CCNY Students Develop **CSO-NO** to Combat Water Pollution

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Writing for Engineering ENGL21007 B2

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Summary

The City of New York can be considered one of the most important cities in the world; it is the city that never sleeps, home to iconic landmarks like the Statue of Liberty, the Empire State Building, and the One World Trade Center. People from all across the world come to this city to experience its beauty and technologies, so why, in a city seen and inhabited by millions, should the waters of New York be so polluted? The Hudson River and East Rivers are the two bodies of water surrounding the island of Manhattan. Today, the waters of these two rivers are incredibly polluted by all kinds of toxic chemicals, plastics, and human waste; the waters are discolored and bear a foul odor because of the pollution. The Hudson and East Rivers were not always this way, and there was a time when these two rivers were a lot cleaner, a time when people could safely swim in the waters of the Hudson River, and we aim to bring that back.

Contents

PRESS RELEASE

New York City's waterways receive a much-needed boost as CCNY students introduce a groundbreaking water filtration solution to address the issue of water pollution.

New York, NY: CCNY students, a leading group of innovators and problem-solvers, today announced the launch of their new water filtration solution, designed to combat the issue of water pollution in New York City. The city's waterways have been impacted by pollutants, bacteria, and chemicals, causing harm to the environment and wildlife.

"Our team is committed to finding innovative solutions to pressing environmental issues, and water pollution is one such challenge that requires urgent attention," says Elsa, Project Lead at CCNY students. "Our new water filtration solution provides a sustainable and cost-effective way to address the root cause of water pollution in New York City."

The new filtration system utilizes cutting-edge filtration processes, including reverse osmosis and activated carbon filtration, to remove a wide range of contaminants from the water. The solution is designed to tackle pollutants at the source, preventing them from entering the city's waterways and causing further harm to the environment.

Features and benefits of CCNY students' water filtration solution include:

- Advanced filtration processes that remove contaminants such as bacteria, viruses, heavy metals, and chemicals from the water.
- Sustainable and cost-effective solution that reduces the need for expensive and environmentally damaging water treatment methods.
- Easy installation and maintenance, with minimal disruption to existing infrastructure.

"We're thrilled to introduce our innovative water filtration solution to the market and believe that it has the potential to make a significant impact on the issue of water pollution in New York City," says Elsa. "Our team is passionate about finding sustainable solutions to environmental problems, and we look forward to continuing our work in this field."

For more information on CCNY students' water filtration solution and other sustainability initiatives, please visit their website or contact the team directly.

Introduction

A big contributor to the pollution in the rivers is the excess rainwater that would overload the city's drain system. The drain systems in the city would capture rainwater and transport it to large water treatment facilities which would make the water drinkable, but all the water that would overload the system would go down a different path where they are transferred into the rivers. The problem with this is, as rainwater makes it way to the drains, all the city's dirt and grime would get swept up as well, then dumping them into the river, but our invention aims to stop the pollution at its root. Our innovation is to create express water treatment stations that are compact and can be built underground. These mini water treatment stations will provide a quick and seamless way to decontaminate the water before it even reaches the rivers; through a series of chambers, we will be able to decontaminate the water of all pollutants, bacteria, and chemicals that may affect the clarity and inhabitants of the rivers. Once we've cut off this supply of pollution, the existing contamination in the rivers will be effectively flushed out over time, and once again the rivers of New York would shimmer with clarity.

Technical Description

1% of the water on our earth is drinkable. This means we have to try and save any water that we are capable of saving. This brings out a big problem in New York City. When it rains, the sewers overflow and sewage flows into the Hudson and East river. Not only does the water from the rivers of NYC get polluted , but the water is then wasted. Our idea essentially is a pipe system that connects all the combined sewer overflows together, filters the dirty water that overflows from the sewers when it rains and stores the water in a reservoir to be ether sent back out into the ocean as clean water, or saved for occasions when water is needed like to put out fires. This system can be separated into three different sections: Intake, Filtration, and Output.

Intake

The system starts off by connecting all the combined sewer overflows with pipes and sending them off to a small underground water treatment plant. The water then goes through a series of filters to remove the waste from the water.

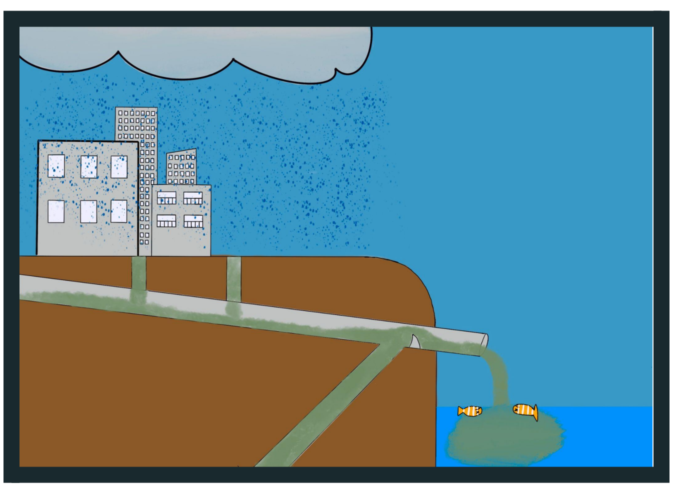

Figure 1: Alvarez, K. (2023) *CSO leaking into local river*

Figure 2: Mclean, M (2023) *CSO outputs connected*

Bar Screen

After the water makes its way through the pipe, the water is then sent through a mechanical bar screen, that removes larger pieces of garbage that makes its way past the initial grates at the entrance of the pipes. This bar screen removes large debris by first blocking them in a gate of closely spaced bars. Once the barrier gets filled, the machine vertically rakes the debris off the barrier and brings it up to a disposal area. The rake then moves back down and goes back to its original position, ready to rake again. The waste in the disposal area is then picked up by garbage trucks and sent to proper disposal areas nearby.

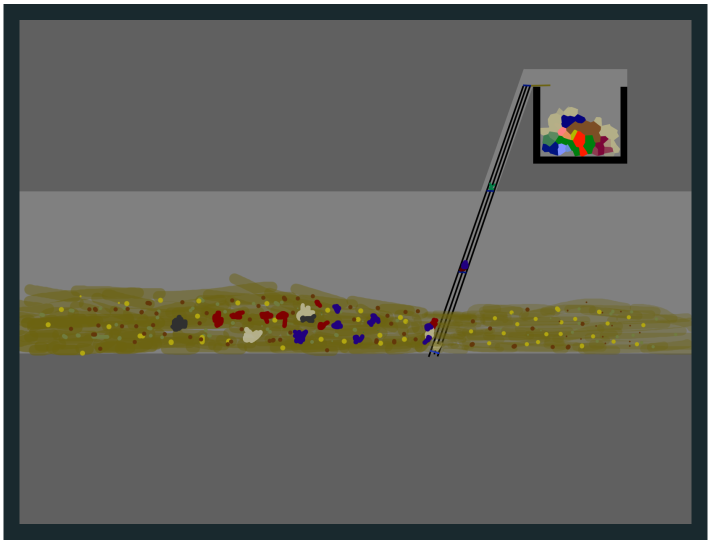

Figure 3: Mclean, M (2023) *Mechanical bar screen*

Coagulation/Clumping Chemicals

After the water passes through the mechanical bar screen, the water then goes back into another pipe where chemicals like aluminum or iron salts, which are positively charged will be injected into the water (CDC, 2019)[1]. These positively charged chemicals will react with the negatively charged particles and they will clump together to form larger particles (CDC, 2019). In the same piping, there will be a fan that will circulate the water and mix together the clumped particles to form even bigger particles called floc (CDC, 2019). The water then flows to a tank where the floc will settle at the bottom due to their weight (CDC, 2019).

[1] CDC. (2019). Water Treatment. Centers for Disease Control and Prevention. https://www.cdc.gov/healthywater/drinking/public/water_treatment.html

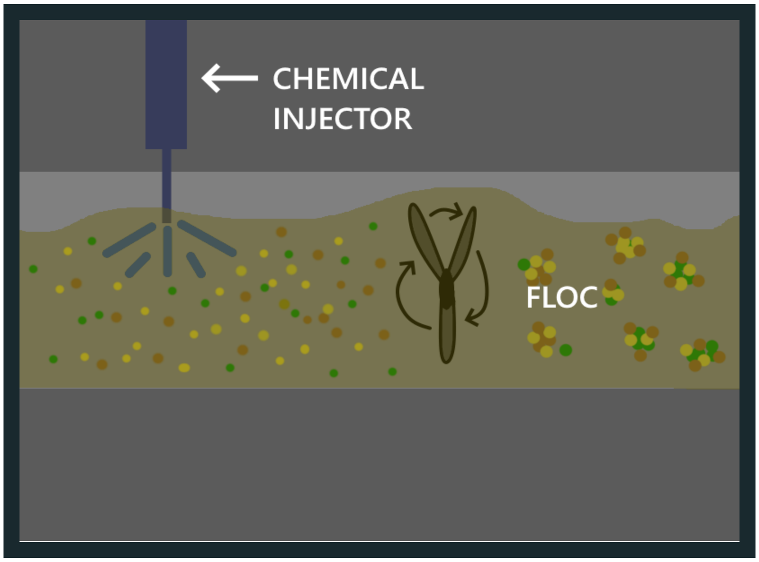

Figure 4: Mclean, M (2023) *Turing sewage particles into floc*

Disposal of Floc

At the bottom of the tank, there will be a conveyor belt system that will remove the floc that settled at the bottom of the tank. The conveyor belt will be split off into sections by walls which will act as buckets to catch the floc and will make sure they won't clog the system. To make sure that the floc isn't disturbed while being disposed of, there will be a mechanical cover that will open and close horizontally above the conveyor belt. The cover will make sure the cleaner water stays above and the floc doesn't move back upwards when being moved.

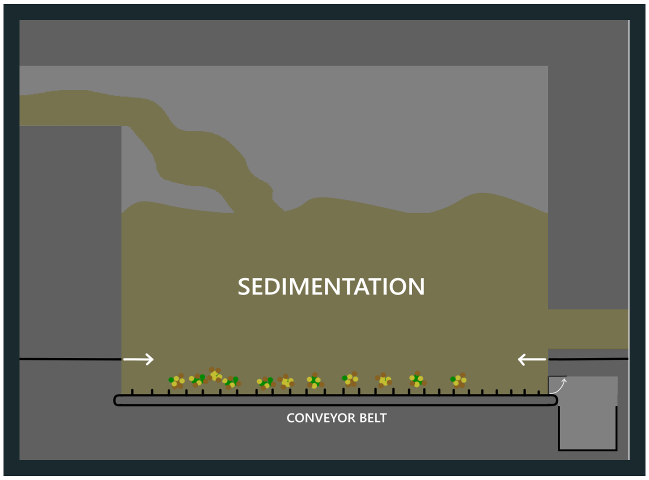

Figure 5: Mclean, M (2023) *Sedimentation*

Reverse Osmosis

After the floc gets disposed of, the cleaner water then goes through another pipe where there will be multiple semi permeable filters that will only allow water to pass through. This is to get rid of any other liquids that may be in the water like urine (Freemesm, 2023). The filters will be replaced after every heavy rainfall.

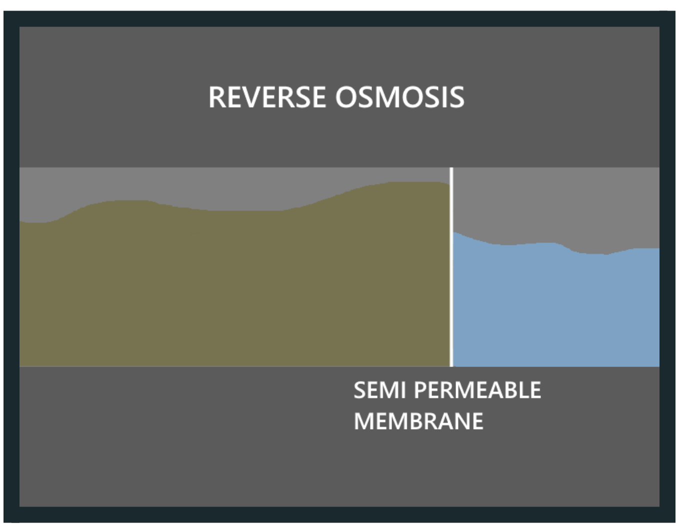

Figure 6: Mclean, M (2023) *Water going through semipermeable membrane*

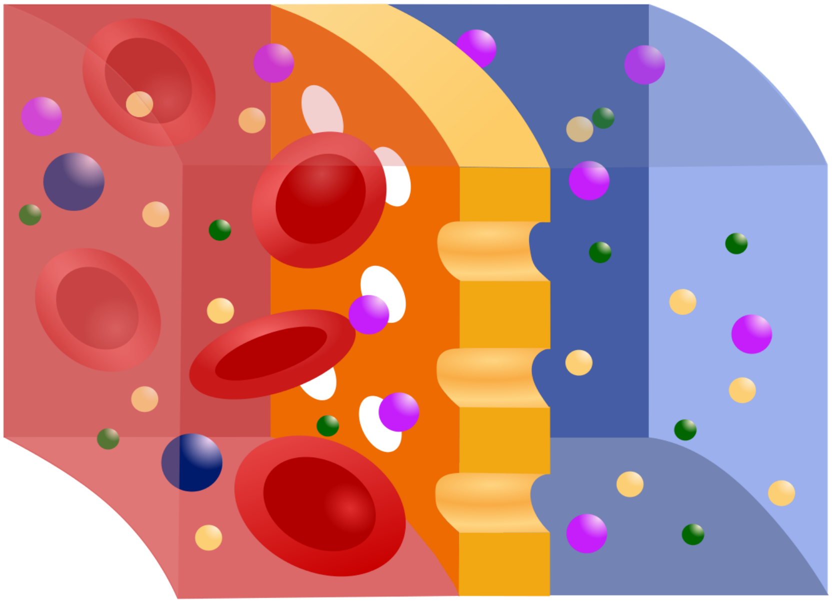

Figure 7: Freemesm. *Semipermeable membrane.* (2023, March 21). In *Wikipedia*. https://en.wikipedia.org/wiki/Semipermeable_membrane

Disinfection

After the water is filtered, the cleaner water is then sent to a tank to be disinfected. Although the water has gone through the various filters, there are still bacteria, viruses, and pathogens that lie in the water. To effectively kill them, we must apply chlorine to the water. The amount of chlorine depends on the volume of the water. it is recommended that ⅕ of a gallon or less of chlorine be used for every 10,000 gallons of water (Clean Water Store, n.d.)[2].

[2] Clean Water Store. (n.d.). How much chlorine to add to storage tank to kill bacteria. https://www.cleanwaterstore.com/resource/how-to-guides/how-much-chlorine-to-add-to-storage-tank-to-kill-bacteria/

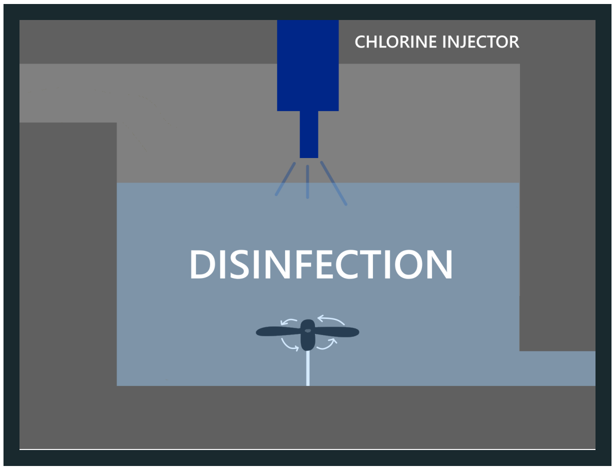

Figure 8: Mclean, M (2023) *Water being disinfected with chlorine*

Output

After the water is disinfected, it can either be sent to a reservoir tank to be collected and stored or the water can be sent into the rivers to flush out the dirty water in the rivers. It would be best to keep this water due to the recent droughts that NYC has been experiencing these past few years.

Innovation process

Location

Our partially underwater/underground filtration systems will be built along the East corner of Rikers Island on the East River; directly between the Bronx and Queens. This location is the center of seven major sewage overflow areas, making it our ideal first location. Image 1A depicts the connections of major sewer overflow locations in NYC and the X marks our facility's proposed location.

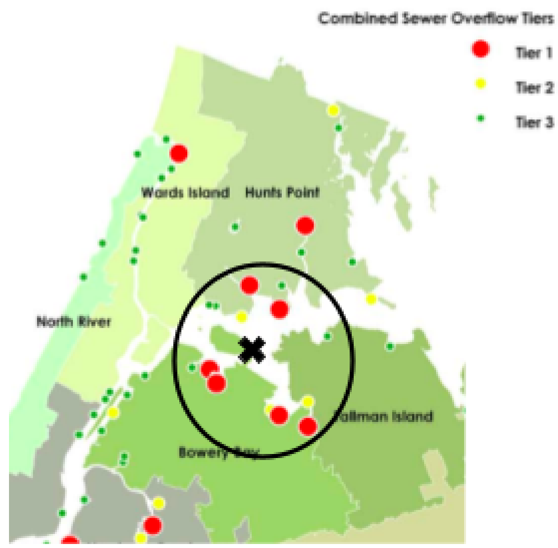

Image 1A. Note. Map of Outflow Tiers 2022 sourced from nyc.gov

Construction and Materials

Construction will begin with 10 miles of cast iron pipes to connect sewer outposts from Bronx and Queens to our facility along Rikers Island. This location has a water depth of less than 20 feet therefore, the pipes will lead to a underground facility. The materials needed for 10 miles of pipes will cost us 80,000 USD. In order to build this structure, a pneumatic caisson is necessary, consisting mainly of cast iron and steel and ranging from 20-30 feet long and 30 feet wide. Additionally, the facility's foundation will be made of cast iron and steel, expected to be about 80 feet wide and 40 feet deep. At about $10 per square foot of foundation and a $10,000 pneumatic caisson, it will cost a total of 30,000 USD for materials. The first filtration system built will be the mechanical bar screen, comprising of thin cast iron bars with 2-inch gaps between them, costing 1000 USD. The next process of filtration will be coagulation which requires the building of a chemical dispersion system and mixing fan, costing $1,000 for installation. The floc remaining at the bottom of this tank will be monitored by a sensor on a converter belt, costing about 50,000 USD for construction. Lastly, a semipermeable layer allowing water will be built costing 10,000 USD for installation. The total cost of all building materials will be 181,000 USD.

Labor Cost

The building of this filtration facility requires numerous amounts of workers of different technological backgrounds. We anticipate a total of 130 laborers throughout a year-long construction process. Beginning with an expected number of 30 total contractors, managers, and engineers with a base hourly pay of 30 USD per hour. Additionally, 70 construction workers, including foundation work, caisson workers, pipe installation, etc, will be hired with an hourly pay of 18 USD. Lastly, specialists and trade workers such as coagulation specialists, welders, etc, will be hired. We expect to hire 30 specialists and will be paid at an hourly range of 20-25 USD. Overall, the expected one year of construction with 130 workers, will cost 900,000 USD for labor. Combined with the materials cost of 181,000 USD, the total cost of this facility will be 1,081,000 USD.

References page

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"CSO Outfalls Map - New York City." *Nyc.gov*, 2022, www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/cso-outfalls-map.pdf.

Appendix A: Evaluation Criteria

1. Effectiveness of the filtration system in removing pollutants from the water.
2. Efficiency of the filtration process in terms of energy consumption and resource utilization.
3. Durability and longevity of the filtration system, including its ability to withstand environmental factors and wear and tear.
4. Cost-effectiveness of the filtration system compared to other water treatment solutions.
5. Ease of installation and maintenance of the filtration system, including training required for operators.
6. Scalability of the filtration system to meet the needs of different areas and populations
7. Impact on the local environment and wildlife, including any unintended consequences of the filtration process.
8. Overall impact on the community, including economic, social, and health benefits.
9. Innovation and uniqueness of the solution, including potential for replication in other contexts or locations.

Appendix B: Task Schedule

4/19: Come up with a team name and assign roles:

- Team lead/editor - Michael
- Press release - Jayvin
- Summary - Keleni
- Introduction - Keleni
- Proposed Program - Michael
- Innovation Process - Elsa
- Technical Description - Michael
- Appendices - Jayvin

4/19 - 4/24: Research topic, summarize research, and create outlines for each section

4/24 - 4/26: Synthesize research into a coherent narrative

4/26 - 5/1: Create drafts for review

5/1 - 5/3: Synthesize drafts into one doc and create cohesion

5/3- 5/8: Edit the final draft and make the presentation