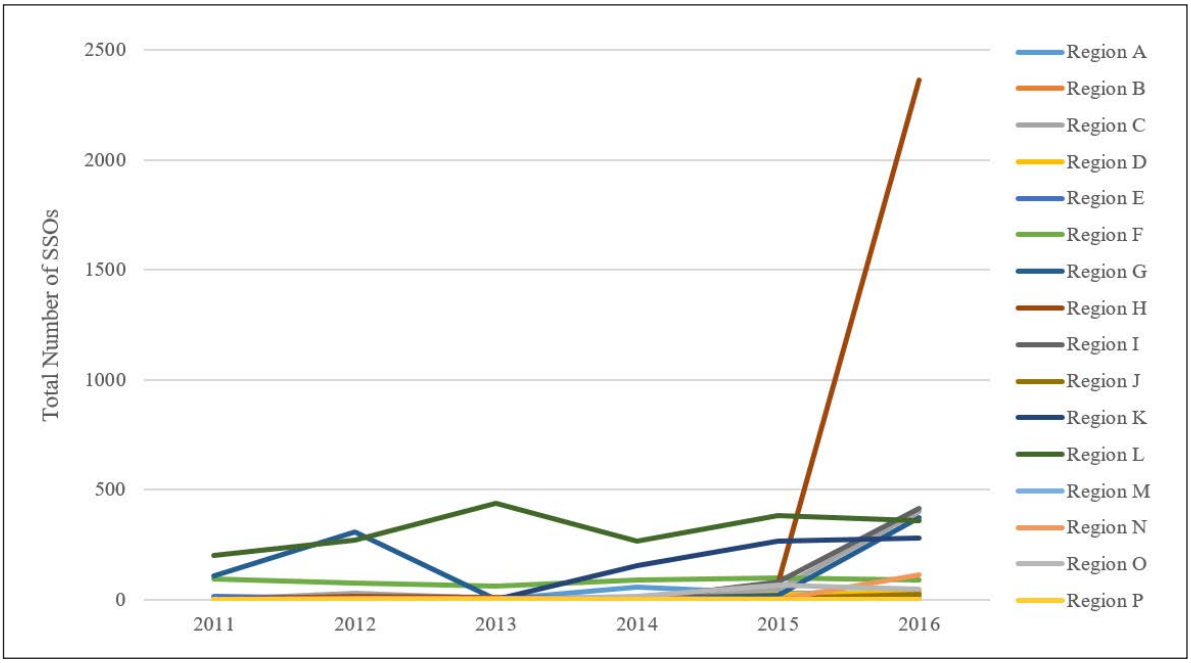

Figure 3. Total number of sanitary sewer overflows by region from January 2011 to December 2016.

Table 3. Total number of lead contamination public education notices by region from January 2011 to December 2016.

	2011	2012	2013	2014	2015	2016	Total
Region A	0	0	0	1	0	0	**1**
Region B	0	0	0	0	0	1	**1**
Region C	0	0	4	1	2	1	**8**
Region D	0	0	1	4	3	0	**8**
Region E	0	0	0	3	0	0	**3**
Region F	0	0	1	3	5	1	**10**
Region G	1	1	3	9	2	8	**24**
Region H	1	2	21	28	35	21	**108**
Region I	0	0	3	2	3	1	**9**
Region J	0	1	3	4	1	0	**9**
Region K	0	0	7	6	5	4	**22**
Region L	1	0	4	4	5	3	**17**
Region M	0	0	0	0	0	0	**0**
Region N	0	0	1	0	1	1	**3**
Region O	0	0	0	0	1	1	**2**
Region P	0	0	0	0	1	0	**1**
Total	**3**	**4**	**48**	**65**	**64**	**42**	**226**

Lead Contamination Public Education (LCPE)

In comparison to SSOs and BWNs, public education notices related to lead contamination decreased during the six-year period. However, there was an overall increase in the number of LCPEs recorded, totaling 226 incidents. The number of incidents increased consistently during the same period in all 16 regions (See Table 3 and Figure 4). Overall, a sharp increase of almost 1,300% is observed in the same six-year period.

There was a notable spike between 2012 and 2013 where reported incidents increased by 1,100% from 4 to 48, respectively. This was most likely attributed to better reporting from the jurisdictions to TCEQ. In Region H, where the highest number of incidents was recorded, this trend was most likely due to the influence from the petrochemical industry. Aging or poorly maintained infrastructure also contributed to the trend.

Four regions—G, H, K, and L—recorded a higher-than-average number of LCPEs. Most of the sources of LCPE notices were from industry followed by municipalities. In Region H, LCPE notices were largely attributed to the petrochemical industry, which is the region's largest economic sector and also "accounts for two-thirds of the petrochemical production in the United States (TWDB 2016a)."

The most pertinent trends in lead notices relate to the population and geographical location of each region. The majority of incidents occurred in Central and East Texas (along the I-35 corridor) and Region C where the population is dense. Region C includes the Dallas-Fort Worth metropolitan area and the fastest growing regions in the state (TWDB 2016b). As previously mentioned, part of this observed increase may be due to the large and dense population and to increased awareness and monitoring of discrete sites (specific schools, churches, industrial facilities, etc.), which may explain part of this observed increase.

Reports of lead in water samples do not necessarily indicate system-wide problems, although areas with significant population growth over the last decade can benefit from newer infrastructure and plumbing codes, thus reducing the incidents of reported lead in drinking water. Within older developed areas, many instances of reported lead in water can be attributed to post-meter in-property plumbing, which may be of significant age.

Overall Results

Despite the few mentioned limitations, the authors believe TCEQ data provides enough detailed information to make the study conclusive. There are various factors possibly causing the fluctuations in total incidents recorded, such as dilapidating infrastructure, extreme weather events, and inconsistent reporting/recording. For this reason, the data analysis focused on overall trends in the six-year period and made note of

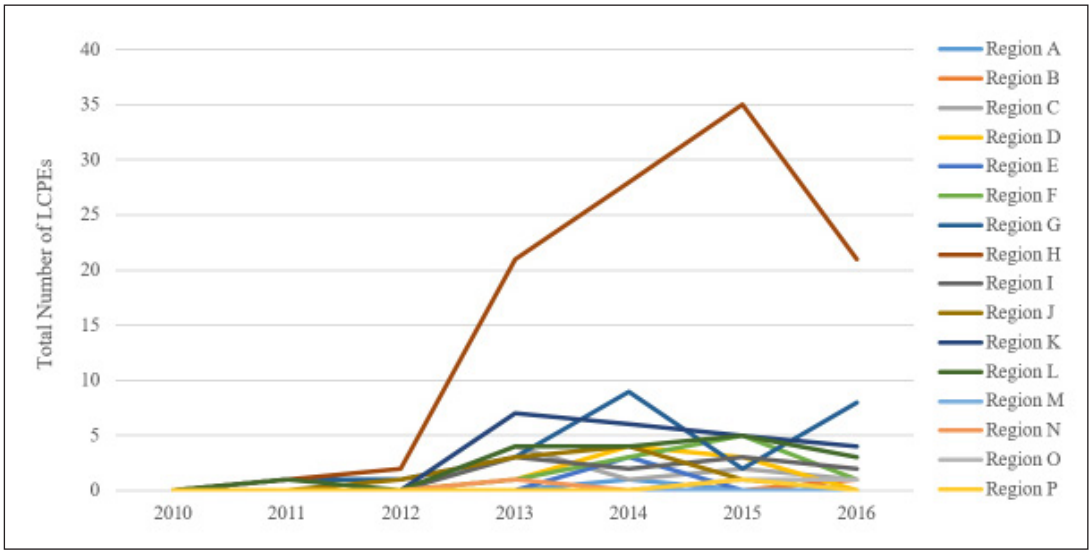

Figure 4. Total number of lead contamination public education notices by region from January 2011 to December 2016.

unique factors as it relates to population density, location, and unique weather patterns.

The study shows that regions with a population of one million or more (G, H, I, K, L, and M) are more likely to have a higher number of incidents associated with BWNs, SSOs, and LCPEs. These regions also happen to be close to or on the Gulf Coast, which makes their water and wastewater systems even more susceptible to extreme weather events, coupled with their aging infrastructure, which impacts capacity management and efficiency.

The data reveals an overall increase in BWNs, SSOs, and LCPEs issued in Texas from 2011 to 2016 (See Table 4). During the study time frame, BWNs increased about 73%, while SSO incidents increased 983%, and LCPE reports increased 1,300%. The formula to calculate the percentage difference is as follows:

(Total number of BWNs or SSOs or LCPEs in 2016 - Total number of BWNs or SSOs or LCPEs in 2011 x 100)/ Total number of BWNs or SSOs or LCPEs in 2011.

The overall trends suggest that there is an increasing frequency of threats to the water quality in Texas. The reasons for the trends are most likely due to pressure on aging water infrastructure from rapid population increases and increased frequency of extreme weather events e.g. flooding and hurricanes. As seen from the results discussion, some areas are driving these trends more than others are, such as Regions H and I. While other regions are low in comparison to the number of incidents between 2011 and 2016, it is important to note that the trend is still upward for most part.

It is important to note that west and northwest regions of the state observed fewer incidents than regions in Central or East Texas or by the Gulf Coast. The reason for such a trend is most likely due to the sparser populations in West Texas regions, along with the lower threat of extreme weather events such as hurricanes and flash flooding.

Unsurprisingly, the number of LCPE notices is relatively low. Lead contamination in drinking water supply is not common in the United States. However, the water crisis in Flint, Michigan, heightened public fears on the issue, especially because of the amplified risks to infants and children. With the EPA declaring that no level of lead is safe for children, the authors believe city and utility leaders have to make a greater investment in identifying the lead lines in their jurisdictions and replacing them in order to avoid another crisis similar to Flint (EPA 2016b).

The data analysis informed the authors' consideration of the regulatory and reporting standards informing the public on drinking water contamination. The significant overall increase in incidents related to BWNs, SSOs, and LCPEs highlights the need for utility officials to consider embedding crisis communications into their outreach strategies, if they have not done so already. Overall trends also strongly suggest an increase in incidents, especially in densely populated regions of the state, which makes the need for a dedicated crisis communication strategy even more compelling.

Table 4. Total number of incidents in Texas from January 2011 to December 2016.

	BWNs	SSOs	LCPEs	Total
2011	544	424	3	971
2012	990	714	4	1,708
2013	1,022	529	48	1,599
2014	1,114	617	65	1,796
2015	1,348	1,104	64	2,516
2016	939	4,594	42	5,575
Total	5,957	7,982	226	14,165
Percentage Change	**73%**	**983%**	**1,300%**	-

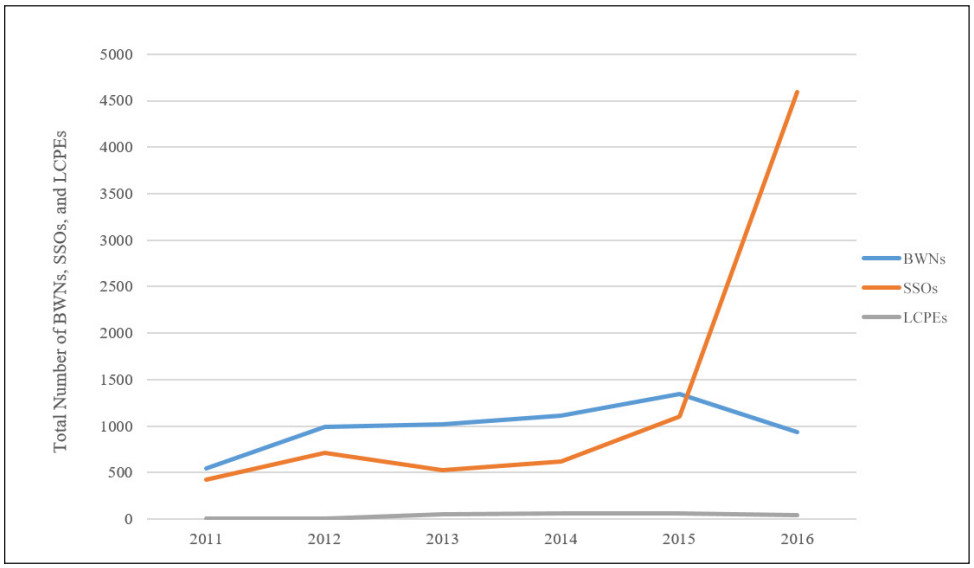

Figure 5. Total number of SSOs, BWNs and LCPEs in Texas from January 2011 to December 2016.

Limitations

The data provided by TCEQ have allowed for strong and conclusive results, the observation of specific trends, and the identification of correlations. However, data analysis was limited by a few ambiguities in the data sets. For example, there was a lack of data reported on the number of incidents, mainly SSOs and LCPEs, recorded between 2011 and 2013. Gaps in the data are most likely due to inconsistencies in data collection, monitoring, and reporting to TCEQ by the respective entities.

Another anomaly observed was in the data obtained on SSOs. Region K reported zero SSO incidents in 2011, and yet listed 919,984 gallons of sewage released. We were unable to ascertain the total number of incidents in 2011 or the rationale for such information management.

DISCUSSION – THE NEED FOR BETTER AND MORE COMMUNICATIONS

To reduce these threats to drinking water safety, utilities will have to continue to invest in improving and maintaining their water and wastewater infrastructure, which is no easy feat. In the meantime, cities will most likely continue to experience water crises of varying proportions.

Water crises often feed peoples' tendencies to exaggerate, incite chaos, and place blame. To prevent a water crisis from doing long-term damage to a company or municipality's reputation, they must invest in thorough communication strategies to engage and educate. A well-managed water crisis helps to manage costs, alleviate community unrest, prevent erosion of public trust, and maintain political credibility.

An example of customer-expressed loss of trust in a utility occurred southwest of Fort Worth, where residents experienced a six-week long BWN in 2016 (Walker 2016). Even after the notice was lifted, residents did not trust their water. One resident said of the impacted water provider, "They seem like they don't care, which makes us not trust them even more and it just seems unethical. It's just not right (Walker 2016)."

Most political and utility leaders and staff who have had the misfortune of being caught in a crisis can attest to how quickly it can become divisive. False and inaccurate stories will often appear in the media, and interest groups will distract from the real issue at hand. Social media adds to the challenge by quickly fueling rumors, which only prolong and inflame the crisis.

During a crisis, there are certain fundamental values that must be integrated into every decision-making process within the utility before it publicly communicates to customers and the broader community. These basic principles of crisis communication include transparency and honesty, clarity and commitment, compassion and reassurance, and listening and engaging.

Transparency and honesty

Transparency and honesty form the backbone of efforts to maintain or rebuild trust and credibility. When a spokesperson is upfront about the cause of a crisis it demonstrates the utility is taking ownership of the situation and showing commitment to the public's welfare. Providing accurate and clear information is the first and most critical step to preventing a crisis from getting out of control. If there is no answer to a particular question, spokespeople can follow up with accurate answers at a later specified time.

Transparency can be demonstrated by divulging details regarding the steps being taken to address the crisis, through regular updates to the public. The consequences of a lack of such transparency, along with broken promises to the public and ambiguous communication techniques, can be damaging to the reputation of a utility or city. Reoccurring water quality crises can and have resulted in resignations of high-level pubic officials. This level of dissatisfaction can also drive voting trends toward change, particularly for local elected officials.

A classic example of where denial or lack of transparency exacerbated a water crisis was in Flint, Michigan. When confronted about his level of knowledge of the situation in Flint before it became public, Governor Rick Snyder of Michigan denied knowledge of the lead contamination, adding, "I wish I would have asked more questions (Oosting and Carah 2016)." He did not provide enough evidence to the public to prove his lack of knowledge on the situation, which quickly made him a target for blame. "...The idea that every one of his top staff were actively debating the Flint Water Crisis and that he was unaware is no longer credible," State Representative Jeff Irwin said (Oosting and Carah 2016).

To this day Governor Snyder's role in the crisis is being questioned. According to a new report from the University of Michigan School of Public Health, Governor Snyder "bears significant legal responsibility for the (Flint water) crisis based on his supervisory role over state agencies (Fonger 2018)."

Clarity and commitment

Clarity and commitment in providing the facts about a water safety crisis will help ensure that the situation is neither exaggerated nor underemphasized. Facts need to be presented simply and without jargon. Sometimes information spread via mainstream or social media is inaccurate or untrue. Online rumors and "fake news" spread quickly and can turn people against an agency overnight.

Inaccuracies about the cause of a crisis only fuel doubt and mistrust in the utility as credible, ethical, and responsible leaders in the community. The facts about a crisis need to be communicated repeatedly, like a mantra, in order to ensure continuous visibility and factual coverage of the situation in local media.

Commitment can be demonstrated by taking responsibility for a situation and its solution, and by ensuring that the facts are disseminated. However, *saying* civic or utility leaders are committed to resolving a crisis without being transparent about the actions being taken serves no purpose.

An example of leaders missing a chance to express commitment has been seen in situations where heavy rains have resulted in several SSOs. In one such incident, local officials did not communicate any actions being taken to solve the problem, instead saying, "There is no way to prevent raw sewage from spewing into the streets when we receive as much rain as we did (Quinn 2015)."

Instead of implying that the problem could not be solved, the city officials should have communicated its focus and commitment to fixing the issue and concrete steps to prevent a reoccurrence. City officials could have also taken the incident as an opportunity to explain why SSOs occur and what the City is doing to reduce incidents.

A good example of a water utility that took responsibility for its actions and went above and beyond to demonstrate its commitment is the San Antonio Water System (SAWS) when it was hit with an EPA consent decree to curb sewer spills by investing an additional $492 million in infrastructure and maintenance.

SAWS' acceptance of the situation and promise to fix the situation was nicely captured in President and CEO Robert Puente's comments, "This agreement is designed for the most cost-effective use of ratepayer dollars and avoids costly federal litigation (SAWS 2013)." Focusing on the customer and emphasizing the legal and fiscal responsibility of the utility is a positive message that helps build public support for the utility.

Compassion and reassurance

Utilities should be relatable to customers and express understanding of a water crisis' impact on their well-being. They should share sincere sympathies with the public while at the same time reassuring customers that experts are managing the crisis with speed, thoroughness, and integrity.

Note that customers and the public do not want nor need to hear about how hard a situation is on the city, utility, or responsible entity. When BP CEO Tony Hayward said in response to the Deepwater Horizon disaster, "There's no one who wants this over more than I do. I'd like my life back," it only angered the public.

A good example of a city official showing compassion comes from former Corpus Christi Mayor Dan McQueen. Following the announcement of a tap water advisory (Hersher 2016), he said, "I hope you guys understand and feel the emotion I have right now. This certainly isn't something the city wanted to do. It's the 18th of December. We have Christmas right around the corner. My heart goes out to everybody in our city right now. I apologize. I apologize personally."

Listening and engagement

Traditional and social media should be used both to assess the public's concern and to disseminate information to the public. For example, Twitter can be used for brief alerts and updates, with Facebook allowing for more elaboration using various media assets such as videos, infographics, links, etc.

While social media reaches a broad spectrum of customers quickly, a crisis response requires direct engagement—usually face-to-face—by utilities and government entities connecting directly with the community. Allow opportunities for people to have conversations and ask officials and experts questions at open houses. This engagement should be conducted from the earliest stages of a crisis to clear up misinformation, help customers understand, and, most importantly, empower them to be heard.

A utility leader who is known for listening and relating to his customers is the former general manager of DC Water, George Hawkins. In 2004, a Washington Post article reported that DC Water attempted to 'cover up' its survey findings of 4,000 homes having lead levels exceeding the federally acceptable level set by EPA. Over 200 stories on the lead issue followed. At that moment, Hawkins being upfront and engaged in addressing the public's concerns helped to qualm the rightfully upset families that were impacted. "We've never denied what happened in the early 2000s…No question, it was a very significant problem in the District…We certainly learned from it, and now we have a very advanced [lead] control system in place (Shaver and Hedgpeth 2016)."

CONCLUSION

The number of SSOs, BWNs, and LCPEs in Texas has significantly increased over the past six years, and the lack of an investment boost for infrastructure development suggest that the trend will continue. Crisis communication on water issues serves as a solution to the larger problem of our water infrastructure needing desperate and urgent attention. But improving water infrastructure is a massive feat and will take years to accomplish. To Texas' credit, several highly attractive public funding mechanisms are in place to assist and incentivize these needed improvements. Yet public funding and local ratepayer capacity alone may not be enough to meet all needs. Private capital investment should also be encouraged and relied upon. Effective communication can promote constituent support for infrastructure improvements. Absent of these efforts, communities may continue to be heavily impacted by water crises.

In order to prevent increased public dissonance, particularly on a highly sensitive issue such as clean drinking water, our recommendation is to increase investment in strategic communication and outreach on water crisis matters. Implementing the principles of effective crisis communication require discipline and experience to act fast while considering all factors of influence. It is important to get the right messages across at the right time. Furthermore, a good crisis communication plan prevents further deterioration of a utility- or city-customer relationship.

If water crises are not managed with the sensitivity needed, public trust can be eroded, and that is very hard to rebuild. This lack of trust in a utility or city officials makes it very difficult to get approval for other initiatives (e.g. rate increases) when needed the most. The water crisis in Flint may have changed public perception toward water utilities indefinitely. Americans doubt their water quality more than ever, and if water utilities do not do a good job of reassuring their customers, especially during a crisis, then water professionals have failed.

REFERENCES

[ASCE Texas Section] Texas Section of the American Society of Civil Engineers. 2012. CPA 2012 Report card for Texas' infrastructure. Available from: http://www.infrastructurereportcard.org/wp-content/uploads/2013/02/2012-Texas-Report-Card-FINAL.pdf

Fonger R. 2018 Feb 20. UM report: Gov. Snyder bears 'significant legal responsibility' for Flint water crisis. M Live. [cited 2018 Aug 29]. Available from: https://www.mlive.com/news/flint/index.ssf/2018/02/um_report_gov_snyder_bears_sig.html

Hersher RH. 2016 Dec 18. Tap water in Corpus Christi is safe, authorities say. National Public Radio. [cited 2016 Sep 22]. Available from: http://www.npr.org/sections/thetwo-way/2016/12/18/506062239/tap-water-in-corpus-christi-is-safe-authorities-say

Morris MM. 2016 Aug 27. Sewer spills put city under EPA scrutiny. Houston Chronicle. [cited 2017 April 6]. Available from: http://www.houstonchronicle.com/news/houston-texas/houston/article/Sewer-spills-put-city-under-EPA-scrutiny-9188683.php

[NY.GOV]. New York Government. 2012. FAQs. Boil Water Notices - Frequently asked questions for residents and homeowners. [cited 2016 Sep 22]. Available from: https://www.health.ny.gov/environmental/water/drinking/boil-water/faq_residents_and_homeowners.htm#q1

Oosting J, Carah J. The Detroit News. 2016 Feb 26. Snyder: 'I'm kicking myself every day' on Flint water. [cited 2018 Aug 29]. Available from: https://www.detroitnews.com/story/news/michigan/flint-water-crisis/2016/02/26/snyder-water-bill-relief/80979926/

Quinn KQ. 2015 Oct 26. City of Houston: Sewage spills can't be prevented in heavy rain events. ABC13. [cited 2016 Sep 22]. Available from: http://abc13.com/weather/city-of-houston-sewage-spills-cant-be-prevented/1052536/

Shaver K. and Hedgpeth D. 2016 Mar 16. D.C.'s decade-old problem of lead in water gets new attention during Flint crisis. Washington Post. [cited 2018 Aug 29]. Available from: https://www.washingtonpost.com/local/dcs-decade-old-problem-of-lead-in-water-gets-new-attention-during-flint-crisis/2016/03/17/79f8d476-ec64-11e5-b0fd-073d5930a7b7_story.html?noredirect=on&utm_term=.c639c71a566c

[SAWS]. San Antonio Water System. 2013 June 4. SAWS agrees to settlement with EPA to curb sewer spills. SAWS Press Release. [cited 2016 Sep 22]. Available from: http://www.saws.org/latest_news/NewsDrill.cfm?news_id=916

[TCEQ] Texas Commission on Environmental Quality. c 2002-2018. FAQs on Sanitary Sewer Overflow Initiative. [updated 2018 June 22; cited 2016 Sep 22]. Available from: https://www.tceq.texas.gov/compliance/investigation/ssoinitiative

[TWDB] Texas Water Development Board. 2016a. Region C Planning Group. [cited 2016 Sep 22]. Available from: https://www.twdb.texas.gov/waterplanning/rwp/regions/c/

[TWDB] Texas Water Development Board. 2016b. Region H Planning Group. [cited 2016 Sep 22]. Available from: https://www.twdb.texas.gov/waterplanning/rwp/regions/h/

[TWDB] Texas Water Development Board. 2017. Texas Water Plan. [cited 2016 Sep 22]. Available from: https://www.twdb.texas.gov/waterplanning/swp/2017/

[US EPA] U.S. Environmental Protection Agency. 2016a. EPA survey shows $271 billion needed for nations wastewater infrastructure. [cited 2016 Sep 22]. Available from: https://archive.epa.gov/epa/newsreleases/epa-survey-shows-271-billion-needed-nations-wastewater-infrastructure.html

[US EPA] U.S. Environmental Protection Agency. 2016b. Basic information about lead in drinking water. [updated 2018 March 23; cited 2016 Sep 22]. Available from: https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water

[US EPA] U.S. Environmental Protection Agency. 2004. Report to Congress: Impacts and control Of CSOs And SSOs. p.24

Walker NW. 2016 Jul 21. Boil order lifted for water customers in Benbrook Neighborhood but distrust persists. NBCDFW. [cited 2016 Sep 22]. Available from: http://www.nbcdfw.com/news/local/Boil-Order-Lifted-for-Water-Customers-in-Benbrook-Neighborhood-But-Distrust-Persists-387890562.html