

Statistical Analysis of Public Awareness of Groundwater Contamination from the Northrop Grumman Plume Affecting Select Communities in Nassau County, New York

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1. Introduction

The Grumman Aircraft Engineering Corporation of Bethpage, New York was a booming aeronautical business in the early 1930s. During this time, they produced the highest quality fighter jets and scout planes for the United States Navy (Darnaud, 2018). It wasn't long after the 1950 expansion that the relationship between Grumman and the Navy collapsed. In 1994, Grumman's once booming business of fighter jets and scout planes faced serious financial problems. After losing their contract with the Navy, Northrop Grumman couldn't fiscally stand on their own anymore (Angelfire). After many years of reviewing historical records involving production practices at Northrop Grumman, there is evidence that a groundwater plume developed due to disposal of waste liquids and leakage from solvent bulk storage containers located at the site during their years of operation (Misut, 2011). Environmental studies by the U.S. Department of the Interior and the U.S. Geological Survey, at the request of the U.S. Environmental Protection Agency (EPA), confirm the following contaminants in the groundwater: Trichloroethylene, Tetrachlorethylene, 1,4-Dioxane, unregulated contaminants and approximately 20 more chemicals that contain radium, a toxic element that contributes to adverse human health effects. A number of maps composed by the EPA and the U.S. Department of Environmental Conservation (DEC) are available showing different scenarios of the contamination, including predictions of future groundwater plume spread (US-EPA; 2017). In 2017 both Northrop Grumman and the U.S. Navy have assured local government officials, local water districts and the surrounding communities that in spite of reports of contamination, groundwater is safe for consumption (South Farmingdale Water District). The Northrop Grumman plume has been spreading throughout the groundwater at an alarming rate over a long period of time (Denaud, 2018). A lawsuit initiated by the Bethpage Water District (BWD) against Northrop Grumman and the U.S. Navy was filed on March 8th, 2019 (BWD, 2019).

Our research is focused on the following two major questions: How informed are the surrounding communities regarding the actual levels of groundwater contamination and are communities and local entities satisfied by Navy's and Grumman's efforts to clean up contamination? It is the authors' expectation that a conducted questionnaire survey and related statistical analysis will approach an indication of whether businesses are fully aware of the level of contamination of groundwater. A statistical analysis of water quality and groundwater contamination awareness was conducted utilizing a survey of restaurant businesses in Bethpage, Hicksville and Farmingdale, NY (see Figure 1). These communities were chosen based on their location in proximity to the initial area of the groundwater contamination at Northrop Grumman.

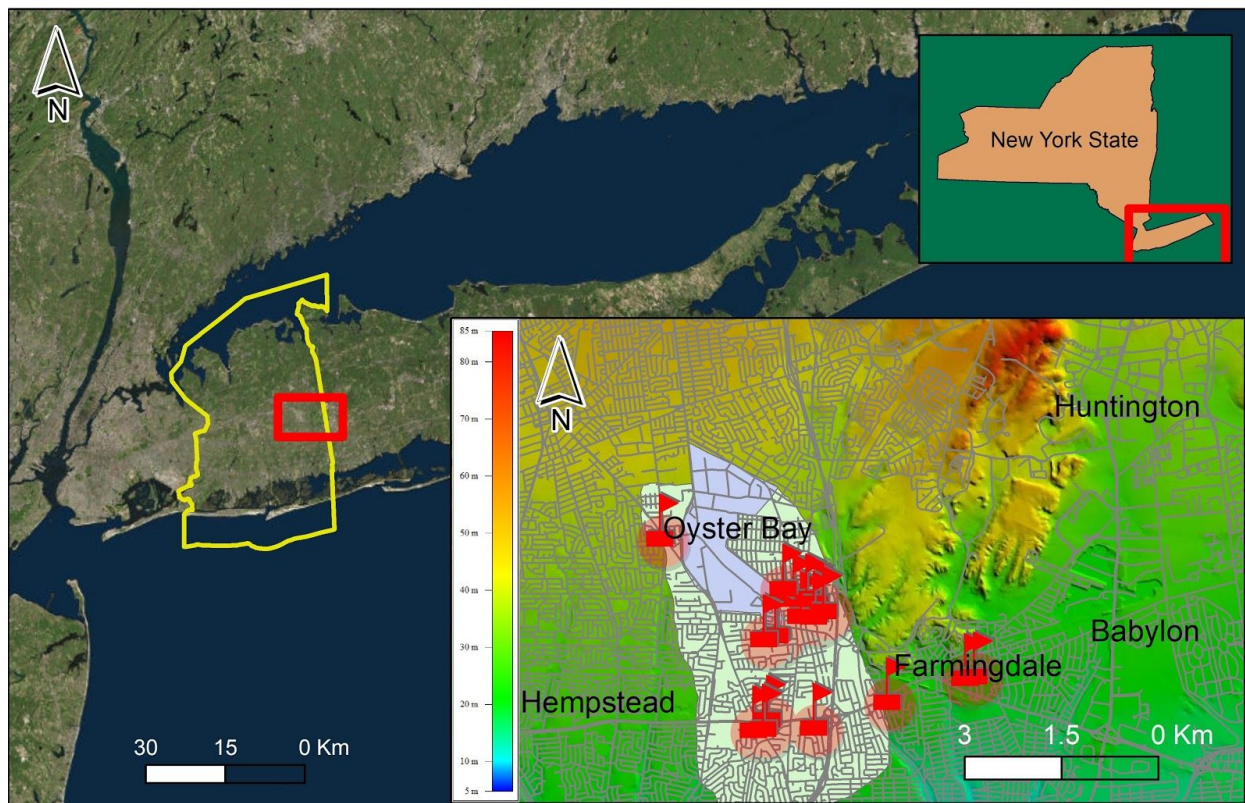


Figure 1: Geographical map of the locations Bethpage, Hicksville, and Farmingdale communities. The light blue shaded polygon area outlines the Northrop Grumman property, and the light green shading depicts the extent of the plume as of 2012 (after Long Island Express, 2016). Questionnaire survey was conducted, and 21 anonymous responses were collected (shown by red flags) by Hofstra University.

2. Methodology

A questionnaire survey was distributed to businesses directly connected to food service in the communities of Bethpage, Hicksville and Farmingdale, New York to collect data on their viewpoint of the quality of their water and how aware they are of the Northrop Grumman groundwater plume. Over thirty-four surveys were distributed through email, phone calls and in-person visits to food service businesses. Twenty-one surveys were completed mostly by in-person visits. Questions are as follows: 1. Are you satisfied with the quality of the tap water in your business?; 2. Are you confident your tap water is contaminant-free and safe to drink for your customers?; 3. Do your customers inquire about the quality of the water?; 4. Do you utilize water filters at your business?; 5. Are you aware of the contamination plume in the groundwater that appears to have originated on the Grumman property in Bethpage?; 6. Does the location of your business in relation to the the Grumman plume concern you?; 7. Do you feel that your location in relation to the Grumman plume has impacted business/profit?; 8. Are you confident that government officials are being forthright (truthful) in providing the level of contamination from the Grumman plume?; 9. Are you confident that government officials are being forthright (truthful) in their level of assurance that groundwater is safe in the area of the Grumman plume?;

10. Do you feel phone calls are an efficient means of communication regarding contamination? A Likert-scale model (Allen & Seaman, 2007) was employed, with responses ranging from 1-5, with 1 corresponding to disagree and 5 corresponding to agree. Questions 1-4 and 5-9 were combined into categorical variables to better compare the results; questions 1-4 focusing on the quality of water and questions 5-9 focusing on the awareness of the Northrop Grumman plume. Question 10 was considered its own categorical variable. In analyzing the grouped variables, we combined similar responses such as somewhat agree and agree, and somewhat disagree and disagree. The data was then standardized (percent) to statistically analyze results. When completing the Chi-square test, we re-coded the variables to increase the significance in the results and to better understand water quality and contamination awareness. Agree was coded as 1, neither agree nor disagree as 3 and disagree as 0. The survey process was completed utilizing a Google form and statistical analysis conducted using the statistical software SPSS.

3. Results

After re-coding the variables, we found that 54.8% of the 21 respondents agreed for our combined variable (Q.1-4), corresponding to perception of water quality, while 35.7% of the respondents disagreed. For the second combined variable (Q.5-9), 43.8% of the respondents disagreed, corresponding to level of awareness of the Northrop groundwater plume, while 35.2% of the respondents agreed. For the third variable (Q.10), 47.6% of respondents disagreed, corresponding to the level of confidence in methods of notification for environmental emergency, while 38.1% of respondents agreed. Only three of the Chi-Square tests, questions 1 and 2; 1 and 4 ; and 6 and 3, provided a Cramer's V of .58 or higher, resulting in a moderate correlation. The sole outlier Chi-Square test, corresponding to questions 8 and 9, had a high correlation with a Cramer's V of .813. Figure 2 represents the correlation results of the questionnaire survey.

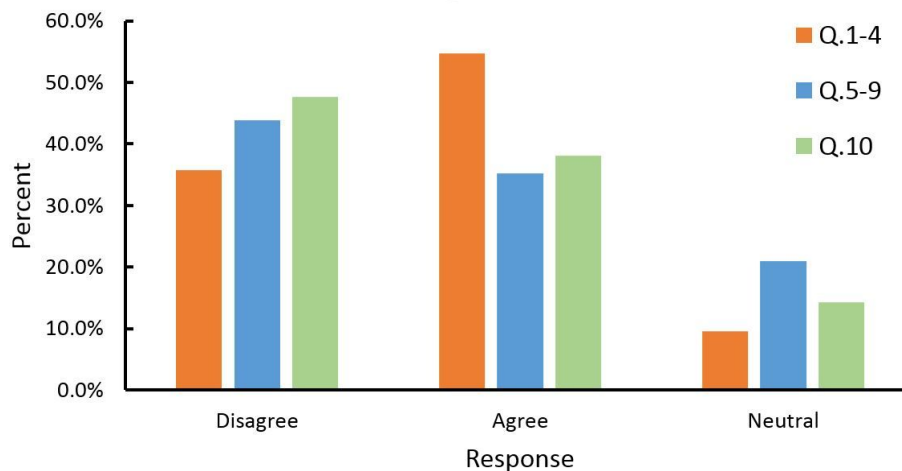


Figure 2: Chart of correlation results of questionnaire survey where questions have been reclassified into three categories. Questions 1-4 depicted by the orange bar represents perceptions of water quality in area. Questions 5-9 depicted by the blue bar represents

the level of awareness of the Northrop groundwater plume and question 10, depicted by the green bar, represents responses of how efficient business owners feel.

Questions 1-4 indicate restaurant managers feel their water quality is sufficient based on the volume of “somewhat agree” responses recorded for this set of questions. Questions 5-9 indicate that most food businesses feel as neutral about their level of knowledge concerning the extent of the plume and how officials are responding to it. Question 10, measured as its own variable, indicates mixed opinion on whether phone calls are an efficient means of communication for environmental emergencies. After analyzing these results, it is evident that food businesses are aware, but do not recognize the severity and impact of contamination. The results indicate that food businesses do not recognize that the plume affects them. Some responses were neutral, indicating a lack of awareness of the significant impacts of the plume. Future research should focus on a larger distribution of business surveys, along with separate residential surveys in the Bethpage, Hicksville and Farmingdale area. Analysis of surveys provided to residents would generate additional data to compare results of business and residential awareness of the Northrop Grumman plume from two different perspectives.

4. Conclusion

The survey study of the level of awareness of the Northrop Grumman contamination plume in the surrounding communities of Bethpage, Hicksville and Farmingdale, NY indicates that business owners in these communities are aware of the local contamination. However, they do not recognize the severity and impact of the groundwater quality. Restaurant businesses in Bethpage, Hicksville and Farmingdale indicate that their water quality is sufficient. The analysis of responses relating to the level of awareness of the extent of the plume have a neutral response, demonstrating that business owners are not appropriately concerned with gaining greater awareness of the growing contamination. We can conclude that most community businesses are moderately aware of the plume and its impact on groundwater, while others are not concerned that this contamination has occurred and affects their business property.

5. Acknowledgement

The ten-question survey was submitted to and approved by the Hofstra Institutional Review Board (IRB) for the use of humans as research subjects. Responses to surveys are anonymous and cannot be traced back to the respondent or their business and are completely confidential. Responses were combined with those of many others and summarized in a report to further protect anonymity.

6. References

Allen, Elaine and Seaman, Christopher (2007). “Likert Scales and Data Analyses”. *Quality Progress*. pp. 64-65

- Angelfire, *The History: The Beginning to WW2*. (n.d.). Retrieved March 10, 2019, from <http://www.angelfire.com/space/grumman/history/grummanhistory1.html>
- Bethpage Water District, Latest News. (2019, March 08). Retrieved March 9, 2019, from <http://bethpagewater.com/News/Detail/167/bethpage-water-district-demands-polluters-pay-for-water-treatment?ReturnUrl=/>
- Darnaud, Denis., (2018). *Don't Drink the Water: The Bethpage Plume* - Nassau County, NY.
- Misut, P. E. (2011). Simulation of groundwater flow in a volatile organic compound-contaminated area near Bethpage, Nassau County, New York-A discussion of modeling considerations. United States Geological Survey, Retrieved March 9, 2019, from <https://pubs.er.usgs.gov/publication/ofr20111128>
- Long Island Express, 2016. Cuomo orders testing of Bethpage's ever-creeping toxic plume. Last accessed: March 5th 2019. <https://www.longislandpress.com/2016/01/28/state-orders-testing-of-bethpages-toxic-plume/>
- South Farmingdale Water District, Grumman Update. (n.d.). Retrieved March 9, 2019, from <http://sfwater.com/resources/grumman>
- U.S. Environmental Protection Agency, Hazardous Waste Cleanup: Naval Weapons Industrial Reserve Plant and Northrop Grumman Corporation Site (NWIRP) in Bethpage, New York. (2017, September 14). Retrieved March 9, 2019, from <https://www.epa.gov/hwcorrectiveactionsites/hazardous-waste-cleanup-naval-weapons-industrial-reserve-plant-and-northrop>