Tree-Hugger Society: Group Project

Revekka Agababaeva

Jacky Chen

Joseph Hu

Jan Omitsu

Javokhir Radjabov

Writing for Engineering, Section 2

Prof. Von Uhl

10th May, 2022

1- Summary:

The project will focus on a way to prevent trees from coming into contact with contaminated water. This goal will be achieved through the use of barriers and a drainage system connecting to the existing infrastructure. By amending the current barriers separating trees from major roads, we are saving the city money that would be used replacing damaged trees and allowing for large scale preservation of nature.

Our team is composed of dedicated engineers and architects pursuing degrees in related fields. This project will be implemented within one and a half years and has an estimated budget of 14 billion.

Appendix and Technical description

2- Introduction

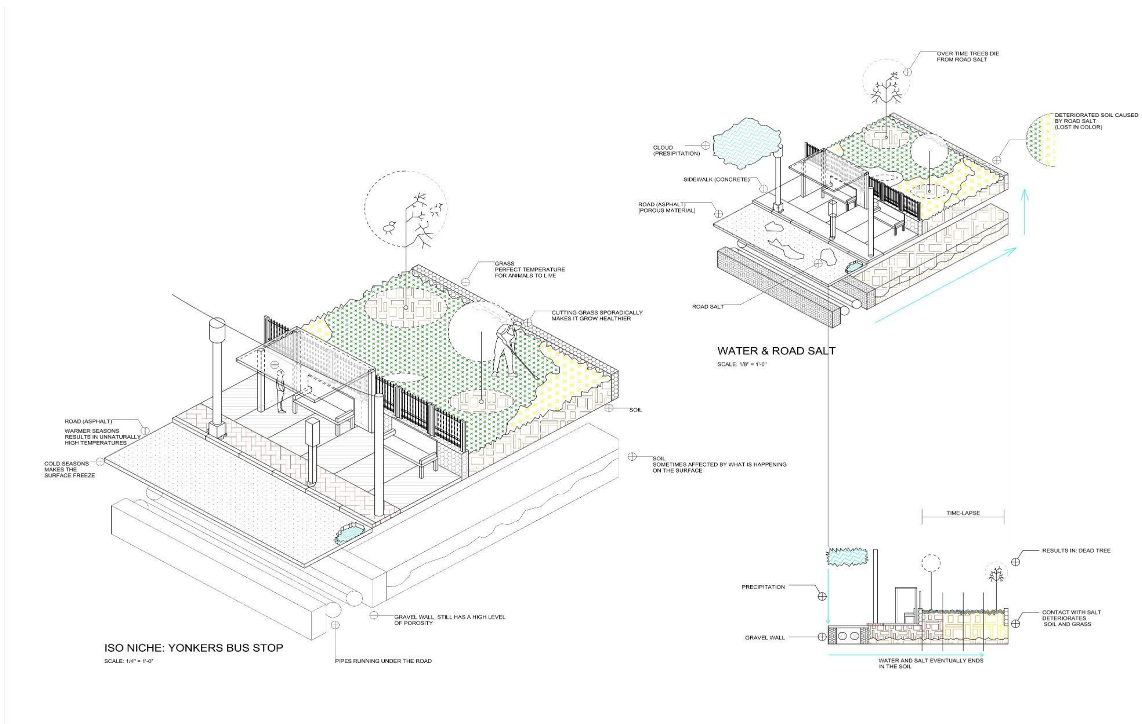
There are several reasons to have trees in high-traffic urban areas. For one, planting trees reduces the unnaturally high temperatures of sidewalks and roads during the summer months. Many who have lived in a big metropolitan area can attest these temperature peaks as an inconvenience. This key factor is a major reason why the city of New York has invested so much money into planting and replanting. An article on the matter by amNewYork states, "the city planned to continue the sped-up tree plantings to cool sweltering summer sidewalks." (amNewYork, 2020). Another inherent benefit in planting trees is their ability to absorb carbon dioxide. According to an informative article written by educator Calvin Norman and assistant professor Melissa Kreye, "When [trees] perform photosynthesis, they pull carbon dioxide out of the air, bind it up in sugar, and release oxygen" (Norman & Kreye, 2022). Especially with the current surge of advocacy for environmental justice, it is no secret why local governments are initiating mass planting programs. Author Peter Wilson wrote an article on the subject for the New York Times, "New York, Denver, Shanghai, Ottawa and Los Angeles have all unveiled Million Tree Initiatives aimed at greatly increasing their urban forests because of the ability of trees to reduce city temperatures, absorb carbon dioxide and soak up excess rainfall" (Wilson, 2022). Planting and conserving benefits everyone: both citizens and the local government.

This project is proposed with a primary focus on amending the relationship between human needs and the conservation of nature, as well as a secondary focus on expanding upon existing architectural systems rather than completely rebuilding the existing structures. By amending the current barriers separating trees from major roads, we are saving the city money that would be used replacing damaged trees and allowing for large scale preservation of nature.

This issue at hand is one that takes a long time to manifest. It starts as a combination of two abiotic factors affecting biotic factors. One way humans affect nature, even indirectly, is through the use of road salt during the colder months. As seen in the figure below, rain mixed with road salt is able to seep through the porous concrete and asphalt, over time reaching the soil of the green side. The example that sparked the idea for this innovation was trees next to a bus stop in Yonkers, NY.

Figure 1

Early Concept (Omitsu, 2022)



The combination of road salt and rain does not affect man-made objects as much as it affects the biotic factors. Trees do not like to come into contact with road salt; this also includes grass and soil in general. What road-salt and water does to grass is debilitate it, which is why the grass turns yellow. This is not an overnight process, but road salt leads to discoloration of the soil and weaker trees. In a publication on the matter, amNewYork states, "the average cost of planting a tree is $2,700 for the current budget year" (amNewYork, 2020). This ultimately damages all of the green area, and costs the city a lot of money in replanting new trees to replace the old and decayed ones. The same amNew York article makes mention of the number of trees, "155,000 trees along streets" (amNewYork, 2020). Pairing the number of trees with the amount mentioned to replant, $2,700, this innovation would be saving the city 418,500,000 dollars.

The money used for replating could be used elsewhere and for better purposes. With this in mind, our group is proposing a solution to this problem. What we are proposing is a way to prevent this water and salt combination from making its way to the soil, ultimately preventing trees from being affected. The idea in mind is a set of barriers around a tree and a small drainage system to reroute as much contaminated water as possible away from the trees.

3- Construction

3A- Innovation Process

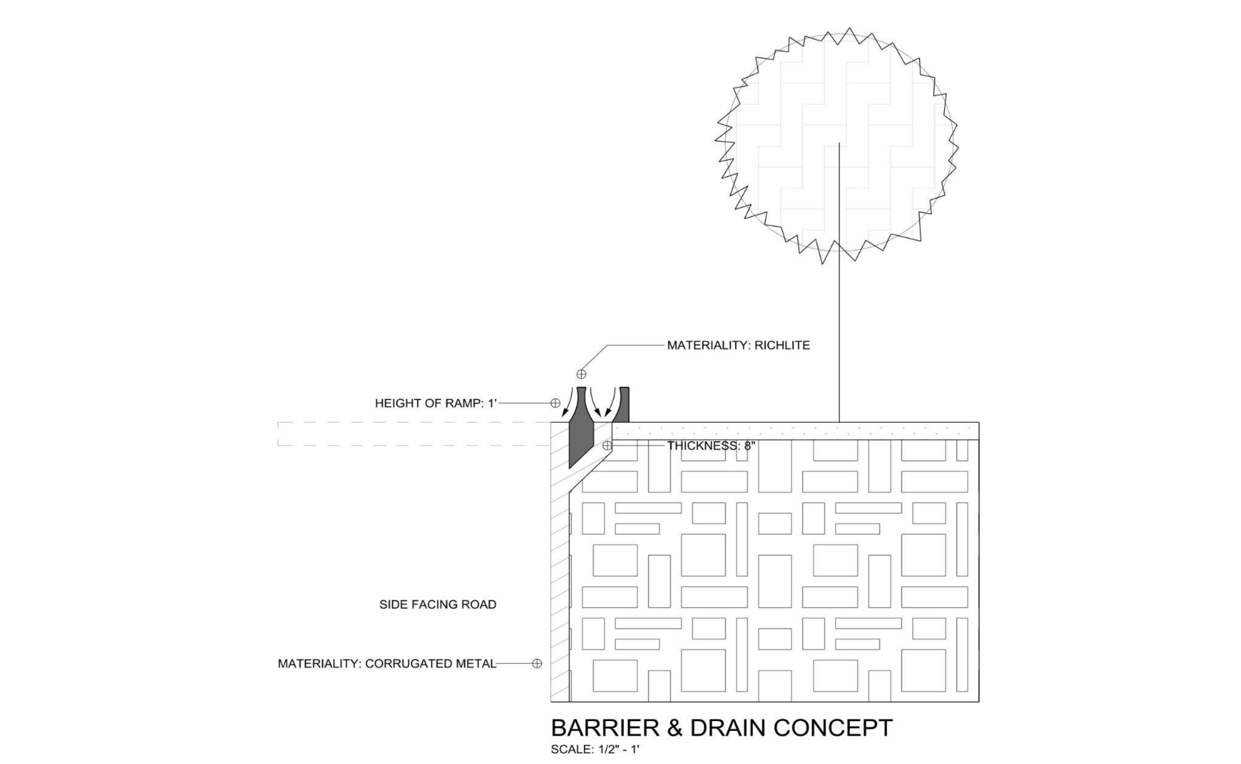
To gain an understanding of the factors needed to implement this innovation to city infrastructure, Ocean Parkway in Brooklyn, New York will be used as a foundation. These factors include: cost, time, materials, labor-power, etc. Even though Ocean Parkway is about 4.86 miles in length, 9.72 miles of road will be accounted for. This is due to the fact that both sides of the boulevard are lined with trees.

A View of Ocean Parkway ([[A picture of Ocean Parkway]], 2016)

The main materials that will be used to make this innovation are Richlite and corrugated steel. Richlite, the material that will be used to make the barrier/drain sustainable, costs about $50.00 per square foot. The cost of Richlite would be about $13.6 billion since the barrier will be fully lined with Richlite. Corrugated steel, the material used to prevent rust and mold, costs about $1.50 per square foot (Team, 2022). Accounting for enough to plate the installment, the total cost of the corrugated steel is approximately $406,470,000. It is estimated to take one and a half years to complete the project. A contract with a 12-20 person private team would cost approximately $10 million. The cost of the materials combined with the labor cost would add up to an estimated $14.2 billion. This estimation is made using retail prices for the materials, which might not be completely accurate; wholesale material generally costs significantly less due to the quantity purchased, so this estimation is subject to great change.

Figure 2

Barrier and Drain Concept (Omitsu, 2022)



3B- Digging and Drilling

On a weekly basis, around 1000 feet of drilling and digging will be required. The width of the hole from drilling will be around half a foot until it reaches the sewer or connects to a pipe leading to the sewers. While on the side with dirt and plants, a hole with a depth of one foot and a width of two feet will be dug. The deepest point will be located away from the drilled pavement side, slanted toward the dirt side. The slope between the lowest elevation of the points will be 1 foot per foot.

3C- Construction

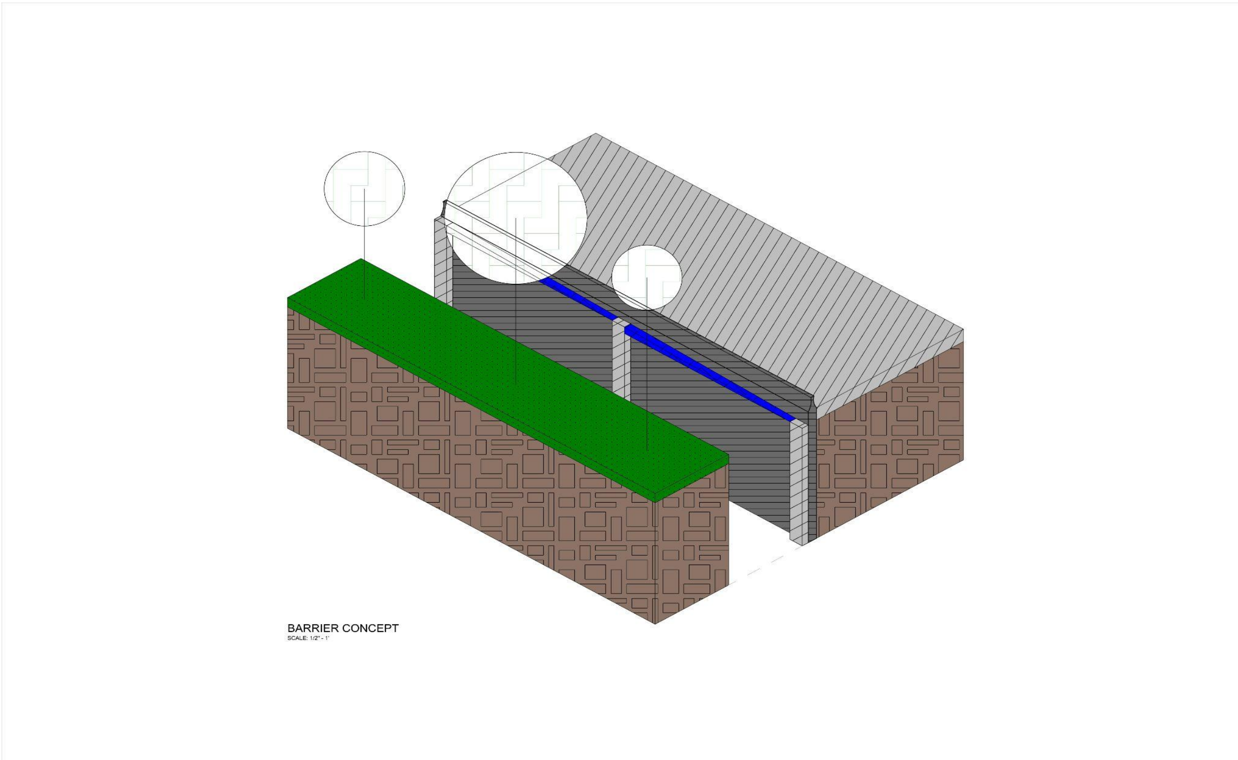
Within the area dug and drilled, a corrugated metal angled pipe will be placed at a periodic location of 10 feet. The angled pipe will have a radius of 0.5 feet. The pipe will not be leveled by the surface, as the highest point of the pipe will be a fourth foot below the surface. After the placement of the pipe, The corrugated metal plated Richlite barrier will be placed on top locking the pipe in place. On the level surface of dirt, a Richlite ramp, with both sides having a slope of one twentieth foot in height per foot in length, will be placed parallel to the road and trees. This will continue for the whole length of Ocean Parkway. On the inside of the structure, a ramp will be placed guiding the liquid towards the closest pipe. At the opening of each pipe, a grid will be placed as a cap for the pipe, preventing the pipe from clogging. The same grid will be placed over the ground-level drilled holes in the side of the structure to prevent safety hazards. The Richlite structure will be angled down from the street side and from the grass side to the center of the structure pipe. This will allow contaminated water that has been splashing over the ramp to slide down the sheet into the pipes.

The car facing side of the extrusion will have three gaps, all ¼ inch wide that run parallel to the road. The first gap will start ¼ inch off of the road in order to create prolonged drainage surrounding the road, with added grates keeping small items that fall on the ground from entering the drainage system. These gaps will allow rain and snow to enter the sewer system directly without making contact with the trees or the soil. This is also a cost effective method, given it is simple enough to perform the needed function and is analog, which means there is no need for extra signaling or electrical systems to be incorporated.

The extrusion will have an internal connection to the existing sewer system underground. Instead of creating a whole new drainage system, this will optimize the movement of the runoff water. There will be an opening between the two sides of the extrusion as well as an opening from the drainage slits on the side of the road. The street side pipe will go straight down to the system and the pipe from the inside of the extrusion will be angled to meet the vertical pipe. They will meet about a foot into the ground, and the extrusion side pipe will be connected to the vertical pipe; the vertical pipe will then lead the water from both entry points to the sewer system. From there, the water will move through the sewer system and be handled by the NYC Water Treatment Plants.

Figure 3

Barrier Concept II (Omitsu, 2022)



The diagram above shows the barrier concept and how it would look like when implemented next to a road. The green slab shows the grass where the trees are located and the brown block underneath would be the soil. On the other block, the road and the barrier is shown. The light gray and brown block is the road and next to it is a long dark gray slab. This slab would be the Richlite barrier which is next to the corrugated metal pipes (shown as light gray slabs). The blue lines are the drainage system that will send the contaminated water to the sewage system.

4- Form and overall materiality

4A- Richlite

The barrier will be made of solid Richlite. One of the reasons the combination of road salt and water is an issue to begin with is due to the road's material, concrete, being too porous. The material chosen for this extrusion is Richlite; this is a composite material made out of compressed fibers infused with resin. On their website, the company states, "Richlite is an incredibly durable, extremely versatile, and highly sustainable material" (Richlite n.d.). With this material, the porosity factor is eliminated from the equation. The material is sustainable and durable, meaning that once built, repairs will be minimal. It is also simple to make in large quantities, so it will not be an expensive material to acquire.

4B- Corrugated metal

The underground section of the barrier will still be made out of Richlite, but most of the tubes will be made out of corrugated steel. Corrugated steel is a practical material to use for this purpose given it is resistant to damage, rust, and mold (Higson, 2020). It is easy to install and maintain, which is important for long-term success of the overall system. It is also relatively cheap compared to other materials on the market.

5- Evaluations

5A- Safety Hazard Test

The grid covering the holes will eliminate safety hazards regarding humans or animals falling into the holes. However, the grid does not prevent small objects from falling through the open grids. Thus, there's no safety hazard, only personal concerns.

5B- Reparation/Replacement Test

The grid and the pipes are required to be repaired or replaced every 4 years due to constant exposure to extreme temperature changes and contact with water. If the condition of the part shows large cracks or holes, then the part will be replaced. Since the barrier and ramp are interlockable and simple structures, replacement and reparation will not be difficult.

6- Task Schedule

	Jan	Revekka	Joseph	Jacky	Jake
Tasks by 5/6	-Purpose and proposal -Materiality: Richlite -Graphics	- Technical Description of drainage and connection to sewer system - Purpose	- Innovation Process	-Appendices	-Research -Calculations
Tasks by 5/11	- Editing	- Editing	- Editing - Added diagram description	- Editing	- Editing

References

amNewYork. (2022, February 2). *More green for less green: NYC tree planting programs slows due to rising costs*. AM New York. https://www.amny.com/new-york/more-green-for-less-green-nyc-tree-planting-programs-slows-due-to-rising-costs/

Higson, D. (2020, July 22). *Why We Use Corrugated Metal to Build Shipping Containers*. Porta-Stor. https://porta-stor.com/use-corrugated-metal-build-shipping-containers/

Norman, C., & Kreye, M. (2022, April 25). *How Forests Store Carbon*. Penn State Extension. https://extension.psu.edu/how-forests-store-carbon

Omitsu, J. A. (2022, May 1). *Early concept* [Illustration].

Omitsu, J. A. (2022, May 8). *Barrier and drain concept* [Illustration].

Omitsu, J. A. (2022, May 5). *Barrier Concept II* [Illustration].

Richlite. (n.d.). *About*. Retrieved May 2, 2022, from https://www.richlite.com/pages/about

Team, T. O. H. R. (2022, March 29). *Metal Roofing Cost Guide (2022)*. This Old House. https://www.thisoldhouse.com/roofing/22454384/metal-roofing-cost

Wilson, P. (2022, March 28). *Befriending trees to lower a city's temperature*. The New York Times. Retrieved May 6, 2022, from https://www.nytimes.com/2022/03/28/special-series/befriending-trees-to-lower-a-citys-temperature.html

[A picture of Ocean Parkway]. (2016). PoliticsNY. https://politicsny.com/2016/04/20/cuomo-fixes-ocean-parkway