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HUMAN RIGHTS, SANITATION, AND SEWERS

Derechos humanos, saneamiento y alcantarillado

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ABSTRACT

The human rights that are enshrined in most western democracies are based on enlightenment ideals of freedom, equality, and justice. Although these core principles are inspirational, their application has not necessarily been equitable or complete enough to provide for the stability, safety, health, and security of all citizens. A more modern understanding of human rights encompasses that which is needed to establish human flourishing, including guaranteed access to water, particularly the clean water provided by adequate sanitation. Without confidence in broad safety and health, and established norms for individual protections, it is difficult for a society to be stable and flourish. Although this argument begins with political philosophy, it ends with a case study in Alabama, one of the poorest states in the United States. This study evaluates the dysfunction caused to local communities and greater society when governmental organizations fail to provide sanitation and guarantee public health for their communities.

Key words: Human rights; sanitation; regulation.

RESUMEN

Los derechos humanos que están consagrados en la mayoría de las democracias occidentales se basan en los ideales ilustrados de libertad, igualdad y justicia. Aunque estos principios básicos son inspiradores, su aplicación no ha sido necesariamente equitativa o completa para proporcionar estabilidad, seguridad y salud a todos los ciudadanos. Una interpretación más moderna de los derechos humanos abarca lo que se necesita para establecer el florecimiento humano, incluido el acceso garantizado al agua, en particular el agua limpia que proporciona un saneamiento adecuado. Sin confianza en la seguridad y la salud en general, y las normas establecidas para las protecciones individuales, es difícil que una sociedad sea estable y florezca. Aunque este argumento comienza con la filosofía política, termina con un estudio de caso en Alabama, uno de los estados más pobres de los Estados Unidos. Este estudio evalúa la disfunción causada a las comunidades locales y a la sociedad en general cuando las organizaciones gubernamentales no brindan saneamiento ni garantizan la salud pública de sus comunidades.

Palabras clave: Derechos humanos; saneamiento; regulación.

1. Right to water

The enlightenment ideals that established Western democracies were necessary for the development of the principles of human rights to freedom, equality, and justice but they may not be sufficient to cover a more modern understanding of the complex network that is needed to establish human flourishing. A central function of government is to provide for the stability, safety, health, and security of its citizens. One can easily argue that guaranteed access to water, particularly the clean water provided by adequate sanitation, is essential for the health and safety of individuals. Without confidence in broad safety and health, and established norms for individual protections, it is difficult for a society to be stable and flourish. Although this argument begins with political philosophy, it will end by evaluating the dysfunction caused to local communities and greater society when governmental organizations fail to provide sanitation and guarantee public health for their communities.

The political philosophy that motivated the development of Western democracies emerges from an analysis of their foundational documents. France, whose fundamental Declaration of Human and Civic Rights includes the stirring words that the “aim of every political association is the preservation of the natural and imprescriptible rights…. Liberty, Property, Safety and Resistance to Oppression” (France Const., Title I, Art. 2), has a constitution that is silent about water. The Italian constitution refers to personal freedom eight times and liberty seven times and clearly states that “Personal liberty is inviolable” (Const. of Ital. Repub., Part I.I, Art. 13).

Despite six references to land, both in terms of safeguarding the "natural landscape" (Const. of Ital. Repub., Fund. Principle, Art. 9) and "ensuring the rational use of land" (Const. of Ital. Repub., Part II.III, Art. 44); there are no references to water. The Spanish constitution specifies, "justice, liberty, and security, and to promote the wellbeing of all its members" Spain Const., preamble) but mentions water only in the context of economy and territory (Spain Const., Sect. 132. 2; Sect. 148.1.10; Sect. 148. 1.11; Sect. 149. 1.22). The Canadian Charter of Rights and Freedoms (sect. 7) provides for life, liberty and security of the person while the United States (US) constitution makes sacrosanct life, liberty, and property (U.S. Const. Amend. V, XIV). There is no discussion of water in either except for the ability of the US congress to "make rules concerning captures on land and water" (U.S. Const. art. I, § 8). In fact, there are no constitutions from Western Europe or English-speaking North America that address human rights to water or sanitation (Dobbins, unpublished manuscript, 2019). The omission of the right to water provides the potential for water to devolve into a commodity or to become the tool of an autocrat. Despite the historical omission of rights to water and sanitation from the constitutions of most democracies, any government that fails to provide such access and protection is failing in its contract with its people.

2. The need for clean water

The distribution of water and the removal of waste exist in that rare space on a Venn diagram where clear ethical and physical necessities overlap. It is an unambiguous, scientific truth that providing water to living creatures is a physiological imperative. If one evaluates plant and animal physiology or human health, the purely physical and utilitarian perspective for clean water is evident. Beginning at the cellular level, all organisms need water. Among other things, water provides structure for cells, transport for critical gases, nutrients, and wastes, support for the Deoxyribonucleic acid (DNA) that encodes the proteins that form body tissues, maintenance for enzyme functions that catalyze cell processes, and stabilization of the proteins that form most intracellular and extracellular structures. Water also performs numerous accessory functions like lubrication, cushioning, and maintenance of stable body temperature. Ultimately, clean water creates the conditions that make life possible.

The presence of water is not sufficient for healthy life. In humans and other animals, unsanitary water, even in adequate quantity, strains the liver by forcing it to work overtime clearing toxins, stresses the immune system, and exposes the body to potentially life-threatening diseases of the digestive system and to parasites. Diseases related to water fall in four categories: Waterborne, Water-washed, Water-based, and Water-related (Gleick, 2002). The first three disease categories are directly related to water quality and sanitation. Water contaminated by feces or urine that contain patholgenic bacteria or viruses (i.e., cholera, typhoid, dysentery and other diarrheal diseases) leads to waterborne diseases (*ibid*). Water-washed diseases (scabies, trachoma and flea, lice and tick-borne infections) result from skin or eye contact with contaminated water while water-based diseases are caused by parasites that live in intermediate hosts in contaminated water (*ibid*).

Parasitic intestinal worms, including the genera *Ascaris* (giant roundworms), *Ancylostoma* and *Necator* (hook worms) and *Trichuris* (whip worms), may infect over 1.5 billion people causing diarrhea, weakness from blood or protein loss, and inhibition of physical and cognitive growth [Centers for Disease Control (CDC) 2013]. Persistent diarrhea, whether from intestinal irritation, cholera, dysentery, or typhoid is deadly, particularly to children. The annual estimated world-wide death rates from contaminated drinking water range from half million people each year [World Health Organization (WHO), 2018] to 3.4 million people, mostly children, as recently as 2001 (WHO, 2001). Pruss and colleagues (2002) estimated that the total world-wide disease burden would be reduced by 10% with improved water and sanitation. Improving sanitation for as little as 1% the underserved populations in Africa would reduce infant mortality by two infant deaths for every 1000 live births (Alemu, 2017).

The human body can last a surprising amount of time without food, but not without water. Kieran Doherty, an Irish hunger striker in the 1990s, lived 72 days without eating (Kieran Doherty TD, 2017). Humans deprived of water experience rapid decay within a short period of time. In extreme circumstances humans will last only a few hours and even in the best cases only a week (Packer, 2002). The longest recorded survival without water is by Italian marathoner Mauro Prosperi who survived 10 days in the Sahara, with a little help from condensation, bat blood, and urine. In the process he lost 16 kg, which was 26% percent of his body weight (Gander, 2014).

3. Perspectives on water and sanitation through human history

Because of the absolute need for water in human daily life and agriculture, civilizations throughout human history have grown near water sources. Collective living and its apotheosis, urbanization, provide particular challenges to the provision of water, sanitation, and public health. The earliest known attempt at urban settlement, Jericho (8,000-7,000 BCE) was adjacent to multiple water sources. The critical importance of sanitation was recognized at least 6,000 years ago. The first known toilet was in Mesopotamia (4,000 BCE) and consisted of deep pits lined with permeable hollow ceramic cylinders that held excrement and let liquids seep out (Wald, 2016). There was no apparent flush mechanism, but multiple cities had pipes of baked clay that transported sewage to cesspits outside the city walls (Antoniou *et al.*, 2016). The first construction of flushing toilet facilities in Europe was in Bronze Age Crete (2,000-1,000 BCE) (Juuti *et al.*, 2007). Archeological excavations in both Minoan and Mycenaean civilizations uncovered toilet ducts and sewer pipes that suggest flushing of the well-constructed lavatories (Antoniou *et al.*, 2016).

Although sanitation was available in the ancient Mediterranean civilizations, it was restricted to the wealthy and powerful. Knossos, the palace and capital city of the Minoans, had terra-cotta pipes to deliver and remove water and a waste management system dating from at least 1,500 BCE (*ibid*). The succeeding Greek civilization saw the extension of toilets to the middle classes and the development of public latrines which were adopted by the Romans (Wald, 2016). Ancient Rome had extensive water systems with fountains, baths, public and private facilities (depending on economic status) and sewage export via pipes to the Cloaca Maxima, which still drains into the Tiber. Wealthy Romans had private facilities while others relied on public latrines with the capacity to seat 50 or more people (Antoniou *et al.*, 2016). Although wastes were generally removed, there is some question as to the effectiveness of the toilet design. Fly larvae accumulated in sewers and had a direct entrance into latrines since Roman toilets had no "trap" (Wald, 2016). This basic drop toilet design that was rinsed by pouring or releasing stored water from outside the toilet continued (with modifications) until the very end of the 16th Century. John Harrington, Queen Elizabeth's godson, invented a toilet with an internal mechanism to release water with a true flush (Antoniou *et al.*, 2016). Although the Queen had a flushing toilet, most didn't. It wasn't until the end the 19th and beginning of the 20th century that technology, mass-production, and the understanding of public health united to create modern toilet facilities that were available to most of the population in Europe and North America (*ibid*).

Modern toilet facilities, effective sewage systems, and drinking water treatment are major contributors to public health including reductions in waterborne diseases like cholera and typhoid fever. Cholera, caused by the bacteria *Vibrio cholerae* (CDC, 2018a), and typhoid, caused by *Salmonella* bacteria (CDC, 2018b), are spread through fecal material in water systems. As the US instituted sanitary sewers and systematic water treatment in the 20th Century the incidence of typhoid fever fell a thousand-fold from 100 cases per 100,000 people to 0.1 cases per 100,000 people in 2006 (CDC, 2012). Although 22 million people worldwide are diagnosed with typhoid fever each year only approximately 350 are diagnosed in the US, most of whom have traveled to countries where typhoid fever is endemic (CDC, 2018b). Cholera is an acute, diarrheal illness that annually infects close to 2.9 million people and causes 95,000 deaths world-wide (CDC, 2018a). The US averages 6 cholera cases annually with a slight increase after an outbreak in Haiti in 2010 (Newton *et al.*, 2011). Of the 23 cholera cases investigated by Newton and colleagues (2011), 22 of the people had traveled to Haiti or the Dominican Republic and one reported consuming seafood from Haiti.

Perhaps because it is clear that water and sanitation are essential to both individuals and society, water has been viewed through a utilitarian economic lens, particularly in Western political thought. The Constitutions of the historic democracies of Western Europe or North America address do not water except in the context of economic or territorial jurisdiction (Dobbins, unpublished analysis, 2019). In Western Europe, only four countries (Estonia, Lithuania, Portugal, and Switzerland) explicitly address environmental protection of water and no countries address the human right to water (Dobbins, unpublished analysis, 2019). The only country in North America whose constitution address a human right to water is Mexico, “Any person has the right of access, provision and drainage of water for personal and domestic consumption in a sufficient, healthy, acceptable and affordable manner” (Mexico Const. Title One, Ch. 1, Art. 4). The general silence on water protection and the human right to water in these constitutions is not surprising. The 1948 United Nations (UN) Universal Declaration of Human Rights does not addresse a human right to clean, safe, accessible drinking water or to sanitation. Indeed, there are no references in this seminal human rights document to water or sanitation (UN, 1948).

4. Toward a new awareness

The strictly utilitarian view of water in the Western world began to change in the 1960s. The eloquent writing of Rachel Carson's Silent Spring (1962) created a growing awareness of environmental challenges and threats from pollution. A series of environmental disasters in the late 60s [i.e., in 1967, the massive spill of 120,000 tonnes (metric tons) of oil from the tanker Torrey Canyon that devastated marine life on the Cornwall coast of Britain and beaches of Brittany in France (Bell & Cacciottolo, 2017); in 1969, the iconic fire on the Cuyahoga River (Cuyahoga River Fire, 1999)], turned awareness into activism and eventually legislation. The first multilateral environmental agreement to protect a river was instituted by five governments (France, Germany, Luxemburg, Netherlands, and Switzerland) to protect the Rhine in 1963 [International Commission for the Protection of the Rhine (ICPR), 1963].

During the 1970s the principles of ecology were developed and the ideas of ecosystem thinking reverberated through institutions, both governmental and non-governmental. The concepts of interdependent ecosystem provided a strong rationale for protecting riverbanks and flood plains to protect rivers and for protecting land to maintain species diversity. When extrapolated to human situations, ecosystem thinking makes it obvious that human communities are built of diverse populations and that communities flourish when all populations are supported and critical resources, like water and sanitation, are broadly available. The new focus on the protection of water as a resource for upcoming generations was epitomized by the Stockholm Declaration, "The natural resources of the earth, including the air, water, land, flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate" [United Nations (UN) Documents, n.d.].

The concept of water and our understanding of its relationship to ecosystems, human life, and human rights can be seen in the changing focus on protecting the Rhine. Initially, the commission focused on establishing jurisdictional considerations, collaborations, and the working language (German and French), while identifying the sources and types of pollution (ICPR, 1963). During this time, the European Union was focused on developing standards for drinking water and establishing tiered water quality requirements for other primary water uses like swimming, fishing, and shellfish harvesting. [European Commission (EC), 2016]. As data accumulated, the

ICPR focused on specific water quality measures (ICPR, water quality, n.d): for example, chloride (Convention on the Protection of the Rhine Against Pollution by Chlorides, 1985) and heavy metals (ICPR Pollution, n.d.). Through the 80s and the 90s the European Union interpretation of water protection (EC, 2016) broadened to include: treating urban waste water, especially for biological contamination, reducing nitrate pollution, improving drinking water standards, and removing point-source pollution from industry. In the 1980s and 1990s the conventions on protecting the Rhine were updated to include sustainable development in a riverine context that included tributaries, banks, and flood plains (ICPR, 1998). Increased biological awareness translated into an ecosystem approach that incorporated species richness and diversity, habitat maintenance and restoration, and removal of barriers to fish migration (*ibid*).

In 2000, the new Water Framework Directive of the European Commission was presented. Although it sought to expand the scope of protection using a river basin approach (like that of the ICPR) and to increase citizen participation (EC, 2016), the focus was still on the physical nature of the rivers and river water, not on human rights to access and interaction. The latest plan for the Rhine River, Rhine 2020, addresses protection of surface and ground water, improvement of ecosystems, and prevention and mitigation of floods (ICPR Targets, n.d.). Improvement of ecosystems implies a commitment to the primacy of biological integrity. The focus on drinking water and flood mitigation implies a right to safe, secure access to water.

These goals of human rights to water, however, were not explicit in water legislation until the most recent decade. In 2010, the UN adopted a resolution (A/RES/64/292) that recognized the universal human right to water and sanitation (UN, 2010a). The goal of the resolution was to provide economic and technological support for improvements in access to water and sanitation. The devastating facts, that at least 884 million people do not have safe drinking water and more than 2.6 billion lack basic sanitation, swayed the majority of delegates (from 122 countries) to support the resolution but there were still 41 abstentions, including the US, the UK, the Netherlands, Canada, Japan, and Botswana (UN, 2010b).

An implicit assumption of much water rights work and legislation is that the need for technical development and increased access to water and sanitation are challenges solely for less developed countries. Western democracies seem to believe that their ideals of justice insulate them from inequities in services. This is clearly false.

5. The challenges of providing clean water and sanitation

In Europe there is water poverty among established and immigrant populations. In 2010 nearly one quarter of water purchasers in England and Wales spent at least 3% of their income on water and sanitation expenses and such "water poverty" is expected to rise to 1/3 of UK households by 2033 (Bradshaw & Huby, 2013). The challenge of providing safe, affordable water and sanitation will be exacerbated by immigration. Immigration increased 41% between 2000 and 2015 with Europe gaining an average 1.3 million new migrants each year [United Nations, Department of Economic and Social Affairs (UNESA), 2016]. This influx has challenged the infrastructure of the receiving countries (Puchner *et al.*, 2018) and there have been outbreaks of numerous diseases including those that are carried by contaminated food and water (Mellou *et al.*, 2017).

A recent study among refugees in Calais, France documented insufficiently maintained water supply and storage, fecal contamination of water barrels, and inadequate sanitation (Dhesi, Isakjee, & Davies, 2018). The UN directives on emergencies requires one toilet per family or one per 20 individuals in emergency situations [United Nations High Commissioner for Refugees (UNHCR), 2007] but the camps in Calais provide less than one-third of the toilets required (Dhesi *et al.*, 2018). In other locations, migrants may not even have access to services. Ventimiglia, a small town on the Italo-French border has over 16,500 refugees, most of whom are not in the Red Cross camps. The majority of these refugees survive under overpasses without access to potable water, sanitation, or shelter (Capitani, 2018). It is not just migrants in Europe who face these challenges. There are extreme difficulties with access to water and sanitation for migrants to the US, particularly along the border with Mexico (Jepson & Brown, 2014; Jepson & Vandewalle, 2016).

The United States prides itself on its resources, but water insecurity and lack of proper sanitation is a challenge in both poorer urban areas and rural districts, particularly where infrastructure is weak and the tax base is low. More than 470,000 households, or approximately 1.2 million people, live without complete plumbing facilities (American Communities Survey 2017). The UN Special Rapporteur on the human right to safe drinking water and sanitation specifically noted sanitation deficiencies in the central Appalachian region, whose communities "face some of the highest poverty and lowest education attainment rates in the United States" (UN, 2011, 7). This area is headwaters to the rivers of the Eastern United States and includes Kentucky, West Virginia, Virginia, and Pennsylvania. In 2002, the US Environmental Protection Agency (USEPA Region 4) estimated that 40% of the households in Kentucky were not connected to a centralized sewage system. As a result, a third of the rivers and streams in the region had high bacterial loads due to the improper disposal of sewage (Harmon in USEPA Region 4, 2002). A decade later an estimated two-thirds of homes in West Virginia and southern Virginia were discharging raw sewage (UN, 2011). Many of these discharges were from "straight pipes" that directly exit a building to discharge sewage onto the ground. There were national (Reauthorization of the Appalachian Regional Commission, 2006) and state (Baldwin, n.d.) investments in the early 2000s to correct the challenges associated with rural sewage disposal in Appalachia. This effort, however, was insufficient. Over 10 percent of the citizen complaints about pollution in Kentucky between 2013 and 2018 concerned "straight pipes" (Walton, 2018).

The challenge of delivering clean water is inextricably linked with the problem of sewage disposal. Almost everyone lives downstream from someone else. Not only is there discharge of treated sewage into rivers, but unintentional discharges and overflows associated with rain are persistent problems, particularly in urban areas (Olds *et al.*, 2018). In 2016 the Alabama Department of Environmental Management (ADEM) began to publicly post (industry-reported) overflows and spills from any waste water treatment plant (WWTP). That year there were 1,271 documented releases that poured a minimum of 28.8 to 46.2 million gallons of raw sewage into lakes, rivers, and streams (Pillion, 2017). In 2018, there were over 2,100 documented overflows usually associated with rain events (author collated from ADEM data, 2018).

These upstream events have tremendous downstream impacts, especially on small water providers. In Texas more than 4% of the water systems that provide drinking water are violating water quality standards and a 2012 USEPA review of public water systems in that state found significant violations of water law in 25% of the evaluated systems (Satija, 2014). South Texas contains unincorporated rural subdivisions (*colonias*) that house low-wage workers without access to water and sanitation (Jepson & Brown, 2014), a condition inconsistent with the laws and status of the US as a first world country. California, the richest stare in the US and the fifth largest economy in the world (Egel, 2018), has similar problems. The residents of Tooleville, a farm-worker community just outside of Exeter, lack basic water and sanitation infrastructure (Ranganathan & Balazs, 2015). Exeter has not supplied Tooleville with water (*ibid*) and the 2010 Exeter water plan boundaries excluded the community (Knopf, 2011). Even where water infrastructure exists in the agriculture-intensive San Joaquin valley of California, working-class, minority communities are more exposed to contaminants like arsenic and receive less attention from State and Federal regulatory agencies (Balazs, Morello-Frosch, Hubbard, & Ray, 2012).

The inequities that reflect race and class are also the reality in much of the rural southeastern United States. Migrant farm workers live without access to clean, safe water and sanitation (Bischoff *et al.*, 2012). Even in stable, long-established communities persistent racial disparities in access to services continue. In North Carolina municipalities, "every 10% increase in the African-American population proportion within a census block increases the odds of exclusion from municipal water service by 3.8% ($p<0.05$)" (MacDonald, DeFelice, Sebastian, & Leker, 2011, 2). This is consistent with historic exclusion of African-American populations from access to musicpial services during the time of legal segregation in the US (Leker & MacDonald-Gibson, 2018). There are five US states whose populations are over one-quarter African-American [Mississippi (MI) 37.8%, Louisiana (LA) 32.6%, Georgia (GA) 32.2%, South Carolina (SC) 27.2%, and Alabama (AL) 26.8% (United States Census Bureau, 2018)].

6. The black belt of Alabama: A case study in social failure to provide water and sanitation

Alabama, particularly the "Black Belt" of Alabama, provides a model for the nexus of race, economics, governmental competence or malfeasance, and regulatory failure in the provision of water and sanitation. The "Black Belt" of Alabama is named for the rich black earth that made it the center of the 19th century cotton industry [University of Alabama Center for Economic Development (UACED), n.d.). Now these counties are among the poorest in the nation with high poverty and shocking disparities in race-related poverty rates (Table 1). Alabama itself is the fourth poorest state in the US. Of Alabama's 67 counties, 64 (96%) have a median income lower than the federal average (Gore, 2017), 19 (28%) have a poverty rate higher than 25 percent (Scott, 2016), and 44 (66%) have a child poverty rate of 25 percent or more [US Department of Agriculture-Economic Research Service (USDA-ERS), 2019]. The burden of poverty falls disproportionately on the African-American population of Alabama particularly in the rural "Black Belt" counties (Table 1).

Table 1. Specific Alabama Black Belt Counties Compared by Income, Poverty Rates, and Poverty Share

	Median Household Income[1]	**Poverty Rate[1] (%)**	**Poverty Rate[2] White (%)**	**Poverty Rate[2] Black (%)**	**Black "Share" of Poverty[3] (%)**
US AVERAGE	$57,652	12.3	13.6	24.7	17.3
AL AVERAGE	$46,472	16.9	12.9	26.6	40.4
Hale County	$34,679	25.1	12.5	45.3	80.2
Lowndes County	$29,785	25.9	4.2	36.5	96.4
Perry County	$22,973	37.2	7.5	46.0	86.2
Wilcox County	$27,012	32.0	4.0	47.3	88.2

[1] From: US Census Bureau Quick Fact, 2018.
[2] Calculated from: DATAUSA, 2016.
[3] From: DATAUSA, 2016.

Alabama's Black Belt provides an laboratory to examine the effects of governmental neglect on both the right to clean water provided by adequate sanitation and the structure of the society. Four counties in the Black Belt of Alabama (Hale, Lowndes, Perry and Wilcox) have well-documented concerns with the disposal of sewage. Public health researchers from academic institutions methodically evaluated homes in Hale and Wilcox counties to reveal that 65% and 93%, respectively, relied on unpermitted sewer systems and many those systems were discharging directly to the ground (Elliott *et al.*, 2017). In Newbern, Hale County, 90% of the households have unlicensed sewage disposal systems with over half of those using "straight pipes" (*ibid*).

In neighboring Lowndes County, 42.4% of residents in the sample population reported exposure to raw sewage within their home and 19 of 55 stool samples (34.5%) from these residents were positive for the hookworm *Necator americanus* (McKenna *et al.*, 2017). This is consistent with previous work by Badham (1993) that identified clusters in Wilcox county where a third of the children had intestinal parasites (helminths). The strongest associations with intestinal parasites were: inadequate sewage disposal, inadequate solid waste disposal, and non-standard water supplies (Badham, 1993). In response to the 2017 work by Mckenna and colleagues, the Alabama Department of Public Health (ADPH) posted a notice on its website that "Environmental study in Lowndes County, Alabama, fails to prove hookworm infection" (ADPH, 2018, 1). Using the standard, less sensitive technique, ADPH reinvestigated "9 of 20 individuals identified as positive" (in the Mckenna study) and "all specimens tested were negative for O & P (Ova and Parasites)" leading the statement "thus no evidence of hookworm infection was found in any of the residents of Lowndes County who were tested" (ADPH, 2018, 1).

Although this statement is factual in a limited way, it is disingenuous, both in its content and underlying philosophy. By definition, scientists do not "prove" their hypotheses. Mckenna was providing not proof, but evidence that should have inspired ADPH to conduct a meticulous investigation of the public health, instead of a limited re-evaluation of less than half of the previously positive subjects. In addition, the molecular techniques used by McKenna and colleagues had been established to be superior to O & P microscopy for detecting parasite loads (Mejia *et al.*, 2013; Cimino *et al.*, 2015). These well-established molecular techniques, including polymerase chain reaction (PCR) that identifies specific parasite DNA, have a consistent track record of higher sensitivity in detecting the parasites that cause malaria (*Plasmodium falciparum*) (Rantala *et al.*, 2010), Chagas' disease (*Trypanosoma cruzi*) (Kirchhoff, Votava, Ochs, & Moser, 1996), and a range of intestinal disruptions from *Giardia intestinalis* to *Cryptosporidium* species (Stensvold & Nielsen, 2012). In fact, Stensvold and Nielsen conclude that their "data indicate that the use of FECT-microscopy alone for general, routine parasitological diagnosis in Denmark has limited diagnostic value" (2012, 540). Interestingly, although CDC calls microscopy "the gold standard" it has specific guidelines for using molecular techniques "like PCR" to identify parasites when "an unequivocal identification of the parasite cannot be made" (CDC, 2016, 1) suggesting that PCR has a great efficacy and precision in identification.

Perry County, which is between Lowndes and Hale Counties, has no demonstrated hookworm infestations but has its own sanitation challenges. The design and operation of the Uniontown municipal sewer system, in southwestern Perry County, have contributed to environmental degradation and potential negative health effects (Pillion, 2018). The Uniontown waste water situation is instructive as it highlights the challenges of failing infrastructure, economic crises from a limited local tax base, poor regional planning, and deplorable regulatory lapses.

The UNointown sewer system empties into an open lagoon with three cells for waste water treatment. Waste water enters the lagoon in the two smaller eastern cells and leaves from the larger, western, finishing cell called the "third cell." The processed water from the large lagoon is pumped 6.5 km south to a spray field where this treated water is ejected through agricultural-style pivot irrigation. The goal of a spray irrigation is disposal of secondary treated wastewater by broadcasting it onto the soil so it will percolate, be filtered by the land, and recharge groundwater (Schreffler & Galeone, 2005). The soil in the Perry County region is predominately from the Kipling series, which is a clay-based soil with low permeability and poor drainage capacity (Engineers of the South, 2014). This particular soil type is unsuited to "Disposal of Waste Water by Irrigation" [Natural Resources Conservation Service (NRCS), soil survey, 2017]. Lack of permeability means that water will collect on the surface and follow lines of least resistance into adjacent surface waters. Both the lagoon and the spray field are bordered by creeks and any overflows will impact those creeks, the agricultural lands adjacent to them, and the local population which fish, swim, and extract water from the creeks.

The Uniontown lagoon is set in the headwaters of Cottonwood Creek. Two tributaries of the creek border the lagoon on three sides and overflows from the lagoon directly enter the creek (Dobbins, personal observations, 2016-2018; ADEM, 2017; ADEM, 2018, ADEM, 2019). A report to ADEM by Uniontown in 2016 on an overflow of up to 1,000,000 gallons from the third cell of the lagoon into Cottonwood Creek states "We are still waiting for a solution to the Infiltration" (Sewage Spills in Alabama, 2016, Uniontown Lagoon). Although there was legal enforcement action by ADEM as early as 2005 (ADEM, 2005) followed by a binding legal action in which Uniontown agreed to fix its problems within 3 years (consent decree) in 2008 (ADEM, 2008a); in 2019 Uniontown is still waiting and the chronic overflows continue.

On 29 January 2019, Uniontown posted a report of an ONGOING sewer overflow from the third cell that began over a year before on 22 December 2017 (ADEM, 2019). This continuous release into Cottonwood Creek was estimated at 500,000 to 750,000 gallons (1.9 to 2.8 million liters), but the lack of metering at the facility and the self-reporting without external validation provides little confidence in the actual numbers. The report states that the, "Lagoon has filled to the point that overflow is flowing through a pipe installed for the purpose of high water levels. This is an emergency overflow pipe installed to protect dam" (ADEM, 2019, sso id: 7976.4). An "emergency overflow pipe" should provide relief in acute, extreme, and unusual situations. Chronic, continuous releases through this pipe belie the word emergency and suggest both persistent volume overload and technical challenges with the existing facility.

The data from the 2017 to 2019 self-report on sewer overflows from Uniontown verify both suppositions. According to these reports, on the 22 Dec 2017 the third cell of the lagoon began overflowing from the same GPS coordinates as the "emergency overflow pipe" into Cottonwood Creek (ADEM 2017). On 27 Dec 2017 a new site at the same GPS as the overflow pipe began overflowing (possibly overtopping the third cell) along with three additional sites on the west side of the same cell. According to posted records, three of these five sites are still releasing sewage water into the creek. The two sites that were fixed took four months to contain during which they released an estimated combined 50,000-100,000 gallons (189,000 – 378,000 liters) of waste water (ADEM, 2018). Although the volume of overflow from one overflow site was not estimated, the combined reported releases from December 2017 to January 2019 from Uniontown's third cell exceeded a minimum of 1.25 million gallons (4.7 million liters) (ADEM, 2018; ADEM, 2019).

The reports on the spills from the "emergency overflow" pipe reveal flaws in the self-reporting process and the condition of the third cell in Uniontown. The initial report on 22 Dec 2017 did not estimate a release volume. A revised report five months later (1 May 2018) listed the total volume released as less than 1,000 gallons, but by six month later (21 Nov 2018) the release volume had increased by over 100-fold (ADEM, 2018). Two months later, the volume of release was between 3 and 5 times what have been estimated in Nov (ADEM, 2018). Such dramatic exponential volume increases within a year (Figure 1) suggests that there is substantive structural failure and volume overload in this cell. If there was a linear increase in volume over time, the alternate conclusion would be that self-reports were substantially underestimated in the initial reporting period.

Uniontown is an exceptional model of systemic failure because both the lagoon and the spray field continue spilling contaminated water into two disparate creeks, and fouling two watersheds, for 11 years after a binding consent decree to eliminate sanitary sewer overflows within three years (ADEM, 2008a). The lagoon is adjacent to Cottonwood Creek in the Black Warrior River watershed, while the spray field floods into Freetown Creek, which is a part of the Alabama River watershed.

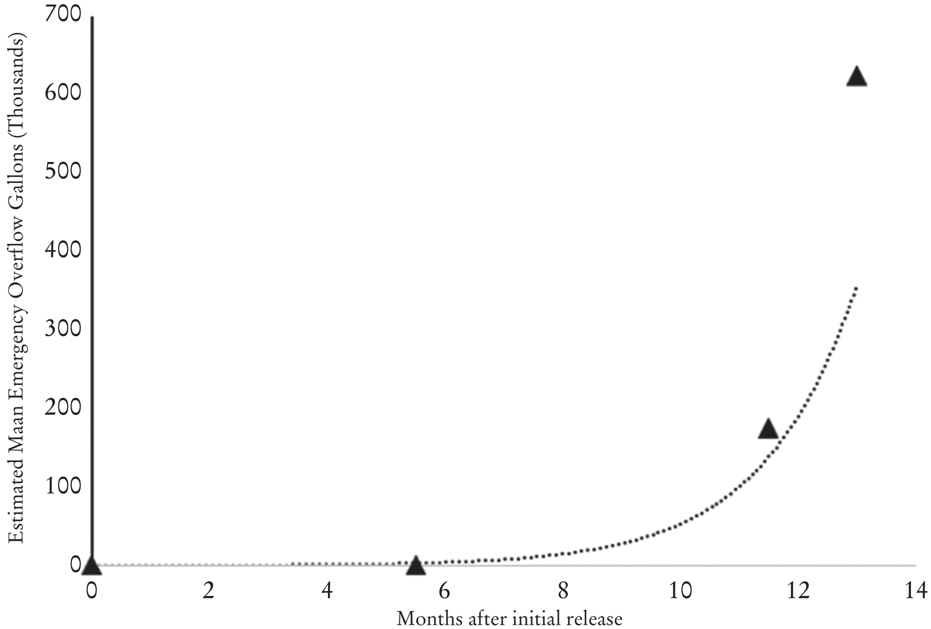

FIGURE 1. Estimated mean release (in gallons) from "emergency overflow" pipe of Uniontown WWTP into Cottonwood Creek between December 2017 (initial release) and January 2019.

In 2018, the spray field dumped over a million gallons (> 3.8 million liters) of waste water into Freetown Creek (ADEM, 2018). In March 2018, there was a massive failure on the berm of the spray field that allowed an unknown volume of water to enter the creek. There were three distinct breaches of the spray field reported for 18 March. On March 24th, water samples from one of these overflows contained between 7,300 and 11,000 colony-forming units of *Escheria coli* in 100 ml (cfu/100ml) (Dobbins, unpublished data). The permit through the National Pollutant Discharge Elimination System (NPDES) for the spray field facility allows a daily maximum of 4,000 cfu/100 ml of *E. coli* (ADEM, 2012). The Alabama guidelines for even the lowest standard of surface water (agricultural and industrial water supply) require that "*E. coli* group shall not exceed a geometric mean of 700 colonies/100 ml; nor exceed a maximum of 3,200 colonies/100 ml in any sample" (McIndoe, Sisk, & Johnson, 2017). A continuous influx of water that contains an order of magnitude more *E. coli* that the maximum allowable will rapidly overwhelm an aquatic system. The greater the number of *E. coli*, the greater the potential for human exposure to pathogenic bacteria.

Although this double public health crisis has been noted for at least 17 years (ADEM, 2002) and there have been numerous sewer issues ranging from the administrative, i.e., failure to report outfall discharges (ADEM, 2007) to the catastrophic, i.e., system-wide failure (ADEM, 2008a) the common theme appears to be regulatory collapse in the face of chronic mismanagement of the sewer system. Evidence of poor management of the sewer system included failure to perform maintenance, allowing sludge to impair performance, and allowing manufacturers to directly dispose waste into the finishing lagoon [Sentell Engineering, LLC. (Sentell), 2009]. Although some of the challenges to upgrading the system were undoubtedly fiscal, there was an abrogation of responsibility to ensure that the manufacturers who were releasing water into the sewer system or WWTP were complying with their permits. As a 2011 Uniontown Municipal Water Pollution Prevention (MWPP) Report noted "Southeastern Cheese dumps directly into our polishing pond" (Sentell, 2012, 20). The engineers contracted to write a response to the consent decree also indicated that, "some of the industries are sending too high BOD (biological oxygen demand) counts over their SID permits and (excess over) permitted volumes (Sentell, 2009, 4). A high BOD is indicative of high bacteria loads, which stresses open-air treatment systems, especially one with compromised aerators. The lack of oversight for and maintenance on the Uniontown WWTP meant that both the function and integrity of the sewer treatment system were compromised.

The checks and balances of a strong government include mechanisms to locate deficiencies and tools to address them. As early as 2002, the relevant regulatory agency (ADEM) noted violations in the Uniontown WWTP (ADEM, 2002). From 2005 to 2018, there were 76 additional citations for non-compliance in Uniontown sewer system (ADEM efile). Despite these continuing violations, an on-going civil action complaint (ADEM, 2005) and a consent decree in which Uniontown agreed to fix its problems within 3 years (ADEM, 2008a) a discharge permit was reissued to the Uniontown WWTP in 2008 (ADEM, 2008b) and 2012 (ADEM, 2012). The regulatory failure was so glaring that the USEPA stepped into to evaluate the Uniontown WWTP. Its report (2013) noted NPDES permit violations for at least 3 years in BOD, fecal coliform bacteria, and nitrogen removal. The report also expressed concern about "deficiencies with the NPDES program in the areas of facility site review, operations & maintenance, and effluent discharge" (USEPA, 2013, 5). This is strong language, but there was no effective follow up.

As a way to cope with the problems of failing infrastructure and volume overload in the Uniontown WWTP, the city and its hired engineers crafted the idea of opening a second spray field. Although this spray field was also in land designated as unsuitable for "Disposal of Waste Water by Irrigation" (NRCS soil survey, 2017), ADEM accepted this solution and added spray field # 2 to the permit (ADEM, 2012). The city of Uniontown obtained and spent $4.4 million in grants from the US Department of Agriculture for WWTP upgrades and to add the second spray field (Selma Times Journal, 2014). On 4 March 2014 ADEM issued a Stop Work order to Baird Contracting Company to cease work on the second spray field (ADEM, 2014). The spray field was never operated and the Engineer on the project stated that, "both of the city's wastewater treatment spray fields — one recently completed by Sentell, and a second, which has been used for decades — are likely to only be used as emergency backups in the future" (Selma Times Journal, 2014, 1).

There is little rationale for permitting the second spray field. In 2011, the engineers called for "a complete rehab of the WWTP" and "repairs to the collection system and pump station" (Sentell, 2011,14). The predicted life of the system was "five years remaining in the condition it is in today" (Sentell, 2011, 14). A year late, the predicted life of the system was "3 months" (Sentell, 2012, 14). The addition of a second spray field could not begin to address such dysfunctionality. Even more disturbing, there were other glaring potential problems. In commenting on the failure of the rehabilitated system, a Sentell engineer stated,

> there are two reasons the newest spray field has not been used; the soil at the spray field is composed of too much clay to allow the treated water to percolate into the ground, and the city's old water meters were not accurately recording the amount of water used in the community every day" (Selma Times Journal, 2014, 1).

It is difficult to comprehend that an engineering firm would not know the consistency of soil before presenting a project, much less undertaking it. Soil reports of Perry County that showed the "Sumter-Kipling-Sucarnoochee" (low permeability) composition were readily available (NRCS, 1997). In fact, as of December 2010, these soil reports were available online (NRCS, 2018). A 2014 report on the Uniontown spray fields states that "the soils at the proposed land application site (spray field #2) are similar in consistency to the existing spray field site (and much of the region)" (Engineers of the South, 2014, 5). Their summary evaluation of the spray field effectiveness considered the soils, the saturation of spray field one, and the "disposal needs of the city" and predicted that "an additional **250 to 300 acres** (emphasis added) of land application area will be required." (Engineers of the South, 2014, 5).

The inability to the engineers to gauge the effluent demands of the Uniontown WWTP are equally frustrating and inexplicable. In reports submitted by Sentell and the City of Uniontown, prior to the development of the project, the measured inflow into the treatment lagoon exceeded the design capacity of the WWTP. In 2011, lagoon inflow exceeded design flow in 8 of 12 months, and the exceeded 90% design capacity in 9 of 12 months (Sentell, 2012). The annual average monthly inflow was 106% of the design capacity (Sentell, 2012), which does not suggest that a simple fix will remedy the problems of the WWTP. In 2011, the lagoon inflow exceeded design flow in 3 of 12 months, and the exceeded 90% design capacity in 4 of 12 months (Sentell, 2012). However, the report notes that "Flows readings are estimates only. The meters do devices do not work at the present time." (Sentell, 2012, 22; 28; 29; 32; 56;117). Similar notes were appended to the 2010 report. The report also notes, that "Southeastern Cheese dumps directly into our polishing pond" (Sentell, 2012, 20). Clearly, direct dumping into the finishing pond was circumventing inflow meters, even if these had been working.

The latest solution to Uniontown's sewer problem is to construct a 20-mile long pipe to a treatment plant in Demopolis, Alabama (Hodgin, 2019). The city has received at least $24 million to fix the leaking sewer pipes, construct a new transport pipe, and pump Uniontown's sewage west to Demopolis, another small Alabama town (Whatley, 2018). The investment may be a spectacular success, but without good oversight the challenges of maintenance and volume overloading could create a cascading effect across the Black Belt and shift the contamination problems to the Tombigbee waterway, where the Demopolis sewer plant discharges.

There are many challenges to adequate sewers and sanitation. Geography, like the impermeable clay soils of the Blackbelt or the steep and narrow mountain valleys of Appalachia, can impose stern constraints on water and sewer infrastructure. These challenges should call forth civic engagement and education coupled with creative engineering solutions. Unfortunately, the history of the Uniontown sewer debacle is rife with examples of failing infrastructure, biased economics, poor planning, lack of community education, and deplorable regulatory lapses. As aptly described in the first World

Water Development Report water and sanitation failures are largely a crisis of governance

> The symptoms of this crisis … include: lack of adequate water institutions, fragmented institutional structures (a sector-by-sector management approach and overlapping and/or conflicting decision-making structures), upstream and downstream conflicting interests …, diversion of public resources for private gain, and unpredictability in the application of laws, regulations and licensing practices (World Water Development Report, 2003, 30).

To reverse the sad saga of Uniontown and all its sister towns, we must remake our priorities (region, provincial, national, and global) and our corporate understanding of the rights of all people to equal services. This will require transformative thinking that prioritize science and ethical decision-making to make long term judgements for the good of most instead of for the short-term gain of a few. One clear measure of a civil society is whether it provides access to clean water and sanitation for all people, unbiased by their race, religion, or economic status. It is time to update our enlightenment ideals. A new political philosophy requires not only ecosystem thinking, but also an infusion of the practical reality that water and sanitation are necessary for human life, human health, and the establishment of conditions where economic prosperity and democratic ideals may flourish.

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