CIVE3331/HLT3300 Field Work Project: Fondren

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Water is essential to human life. Access to clean water is important to humans because of its impact on health. Unfortunately, not everyone has access to clean water, and a few studies suggest that there may be disparities between water quality, socioeconomic factors, and race. A study conducted in California's San Joaquin Valley between 2005 and 2011 establish that demographics factors and socioeconomic factors were correlated "with exposure to nitrate and arsenic contamination and noncompliance with federal standards" (Balazs & Ray, 2014). In 2006, 60,000 people in colonias along the U.S. – Mexico border did not have water or sewer infrastructure, despite the $1.4 billion allocated to help construct these infrastructures (VanDerslice, 2011). Houston is a large city that consists of many diverse neighborhoods. It is important to determine if such disparities exist in a large city so that further actions can be done to address the issues that exist in many places. For the Fondren neighborhood, we will examine the water quality parameters, examine any association between the pH of the water and the percentage of unemployment, distance to health clinics, and distance to grocery stores. We will determine if the correlations between these factors suggest any disparity between the water quality and the demographics of the area, and we will also determine if poor access to health clinics and grocery stores imply poor water quality.

One of the four water quality parameters that we tested our water sample for was pH level. The pH level of water is a secondary water contaminate that impacts drinking water aesthetically. The pH level of drinking water is not regulated by the U.S. Environmental Protection Agency (EPA). However, EPA does recommend that water should be maintained between pH levels of 6.5 and 8.5. Water with a low pH level can cause water to extract small metals from pipes which leads to damaged pipes and drinking water having a metallic or sour taste. On the other hand, if the pH level is to high it means there are excess minerals in the drinking water. Having high levels of minerals can lead to drinking water tasking bitter and can also cause scale build up in pipes.

Chlorine is another parameter that we tested our water sample for. The EPA considers chlorine as a primary disinfectant. While chlorine is great for keeping pools clean and destroying the bacteria in our drinking water, it is not a good idea to be ingest high concentrations of it. Having high concentrations of chlorine in drinking water can lead to cancer and kidney and liver damage.

Another parameter that we tested our water sample for was copper. The human body naturally contains copper. Human bodies develop a natural mechanism to keep a proper copper concentration level. However, if the body is exposed to high concentrations of copper in drinking water it can make you vomit, get diarrhea, feel nausea, and get stomach cramps. In extreme cases, high concentration of copper can lead to kidney and liver damage.

The final parameter that we tested our water sample for was Arsenic. Arsenic is a naturally occurring element in rocks and soils. Arsenic is odorless, tasteless, and colorless in water even in high concentrations. Some acute effects of consuming high concentrations of arsenic include nausea, vomiting, and fatigue. Chronic exposure to higher than recommended concentrations has been linked to cancer.

The buildings in the area looked relatively old. In addition, the streets appeared to have potholes along with uneven pavement. Overall, the area looked sustainable.

Methods

Demographic Model Creation

We used the Tableau dashboard to indicate the expected percentages for the demographics of the people in the area. We looked at the table concerning the demographics regarding our census block group.

Demographic Model Validation (observations)

We decided that we would walk around the study area and count how many people fit into the desired categories. In addition, we walked into a Walmart, Goodwill, and McDonald’s. In regards to counting the people over sixty-five, we decided to count people who either had white hair, wrinkles, or carrying a cane/walker. For counting the people under eighteen, we decided to count people who appeared to be children or anyone who looked as if they were still in high school. As far as counting for Hispanics, Blacks, Whites, and Asians, we counted people with regards to their skin color. In counting the poor to fair health people, we counted people who appeared to be overweight and smoking. We counted the unemployment data by counting people who were homeless. For non-citizens, we counted a person who we overheard talking about citizenship information. To measure household income, we estimated by researching the cost of a home in our study area as well as looking at the cars in that area.

Health Infrastructure Model Creation

Prior to using Google earth, we googled the locations of the clinics, hospitals, and grocery stores and then used to Google earth to validate the locations. We color coded the pins to mark whether the location was a park, clinic or hospital, or grocery store.

Health Infrastructure Model Validation

First, we used Google Maps to identify the hospitals, clinics, and grocery stores around our study area. Then we traveled to those locations and see if the distance matched what it said on Google. Then once we verified that, we used Google earth and pinned the locations according to our previous data.

Water Sampling and Measurement

The first water sample collection site was Walmart. The water collected was from a drinking fountain near the restrooms. The store was compact compared to other Walmart's in the Houston area. The water fountains were easily accessible. The area surrounding the water fountain was very clean and the drinking fountains were contemporary and clean.

The second sample collection site was Fiesta Mart. The water was collected from a water fountain near the restrooms as well. The water fountains were in an odd location in what seemed to be a stock room for the merchandise at the back of the store. The area around the water fountains seemed old and worn and the lighting in the room was not as bright as the rest of the store. The water fountains were clean but looked outdated.

The on-site field test were done on October 20th and were meant to measure total chlorine concentration and the pH of the water. For both sites, we collected the water in a large sample bottle. We stirred the water sample with the WaterWorks 487995 pH strip. We observed the color left by the water on the pH strip and compared it the colors on the provided chart to obtain a pH value for the water sample. We drained the water used and collected a new sample of water in the same bottle. We stirred the water sample with the WaterWorks 481110 chlorine strip to observe the color change in the strip. The figures below show the strips after used. We used the provided chart to compare the colors and obtained a value for the total chlorine concentration in mg/L. We recorded both values, drained the water sample in the large bottle, and collected a water sample in a small sample bottle to run a copper test in lab. For the second site we also collected a new water sample in the large bottle for an arsenic test in lab. Both small water sample bottles and the large water sample bottles were stored tightly in a refrigerator until the day of the copper and arsenic test.

Figure I. Test Strips After Usage for Site 1

Figure II. Test Strips After Usage for Site 2

The copper and arsenic test were done in lab on October 30th. For the copper test we used a Hach 2745125 dip strip. We dipped the strip in the water and stirred it for 5 seconds. We let it sit leveled for 60 seconds and compared the copper test pad to the color chart provided. We compared the colors to estimate a value for the copper concentration in mg/L.

For the arsenic test, we used an Industrial Test System 481303-5. Before we started, we made sure the water temperature was between 22^{o}C and 28^{o}C using a thermometer. We then added 100 mL of the water sample into the reaction bottle. We followed by adding the contents of the first reagent to the reaction bottle and shook it vigorously for 15 seconds. The we added the contents of the second reagent and shook it again for 15 seconds and allowed it to sit for 2 minutes to minimize sulfide interference. After the two minutes, we added the contents of the third reagent and shook for 5 seconds (This step was performed in the fume hood). We switched the regular cap for the turret cap and waited 10 minutes. After the 10 minutes, we pulled the turret up and carefully removed the test strip with the testing pad. We then used the color chart to match the color of the exposed side of the testing pad and recorded the results in ppb.

Water Quality – Risk Assessment

For all the calculations below, we will use the EPA Exposure Factors recommended for risk assessment (Masters & Ela, 2008).

The Average Daily Dose (ADD) is the dose that a person intakes per day during the exposure. The ADD can be calculated using

$$ADD = \frac{Concentration(in\ water, air, soil) \cdot Daily\ Intake\ (of\ water\ soil\ air)}{Bodyweight\ (e.g.kg)}$$

We use 70 kg and 15 kg as typical bodyweight for an adult and child, respectively. For daily intake, we assume that an adult consumes 2 L of water per day, and a child consumes 1 L of water per day.

The hazard quotient is the ratio of the average daily dose (ADD) to the reference dose (RfD) that represents the highest acceptable (safe) exposure, as shown with this equation.

$$Hazard\ Quotient\ (HQ) = \frac{ADD}{RfD}$$

The hazard index is the combined hazard quotients from multiple chemicals.

$$Hazard\ Index\ (HI) = \Sigma HQ$$

If the hazard index is greater than 1, the exposure is said to be unsafe. On the other hand, if the hazard index is less than 1, the exposure is said to be safe.

The Chronic Daily Intake (CDI) is the dose an averaged over an entire lifetime. It can be calculated using this equation

$$CDI = \frac{Concentration \cdot Daily\ Intake \cdot Exposure\ Frequency \cdot Exposure\ Duration}{Bodyweight \cdot Lifetime \cdot 365}$$

We use 70 years per lifetime as a typical lifetime for both adult and child. We assume that the exposure duration is 30 years for both adult and child, and the exposure frequency is 350 days per year for both adult and child.

The incremental lifetime cancer risk for arsenic is calculated using this equation

$$Cancer\ Risk = CDI \cdot Potency\ Factor(PF)$$

Where the potency factor indicates how much the exposure increases the risk of cancer. The potency factor for arsenic is 1.5.

If the Cancer Risk is greater than 10^{-6}, the risk is said to be unacceptable. If the Cancer Risk is less than 10^{-6}, the risk is said to be acceptable.

Data analysis

For the water quality of the tap water, we will determine if the pH, chlorine, copper, and arsenic content are acceptable or not. We will determine if the contents of the tap water is in compliance with EPA standards, and we will also compare the contents with the City of Houston averages. The Hazard Index, Incremental Lifetime Cancer Risk, and Cancer Risk will also be calculated to see if the water is safe to drink, and if the cancer risk from the water is acceptable.

We will analyze the data by constructing a table using various variables to describe the association between social factors and tap water quality. For our group, we will determine if there are any correlations between the pH of the water and the percentage of unemployment, distance to health clinics, and distance to grocery stores. To determine the strength of correlation, the Spearman correlation coefficient analysis will be used. First, we will gather all the data containing the social factors and the tap water quality for each group. Then we will extract the necessary data to determine correlation. We will assign a rank both X and Y data in Excel using the Rank function, **RANK.AVG.([X or Y datum], [X or Y data set], 1)**, and once every data information has been ranked, we will calculate the Spearman coefficient, ρ**,** using the function **PEARSON([RankX data set], [RankY data set])**. The Spearman coefficient will be a value between -1 and +1, and a positive number will indicate a positive correlation, and a negative number will indicate a negative correlation. The closer the number is to -1 or +1, the stronger the strength of the correlation is between the two data, and the closer the number is to 0, the weaker the strength of the correlation is between the two data.

An absolute ρ – value between 0.00 – 0.19 is considered to have a very weak correlation. A ρ – value between 0.20 – 0.39 is considered to have a weak correlation, and a ρ – value between 0.40 – 0.59 is considered to have a moderate correlation. A ρ – value between 0.60 – 0.79 shows strong correlation, and a ρ – value between 0.80 – 1 demonstrates a very strong correlation. A ρ – value between 0.60 – 1 would indicate a disparity between water qualities, demographic profile, and health infrastructures.

Results

Demographic Profile

Computer Model. Based on the Tableau Dashboard, the percentage of people over the age of sixty-five is 21.76% and the percentage of people under the age of eighteen is 22.36%. The majority of the people living in this area is white, 92.5%, with Hispanics at 8.3%, Blacks at 4.4%, and Asians at 3.49%. The percentage of people who are unemployed is 5.24% while the household income is approximately $98,625. The percentage of people who are non-citizens is 1.56% and the percentage of people in poor to fair health is 0.142%.

Observations. As a collective result we found that majority of the people that reside in this area are minorities with Hispanics being 30%, Blacks at 14%, Whites at 12%, and Asians at 4%. The population we observed included 19% of people who are over the age of sixty-five while 16% of the people are under the age of eighteen. 0.667% of the people were unemployed, 4% of the people appeared to be in poor to fair health, and 0.333% of the people were non-citizens. The household income still came to be approximately $98,625.

Demographic Profile

Subject	Dashboard	Observation	Comparison Data
•% over 65	21.76%	19%	Accurate
•% under 18	22.36%	16%	Accurate
•% unemployment	5.24%	0.667%	Accurate
•% Asian	3.49%	4%	Accurate
•% Blacks	4.4%	14%	Above
•% Whites	92.5%	12%	Below

•% Hispanic	8.3%	30%	Above
•% Poor to Fair Health	0.142%	4%	Accurate
•% Non-citizens	1.56%	0.333%	Accurate
•Household Income	$98,625		

Conclusions. Overall, the data seemed to correspond to the Tableau Dashboard except we observed a lower number of Whites and a higher number of Blacks and Hispanics.

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Health Infrastructure

Computer Model. There were 14 pins in total. There were 6 clinics and hospitals. There were 4 grocery stores. The locations were available all throughout our study area.

Observations. There were 6 clinics and hospitals, 4 grocery stores, and 4 parks. We also observed 4 transit stops.

Conclusions. The model was very similar to our observations. It was off by a few miles but other than that they were very close.

Water Samples

Observations. The water quality results for Fondren site is displayed on Table I. We were not able to get the exact value for the arsenic content; the test strips used does not determine arsenic content of less than 1 ppb. The EPA's Primary Drinking Water Standards require water to have a chlorine concentration that is less than 4.0 mg/L, a copper concentration that is less than 1.3 mg/L, and an arsenic concentration that is less than 10 ppb (µg/L); pH is not an enforceable standard ("National Primary Drinking Water Regulations", 2017). All our water quality parameters meet the Primary Drinking Water Standards. Most of the water quality results are in compliance with the EPA Secondary Drinking Water Standards, except for chlorine concentration ("Secondary Drinking Water Standards: Guidance for Nuisance Chemicals", 2017). The water tested on both sides contain a chlorine concentration of 0.1 mg/L, which is less than the minimum residual chlorine level of 0.2 mg/L entering the distribution system.

The quality of the water test varied in comparison to the City of Houston's average, as shown in Table I. The average pH of water in Houston was not provided, so we could not compare our pH level. The average chlorine level in the City of Houston is 3.556 mg/L, which is above our site's average and is in compliance with the EPA standards. Our chlorine content for both sites is below Houston's average. The copper level in the water tested is above Houston's average, which is 0.0513 mg/L. As for arsenic, we were not able to make a comparison since we did not get the exact concentration value of the arsenic in the water tested. The average arsenic concentration of the City of Houston is 0.002035 mg/L, which is equivalent to 2.035 ppb.

Table I. Water Quality Results and Evaluation

	Value for Site 1	Value for Site 2	Mean Value	Compliance with EPA Standards	Comparison to City of Houston Average
pH	7	7	7	Yes	N/A
Total Chlorine [mg/L]	0.1	0.1	0.1	Yes and No	Below Houston's Average
Copper [mg/L]	0.4	0.4	0.4	Yes	Above Houston's Average
Arsenic [mg/L]	<1 pbb	<1 pbb	<1 pbb	Yes	N/A

The hazard index and the incremental lifetime cancer risk for both adult and child are calculated; the values are shows in Table 2 below. To calculate these values, we used the assumptions and equations from the Water Quality – Risk Assessment section. For the calculations, we did not have the exact concentration of arsenic, so we assumed that the concentration of arsenic is 0.5 ppb, or 0.0005 mg/L.

The hazard index that we calculated for both adult and child consist of the sum of hazard quotients from copper and arsenic. Since both hazard index are less than 1, the water that we tested is safe to drink for both parties.

We also calculated the incremental lifetime cancer risk from arsenic for both adult and child. Although copper can cause sicknesses, the EPA does not consider copper as a human carcinogen. For both parties, since the incremental lifetime cancer risk is greater than 1 x 10^{-6}, the cancer risk is unacceptable.

Table II. Water Safety Results

	Hazard Index	Safe to Drink?	Incremental Lifetime Cancer Risk (Arsenic)	Cancer Risk Acceptable?
Adult	0.33262	Yes	8.80E-06	No
Child	0.77861	Yes	2.10E-05	No

Analysis and Discussion. The hazard index and the incremental lifetime cancer risk for both adult and child are not accurate, since we assumed that the arsenic concentration is 0.5 ppb. The arsenic test kit that we used, Industrial Test System 481303-5, does not indicate arsenic concentration below 1 ppb. Many groups who conducted the same experiment encountered the same problem of not getting an exact value for arsenic concentration, as proven in the Google Earth Pro Map provided to us.

To fully determine if the drinking water is safe, we can use a different experimental method. There are laboratories accredited by The State of Texas under the National Environmental Laboratory Accreditation Program, NELAP, that use EPA approved Drinking Water Analytical Methods to test water quality ("Environmental Laboratory (NELAP) Accreditation", 2017). These laboratories must use an EPA – approved drinking water analytical method to test drinking water; these are the same methods used to officially analyze water quality parameter to meet “federal monitoring requirements” and “demonstrate compliance” with drinking water regulations ("Learn about Drinking Water Analytical Methods", 2017). These methods are developed by many organizations, such as the EPA and ASTM International. The advantage of sending the water samples to these laboratories is that the results will be very accurate. This is especially helpful in analyzing the hazard index and the incremental lifetime cancer risk for the water samples, since we will get the exact arsenic concentration value. The disadvantage of sending the water sample is that it will be expensive. Since there are 20 groups that will conduct the same experiment, the cost of analyzing the water samples in these laboratories will be significantly higher compared to the cost of analyzing them inside classroom labs.

Analyses of Association.

Demographic Profile and Water Quality. Figure I shows the association between pH and percentage of unemployment. The Spearman coefficient for this association is -0.017307774, and since this number is between 0 to 0.19, the coefficient indicates that there is a very weak correlation between the pH and the percentage of unemployment. This correlation does not indicate any disparities between the pH of water and the percentage of unemployment.

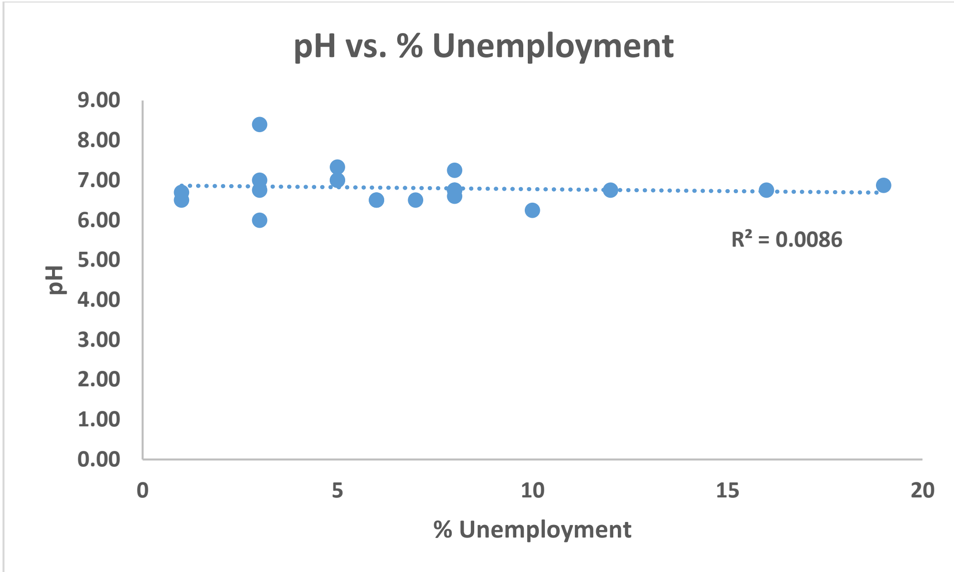

Figure I. Association Between pH and Percentage of Unemployment

Health Infrastructure and Water Quality. Figure II shows the correlation between pH and distance to health clinics (miles). The Spearman coefficient for this association is 0.329126601, and since this number is between 0.20 to 0.39, the coefficient indicates that there is a weak correlation between the pH and the distance to grocery stores. Because the correlation is weak, this association is not significant enough to indicate if poor access to health clinics imply poor water quality.

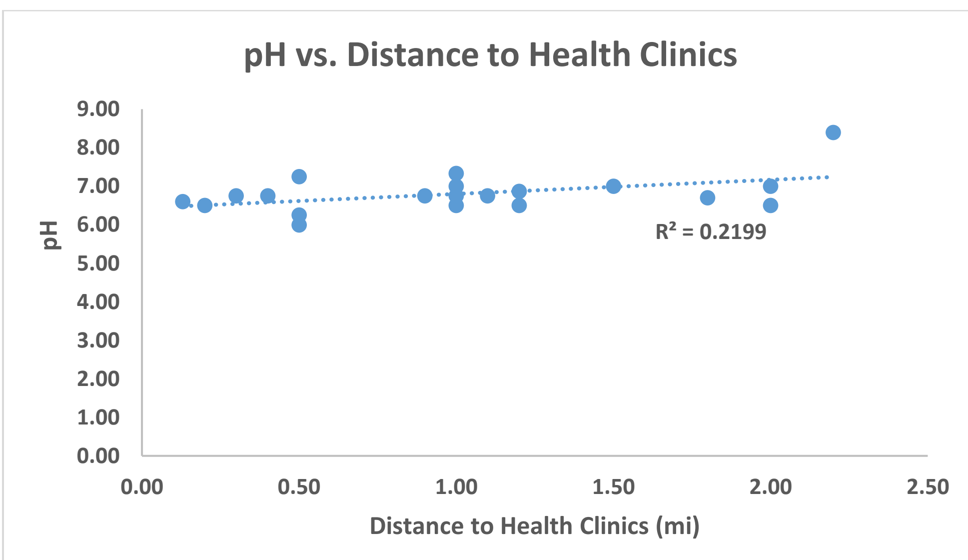

Figure II. Association between pH and Distance to Health Clinics (miles)

Figure III below shows the correlation between pH and distance to grocery stores (miles). The Spearman coefficient for this association is 0.212687897 , and since this number is between 0.20 to 0.39, the coefficient indicates that there is a weak correlation between the pH and the distance to grocery stores. Because the correlation is weak, this association is not significant enough to indicate if poor access to grocery stores mean poor water quality.

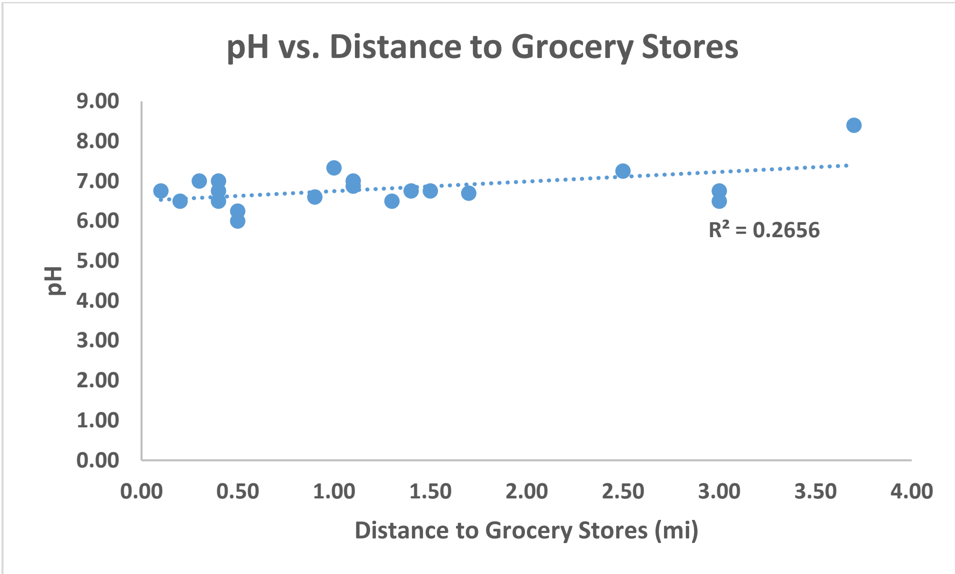

Figure III. Association Between pH and Distance to Grocery Stores (miles)

Conclusion

The water quality in Fondren is safe. All water quality parameters meet the EPA's enforceable Primary Drinking Water Standards. Most of the parameters also meet the EPA's secondary drinking water standards, except for chlorine, which is lower than the minimum residual chlorine level of 0.2 mg/L entering the distribution system. In comparison to the City of Houston's average, we were not able to compare the pH level because the average pH for the City of Houston is not determined, and the arsenic concentration of our water sample in undefined. Our chlorine level is below Houston's average, and our copper concentration is above Houston's average.

Assuming that the arsenic concentration of the water tested is 0.5 ppb, the drinking water for Fondren is safe to drink for both adult and child, since both hazard index is below one. However, the cancer risk for both adult and child are unacceptable, since the incremental lifetime cancer risk for both parties are above 1 x 10^{-6}. These values are not accurate, since we were not able to get an exact value for the arsenic concentration due to the limitations of the provided arsenic test kit. To get an accurate value for the water quality parameters, we suggest that the water get tested at a Drinking Water Laboratory that uses an EPA - approved drinking water analytical methods.

The associations that we analyzed are not significant enough to suggest disparities between water quality, demographics, and health infrastructures. The Spearman coefficient between the pH and the percentage of unemployment is -0.017307774, and this indicates a very weak correlation between the two. For the pH and the distance to health clinics, the Spearman coefficient is 0.329126601, and this indicates a weak correlation. The Spearman coefficient between the pH and the distance to grocery stores is 0.212687897, and this also indicates a weak correlation. These Spearman coefficients are not significant enough to suggest any disparities that exist between the water quality, demographics, and health infrastructures.

Our results do not correlate with the results from places that experience disparities with water quality, such as the California's San Joaquin Valley and the colonias along the U.S. – Mexico Border. Based on the water quality parameters and associations, Houston's water met all the EPA's primary standards for drinking water. Despite the demographic and socioeconomic diversity in Houston, many residents have access to clean water. Residents also continue to have access to clean water, whether they live near or far from health infrastructures.

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Appendix A

Health Infrastructure Scorecard

Location 482, 014, 219, 002

Medically Underserved (Yes/No): No

# of Clinics within 1 mile: 1

# of Hospitals within 1 mile: none

Nearest Clinic Name: Braeswood Family and Occupational Clinic

Distance from center point in study area: 1.5 miles

Travel Time from center point in study area: 6 minutes

Nearest Hospital Name: Memorial Hermann Southwest Hospital

Distance from center point in study area: 2.7 miles

Travel Time from center point in study area: 9 minutes

Food Desert (Yes/No): No

Nearest Grocery Store Name: Walmart Neighborhood Market

Distance from center point in study area: 0.3 miles

Time from center point in study area: 2 minutes

Parks in the Study area (Name and nearest cross streets)

Braesmont Park: 0.5 miles

Cross Street: 2 minutes Kuldell Dr, Pontiac Dr

Bayland Park: 1.2 miles

Westbury Park: 1.0 miles

Stein Park: 0.9 miles

Goldwin Park: 1.5 miles

Meyerland Park: 1.5 miles

Meyers Park: 1.5 miles

Mass Transit Stops (tell which streets, what type, and how many): Total: 4

Hillcroft Ave at Braesheather Dr (bus stop)

Hillcroft Avenue at Braeswood Blvd (bus stop)

Hillcroft Ave at Bayou Bridge Dr (bus stop)

Hillcroft Ave at Rutherglenn Dr (bus stop)

Bike Lanes: NA

Sidewalks: South Braeswood and Hillcroft, goes about 5 miles, good condition

Appendix B

Demographic Profile Scorecard

Location: 482, 014, 219, 002

Age

% over 65 per Tableau Dashboard Data: 21.76%

<u>Observations</u>

Describe Indicator: white hair, using a cane or walker, wrinkles

What did you see: We saw an adequate amount of people who appeared to be over the age of sixty-five.

%under 18 per Tableau Dashboard Data: 22.36%

<u>Observations</u>

Describe Indicator: people who appeared to be in school or were babies

What did you see: We saw a considerable amount of young people, since we went to our census block group on a weekend.

% Hispanic per Tableau Dashboard Data: 8.3%

<u>Observations</u>

Describe Indicator: people with olive skin color

What did you see: We saw a lot of Hispanics in the area who also spoke Spanish while we were there.

% Unemployment per Tableau Dashboard Data: 5.24%

Observations

Describe Indicator: homeless

What did you see: We saw very few homeless people in the streets.

Race

% Asian per Tableau Dashboard Data: 3.49%

Observations

Describe Indicator: people with tan skin and black hair

What did you see: Of all the ethnicities, we saw the fewest number of Asians.

% Black per Tableau Dashboard Data: 4.4%

Observations

Describe Indicator: people with dark skin

What did you see: We saw more people with dark skin than we expected.

% White per Tableau Dashboard Data: 92.5%

Observations

Describe Indicator: people with fair skin

What did you see: We saw less people with fair skin than we expected.

Household income (median) per Tableau Dashboard Data: $98,625

Observations

Describe Indicator: cars and homes/apartments in the area

What did you see: We saw a few nice cars along with some nice looking apartments.

% Non-citizens per Tableau Dashboard Data: 1.56%

Observations

Describe Indicator: people speaking about citizenship

What did you see: We overheard a few people talking about citizenship issues.

% Poor to Fair Health per Tableau Dashboard Data: 0.142%

Observations

Describe Indicator: people with handicap signs, hospital bands, and people who appeared to be overweight

What did you see: There were quite a few people who were overweight. We also saw cars who had handicap signs and people wearing hospital bands.

Appendix C

Results Analysis of Associations Between Social Factors and Water Quality

Water Quality	**Social Factor**	**r**	**t**	**p**	**Association**
Hazard Index	Household Income	-.12	-.492	> .05	No
Hazard Index	Distance to grocery store	-.49	-2.361	< .025	Yes
Hazard Index	Distance to clinic	-.50	-2.440	< .025	Yes
Hazard Index*	Distance to hospital	.18	.773*	> .05	No
Hazard Index	% Unemployed	.37	1.676	> .05	No
Hazard Index	Poor to fair health	.27	1.198	> .05	No
Hazard Index*	Non-Citizen	-.19	-.827*	> .05	No
Total Chlorine	Household Income	.187	.807	> .05	No
Total Chlorine	Distance to grocery store	.14	.616	> .05	No
Total Chlorine	Distance to clinic	-.22	-.965	> .05	No
Total Chlorine	Distance to hospital	-.31	-1.360*	> .05	No
Total Chlorine	% Unemployed	-.02	-.092	> .05	No

Total Chlorine	Poor to fair health	.05	-.199	> .05	No
Total Chlorine	Non-Citizen	.36	1.622*	> .05	No
Cancer Risk	Household Income	-.27	-1.194[1]	> .05	No
Cancer Risk	Distance to grocery store	.34	1.557[1]	> .05	No
Cancer Risk	Distance to clinic	.40	1.856[1]	<.05	Yes
Cancer Risk	Distance to hospital	.26	1.165[1]*	> .05	No
Cancer Risk	% Unemployed	.09	.370[1]	> .05	No
Cancer Risk	Poor to fair health	-.67	-3.862[1]	< .001	Yes
Cancer Risk*	Non-Citizen	.92	9.693[1]*	< .0005	Yes
pH	Household Income	-.01	-.024	> .05	No
pH	Distance to grocery store	.18	.797	> .05	No
pH	Distance to clinic	.32	1.414	> .05	No
pH*	Distance to hospital	-.59	-3.093*	< .005	Yes
pH	% Unemployed	.04	.161	> .05	No
pH	Poor to fair health	.17	.728	> .05	No

pH*	Non-Citizen	-.30	-1.334*	> .05	No

1=Estimates uncertain due to high number of ties for Cancer Risk

*=17 degrees of freedom; all other computed at 18 degrees of freedom