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Proposed Greywater System

Earth is the only planet known to man to have consistent, bodies of liquid water on its surface(Are There Oceans On Other Planets). Water covers 70.9% of Earth's surface, but only 3% of Earth's water is freshwater(Water Trivia Facts). Considering the scarcity of freshwater it is surprising how much freshwater humans waste. People use fresh water for unnecessary processes such as watering lawns, flushing toilets, generating power, running industrial process and irrigating fields. In 2005 thermoelectric power generation accounted for 41.5% of total freshwater withdrawals, irrigation accounted for 37%, domestic use consumed 8.5% and industrial processes used 5% of the total U.S. freshwater withdrawals(EPA WaterSense). In Los Angeles water is a scarce and precious commodity. The land that Los Angeles is built on was originally a desert and only through the use of extensive water systems is Los Angeles able to be the the lush massive city it is today. With the current drought that is affecting California people are looking for ways to save water. As it is now all rainwater in California is washed into storm drains where it is then deposited into the Pacific Ocean. The capture, filtration and reuse of rainwater in Los Angeles could greatly reduce the strain that the city puts on California's water supply. In order to recycle and store rainwater in California a new system involving the installation of pipes and treatment plants would need to be

implemented ,but the amount of water that could be saved in doing so would be greatly beneficial to California and worth the cost.

The system in Los Angeles that is currently in place directs rainwater into storm drains where it then flows into various channels or rivers and then is deposited into the ocean(Los Angeles County Storm Drain System). This system gets rain off of the streets but it wastes lots of valuable freshwater. Storing this water in underground containers would allows Los Angeles to use of this water at a later time. The most rainfall that Los Angeles has experienced in one day occurred on march 2, 1938 when Los Angeles received 5.88 inches of rainfall (Record Rainfall by Day of Year). The total square miles that Los Angeles encompases is 468.67 square miles (State and County QuickFacts). So on March 2, 1938 Los Angeles received 11,063,048,544,092.16 cubic inches of rain (1,881,470,840,832 square inches x 5.88 inches), which is 47,891,984,686 gallons of water in one day. At a cost of $28,195 for a 30,500 gallon water tank(RainMaster Corrugated Steel Tank Systems) this storage system would cost an estimated $4,427,260,682.69 this would be the high end for the estimate but, this system would be able to function even with massive amounts of rainfall. This system would be really pricey so a better alternative would be to pump the outflows of the storm drains to a already present reservoir such as the hetch-hetchy reservoir or create a new reservoir closer to Los Angeles. The cost of pumping to an already existent reservoir would be substantially lower than storing the water in Los Angeles but the cost of creating a new reservoir can not be estimated accurately with just internet research. The clear advantages of a reservoir is that a reservoir can hold a lot more water and takes less money to build

since the land is already owned by the government were as the cost of land in the city is extremely high. Additionally a shallow dam is all that needs to be constructed to form a reservoir. Probably the cheapest option however would be to pump the storm drain runoff into already existing aquifers in California. Many of these aquifers are actually being depleted so a new source of water would be welcome and could be accommodated (Gorman). The cost of building the infrastructure to access an aquifer are hard to estimate, but one could assume that it would be around equal to that of building a reservoir because although it does not require building a dam, it does require deep earth drilling to run piping to the aquifer. In order to avoid possibly contaminating California's aquifers using a new or existing reservoir would most likely be the best option to store the rainwater of Los Angeles.

The water collected from Los Angeles's system of storm drains would have to be filtered before it could be used. Currently there already exists water treatment plants in Los Angeles one such plant is Hyperion. Hyperion uses three different filter systems to filter their water before they release it into the bay. Though Hyperion is capable of the filtration of storm drain water it already runs at high capacity and would be over worked if it also had to filter the storm drain water on top of the sewage it currently processes. In fact when it rains Hyperion can actually have trouble handling the increased amount of water that come through manhole covers or leaking pipes(Hatch). Thus the construction of new water treatment plants would be necessary. Currently the Hyperion plant processes 350 million gallons a day(Hyperion Treatment Plant) and that represents only about 16% of the total water Los Angeles uses since only domestic, public and industrial

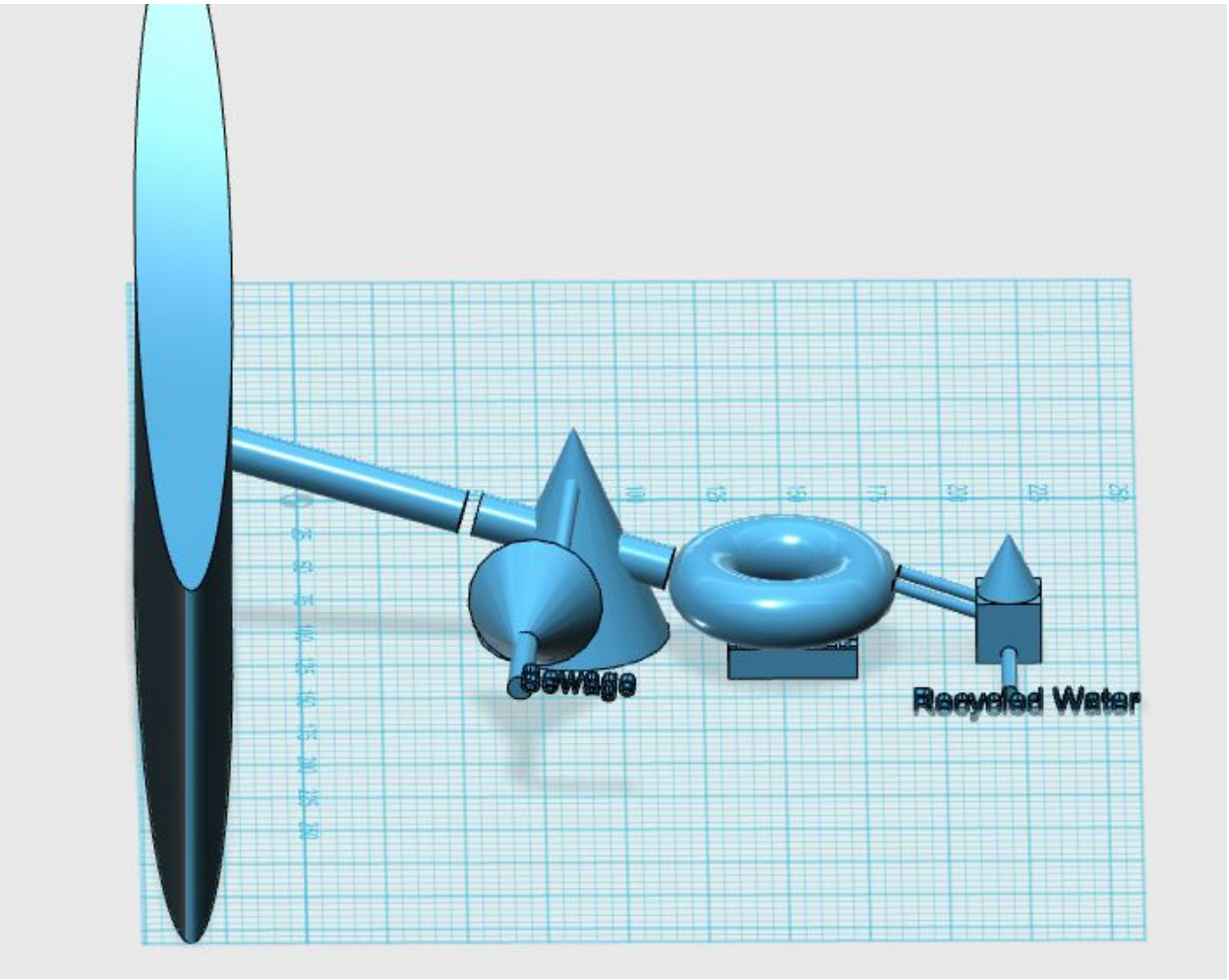
sources are sent to waste plants and those processes make up for 16% of water consumption (EPA WaterSense). Thus it can be estimated based off the national averages that Los Angeles uses 2,187,500,000 gallons a day (350,000,000/(.16/100)). In order to meet Los Angeles's consumption of water about five water recycling centers the size of hyperion would have to be constructed. These plants could be constructed anywhere inside or outside Los Angeles and the water would be pumper to them. In order to save on the cost of installing pipes it would be best to build these plants on the already established main outlets of the storm system. Spreading the plants out across Los Angeles to regionalize the water treatment would also decrease the cost of pipe installation. The specific locations of the plants will rely on the cost and availability of property in each area.The current water demands of Los Angeles suggest that three Hyperion sized plants would need to be created in order to recycle enough water in Los Angeles to substantially decrease the cities fresh water consumption.

In order to recycle the storm water new treatment plants will have to be constructed. These plants will process the water both physically and chemically. The water to these plants will be pumped from the reservoir directly to the water treatment plants. From the plant the treated water will then be pumped to facilities throughout Los Angeles, such as factories or farms, that can utilize the recycled but not drinkable water. When the water enters the plant it passes into a sediment tank. Inside this triangular tank the solids settle to the bottom and light oil and greases rise to the top. This sewage sludge is sucked out of the water and then pumped to Hyperion or other treatment plants to be dealt with. The water is sucked from the middle of the sediment tank and passed into the

flocculation chamber which is a cylinder but is portrayed as a doughnut to enable the viewer to see the internal filters. The water flows into the cylinder and any dissolved chemicals are bonded with, creating flakes that can be caught in the filters. Then after this the water is considered clean enough to use but not drink as it is only cost effective to make the water usable and not potable. The majority of water use, as discussed above, comes from agricultural and industrial processes. Domestic use makes up a very small percent of total freshwater consumption but to create pipes for this recycled water in all the neighborhoods in Los Angeles and to filter the water to drinkable levels would cost massive amounts of money and consume large amounts of time. Thus to save money it makes the most sense to provide this recycled water only to industrial zones. This could also cut down on the amount of plants that need to be build which saves even more money. The actual cost of each treatment plant is estimated to be $1,211,275 (Project Cost Management) as the coagulation and flocculation system is estimated to cost $401,305, the sedimentation system is priced at $280,000, and the filtration system inside the flocculation system would cost and estimated $529,970 with $525,00 of that being for the infrastructure and the remaining $4,970 for the filter. Though these plants would cost a lot of money, costs could be cut by limiting the access of the recycled water supply to only heavy water using industrial areas. The system would save massive amounts of water though and make sense for such a water strained area like Los Angeles.

Fresh water is a valuable commodity and Los Angeles uses copious amounts of it. As water expert Andy Lipkis so perfectly put it, “Why make freshwater when we could collect the water that falls from the sky? Even on the driest year in recorded history in

2013, it still rained 3.6 inches in Los Angeles. An inch of rainfall in L.A. generates 3.8 billion gallons of runoff, so you're talking about more than 12 billion gallons of water that could be captured, but that flows within hours down our concrete streets and into the ocean. There's enough rainwater to be harvested to produce 30-50% of the entire city's water needs."(Zakaras). The solution to Los Angeles's water problem is simple, harvest rainwater. The actual implementation of this solution however is not as easy as it sounds. The storm drain system is already set up to capture the rainwater, but because rainwater from Los Angeles picks up pollutants from the city and due to the sheer volume of water that would need to be stored another reservoir outside Los Angeles would have to be created. In order to process all this rain water new water treatment plants would have to be created at an estimated price of about four million dollars each. In order to cut the cost of the overall project and make this solution more feasible the plants would only process the water twice, once for physical waste and a second time for chemical waste. To cut additional costs that arise from piping installation, recycled water would only be available and routed to industrial centers or agricultural areas as they tend to use the most amount of freshwater. The feasibility of this solution would depend on how much the city of Los Angeles and the State of California would be willing to spend on such a project and the cooperation of the private sector in adapting their business for recycled water. The project could be constructed in pieces and the success of the each section measured in order to determine if the next section should be built. This would minimize the risk the project poses to the government and increase the chances of implementation. In order to solve the water crisis in Los Angeles the city needs to start utilizing rainwater.



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