Southeast Rural Community
Assistance Project, Inc.

50 YEARS OF WATER

Impact of SERCAP Efforts Since 1969

Prepared by Capita Neuro Solutions LLC on behalf of Southeast Rural Community Assistance Program, Inc., June 2019

CONTENTS

WHAT LIFE WOULD BE LIKE WITHOUT SERCAP, INC.

The Lewin Family
March 2018

Marianne Lewin has lived in Washington County, North Carolina, outside of Plymouth township off NC-45, for her entire life. Her family has always been here, as far back as they know. Her great-grandfather built the current family home in 1946, just after coming back from Germany. It's a small home, but it's theirs and it carries the memories of generations.

In 1982 her grandfather dug the well out back – trickle-down economics was the talk of the day, but damned if they were going to have trickle-down plumbing. He and two other families had dug wells all over Plymouth that summer. She was just a child, but she remembers being fascinated by the loud diesel-powered auger the adults had used to dig. They even ran pipes into the homes and dug septic pits – rudimentary plumbing, but plumbing nonetheless. People in Washington County had always taken care of each other. They had to, to get by.

Today, Marianne is a pleasant woman, but it's always a tired smile she shows, and never with her teeth. Her enamels are pitted and she's very self-conscious about showing them. Pain moved into her hips, knees, and elbows years ago, and it's made no signs of moving out. On good days pain is all that it is; on bad days she has trouble moving or even standing up. Hot showers help a bit, but the well is unreliable, especially in the deep winter. Recently she's noticed her heart start to flutter and race all on its own, sometimes suddenly squirming in her chest before settling back to normal. She knows that she hasn't had the easiest life, but she wonders if she should feel this worn down at 40.

She used to work up the road at the Domtar paper mill, but between her slowed movement and the days she can't make it out of bed, she hasn't had a regular job in the last 18 months. She takes odd jobs as she can, cleaning mostly, but the days that she can work are becoming less and less frequent. Government assistance has been supporting her for about a year now.

Alvin Lewin is 17, finishing up his junior year of high school. He's big for his age, and even more so for his family. His father was 5'9, Marianne stands 5'2, but Alvin towers at 6'5 and Marianne would swear he's still growing. He wishes he could use his height for basketball but he's frail for his size. He's broken his wrist twice in the last 5 years, as well as his clavicle and his tibia, and there's a dull ache in his right foot that he suspects means that something is out of place.

Alvin has been forced to grow up faster than most in the last 2 years. His mother's poor health requires a lot of his time and attention, and bills that never seem to get smaller require him to work whenever he can. He spends several days a week refilling fumigation tanks and doing equipment maintenance for a local exterminator. In years past Alvin used to be a reasonably good student in school, but lately he's been missing several days each month, between having to look after his mother and picking up work when he can. Graduating is looking more and more unrealistic, and he's thinking about dropping out.

Once or twice a year, Marianne or Alvin or both get badly sick. Coming down with the bugs, they call it. They're not sure what it is, but it's fairly predictable in its pathology. A bad fever with sweating and coughing, or a violent intestinal ailment with persistent diarrhea and stomach cramps. They can't go to work or school when this happens; they can't even leave the house. Both of them know there's no good end to the path they're on, but neither of them will admit it to the other, and neither of them sees any way out.

The Lewin family's story is not unique, nor even especially rare. Fluorosis, resulting from naturally-occurring fluoride in the ground leeching into a hand-dug well, attacks the calcium in their bones and teeth, and over time even their hearts. It damages the thyroid during childhood and adolescent development, causing abnormal growth. Bacteria fester in substandard septic tanks, overflowing during periods of heavy rain. These spill over into the well system or even just tag along on a muddy footprint, causing typhoid fever, diphtheria, cholera, and gastroenteritis. Conditions that are commonly considered eradicated in the United States in fact persist, finding a strong foothold in the areas where clean water hasn't washed them away. In struggling to deal with these challenges, any kind of meaningful social or economic pursuit becomes a distant dream.

Though fictional, families like the Lewins live all throughout the Southeast United States. Indeed, many exist in far worse situations than depicted here, absent any sort of plumbing or septic systems, facing very real threats of lethal infection on a regular basis. Most of these families live near or below the poverty line, with the day-to-day challenges of survival taking precedence over finances or even the basic human drive for self-empowerment. Without clean water or reliable sanitation, there is little ability for these families to step beyond their current lots and move forward.

SUMMARY OF FINDINGS

Throughout the course of its 50-year operational history, the Southeast Rural Community Assistance Program, Inc. (SERCAP) has had an outsized impact on the 7-state region it serves and the people who live there. Operating with a cumulative inflation-adjusted investment of $520 million over 50 years, it has been able to create over $100 billion in economic activity, prevent more than 225,000 cases of disease and disability, and save more than 17,000 lives.

SERCAP has been able to achieve this disproportionate impact by targeting upstream factors that allow for a strong multiplicative effect. Through providing clean drinking water and safe wastewater disposal, SERCAP is able to touch health & disease, education, employment, racial disparities, and even population distribution.

When factoring for inflation, SERCAP's funding has declined substantially over the past 30 years. Given how critically important the organization is in creating positive outcomes for individuals in the rural Southeast, significant efforts must be made to stabilize and even boost funding so as to preserve this legacy of accomplishment.

BACKGROUND

Lack of clean drinking water and wastewater disposal causes a range of adverse outcomes. These can be broadly classified as primary, secondary, and tertiary harms. Primary harms occur directly as a result of lack of clean drinking water and sanitary wastewater disposal. Secondary harms arise from the consequences of primary harms, usually on a longer timescale and of more complex impact. Tertiary harms result from the interaction of primary and secondary harms with large populations. They manifest the most slowly, on the town-level and above.

PRIMARY RISK: DISEASE

The most direct and obvious harm due to lack of water infrastructure is disease. Contaminated drinking sources and improper waste disposal provide fertile breeding grounds for viruses and bacteria and make infection much more likely. While substandard water delivery and disposal exacerbates the severity of every disease, there are several that preferentially exist in such conditions. Normally rare due to water treatment infrastructure, they readily reproduce and infect humans when good standards for clean water are not met.

A common element to most of these diseases is that they are largely absent from most of the United States, and as such tend to be overlooked. It is important to understand that while diseases have expected infection and mortality rates, these figures become much larger in the absence of good sanitation. The diseases discussed here show an average of 56% reduction in mortality and nearly 90% reduction in morbidity with access to clean drinking water and proper wastewater disposal.

TYPHUS

A bacterial infection causing fever and skin rash. Mortality can reach up to 60% in areas with poor access to medical treatment. While uncommon globally and especially rare in the United States, it thrives in areas with poor sanitation.

DIPHTHERIA

A highly contagious bacterial infection causing fever and cough. It is generally rare due to vaccination but persists in areas with poor medical access. Mortality rates average 5–10%, and as high as 20% in young children.

CHOLERA

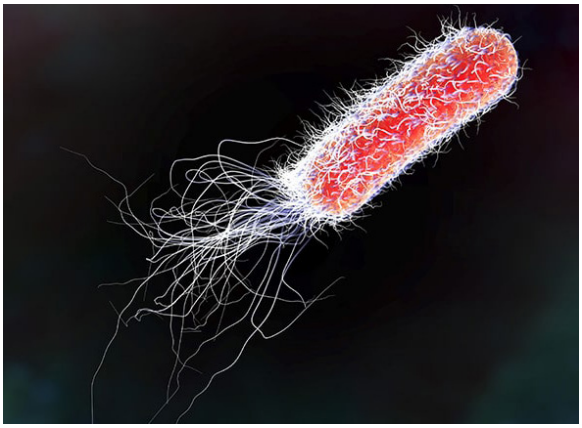
A bacterial infection of the small intestine, causing severe diarrhea and subsequent dehydration. Rare in the developed world, it thrives in regions with substandard sewage management. Mortality is typically under 4% with good medical access but can reach as high as 50%.

DYSENTERY

A condition affecting the intestines, especially the lower intestine. It may be of viral, bacterial, or parasitic origin. Similar in pathology to cholera, it results in severe diarrhea and dehydration. Mortality with good treatment is low, under 4%.

GASTROENTERITIS

An umbrella term referring to inflammation of the stomach and intestine. It may be viral, bacterial, fungal, or parasitic, but is highly contagious in all cases. It causes fever, vomiting, diarrhea, and electrolyte imbalances. Although not meaningful lethal, it causes substantial lifestyle disruption through its debilitating effects and its contagiousness.



MENINGITIS

An inflammation of the central meninges around the brain and spinal cord. It results in fever and headache, and sometimes skin rash. Most commonly viral, the bacterial variant is especially malignant. The viral variant is rarely fatal, while the bacterial form is 90–95% fatal when untreated. Even with antibiotic treatment, bacterial meningitis shows 25% mortality.

HEPATITIS A

A viral infection of the liver, manifesting as fever, nausea, vomiting, diarrhea, and jaundice. Rarely fatal, it is still highly debilitating. Infection most commonly occurs through contaminated drinking water.

ESCHERICHIA COLI

A broad class of fecal bacteria commonly present in the world. More virulent strains can cause gastroenteritis, meningitis, hemorrhagic fevers, and urinary tract infections, as well as food poisoning. As a fecal bacteria, any substandard sanitation is a vector for contagion. Mortality from *E. coli* exposure ranges from 2-5%, depending on the nature of infection.

GIARDIA

A class of intestinal parasite common throughout the world. Infection results primarily in nausea, vomiting, and diarrhea. Spread is primarily through contaminated drinking water or contact with infected feces. Although not meaningfully lethal, *giardia* debilitation can persist for 6 weeks or more.

CAMPYLOBACTERIOSIS

A bacterial infection of the digestive tract, causing breakdown of stomach and intestinal tissue. Infection is typically via contaminated drinking water as well as person-to-person and even pet-to-person. It is rarely fatal but is debilitating and quite contagious.

SHIGELLOSIS

A bacterial infection of the intestine, manifesting as fever, abdominal pain, and digestive abnormalities. Infection most commonly occurs from exposure to feces via contaminated food and water, flies, and unwashed hands. Shigellosis spreads especially quickly among children. Its prognosis is highly dependent on the quality of available medical care; in underserved areas, mortality can reach 5-15%.

PRIMARY RISK: TOXICITY

Chemical toxicity can also occur as a consequence of contaminated water. This most frequently happens as a consequence of improperly-dug or poorly-maintained wells. Toxicity is not as acutely problematic as disease but exhibits pernicious long-term effects. Developmental disabilities, birth defects, and intractable chronic conditions commonly occur as a result of prolonged exposure to toxic compounds.

ARSENIC

The most common toxic agent found in drinking water is arsenic. Highly abundant in the ground, prolonged exposure is carcinogenic, especially in regard to skin and bladder cancers. It also causes developmental disabilities in children, particularly disabilities of intelligence, cognition, and focus.

NITRATES

Nitrates in the soil are almost as common as arsenic. A byproduct of both synthetic and natural fertilizers, nitrate exposure diminishes the capacity of the blood to transport oxygen. Prolonged exposure can cause neurocognitive decline in both adults and children.

ORGANOPHOSPHATES

Organophosphates are another agricultural byproduct. Commonly used as insecticides, organophosphate compounds easily enter the soil after storms, where they can readily contaminate groundwater supplies. Prolonged exposure is known to cause memory loss, depression, sleep dysfunctions, and diabetes. Exposure in children can result in significant lifetime neurological disability.

FLUORIDE

Fluoride can occur in naturally high concentrations in the soil, resulting in a condition called fluorosis. While low levels of fluoride in drinking water has beneficial effects on dental health,

higher levels are problematic. Fluoride aggressively binds calcium, causing pitting of both the bones and teeth with chronic exposure, and can even result in cardiac arrythmias.

HEAVY METALS

Heavy metal contamination of drinking water commonly occurs as a result of substandard plumbing. Most frequently seen is lead poisoning. A neurotoxin, lead exposure causes memory impairment and tactile dysfunction in adults, and severe intellectual impairment in children.

PRIMARY RISK: INFANT MORTALITY

Lack of clean drinking water and sanitary waste disposal results in pronounced increases in infant mortality rates. Nationally, the current infant mortality rate sits at 5.82 deaths per 1000 live births. Globally, regions with substandard water delivery and removal services display much higher rates. The highest global rate presently sits at 110.6 deaths per 1000 live births, but countries in this range suffer from massive systemic deficiencies in services and infrastructure across the board. Normalizing to countries with similar levels of medical services, infant mortality in underserved regions of the Southeast would rise to 10-12 deaths per 1000 live births, a 200% increase.

SECONDARY RISK: SCHOOL ATTRITION

A common consequence of infectious disease is not being able to leave the home. This creates a challenge, as schools require attendance. Given the current climate of strict attendance policies, students who miss too much class are often expelled. Even if they are not expelled, missing too much class can make it extremely difficult for a student to keep up when they return, increasing the likelihood that the student will give up and abandon their schooling.

Dropping out of high school is strongly correlated with a number of negative consequences. A high school dropout has a 1-in-10 change of being arrested for a felony. Beyond this, earning potential for high school dropouts is on average $7400 per year less than earning potential for high school graduates.

SECONDARY RISK: JOB LOSS

As with schools, employers require an employee to be present. When an employee is sick or disabled and unable to do so, they suffer lost wages. Too many absences usually results in termination of employment. Unemployment severely impacts financial health and is associated with a wide array of problematic social behaviors.

TERTIARY RISK: POVERTY

Poverty manifests a vicious cycle. Lower-income individuals are the most likely to live in underserved communities, and thus suffer the greatest risk of problematic health outcomes. This in turn results in lost wages and increased costs subsequent to medical care. Unfortunately, these individuals have the least ability to absorb unplanned expenses, pushing them further into poverty and further increasing their health exposure. This cycle is further exacerbated by wage loss and unemployment.

Poverty may be acute, occurring for a limited period of time, or generational, lasting across generations. The combination of adverse health with underemployment or unemployment dramatically increase the likelihood of generational poverty, which is associated with a number of cognitive dysfunctions, antisocial behaviors, and epigenetic impacts.

TERTIARY RISK: ECONOMIC LOSS

Damage to local and regional economies arises from interactions among multiple discrete sources. Health problems reduce both productivity and days able to work in affected individuals. Increased rates of dropping out of high school reduces the pool of skilled candidates and substantially reduces lifetime earning potential. Deaths due to disease and toxicity result in a complete removal from economic participation and create further economic strain on surviving family members.

As total economic productivity declines, spending power declines, businesses contract, and fewer jobs become available. Tax revenues decline, diminishing the efficacy of government and reducing the availability of additional services. This can feed into problems of poverty, making the consequences even worse.

TERTIARY RISK: POPULATION LOSS

As health and economic problems accumulate, people who have the ability to do so often leave the area in search of a better living situation. Such individuals are usually the most comparatively affluent and have the highest degree of employability. This creates brain drain and wealth drain, reducing opportunities for local economic development. It also reduces the tax base and further constricts the ability of the government to provide effective services.

TERTIARY RISK: INEQUALITY

While everyone suffers the same harms from the problems described here, minority communities make up a disproportionately high percentage of underserved rural regions and show a 10-15% greater poverty rate in these regions than the national average. Given this, they face a much greater exposure to these problems. As discussed above, individuals and families who are impoverished are least likely to be able to relocate, and so minority families are most likely to be functionally condemned to generational poverty within discrete geographic regions. While this is bad enough, it further creates geographic division between ethnic communities and causes further stratification of society.

SERCAP'S EFFORTS

To combat these challenges, SERCAP has engaged a number of different approaches over the last 50 years. Most are aimed at the root problem: lack of clean running water and sanitary wastewater management. In resolving these, each of the primary, secondary, and tertiary harms can be effectively reduced.

SERCAP's projects have generally taken on six general types:

NEW INFRASTRUCTURE PROJECTS

New infrastructure projects provide water and wastewater management to homes and communities that do not possess them. This is the historical core of SERCAP's services. These projects can involve direct funding and labor or can consist of technical assistance and consulting to local authorities. These projects include water services, wastewater services, or both. The current direction of work primarily involves installing water and wastewater lines to previously-unconnected homes and digging up-to-standard wells for homes and communities with no practical access to municipal distribution services.

MAINTENANCE PROJECTS

Maintenance projects keep existing infrastructure in good working order through upkeep and repair efforts. SERCAP is currently facing a consequence of its own success: more and more regions have up-to-standard services in place, so a greater percentage of projects are maintenance projects now than ever before. As every completed infrastructure project eventually will require maintenance, this is certain to continue into the foreseeable future.

SUSTAINABILITY PROJECTS

Sustainability projects have perhaps the most ambitious goal of all: enabling communities to become self-sufficient and effectively maintain their own services. There is some degree of overlap in sustainability efforts with both study projects and training projects, discussed below.

HOUSING PROJECTS

Housing projects consist of rehabilitation and rebuilding individual properties, as well as possible technical assistance in planning and financial advisory. They may also involve loans to low-income families for the construction, purchase, or servicing of a home. Rebuild & rehab projects often arise in the course of interacting with a local community while performing other non-housing projects. Housing projects do not have the population-wide reach that many other projects do. However, they typically have the deepest and most meaningful individual impact and foster goodwill within the community.

WORKFORCE DEVELOPMENT AND TRAINING PROJECTS

Training projects cultivate skills and knowledge in local service providers. This is an essential step towards self-sufficiency and facilitates optimization of services. They can also engage the local community to drive adoption of healthy practices. Training is an essential part of long-term sustainability and often crosses over with other projects.

STUDIES

Studies provide technical information to support future efforts. These can vary immensely in scope, encompassing feasibility, design, planning, and even public perception. While they are standalone projects, studies are often a critical initial stage in other infrastructure and sustainability projects.

COUNTERFACTUAL ASSESSMENT

SERCAP has been active since 1969, performing hundreds of projects which have touched millions of people directly or indirectly. And while it has a strong written record of what it has accomplished, to date there has never been an assessment of what the 7-state service region would look like absent SERCAP's efforts.

This report examines that question, looking at the consequences of the disappearance of SERCAP's efforts 1 year ago, 5 years ago, and 50 years ago. By examining what the Southeast region looks like in 2019 in each of these conditions and comparing to what the region actually looks like today, it is possible to determine exactly how effective and important SERCAP has been to the people of the region and to the country as a whole.

1 YEAR WITHOUT SERCAP

If SERCAP had ceased operations in 2018, the landscape in 2019 would appear similar to the present state. The relatively recent shift in priorities from new infrastructure to maintenance and sustainability efforts means that there would be few immediately visible effects. In total, approximately **50–60,000** individuals would be affected by lack of services, with mild to moderate effects on health outcomes, financial burden, and economic sustainability. In the year immediately following, there would be an additional **80–90** cases of preventable infectious disease resulting in **15–20** additional deaths. An additional **15–25** students would drop out of high school, with **1–3** felony arrests likely among them. Loss in economic activity from all causes would total **$3.5 million** in 2019, with a similar loss likely in all following years. These effects would be felt disproportionately within minority communities, primarily among African American populations in Virginia and the Carolinas. Cessation of 2018 operations represents:

- **$758,000** in lost infrastructure development affecting **48,717** individuals
- **$1,310,000** in lost maintenance affecting **309,902** individuals
- **$1,369,000** in lost sustainability efforts affecting **293,519** individuals
- **$1,312,000** in lost housing development affecting **5,027** individuals
- **$217,000** in lost training affecting **46,463** individuals
- **$339,665** in lost studies affecting **163,230** individuals
- approximately **96** counties would be affected in **7** states, the majority in Virginia and North Carolina

The **largest immediate impact would be from lack of service due to the loss of new infrastructure.** Loss of maintenance and sustainability efforts would cause some lack of service as well, as previously-constructed water and wastewater projects gradually break down.

One year is not sufficient time for this to have a large impact, but there would still be some sort of breakdown in **3–5%** of previously-completed projects, interrupting delivery of water and removal of wastewater. Unlike infrastructure loss, maintenance loss would be felt asymmetrically across the service region. Breakdowns would occur disproportionately in Virginia - as the longest-standing participant state with therefore the oldest infrastructure, infrastructure there requires the most upkeep effort.

Lost 2018 training and housing projects would show little impact in 2019. Both of these types of efforts are targeted at long-term sustainability and enablement, and loss of these would not show substantial impact between 2018 and 2019. Likewise, loss of studies aimed at facilitating future efforts would have little immediate consequence on the ground.

The most noticeable effects in 2018 would manifest in **health outcomes.** Clean water delivery and waste water disposal profoundly reduce both rates of infection and lethality of infectious diseases, so loss of these services causes significant health problems. In contrast, major economic consequences would not have time to manifest with a 1-year loss of services. The health impacts would cause a mild increase in the financial burden on families, owing to both an increased utilization of medical services as well as lost wages during periods of illness. While the gross burden would be comparatively small and spread among a relatively large population, it would also be concentrated in lower-income populations who are least able to absorb unplanned costs.

Immediate health impacts would appear slight. There would be an **uptick in the prevalence of several diseases, 30–45 additional cases in 2018, representing a 200–300% increase in the relative prevalence. Most notable would be increases in hepatitis A, giardia, campylobacteriosis, shigellosis, and E. coli infections.**

All of these diseases are quite infectious and would result in a wave of secondary infections, with total expected infections at 80-90 individuals. Perniciously, children are most susceptible to these conditions and face the highest mortality risk. Without the availability of sanitary water or waste disposal, the lethality of these diseases increases dramatically. **Between 10 and 15 of these infections would prove fatal, with 7 to 10 of the fatalities being children.**

Infant mortality would increase gradually throughout the year in the unserved regions. Current figures from the National Institutes of Health place the infant mortality rate at 5.82 deaths per 1000 live births in the United States. Births through January and February of 2018 in SERCAP's

former service region would hold to this rate, and would then progressively increase through October, finally arriving at an infant mortality rate of 9.7 to 9.9 deaths per 1000 live births. In the unserved population of 48,717 individuals, this amounts to an additional 2–3 perinatal fatalities per year.

In the longer term, health effects would begin to compound. The **greatest risk would come from nitrates, arsenic, and organophosphates in the soil, leaching into the groundwater. Again, children are the most susceptible to these risks, with a high vulnerability to developmental damage.** Arsenic is the greatest threat, with the United States having a high abundance of arsenic in the soil. As a neurotoxin, long-term exposure to arsenic in children is associated with decreased test scores, diminished vocabulary, and hyperactivity. This sort of damage would not manifest in 2018 or even in the immediately subsequent years but would factor into the long-term socioeconomic consequences.

These developmental outcomes would be exacerbated by nitrate and organophosphate exposure. Both cause developmental abnormalities, nitrates from hypoxia and organophosphates from neurotoxicity. Both classes of chemicals are major components of agricultural runoff, which is a major risk factor in SERCAP's main service areas. **Long-term, the cumulative exposure to these compounds would result in a 1–2 point decrease in average measured IQ, as well as causing significant social impairment.**

Even longer-term, arsenic and nitrate are known carcinogens, with particular impact on skin and bladder cancers. A mild increase in exposure would result in **additional 200–220 cancer diagnoses annually, mostly skin cancer, from 2028 onward, with 1–2 additional deaths each year thereafter.**

In addition to worsened health outcomes, there would be a number of problematic socioeconomic effects. Again, the immediate manifestation would not be profound, but the medium-to-long term effects would be highly consequential.

High school dropout rates would increase slightly due to illness-related truancy as well as cognitive decline. The current dropout rate sits at **6.1%** nationally. This would elevate to **6.7%** in the unserved region by the end of 2018, increasing to approximately **8%** by 2020 as health and cognitive effects accrue.

This amounts to an additional **15–25** students dropping out annually beyond the expected 60 for this population. Given the well-documented impact of dropping out of high school on earning potential, this amounts to **$6 million** in lost lifetime earnings every year. This also almost by definition results in an **15–25** additional individuals living below poverty level.

Using the estimated return values from Cutler & Miller's 2005 study of mid-20th-century infrastructure development, the **lost $758,000 in infrastructure projects extrapolates to $17,434,000 in lost lifetime economic activity solely from the lack of investment.** This estimate is quite low, however, as it is based on mid-20th-century data where a substantially smaller percentage of the population participated in the economy, as well as omitting actuarial valuation. Looking at deaths alone and using FDA actuarial valuation figures for economic value of a person, the lifetime economic loss is approximately **$134 million.** Assuming a 40-year generational cycle, this amounts to **$3.35 million** per year. In conjunction with the economic losses due to the increased prevalence of dropping out of high school, the overall 1-year loss in economic activity projects at approximately **$3.5 million.**

5 YEARS WITHOUT SERCAP

If SERCAP had ceased operations in 2014, the 7-state region would be noticeably different in 2019. A 5-year interruption would be long enough for lack of maintenance and sustainability efforts to meaningfully affect large numbers of people. Approximately **350,000** people would end up affected by lack of services. Adverse health outcomes would begin to accumulate and long-term problems would begin to manifest more meaningfully, creating adjacent social and economic impact. Throughout the 5-year period there would be **170** additional deaths arising from **1100** preventable cases of infectious disease. Cancer prevalence, developmental disorders, and infant mortality would all rise sharply. **140** students would drop out of high school, losing approximately **$1 million** in lifetime earning potential and leading to **13 to 15** felony arrests. Total lost economic activity would tally **$136 million** throughout the affected regions. Minority families throughout the service areas would experience a marked encroachment of poverty, and population growth in smaller affected counties would begin to slow.

Cessation of operations in 2014 represents:

- a cumulative **$3,569,000** in lost infrastructure development affecting **224,925** individuals
- **$6,165,000** in lost maintenance affecting **1,430,799** individuals
- **$6,439,000** in lost sustainability affecting **1,355,157** individuals
- **$6,165,000** in lost housing development affecting **23,212** individuals

- $1,023,000 in lost training affecting 214,519 individuals
- $1,597,000 in lost studies affecting 753,621 individuals
- approximately 120 counties would be affected in 7 states, the majority in Virginia, North Carolina, and South Carolina.

As with the 1-year effects, **loss of new infrastructure would be the greatest** contributor to all outcomes. Loss of maintenance and sustainability projects would begin to become a significant problem, however, and effects would start to manifest outside of Virginia. Virginia would suffer a major regression of services, with 30-35 previously-completed projects falling into disrepair. The remaining 6 states would lose functionality in 10-13 previously-completed projects.

What infrastructure and services remained would operate at decreased efficiency and see decreased utilization due to lack of training in both operators and end users. This would further compound health outcomes as well as scale of service provided, though carryover from training operations prior to 2014 would mitigate this some.

Lost housing efforts would affect nearly 7700 families to various degrees. Evictions and foreclosures would be the major observed consequences, further exacerbating poverty and income inequality in the affected counties.

Health outcomes would begin to manifest early in 2014. Infectious diseases would show a moderate initial increase in contagiousness and lethality. An initial wave of meningitis and hepatitis A would show the greatest prevalence and a moderate elevation in expected mortality rates, up to 3% an 1%, respectively. *Giardia* parasites and campylobacteriosis would accompany this. Though none are especially lethal, they would strain sanitation efforts and reduce immune resistance. In the wake of this, cholera, diphtheria, typhus, and bacterial meningitis would become more prevalent. Much more dangerous, mortality rates for these infections would range from 5-15%. The aggregate effect of infectious diseases over the 5-year period would amount to 1100 additional cases of infection, with 170 deaths resulting. Notably, many of these disease have been functionally eradicated in the States in 2019. Lack of basic sanitation, however, would allow for their return.

Increases in infant mortality would not be immediately evident but would begin to be noticeable

by March-April 2014. Through the rest of the year, the rate would climb from 5.8 to 9.9 deaths per 1000 live births. This trend would continue into June 2015, leveling off at approximately 11 deaths per 1000 live births. Given the birth rates through this time period and the affected population of 350,000 individuals, this would result in an additional 53 perinatal deaths in the span.

While not quite long enough for severe chronic impacts to manifest, the 5-year period would be sufficient for the emergence of developmental disability as well as some acute toxicity from exposure to chemical agents. **An additional 380 instances of developmental disability would emerge, largely manifesting as decreased intelligence, antisocial behavior, and possibly some degree of autism-spectrum disorders.** Affected adults would likewise suffer neurocognitive effects such as memory impairment, sensory abnormalities, and inappropriate social affect. Acute toxicity would result in 13 deaths from exposure to heavy metals and/or organic compounds.

Drinking water contamination by arsenic and nitrates would facilitate the development of cancers. While the 5-year period is not long enough for the full scale to become clear, there would still be an additional 140 diagnosed cancers, leading to 4 additional cancer deaths. Both the prevalence and mortality rate would continue to increase beyond 2019, plateauing in 2024-2025, at an additional 15 cancer deaths per year.

As has been discussed previously, adverse health outcomes aggregate and compound to create socioeconomic strain. Increased prevalence of disease and disability results in a decrease in the number of ambulatory days for an individual. In the case of students, this would result in an additional 140 to 180 students dropping out of high school from both truancy-based expulsions and difficulty keeping up as a result of absences. This would in turn result in an additional **13-15 felony arrests**, and $**8.2 million in lost earnings over the 5-year period. Lifetime lost earning potential would amount to $41.1 million.**

The total impact due to the loss of SERCAP's efforts, as a consequence of lost earning potential, lost wages, unemployment, and death, would amount to $135.2 million in lost economic activity over the 5-year period, with a lifetime value of $1.9 billion dollars. This in turn results in $3.1 to $3.5 million in lost tax revenue annually, straining municipal services and diminish the availability of government support.

Poverty rates in the affected populations would rise to 15-18% overall, and 30-33% for minority communities. Generational poverty would not have time to become strongly entrenched by 2019, but the groundwork for such an outcome would be laid. Rates of child abuse would rise slightly, from 5% to 5.5-6%. Rate of spousal abuse would increase as well, from 1.3% to approximately 2%.

Loss of housing services and assistance would affect 7,692 families in the 7-state region. The overwhelming majority of this would be loss of loan programs and loss of financial counseling. Both would have an adverse impact on home ownership and foreclosure rates. Approximately 540 families would suffer foreclosure, and 2300 would face eviction.

African American families would be the hardest hit by all of these outcomes, followed closely by Hispanic and Native American families. Being disproportionately impacted by both medical and economic problems would result in further social disenfranchisement and barriers to participation. Communities would suffer and iso

As life becomes more challenging in the affected regions, a slow emigration would begin. Brain drain and wealth drain would start to become problems, as those of means would start relocating to better locales. Population growth would slow in towns and counties suffering the greatest loss of services. It would not achieve genuine population contraction by 2019, but unchecked, smaller counties would face that eventuality by 2028.

50 YEARS WITHOUT SERCAP

If SERCAP had never existed, the landscape of the Southeastern United States would not be recognizable in 2019. **3.1 million** individuals in total would be affected by substandard water infrastructure, with nearly **2 million** lacking modern-standard water services. Total lack of services and support for these individual would immediately manifest in declining health outcomes, which would rapidly propagate to major social and economic malaise. Over the following 50 years, there would be:

- an additional **220,000** cases of disease resulting in **14,350** deaths.
- Chronic exposure to toxic compounds would cause **1100** deaths and result in **6700** cases of developmental disorders and birth defects.
- The trickle-down impact from this massive increase in mortality would be far-reaching, entrenching poverty and further straining communities due to lack of tax revenue.
- An additional **29,000** students would drop out of high school, leading to approximately **3000** felony arrests.
- A total of **$131 billion** in aggregate economic activity would be lost.
- Poverty becomes the norm in underserved counties, and while total population growth is largely unaffected, there is a major redistribution of population throughout the Southeast.

A complete absence of SERCAP's efforts represents:

- a cumulative **$285,100,000** in lost infrastructure development affecting approximately **2 million** individuals
- **$73,370,000** in lost maintenance investment
- **$83,100,000** in lost sustainability investment
- **$26,600,000** in lost housing development
- **$24,200,000** in lost training investment
- **$27,200,000** in lost studies
- approximately **160** counties would be affected across 7 states

The complete erasure of all of SERCAP's efforts since 1969 would be catastrophic. Lack of basic water delivery and sanitation would amplify the

rate of multiple infectious diseases **200–350%** relative to today, manifesting in **90,000** additional cases in the 50-year span. This would in turn result in **12,500** preventable deaths. Being the most vulnerable to these types of infections, children would make up **8,700 to 9,500** of these deaths.

Infant mortality in affected counties would sit well above the national rate of 5.82 deaths per 1000 live births. This rate would rise as high as **13** deaths per **1000** live births in the worst-affected regions, and average between 11 and 12 deaths per 1,000 live births in underserved regions of the Southeast United States. Over the span from 1969 to 2019, this represents an additional **2,200** perinatal deaths.

Medical issues due to chronic exposure to toxins would be rampant. Contamination of drinking water by arsenic, nitrates, and organophosphates in the soil would result in 1100 additional deaths, and 6500 instances of developmental disorders and birth defects in young children. Given the known cognitive issues in adults arising from exposure to these toxins, there would be a worsening of social and economic consequences arising from memory loss, depression, anxiety, and hostile behavior.

Toxin exposure would also increase rates of skin, bladder, and colon cancer. In the affected population of 2 million, there would be an additional 130,000 cases diagnosed, leading to 1,850 additional deaths.

The total additional mortality would be massive. The 17,650 deaths account for nearly 1% of the population in the affected areas (0.88%). The overall burden would strain regional health systems, likely worsening the outcomes even further than reported here, which in turn would exacerbate all subsequent impacts.

The trickle-down from health and medical outcomes would create widespread socioeconomic effects. High schools would see a substantially greater rate of dropouts, owing to illness-related absences, cognitive decline, and anti-social behavior. **Overall dropout rate in underserved regions would approach 10%, leading to an additional 29,315 dropouts. This amounts to $8.5 billion in lost lifetime earnings and leads to an additional 2,900-3,000 felony arrests**.

Accounting for lost earning potential, lost wages due to illness, decreased investment from lack of funds, and fatalities, **the loss of SERCAP's efforts results in a $139 billion reduction in economic**

activity over 50 years, amounting to $2.8 billion annually. The ripple effects from this are wide-ranging. Annual tax revenues fall by **$65–80 million** annually, causing a reducing of municipal services. Businesses close and wages fall. Poverty rates in the affected regions stand at **25–30%,** and **40–45%** for minority communities.

35,817 families would be affected by lack of housing services. Lack of loan availability and financial counseling result in approximately 2,500 families suffering foreclosure on their homes, and 7,000 to 10,000 families being evicted. Bankruptcy filings would paradoxically remain relatively stable, but largely because the associated legal fees in making such filings would be too expensive. Instead, debt would continue to accumulate, further burying affected families.

In this economic landscape, **generational poverty, defined as having been in poverty for 2 or more generations, would become rampant. While the current national rate of generational poverty is 3.5%, this would become 6% in the 7-state service region and approaches 20% in directly-affected counties.** This would initially occur as a consequence of the economic effects described above but would rapidly become self-perpetuating. Household living in poverty show significantly greater rates of child mistreatment and spousal abuse, as much as doubling the relative prevalence in the population as a whole. These in turn are known to result in depression, learned helplessness, and epigenetic dysregulation, all of which make escaping poverty substantially less likely. With each passing year without adequate water and housing assistance, poverty would entrench further and further throughout the region.

All of these effects would be disproportionately felt by minority populations, **primarily African Americans and Hispanic communities**. Underserved rural areas show a **5–15%** greater minority presence than regional averages, and minority populations show a **10–15%** greater rate of poverty national averages. The initial health impacts would be more prevalent in minority communities, and these communities have on average less financial ability to cope with these impacts and the subsequent economic effects. African American, Hispanic, and Native American communities throughout the Southeast would fall even further behind national averages with little chance of recovery.

Substantial **expanses of Virginia end up as functional ghost towns**. Alleghany, Amelia, Appomattox, Bath, Bland, Brunswick, Buckingham, Charles City, Craig, Cumberland, Dickenson, Essex, Floyd, Giles, Grayson, Greene, Greensville, Highland, King and Queen, King William, Lancaster, Lunenburg, Madison, Mathews, Middlesex, Nelson, Northampton, Northumberland, Nottoway, Patrick, Rappahannock, Richmond, Southampton, and Surry counties all suffer massive population contraction as those who are able to move away. Those who remain are those with the least means, resulting in a spiraling loss of municipal services as tax revenue falls. Poverty rates within these communities approach 60%.

This trend unfolds more slowly in adjacent states, most prominently in North and South Carolina. The Carolinas lag behind Virginia 10 to 15 years in manifesting this county contraction but do eventually face it and all of the subsequent effects. North Carolina sees it occur in Alleghany, Avery, Bertie, Camden, Chowan, Clay, Gates, Graham, Hyde, Jones, Mitchell, Pamlico, Perquimans, Swain, Tyrrell, Washington, and Yancey counties, while South Carolina sees it in Allendale, Bamberg, Calhoun, Hampton, Lee, and McCormick counties. Atypical population dynamics mute this effect in Delaware, Maryland, and Georgia. As a latecomer to the region, Florida does not suffer enough infrastructure loss to drive this level of contraction by 2019.

This population relocation has national consequences, as congressional districts are redrawn subsequent to the census. Representation is further concentrated around urban areas, both diminishing the influence of rural areas and diluting the vote strength of individuals who relocate. As counties contract, so do the towns within them. While there is some population loss due to mortality, as discussed previously, the greatest contributing source is emigration. Minimum viable population for a township is approximately 140 individuals. Above 140 inhabitants a town should have a detectable growth rate, however small. Below this, however, growth rate becomes negative and a town eventually becomes functionally extinct. The first extinctions start occurring in the early 1980's and continue through 2019. In total, 30–50 small towns are lost in Virginia alone.

Beyond economic impact, small rural communities represent a form of cultural memory that does not exist in cities or suburbs. Arthur Morgan, original chairman of the Tennessee Valley Authority, maintained that small rural communities formed the basis of national culture, and the very roots of civilization are found within these communities. As small towns contract and disappear, unique and irreplaceable elements of the national identity disappear with them.

CONCLUSIONS

In examining the landscape in the absence of SERCAP's efforts, the critical importance of these efforts becomes clear. Looking at the 1-year, 5-year, and 50-year impacts from a different angle, it is readily apparent the degree to which SERCAP has supported the Southeast United States and the people who live there.

In 2018, SERCAP's efforts:

- prevented **85** cases of infectious disease such as hepatitis, meningitis, and typhus
- prevented **17** deaths from diseases and infant mortality
- prevented **2,000** cases of cancer over the next 20 years
- prevented **15** cancer deaths over the next 20 years
- kept **20** high school students from dropping out
- prevented **2** felony arrests
- created **$3.5 million** in economic activity
- positioned the service region to receive **$134 million** in economic benefit over 40 years

Since 2014, SERCAP's efforts:

- prevented **1,100** cases of infectious disease such as hepatitis, meningitis, and typhus
- prevented **170** deaths from diseases and infant mortality
- prevented **140** cases of cancer
- prevented **4** cancer deaths
- kept **140** high school students from dropping out
- prevented **13** felony arrests
- created **$135 million** in economic activity
- positioned the service region to receive **$1.9 billion** in economic benefit over 40 years

Since 1969, SERCAP's efforts:

- prevented **90,000** cases of infectious disease such as hepatitis, meningitis, and typhus
- prevented **12,500** deaths from infectious diseases
- prevented **2,200** infant mortalities
- prevented **130,000** cases of cancer
- prevented **1,850** cancer deaths
- prevented **1,100** deaths from exposure to metallic and/or organic toxins
- prevented **6,700** instances of developmental disorders and birth defects
- kept **29,104** high school students from dropping out
- prevented **2,900** felony arrests
- created **$131 billion** in economic activity over 50 years

This level of impact is astounding. It demonstrates how effective upstream interventions can be when the right starting point is selected. Drinking and waste water feed into health outcomes, which feed into education and employment outcomes, which feed into financial well-being outcomes, which feed into community outcomes, which feed into regional and national outcomes. Providing for the most basic human need has, intentionally or not, positioned SERCAP to exert disproportionate influence in creating generalized social good.

Perhaps more astounding is how much SERCAP has been able to accomplish with so little. When taking inflation into account, SERCAP is currently at its lowest level of funding since 1971. Adjusted funding peaked between 1980 and 1983, and it has declined since then. This decline appears to be tapering off since 2013, but extrapolation of the trend does not suggest a natural rebound without intervention of some sort.

This trend must be countermanded as quickly as possible. Given the magnitude and scope of leverage SERCAP is able to exert through its core mission, interruption or reduction of services would be a major blow to the region. Efforts should be undertaken to actively engage members of congress from the 7-state region to stabilize or increase funding levels for the next 5–10 years. Ideally, efforts to create a sustainable endowment should also be pursued.

It is a testament to the commitment and belief of SERCAP's members and community partners that it has been able to be so effective through the last decade despite this decrease in available funding. It is notable that SERCAP has radically improved its cost-effectiveness over the course of its 50-year history. While the original funding for the Demonstration Water Project (DWP) and

the subsequent Virginia Water Project (VWP) amounted to substantially more money in inflation-adjusted 2019 dollars, SERCAP has increased the number of executed projects, number of served communities, and number of impacted individuals by orders of magnitude in the decades since.

In its initial years of operation, the DWP and VWP averaged more than $100 spent per individual served. Since the turn of the century, SERCAP is averaging $6.71 in investment for each individual served. This does not indicate a decrease in services; indeed, SERCAP's scope of projects has remained remarkably high over the last 20 years. Instead it indicates phenomenal operational efficiency. SERCAP is reaching more people with less money, by leveraging experience and community trust.

Given the magnitude of financial impact SERCAP is able to achieve, taken in conjunction with its trusted position in the community, it merits exploration as to whether it may be beneficial to perform a pivot or rebrand to emphasize the economic and public good aspects of SERCAP's mission. Indeed, the organization is exceptionally well-positioned to be a regional intermediary for social justice. Congress and the public do not generally perceive clean drinking water as a problem of the United States, and as such are more inclined to be dismissive of pleas for funding or attention. A shift in emphasis could recover much of this perception and ease funding efforts without requiring any change in SERCAP's core mission.

What Life is Like, Thanks to 50 Years of Clean Water, Working Sanitation Systems, and Safe and Affordable Housing

The Lewin Family- March 2018

Marianne Lewin still lives in Washington County, North Carolina, outside of Plymouth township off NC-45, and she doesn't plan to leave. It's her home, her family's home, and their house has never served them better.

In 2012, a SERCAP project extended the water and sewer mains from downtown Plymouth to the outlying surrounding areas, promising a reliable and clean water supply while also eliminating the need for their septic tank. For all the promising talk, Marianne was hesitant about the plan at first – her grandfather built the well and piping that supplied their home, and it had served them well for decades. She was resistant when she learned that she would have to pay monthly for water service she had been getting for free. She was outright hostile when word came that the county would be charging her to connect the pipes.

In the end, concern about the well-being of her then-11-year-old son won out. His eyes had been yellow and his skin sickly for a month, and

As part of the initial project, SERCAP arranged for financing for the connection fee, as well as financial counseling for making payments. It was more than she would have liked to have paid at the time, but the loan has long-since been paid off, and Marianne now has a credit rating – and a very good one, at that. The financial counseling also helped her manage the monthly payments more easily than she expected. Today, the water bill receives no more attention than the electric bill of the property tax assessment.

Six months after the water lines were connected, Marianne noticed the pain in her joints lessening slightly. The improvement continued for well over a year. Now her days confined to bed have been fewer and fewer, and her heart is as healthy as it's ever been. Most days she makes it in to work at the Domtar mill without any trouble. It's not an easy life – there could always be more money, and

she's a step slower than she feels like she should be – but she knows she made the right choice for herself and her son.

Alvin is a healthy and hale 5'10, too short for the halfhearted basketball dream he's always nursed but not undone or upset by that. He's finishing up his junior year at Washington County High School and is looking forward to starting the fall semester and his senior year. He works weekends at the local NAPA Auto Parts store - not a dream job, but well-paying by 17-year-old standards. It's even let him accumulate a small amount of savings. He's about to take the ACT in April and is thinking about enrolling at Beaufort County Community College after he graduates. If he scores well enough on the ACT and can save enough money through the summer, he might even look at ECU.

METHODOLOGY & DATA

EXTRAPOLATION OF HISTORICAL SERVICE

Due to multiple changes of location, as well as a building fire in the 1990's, SERCAP's records of projects & financials are substantially incomplete. It is therefore impossible to conduct a wholly fact-based analysis of past efforts and was necessary to reconstruct the historical impact as accurately as possible. Reasonably complete records are available for most of the 21st century. These were combines with known data points extracted from annual reports, historical documents, IRS filings, and personal interviews with longstanding SERCAP employees, in order to interpolate the missing records and determine total historical impact.

Known data points were regressed annually back through 1969. Data points included total funding, inflation-adjusted funding, percentage allocation to individual states, and percentage allocation to different project types. Project types included new infrastructure, infrastructure maintenance, sustainability efforts, studies, and training.

The best overall indicator of efforts was inflation-adjusted dollars. This accounted for most major observations, particularly the scaling subsequent to the 1979 incorporation of additional regions, as well as allowing for direct comparisons across time periods. The best-fitting model, both mathematically and logically, was determined to be the following 4th-order polynomial:

$$y = -27.0111533935851x^4 + 216452.826383023x^3 - 650433042.46077x^2 + 868654700799.92x - 435021379993773$$

where y is total operating budget in 2019 dollars and x is the year. This resulted in a correlation coefficient of 0.939, indicating an exceptionally good fit.

Unless otherwise indicated, all dollar values are presented as inflation-adjusted to 2019 dollars. This model was used in conjunction with historical population data to extrapolate the scope and scale of SERCAP service projects over the years.

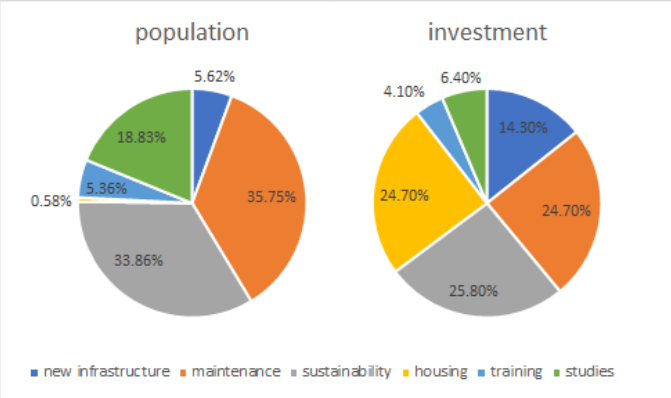
SERVICE PROJECTS

Once SERCAP's service history had been modeled, scope of service projects was analyzed to determine areas and magnitudes of impact. SERCAP projects can be classified into several types:

- ***New infrastructure*** projects provide service where none existed previously. This is the historical core of SERCAP's services. New infrastructure can include both water and wastewater services, and at this point in time largely consist of installing water and wastewater lines to previously-unconnected homes. It can also include digging of new up-to-standard wells for homes and communities with no practical access to municipal services.
- ***Maintenance*** projects involve upkeep and repair of existing infrastructure, so that service is not diminished or lost. As a consequence of its own success, a greater percentage of projects are now maintenance projects than ever before. This trend is expected to continue, as every completed infrastructure project immediately becomes a potential site of future maintenance.
- ***Sustainability*** projects aim at enabling communities to effectively maintain their own services and become self-sufficient. There is some crossover here with both study projects and training projects.
- ***Housing*** projects consist of rehabilitation and rebuilding individual properties, as well as possible technical assistance in planning. They often arise in the course of interacting with a local community while performing other non-housing projects. Housing projects tend to affect primarily single homes, and as such do not have the population-wide reach that many other projects do. However, they typically have the deepest and most meaningful individual impact.
- ***Training*** projects aim to educate and develop skills in local service providers, maximizing their performance and reducing the need for follow-up actions by SERCAP. As mentioned previously, training projects frequently support long-term sustainability and can cross over with these types of projects.
- ***Studies*** provide informational groundwork for subsequent projects. These can vary immensely in scope, encompassing feasibility, design, planning, and even public perception. While standalone projects, studies are often a critical initial stage in infrastructure and sustainability projects.

The relative percentages of each of these types of projects can be described either as a function of population served or as a function of total investment. Some notable differences appear when plotting these next to each other:

The most prominent discrepancy is the relative contribution of housing efforts. Relative to the number of individuals affected, housing projects make up only 0.58% of SERCAP efforts, but account for 24.70% of the total financial investment. This is reflected in the dollars spent per individual served calculation: while typical project investment is $6.71 per individual, housing projects average $8443.61 per individual served, more than a thousand-fold greater than the overall average.



This comparison show studies and maintenance projects to be the most cost-effective types of projects. Maintenance projects make up 24.70% of the total investment while accounting for 35.75% of individuals served, while studies make up 6.40% and 18.83% of individuals served and investments, respectively.

New infrastructure projects do not appear to be a high-ROI at this point in time. They make up 14.3% of total investment while only accounting for 5.62% of individuals served. This is most likely a consequence of SERCAP's own success. As more and more new infrastructure projects have been completed, the remaining needed projects tend to be in the most difficult-to-service areas. Fewer infrastructure projects will be required going forward, while the comparative cost of those that are necessary will only increase.

SCALE

Historical data points indicate that SERCAP projects reach 20-30% of counties within a state through efforts in the 21st century. There is substantial correlation between served counties and both low income and minority population. Overall, there is an average $22,099 investment per project, affecting 660 individuals directly and 3293 individuals total including adjacency and spillover.

HEALTH IMPACT

NIH and Center for Disease Control (CDC) values were used to calculate morbidity and mortality of given conditions.

ECONOMIC IMPACT

In calculating economic impact due to lost life, Food & Drug Administration (FDA) actuarial tables were used. Department of Education figures were used in evaluating school enrollment and consequences of dropping out.

PROJECT MAKEUP IN THE 20TH CENTURY

New infrastructure

- $18,043 per project
- $1225.64 per individual served
- $28,067 per county

Maintenance

- $16,820 per project
- $66.25 per individual served
- $25,726 per county

Sustainability

- $16,951 per project
- $31.24 per individual served
- $32,692 per county

Housing

- $87,175 per project
- $42,117.36 per individual served
- $145,292 per county

Training

- $35,902 per project
- $25.27 per individual served
- $35,902 per county

Studies

- $18,767 per project
- $82.76 per individual served
- $18,767 per county

Total

- $22,099 per project
- $33.47 per individual served
- $55,248 per county

347 Campbell Ave, SW

Roanoke, VA 24016

sercap.org

540.345.1184

50 Years of Water