Reflection on research and design process: Engaging with Water

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Research reflection: P1 and P2

During the research emphasis was laid on the essence of building more water resilient environments that adapt and respond to the changing climate. Heavy rainfall and rising sea levels, but also water scarcity are becoming a reality which asks for a different approach on how we design our cities and buildings. More space needs to be created to capture and release water when needed, like the functioning of a sponge. Therefore, during this research a design guideline was created showing how to work with and tackle the water problems a specific area is facing. The research is supported with an analysis of sustainable water interventions, like sustainable urban drainage systems (SuDS) and Green Infrastructure (GI). An integral approach on three different scales is necessary to create a water resilient building, as each location and or site has different characteristics and challenges that need to be faced. Moreover, the plead to adapt to our water systems and give more room to water streams is supported by biomimicry and biophilic design aspects. Water is not only a thread, but also a pleasant feature whereoff its potentials are mainly still unused, like the psychological effect of water on our health, and the calming effect it has on people because of negative ions that are released by streaming water. Negative ions constribute to the production of serotonin, also known as the 'feel good' chemical in our bodies. In our buildings it can help enhance our well-being as we have become used to living indoors, which these days leads to stress and depressions. The overall problem statement is here the missing link of the absence of the awareness to become more sustainable with our water systems, and why it is essential to implement smart water systems into our living environment. This is not only visible among citizens, but also among the investers that hold the power of certain design descicions in their hand. The different stakeholders therefore need to be stimulated and activated to be able to implement sustainable drainage and re-use systems.

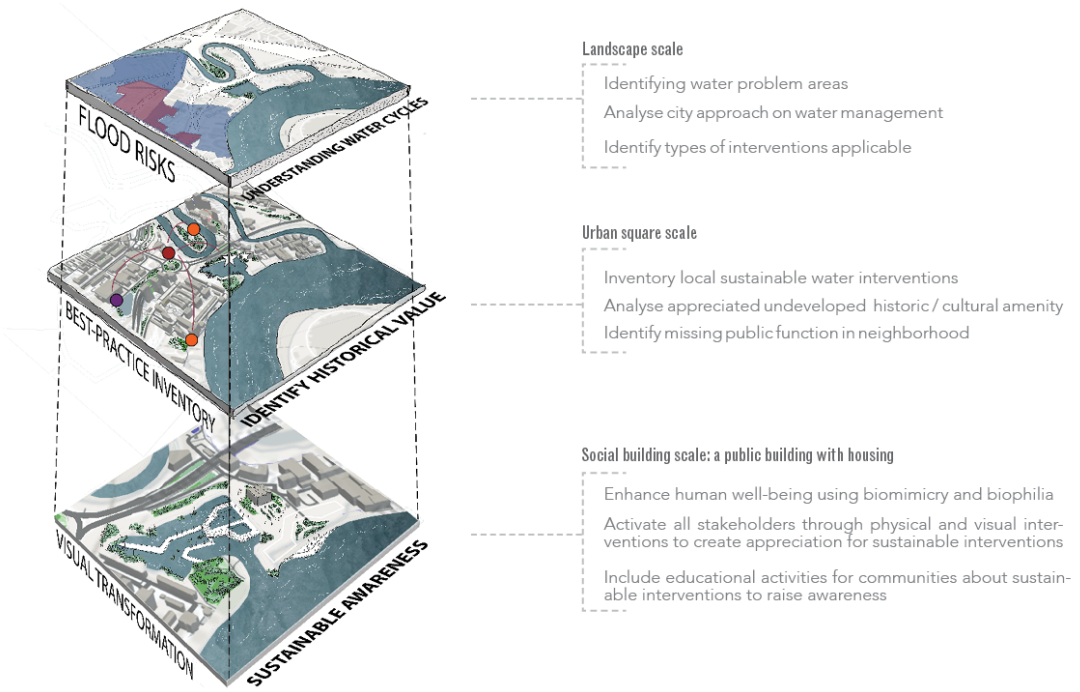

Figure 1: Research design guideline: connecting scales with water sensitive designs (image by author)

The three scales help to get a full picture of the intervention types that could be applied to a specific area. The landscape scale is a broad perspective on what type of interventions could be applied in the urban city structure based on the landscape typology it is situated in, like a city next to the sea or river. Aspects to consider, are the governmental approach on water management, but also interventions that have already been applied to tackle local water problems, to fit within the plans and ease the integration process. For this scale, water flood risks or water scarcity risks need to be inventoried to get started and see what risks the location is facing.

The urban square scale focussed more on comparing the succes of the types of interventions that are applicable in and around buildings, streets and parks. It showed that combining these technical interventions with interactive water playgrounds or activities is received as very pleasant as water is also a soothing element to the eye and moreover has a cooling effect, thus contributed to an increased health. The system types: sustainable urban drainage systems (SuDS) and green infrastructure (GI) can also be combined to not only be successful in terms of water management, but also as an enrichment in our living environment. For each location different urban drainage system combinations can be made, depending on the water flood type it is trying to resolve, like surface flood water or river floodings. Finally, the compared projects of the framework showed that new initiatives among inhabitants emerged when a better water quality was created.

Lastly, the social building scale finally focussed more on the effects of water on our human health related to living indoors, while taking in consideration its natural potentials. Biomimcry analyzes the effect of using nature's forces to recreate natural systems to promote energy efficiency in buidlings and cities. Biophilia on the other hand focusses more on the human's well-being indoors through the usage of natural elements, like placing plants in work areas, or fountains in public areas. These are visual translations that people can understand, which is of importance to communicate the sustainable awareness that needs to be stimulated. On the other hand, other stakeholders also need to be motivated which asks for a different approach, such as licenses and awards like BREEAM. Those are motivating factors to integrate water saving systems in designs. Focussing more on the aspect of water, it can also be used for multiple senses, like the sound of streaming water, but also the feeling and visual reflection of water. Combining the technical interventions with interactive visual systems can lead to more sustainable awareness and can create connections among locals in the end to stimulate collective water management and water saving habits within communities.

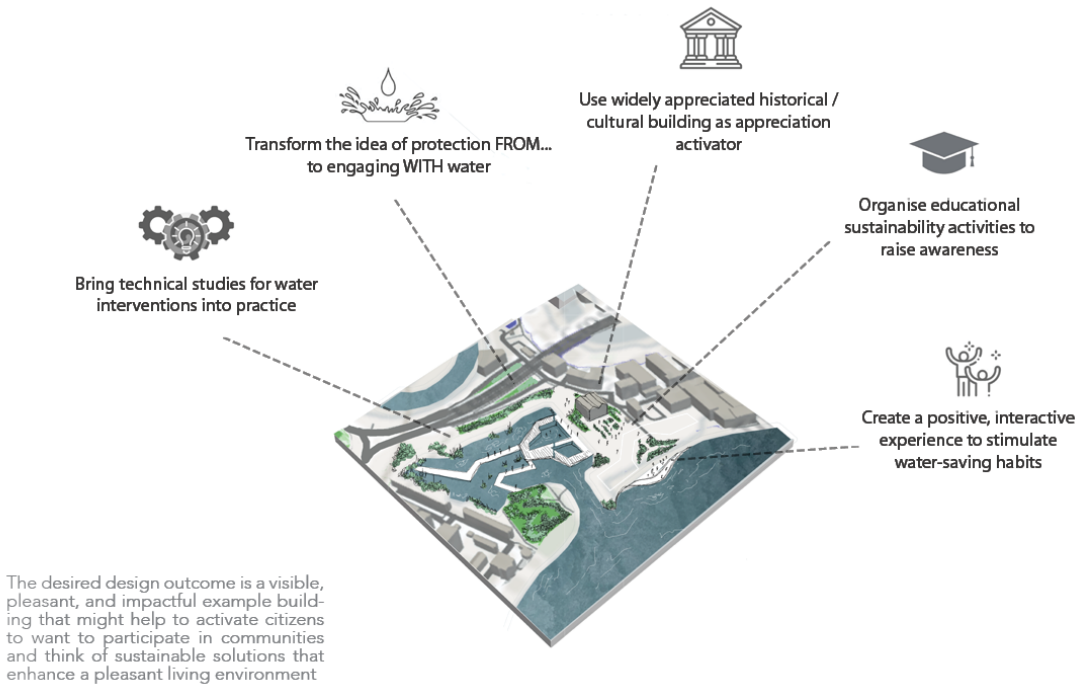

Figure 2: Desired design outcomes: helpfull outcomes to integrate water interventions in existing areas suffering from water flood risks (image by author)

After having researched all three scales on how to implement water intervention types and how to create enough awareness of the neccessity to adapt to our changing climate regarding collective water management, it has become clear that it is a very complex process. Many stakeholders are involved to be able to realise sponge buildings, as it asks for more investments from all types of clients and parties. Thus, not only water saving habits are reached among people by showing them the water type interventions visually. Important motivating factors are outstanding awards and certifications for the very most sustainable buildings. From research it had become clear that certifications and awards will lead to an incorporation of more sustainable systems within buildings, while otherwise it would have been left out, and thus work as a motivating factor.

Product: site selection and final design descisions (P3 and P4)

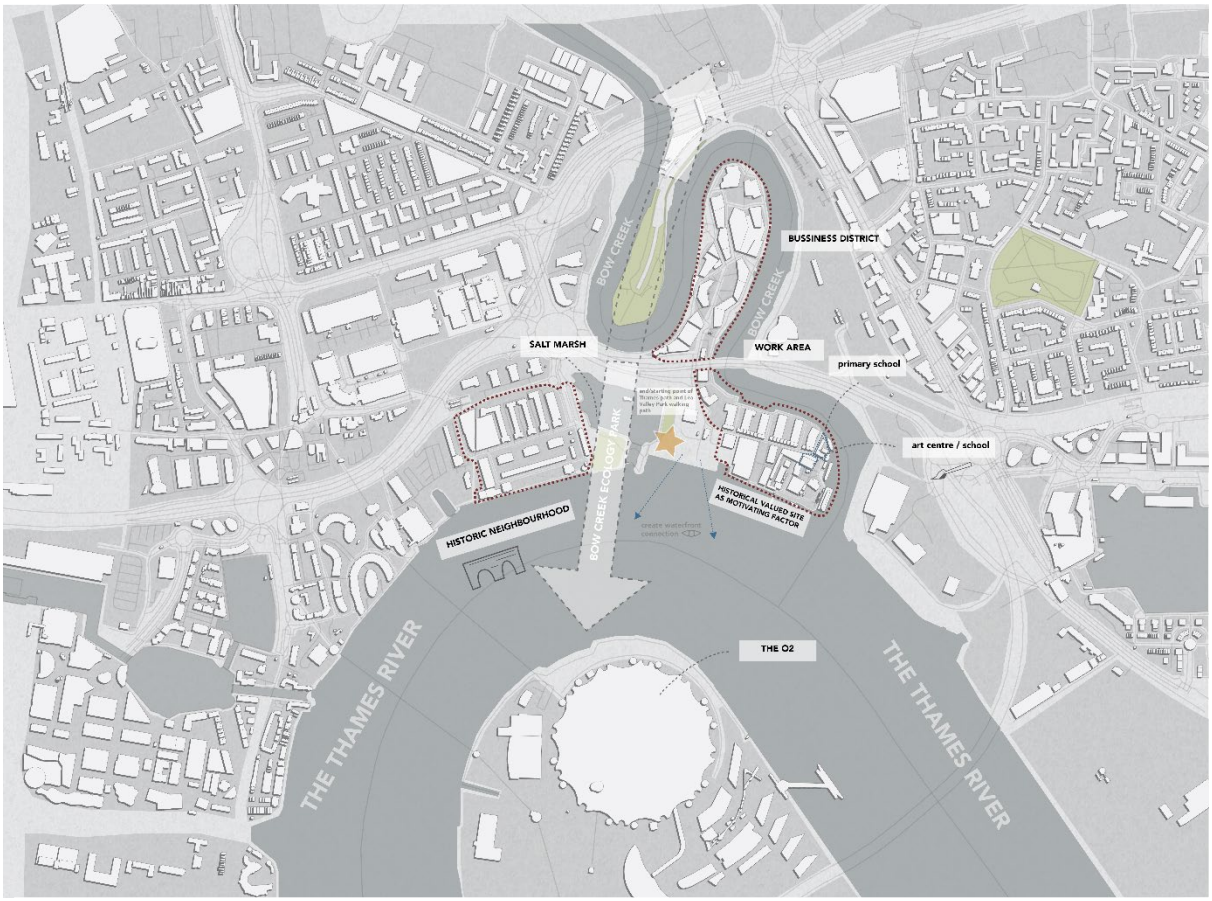

Figure 4: Masterplan Orchard Wharf, London for water resiliency 1 to 20.000 (image by author)

From the research a site suffering from water problems was chosen to test the guideline and design approach that could later serve as an example on how to tackle water problems and integrate sustainable urban drainage systems within buildings that interact with its users. A site located next to the Thames was selected that in the future would suffer from riverine floodings, but also surface floods due to heavy rainfall that would become more frequent. The sustainable urban drainage systems were compared within the research to see what system would fit best. The design descisions were based on the guideline created steps, which started with the landscape scale, followed by the urban square scale and finally the social building scale. It has become clear that it is quite a challenge to intergate water sustainable systems where people can have interaction with, but the design approach has showed that it is possible to implement the technical interventions in an aesthetical way, without disrupting the overall design and could even lead to innovative new design ideas. Looking at all the interventions that need to be built and integrated it would cost a lot of investments to be able to build water resilient buildings that function as a sponge. Stakeholders need to be convinced of the long term benefits the building would

generate for them. In this approach it turns out that you have to use smart tricks, like using cheap and local building materials that would outweight the costs of the sustainable urban drainage systems. Also, to be able to create affordable housing, which forms an even bigger challenge, as the costs of the housing must remain low. This, while keeping in mind the water resilient characteristics of the materials. Within this project for example cross laminated bamboo is used as a local resource material. Bamboo can grow quite fast and absorbs more carbon dioxide than regular CLT wood, making it a contributor to CO2 emmision reduction. Besides, the selected insulation type is hemp insulation, which can grow locally and quick, but is also more water resistant then other insulation types. Not only local materials can be a descision factor. The biomimic elements, like using the warmth and light potentials of the sun, or natural wind flow can also help to reduce the costs on the long term. These aspects fit within the urban square scale that make the project more efficient and cost effective. The social building scale is the most important factor that determines the final costs. For the façade design, gutters are being made visible on the exterior and become part of the design, just like the visible air filtering system within the inner courtyard, so people can enjoy them visually and physically. The designed building is designed as an optimal example solving all the water problems, while also creating a healthy habitat for the citizens. Special attention to the investment costs needs to be paid, as the costs for keeping the soil intact will stay low, because almost no underground drainage systems need to be placed. The collection and controlling of water run-off takes place above the ground, easing the underground water management systems of the endless maze of pipes because the building will re-use all the water and everything left-over streams towards the plants to irrigate.

Process: relation between research and design

Figure 4: Urban plan design scale water resiliency 1 to 1000 (image by author)

To be able to tackle all the problems the three scales were used as a design base, starting with the landscape scale. This approach leads to a save design where different heights of possible floodings were taken as a starting point. Also to divide the different descisions into smaller steps. It turns out that starting with this scale works the best, as the building becomes embedded within a landscape that adapts to changing weather types. This way, the buildings make room for the water and guide it to specific areas chosen to collect water. It results in safe spaces where floodings are regulated in specific areas. In times of danger from high tides, people can safely leave the location by incorporationg air bridges that connect the buildings to one another. As can be seen in the diagram, the buildings have a specific, unusual form that have been created through the thought of guiding the water to assigned water collecting areas. The formation of the strict grid that was created by the landscape form, had led to less freedom in designing the building blocks, because the waterways have determined the formation of the blocks, which might be a design restriction. It was not possible to create a repetitive, systematic grid, which then might result in more building costs, which could be a determining descision for the client. Something to take into consideration. But when water levels rise, at least the building is more protected from damage. Building close to the riverfront can on the one hand lead to a very qualitative living environment, but on the other hand brings challenges regarding the quality of regular building types in times of water floods. Mostly, buildings cannot recover very well from water damage, resulting in a lot of reparing costs. Through the process of looking for materials that are water-resistant, or how to make materials water resistant, it becomes more profitable to apply these types of materials to be able to recover quickly after a flooding happened. Certain design principles have been used to reduce the risk of flood damage on also a smaller scale. Cross laminated bamboo (CLB) turns out to be a good alternative to the regular building materials the market has to offer, as it is more water resistant than CLT and more environmentally friendly than water resistant concrete.

Regarding the research, more focus could be put on the analysis of building materials and how to make them water resistant. In the example building butresses have been used to slow down the water and protect windows from cracking (as rubble will be taken by the water stream), which is a thought reasoning, by basically thinking of the functioning of a buttress. The buttresses had become part of the building, as both a technical and aesthetical aspect, showing a beautiful integration of both. Therefore, you could dive a bit deeper into this subject. For this research, multiple scales were analyzed, which gives a good overall view on how to approach water problem areas and design sponge buildings. Another research on a smaller, detailed scale could be conducted to confirm the water resiliency of certain building materials.

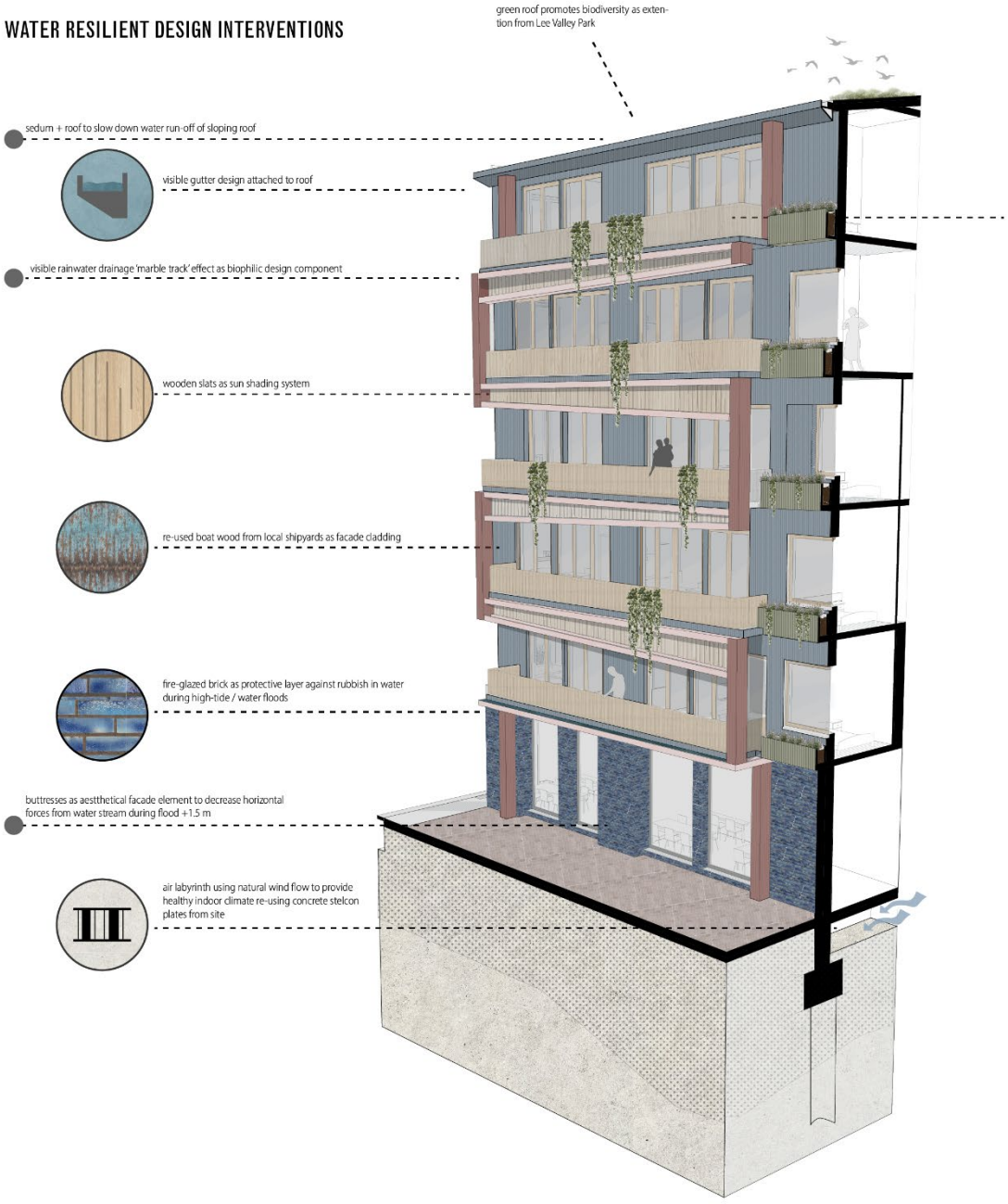

Figure 5: Water intervention types overview aesthetical elements in facade (image by author)

The relationship between the graduation (project) topic, studio topic and mastertrack Architecture

First, the graduation topic focusses on implementing water into buildings to create water sensitive designs, which is something that should get more attention regarding the future of our city and the climate change. The studio focusses on technical research combined with an architectural design. Water is a technical topic, that can be applied in buildings in an aesthetic way, by combining and integrating the two different research topics. The master track is Architecture, focussing on creating new architecture typologies challenging you to think creatively and designing more than just beautiful buildings, but can really add something to our living environment and everyday life. Since the graduation topic is about creating new design approaches for the future it is relevant for the way we design nowadays. It also requires an integration of landscape in architecte (when focussing on collective water management, whereby sustainable urban drainage systems (SUDS) and Green Infrastructure (GI) are part of, which fits in the overall approach of the MSc AUBS Master's programme.

Elaboration on research method and approach chosen by student in relation to the graduation studio methodical line of inquiry, reflecting on scientific relevance

The graduation studio has three design domains, which are Make, Flow and Stock, whereby student can choose a direction for a specific research and design topic. The designed project fits within the Make domain, as it focusses on creating new architectural typologies that lead to healthy living environments that adapt itself to the changing climate as Make focusses on how buildings can be developed for the future in a sustainable way. Hereby, there is also the possiblity to work and test new building materials, applicable to new and existing buildings. The domains help forms different topics on what to research and get a clear picture of problem statements and how to approach the problem using technical and architectural design solutions.

Relationship between the graduation project and the wider social, professional and scientific framework, touching upon the transferability of the project results

The aim of the design is to optimize the existing city structure regarding water conservation and revitilize the current living environment to a healthier habitat that benefits inhabitants on multiple aspects. The design is used as a translation tool to address communities on how to become sustainable on indoor and outdoor level. Surface water used in designs for example, functions as a water reservoir and cooling element for people. By using different design criteria that can be applied to each location with a unique approach, the research becomes generic but is still location specific. And since the existing areas that are facing floods and drought are being transformed into interconnecting spheres of water retainment, a deeper connection to nature is created (CWRA Steering Group, 2019; Simpkins, 2024). Of course, different interventions need to be applied on different locations. The chosen location in London is an example that will apply the developed research project and will test the guideline. In general, the thematic research is a research design tool to help understand natural water cucles and how to implement them in our society on a sustainable and social level leading to healthier cities to live in. Whilst the media mostly informs us on the disastrous events happening around the world regarding the climate change with people dying from the inevitable devastation of settlements and nature, this will make it seem as if acting upon the climate change is of no important anymore. Seemingly makes it even feel there is no possibility in saving the planet anymore. Focus on the small sustainable improvements to better our environment is therefore of imporance as it brings a more positive glance of the future. It encourages people to think of creative outcomes.

Planning towards P5

After the P4 presentation, a model will be made to show how the design principles have influenced the aesthetic look of the building. It then becomes more graspable, to be able to see how the building was build-up and formed. Moreover, a smaller research and overview of the design descisions for material use will be made that could be further looked into, as the water floodings are becoming our reality sooner than we might assume and show the neccessity of become more sustainable regarding water management.

Critical questions that remain, are:

- How to motivate the big investors to invest in integrating sustainable water systems within buildings?
- How to teach local people about water management in a simple understandable way?
- What are sustainable, durable materials that can withstand water floods?

APPENDIX

1. Cleveland Clinic, C. C. M. (n.d.). Serotonin. Cleveland Clinic. Retrieved from https://my.clevelandclinic.org/health/articles/22572-serotonin#:~:text=What%20is%20serotonin%3F,(your%20peripheral%20nervous%20system) on June 12th, 2024.
2. CWRA Steering Group (2019). *City Water Resilience Approach*. ARUP. Accessed on September 20th 2023, from https://www.arup.com/perspectives/publications/research/section/the-city-water-resilience-approach