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# Nor Any Drop to Drink: A Systems Approach to Water in America

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## **Abstract**

The water crisis has been a “hot topic” in recent years. By synthesizing some of the existing literature on this subject, this thesis aims to encourage Americans, particularly those people less familiar with the topic, to start thinking about water issues in a new way, specifically by thinking in systems. Drawing from Donella Meadows, Thomas Hughes and concepts such as complex adaptive systems, it frames the problems with bottled water, and the drinking water distribution system, more generally, in a particular way. More specifically, this paper analyzes the water distribution system by breaking it into two main parts--the municipal water supply and the bottled water industry--and also analyzes these components as a whole system. In addition, the paper highlights health, safety, environmental and social justice issues surrounding the nation’s failing water system. Because the water system crisis can be interpreted as a symptom of larger problems faced by society, thinking in systems for this particular case is a meaningful exercise applicable to understanding other sustainability issues.

## **Keywords**

water, technological systems, Hughes, bottled water, public health

NOR ANY DROP TO DRINK:  
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## **Abstract**

The water crisis has been a “hot topic” in recent years. By synthesizing some of the existing literature on this subject, this thesis aims to encourage Americans, particularly those people less familiar with the topic, to start thinking about water issues in a new way, specifically by thinking in systems. Drawing from Donella Meadows, Thomas Hughes and concepts such as complex adaptive systems, it frames the problems with bottled water, and the drinking water distribution system, more generally, in a particular way. More specifically, this paper analyzes the water distribution system by breaking it into two main parts—the municipal water supply and the bottled water industry—and also analyzes these components as a whole system. In addition, the paper highlights health, safety, environmental and social justice issues surrounding the nation’s failing water system. Because the water system crisis can be interpreted as a symptom of larger problems faced by society, thinking in systems for this particular case is a meaningful exercise applicable to understanding other sustainability issues.

## **I. Introduction**

When turning on a faucet, most people do not consider the fact that they are in fact participating in a system. They do not envision the water that comes from the sink as having once fallen to the earth as rain and then perhaps flowing into a lake. From the lake, it may have been taken into a pipe to be carried to a water treatment plant or directly to their household. Retrieving hot water from the tap does not look appreciably different, except for the fact that it requires turning a different lever or moving the same lever in the opposite direction. People do not see the water being heated up nor do they see the origins of the energy required to do so. There is no loud “boom” from the boiler. Additionally, because of this infrastructure disconnect, individuals do not habitually think about where the water goes once it swirls down the drain or leaves their bodies either. They do not picture used or wasted water running into sewers and seeping into the ground or evaporating into the air and condensing in the clouds, only to begin the cycle all over again.

When people quench their thirsts with bottled water instead of tap, the same infrastructure disconnect holds true: they do not think of this daily occurrence as participating in a system. As part of this tendency to think in terms of isolated actions rather than systems, more and more it seems, “An entire generation is growing up with the idea that drinking water comes in small plastic bottles.”<sup>1</sup> It also does not help that the labels on disposable plastic water bottles can be deceptive and lack adequate information about the product. For example, the fact that the packaging features a picturesque landscape does not mean that the water came from a spring in the mountains. Furthermore, even if the source of water is somewhere in that pristine wilderness setting, the product still may not be as environmentally friendly as it is made out to be. For

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<sup>1</sup> Elizabeth Royte, *Bottlemania* (New York: Bloomsbury USA, 2008), 42.

instance, nearly all labels fail to tell consumers about the true energy that goes into the production and transportation of that bottle of water.

Though involved in a more technical, higher energy-consuming system today, the option of bottled water is not new. In fact, in 6000 BCE, pottery had been invented and could be used to store water. Even earlier, pitch-lined baskets, hollowed-out trees, gourds, large shells or woven grass containers were likely water storage vessels too. Glass bottles have also been around for a relatively long time, as the Syrians invented them in 100 BCE.<sup>2</sup> What is different about bottled water today is that this newer delivery system involves additional production, transportation and disposal networks as well as the promotional tactics of merchandizing and marketing. This brief discussion of two possible avenues for quenching one's thirst, engaging with the public water distribution system and purchasing bottled water, serves as a reminder that today's water distribution system is not exclusively made up of the municipal drinking water network involving pipes, drinking fountains and faucets.

With any utility, such as electricity or heat, people have a tendency to simply think about the small component of the system with which they immediately interact, rather than conceptualize the entire system. However, if individuals do not look beyond the instant in which water flows from a faucet or the water bottle in their hand and consider the components of the larger system of drinking water distribution, then they lack a consciousness about the greater water issues facing society. The entire water distribution system in the U.S.—public and private—is currently a system in crisis. This leaves some people wonder, how exactly did it get to the point that we have turned away from one of the best public systems of water distribution in the world and invested so heavily in the bottled water industry?

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<sup>2</sup> Royte, *Bottlemania*, 23-24.



Many scientists and writers have been seeking to understand the phenomenon of bottled water and the broader drinking water crisis, particularly in the last couple of years. The issue of water has not gone unnoticed. People have been dubbing water the “new oil” or “blue gold,” suggesting that is a scarce, precious resource that we ought to preserve. For example, in *The Ripple Effect* (2011), Alexander Prud’homme writes about the fact that while demand for water has grown due to climate change and the growing world population, freshwater supplies are threatened and diminishing. Robert Glennon also discusses America’s looming water catastrophe in *Unquenchable* (2010), in the hopes that by recognizing the worth of water, humans will begin to conserve it. In addition, Elizabeth Royte and Peter Gleick both seek to explain how water, a free natural resource, has become a wildly successful commercial product in the 20<sup>th</sup> and 21<sup>st</sup> centuries in *Bottlemania* (2008) and *Bottled and Sold* (2011), respectively. These are just a few examples of the attention given to the water crisis in contemporary discourse.

Despite the fact that the issue has garnered attention, and even if people are beginning to feel the effects of the water crisis, it seems Americans on the whole are not truly internalizing or adequately addressing the problems associated with drinking water. For that reason, this paper contextualizes the issue, using systems thinking as a heuristic device. This exercise of examining the current water distribution system from the perspective of systems theory will help readers, particularly those who are not as close to the topic of sustainability, reflect on what is really occurring with the nation’s water, what kind of statement purchasing bottled water makes and what it means to be participating in such a system of water distribution. It is important for individuals to take a step back to examine or question what they are doing, why they are doing it and what are the possible effects of their actions on both people and the planet.

In order to understand this issue of bottled water from a systems perspective, this paper first explains the framework of systems thinking, particularly as put forth by Donella Meadows in *Thinking in Systems*. Second, it applies systems thinking as a means of framing safety concerns about drinking water quality. The third section introduces another conception of systems, specifically Thomas Parke Hughes' definition of technological systems, and it applies Hughes' notion of technological momentum to the evolution of the bottled water industry. In doing so, this section reviews some of the existing literature written about culture and bottled water and presents an analogy between the United States' bottled water and fast food cultures. The fourth section of the paper looks at systems from a sustainability standpoint, while the fifth section explains what the model of a complex adaptive system can explain about the bottled water industry. Finally, the conclusion suggests how systems thinking can lead to positive change.

## **II. A Systems Approach to Water**

As previously mentioned in the introduction, the root of so many environmental problems is an infrastructure disconnect or the difficulty of thinking in terms of systems. In many cases, individuals have a tendency to create mental models that fail to factor in all parts of the system or ones that bound the system too narrowly. Instead of picturing the plastic from a bottle of water taking up space in a landfill, for example, they imagine it disappearing into some sort of cloud in their minds. They do not conceive of the full cradle-to-grave, or end-to-end, life cycle of a product, such as bottled water, which broadly includes production, transportation and disposal.<sup>3</sup> Taking a systems approach to understanding the current problems with drinking water in the U.S. is key to helping society solve its complex problems.

As an initial step, therefore, it is necessary to nail down some basic definitions of systems and apply them to the tasks of examining and understanding the country's bottled water culture. After all, from engineers and architects to biologists, many thinkers across a variety of disciplines think in systems in order to understand how the world works. This paper applies those broad themes from systems thinking to the specific system of drinking water distribution. It later introduces two particular models of systems, Hughes' idea of technological systems and complex adaptive systems.

Donella Meadow's book, *Thinking in Systems*, demonstrates the use of systems as problem-solving devices. Meadows writes, "At a time when the world is more messy, more crowded, more interconnected, more interdependent, and more rapidly changing than ever before, the more ways of seeing, the better."<sup>4</sup> The value of the systems-thinking lens, according

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<sup>3</sup> Donella Meadows, *Thinking in Systems: A Primer* (White River Junction, Vermont: Chelsea Green Publishing Company, 2008), 96.

<sup>4</sup> *Ibid.*, 6.

to Meadows, is the way in which it hones people's abilities to understand parts, see interconnections, and ultimately, to envision new possibilities for redesigning the world. Therefore, this systems approach will encourage readers to holistically view the current drinking water crisis and to identify particular patterns of behavior in order to make educated predictions for the future.

In addition, a systems approach to analysis involves looking at individual elements as an interrelated whole. That entails acknowledging or debunking the common misconception that bottled water and municipal water supply systems compete with one another, when they are in fact overlapping and connected. For the purpose of this paper, the bottled water system (sometimes referred to as the bottled water industry or private water system) includes the people, equipment and processes involved in extracting water, producing or filtering the product of bottled water, distributing the product to consumers and disposing of the waste. The municipal water supply system (also referred to as the public water supply or tap water) is also a conglomerate of people, equipment and processes, which delivers drinking water to individuals through faucets and public drinking fountains. Together, the bottled water industry and the public water system are part of a larger whole, referred to throughout the paper as the larger or overall drinking water system. This larger, combined system works towards the common goal of providing people with a clean drink of water.

In studying the drinking water system, one must also think about its surrounding environment, as a system may be "buffeted, constricted, triggered, or driven by outside forces."<sup>5</sup> The environment of a system consists of those factors that can affect its performance, but over which the system has no control. For instance, because the bottled water industry requires a transportation network, it operates, in part, on the premise of cheap oil. The price of fuel,

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<sup>5</sup> Meadows, *Thinking in Systems*, 2.

therefore, is an example of an external factor that affects the system but lies outside its realm of control. Increasing prices also affects the cost of bottled water production, as many plastics are petroleum-based. The water cycle is another example of an outside environment that influences the entire drinking water system. Humans cannot control when or where rain falls, yet that water is essential to providing drinking water by any means, public or private. Additionally, as a result of climate change, weather patterns are becoming less predictable, and drought will be a more common occurrence.

Thinking in systems is not simply for the purpose of dividing a system into its components or examining its context. It also sheds light on connectedness and relationships within systems. As a result, breaking down the drinking water system into constituent parts or components in order to study connections paints a more nuanced picture of America's water problem as a whole. The next section provides a detailed example of how thinking in systems sheds new light on the issues with drinking water quality.

### **III. Safety as a System: Water and Delivery**

Because everything in a system is interconnected and interdependent, people must think in terms of the whole system in order to understand the full picture of water safety. Safety implies that both the water itself and physical means of conveyance are contaminant-free because the fact that a source of water is clean does not preclude the water from gathering contaminants on its journey to the people who drink it. First, the sub-section entitled “The Safety of Water Itself” will examine historical health and safety concerns about tap water, many of which linger in people’s minds today. The second sub-section, “The Safety of Water Delivery,” takes a look at the safety of the infrastructure and other physical means of conveyance of water. This reflection affirms the necessity of thinking in systems because safety is a two-pronged issue. One cannot isolate the water from the infrastructure. Additionally, the following discussion shows how the municipal and private systems of water distribution are inextricably linked, as the health considerations with tap water are actually similar to, if not the same as, those with bottled water.

#### **The Safety of Water Itself**

Illness or even death from contaminated water has been a somewhat common occurrence throughout history. There are numerous historical examples of the pollution of water sources, which perhaps continue to influence the skepticism about public water supplies today. For example, the attribution of Philadelphia’s 1790s Yellow Fever outbreaks to putrid waste and air and unclean drinking water contaminated by waste prompted the creation of the country’s first municipal water system, the Fairmount Waterworks, in 1801. Another example from the 1800s is that when the Eastern United States cities of Lowell and Lawrence realized that rivers cheaply

and conveniently carried away human waste, Midwestern cities, such as Chicago, followed suit. In these cases and in similar events, the contamination of the water supply caused outbreaks of cholera and typhoid.<sup>6</sup>

An article called “Fountain of Death,” published in *Science News-Letter* in 1960, presents another example of public health concerns related to water and sewage. In this article—whose title alone conjures fear related to water—former Oklahoma Democratic Senator Robert S. Kerr warns, “This fountain of death...has become a serious threat to our way of life and is a major hazard to the national health as well as a major cause of the destruction of our fish and wild life.”<sup>7</sup> In this excerpt, Kerr is referring to specific problems with sewage systems that caused the pollution of waterways. This negative health association of sewage with drinking water lingers today.

Many Americans still fear the mixing of sewage and drinking water, just as the Kerr worried in the 1960s. An article written in 2007, “From Sewage, Added Water for Drinking,” explains “toilet to tap” or “indirect potable water reuse,” which involves the purification of sewage into drinking water. In this method of purification, sewage undergoes a process of microfiltration, chemical treatment, exposure to ultraviolet light and reverse osmosis before it is injected underground to replenish aquifers.<sup>8</sup>

While this purification technology helps with water conservation efforts, particularly in drought-prone areas, as Robert Glennon writes in relation to the toilet to tap proposal, “...public perception—the ‘yuck’ factor—is difficult to overcome.”<sup>9</sup> For some people, the very language,

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<sup>6</sup> Robert Glennon, *Unquenchable: America's Water Crisis and What to Do about it* (Washington, DC: Island Press, 2009), 208-209.

<sup>7</sup> “Fountain of Death,” JSTOR, *The Science News-Letter* 78.26 (1960): 418.

<sup>8</sup> Randal C. Archibold, “From Sewage, Added Water for Drinking,” *New York Times*, November 27, 2007, accessed February 16, 2011, [http://www.mytimes.com/2007/11/27/us/27conserve.html?\\_r=1&scp=](http://www.mytimes.com/2007/11/27/us/27conserve.html?_r=1&scp=).

<sup>9</sup> Glennon, *Unquenchable*, 165.

“toilet to tap,” negatively shapes their opinion. While its name tells people where their water comes from, it may also frighten them, bringing to mind historical examples of water contaminated by waste. The label, for better or worse, makes it apparent that one is drinking water that was once in a toilet.

There are, of course, laws in place to protect the quality of drinking water and to ensure that sources, such as toilet to tap are in fact potable. The United States Environmental Protection Agency (EPA) regulates drinking water through legislation, such as the Safe Drinking Water Act, which mandates that municipal water providers annually test their supply for an array of chemicals. In 1974, when President Ford introduced the Act, he proclaimed,

Nothing is more essential to the life of every single American than clean air, pure food, and safe drinking water. There have been strong national programs to improve the quality of our air and the purity of our food. This bill will provide us with the protection we need for drinking water.<sup>10</sup>

According to Senator Barbara Boxer, when Congress last amended significant portions of the Act, it strengthened public health protections and expanded the public’s right to know about the quality of the water they drink. However, she also points out that an update is overdue. Congress last amended the Safe Drinking Water Act in 1986 and 1996.

At the same Senate meeting about public health and drinking water, Senator Benjamin Cardin agreed with Boxer, stating, “...Our water infrastructure grades a ‘D-’. It’s in dire straits and is in desperate need of new attention and greater investment.”<sup>11</sup> The following discussion presents some of the problems with water contamination, explaining why our water infrastructure merits a near-failing grade. In short, because legislation does not keep pace with

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<sup>10</sup> Barbara Boxer and Senate Environment and Public Works Committee, “Public Health and Drinking Water,” FDCH Congressional Testimony, accessed February 10, 2011, EBSCO.

<sup>11</sup> Benjamin L. Cardin and United States Senate, “Public Health and Drinking Water,” FDCH Congressional Testimony, accessed February 10, 2011, EBSCO.



the production of new chemicals that threaten water quality, the problem of uncertainty about safety remains.

Despite the function of regulation and testing, troubling examples of current drinking water contamination problems abound. In “Debating How Much Weed Killer Is Safe in Your Water Glass,” Charles Duhigg describes our failing water regulation system as the following:

In January, a Government Accountability Office report said that the EPA’s system for assessing toxic chemicals was broken, and that the agency often failed to gather adequate information on whether chemicals posed health risks. Forty percent of the nation’s community water systems violated the Safe Drinking Water Act at least once last year, according to a Times analysis of EPA data, and dozens of chemicals have been detected at unsafe levels in drinking water.<sup>12</sup>

Duhigg—who writes about a popular weed killer called atrazine that washes into drinking water supplies, particularly in America’s Corn Belt—argues that the EPA lags behind when it comes to the regulation of drinking water.<sup>13</sup> In particular, Duhigg states that despite the potential harm of the chemical, which includes birth defects, low birth weights and menstrual problems, “Officials at the Environmental Protection Agency say Americans are not exposed to unsafe levels of atrazine. They say that current regulations are adequate to protect human health, and that the doses of atrazine coming through people’s taps are safe—even when concentrations jump.”<sup>14</sup> In addition to facing atrazine contamination, many people in the United States face serious groundwater pollution problems associated with nitrogen fertilizers, among other chemicals. For example, the U.S. Geological Survey’s Robert Hirsch, reports that because of the generally unregulated use of nitrogen fertilizer, “Iowans are literally poisoning themselves.”<sup>15</sup>

Frighteningly, a 2005 study by the Environmental Working Group (EWG) shows that such a problem is not limited to Iowans. It found that tap water in 42 states contained more than

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<sup>12</sup> Charles Duhigg, “Debating How Much Weed Killer is Safe in Your Glass,” *New York Times*, August 22, 2009, accessed February 16, 2011, <http://www.nytimes.com/2009/08/23/us/23water.html>.

<sup>13</sup> *Ibid.*

<sup>14</sup> *Ibid.*

<sup>15</sup> Glennon, *Unquenchable*, 67-68.

140 unregulated chemicals, many of which originated from agricultural inputs.<sup>16</sup> One of these harmful contaminants that the study detected is perchlorate, a rocket fuel ingredient that disrupts thyroid function in adults and damages infants' brains.<sup>17</sup> According to EPA administrator Lisa Jackson, between five million and 17 million Americans face exposure to perchlorate in the water they drink.<sup>18</sup>

Jackson mentions that the EPA is also working to limit exposure to chromium-6, a probable carcinogen used to make steel and metal plating. This chemical, also known as hexavalent chromium, plays a leading role alongside Academy Award-winning Julia Roberts in a based-on-a-true-story film. *Erin Brockovich* (2000) follows an unemployed single mother's investigation of the Pacific Gas & Electric Company, which poisoned Hinkley, California residents by improperly and illegally dumping the toxic waste of chromium-6, which leached into water supplies. Not only do the issues raised in this story persist today in communities across the United States, but also the real life Erin Brockovich still appears in the news as she continues to battle water contamination issues and wages other public health and safety campaigns.<sup>19</sup>

Another present-day business practice that threatens tap water quality is hydraulic fracturing, a process used to capture natural gas locked away in tight spaces. Called hydrofracking, or fracking, for short, this process involves injecting chemicals underground to help drills bore through hard rock, which is a practice that threatens nearby water sources.<sup>20</sup> The oilfield services corporation Halliburton developed this drilling technology, which is why it is no

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<sup>16</sup> Glennon, *Unquenchable*, 68-69.

<sup>17</sup> *Ibid.*, 69.

<sup>18</sup> Wendy Koch and Elizabeth Weise, "Limits on Toxic Perchlorate to be Set for Tap Water," *USA Today*, February 3, 2011, accessed February 14, 2011, EBSCO (AN J0E336919304611).

<sup>19</sup> "Erin Brockovich Still Battling PG&E," *ABC News*, December 11, 2011, accessed December 20, 2011, <http://abcnews.go.com/Nightline/video/erin-brockovich-battling-pge-15134247>.

<sup>20</sup> Jeff Brady, "Face-Off Over 'Fracking': Water Battle Brews on Hill," NPR, May 27, 2009, accessed April 3, 2011, <http://www.npr.org/templates/story/story.php?storyId=104565793>.

coincidence that in 2005, the Bush/Cheney Energy Bill exempted natural gas drilling from the Safe Drinking Water Act. Because the bill freed natural gas companies from disclosing the chemicals they use in fracking and stripped the EPA of its regulatory powers, it is often referred to as the Halliburton Loophole.<sup>21</sup> *Gasland* (2010), a documentary by Josh Fox, exposes the effects of the largest domestic natural gas drilling boom in history, one of which is ignitable tap water.<sup>22</sup> The sight of water flowing from a kitchen sink and bursting into flames in the movie, and particularly in real life, is frightening, especially given the fact that many people whose supplies are affected by fracking are unaware that their water can burst into flames.

Another potentially harmful substance in water is pharmaceuticals. Even Elizabeth Royte, a staunch advocate of drinking tap water, still concedes that there is a degree of uncertainty about the safety of drinking water supplies. When championing the benefits of the water that comes from our faucets, rather than from a plastic bottle, she mentions that drinking water contains trace contaminants of substances that people do not want to drink. Royte states,

Delivered by gravity, tap water generates virtually no waste. All that, and it contains no calories, caffeine or colorants either. (Yes, New York's water—like that of other cities—contains trace amounts of drugs, but we lack proof, so far, that exposure at these low levels is a human health risk.)<sup>23</sup>

Royte's parenthetical comment must leave some readers feeling unsettled and wondering, how can one prove that these trace amounts of drugs do not have a negative effect? After all, most people tend to like calculable or known risk, or in other words, things that they can measure or prove. In keeping with that idea, they do not like hearing responses such as "we don't know why that happened" or "there *may* be a chance of an adverse reaction."

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<sup>21</sup> "Hydraulic Fracturing FAQs," *Gas Land*, accessed April 3, 2011, <http://www.gaslandthemovie.com/whats-fracking>.

<sup>22</sup> "About the Film," *Gas Land*, accessed April 3, 2011, <http://www.gaslandthemovie.com/about-the-film>.

<sup>23</sup> Elizabeth Royte, "A Fountain on Every Corner," *New York Times*, May 23, 2008, accessed February 15, 2011, <http://topics.nytimes.com/topics/reference/timestopics/subjects/f/fountains/index.html>.

A possible consequence of ingesting trace amounts of drugs over an extended time period through drinking water is antibiotic resistance, which is when a microorganism can survive exposure to a medication. Resistance facilitates the growth of new strains of diseases that we are not adequately equipped or able to treat. When author Robert Glennon discusses indirect potable water reuse, the toilet to tap method discussed earlier in the section, he also explains that the water treatment process does not remove drugs from water. This is a concern because as a 2008 report by *California Water News* suggests, as much as 90 percent of drugs that leave the body are unchanged and still active.<sup>24</sup> A lack of proof that there is human health risk, therefore, will not convince many people that there are no issues with drinking tap water. Again, this naturally leaves one to question whether there is a guarantee that public water sources are clean.

To help consumers understand the quality of their household water source and decipher tap water regulations, the Drinking Water Research Foundation (DWRF) published a guide to reading a water quality report. The DWRF explains that public or community water systems must provide a drinking water quality report, also called a consumer confidence report, to customers on an annual basis. There are sometimes exemptions from certain testing requirements, and if this is the case, customers must be notified. Similarly, if public drinking water exceeds the microbial standard for fecal coliform bacteria and *E. coli*, the municipality must issue a boil water alert. [NB: It is not clear how individuals are notified in the case of testing exemptions or other alerts.] In all, the DWRF guide reiterates that public water must meet EPA standards established under the Safe Drinking Water Act.

Unfortunately, despite such guides about how to read a water quality report distributed in some communities, in many cases, finding out information about a municipality's water quality is easier said than done. After researching water safety information, it seems that figuring out the

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<sup>24</sup> Glennon, *Unquenchable*, 167.

“drinkability” of tap water usually requires a good deal of patience. When using the EPA’s website to look up drinking water quality, for instance, searches may turn into wild goose chases or simply lead to dead ends. Clicking on links for information about individual areas might bring up a page that reads, “contact your town for more info.”<sup>25</sup> It is common to find broken hyperlinks and out-of-date pages on such websites. Therefore, not only is this process of seeking information about water safety frustrating, but it also does not necessarily lead to finding an answer.

The difficulty in ascertaining water quality is one important impetus for which some consumers buy bottled water. Many people assume that the fact that the product is factory-sealed and labeled is a quality assurance that bottled water is free of the health concerns related to municipal water. As Royte phrases it, “People start migrating toward what they trust, and they trust bottled water.”<sup>26</sup> As described, even if the EPA gives the “thumbs up” to a particular water source, some people may still question, how does an individual ensure that his or her household supply is safe? The next section will discuss how the means of transporting or containing water, from the tap or a bottle, affects water quality.

It is important to keep in mind that the problems that plague the public water distribution system also impact the bottled water system. Although the bottled water industry may prosper from consumers’ fears about tap water, they do not escape all problems related to water quality. Tap water and bottled water are interconnected systems, linked by their common use of the natural resource of water. When people drink bottled water, they are really dealing with two systems at once because, after all, the surface and groundwater sources from which tap water

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<sup>25</sup> EPA, “Local Drinking Water Information,” *EPA*, May 2, 2011, accessed May 7, 2001, <http://water.epa.gov/drink/local/>.

<sup>26</sup> Royte, *Bottlemania*, 135.

originates—whose quality may be tainted by contaminants—are the very same sources that go into bottled water.

In fact, sometimes, such as in the cases of Pepsi-Cola’s Aquafina and Coca-Cola’s Dasani, the water in the bottle just comes from the tap. Statistics show that about 44 percent of “purified” bottled water sold in the U.S. originated as municipal water.<sup>27</sup> This is a reason for which water sold in some branded bottles may have the same problems as tap water. According to a *New York Times* blog post from 2009, titled “Bottled Water Makers in the Hot Seat,” the EWG found chemical contaminants in tests of bottled water, and they are now calling for greater oversight of the bottled water industry.<sup>28</sup> Many authors agree that several of the purported safety advantages of bottled water do not hold true. In response to the question about whether bottled water is safer, Robert Glennon states that the FDA “...does not require bottled water companies to treat their products to remove a variety of pesticides, heavy metals, and bacteria.”<sup>29</sup> This is because while the EPA regulates drinking water as a utility, the Food and Drug Administration (FDA) regulates bottled water as a food product.<sup>30</sup> Many other water experts, including Peter Gleick of the Pacific Institute, agree that some bottled water is no safer than tap water in the U.S.<sup>31</sup>

Ultimately, bottled water is a just subsystem within the umbrella of the nation’s entire drinking water system, and as such, it is not immune to the issues that plague municipal water. Regardless of whether one of its endpoints is a factory-sealed bottle or faucet, water of poor

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<sup>27</sup> Leora Broydo Vestel, “Bottled Water Makers in the Hot Seat,” *New York Times*, July 17, 2009, accessed February 15, 2011, <http://green.blogs.nytimes.com/2009/07/17/bottled-water-maker>.

<sup>28</sup> *Ibid.*

<sup>29</sup> Glennon, *Unquenchable*, 75-76.

<sup>30</sup> “What’s My Water Quality?,” *Drinking Water Research Foundation*, 2011, accessed March 30, 2011, <http://www.thefactsaboutwater.org/what-s-my-water-quality>.

<sup>31</sup> Salvatore Cartoni, “The United States of Bottled Water: Our Thirst for Liquid Fool’s Gold,” *Take Part*, September 4, 2011, accessed December 13, 2011, <http://www.takepart.com/article/2011/09/04/bottled-sold-and-unnecessary-america%E2%80%99s-foolish-allegiance-bottled-water>.

quality requires treatment. The only difference between bottled and tap water is who does the filtering and screening: municipalities or corporations.

### The Safety of Water Delivery

In determining water quality, one must also consider the safety of the pipes and the receptacles that transport or hold the water. Water is not safe simply because the source passes EPA regulation for tap water or FDA regulation for bottled water. The following section looks at safety issues related to the physical infrastructure components of the drinking water distribution system, including drinking fountains, plumbing fixtures and bottles.

First, regarding the safety of drinking fountains, in *The Gospel of Germs*, Nancy Tomes suggests some reasons for which many people have associated public water fountains and disease. She explains that people's standards for hygiene changed as they became schooled in germ theory in the late 1800s.<sup>32</sup> According to Tomes, bacteriology, developed in the 1870s, established the principle that microorganisms cause the spread of disease, and as a result, gradually "older theories of atmospheric infection gave way to a more modern understanding of how diseases are transmitted by casual contact, food and water contamination, insect vectors, and healthy human carriers."<sup>33</sup> It makes sense, therefore, that people continue to view contact as a culprit of the spread of germs and disease.

While water fountains today receive official certification for meeting health and safety requirements and users' lips do not make contact with the spout, previous designs caused greater concern about hygiene. Historic water fountains, such as one version that included drinking cups, metal vessels chained to the fountain used to catch and sip the flowing water, demonstrate this

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<sup>32</sup> Nancy Tomes, *The Gospel of Germs: Men, Women, and the Microbe in American Life* (Cambridge: Harvard University Press, 1998), 4.

<sup>33</sup> *Ibid*, 6.

idea. One *New York Times* reader in 1900, identified as “Taxpayer,” expresses his or her concerns about drinking cups in parks, writing, “Allow me, through your paper, to express to Mr. George Clausen, Commissioner of Parks, my admiration for the excellent manner in which he is doing away with the filthy, germ-spreading cups in Central Park.” The taxpayer continues, “I have always dreaded drinking from the public cups, but now one can drink out of the new fountain without the least fear of disease.”<sup>34</sup> Based on his or her praise for the Commissioner of Parks, it is clear that in the early 1900s, some people feared contracting an illness from this particular design of water fountain, which requires drinkers’ mouths to make contact with something that others have used before them.

Another letter to the editor, written in 1914 and titled “New Drinking Fountains,” also demonstrates the public expectation of safe and refreshing drinks, and it outlines guidelines for drinking fountains. The author of the letter, Philip S. Platt, superintendent of the Bureau of Public Health and Hygiene, argues, a water fountain “must be as strong as Gibraltar, or else its days are numbered,” “intrinsically valueless, or else its hours are numbered” and “sanitary, or else it is a common drinking cup and a serious danger.”<sup>35</sup> Again, sharing a drinking cup is commonly understood to be unhygienic.

Not all diseases are transmitted through contact, however. In the 1980s when some people feared that they could contract disease from using the same drinking fountain as an AIDS victim, a series of ads tried to combat the misconception. One ad reads, “Another myth down the drain...AIDS isn’t transmitted by drinking from the same water fountain as an AIDS victim.”<sup>36</sup>

<sup>34</sup> Taxpayer, “Drinking Cups in Parks,” *New York Times*, August 5, 1900, February 14, 2011, ProQuest.

<sup>35</sup> Philip S. Platt, “New Drinking Fountains; Six Have Been Installed Which Are Sanitary and Efficient,” *New York Times*, June 14, 1914, accessed February 14, 2011, <http://query.nytimes.com/gst/abstract.html?res=FA0D16FE3F5E13738DDDAD0994DE405B848DF1D3&scp=20&sq=water%20drink%20fountain&st=cse>.

<sup>36</sup> U.S. National Library of Medicine, “Another Myth Down the Drain,” Images from the History of Medicine, accessed March 30, 2011, <http://www.nlm.nih.gov/hmd/ihm/>.



Another ad from the Ontario Ministry of Health similarly tries to dispel the myth, and it provides phone numbers to call to find out more information.<sup>37</sup> Nonetheless, as briefly shown by the above examples, people have certain persisting concerns and misconceptions about health and hygiene that may affect whether they use drinking fountains today. The notion of the spread of germs through contact persists, even if it is not true of all viruses; many people are still afraid and prefer not to share.

Another water delivery infrastructure consideration is the safety of plumbing fixtures. Some pipes and other water supply system parts can contain lead, which leaches into the water. One proposed method for avoiding lead contamination called flushing involves allowing water to flow from the faucet for a given period of time before drinking or using it. There are disputes about whether this method is effective to avoid drinking contaminated water. As one author explains,

Our children are exposed to lead in water at school and at home, and the results can be devastating. Parents must teach children never to drink first-draw water at home. The water should be turned on and allowed to run a minute or so or until it becomes cold, to avoid lead leached from faucets. Unfortunately, this procedure may be useless at a school water fountain, where the internal volume is several liters.”<sup>38</sup>

To put it simply, flushing is not necessarily practical or effective. Two articles, “Effectiveness of Flushing” by Eileen Murphy and “Gastrointestinal Upsets” by Lynda Knobeloch, Meg Ziarnik, *et al.* specifically address the effects on the human body of the corrosion of copper plumbing in drinking water. Based on various case studies, the authors found that copper-contaminated

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<sup>37</sup> U.S. National Library of Medicine, “Can You Get Aids from a Drinking Fountain?” Images from the History of Medicine, accessed March 30, 2011, <http://www.nlm.nih.gov/hmd/ihm/>.

<sup>38</sup> Arthur H. Perler, “Let Water From Faucets Run Until Cold to Get the Lead Out,” *New York Times*, November 17, 1990, accessed February 14, 2011, <http://www.nytimes.com/1990/11/17/opinion/1-let-water-from-faucets-run-until-cold-to-get-the-lead-out-455890.html?scp=1&sq=Let%20Water%20From%20Faucets%20Run%20Until%20Cold%20to%20Get%20the%20Lead%20Out&st=cse>.

drinking water may be a relatively common cause of stomach upsets, abdominal cramps and diarrhea, and these findings are consistent with previously published reports.<sup>39 40</sup>

Another article on the same topic, “Let Water From Faucets Run Until Cold to Get the Lead Out,” explains the “eight-percent rule,” which limits the amount of lead permitted in water fixtures.<sup>41</sup> This rule originates from the Lead Contamination Control Act of 1988, which banned lead solder and linings in plumbing systems and coolers. However, brass, which contains as much as eight percent lead, is still permitted.<sup>42</sup> If people have out-of-date fixtures or lack information about what their pipes are made out of, then they may run the risk of lead leaching into water, despite the fact that water quality reports may indicate that it is safe for them to drink from the tap.

As previously mentioned, health-related concerns about the quality of drinking water should not be limited to tap water. Just as copper pipes, for instance, can affect water quality by leaching lead, dirty equipment in bottling facilities may contaminate bottled water.<sup>43</sup> In addition, there may be issues with contaminants that leach from plastic packaging. Most water bottles are made from polyethylene terephthalate (PET) plastic, a polymer derived from oil, with other ingredients added for flexibility, color and strength. A softening agent contained within PET called phthalates reportedly disrupts the endocrine system, which is important to growth and development.<sup>44</sup>

Similarly, another material used to make bottles, polycarbonate, is now known to leach tiny amounts of bisphenol A (BPA), a chemical that mimics estrogen. The more scratched the

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<sup>39</sup> Eileen A. Murphy, “Effectiveness of Flushing on Reducing Lead and Copper Levels in School Drinking Water,” *Environmental Health Perspectives* 101.3 (August 1993): 240-241.

<sup>40</sup> Lynda Knobeloch, et al., “Gastrointestinal Upsets Associated with Ingestion of Copper-Contaminated Water,” *Environmental Health Perspectives* 102.11 (November 1994): 958-961.

<sup>41</sup> Perler, “Let Water From Faucets Run.”

<sup>42</sup> Ibid.

<sup>43</sup> Royte, *Bottlemania*, 144.

<sup>44</sup> Ibid, 148.

water bottle, and the hotter the liquid inside it, the more BPA it leaches. Some reports show that tiny amounts of this chemical can cause genetic changes that lead to prostate cancer and other health issues. Therefore, refilling a plastic bottle, too, can be dangerous, especially if harmful bacteria are also growing inside of it. Reusable bottles must be washed out in warm, soapy water before future use to avoid such bacteria.<sup>45</sup>

Furthermore, BPA-free products may not be any safer, as they might contain alternative ingredients that have even more chemical activity than those containing BPA. *Discovery News* contributor Emily Sohn reports that a BPA-free label does not mean that product is harmless. She writes about a study in which scientists found that virtually all of the plastic baby bottles and food and beverage packages tested leached chemicals that acted like estrogen, even though many were free of BPA. Unfortunately, it is also difficult to find out exactly which products pose a risk.<sup>46</sup> Regulatory agencies, as a result, need to further study the effects of chemicals that leach from plastic. They also ought to investigate plastic making itself, as it is a process that produces harmful emissions of nickel, ethylbenzene, ethylene oxide, and benzene.<sup>47</sup>

In sum, even if an original source of water is deemed safe, if this otherwise safe water comes in contact with particular surfaces or objects that facilitate the spread of germs or leach chemicals, then it may no longer be safe to drink. A systems approach to understanding water safety, therefore, emphasizes how individuals ought to think about the delivery means or conveyance of water in addition to the quality of the source itself.

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<sup>45</sup> Royte, *Bottlemania*, 151.

<sup>46</sup> Emily Sohn, "Even BPA-Free Plastic Not Always Safe," *Discovery News*, July 15, 2011, accessed December 20, 2011, <http://news.discovery.com/human/bpa-plastic-food-hormones-chemicals-110715.html>.

<sup>47</sup> Royte, *Bottlemania*, 139.

#### **IV. Technological Momentum and Bottled Water Culture**

Another way of viewing America's drinking water distribution system is through the lens of *technological* systems, a theory developed by historian of technology Thomas Parke Hughes. Hughes writes about the analysis of technological systems in *Networks of Power* and in "The Evolution of Large Technological Systems," in which he defines technological systems as the following:

Technological systems contain messy, complex, problem-solving components. They are both socially constructed and society shaping. Among the components in technological systems are physical artifacts, such as the turbogenerators, transformers, and transmission lines in electrical light and power systems. Technological systems also include organizations, such as manufacturing firms, utility companies, and investment banks, and they incorporate components usually labeled scientific, such as books, articles, and university teaching and research programs. Legislative artifacts, such as regulatory laws, can also be part of technological systems. Because they are socially constructed and adapted in order to function in systems, natural resources, such as coal mines, also qualify as system artifacts.<sup>48</sup>

Extending Hughes' idea to the case of drinking water, the physical artifacts of the system include water mains, pipes, faucets, drinking fountains, bottles of water and so on. The drinking water system, however, is not solely made up of these physical or technological components. The system also includes legislation and regulation, utilities and transportation networks, bottle manufacturing plants, water treatment stations and more. This is similar to the initial definition of the drinking water system and its private and public subsystems in the earlier section of this paper, "A Systems Approach to Water," because Hughes' definition not only includes technological components but also social, political and other environmental factors.

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<sup>48</sup> Thomas Hughes, "The Evolution of Large Technological Systems," in *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology*, ed. Wiebe E. Bijker et al. (Cambridge, Massachusetts: The MIT Press, 1989), 51.

A key takeaway from Hughes' discussion of technological systems is the idea of technological momentum, which merges the opposing theories of strict social and technological determinism. What Hughes argues is that society does not fully dictate the development of technology, nor does technology exert complete dominance over society. He explains, "The degree of freedom exercised by people in a system, in contrast to routine performance, depends on the maturity and size, or the autonomy, of a technological system." Hughes continues, "Old systems like old people tend to become less adaptable, but systems do not simply grow frail and fade away. Large systems with high momentum tend to exert a soft determinism on other systems, groups and individuals in society."<sup>49</sup> There is a two-way interaction or cause-and-effect relationship between technology and society. The concept of technological momentum proposes that large-scale systems have some flexibility when they are defined in their early stages. However, once people establish ownership, control and technical specifications, then the systems become more rigid and less responsive to social pressures.<sup>50</sup> The idea of momentum partly explains why many Americans are so entangled in the consumption of bottled water and why it is difficult for them to change their habits.

For example, the creation of the private bottled water distribution system required massive investments in a production and transportation infrastructure. Additionally, if the factories that produce the bottles have particular specifications, it may be difficult and costly difficult to re-engineer the bottles themselves. The particular locations in which these factories are located can also make it difficult to change how and where bottled water is distributed to consumers. Nonetheless, these rigidities of the system should not be mistaken for determinism.<sup>51</sup> Now that a basic overview of Hughes's conceptions of technological systems and momentum

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<sup>49</sup> Hughes, "The Evolution of Large Technological Systems," 54-55.

<sup>50</sup> David Nye, *Consuming Power* (Cambridge, MA: MIT Press, 2001), 3.

<sup>51</sup> *Ibid.*, 4.

has been established, the following section will briefly examine how the socio-technological system of drinking water has evolved and gained momentum over time.

### Quenching the Thirst of a Fast Food Nation

As the theory of technological momentum explains, large technological systems have some flexibility in their early stages. As such, in the beginning, people influenced some of the technologies involved in the commercialization of bottled water. Americans first created and supported the country's bottled water industry in the early 1900s because of their concern about the quality of drinking water supplies.<sup>52</sup> While negative health perceptions about municipal water still linger and motivates individuals to purchase bottled water today, the technological system also now exerts a soft determinism back on society. Certain groups of people have stopped seeing bottled water as a choice. Instead, because bottled water is so readily available in supermarkets and other stores, and because disposable bottles are convenient, participation in bottled water culture has become a way of life. The following discussion describes the ways in which the bottled water industry has gained momentum as a technological system. It highlights key cultural factors related to the popularity of bottled water, including a desire for convenience and the value of individuality or personalization.

Bottled water is connected to a larger technological system that also exerts a degree of determinism on society: the nation's transportation infrastructure. The reliance on roads and the automobile in the U.S. and the settlement pattern of sprawl have specifically contributed to the demand for bottled water because of the particular infrastructure it has promoted and requires. The nation's decentralized settlement pattern necessitates a network of roads and the use of cars

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<sup>52</sup> Columbia Water Institute, "Bottled Water," *Columbia University Earth Institute*, accessed December 19, 2011, [http://water.columbia.edu/?id=learn\\_more&navid=bottled\\_water](http://water.columbia.edu/?id=learn_more&navid=bottled_water).

to move people and objects from place to place. In turn, the fact that individuals are so reliant on automobiles and spend so much time driving has helped make water fountains near obsolete in many public places. People more readily find stores selling water rather than something like bottled water refill stations.

Similar to the way in which cell phones made payphones obsolete, disposable water bottles have diminished the demand for drinking fountains. In *Consuming Power*, historian David Nye writes about the death of the “walking city” due to the adoption of the automobile and the great mobility it provides. He explains, “In the decentralized world of automotive distances, most of the life of the street disappeared, including venders, delivery boys, the casual walk, the accidental encounter...the neighborhood store, sidewalk displays, and the sidewalks themselves.”<sup>53</sup> This idea applies to current state of drinking fountains. It is logical that the rise of the automobile is important to the trend of bottled water and the corresponding demise of fountains. People simply do not pass by drinking fountains on foot frequently enough.

City residents across the United States point out that water fountains are confined to parks and playgrounds, and they are not located on the busy streets that pedestrians traverse daily. Some people today claim, “If drinking fountains were as ubiquitous as fire hydrants, there would be no need for steel thermoses, plastic bottles or backpack canteens.”<sup>54</sup> When water fountains are inaccessible or simply do not exist in practical locations, the situation can seem to necessitate buying or carrying around a bottle of water. The United States, in particular, has become a “fast food nation” in which convenience rules, with many Americans driving to a drive-through window to pick up a meal. Our current situation with bottled water is truly in

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<sup>53</sup> Nye, *Consuming Power*, 179.

<sup>54</sup> Jon Han, et al., “Thirsting for Fountains,” *The New York Times*, August 14, 2009, accessed February 16, 2011, <http://www.nytimes.com/interactive/2009/08/14/opinion/20090814opart-fountains.html>.

keeping with the author of *Fast Food Nation* Eric Schlosser's observations about society; there are many parallels between the purchase of fast food and plastic disposable water bottles.

Another similarity is that given the vast array of water bottle brands on supermarket, cafeteria and convenience store shelves today, bottled water marketing is similar to that of fast food as it plays on people's desire for individual choice. The labels come in all different colors, and the bottles are in all different shapes and sizes. Fast food advertising responds to the values of personalization and convenience, the same values many consumers find in bottled water. One of the most notable examples of this is Burger King's slogan, "Have It Your Way." In a 2005 *USA Today* article titled "Burger King Tries Old Slogan Again," the author quotes Andrew Keller, creative director at ad agency Crispin Porter + Bogusky, who explains, "BK's vintage line also fits well with the emphasis in pop culture now on individuality." Keller also states, "At a time when self-expression and mass customization are critical elements of culture, the line makes total sense." The results from polls about consumers' reaction to the new use of the old slogan affirm that people today value individuality.

In their daily lives, from driving to quenching their thirst, people value individualization. Cars provide independence, allowing individuals to drive wherever they want to go and to do so on their own time. When people order fast food, they expect and get little or no wait too. Similarly, they value individualization when it comes to swigging water—particularly because they do not want to put their lips where someone else's mouth has been before. Many people do not want to waste their time looking for a fountain either. Besides, the infrastructure just is not there. It seems, drinking fountains are not widespread enough to be convenient. People want their water whenever they want it, or in other words, instant gratification. It is all about satisfying one's individual needs and owning his or her own time.



The invention of polyethylene terephthalate, or PET, plastic is significant to the relationship between culture and bottled water because it has made containers light, portable and also “toss-able”—people can discard the bottles when they no longer have a need for them or when they simply get tired of holding an extra item. Even if drinking fountains were more widespread and conveniently located, in most places, unfortunately, there are not ample recycling bins to capture the discarded plastic containers.

In summary, people often opt for a disposable plastic water bottle over a reusable one for a variety of reasons, beyond perceived necessity. Disposable bottles are usually more convenient and they are personal. While water fountains may not be available or do not function at times, there are no maintenance issues with bottled water. Consumers can also carry a bottle around and drink it wherever they go. It is theirs, and they are not obligated to share it. When they finish drinking it, they can even toss it in a recycling bin (hopefully!) to lighten their load. Because bottled water is convenient, portable, individual and also embedded within the country’s well-established transportation infrastructure and pattern of sprawl, many people see bottled water as the obvious or only choice for quenching their thirst while on the go and throughout their day.

## **V. Environmental and Social Justice Issues with Bottled Water**

Bottled water may have the perceived advantages of being more convenient and personal. However, the growth of this private water system comes at the expense of the public water distribution system, and it will only create more problems. In *Thinking in Systems*, Donella Meadows warns that some of the biggest problems facing the world are system failures; fixing one piece of a system in isolation from others cannot solve this breed of problems. Based on that wisdom, investing in the bottled water industry as a solution to the problems people find with the municipal water system only addresses the failings of just one small piece of the overall drinking water system, and therefore, will be ineffective.

The authors of *Resilience Thinking*, Brian Walker and David Salt, agree with Meadows that negative consequences result from maintaining just one part of a system. They write, “The key to sustainability lies in enhancing the resilience of social-ecological systems, not in optimizing isolated components of the system.”<sup>55</sup> As an example, the previous sections demonstrated how bottled water has grown in popularity, how people have been turning to it as an alternative to municipal water supplies and how the bottled water industry has also exerted a light determinism back on individuals within society. It is crucial to note that when individuals selectively manage the drinking water system exclusively for bottled water, either through purchasing the product or providing tax breaks to bottled water companies, the municipal water system becomes neglected. In this way, turning one’s emphasis to just one part of the system causes another part of the system to decline. In short, each part of a system can affect the behavior of others.

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<sup>55</sup> Brian Walker and David Salt, *Resilience Thinking: sustaining ecosystems and people in a changing world* (Washington, D.C.: Island Press, 2006), Kindle Edition, 9.

The following sub-sections show how investment in the bottled water industry is not only a “band-aid fix” that does not address the larger issues with the drinking water system, but also an action that exacerbates problems and makes the entire system unsustainable. Two main threats to the sustainability of the drinking water system are related to ecological and social justice, described individually below.

### Environmental Issues with Bottled Water

While municipalities deliver water to a defined community, bottled water companies ship their product nationally and even globally. Additionally, bottled water involves extra processes, such as the manufacturing of bottles to contain the water, and it also creates the problem of how to dispose of these containers. For these reasons, bottled water has a greater ecological impact than tap water, specifically in terms of energy use and the consequences of water extraction on local ecosystems.

Annie Leonard’s short educational online film, “The Story of Bottled Water,” exposes some of these energy-related concerns with disposable water bottles. In the video, Leonard states that the processes of extraction and production use enough oil and energy to fuel one million cars. On top of that energy expenditure, even more energy goes into shipping the product across the globe.<sup>56</sup> In terms of energy, it takes about 5.8 to 10.2 megajoules (a measure of energy equivalent to  $10^6$  joules) to bring a typical one-liter plastic water-filled bottle from France to Los Angeles. This is approximately 1,100 to 2,000 times more than the energy needed to provide tap water to a household.<sup>57</sup>

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<sup>56</sup> Annie Leonard, “The Story of Bottled Water,” *The Story of Stuff*, accessed February 26, 2011, <http://storyofstuff.org/bottledwater/>.

<sup>57</sup> Vestel, “Bottled Water Makers in the Hot Seat.”

Furthermore, bottled water is not only tied to oil for fuel; its production also requires petrochemicals. It takes the equivalent of 50 million barrels of oil to produce enough PET bottles to satisfy the global demand for bottled water annually, and these bottles leave Americans with a huge waste disposal problem. About 80 percent of those bottles used each year wind up in landfills at the end of their lifetime of use. Leonard also found that most water bottles are not recycled, but rather they are “down-cycled,” which means that the plastic containers go into lower quality products just to be thrown away later.<sup>58 59</sup>

Another environmental consequence is that the extraction or pumping of water for the purpose of bottled water can further diminish the quality of the very water supply people drink. Over-pumping draws heavy metals and other pollutants into drinking water. It also washes away soil or bedrock, creating sinkholes.<sup>60</sup> Individuals may wonder about thresholds, such as the amount of water that it is permissible to extract from a single area or when to stop pumping. Unfortunately, the movement of groundwater is imperfectly known, and it can be extremely difficult to prove the harm caused as a direct consequence of water extraction.

In defense of its actions, the bottled water industry points out that it is only responsible for approximately 0.02 percent of the total groundwater withdrawn annually. However, one must keep in mind that companies take this water from the same few places, not from sites spread out across the globe. They also move that portion of water to other watersheds, meaning that the water is not discharged into the same places that it would be if pumped by a local utility for the use of a community.<sup>61</sup> To put all of this simply, the technological system we have adopted that

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<sup>58</sup> Vestel, “Bottled Water Makers in the Hot Seat.”

<sup>59</sup> Leonard, “The Story of Bottled Water.”

<sup>60</sup> Royte, *Bottlemania*, 58.

<sup>61</sup> *Ibid*, 59-60.

supports the production and distribution of disposable plastic water bottles has significant ecological ramifications.

### Social Justice Issues with Bottled Water

Our current reliance on bottled water is not sustainable—environmentally or socially speaking. In fact, eerily, we historically associate drinking fountains with segregation and the Civil Rights Movement of the 1960s, yet fountains continue to be a symbol of drinking water inequality today, as bottled water supplants fountains and other public means of distribution. From the 1870s to 1960s, under the segregated facilities under Jim Crow were considered “separate but equal.” Of course, the equal part was not necessarily true during that time period, and it certainly is not true today either. Our current juxtaposed, competing water distribution systems, the public system and the private bottled water industry, are trending further towards separate and unequal.

If one reflects upon all the horror stories about drinking water, from ignitable tap water as a result of fracking to carcinogen-laced bottled water, as was the case with Perrier in the 1990s, we more deeply appreciate the need to maintain and improve our entire drinking water system so that there is equal access to safe drinking water. However, as more money is devoted to the bottled water industry, which for many people seems to serve as a replacement for the public system, then fewer resources will be devoted to improving water infrastructure. Again, this presents the nation with a huge inequality issue.

Many people have written about fears regarding the commodification of water. For instance, Robert Glennon warns readers of *Unquenchable* about the dangers of privatization, stating,

To conceive water as private property—owned by someone who can unilaterally decide whether to sell it, to whom, for how much, and for what purpose—raises profound philosophical and moral issues as well as troubling political questions about the role of corporations, especially multinational corporations, and about the ability of local communities to be independent, autonomous, self-sufficient, self-determinative.<sup>62</sup>

Similarly, James Gustave Speth critiques the commodification of water in *The Bridge at the End of the World*. He states,

Advocates for the poor are seeking to have access to drinking water declared a fundamental human right that must be recognized by governments and others. But water has in fact become a huge international commodity, with major business lines in wastewater services, drinking water supply, and bottled water. It is perfectly appropriate to demand that water be priced at its full costs to large consumers but inappropriate not to provide a drinking water lifeline affordable and available to all.<sup>63</sup>

The ability for some groups of people over others to purchase bottled water produces winners and losers. In all, the general consensus among anti-commodification advocates, similar to the opinions of Glennon and Speth, is that the privatization of water, something so essential to life, is immoral.<sup>64</sup>

One example of protest in response to the privatization of water is an incident in which an operative for the Earth Liberation Front (ELF) placed four incendiary devices inside a Michigan pump station that serviced a Nestlé bottling plant. While the devices failed to ignite, ELF made its point clear; the group believed that the substation was *stealing* water, a fundamental necessity for life. For that reason, ELF argues, “no one can be allowed to privatize it [water], commodify

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<sup>62</sup> Glennon, *Unquenchable*, 245.

<sup>63</sup> James Gustave Speth, *The Bridge at the End of the World: Capitalism, the Environment, and Crossing from Crisis to Sustainability* (New Haven: Yale University Press, 2009), 104.

<sup>64</sup> Royte, *Bottlemania*, 6.

it, and try to sell it back to us.”<sup>65</sup> Nestlé Poland Springs, in particular, is an example of a bottled water company that positions itself as small and local. However, while its slogan is “What it means to be from Maine,” it is really a corporation quite indifferent to the needs of the people who their operations affect, especially the ones living in the small towns from which the company extracts water.<sup>66</sup> That is why many individuals, like Elizabeth Royte, see drinking bottled water as a political act or statement that affirms that water is a commodity, and that it is permissible that corporations control it.<sup>67</sup>

These social justice issues surrounding drinking water cause one to consider important questions, such as whose values prevail and how does society negotiate and determine those values? In summary, many people see access to clean drinking water as a fundamental human right, yet if individuals keep buying water bottles, then money will not be invested in public water infrastructure and upkeep. We must preserve public water supplies by addressing the problems of the drinking water system as a whole, as too many people cannot afford to drink anything but municipal drinking water.<sup>68</sup>

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<sup>65</sup> Royte, *Bottlemania*, 5.

<sup>66</sup> *Ibid*, 61.

<sup>67</sup> *Ibid*, 208-209.

<sup>68</sup> *Ibid*, 135.

## **VI. Complex Adaptive Systems and Uneconomic Growth**

Systems evolve over time. For instance, system might grow in scale or one part of a system may begin to dominate another. Hughes, as an example, explains the changes of technological systems through his concept of momentum. As previously discussed, when a technology is young, society is able to exert control over the use and scope of that technology. In the technology's later stages, however, it becomes more enmeshed in society and exerts its own deterministic force. Another model of the evolution of systems follows what is called the complex adaptive cycle. The following section will define complex adaptive systems and explain the different stages through which they cycle. It then relates the model to the bottled water industry and the concept of uneconomic growth. This discussion concludes with an explanation of the limits to growth as well as the implications of growth for the drinking water system.

As authors Brian Walker and David Salt write, "Adaptive cycles don't just happen in nature, they happen in communities, business, and nations" because complex adaptive systems are systems involving many dynamic or shifting elements, rather than static entities.<sup>69</sup> These systems tend to follow what is called the adaptive cycle, which involves the following four phases: exploitation, conservation, release and reorganization. These stages are also referred to as the *r*, *K*, *omega* and *alpha* phases, respectively. The model of complex adaptive systems serves as a tool for understanding what is presently occurring with the bottled water industry.

Because systems are most efficient and productive in the exploitation stage of an adaptive cycle, businesses and the government are motivated to maintain this particular stage of the cycle and try to keep the system from progressing into the conservation and then release phases, as it would naturally progress. However, the longer the growth phase of a system lasts, the more

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<sup>69</sup> Walker and Salt, *Resilience Thinking*, 80.



strongly interconnected the system becomes. This ultimately decreases the system's capacity to absorb disturbances or shocks and respond to change.

This is true of the bottled water industry, which motivated by profit, aims to keep business in an "optimal state" of growth and hold it there indefinitely. However, the world does not work that way. As stated by American poet Ogden Nash, "Progress might have been alright once, but it has gone on too long."<sup>70</sup>

Many people seem to have forgotten about the natural pattern of the complex adaptive cycle because after the Industrial Revolution, people found ways to maximize production. Since then, the country has seemingly sustained growth for a while, even as it likely approaches the limits of growth. However, the complex adaptive model suggests that after rapid growth or the exploitation of resources, there is likely to be a release phase or collapse.

In "Economics in a Full World," economist Herman Daly discusses this notion of good versus bad growth. Daly argues that unchecked economic growth essentially denies that there are biophysical limits and that growth cannot go on forever.<sup>71</sup> This is in opposition with neoclassical economics, which posits that there is always a substitute for something and that technology provides humans with opportunities to innovate their way out of many problems.

Oftentimes, in defense of their current unsustainable practices, companies argue that changing business as usual will cost more money, causing prices of goods to rise and forcing corporations to layoff workers. A related argument is that higher prices will deprive consumers of a product they might want to buy.<sup>72</sup> This is exactly what has played out throughout history, such as with U.S. Steel in Gary, Indiana, which Andrew Hurley writes about in *Environmental Inequalities*. One problem or fallacy of growth discussed by Hurley and others is the notion off-

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<sup>70</sup> Walker and Salt, *Resilience Thinking*, 6.

<sup>71</sup> Herman Daly, "Economics in a Full World," *Scientific American* 293.3 (2005): 100.

<sup>72</sup> Royte, *Bottlemania*, 87.

the-books pollution. Companies simply jettison their waste wherever they feel like, and they do not pay the costs of these externalities. However, the global population is approaching the limit of the Earth's capacity to assimilate waste, a state that Daly terms a "full world."<sup>73</sup> Additionally, and as described in *Environmental Inequalities*, many corporations externalize costs quite unequally. Certain people, who are often of poor minority groups, are the ones who bear the brunt of environmental health issues.

The lack of accountability of corporations exacerbates the social justice issues related to drinking water. For example, because there is no bottled water tax, the water-extraction business does not contribute to the economic welfare of the towns from which it takes water.<sup>74</sup> In fact, many companies pay essentially nothing for the water they extract, while they make a lot selling it.<sup>75</sup> The current cost of producing bottled water is not the true cost because it does not take into account externalities, such as pollution. Furthermore, the amount of money that consumers pay for bottled water does not reflect the actual costs of the product either. If companies do not pay for pollution associated with bottled water manufacturing and distribution, individuals pay the consequences somewhere along the line, either by having their tax dollars directed towards cleaning up industrial pollution or by suffering from resulting environmental health problems.

### Manufactured Demand and Advertising

The powerful influence of marketing and advertising is often cited as an explanation for the rising popularity of the bottled water industry. Annie Leonard calls this use of advertising "manufactured demand," and she explains companies' desire to sell ever-increasing amounts of

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<sup>73</sup> Daly, "Economics in a Full World, 102.

<sup>74</sup> Royte, *Bottlemania*, 85.

<sup>75</sup> *Ibid*, 180.

products in order to sustain economic growth in “The Story of Bottled Water.”<sup>76</sup> She claims that while consumers initially protested the sale of bottled water, arguing that water should be free, they were eventually scared and tricked into believing that tap water is dirtier than bottled water.

Advertising for bottled beverages has been particularly successful in turning tap water into the “enemy.” In fact, some companies, such as Coca-Cola, have gone as far as to put out false information about the advantages of bottled water over tap. *New York Times* reporter David Gallagher writes about Coca-Cola’s H<sub>2</sub>O program, which tried to help the restaurant industry, specifically the Olive Garden franchise, to reduce the amount of customers who drink only tap water at dinner. Quoting directly from the H<sub>2</sub>O website, Gallagher writes,

Water. It's necessary to sustain life, but to many Casual Dining restaurant chains it contributes to a dull dining experience for the customer. Many customers choose tap water not because they enjoy it, but because it is what they always have drunk in the past. In response, some restaurant chains are implementing programs to help train crews to sell alternative choices to tap water, like soft drinks and noncarbonated beverages, with the goal of increasing overall guest satisfaction. Because of its own successful campaign against water, the Olive Garden has recently sent a powerful message to the entire restaurant industry—less water and more beverage choices mean happier customers.<sup>77</sup>

In short, the goal is to influence customers to abandon their habit of defaulting to order tap water in order to experience other beverages. The H<sub>2</sub>O campaign argues that bottled beverages improve overall dining experience. However, the subtext is that this is a strategy that aims to increase the restaurants’ and beverage corporations’ revenue.

In other cases, promotional tactics go further than just calling tap water boring. For example, Brita, turns consumers against tap water in its marketing strategy because the way to get people to invest in its home filtration products is to plant the idea that tap water is not safe to drink on its own. One of the company’s advertising campaigns is based on the premise that the

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<sup>76</sup> Leonard, “The Story of Bottled Water.”

<sup>77</sup> David Gallagher, “Just Say No to H<sub>2</sub>O’ (Unless It’s Coke’s Own Brew),” *New York Times*, September 2, 2001, accessed February 15, 2011, <http://www.commondreams.org/headlines01/0902-01.htm>.

water we drink, the water in our toilets and the water we use to mop the floor or water our lawn all comes from the same source. A thirty-second television spot by Brita compared the water in a drinking glass to the water in a toilet bowl and probes viewers, “Tap and toilet water come from the same source. Don't you deserve better?” This ad and similar ones successfully turned audiences against tap water or at least caused them to pause to question the cleanliness of the water they drink. As a result, Brita overcame the standstill in its pitcher water filtration system sales, which was due, in part, to the popularity of bottled water. Even though Brita's products require water, the company must also make tap water appear unsafe or undesirable in order to make a profit.<sup>78</sup>

The rhetoric of the Brita ad campaign mirrors the language used by leading figures in the bottled-beverage industry. For example, Susan Wellington, president of the Quaker Oats Company's United States beverage division, which makes Gatorade, declared, “When we're done, tap water will be relegated to showers and washing dishes.”<sup>79</sup> Similarly, Robert Morrison, vice chairman of PepsiCo, stated in 2000, “The biggest enemy is tap water.”<sup>80</sup> Ironically, Aquafina, PepsiCo's brand of bottled water, bottles and sells perfectly potable municipal water, showing that to the beverage industry, tap water is acceptable if consumers can be made to pay for it.<sup>81</sup> Bottled beverages, after all, feature water as a main ingredient. Tap water is simultaneously the enemy and a key element of the precise products that certain beverage companies are marketing.

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<sup>78</sup> Canadian Advertising Success Stories, “Brita,” *CASSIES*, 2007, accessed February 16, 2011, [http://www.cassies.ca/winners/2007winners/winners\\_brita.html](http://www.cassies.ca/winners/2007winners/winners_brita.html).

<sup>79</sup> David F. Gallagher, “Having Customers Say No to Tap Water,” *New York Times*, August 20, 2001, accessed February 16, 2011, [http://www.stayfreemagazine.org/public/coke\\_story.html](http://www.stayfreemagazine.org/public/coke_story.html).

<sup>80</sup> *Ibid.*

<sup>81</sup> *Ibid.*

It is clear that promotional strategies have been successful in manufacturing demand. As the Beverage Marketing Corporation, a research, consulting and financial services firm dedicated to the global beverage industry, reports “Despite the persistent challenges that have faced bottled water in recent years, longer-term developments point to a continued thirst for bottled water. Americans upped their annual consumption of it by more than 11 gallons from 16.7 gallons per person in 2000 to 28.3 gallons in 2010.”<sup>82</sup> Unfortunately, as previously discussed, the success of the bottled water industry is not just any growth. It is *uneconomic* growth with ecological and social ramifications.

### End of Economic Growth?

Many people view sustainability as a heretical notion because it opposes the country’s current prevailing narrative about the importance of economic growth, which is generally seen as a prerequisite for power and control in this nation. For this reasons, the government and certain individuals try to prolong the growth of some rather unsustainable systems, such as the bottled water industry. Nevertheless, especially as energy gets more and more expensive, individuals may begin to realize that this growth and progress narrative is a fallacy.

Returning to the model of complex adaptive systems, what is happening in the effort to maximize bottled water revenue is that the country begins to put all its eggs in one basket. This is what Walker and Salt call “classic K phase behavior.”<sup>83</sup> Heavy or exclusive investment in bottled water limits other options for drinking water distribution, and it also requires intensive management and expensive energy inputs, such as oil, which is no longer cheap energy. As a

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<sup>82</sup> Beverage Marketing Corporation, “Bottled Water Recovers Somewhat from Recessionary Years, New Report From Beverage Marketing Corporation Shows,” *Beverage Marketing*, September 2011, February 15, 2011, <http://www.beveragemarketing.com/?section=pressreleases>.

<sup>83</sup> Walker and Salt, *Resilience Thinking*, 143.

consequence, the drinking water system becomes less resilient, which means it has a weakened ability to recover from disturbances; it loses its ability to restore and repair itself.<sup>84</sup>

Furthermore, as a system increases in rigidity, it nears the possibility of a crisis or breakdown. Exponential growth cannot go on forever, and as Donella Meadows explains,

When the state of one stock is determined by trying to surpass the state of another stock—and vice versa—then there is a reinforcing feedback loop carrying the system into an arms race, a wealth race, a smear campaign, escalating loudness, escalating violence. The escalation is exponential and can lead to extremes surprisingly quickly. If nothing is done, the spiral will be stopped by someone's collapse.<sup>85</sup>

In the case of the drinking water system, the two “stocks,” defined as material that accumulates in a system over time, are public and private water supplies. The next section addresses some of the potential outcomes of such a forecasted collapse.

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<sup>84</sup> Meadows, *Thinking in Systems*, 78.

<sup>85</sup> *Ibid.*, 126.

## **VII. Conclusion**

The focus of this paper has been to provide a well-rounded view of the problems with today's drinking water system through the lens of systems, and with specific attention to the problems associated with the bottled water industry. The model or behavior of systems, used in a variety of disciplines, paints a particular picture of America's drinking water system that illustrates how bottled water and tap water are inextricably linked and how the problems that affect one part of the drinking water system influence other components. Systems thinking, in turn, explains why problem solving ought to be holistic, rather than only address one component of a system. Current societal trends have shown that managing the drinking water system for the production of bottled water is an ecologically, socially and economically unsustainable practice that ultimately fails society as a whole.

It is not that all Americans have been oblivious to the problems with drinking water from both the tap and bottles. The problem is that while people may be feeling the effects of the flawed system, most present actions to combat the crisis are not targeting the root of the problem. Despite this critique, there are some people who note that consumers are already taking a stand and saying "no" to bottled water, for example, by toting around refillable bottles, such as Nalgene, instead. Even Peter Gleick optimistically writes the following:

We're now in Phase 3 [what Gleick sees as an age in which access to safe tap water as affordable for all], with a growing consumer backlash against bottled water. People are more aware of the high environmental and, especially, economic costs of bottled water, which costs 1,000 to 2,000 times more than the same quality tap water. And there is a growing movement of universities, restaurants, municipalities, and even states to stop buying bottled water, especially when tap water is available.<sup>86</sup>

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<sup>86</sup> Peter Gleick, "Why Spend Public Money for Private Bottled Water," *Circle of Blue*, October 12, 2011, accessed December 9, 2011, <http://www.circleofblue.org/waternews/2011/world/peter-gleick-why-spend-public-money-for-private-bottled-water/>.

Nevertheless, as this paper has shown, the municipal water distribution system is still fraught with problems too. Additionally, it is possible that banning the bottle will just lead to the substitution of other bottled beverages for bottled water. These individual behavioral changes such as refilling bottles from the tap or fountain are not altogether inconsequential. However, they do not necessarily reflect whether people deeply understand the problems with the drinking water *system*.

While it takes patience to confront these messy, complex problems related to the current flawed drinking water system, the practice of systems thinking is valuable. If one does not identify the underlying problem, including the causes, behaviors and patterns of the system, then the same problems will continue to occur. Again, while attention has been brought to this issue of access to clean, safe drinking water, not all people are changing their pattern of behavior in response. Furthermore, as systems thinking teaches, it is not enough to make a superficial change. Instead, this problem requires a change in consciousness, followed by a corresponding change in action. If people do not reframe the issue of water, then they will continue to behave as if it is not a problem.

Many thinkers have signaled the need for a new collective consciousness, from Aldo Leopold, who believed nothing could be done about conservation “without creating a new kind of people,” to Albert Einstein, who stated that today’s problems cannot be solved with today’s mind.<sup>87</sup> Additionally, James Gustave Speth and Mihir Shah both point out some changes that need to be made to society’s way of thinking in “Towards a New Consciousness in America: Roles for Grantmakers” and “The Power of Uncertainty,” respectively. Speth writes that sources for widespread change include social movements, sustained efforts at education and crises that

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<sup>87</sup> James Gustave Speth, “Towards New Consciousness in America: Roles for Grantmakers,” *Biodiversity* 20.3 (2010): 3-4.



“profoundly [affect] shared values and [delegitimize] the status quo and existing leadership.”<sup>88</sup>

Shah similarly discusses the possibility of change after what he calls a “dethronement,” a crisis that presents a clean slate or opportunity to rethink people’s current behavior.<sup>89</sup> As Benjamin Franklin fittingly quipped too, “When the well runs dry, we shall know the value of water.”

Nonetheless, in the event of a cataclysmic event that provides Americans with an opportunity to change “business as usual,” individuals who are part of this movement for change will need to have the right leadership that inspires others and, more importantly, thinks in terms of systems. For that reason, it is important that individuals more actively pursue other avenues of change such as social movements or education, and that they do not just wait around for a dethronement, especially because efforts such as education can temper the magnitude of a potential future economic or political breakdown.

Most importantly, not only does systems thinking provide a potential remedy for the drinking water situation by fostering a new perspective of the world, which is likely to encourage a change of values and eventually a change in action and policy, but it also provides a possible solution for other similar problems faced by the nation; it is not just with the issue of drinking water that we see the conflict of public versus private, but also in healthcare, education, as well as other systems that affect the quality of individuals’ daily lives.

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<sup>88</sup> Speth, “Towards New Consciousness in America,” 5.

<sup>89</sup> Mihir Shah, “The Power of Uncertainty: Reflections on the Nature of Transformational Initiatives,” *Economic and Political Weekly* 45.25 (2010): 61.

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