NOT IN OUR COMMUNITY – AN ACTOR NETWORK THEORY ANALYSIS OF THE CHLORAMINES CONTROVERSY IN CHARLOTTESVILLE, VIRGINIA

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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There has been an increasing number of emerging contaminants that can be found in our waterways. Biological contaminants, such as antibiotic resistant bacteria, can be a serious health risk for those that come in contact with them, especially as illnesses contracted from the bacteria can be deadly (CDC, 2019, para.1). Further, antibiotic resistant bacteria may contaminate drinking water supplies downstream of wastewater treatment plants depending on their persistence in the environment. In response to the increase in these contaminants, the U.S. Environmental Protection Agency (EPA) periodically updates drinking water regulations which dictate treatment standards for water treatment facilities. When these regulations are updated, community water authorities are required to assess the compliance of their water infrastructure and make changes where necessary. The success of these updates is largely dependent on both the existing water infrastructure as well as public participation in the process (Greenberg, 2016). In order to understand the role of transparency and community awareness on the successful implementation of water infrastructure in different communities, a network analysis will be conducted on the actors surrounding a controversy over water treatment in Charlottesville, Virginia.

While the Technical project will investigate infrastructure interventions to prevent the spread of antibiotic resistant bacteria in the Charlottesville community, the Science, Technology, and Society (STS) project will employ Actor Network Theory to investigate the effect of community response to water infrastructure decisions. The topics presented for the Technical and STS research papers are coupled through the prospect that as antibiotic resistance becomes a more prominent issue in water treatment, it will require water authorities to work with communities to update water treatment infrastructure.

CONTROVERSY OVER WATER IN CHARLOTTESVILLE

In 2012, the City of Charlottesville, Virginia and the surrounding Albemarle County experienced significant controversy with regards to a water infrastructure decision. In response to the EPA updating a section of the disinfection byproduct regulations, the Rivanna Water and Sewer Authority (RWSA), in charge of both drinking and wastewater treatment in the area, was required to upgrade their drinking water disinfection system (Frederick, 2012, p. 2). The water authority chose to switch from free chlorine to chloramines, a compound of chlorine and ammonia, for water treatment; a decision that was met with extreme community pushback (Frederick, 2012; Wheeler, 2012a; Wheeler & Beale, 2012a). After months of discussion and community response, the less expensive chloramines were tabled and a combined method using activated carbon and chlorine was pursued (Wheeler, 2012b).

WHY WAS THERE SO MUCH PUSHBACK IN CHARLOTTESVILLE?

The situation in Charlottesville, Virginia was not unique. According to Thomas Fredricks, the executive director of the RWSA board of directors, in a comment to NBC29, "approximately 40 percent of the US population, and 76 percent of the population of Virginians" drank water treated with chloramines in 2012 ("Debate Over Disinfecting Our Water," 2012, para. 15). So why was there so much pushback in the Charlottesville community about switching to chloramines? A combination of a highly educated population, a long history of community activism, local newspapers willing to closely follow the issue, public media, and local government's transparency on the issue may have all contributed to this controversy and its ultimate solution.

The controversy began when engineers from the Rivanna Water and Sewer Authority proposed the use of chloramines to replace chlorine as the secondary disinfectant, shown at the beginning of the timeline in Figure 1 (Frederick, 2012). As chloramines are both less expensive and easier to implement, the decision was made to pursue chloramines over other treatments, such as a combined activated carbon and chlorine treatment (Frederick, 2012). However, once these plans entered the public forum in March, they were met with varied resistance by multiple groups in the community, as seen in the timeline in Figure 1 (Brashear, 2012; Tubbs, 2012). A local news source, Charlottesville Tomorrow, followed the situation avidly and publicized information regarding the official hearings as well as informational meetings which included activists against the adoption of chloramine (Wheeler, 2012a). Local officials, realizing a portion of residents were against the change, held public hearings and eventually decided to forgo the use of chloramines in favor of other alternatives in late July (Brashear, 2012; Wheeler, 2012b)

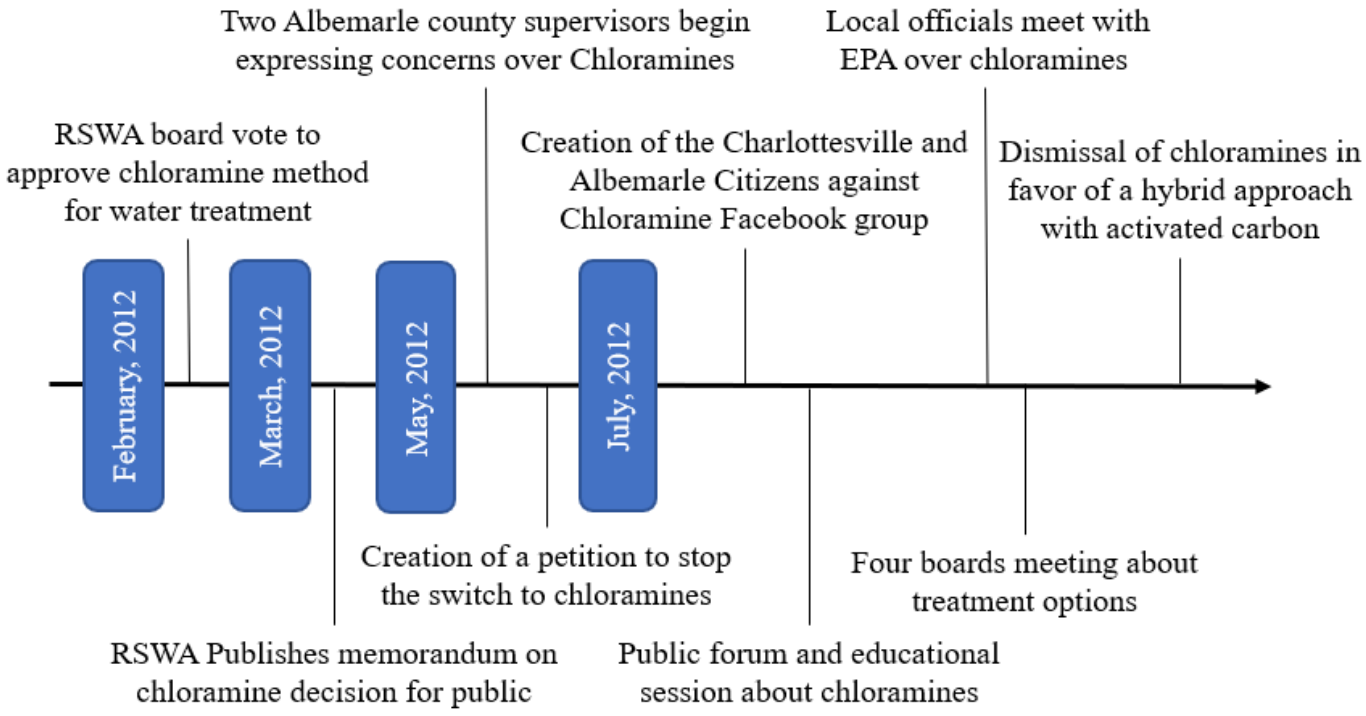

Figure 1: Timeline of Events during the Charlottesville Chloramine Debate: Events leading up to the decision to stop perusing chloramine treatment for water disinfection (Sutton, 2019).

ANALYZING WATER SYSTEMS WITH ACTOR NETWORK THEORY

Actor Network Theory (ANT) was chosen to analyze the chloramine controversy in Charlottesville due to its relevance in analyzing municipal water systems which was explored in Deya Roy's paper "Understanding the Delhi Urban Waterscape through the Actor Network Theory." The paper was written in 2014 amidst deepening concerns over a water crisis happening in Delhi, India due to a severe lack of potable water, particularly in the slums which house "almost half of Delhi's population" (Tamim, 2014, para. 13). Roy, an environmental policy researcher with experience working in water public policy in urban areas throughout India, was focused on gaining a deeper understanding of the Delhi urban water system and which actors were the most influential in the process (Roy, n.d.). Additionally, she strove to outline a socio-technical theory that was capable of analyzing complex municipal water systems, so to better advise policy makers about decisions over water infrastructure and governance. Roy stressed that urban water networks could not be adequately analyzed without assessing both the interconnected nature of the system as well as the human and non-human actors within it, which she indicates can be best done through the use of the Actor Network Theory model.

Actor Network Theory is an analysis method focused on studying a situation by looking at the interactions between different groups of actors (Law & Callon, 1988, p.285; Johnson, 2005, p.1792). Each of these actors is motivated by their own interests and can have different levels of influence on a central issue (Jolivet & Heiskanen, 2010, p. 6748). A summary diagram of expected actors and their network for the Charlottesville water controversy is shown in Figure 2 on page 7, with the method of drinking water treatment as the central issue. Actants are also added to show influences that are very important to each actor and thus may affect their opinion on the central issue.

Roy explored other theories of socio-technical thought, such as Social Construction of Technology and Technological Determinism in order to show how both are too focused on either the societal or technological aspects to fully analyze "technology and society [that] exist as a seamless web" as is the case for municipal water systems (Roy, 2014, p. 323). This rationalization led Roy (2014) to Actor Network Theory which consists of a network of actors who are "defined through their interaction with other actors" (p. 324). The theory's focus on relationships allows for "contestation and negotiation between users and the service providers" which is especially important in urban waterscapes where the water infrastructure is highly influenced by multiple interacting groups and community expectations (Roy, 2014, p.333). As municipal water systems are a combination of public and private providers, it is important that the method used to analyze the system can show these relationships between different sectors and how they interact with consumers and technology.

Roy (2014) also identified Actor Network Theory's focus on the "relationships between the human and the non-human" as an integral aspect for analyzing urban water systems (p.324). Water is a basic necessity, and when subject to the infrastructure and governance required in communities, its access is limited not only by technological infrastructure but by "economic, social, and cultural processes" as well (Roy, 2014, p.332). While other methods are critical of treating non-human components as actors, Roy (2014) argued that their inclusion would allow for better regulation of water resources and infrastructure as well as a better understanding on the "impacts of water management" (p. 327). To continue expanding on this concept, Roy (2014) employs a method similar to Wejnert (2002) to analyze both the human and non-human actors within the network. In order to further develop a network analysis, Barbara Wejnert (2002), an accomplished researcher in political sociology, proposed that the study of a human actor's

personal characteristics, such as education level and economic situation, could shed light on their willingness to adopt a technology (p.320; “Barbara Wejnert,” n.d.). Analysis of individual traits will help to better characterize the responses of the Charlottesville community, the activist groups, and the water infrastructure itself.

By employing Wejnert’s in-depth characterization of groups in combination with ANT’s method of analyzing both human and non-human actors, a more holistic view of the situation influencing water infrastructure and other public utility decisions can be understood.

WHO IS PULLING THE STRINGS IN THIS CONFLICT OVER WATER?

In order to understand what factors influenced the outcome of the 2012 chloramines controversy, six actors were chosen for analysis; these include the City of Charlottesville, Albemarle County, the Rivanna Water and Sewer Authority, activist groups, consumers of local water, and local water infrastructure. For each of these actors, characteristics that made them influential in the chloramine controversy was explored, including their composition, importance or knowledge in the area of drinking water, their stake in the issue, and other factors that influenced their decision-making process. The presented actors were selected based on their relationship to the decision-making process during the debate over the water disinfection method in the Charlottesville community. The Actors chosen, as well as the primary actants that influenced their decision, are summarized in diagram form in Figure 2 on the next page, with actors shown in green and actants in light blue.

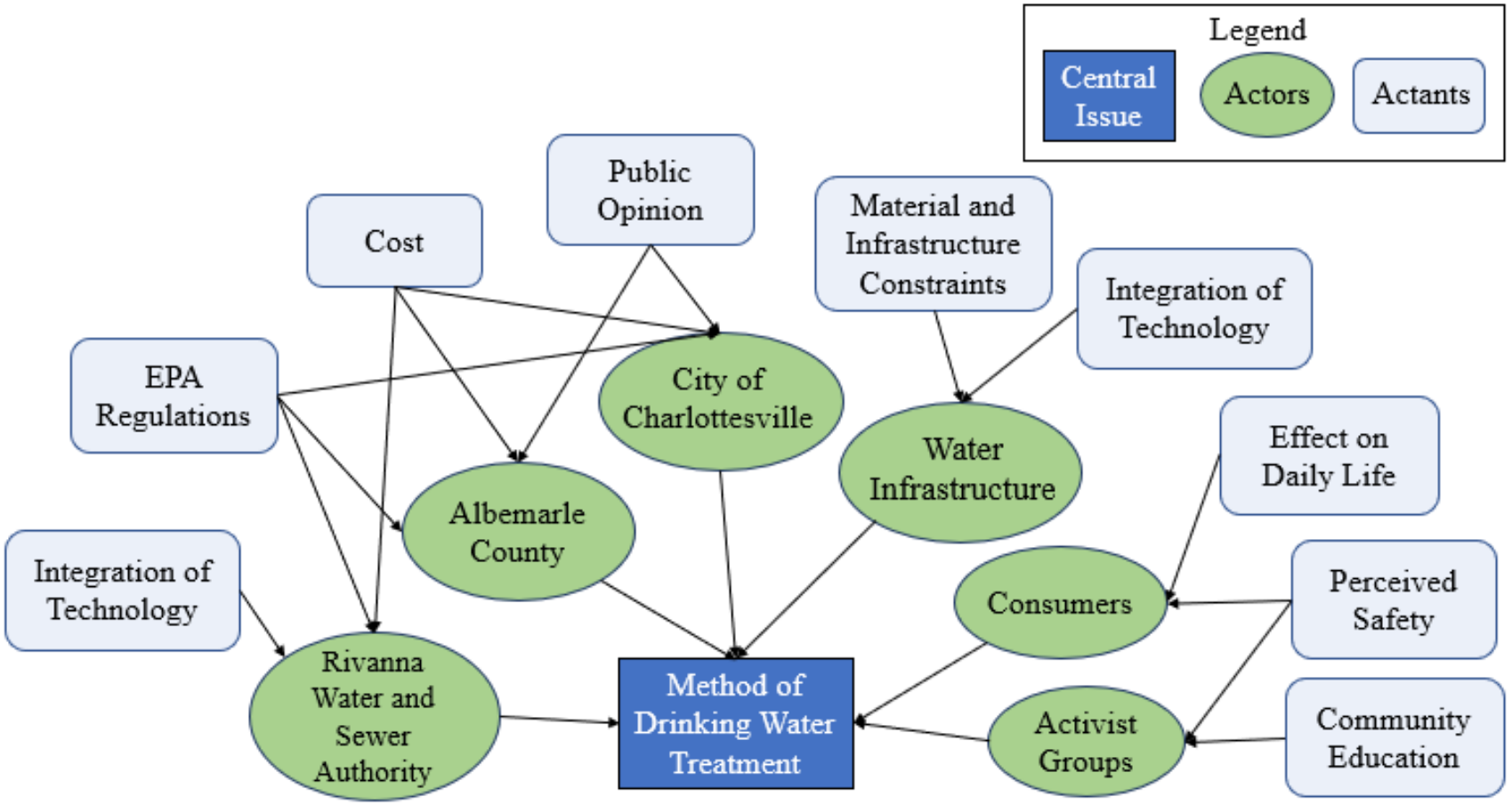

Figure 2: Charlottesville Chloramines Debate Actor Network Theory Diagram: A diagram showing the main actors in the Charlottesville chloramines debate and the actants that influence each within their network (Sutton, 2020b).

City of Charlottesville

The City of Charlottesville is led by the Charlottesville City Council, a decision-making body composed of five members, two of which are elected mayor and vice mayor within the council ("city Council," n.d.). The Charlottesville City Council was one of four decision-making bodies to have the final say on the chloramines debate, with the other three including the Albemarle Board of Supervisors, the Rivanna Water and Sewer Authority, and the Albemarle County Service Authority (Wheeler & Beale, 2012b, para. 6). Kathy Gavin, a member of the council, was the first to motion to stop "consideration of chloramines and [authorize] an interim study of a hybrid granular activated carbon filtration system" (Wheeler, 2012b, para.6). While the City of Charlottesville was initially driven by actants such as costs and meeting required regulations for drinking water set by the EPA, they later became especially attuned to public opinion and held public hearings with the other three decision making boards (Beale, 2012b). The actants for the City of Charlottesville, and the additional network they are involved in, are represented in Figure 2.

Albemarle County

In Albemarle County, the primary decision-making body is a six-person board of supervisors. In order to promote equity in representation, each supervisor is from a different magisterial district in the county ("Albemarle County Board of Supervisors," n.d.). The Albemarle board of supervisors was also included in the four decision-making boards meeting and contributed heavily in the decision to suspend chloramines as an option. Supervisor Duane E. Snow, from the Samuel Miller district, was first to make the motion that chloramines be removed as an option, claiming "I haven't heard anyone promoting chloramines" ("Duane Snow," n.d.; Wheeler, 2012b, para. 3). Additionally, the Albemarle County board was the first of

the four boards to vote to stop consideration of chloramines (Wheeler, 2012b). The Albemarle County Board of Supervisors has a similar set of actants as the Charlottesville City Council due to the similarities in their purpose. While initially driven by cost and regulatory requirements, Supervisor Kenneth C. Boyd showed that many of the board members were trying to be "very open minded and interested in hearing from the public" in order to "come to some sort of consensus" on the issue (Beale, 2012b, para. 22).

Rivanna Water and Sewer Authority

The Rivanna Water and Sewer Authority (RWSA) handles the drinking and wastewater treatment for the City of Charlottesville and Albemarle County. The Water Authority is a wholesale provider which works with Charlottesville Public Utilities and the Albemarle County Service Authority (ACSA) in order to interact with consumers of water and wastewater services ("Who we are," n.d.). At the time of the chloramine's controversy, Thomas L. Frederick Jr. was the Executive Director of the RWSA. In March, two months before questions over chloramines began to emerge, Frederick (2012) sent a memorandum to the Charlottesville City Council to detail the approval of chloramines by the RWSA. The memorandum was publicly accessible and published by Charlottesville Tomorrow, providing transparency to the public regarding why the decision was made. In addition to this document, they also took further steps in reaching out to the public through holding a Safe Water Symposium, where they invited water experts that both supported and opposed chloramines. Within the memorandum, Frederick (2012) details many of the actants that encouraged RWSA to choose chloramines over other treatment options, which included EPA regulations, current infrastructure integration, and cost. While several technologies were explored, as stated in Frederick's (2012) memorandum, "the benefits of more expensive alternatives did not outweigh their high costs" which would lead to "much higher water rates"

for residents (p. 3; p. 4). The RWSA was not favorable to constructing additional infrastructure, especially if it would still require additional use of chloramines to meet EPA standards or increase the project timeline so that they would not be in compliance with EPA regulations by the compliance date, thus accruing high fines (Frederick, 2012, pg. 3-4). Despite their preference for chloramines, the RWSA did make efforts to reach out to the community for feedback, however this was done only after the primary decision to pursue chloramines was made. This decision lead to setbacks in implementing the new water treatment method and caused a portion of the community to feel like it was on the defensive against a decision made without their consent.

Activist Groups

Activist groups played a large role in keeping the public informed about current information or developments concerning the use of chloramines. The distribution of activist groups spanned from local to out of state, but the most prominent group was Transition Charlottesville-Albemarle, hereinafter referred to as Transition. Transition is a grassroots organization focused on "creating more resilient and self-reliant communities" ("Transition Charlottesville/Albemarle," n.d., para. 1). During the controversy Transition sponsored a "teach in," at Jefferson Madison Regional Library to "share their concerns about risks to public health and safety" from chloramines (wheeler, 2012a, para. 1). A major supporter of this movement was Charlottesville resident Lorrie Delehanty, a medical researcher at the University of Virginia School of Medicine who was cited several times by Charlottesville Tomorrow speaking against chloramines in the community (Wheeler, 2012a; "Lorrie Delehanty," n.d.). While Transition was the local chapter of a larger organization, Transition Network, and supported by the Chloramine Information Center, another national organization against the use of chloramines, there were also

other local efforts to oppose the usage of chloramines including the "Charlottesville & Albemarle Residents Against Chloramine" Facebook group and the "Stop Chloramines from entering your tap water" online petition (Wheeler, 2012a; "Charlottesville & Albemarle," n.d.; "Stop chloramines," n.d.). These activist groups were often heavily concerned about the safety of the community and this focus on safety is treated as the primary actant for this actor. Members of these groups would cite instances when chloramines had a negative effect on the community they were instituted in or harmed people in contact with them (Beale, 2012a; Wheeler, 2012a). Further, Transition seemed to be especially concerned with spreading a technical understanding of chloramines and the safety attached. However, in certain instances they would use statements such as "if a [water] line breaks, it ends up killing everything downstream," which was spoken to Charlottesville Tomorrow reporter Wheeler (2012a), and promoted fear of the treatment method over technical comprehension (para. 7).

Consumers of Local Water

Both Albemarle County and Charlottesville City residents are included as consumers of water affected by the required drinking water change. By conducting a demographic analysis, as recommended by Wejnert (2002), certain characteristics that may influence thought patterns in the community can be identified. Demographics analyzed for this paper include age distribution, economic status, and level of highest education attained. These three attributes were chosen due to their relevance to different areas relating to the chloramines debate as well as actants relevant to other actors. All data for these analyses were collected from the American Community Survey (ACS), which is conducted by the US Census Bureau on a sample of a community yearly to provide information supplemental to the US Census (US Census Bureau, 2020).

The distribution of age in residents of Charlottesville and Albemarle county is shown in Figure 3 below. Albemarle tends to have a similar age distribution as the national average, which is primarily middle age, whereas Charlottesville, most likely influenced by the University of Virginia, has a large population of 20 to mid-30 year olds. These age distributions show a prevalence of young to middle age adults which are most likely beginning to settle in the area and start families, of which they would be concerned in keeping certain standards of health.

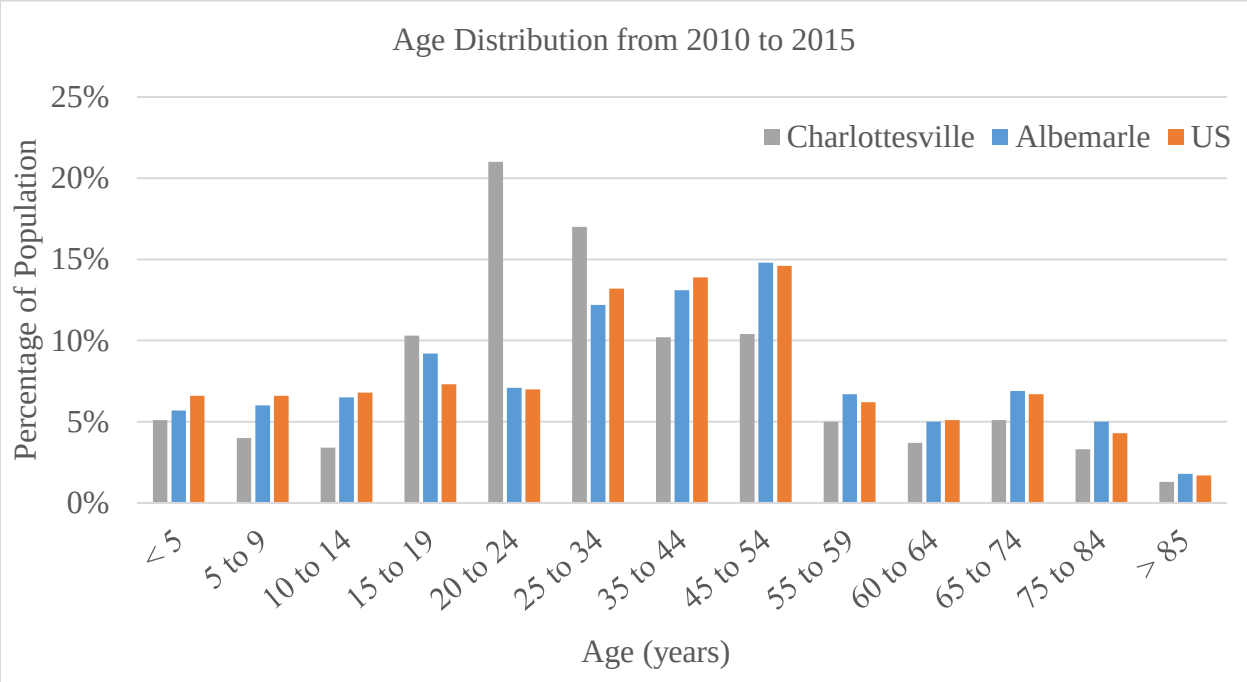

Figure 3: Age Distribution from 2010 to 2015: a chart showing a comparison in age distribution between the Charlottesville, Albemarle, and United States areas (Data from the American Community Survey, Demographic and Housing Estimates TableID DP05, adapted by Sutton, 2020a).

Transitioning from chloramines to a more expensive treatment method would generate additional costs which would be transferred to the consumers of water in Charlottesville and Albemarle. Therefore, it is important to look at income distribution in these areas, shown in in Figure 4 on the next page, to understand the community's support of the movement. The Albemarle population tends to have a higher percentage of their population in upper income

brackets, allowing more freedom for the community to choose a more expensive technology that will likely raise water utilities. The City of Charlottesville, however, has higher percentages of the population in some of the lowest income brackets. The large percentage of the population in the lowest income bracket is most likely influenced by the large amount of university students living in the area. While changing water utilities can affect cost of living in the area, university students, especially those seeking undergraduate and master's degrees, traditionally have little input in local decisions, such as water treatment methods, due to their short time living in the area.

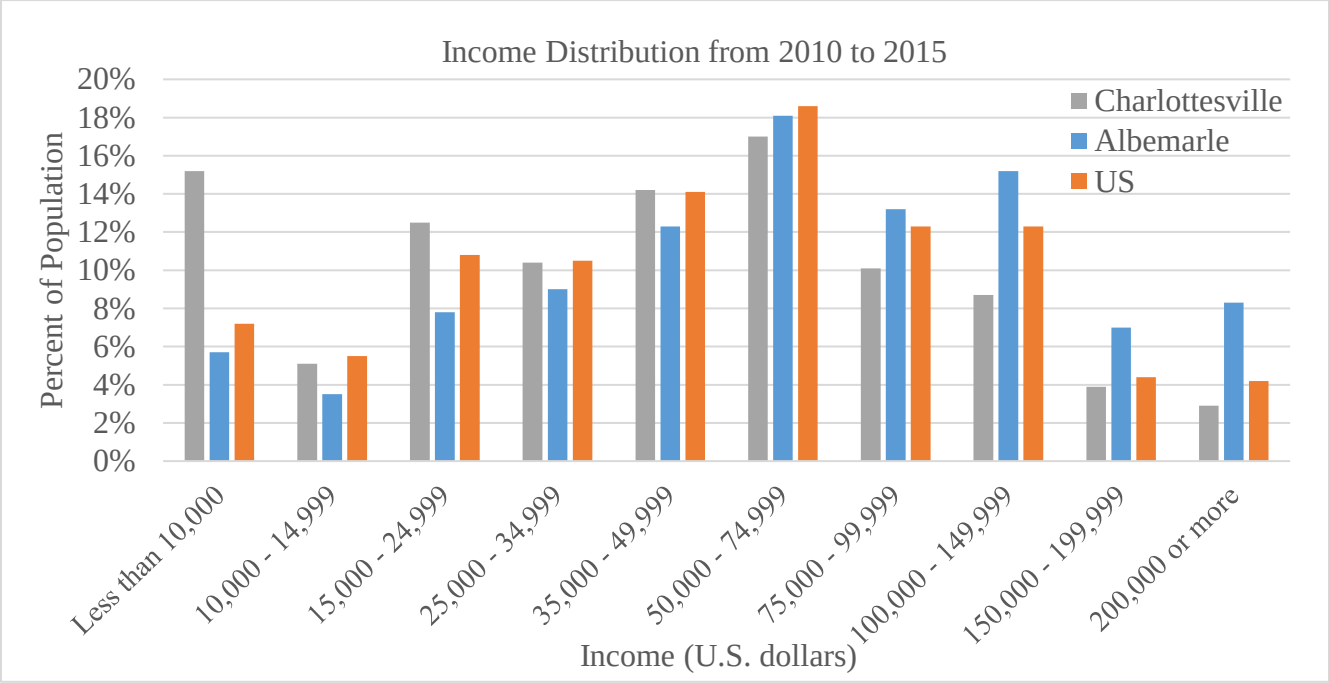

Figure 4: Income distribution from 2010 to 2015: a chart showing a comparison in income distribution between the Charlottesville, Albemarle, and United States areas (Data from the American Community Survey TableID S1901 adapted by Sutton, 2020d).

Finally, much of the community spoke of health concerns or other technical considerations. The Charlottesville and Albemarle communities are largely educated to a bachelor's level or higher, as can be seen in Figure 5 on the next page, which is most likely influenced by proximity to the University of Virginia. Along with many additional factors,

higher levels of education are associated with increased participation in civil and social discussions (Campbell, 2006). The Charlottesville and Albemarle communities exhibited this behavior through online media, such as Facebook groups and petitions, and in-person methods, such as the attendance of over 100 community members at an information panel (Wheeler, 2012c).

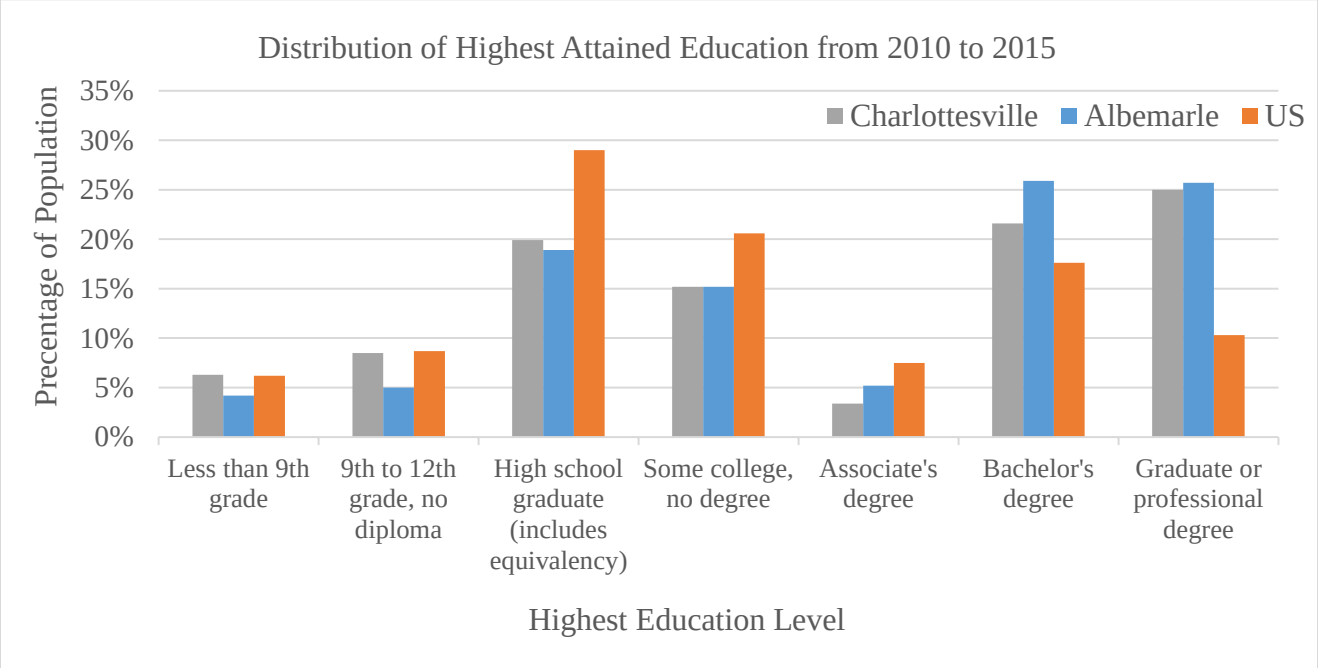

Figure 5: Distribution of Education Level from 2010 to 2015: a chart showing highest education level obtained in Charlottesville, Albemarle, and the United States. (Data from the American Community Survey, Educational Attainment TableID S1501, adapted by Sutton, 2020c).

Community members cited many concerns about the use of chloramines in the community, with the primary actants being safety and effect on daily life. One resident is cited with stating that "qualifying for the cheapest solution … doesn't mean we have to take it over the safest one" (Beale, 2012b, para. 8). These opinions show that residents were much more concerned over potential health effects as opposed to cost concerns, which was most likely driven by a combination of higher education levels, age, and the average income of residents participating in this debate.

Local Water Infrastructure

The City of Charlottesville and Albemarle County currently have five drinking water treatment plants that have a combined capacity to produce 19 million gallons per day, all of which were operational at the time of the chloramines debate ("Drinking water," n.d.; "Press release," 2018). Within both the city and county there are 67 miles of water transmission pipes which do include materials such as copper and lead ("Drinking water," n.d.). By treating the pre-existing water infrastructure as an actor in this system, its condition and reaction to changing the water disinfection method can be treated as actants that interact to influence some of the discussion and criteria during the chloramines controversy. Some experts were worried about the possibility of existing infrastructure responding negativity to chloramines, such as what happened in Washington D.C when lead was leached from pipes after transitioning to chloramines (Wheeler, 2012; Shaver & Hedgpeth, 2016). Once added "Chloramines [can] cause pipe corrosion and that led to the lead in the water" as was explained by Dr. Julia Whiting, a Charlottesville medical physician, in a statement to Wheeler (2012a, para. 12). In light of these per-existing cases, caution should be exercised before instituting a new treatment technology. However, the Albemarle County Service Authority and City of Charlottesville publish yearly reports with the help of RWSA on water quality that detail contaminant levels such as lead, a practice that would have alerted the community to any issues should chloramines have been instituted (Albemarle County Service Authority, 2019; City of Charlottesville Utilities, 2019). Taking these cautions into consideration, materials and the condition of existing infrastructure would act as a constraint on the treatment method used in order to prevent unintended water quality outcomes and leaching in pipes. In addition, another actant could include the ease of integration of new technology with the rest of the system. Easily integrated technology would

decrease upset of pre-existing water infrastructure which may also prevent unintended water quality outcomes.

IMPACT OF HOLISTIC WATER SYSTEMS ANALYSIS

In the Charlottesville chloramines controversy, the participation of activist and consumer actors invariably altered the outcome of the water treatment methods chosen. However, is this much involvement from the public the best outcome? Chloramines were a valid water treatment method, endorsed by the EPA and used by an estimated 68 million Americans, with only a few instances of serious issues as a result of their use ("Disinfection with chloramines," 2019). The RWSA, and then in turn the City of Charlottesville, Albemarle County, and their residents, ended up spending substantially more on a water treatment method that took "very high-quality water to super-very high-quality water" according to Fredricks (Wheeler, 2013). While it is important that communities have a say in how certain public services, such as water treatment, are being conducted, those communities must in turn put some level of trust in the engineers and policy makers that are making these suggestions. Additionally, caution must be taken to prevent fear mongering or over consideration from one actor or group of citizens. The citizens that did a majority of the protesting during this controversy may have only been a small subset of the community, but they were driven to make their point heard. The local governing bodies willingness to listen to the community and be transparent over their decision-making process encouraged involvement and activism in the Charlottesville community. In turn, the educated community was able to make informed decisions over their water treatment process and influence the outcome of the decision. The use of Actor Network Theory shown in this paper can be used to better inform policy decisions and understand public reaction to changes in community services like municipal water and wastewater. With earlier consideration and

involvement of community actors and their actants, fewer controversies and delayed implementation plans would happen and communities would be able to make informed decisions about their municipal services.

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