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Ala Wai Canal: The Bridging of Opposites

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Our lands were once naturally able to buffer, absorb, and filtrate water from the mountains. These qualities were lost when the Ala Wai Canal was created and Waikīkī became densely urbanized. Up in the mountains, the Makīkī, Mānoa, and Pālolo streams, which feed into Ala Wai, were degraded when neighborhoods were built around them, worsening the systematic health of the watershed and Ala Wai Canal. Trash, debris, petroleum, and sediment plague the waters—often washing up along the Ala Wai Canal after storms. The presence of concrete dominated the landscape, and soon, the health of our land, water and ecosystems were an afterthought—forgotten. The impervious nature of our buildings, roads, and sidewalks deflects much untreated and polluted water into Ala Wai watershed—affecting its water quality and health. These practices now threaten the communities near the watershed. Ala Wai watershed is not equipped for a 100-year, or even a 10-year-flood. A flooding event of any of these magnitudes will be disastrous for the numerous communities near the Ala Wai Watershed—crippling our economy. Titled “The Bridging of Opposites,” our conceptual design proposal focused on the improving waterways that make up the Ala Wai Watershed by remediating water quality and preventing flooding. Our project inspires the communities of O’ahu to consider the ability of our lands to naturally use water to create healthy and resilient ecosystems. Instead of creating short-sighted measures, we opt for the integrative approach relying on the manipulation of our land and water systems to create places that are environmentally rich, responsible and resilient while accomplishing our socio-economic needs.

Jonathan Quach
I graduated from UH Mānoa with a Bachelor of Environmental Design in 2017 and I am currently a candidate for the Doctor of Architecture degree at the UH School of Architecture focusing on ecological design. While shaping our vision for Ala Wai Canal, we had issues with comprehending the scale of the Ala Wai Watershed because issues were both within the canal and the mountain streams that drain into it, and we had to somehow create a responsive system that accommodated one another. Working together with friends from different disciplines made the collaboration all the more fun and intriguing as we each came up with different approaches to the problems based on our training—creating a more well-rounded and effective solution to the issues at hand.

Thien Phuc Ngoc Nguyen
This project was a collaboration between three friends with huge aspirations to tackling ongoing issues of the Ala Wai canal by making it efficient, sustainable, and beautiful. I graduated with a Bachelor of Arts in Biology and my academic goal is to attend medical school to become a doctor and contribute back to my community. This project serves as an important outlook of how our environment is crucial in shaping our quality of life. As such, these insights will pave the pathway towards forward thinking from people with various backgrounds in taking actions that is greatly needed to preserve our history, maintain our present, and ensure our future.

Isabella Yu
I am currently pursuing a Bachelor of Arts in Economics. This project was an opportunity for my partners and I to combine our different backgrounds to come up with innovative solutions to an ongoing problem in metropolitan Honolulu. The road to true progress lies in sustainable development and we hope that this project reminds our readers that urban development does not need to be at the cost of the community and its people.
The Upper-Watershed

The Ala Wai watershed is comprised of three mountainous streams Makiki, Mānoa, and Pālolo, which channelize into the Ala Wai Canal (Fig. 1). In the upper-watershed, the backyard of residences in Mānoa and Pālolo meet right at the edge of the streams and canals of the watershed. In lower watershed areas, the Makiki, McCully and Waikiki neighborhoods are densely urbanized with numerous high-rise developments in close proximity to the Ala Wai Canal. The channel is systematically prone to flooding and in the event of a 100-year flood, would put numerous communities and assets at high risk of damage—the results would be disastrous, crippling communities and O‘ahu’s economy (Hofschneider 2015). The risks and consequences of an unequipped watershed have already been revealed in the Mānoa flood of 2004 in which intense rainfall led to Mānoa stream overflowing at several of its banks, forming a debris clog in the stream causing a great overflow in surrounding areas, amounting to approximately 85-million-dollars in damages, mostly to the University of Hawaii and 120 homes (“Flooding in Hawaii”). Therefore, in our proposal, we would first improve the upper watershed region by implementing forebays and constructed wetlands periodically in Makiki, Mānoa, and Pālolo watersheds to collect and filtrate sediment, outfall, and run-off before flowing into the Ala Wai Canal.

Cutting and Filling

For both of our upper and lower-watershed strategies, we employed the land-forming technique known as the “cut and fill” method as the basis of our ecological resilience strategies. The method excavates earth to form waterbodies and relocates the excavated material elsewhere on-site to create berms and mounds. Upstream in the mountainous waterbodies, the “cut and fill” method was applied to create the series forebays and wetlands in which the excavation was reused as dirt mounds to separate the filtering and the filtrated waterbodies. Downstream, in the heart of Ala Wai Canal, the existing Ala Wai recreational park and golf course features an extensive redesign to its topography, where “cut and fill” was applied to form reservoirs, temporal lakes, retention-detention basins, and protective berms along the edges of the canal. The berms are also soft, natural edge condition, which people can access, and forms a barricade should water levels rise and attempt to surge in. Furthermore, the berms guide the flow rainfall and outfall into storage. Within the park and golf course are pond reservoirs functioning as retention and detention basins working to retain water, containing an assortment of native plants and other ornamentals to remediate the water quality. The goal of transforming the park and golf course is not only to create a spectacle within the landscape to attract users, but also functional at an environmental level, working as sponges to hold, filter, clean and release captured water, and when needed, work as a soft shield from storm surges.

Creating a Healthier Watershed

The water flow from the mountainous streams of Makiki, Mānoa, and Pālolo is much to blame for the poor water quality in the Ala Wai Canal. Sediment build-up, polluted surface run-off, and lack of rainfall filtration are issues leading to degradation of the watershed which contaminates the waterbodies preceding the canal. Surface run-off is water that carries everything that has fallen onto the streets such as trash, pesticides, fertilizer, rubber from tires, trash and debris (“Neither Sewer nor Stream”). The neighborhoods of Makiki, Mānoa and Pālolo limit the amount of alterations that can be done to their waterbodies because homes are built on the very edge of the channel. However, what we can do is to implement forebays and wetlands early-on in the stream before the start and after the end of the neighborhoods. Forebays are flood control devices that trap sediment and debris by slowing the flow of water. These systems are reservoirs which will then release filtrated water in a controlled manner back into the waterway.

We can then place these techniques strategically throughout the upper watershed to develop a filtration system that creates cleaner water leading towards the Ala Wai Canal (Fig. 2).
The forebay system will be strengthened by implementing a wetlands system after each reservoir to further clean the water before releasing it back into the main stream waterways. Repeating these filtration processes periodically throughout the upper-watershed will lead to a cleaner and healthier watershed and ecosystem. Forebays and wetlands are riparian zones that are able to carry and control heavy quantities of water and, in turn, initiate natural habitats upstream for local flora and fauna—catalyzing biodiversity (Fig. 3). The goal of implementing these natural filtration systems is to create an upper watershed that functions better and is capable of remediating its health in the coming years. To further alleviate the pollution that surface run-off brings to the watershed, we propose to filtrate outfall and run-off through the use of green roofs and green walls on existing homes and buildings, permeable/porous pavement on sidewalks and parking spaces, and next, bio-swales and rain gardens along the streets and lastly, wetland remediating systems in underutilized park spaces.

**Sediment, A Pest No Longer**

Sediment is widely perceived as waste, and a plague to the health of streams, however when used properly, is actually useful in helping to increase agricultural yields ("Sediment"). Thus, we should not let sediment go to waste because it holds great promise to be utilized to assist soil fertilization. Hence, in our proposal, we want to initiate watershed management programs in which captured sediment will be collected, cleaned, redistributed, and repurposed to further agricultural uses around O‘ahu. Sediment enriches the soils with its nutrients, and sedimentary soils are known to be more favorable for farming ("Sediment"). Increased watershed management within our streams will create opportunities for volunteering, employment, neighborhood interaction, educational collaborations, and diversified agriculture—transforming the Ala Wai watershed into socio-economic source for O‘ahu. Over time, the sequences of forebays and wetlands in the upper-watershed will make the waters clearer and the sediment will make our lands and farms bloom with abundance. The goal is to convert something perceived as waste into something useful and impactful on the health of our precious ecosystems and communities. Henceforth, the mountainous watersheds of Makiki, Manoa, and Palolo have the potential to educate citizens of the significance of agriculture uses such as farming and gardening to our quality of life and wellbeing—become catalytic cores for ecology, biodiversity, agriculture, and socio-economic growth.

**The Lower-Watershed**

The Ala Wai canal was initially created to divert water from the mountainous watershed to transform what was once a wetlands area into the destination we know today as Waikiki—the center of O‘ahu’s economy and tourism—approximately 30-billion-dollars was invested in Waikiki to ensure that tourism and O‘ahu’s economy continue to flourish. Back then, the
project only served one function: to drain the wetlands and fill the area with artificial land which became densely urbanized. Today, Ala Wai Canal is at the heart of two neighboring communities, separating the McCully and Waikīkī neighborhoods. In the event of a 100-year flood, the canal would overflow and drastically flood all the neighboring communities, threatening the life and well-being of its residents and our economy. To make matters worse, the water quality in Ala Wai Canal is notoriously poor, as it is still contaminated with bacteria, pathogens from sewage spillage a few years ago. Before the time of the Ala Wai, wetlands dominated the area which possess the natural ability to filter drainage, run-off from the upstream valleys of Makīkī, Mānoa and Pālolo. Furthermore, the wetlands were both a filter and buffer to upslope drainages. All these natural systems were lost when the Ala Wai was created, and the introduction of built and paved surfaces tossed more run-off into the canal, resulting in polluted waterways both upstream and downstream (“Neither Sewer nor Stream”). As mentioned earlier, surface run-off is water that comes into contact with the likes of trash, pesticides, fertilizer, tires, petroleum, trash and debris—all of the like currently flow directly into our streams and waterways. Thus, the second part of our proposal, is to transform the lower-watershed area by bringing back the natural ability of the wetlands to absorb and clean the water to make the land and waters of McCully and Waikīkī more recreational, engageable and usable again (Fig. 4).

**Diverting the Flow**

The first intervention in the lower-watershed is diverting the waterflow of the Mānoa-Pālolo stream which currently feeds directly into the canal through the Ala Wai Golf course (Fig. 5). The Ala Wai Golf Course is vital in providing protection to neighboring communities. The golf course is a large relatively flat tract of land which will feature a redesigned topography to function as a large basin to carry the water surge from the Mānoa-Pālolo Stream. Functioning as a large “green” sponge, the new golf course will possess a larger series of forebays, retention-detention basins, and series of constructed wetlands within its new topography (Fig. 6). Over time, the basins become bio-swales as vegetation and plants phyto-remediate the water. Soon, the water becomes a catalyst facilitating

**Figure 4** Ala Wai Bridging of Opposites Master Plan.

**Figure 5** The Ala Wai Golf Course.

**Figure 6** Newly designed golf course with new topography to guide water into retention basins. The readapted course features wetlands ecosystem integrated with the functions of a traditional golf course.
bio-diversity by allowing life to blossom and self-sustain by creating a safer, and healthier habitat for birds and aquatic creatures. By doing this, the golf course becomes something beyond the underutilized, scarce, and flat-track of land it currently is today. The new water bodies, streams and slopes that engulf the course make the game more challenging and immersive. New walkways and promenades will meander through the wetlands—creating breaks in between each hole for golfing loyalists to enjoy (Fig. 7). Overall, retrofitting the course with these natural water systems merges ecology with recreational uses—creating a precedent for a space that can be both environmentally responsible and still retain the its core qualities (Fig. 8).

A Porous Park

Across from the golf course is the Ala Wai Recreational Park, a green-public-space that is moderately used but lacks the ability to treat water and shield the community from it (Fig. 9). Like the golf course, the park will also feature a new landscape to guide and manipulate water where the topography is designed to accommodate floodable promenades and an amphitheater (Fig. 10). The goal of redesigning the park is to increase usage and awareness through amenities that have the potential to be used programmatically, economically, and function resiliently. The new amphitheater can become a gathering place within the community, holding events and concerts. In a storm event, the amphitheater is filled with water, becoming a lake (Fig. 11). Along the shoreline of the park is a natural, porous edge containing ponds and protective berms (Fig. 12). The undulating landscape of the park is designed to guide, collect, and discharge water when needed. All features of the park bare the ability to be temporarily flooded, disappearing and reappearing when the storm subsides. Visitors will be greeted by a more established park through an engaging network of walkways and alternative routes circulating the ponds (Fig. 13). During times throughout the year, some paths along the edge near the water are rendered inaccessible as water levels may rise and consume them (Fig. 14). The floodable aspect of the park will demonstrate to the user and visitor the sense of impermanence, adaptability and evolution.
Figure 10  Pond reservoirs, new promenades and amphitheater add new opportunities creating a more engaging dynamic park.

Figure 11  The amenities of the park are designed to be adaptive to floods, becoming lakes and ponds shielding the communities in the event of a storm surge.

Figure 12  Multi-layered experiences are embedded into the landscape of the park. The pedestrian bridges connect the McCully and Waikiki neighborhoods.
Bridging the McCully and Waikīkī

The Ala Wai Canal has long divided the McCully and Waikīkī neighborhoods, offering no pedestrian accessible bridge to ease accessibility and connectivity to one another. Therefore, one of the goals in our design is to connect these two neighborhoods together through three pedestrian foot bridges (Fig. 15). Introducing multiple modes of connectivity encourages more access through walking, biking and running. The availability of parking in Waikīkī has always been scarce and the
price for it—exhaustible. Thus, these new pedestrian crossings encourage commuting by foot to both McCully and Waikīkī neighborhoods—alleviating the urban congestion that McCully-Waikīkī is notorious for. The bridges begin at the edge of the Ala Wai Recreational Park, suspend over the canal and connect through to the primary corridors feeding into the core of Waikīkī, where all the main businesses, hotels, and destinations are located.

**Elevating the Waikīkī Promenade**

On the Waikīkī side of the canal, is a hardscape promenade that covers the entire length of the Ala Wai Canal (Fig. 16). The promenade is a popular place to enjoy walking, jogging, bicycling and running. In this intervention, the promenade will be elevated by seven-feet to combat sea-level rise, and feature balconies or “Lanais” cantilevering over the water to expand the walkway to accommodate its range of uses more safely and efficiently (Fig. 17). Bio-swales and grass surfaces will line the street side of the promenade, functioning as rain gardens to absorb and filtrate storm water and surface run-off. Composing the bio-swales are soils capable of absorbing and holding-in the influx of water and using it to support ecologies and promote life (“Rain Gardens and Bioswales.”). The swales collect polluted surface water run-off from roads (sheet flow), stores it, and over time, cleans it, and uses it to catalyze biodiversity instead of letting the water pour directly into the canal (Fig. 18). On the balconies along the edge of the water, people can stop and see a multitude of things happening: people moving about the walkway and bridges, lushly vegetated floating gardens lining the promenade, and paddling teams canoeing in the canal. The Ala Wai has always been a popular place to canoe and kayak. Thus, adding viewpoints along the channel accentuates the spectator sport of canoeing, sharing the significance of canoeing in Hawaiian culture with people of all walks of life.

**Figure 16**  Waikīkī promenade along Ala Wāi Canal.

**Figure 17**  The redesigned Waikīkī promenade with rain garden, vegetated riverbank, viewing lanais and solar walkway.

**Figure 18**  The floating gardens along the edges of the canal create an attractive waterscape while remediating water quality. The roots of the plants feed into the water, absorb the contaminants and pathogens from waters, and doubles as a reef culture for fish.
Naturalizing the Edges

As part of our initiative to clean the water within Ala Wai Canal, we propose the deployment of Bio-matrix floating gardens along the edges of the entire canal. Bio-matrix floating riverbanks, is a technology that appears as an attractive waterscape aesthetic and also helps improve water quality and increase ecological growth (“Floating Riverbanks”). The floating gardens along the edges of the canal create an attractive and responsive waterscape aesthetic while helping to improve water quality and increase ecological growth. The gardens are aligned to compose a riverbank—naturalizing the edge. Within it lies an aeration tank which conceals a propeller that periodically rotates in the water. Aeration increases the water quality within the canal because increased circulation makes the water more active instead of remaining stagnant. The roots of the plants feed into the water, absorbing the contaminants and pathogens from the water and double as a reef culture.

Solar Walkways

Ala Wai Canal receives a generous amount of sun exposure throughout the day, we propose harvesting the sunlight and converting it into energy through a solar walkway. Throughout the day, much of the heat from the sun is absorbed into the concrete paving that makes up our buildings, sidewalks and pathways. The heat stored within our impervious structures contributes to the urban “Heat Island Effect,” which creates higher ambient temperatures during the day as heat in collected, and at night, when heat is released into the air. A solar walkway system would transform our walkways into self-sustaining, catalytic elements within the cityscape—creating a smarter streetscape (Liu 2014). Hence, all the main pathways of the Ala Wai Recreational Park and Waikīkī promenade will feature walkable solar panels to collect heat from the rays of the sun, create renewable energy, preserve it to light the walkways at night, and power the light towers in the waterways. The integration of solar walkway technology into our cityscape adds to the initiative of O‘ahu’s Clean Energy Initiative, where the Hawaiian Islands are powered 100% by renewable energy by 2045 (“Hawaii Clean Energy Initiative”). During the day, the solar panels will collect energy, at night, they will be self-lit—creating a dynamically alluring promenade. Furthermore, the panels can be programmed to generate different rasterized patterns and colors—lighting up and livening the walkways in an immersive way—increasing both safety and park use at night.

Increasing Community Awareness

As mentioned above, automated light towers are placed throughout the Ala Wai Watershed to monitor the health of water and flood safeness. The purpose of the light towers is to create a responsive network that is able to actively relay information to the residents about the status of the water quality, water level, and notify people of potential flood evacuation precautions. The first feature of the light towers will be able to assess the water quality of the streams from the mountains and canal. Each tower accesses the nitrogen, pH, and turbidity levels of the water, and in response, is programmed to light up, flashing in specific modes. The normal appearance of the tower is of white light to illuminate the dark areas of the waterways, and foremost, will periodically transition to flashing green light to signify good water quality, orange for moderate water quality, and red for bad water quality, and flash red continually to notify citizens of any drastic activities in the waterway and any noticeable rises in water levels.

Each light tower will be composed of four light boxes, in between each box are three light slits to represent three stages of alerts regarding water-activity. The first, the lowest slit, “alert one,” stands for increased activity in the waterway, the second slit, “alert two” means that there are noticeable water-level rises and that caution should be taken, and lastly, the highest slit, “alert three” means that flood mitigation systems of forebays, retention-detention basins, wetlands are near max capacity. The presence of the light towers lining the edges of streams and canal actively notify citizen on the status of the waterways, becoming symbols representing numerous communities that reside near the Ala Wai Watershed. The towers increase people's awareness, and, in turn, their consideration of water related issues and inspire them to actively ensure that the towers do not display orange or red lights. The towers work as a motivator to increase efforts represent our communities appropriately by preserving and prolonging the health and well-being of our waterways.

Conclusion

Over time, our relationship with our land and waterways became increasingly detached, we began to perceive these precious elements as opposites—land as something to pave over and water as something to avoid, push aside and bottleneck. Before Ala Wai Canal and Waikīkī, our lands were once able to naturally shield settlements, absorb, filtrate and clean water, and irrigate over unique 100 species of taro. All these qualities were lost once settlements became densely urbanized, leading to tainted soils, polluted waterways, and floods. In “Bridging of Opposites,” we seek to bridge divided communities by bridging the severed relationship with land and water through design (Fig. 19). Our vision will not only improve water quality, and control flooding in the canal, and nearshore environments, the design also aims to weave the community together by creating a multi-purpose space that is accessible, safe, economically rich, educational, and an overall more engaging human experience (Fig. 20). Our mission in “The Bridging of Opposites” is...
Figure 19  Ala Wai Canal is equipped for resiliency through both ecological and functional interventions: a flood adaptable park and golf course, pedestrian bridges connecting the communities, elevated Waikīkī promenade and primary walkways lined with solar energy harvesting panels.

Figure 20  Above are isolation diagrams depicting the anticipation of each individual design element for future flood events. The topography of the Ala Wai Recreational Park allows for its edges to be drastically flooded to shield the McCully neighborhood. On the other hand, the Ala Wai Golf course will function as a large reservoir where water is collected and stored. In the upper-watershed, forebays will mitigate the intensity of floods and wetland systems will absorb and purify the water.

to create safe, self-sustaining and inspirational environments from the top to the bottom of the watershed that will draw the attention of the local and visiting communities (Fig. 21).

References
