

Water Crisis of 2030: Digests
 Alternative Future Project
 EGRS/EVST 373, Spring 2016

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2018- Feasibility Study of Residential Greywater systems in California

AECOM

Department of Water Resource Engineering

Los Angeles, California

Memorandum

To: Madeline Harro, Governor of California
 From: Julie Vuotto, Water Infrastructure Advisor, PE
 Date: April 8, 2018
 Subject: Feasibility Study of Residential Greywater systems in California.

Drought conditions, pollution, waste, over-draw, and population increase has made freshwater scarce over the last decade. We are now living in a world where conservation and reuse practices must be implemented in order to survive as a species in the future. In 2016, fresh water was used in many aspects of our lives, whether we realized it or not (perhaps why we took it for granted). The residents of the California have a responsibility to the United States to work to reduce their water use of the already stressed freshwater system before it collapses.

Water served as a luxury in the 19th century, i.e. long showers, green lawns, recreational swimming pools, etc.. Suggested solutions for handling this issue include greywater reuse, new sources of freshwater (from saltwater, lake water, air), shrinking the agricultural industry and implementing policies and regulations on trade. This report aims to assess the feasibility of greywater recycling systems for residential use by the state of California.

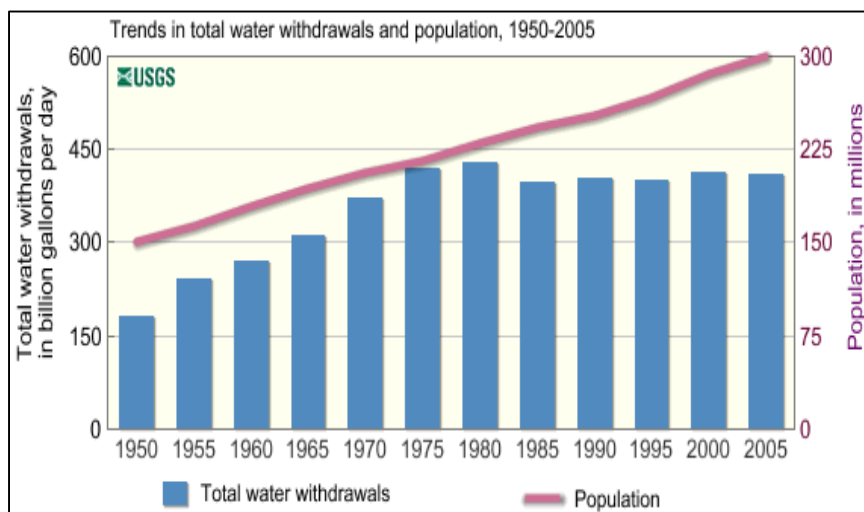


Figure 1: Population and Water Use Correlation (USGS)

Traditionally, freshwater has been extracted from the ground's natural aquifers through the use of wells. Wells were used to pump up safe drinking water by hand, and were mostly present on a household scale. As public health was linked to water quality, purification and filtration systems were implemented. Local governments began coordinating the collection and treatment of drinking water from reservoirs: freshwater basins, in-ground aquifers, rivers, and wells

making it safe and easily assessable for all American citizens. In areas where demand outweighed the supply from groundwater or rivers, such as large suburban developments, water towers produced a cheap “reservoir” solution.

Residentially, water had been readily available for drinking, plumbing, cleaning, heating and cooling, and lawn maintenance. USGS conducted water consumption surveys every five years and in 2005 the survey concluded that California drew the most groundwater (Figure 2), which has left the state in a decade long drought. These past practices indicate a shift in water reuse thinking is needed.

To put residential water consumption at ease and to efficiently use appropriate amounts of freshwater, it would be beneficial to implement greywater-recycling systems in suburban homes. Greywater is defined as the “gently used” water from sinks, showers, and washing machines. Greywater has always been produced and wasted in abundance in suburban, California homes, providing a solid solution to alleviating residential water demand.

According to an old case study of a cost-benefit analysis of greywater system

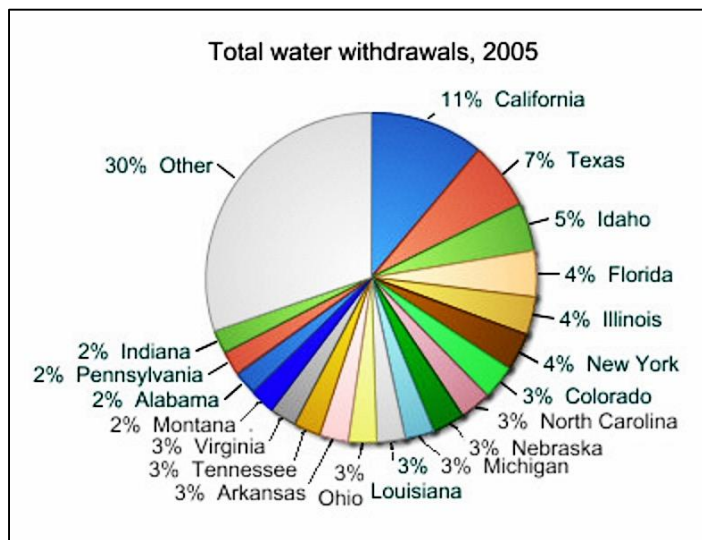


Figure 2: U.S. Water Distribution in 2005 (USGS)

implementation in Los Angeles, cities can reduce water consumption by 27% for single-family homes and by 38% for multifamily living (Yu, 2013) by converting to greywater recycling practices. Building codes and plumbing systems were altered for the study to divert greywater for reuse, and over 4000 MWh/year (megawatt hours per year) of water related energy use was reduced, at only 1% population participation of the study. Economic incentives for the alteration of building codes include providing rebates and low to zero interest.

The first implementation of

greywater can require no infrastructure change at all.

The simplest way to reuse greywater for irrigation is to collect “warm-up” water (the water that is wasted when waiting for water to reach a certain temperature) and in buckets. It is also possible to “bucket flush” toilets with the water collected from showers. By promoting the use of natural shampoos and soaps, this greywater will contain less oils and chemical contaminants than cleaners with high salt content.

However, by installing gravity pipe system networks households can recycle shower and laundry water in a cost effective method. Collecting shower water with gravity based pipe networks eliminates the need for pump, which is both cost-effective and simple. Drainage pipes can branch out to root zones of trees and plants, and requires minimal maintenance in the long run (Greywater Action). It is also possible to collect water from washing machines through “laundry drums”; a system that pumps laundry water into storage to be used for irrigation. This is the cheapest and easiest system to install (Greywater Action). Another “laundry-to-landscape” technique attaches the washing machine draining hose to an irrigation system. An example of this is illustrated in Figure 3. It is important to note that water from kitchen sinks are high in grease due to food content, and are not allowed under many greywater codes (Greywater Action). Water filled with organic components can clog pipe systems. The organic matter that enters these systems, however, can be decomposed with the use of mulch basins.

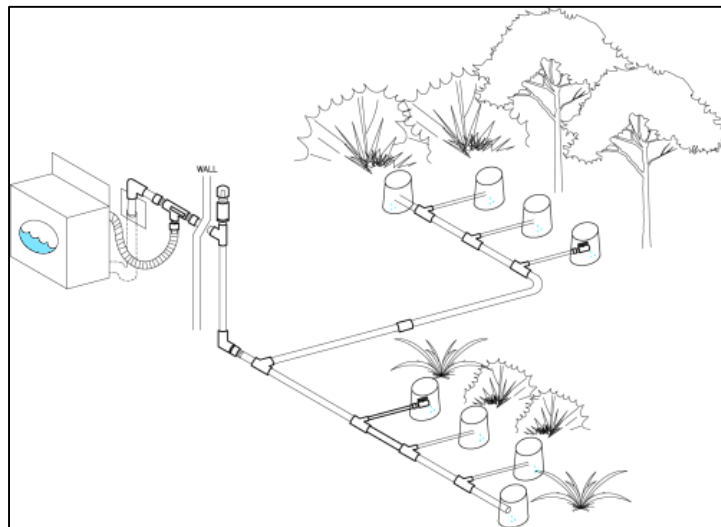


Figure 3: Landry-to-Landscape Irrigation Technique (Greywater Action)

Implementing these greywater systems will result in efficient use of the scare water supply of today. These systems are cost-effective and provide environmental benefits. AECOM suggests California to create building codes for installation of these greywater systems.

Works Cited

"Greywater Reuse." *Greywater Action*. American Rain Catchment Systems Association.

Web. 05 Apr. 2016. < <http://greywateraction.org/greywater-system-examples/>

Figures 1 and 2:

"Total Water Use in the United States, 2010." *The USGS Water Science School*. USGS, 2 Dec.

2015. Web. 04 Apr. 2016. <<http://water.usgs.gov/edu/wateruse-total.html>>

2022- McGyver's Guide to Living with Residential Greywater systems

Dear Diary,

April 6, 2022

We got a visit from our “friendly” County Water Commissioner again this week. He came to give his typical “We are all in this together” speech about being good water stewards. It’s no mistake he makes his routine visits to our residence because it’s no secret our family uses more than our monthly allotted share of water. Just like it is no secret Mr. Drummer commissions a county that ends up above its limits more often than not, which makes him look bad to the state commissioner. All the words he uses are those of suggestion and motivation, but the tone expresses nothing more than “do this or I shut your water off.”

Every week I give him a sweet smile and nod in agreement, saying, “Of course, Mr. Drummer. Every citizen has the responsibility to contribute to this new water world in a positive way.” This statement irks his entire body because he knows that I mean my family’s contribution will not come from using less water.

If all my family tried to accomplish was reducing the amount of water we use, we would be the star citizens of Western Run County. We converted our lawn to a desert landscape and ditched our moderate swimming pool long before the regulations required it in 2021. My husband, Zack, and I have a combined shower time of 3 minutes, and we invented a biofilter system that allows us to shower in the water used for Reagan’s, our five year old son, bath! We side skirted the need for any water use in food preparation by organically growing all our fresh fruits and vegetables in our backyard.

Considering the list displaying our strong commitment to reusing and reducing our use of the water, the world’s most precious resource (that still feels strange to say), you might be wondering how are family goes over our monthly allotment. Well, Zack and I have committed this past year to reinventing or improving the grey water system the state of California set up for us. Our research, such as the biofilter, allows us to test the implementation of different filters and water routes to best reuse water to the point where homes could cut their freshwater supply need by 60% compared to the state’s 38% reduction, and we are close to having a fully functioning system!

Mr. Drummer also never forgets to remind us that any change to the state issued grey water system and participating in trading of water allotments are federal offenses punishable by

up to five years in prison each. I can't blame the government for wanting to deter wrongdoers from tinkering with their system to allow them to use more water or get higher water pressure, or from preventing water gangs from forming if trading of water allotments was allowed. We decided to ignore these rules when we used our grey water system for the first time and realized, in typical state government fashion, they'd installed the lowest-budget, lowest-quality system they could afford the patent to. With Zack's plumbing knowledge from growing up in a family plumbing business and my background in civil engineering, we decided we could design a more efficient system.

We surpassed the theoretical max of the state's system with just a few minor tweaks, and then we got addicted to seeing how much better we could make it. With the beginning of the research we realized we had to use a fair amount of water in order to test the systems. When we realized we couldn't go over our water allotment more than about 5-10 gallons without serious repercussions, we decided to go to our neighbors and ask to buy their excess water allotment. We obviously selected the neighbors we asked conservatively because proposing something illegal, didn't always earn you "neighbor of the year."

Until next time,

Aliza Furneaux

Dear Diary,

April 8, 2023

It's sunny days like these that make me nostalgic. I can still remember growing up in a world where relaxation and vacation were associated with water. Can you believe we used to have swimming pools and water parks? Although, there was nothing better than laying by the pool with my sister during long hot summers. We'd sit out under the scorching sun until we couldn't take the heat anymore and our skin tingled. We would run across the burning sidewalk and plunge into the chilly pool. I could swim for hours, diving for pennies we threw in for one another, doing handstands in the shallow end, and judging one another's dives into the deep end. It's hard to remember how families all over California had swimming pools full of freshwater to

use for luxury, and not feel guilty that we didn't do a little bit more to reduce our use of water back then in anticipation for the future.

The government never considered reduce and reuse water movements as legitimate because we never considered water a precious resource. It seems counterintuitive to us now, how could you not consider a commodity essential for life and in limited supply a precious resource? When I was in college in 2016, debates squabbled over the price of oil, natural gas, coal, and how renewable energy would never take off without being cost competitive. We cried out for renewable energy with less carbon dioxide emissions to save the planet before it's too late, but we never thought about the price of the rising commodity, the commodity used in almost all other energy production methods, WATER. Even environmental movements like "Take back the tap" encouraged the reduction in use of plastic, but lacked a water conscious focus.

How had we been so oblivious to the security of the future? Looking at Reagan I can't imagine how we ever were so careless and thoughtless of polluting a once abundant supply of water. I know it might be silly, but if we had cried out for stricter regulations to protect our water quality and were conscious of the water we were using, Reagan might be able to experience a swimming pool or even soda!

When the ban on any beverages using more than 50% water was implemented in 2030, I've never seen an American culture die so quickly. Soda or pop or whatever you called it depending on your region, was an American staple, but now there are generations that will never even know what soda pop is.

Dreaming of soda,

Aliza Furneaux

2026- 20 Things You Would Only Remember if You Grew Up Before the 2020 Water Crisis

Dear Diary,

April 10, 2026

In between dumping chlorine into our greywater storage tanks and hanging up the laundry on our clothesline, I was scrolling the Internet for some recipes. I ended up chatting with an old high school friend, Aliza, about how our kids are doing in school. She was explaining that her son Reagan was upset because his teacher stopped giving out juice boxes to the class during recess. It turns out that the district budget would not allow for the purchasing and distribution of any juice beverage because of the high water content. Poor Reagan!

As we were chatting, she sent me the funniest BuzzFeed article. I was laughing out loud through the whole thing! BuzzFeed never fails to hit the nail on the head. Life before the late 2010s, when water was readily available, was such a carefree time. It is so hard to think about living that way, now!

(Theme and images taken from www.Buzzfeed.com)

BuzzFeed Life



20 Things You Would Only Remember if You Grew Up Before the 2020 Water Crisis

1. Your showers were legally allowed to be more than 4 minutes.



2. Lawns? Green? Grass?



3. Your friends had pools that you could swim in during the summer.



4. And don't forget water parks!



5. You could purchase fountain drinks at restaurants and supermarkets.

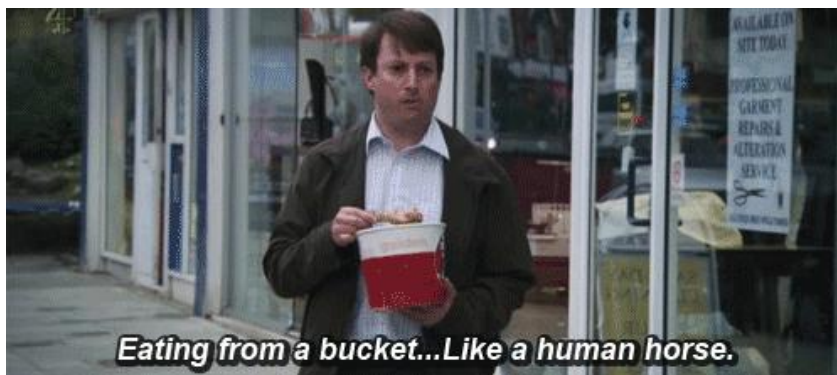
me: *doesn't drink soda because it's unhealthy*

me: *drinks alcohol*

6. You didn't have to wait for fruits to be in season!



7. There weren't buckets covering every inch of your house to collect as much water as possible.



8. You were able to do laundry more than once a month.



9. Ocean water was for the fish (you also couldn't even IMAGINE drinking it).



10. Your house didn't reek of chlorine because of your greywater storage tanks



11. You also thought greywater literally meant “grey” water



12. You had smelly soaps and shampoos full of salts and chemicals that could go down the drain legally.



13. The nasty County Water Commissioner didn't knock on your door every week to keep your water use in check.



14. Rain used to ruin your outdoor plans, but now it causes sheer joy.



15. Fountains were beautiful touches to landscapes.



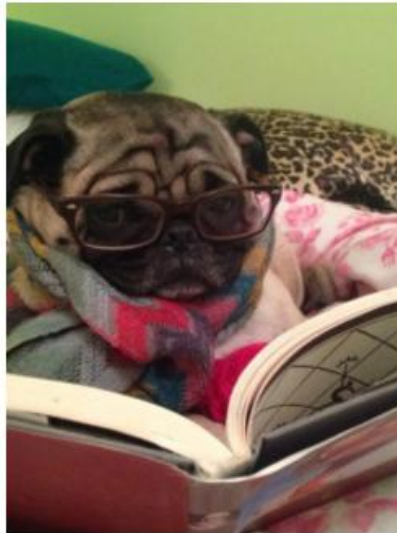
16. Now, everything is just brown.



17. LOL when sports used to be played on REAL grass.



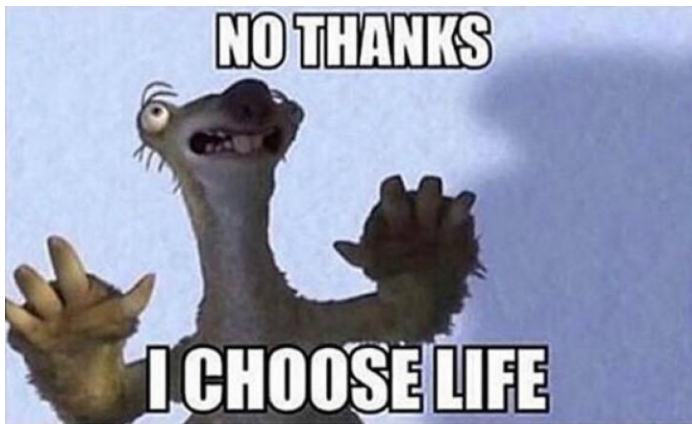
18. And you could flush a toilet whenever you wanted.



19. You could find water fountains at schools and on playgrounds.



20. Finally, you didn't even have to worry about preserving a life necessity.



2030- Proposed Water Resource Infrastructure Overhaul for the United States

AECOM
Department of Water Resource Engineering
Los Angeles, California

Memorandum

To: Benjamin Cohen, Chair of the Council on Environmental Quality
From: Aliza Furneaux, Water Infrastructure Advisor, PE
Date: April 8, 2030
Subject: Proposed Water Resource Infrastructure Overhaul for the United States

INTRODUCTION

AECOM is proposing a new way of thinking about our water infrastructure in response to the water scarcity we've been feeling over the last decade. Attitudes and technology need to shift simultaneously to alleviate the national water stress

SOLUTION

AECOM's new water infrastructure is based around a rain collection system for parts of the country with larger amounts of rainfall and propensity for flooding, while at the same time installing wastewater facilities with the capability to convert the water back into potable drinking water.

The rain collection system was piloted in Easton, PA where the rainfall has increased tenfold over the last 15 years. AECOM removed all of the previous combined sewer infrastructure of the city. The city's residents had grey-water systems and rain barrels installed in their homes to help them reuse some of their water. The residential amendments also reduce the flow going through the new sewer only line, which lowers the overall cost. Alongside the new sewer line, a rain collection line was installed to capture all of the runoff of the region. The line ran to the city's drinking water facilities and the sewer line to the wastewater treatment facility. The current drinking water facilities were retrofitted with large 1 million gallon tanks.

FINDINGS

The piloted test found that by approaching the water issue in Easton from a residential and infrastructure angle, there was larger success of the project. For one, with greywater systems and rain gardens, residents sent less water down their sewer line, allowing for smaller sewer pipes to be installed, saving a considerable amount. This installation saving was complimented by the savings seen in treating nearly 60% of water that used to be considered "wastewater" at a drinking water facility versus the wastewater facility. The rain collection water cost significantly less to be treated at the drinking water facility because the processes are less energy intensive.

AECOM hypothesized by collecting rainwater and recycling it, the City of Easton would have more water than was needed to meet the cities demand. With the extra supply, the

city is now able to distribute their extra water to cities around the United States who are in water trouble.

FUTURE

With the large amount of Northeastern United States region in current rainfall excess, AECOM projects the United States water demands could be covered entirely by installing the double outflow infrastructure in the northeastern cities.

2033- Water, Food, and Pinterest

As the drought in California continues we have resorted to using greywater for most uses other than what feels like drinking. I remember a few years ago where I would just dump my water out if it got too warm, and then go get a new glass. Now with scarce water the amount and types of food available are becoming more and more scarce as well. Luckily advances in technology have allowed for some more efficient processing of gray water to use for agriculture and cleaning.

We no longer can afford the astronomical environmental or economic prices of beef and pork due to the costs of farming them. I remember seeing back a few years ago that PETA said that “Not eating a pound of meat saves more water than not showering for six months.” I thought that was crazy originally and based it off the stereotype that eco-friendly people hardly ever showered so it probably was true. Luckily in California, it is not hard to find plant based foods for protein and other nutrients. The only problem is that these food prices have risen astronomically with the water crisis. We actually just bought this awesome new dish drying rack for our kitchen.



Not only do we reuse the little bit of water left from our dishes drying, but we no longer have to worry about watering small plants like herbs to cook with. Although these ways of saving water might seem like a stretch at first, we no longer have to waste and most likely over water our plants, and we no longer just let water go down the drain. I also started a pinterest board to find more ways to conserve water, and see what new recipes we can make from scraps and less water based foods.

<https://www.pinterest.com/jstessl29/water-conservation/>

2035- “A Thorne in your side” Blog entry

For the past decade, the government has been trying to push us citizens to use less freshwater and get more and more of our water from recycled sources. Older sources are no longer sustainable or reliable given the current global population. The continued scarcity of surface water has demanded that new alternatives be found, without significantly increasing energy usage. These changes have affected everyone around the globe, but most dramatically those in developed countries where water was once taken for granted.

In 2016, we could take showers as long as we wanted, use limitless water for agriculture and industry. There was even enough ground water for some people to have wells that supplied their individual household. Though those wells do still exist, the shrinking of local rivers and lakes has long since dried them up. They have become useless, and our everyday lives are controlled by the need to recycle and reuse all the water that we possibly can. Showers and bathing time are strictly regimented, and not a drop of water goes to waste. Shower time is strictly limited to 4 minutes per day with small pauses to allow for shaving and other tasks that do not require constant water use. Sinks are programmed to shut off after only 1 minute of continuous use per person per day. This includes teeth brushing, hand washing, and even shaving.

At first it was very difficult to live this way, when in the past we were used to using as much water as we wanted. Such metered and efficient use of water requires a lot of thought and attention that we hadn't been used to.

Luckily, as time has gone on it has become less difficult and we have learned how to be more disciplined with our use of not only water, but also other natural resources. Daily routines revolve totally around water usage, or really the lack thereof. Bathing is done in the morning, so that the resulting greywater can be used and processed throughout the day. Care is taken while bathing to use as little soap and chemical-laden products as possible, again to help maintain the quality of the resulting greywater. The cleaner the greywater is, the more useful it is, and therefore less freshwater needs to be used. After the day's activities, on days when it is necessary, laundry is done. It is done later in the day in order to maximize the amount of greywater available for use. The water used for laundry is a combination of freshwater previously used for laundry and the best available greywater. Every once in a while, freshwater

is used for laundry to introduce newer water into the system. After the laundry is done, any remaining greywater is toted outside and used for irrigation of personal gardens. The water left over after irrigation is treated and stored for the following day, or if it is too dirty it is sent down the sewer/septic system. Food preparation is done entirely with freshwater, along with the subsequent dish cleaning.

The United States started a greywater revolution, defining greywater as any water, other than sewage, that would drain from a household, i.e. it is a result of any of the previously listed “clean” water uses. All houses today have greywater treatment systems installed in order to process and reuse household greywater. The treatment systems require daily upkeep, which has become part of the morning routine. In order to avoid the nasty smells that come with storing untreated greywater chlorine must be added to the storage tank, much like a swimming pool. Also similar to a swimming pool are the daily water quality checks that are required to ensure the waters cleanliness. Less frequent maintenance involves checking and changing filters where necessary.

It might seem odd to think about it now, but at the time greywater systems were not back by popular demand. Large groups of citizens called out to make moves similar to China and rely on desalinization. The majority of China’s current “freshwater” comes from purified, desalinated seawater. All of the old water transportation systems still exist and are used for the same purpose. However now they are supplied by ocean-side water treatment facilities that process seawater as efficiently as possible. Due to limitations in the technology, this source is incredibly expensive, energy intensive, and compared to freshwater processing, inefficient, which has hurt China’s economic growth and GDP.

20 years agos, citizens wouldn’t believe the array of applications greywater can be used as when it comes from a clean system. All irrigation; including food crops, lawns, trees, and ornamentals, is done with greywater. Some care must be taken with food crops, and the water can affect the alkalinity of the soil, but for the most part greywater can be universally used for irrigation. Greywater is also used for toilet flushing, where the quality of the water is totally irrelevant, as it would go to the now seldom used septic/sewer system. Well treated, or lightly used greywater can also be used for laundry, provided the laundry has not previously had diapers in it. There is, compared to the water system of the past, significant effort involved in using

greywater for these things. Irrigation involves some means of manually spreading the water (usually with a watering can) and is far for time consuming than simply pulling out the hose used to be. Toilet flushing with greywater involves the most effort, because the water must be pumped directly into the toilet. Otherwise the water can damage the flushing mechanism, or worse, the greywater could be siphoned back into the freshwater supply if the pressure drops too low.

Life in this water scarce society is exhausting. Life in 2016 had enough to think about, enough stresses, and enough nuance. Nowadays we must worry tirelessly about something that used to be so automatic. Every action that is taken is taken with the thought of water in mind. Exercise is sometimes avoided so that clothes won't need to be washed, diet changes based on what requires less water to cook, and the list goes on. I long for the day where technology can be developed to a point where "limitless" freshwater is again economically and energetically feasible, and we can go back to living life without the ever constant thought of water.

Thorney thoughts,

Mike Thorne

2037- An Archivist View of 2020 Water Crisis

The signs of an impending severe water crisis were clear as far back as the early 2010's. In late 2011, California entered the driest time in its history. The drought continued to get worse until 2016, when it began a rapid spread. The wasteful water usage habits of the general population began to take its toll on the sources of freshwater that were typically relied upon. Citizens of the past had no quotas or restrictions on water use, and abused the vast abundance of water available at the time. Showers stretched as long as 30 minutes, clothes were washed with clean freshwater, and grass--of all things--was also watered with freshwater! This was also a time when such things as water parks still existed. Water was so readily available and so abused that thousands and thousands of gallons were used exclusively for recreation and made unviable for drinking because of the chemicals used to keep it safe for swimming.

Back in these times, virtually no one, save for a few remotely located people, had greywater systems installed in their homes. Today, of course, such systems are commonplace because of mandated buildings codes. We have adjusted to the lifestyle changes necessary for the successful use of these systems. For example, the detergents, soap, cleaners, and chemicals that people in 2016 washed down the drains would wreak havoc on household water supplies if introduced into today's greywater systems. It is important for many of today's uses of greywater that there be as little use of chemical laden products as possible. Life has come to revolve around using these systems.

When the systems first came about, there were major shifts in everyone's daily habits, and socio-technical systems had to adjust as well. As with the previous example, companies had to introduce more environmentally friendly soaps and laundry detergents, people had to get used to maintaining and using these systems, and many native plant/tree species died off due to the lack of freshwater. The greatest changes were with the attitudes people had towards water. As I said above, people of the past had no concept of water conservation. The attitude had to shift completely around from not thinking about water use at all, to having it be something that is thought about every time the water gets turned on.

The initial change was hard for most people, but as a society we are better for it. It has taught people to learn to conserve more, in more areas than just water. Fossil fuel consumption is at a century low, primarily because people have made a concerted effort to take personal

accountability for the health of the environment we have been given to live in. Because of the vast amounts of water being saved, hundreds of dams have been removed across the country due to the lack of need for the reservoirs they created. It has allowed the natural flow of rivers and waterways to return and has significantly boosted the health of marine ecosystems. Small everyday lifestyle changes on the part of everyone has had a tremendous effect and has likely saved our planet from the worst of the future consequences of global warming.

2040- Social views that lead to 2020 Water Crisis

The California droughts during the 10's should have been taken more seriously. Time lapse photos from just a single year show how drastically the precious resource of water was wasted (Figures 1,2, & 3). Looking back to the 10's California was the epitome of frivolous fresh water management. In the year 2016 there was over 25 water parks just in the state of California. These parks pumped thousands of gallons in a single day to stay running just for human amusement. The water in these parks also had to be treated with a slew of chemicals to keep the fresh water "clean". Thinking became so muddled that water filled with a laundry list of chemicals was considered clean. Visibly clean water held higher priority over chemical-free clean water. Reference Figure 4 for list of common chemicals used in pools to keep them in the pristine recreational shape.

Society's obsession with maintaining the wastefully archaic version of a lawn contributed to the larger water crisis, especially in California. It was no shock back in the 10's that a lush green yard was a status symbol, specifically in climates that made green lawns hard to maintain like California. Watching reruns of old television shows like Keeping Up with the Kardashians and The Real HouseWives of Beverly Hills/ Orange County one would never know that there was a severe water crisis happening. The opening credits boast running fountains, perfectly green and lush lawns, and sparkling clean cars. Meanwhile other residents of California were taking water conserving showers, their lawns were dead or turf, and a light rain was the only time your car got cleaned.

Instead of focusing on rising oil prices, society should have been focusing on making sure a resource essential to life wasn't being destroyed. When greywater systems were installed, personal hygiene companies had to rethink their whole approach. Only in 2016 were there big changes by beauty and soap companies to slowly get rid of parabens from their products, which had been known to be harmful for years. The small plastic beads in hand soaps and face washes were a staple. High end organic beauty companies like Lush Cosmetics started before the greywater regulations and gained economic profit from the foresight. They made facial scrubs with all natural abrasives like salt, sugar, sand, and so much more. Unfortunately fertilizers and pesticides used never changed to be less toxic in run offs. The vast amounts of nitrogen added to water sources made natural sources toxic to most animals, plants, and other organisms living in

the water. These animals did not get to live in the purified water that we used. They slowly died or adapted to their changed environment while we changed the environment to toxic and then nontoxic to better ourselves. We should have focused on finding ways to make these fertilizers and pesticides less toxic to water, rather than focusing on better ways to remove these toxins from the water.

The past generations of Americans had the wrong idea of fixing problems. They believed they could just find new technologies to fix problems other technologies caused. Thankfully through attitude and behavior changes, solutions approach a broader socio-technical system to avoid a relapse of the Water Crisis of 2020.

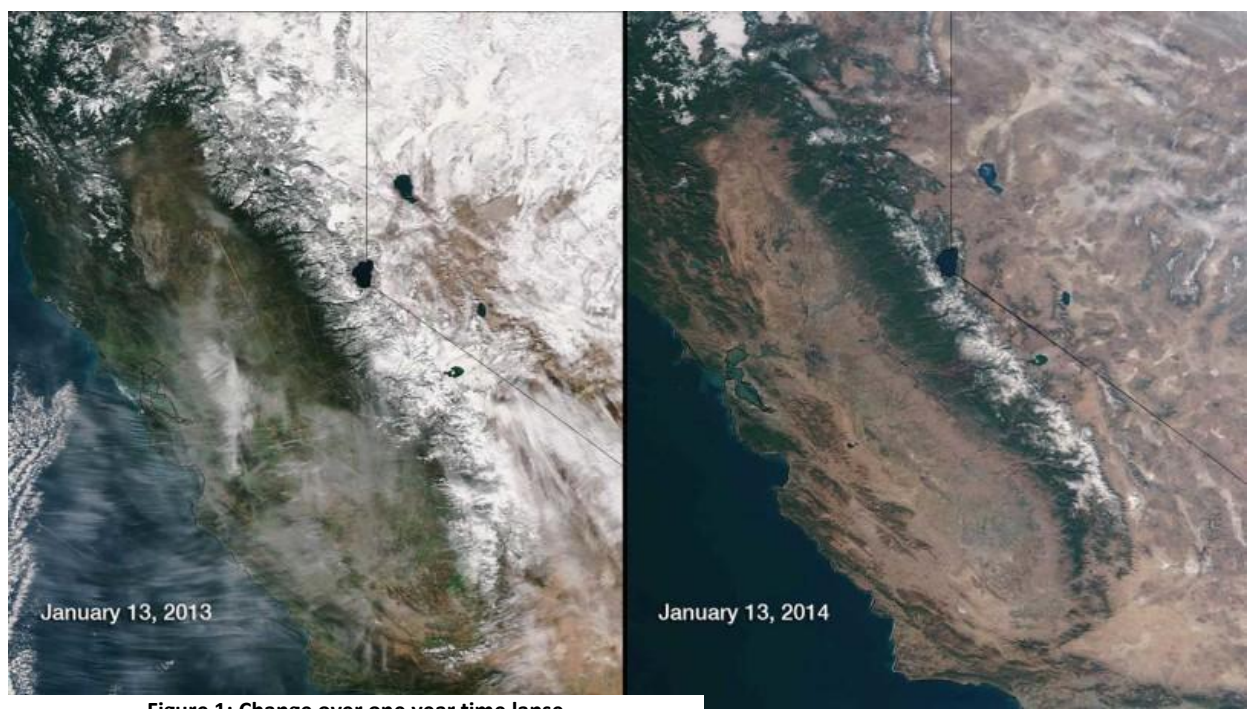
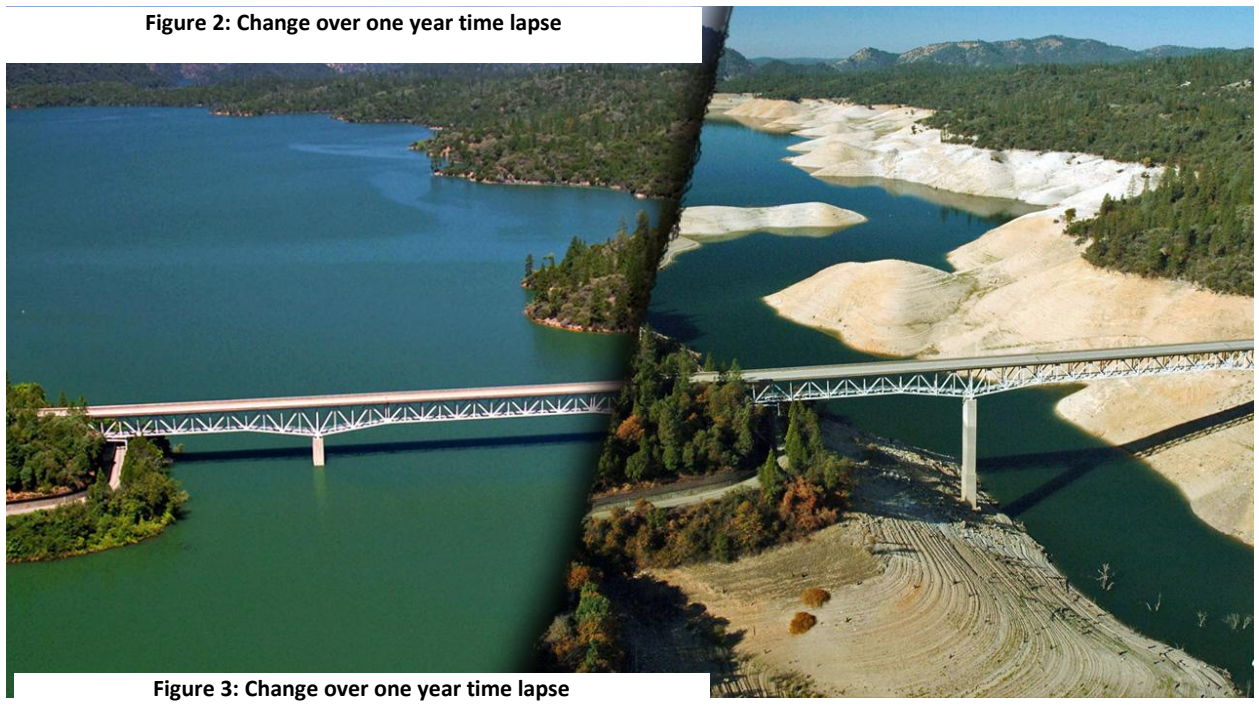


Figure 1: Change over one year time lapse





Water Balancers	Sanitizers	Algaecides	Shocks / Oxidizers	Others
Sodium Carbonate	Chlorine	Quaternary Ammonia	Sodium Di-Chlor	Clarifiers (enzyme based)
Sodium Bisulfate	Bromine	Polyquats	Calcium-Hypochlorite	Metal removers (may contain phosphates)
Sodium Bicarbonate	Polyhexa-methylene Biguanide	Copper Sulfate Pentahydrate	Lithium Hypochlorite	Stain inhibitors
Muriatic Acid	Copper	Colloidal Silver	Sodium Hypochlorite	Scale inhibitors
Calcium Chloride	Silver	Sodium Tetraborate	Mono-persulfate	Cyanuric Acid
		Sodium Bromide	Peroxy-monosulfate	

Figure 4: Table of common chemicals used in pool water