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Dedication

I dedicate this to the Lord, without him, this would not be possible, eternally grateful for his love and help during this process. I would also like to dedicate this to my parents, their support and encouragement are my motor to continue on.

Acknowledgements and thanks

Without the Lord, I would have not been able to accomplish this goal. I thank him for his guidance and wisdom during all of my years in the School of Architecture. I would also like to thank my parents for their prayers, unconditional support and presence during my thesis process. Dad, thank you for being my partner and confidant in all things design. Mom, thank you for being my constant motivation.

Abstract

Abandoned public properties and lots abound in nature-less environments where only the concrete prevails. Slowly but surely, nature finds a way to take back what was once its home but, in a toxic remain. This leads to unsecure spaces that are not safe for the enjoyment of the community and are not healthy for the growth of natural species. In Puerto Rico, the growing number of abandoned architecture and vacant lots are incrementing at a vast pace, causing the reign of brownfield sites that affect public safety, economic development and poor environmental management. This leads to the question: Can abandoned properties become part of the green infrastructure to promote a pro environmental consciousness? A possible solution is to manage the mishandled for it to be integrated in the green infrastructure, interconnecting environmental spaces and incorporate amenities for public use. The intervention methodology will be to repurpose a brownfield site into a Civic Center with recreative spaces in a sustainable way, becoming thus a Smart Growth opportunity to address the non-market values of ecosystems and misused lots, where nature can prevail. For purposes of this investigation, the research of the environmental contamination and the importance of a pro-environmental mentality will be made. As well as the study of brownfields caused by negligence of public nuisances will lead to determine a site that has suffered abandonment and that is being “taken over” by nature. The use of bibliographic sources, such as the United Nations and EPA reports, are going to be analyzed; and interviews will be made to experts in the fields of reforestation, green infrastructure and brownfields such as Dr. Pedro Rivera, Cynthia Burgos and Zolymar Luna.

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Introduction: Nature is calling, she wants her place back

Abandoned public properties and lots abound in nature-less environments where only the concrete prevails. Slowly but surely, nature finds a way to take back what was once its home but, in a toxic remain. This leads to unsecure spaces that are not safe for the enjoyment of the community and are not healthy for the growth of natural species. Nature being a fundamental part of life is degrading at a vast pace due to erroneous human activities, causing a pressing need for its survival. The necessity for a vessel to promote awareness becomes clear where a pro environmental consciousness is lacking.

In Puerto Rico, the growing number of abandoned architecture and vacant lots are incrementing at a vast pace. Countless news articles expose over 250,000 empty homes[1], 365 closed schools[2], and 8,000 commercial premises[3] that make only a part due to economic recession and market collapse. Furthermore, there are brownfield sites that also affect public safety, economic development, historic preservation, and most importantly, the environment. The mishandling has led to poor environmental growth since it confronts a struggle to form healthy and abundant ecosystems.

Can abandoned properties become part of the green infrastructure to promote a pro environmental conscious? A possible solution is to manage the mishandled for it to be integrated in the green infrastructure, interconnecting environmental spaces and integrating amenities for public use. The intervention methodology will be to repurpose nuisances into recreative spaces in a sustainable way, becoming thus a Smart Growth opportunity to address the non-market

[1] Ronald Ávila-Claudio, *Mas de 250,000 Viviendas Vacías En Puerto Rico, Según Estudio*, *Metro PR*, 2018.

[2] El Expreso, *Abandonadas 365 Escuelas*, *El Expreso*, 2019.

[3] Istra Pacheco, *Locales Que Nos Pueden Sacar Del Hoyo*, *Primera Hora*, 2016.

values of ecosystems and misused lots and turning them into benefits using green infrastructure strategies where nature prevails. An example of this is the implementation of strategies that are present in urban forests and effective public spaces for the bettering health, education and enjoyment for the community.

For purposes of this investigation, the research of the environmental contamination, such as deforestation caused by human activities, the importance of a pro-environmental mentality, and laws and entities that are viable for environmental protection, will be the starting point into the development of the first chapter. Interviews will be made to experts in the fields of reforestation and green infrastructure, such as Dr. Pedro Rivera and Cynthia Burgos. For the second chapter, the study of brownfields caused by negligence of public nuisances will lead to determine a site that has suffered abandonment and that is being "taken over" by nature. Next will be to map their location, study the history, placement and social/cultural impact. Then, view where it majorly abounds in the island to study the history and culture of the chosen town and thus chosen community. Also, visits and photographic research of the locations of the chosen typology and the use of interviews to the community will be made, as far as possible, due to the pressing times. Furthermore, the identification of what type of environment is found, what type of greenery can benefit the space and what architectural methods can be used to exalt and protect the growing environment will be key. The use of bibliographic sources such as the United Nations reports (The New Urban Agenda, The Brundtland Report and 2030 Agenda), books such as "The Green New Deal - Why the Fossil Fuel Civilization Will Collapse by 2028, and the Bold Economic Plan to Save Life on Earth" by Jeremy Rifkin and *Infraestructura Verde y Nuestros Parques* by María Juncos and articles such as *Los estorbos publicos en Puerto Rico* by Luis Gallardo for statistics of public nuisances.

Chapter 1: Knowing our endangered Environment

1.1 Environmental Degradation – DANGER – Global Emergency Ahead!

This is the alarming reality we're facing: climate change causing environmental degradation and becoming one of the major obstacles to a worldwide sustainable development. According to the Intergovernmental Panel on Climate Change (IPCC), a scientific resource in the United Nations, stated in 2018, the acceleration of global warming emissions and climatic events as a warning to mitigate such actions that are causing these events.[4] Erroneous human activities have caused the environmental threat of natural resources, an example is deforestation, a global problem that affects, not only the diverse ecosystems and biological life in the planet, but also the survival of 2 billion people who rely on forests for food and shelter.[5]

Forests being green communities composed by trees, flora and fauna are found all over the world, with distinctive species according to the region, that help regulate the climate. Yet only 30% of the earth's surface[6] is covered by them. Once they are cut down, they release all the stored carbon dioxide, one of the four principal greenhouse gasses, into the atmosphere causing an increase of three-quarters into the atmosphere.[7] Furthermore, the environmental neglect has caused a degradation and has led to the desertification of arid zones and 3.6 billion hectares. [2]

According to a study led by Christina Nunez from National Geographic, 13 million hectares of forests disappear yearly and, between 1990 and 2016, the world has lost over 502,000 square

[4] Jeremy Rifkin, *The Green New Deal - Why the Fossil Fuel Civilization Will Collapse by 2028, and the Bold Economic Plan to Save Life on Earth*, 2019, 5

[5] Christina Nunez, *Climate 101: Deforestation*. National Geographic, 2019. https://www.nationalgeographic.com/environment/global-warming/deforestation/.

[6] United Nations, *2030 Agenda for Sustainable Development*, 2018, 69

[7] Natalie Tawil, *Deforestation and Greenhouse Gases*, 2012, 2

miles of forests.[2] Although natural factors, such as wildfires and overgrazing cause deforestation, the human factors are the major contributors to such devastating act. Example of these are agriculture (crops), developed land (urban sprawl), logging for paper and wood and livestock (beef and other animal products for consumption). The destruction and degradation of forestland has led to the emissions of carbon dioxide (81%), methane (10%), nitrous oxide (7%) and halocarbons (3%), resuming that the concentration of these have increased since the industrial era.[8] Although forestry and agriculture are guilty of emitting 24% of greenhouse gasses, according to the Environmental Protection Agency (EPA), construction and industrial activities, such as urbanization, constitutes 26% of the carbon dioxide emitted.[5]

Rural and urban population growth demands for facilities, such as buildings and waste space, to fulfill human needs, thus, the increase of lands needed lead to the wipeout of natural environments. These lands, that were abundant in green life, supported the soil and the runoff waters, thus controlling the possibility of erosion. Nonetheless, the absence of tree roots to sustain the soil leads to a land easily prone to flooding and erosion, two factors that continue to worsen with hurricanes and mudslides. Natural environments are needed to mitigate thoughtless actions from our part and natural phenomenon that continue to worsen. They are often valued and cared so far as they provide to human needs, yet they are also victims of human exploitation, consumption and production means. The earth cannot afford to lose more of its forests. After decades of not viewing climate change as a red sign, now there are measures to try and salvage what's left to protect and restore.

1.2 Pro-Environmental Consciousness

[8] Environmental Protection Agency, *Greenhouse Gas Emissions*, Environmental Protection Agency, 2018. https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

The term Pro-Environmental Conscious was derived in the 1960's as a study of the Environmental Psychology field. It is a psychological term that seeks to understand how human beings are influenced by surrounding factors such as: social, cultural and economic factors, education and awareness factors, also attitudes, emotions and individual sense of responsibility factors.[9] Every factor influences each action and will shape the mentality of how to respond to the environmental crisis. An example of this are US linear models shown in Figures 1 and 2:

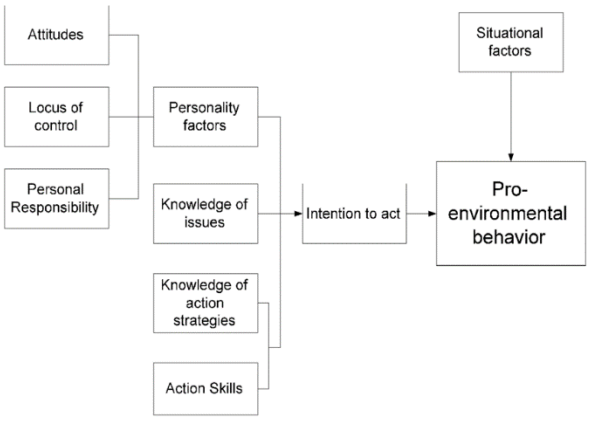

Figure 1: Models of predictors of environmental behavior (Hines, 1986)

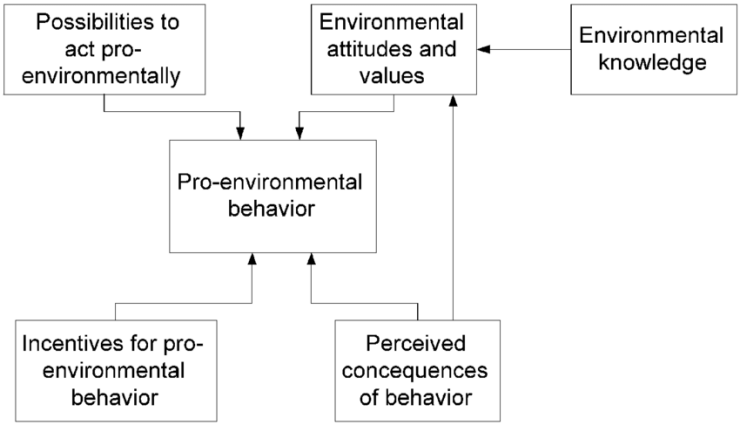

Figure 2: Model of ecological behavior (Fietkau & Kessel, 1981)

Each citizen must realize that they are a part of the problem, but, in terms of valuing nature and its ecosystems, they can help towards the solution through the education of the importance of conservation and having direct experiences with the endangered environments.

It took decades for the human being to understand the impact of negligent actions towards a vital green lung. This is why it is important to understand that:

> Nature responds to our actions. It is a reflection of who we are. It is a mirror of our society and how we interact with each other. To hurt her is to hurt ourselves.[10]

[9] Anja Kollmuss and Julian Agyeman. "Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?" *Environmental Education Research* 8 (2002), 3

[10] Joaquin Mont, *Para La Naturaleza*. Para La Naturaleza, 2017, https://www.paralanaturaleza.org/.

Human and Natural life are linked and must coexist in harmony, the involvement and interconnectedness of both ends must carry the responsibility to supply their needs in an ethical manner; therefore, the conservation of the environment is vital.[11] Reorienting civilization with sustainable strategies to value the intrinsic qualities of nature, such as belonging and respect, is missioned in a global scale to apply it in a local and municipal context. An example of this is the World Environment Day, celebrated June 5th, to sensitize people towards the protection of their environments. Another method towards environmental education are the sustainable developments envisioned by the various reports of the United Nations, such as The Brundtland Report, The New Urban Agenda and the 2030 Agenda, to portray the global environmental threats and the goals to overcome the ongoing crisis. The long-term environmental strategies seek to reinforce the importance of conserving the abundant and threatened ecosystems. Two examples that interlock are Goal 11 and Goal 15:

GOAL 11 – Sustainable cities and communities = make cities and human settlements inclusive, safe, resilient and sustainable. By 2030, provide universal access to safe, inclusive and accessible green areas and public spaces, particularly for women and children, elderly people and people with disabilities.[12]

GOAL 15 – Life of terrestrial ecosystems = protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, fight against desertification, stop and reverse land degradation and stop the loss of biodiversity. By 2020, promote the implementation of sustainable management of all types of forests, stop deforestation, recover degraded forests and significantly increase afforestation and reforestation worldwide.[13]

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[11] Dirk Willem, *Why Care for Nature? In Search of an Ethical Framework for Environmental Responsibility and Education*, 2006, 144

[12] United Nations, *2030 Agenda for Sustainable Development*, 2018, 55

[13] United Nations, *2030 Agenda for Sustainable Development*, 2018, 67

They should be applied in a sure pace since the unsustainable consumption is incrementing at a vast pace, causing biodiversity loss, pollution, pressure on ecosystems, among other factors.[14] Furthermore, they are committed to global reforestation to improve, protect and recover degraded forests and environmental services, such as natural habitats, water and biodiversity. Cities and human settlements must manage a sustainable way of consumption and production to be able to minimize their environmental impact.[15] Rehabilitating and revitalizing urban areas in a sustainable way is one of the goals into transforming and revitalizing the problem. As mentioned in the New Urban Agenda:

> There is a need to take advantage of the opportunities presented by urbanization as an engine of sustained and inclusive economic growth, social and cultural development, and environmental protection.[16]

In the late 19th and 20th centuries, conservation movements were a call to protect land, water and wildlife from excessive urban development and industrial uses.[17] That is why to promote a pro-environmental consciousness and carry out environmental protection in urban areas where nature is at risk, the term green infrastructure exalts the recuperation, conservation and restoration of ecosystems in a viable manner. Examples of what can be found in them are: permeable pavements, bioswales or vegetated swales, trees, rain gardens, planter boxes, among others. These resources target specific priorities by assessing pressing environmental threats and needs, such as reducing pollutants and lessening water flows, that interconnect and perform for the bettering of the environment.

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[14] United Nations, *The New Urban Agenda*, 2017, 18

[15] Ibid, 19

[16] Ibid, 15

[17] USDA Servicio Forestal, *Inventario Detallado de Áreas Protegidas y Otros Mecanismos Para La Conservación de Terrenos En Puerto Rico*, 2019, 3

Human greed can only go so far to exploit green spaces for own benefits, considering the way we treat ecosystems in a dispensable way, that is why the concept of green infrastructure highlights the significance and importance of ecosystems so they will be treated as they should.[18] The term enables communities and cities to become the source of solutions by networking efficiently natural spaces to improve the community atmosphere and quality of life. Strategizing the focal points of natural elements in populated urban areas will permit the access of local communities to contact with nature, since they will stimulate and will ensure the functioning of ecological processes.

Since it is a web of natural green spaces, in which there are protected ecosystems such as bodies of water, wildlife habitats, agricultural reserves and non-urbanized lands[13], the concept of green infrastructure, conceived in the 19th century when the construction of urban parks in the cities of the United States began, also appoints to natural landscapes in urban areas that have been impacted by human activity. Examples of these are urban parks, greenways and linear parks between built areas, that become strategies to bring green elements to cities.[19] But, due to the sprawling growth of grey infrastructure, such as urbanizations and commerce, it has caused inefficient use of land and abandonment of impacted estates, severely damaging green infrastructure.

The term “Smart growth” devised by the Environmental Protection Agency (EPA) in 1995, is an approach to urban sustainable development, that not only considers economic viability, it also seeks to respect the community environment and the conservation and protection of natural resources. It:

[18] María Juncos, *Infraestructura Verde y Nuestros Parques*, 2005, 11

[19] María Juncos. *Hacia El Desarrollo Inteligente - 10 Principios y 100 Estrategias Para Puerto Rico*, 2018, 12

Contemplates an integral and regional planification based on the efficient use of lands, directs efforts toward redevelopment or rehabilitation of abandoned – or unused – industrial buildings and land that are in or near urban areas, and promotes the creation of distinctive, attractive, safe, pedestrian-friendly communities. [20]

Among these goals, they present 10 principles that can be applied to better urban development[21]:

1) Mix land uses
2) Take advantage of compact design
3) Create a range of housing opportunities and choices
4) Create walkable neighborhoods
5) Foster distinctive, attractive communities with a strong sense of place
6) Preserve open space, farmland, natural beauty, and critical environmental areas
7) Strengthen and direct development towards
8) Provide a variety of transportation choices
9) Make development decisions predictable, fair and cost effective
10) Encourage community and stakeholder collaboration in development decisions

Smart Growth and Green Infrastructure must go hand in hand to orientate wisely the sustainable development for communities and management of natural environments to promote an optimum quality of life.

1.3 Laws and Entities working towards a better environment

A global effort is needed to reduce gas emissions due to deforestation, but local movements financed by public funds can bring change (one sector at a time). To bring about

[20] María Juncos. *Hacia El Desarrollo Inteligente - 10 Principios y 100 Estrategias Para Puerto Rico*, 2018, 15
[21] Environmental Protection Agency, *This Is Smart Growth*, 2006, 4

sustainable efforts such as Smart Growth to promote a pro-environmental conscious in local communities, governmental action must take place and understand that natural resources are an integral part of state and municipal development policies and plans. This is why it is:

> Necessary to recognize that the green infrastructure is composed of green spaces with a purpose and that the development, management and expansion of it has to be an integral part of the budget for public investments, as it is for grey infrastructure.[22]

Governmental agencies are responsible to delegate and designate entities, public politics and programs to ensure and monitor the protection and care of green infrastructures, yet they don't receive the corresponsive economic help to carry out the management in an effective way. It is a task that requires the same attention to the grey infrastructure developments, which are long-term commitments with a hefty financing and well planned in advance. [17] Of course, there has been an increase in citizen awareness in recent years compared to the little citizen participation in environmental matters for the decade of the 70s and 80s. Yet, despite the increase of the people's claims, government agencies do not have sufficient financial resources to address effectively and efficiently the complaints, their implementation programs and their inspection programs, among others.[23] And the answer is simple: the environmental crisis is not their priority due to the ignorance of facts, among them, natural resources are limited. If there is good environmental state there will be a better quality of life, fewer illnesses, less spending on health services, more natural resources and better economic development.

That is why for an efficient and functioning system, the value of green spaces is a determining factor for economic vitality alongside grey infrastructure. The landscape architect

[22] María Juncos. *Hacia El Desarrollo Inteligente - 10 Principios y 100 Estrategias Para Puerto Rico*, 2018, 14

[23] Diana López, *VI-093 - EL DESARROLLO SOSTENIBLE EN EL MILENIO: LEYES AMBIENTALES VIS A VIS LA EDUCACIÓN AMBIENTAL (LA EXPERIENCIA EN PUERTO RICO)*, 1999, 4

Frederick Law Olmsted proved this point by designing in the late 19th century Central Park in New York. His goal was to invest public funds in a large urban forest park that will later on help secure a substantial return to the city by giving shape and value to the lands around the park.[24] The value of the properties near Central Park incremented 9 times over the years and the Central Park Conservancy maintains its state with raising nearly $74 million annually to continue its operation. A substantial budget of $200 million invested in this project has produced over $1 billion for the state of New York for park and community improvements.[25] This is an example of the importance of green infrastructure for the benefit of governments and landowners by contributing efforts to reduce their carbon footprint. As mentioned previously, human greed can only go so far to exploit green spaces for own benefits, this is why the creation and funding of environmental public politics are vital for the conservation of natural spaces.

In Puerto Rico, a considerably low budget for the protection and management of green infrastructure has caused the loss of the value and identity of these important spaces. One of the main causes of the lack of implementation of environmental laws is the lack of sufficient financial resources, by government agencies, to address duly the matter. According to data from the Management and Budget Office, only 1% of the government budget goes to agencies that must ensure the well-being of green infrastructure and 28% goes to the development and maintenance of gray infrastructure. [19] Local examples of the exorbitant funds to gray infrastructure are:

1) *Superacueducto* – total cost = $545 million
2) *Corredor del Este – Ruta 66* – total cost = $165.6 millions
3) *Tren Urbano* – total cost = $2.2 billion

[24] María Juncos. *Hacia El Desarrollo Inteligente - 10 Principios y 100 Estrategias Para Puerto Rico*, 2018, 15
[25] Sarah Miller, “Central Park Conservancy: History.” Central Park Conservancy, 2020.

The negligent way the government handles public funds affects the procedures of environmental public policies to work towards a bettering scenario for all. That is why the exposition of environmental public policies must be studied, reinforced and administered with due validity. The environmental laws that regulate human activity in Puerto Rico are: laws of the United States of America, known as federal laws – a total of fifty-four, and the ones of the Commonwealth of Puerto Rico, known as local laws. The governmental entity that is responsible for the implementation of the local laws that work for the protection and management of the biodiversity is DRNA - Department of Natural and Environmental Resources. They manage twenty state forests, thirty-five natural terrestrial and marine reserves and five wildlife refuges. Also, they have divisions that are in charge of specific areas and ecosystems, such as the Forest Management Division. Their responsibility is to ensure the protection and conservation of the protected natural areas through planning, research and formulation of management plans, such as the proposal of *Proyecto Anillo Verde*. Furthermore, functions and services are also made, such as the following that are stated in the DRNA website =

1) Manage all twenty state forests
2) Manages recreational areas, trails, and forest campsites
3) Guide the public visiting the forests
4) Carry out, together with the Academy of Scientific Research, to help the conservation of the natural resources of the forests
5) Protect and manage endangered species in the forests
6) Brigades of forest firefighters who attend to fires in forest areas

Amongst the protected ecosystems, the subtropical *Carite* State Forest, in between *Patillas*, *Guayama* and *Cayey,* was the reason towards the study of the ecosystems and abandoned properties in Puerto Rico. The forest was established in 1935 as a movement to protect the rivers found in this environment and, at the same time period, various amenities were placed for public use, such as cabins and bathrooms. Also, there were designated camp sites, walk roads that lead

to the rivers and barbecue area. Sadly, due to the pass of Hurricane Maria in 2017, it destroyed the cabins, and vegetative material blocked the roads. To this day, DRNA has done nothing to clean and restore this protected environment. It is not a safe area to wonder and walk freely, filled with rotten and broken materials, it is certainly a toxic environment for the sustainability of the forest.

One might think that since it is found in one of the “greenest” villages in the island, that it is fine to leave the forest as it is, since it was there in the first place and it will continue to be there. But the problem is that human beings took a part in managing the forest for public use and, since the tropical storm, it destroyed completely the man-made edifications. Thus, leaving a public nuisance in the very core of the ecosystem, which means = danger. On a positive note, there are laws that need to be paid more attention and need to be implemented since their sole intention is to protect these environments:

1) Environmental Public Policy Act: to repeal and replace Act No. 9 of June 18, 1970, the Environmental Public Policy Act was amended in September 22, 2004. It ensures that the Commonwealth of Puerto Rico is fully responsible of using all means and measures, including technical and financial assistance, for the purpose of ensuring the well-being of natural systems. This also includes municipalities’ efforts and public and private organizations that must work in cooperation with the following measures = to promote an effective protection of the environment, ensure the integration and consideration of environmental aspects in government efforts and to create the Commission for Planning Responses to Environmental Emergencies that is linked to the Environmental Quality Board (“Junta de Calidad Ambiental”). The interference of other government policies and programs preventing the objectives of this law must not occur, since they aim to achieve the greatest and most effective protection of the environment and ensure that environmental aspects are integrated and taken into account in all governmental efforts to

satisfy the social and economic needs of the present and future generations of Puerto Ricans.[26] The law also recognizes the right for a healthy environment and has established 4 objectives for a sustainable development, found in pg. 6, Article 3:

1) The most effective protection of the environment and natural resources
2) The most prudent and efficient use of natural resources for the benefit of all citizens.
3) A social progress that recognizes every citizen's needs
4) Achieving and maintaining high and stable levels of economic growth and job production.

To further abound in the repeal of the Act No.9 of June 18th 1970, it was known as the original "Environmental Public Policy Act" and their efforts were towards the protection of the diverse ecosystems in the island, due to inadequacy of the management and administration of natural resources. The Civil Legal Health and Welfare Commissions, in their Joint Report to the Senate of the island commented the following towards their reality:

> We must maintain an environment that allows the greatest purity and cleanliness of air and water, the conservation of our natural resources such as our forests, rivers, beaches, as well as our fauna, flora and all kinds of marine and aquatic species. The automobile, industrialization, population growth and the growth of urban areas are the greatest enemies of our environment; causing destruction and waste that denies the ability to achieve a healthy life. [21]

> The recognition of addressing the problem with a law that states the importance of the general well-being and harmony of both humans and nature, was the first and main statutory scheme adopted in Puerto Rico to comprehensively address the specific issues that arise in the country in relation to the administration and protection of the

[26] Constitución de Puerto Rico, *Ley Sobre Política Pública Ambiental [Ley 416-2004, Enmendada*], 2013, 2

environment.[27] It was a monumental step towards the future that led the *Junta de Calidad Ambiental* to be the first regulatory agency, in America, dedicated to the control of pollution and environmental degradation.

History was made since the *Junta de Calidad Ambiental* was created. A grand dissatisfaction in how natural resources were being managed erupted in the 1960's. The mission entrusted by the Legislative Assembly of Puerto Rico to this agency was to protect the quality of the environment, by controlling the air, water, soil and noise pollution. Furthermore, to create and maintain harmony between man and nature, and fulfill social and economic needs. To achieve this, they were responsible for the public policy that promotes the improvement and conservation of the environment to address health requirements and recommend it to the Governor. But, now the DRNA is in charge of the agency, changing priorities and neglecting the efforts made for a better environment.

2) Act No. 195 – Reforestation, Administration and Conservation Program of Natural Resources: Another program that was a part of the DRNA, founded in 1998, was created to meet the urgent need for planting, caring for and managing trees in rural and urban areas of Puerto Rico. The funds that were assigned during the time period of five years for its execution was a total of $10,000,000 that needed to be put to use for the sake of the environment and public health. The motives that led to the creation of this act were the urban sprawl, the population growth threatening the fragile life of natural resources and to massively increase the vegetative cover to minimize the environmental damage in the island.[28]

[27] Constitución de Puerto Rico, *Ley Sobre Política Pública Ambiental [Ley 416-2004, Enmendada*], 2013, 3

[28] Constitución de Puerto Rico, *Ley Del Programa de Reforestación, Administración y Conservación de Recursos Vivientes En El DRNA*, 1998, 1

The program rested in the hands of the Secretary of the DRNA to help and cooperate on reforestation purposes in urban and rural settings under the terms that best responded to the public. The Secretary had legal power to carry out the motives and plans such as, encouraging the practice of planned planting in the construction industry and using existing trees in new designs to mitigate the impact, to promote a sustainable development. Furthermore, the Secretary could also authorize and provide incentives through regulation to non-profit organizations, student and community groups registered in the Department of State, to fulfill projects of reforestation and maintaining trees in designated areas.[29] This points to understand that the search for alternatives for the protection and conservation of ecosystems were discussed and funded, yet the proof of the use of the total funds towards the projects and plans was not verified.

In conclusion, the environmental crisis is not a priority to the government of Puerto Rico. Federal and local laws are anthropocentric and not biocentric, that is, the society established rules for the protection of human beings and not for biodiversity.[30] For years, these entities have had in possession protected environments that are not maintained nor restored. They all have an important value, yet only the ones that are globally known, are the ones taken care of. Such as *El Yunque* National Rainforest cared by the US Forest Service. It is evident that the initiative to better our ecosystems must come from communities, people that are willing to commit for the well-being of nature. Thankfully, there is hope.

Non-profit organizations, such as *Para la Naturaleza,* are working tirelessly to reforest, protect, manage and care for the diverse ecosystems in the island. They also educate anyone

[29] Constitución de Puerto Rico, *Ley Del Programa de Reforestación, Administración y Conservación de Recursos Vivientes En El DRNA*, 1998, 3

[30] Diana López, *VI-093 - EL DESARROLLO SOSTENIBLE EN EL MILENIO: LEYES AMBIENTALES VIS A VIS LA EDUCACIÓN AMBIENTAL (LA EXPERIENCIA EN PUERTO RICO)*, 1999, 16

who is willing to learn and contribute to the movement, the people move the people. *Para la Naturaleza (*PLN*)* - The PR Conservation Trust (*Fideicomiso de Conservación)* was founded in 1968 as a non-profit entity, not tied to the government, with the mission of ensuring healthy ecological systems and promoting among its inhabitants, a sense of responsibility regarding the conservation of nature. They created a new unit for management purposes and fundraising initiatives for the bettering of all-natural resources named *Para la Naturaleza.* They have 5 nurseries around the island where they have been able to propagate 248 native trees. Their goal is to protect 33% (an adequate average that will maintain the ecosystems for its future survival) of land of high ecological value by 2033, since:

> Currently, Puerto Rico legally protects only eight percent of its surface, which places us in the lowest row of the global conservation percentages, which vary from six percent to 45 percent. If we want to ensure a sustainable and healthy country in the long term, we have to join forces now to protect the ecosystems that are fundamental to our future. [31]

Not only is their focus on the preservation of ecological areas, but also in educating citizens and communities by giving them the tools to learn how to take care of natural resources in a sustainable way. As they learn, they can contribute and volunteer to help, in the way the can. An example of this was two years ago, after Hurricane Maria, seven thousand volunteers helped to plant seventy thousand native trees. It is an extraordinary accomplishment and motivation towards their second goal – to plant another 680,000 trees in the next five years, as stated on their website.[32] Furthermore, they handle natural areas that are part of the PR Conservation trust as well as, *Hacienda Buena Vista*, *Hacienda la Esperanza* and the *Cabezas de San Juan*. In each one they focus on the education through multiple protected resources, so that the public can

[31] Fernando Lloveras, *Para La Naturaleza*. Para La Naturaleza, 2019, https://www.paralanaturaleza.org/.

[32] Fernando Lloveras, *Para La Naturaleza*. Para La Naturaleza, 2019, https://www.paralanaturaleza.org/.

experience the ecosystems and learn about the importance of their conservation. The sole beneficiary is the people of Puerto Rico.

*Fundación Puertorriqueña de Conservación (*FPC*)* **–** It is a private non-profit environmental organization founded in 1987 by a group of scientists, businessmen and community leaders, whose mission is to conserve the island's biodiversity and natural resources. They carry out procurement, research and education projects for citizens of all ages, whom can also participate in their clean-ups, talks and programs. Also, they provide valuable information in their website of how to reduce-reuse-recycle, global warming, the importance of trees, the conservation of water bodies, among others.[33]

*Organización Pro Ambiente Sustentable (*OPAS*)* – The non-profit organization was founded in 2005 beside the Tourism Company of Puerto Rico (*Compañía de Turismo*). Their mission is to educate citizens of all ages about sustainable actions and methods through environmental programs, such as Eco Schools. They count with fifty-two public and private Eco schools that teach children about how to identify environmental problems in their communities to raise awareness, to respect nature and properly manage natural resources, and learn through a pro-environment curriculum. Educating about how fragile and important is the environment from a young age is key for them to grow into conscious citizens that can positively impact their communities. OPAS also manages programs such as Green Key, certifying hotels and tourist facilities, Young Reporters for The Environment, for young people whom have an interest in environmental journalism, among other programs.[34]

[33] Hector Salaman, *Fundación Puertorriqueña de Conservación." Fundación Puertorriqueña de Conservación*, 2017,1

[34] Nadja Rivera *Organización Pro Ambiente Sustentable*, 2018, 1

Despite the efforts of these organizations, it is not enough to mitigate the growing environmental problem. The management of green infrastructure must acquire such an importance for all citizens for a change to occur. This is why the Geospatial Inventory of Protected Ecosystems of Puerto Rico was created, by environmental non-profit organizations and government entities, to properly manage and protect the diversity of natural resources in the island. The manual published in 2019 was a recent effort to provide valuable information to all whom are interested in the care and survival of nature for sustainable development efforts:

> A detailed description of which protected areas are open to the public, how they can be accessed and what services each one provides, would promote enjoyment in protected areas and promote an economy of outdoor recreation.[35]

Over the past decades, Puerto Rico has replaced its agricultural economy (sugar cane, coffee and tabaco) with an industrialized economy that has increased urban development. To mitigate the urban sprawl, protected natural areas have proven to be an efficient mechanism to stop urban development at a certain point and to resist the expansion of the urban carbon footprint.[36] Example of protected natural areas in urban contexts are the *Laguna del Condado Estuarine Nature Reserve, San Juan* Bay Estuary, *El Bosque San Patricio, Corredor Ecológico de las Cabezas de San Juan,* among others, offer residents a direct experience for recreation and connection with nature. Furthermore, they serve to reduce meteorological conditions, thus reducing the “heat island effect” which alters temperatures, humidity and precipitation in urban areas. [30]

[35] USDA Forest Service, *Inventario Detallado de Áreas Protegidas y Otros Mecanismos Para La Conservación de Terrenos En Puerto Rico*, 2019, 37

[36] USDA Forest Service, *Inventario Detallado de Áreas Protegidas y Otros Mecanismos Para La Conservación de Terrenos En Puerto Rico*, 2019, 21

The agencies and organizations, which will be mentioned shortly, are in charge of the care of the protected areas all over the island. Yet participatory planning and collaborative incentives between community leaders and groups have become fundamental strategies for the management of public and private protected areas.[37] In addition to developing community participation and empowerment, future generations may benefit from the actions that take place in the present thanks to citizen intention.

The government agencies that manage the largest number of public protected areas are[38]:

1) *Departamento de Recursos Naturales y Ambientales* (DRNA) = 84%
2) USDA Forest Service = 9%
3) U.S. Fish and Wildlife Service (USFWS) = 7%

The non-profit environmental organizations that manage the private protected areas are[32]:

1) *Para La Naturaleza* (PLN) = 93%
2) *Casa Pueblo* = 4%
3) Tropic Ventures = 2%
4) *Ciudadanos de Karso* (CDK) = 1%

*The *Luis Muñoz Marín* Foundation is not present in these statistics because the land under its administration represents less than 1% of the private protected areas. [32]

[37] USDA Forest Service, *Inventario Detallado de Áreas Protegidas y Otros Mecanismos Para La Conservación de Terrenos En Puerto Rico*, 2019, 74

[38] USDA Forest Service, *Inventario Detallado de Áreas Protegidas y Otros Mecanismos Para La Conservación de Terrenos En Puerto Rico*, 2019, 72

In Fig. 3 it is shown how dispersed they are according to each municipality, we must remember the previously discussed term Green Infrastructure, since the interconnection of each ecosystem would be ideal.

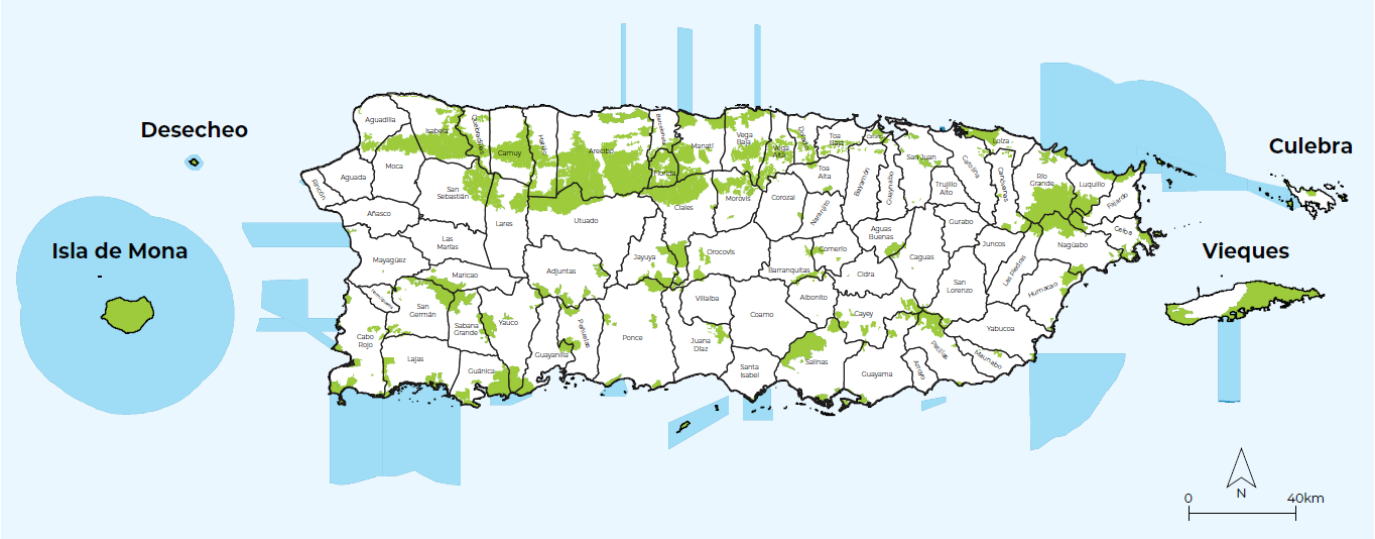

Figure 3: Áreas Protegidas por Municipio, Inventario Detallado de Áreas Protegidas y otros mecanismos para la Conservación de Terrenos en Puerto Rico (US Forest Service, 2019, 64)

According to Fig.3, the municipalities with the highest percentage of terrestrial protected areas (not incluiding municipal parks) are: Florida, *Vieques* and *Arecibo*; among the ones with the lowest percentage are: *Juncos* and *Rincón*. The different types of ecosystems, found in Proportion of Land cover and land use categories within protected areas[39], are:

(1km2 = 1,000,000 square meters = 100 hectares)

1) Wooded wetlands = 50.2 km2
2) Inland waters = 29.9 km2
3) Natural barriers = 4.6 km2
4) Forests = 919.6 km2
5) Non-Forested Wetlands = 47.9 km2
6) Forests and Bushes = 171.2 km2

[39] USDA Forest Service, *Inventario Detallado de Áreas Protegidas y Otros Mecanismos Para La Conservación de Terrenos En Puerto Rico*, 2019, 69

7) Grasslands = 198.6 km2
8) Constructed Surface = 9.2 km2

In these natural protected areas we may find an abundance of ecosystems which are vital for the biodiversity of flora and fauna. These are fundamental to diminish climate impact from dense urban areas and obtain benefits from nature without exploiting them. Citizens must be conscious of their actions and be pro-environment before its to late. As arborist Dr. Pedro Rivera, committed to the reforestation of Puerto Rico with over twenty five years of experience in the production and planting of vegetative native and endemic plants and trees, shared:

> "The community has to act, we can't count on the government since the environment is not their priority. People have to take over the protected areas before we loose them completely to dangerous planning for thoughtless construction. Nature is needed everywhere, environmental education and proper management has to take place to save our island." – Interview to Dr. Pedro Rivera, September 21st, 2020 via Google Meets

Chapter 2: The environmental impact of abandoned properties

Having analyzed the importance of green infrastructure, we must also bring into coalition the consequences of abandoned properties that are damaging for the public health, survival and growth of natural areas. It is hard not to acknowledge the vast consequences abandoned properties and vacant lots can provoke: contaminated sites endangering the health of people and biodiversity, water accumulation attracting pests, damage in the near natural areas, among others, are just a few of the negative impacts. It is a plague that has affected urban areas island-wise that continuously affect public security, economic development, the environment and property value.

Since the rampant growth of buildings in dense urban areas, the vast quantity of abandoned properties are designated as "public nuisances", on account of ending up as clandestine garbage dumps. This term is widely use, not only in construction, but also anything that produces any harm, inconvenience, damage, or that hinders enjoyment of life or property.[40] Also, the sole destruction of abandoned estates is also considered a public nuisance. As established in the Article 277 from the New Civil Code in 1904 to justify the harm of the nuisances:

> Anything that is harmful to health, indecent or offensive to the senses, or that interrupts the free use of the property, so as to prevent the comfortable enjoyment of life or property, constitutes a disturbance that gives rise to an action.[41]

Architectural development must not interpose over natural areas, yet public nuisances do exactly that. They do not contribute to the economy or provide services due to their neglect and harm the state of ecosystems that live nearby. This pattern is repeatedly seen around the island,

[40] Luis Gallardo, *Los Estorbos Publicos En Puerto Rico*, *Revista Juridica*, 2018, 117

[41] Luis Gallardo, *Los Estorbos Publicos En Puerto Rico*, *Revista Juridica*, 2018, 123

lacking an ecological mind set for reuse. Due to their state of ruin, they are unsuitable, unsafe and harmful for public use. Municipalities have to determine, according to criteria established by the Law, whether the nuisances can be repaired, improved or destroyed,[42] since they affect gravely nearby communities and ecosystems. Assessments must be made to identify affected natural areas caused by the nuisances, since they are the source of valuable services, such as flood mitigation, water filtration, thermal regulation, among others. The degradation of these services could significantly pose a threat to the climate, biodiversity and public health.[43]

An example of this is the term brownfield being contaminated sites that can potentially be hazardous due to abandonment, negligence and/or legal conflicts, that can complicate reuse possibilities and procedures due to the state of the spaces. Also, waste dumped by industries that use large amounts of chemicals harmful to health and natural resources, generate hazardous and non-hazardous waste that affect the air, water, soil and near biodiversity. By provision of law, industries that handle dangerous substances have to notify of all contamination to the environment. The public notice operates as an incentive for them to avoid, at all costs, to go beyond what is allowed in terms of contamination[44], since contaminants are left behind causing health effects for humans and the state of the environment. The most commonly found, reported to the Environmental Protection Agency (EPA), are: lead, petroleum and asbestos.[45]

Sadly, according to the EPA, there are approximately 450,000 brownfields in the United States and 170 brownfields in Puerto Rico. Since the last Hurricanes Irma and María in 2017 that devastated the island, the numbers of abandoned commercial and industrial properties rose

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[42] Ibid, 136
[43] Ruhl J, *Making Nuisance Ecological*, *Case Western Reserve Law Review* 58, no. 3 (2008), 757
[44] Diana López, *VI-093 - EL DESARROLLO SOSTENIBLE EN EL MILENIO: LEYES AMBIENTALES VIS A VIS LA EDUCACIÓN AMBIENTAL (LA EXPERIENCIA EN PUERTO RICO)*, 1999, 4

[45] Environmental Protection Agency, *Environmental Contaminants Often Found at Brownfield Sites*, 2019, 1

considerably, many of these leaving hazardous and polluting substances.[46] Most of these are found in urban areas that pass on to be considered "public nuisances" since they are not taken care of. It is unfortunate that these properties, sites and areas are not considered for redevelopment. They are often overlooked for repurposing due to the effects of the possibly present contaminants that can expose citizens, causing obstacles to actually utilize them. But what developers and communities must understand is that they can safely reuse a brownfield site thanks to EPA programs, such as the Toxic Release Inventory Program (TRI) and the Brownfields and Land Revitalization Program, whose sole purpose is to report and clean the areas of dangerous contaminants for sustainable developments.

The TRI program, devised in 1986, surged by the concern of citizens of not knowing how much and how many chemical substances were being released by industrial companies. There was a lack of information that had to be available for chemical emergencies responses, thankfully the EPA heard their plea. The program provides data, available to the public, from industrial facilities of which types of toxic chemicals they handle, how they dispose of them and if they're taking measures towards the correct disposal of them. It also includes any reports of accidental releases and cleanup management. There are 103 TRI facilities in Puerto Rico that are assessing and keeping track of the chemical managements and emissions of industries and manufacturing companies.[47] This is another example of how the masses can provoke changes of view in entities to target specific concerns.

Thanks to the voice of the people, EPA's top priority is to, other than provide information, to repurpose abandoned properties to benefit communities through the Brownfield and Land

[46] Environmental Protection Agency, *EPA and the Centre for Creative Land Recycling to Hold Brownfields Redevelopment Events in Puerto Rico*, 2019, 1

[47] Environmental Protection Agency, *Reuse Possibilities for Brownfield Sites*, 2019.

Revitalization Program. The benefits they can enjoy, once the designated areas are cleaned up and reinvested are[26] :

1) Increase in local tax bases
2) Economic development - Job growth
3) Utilization of existing infrastructure for redevelopment such as[28] :
    a. Commercial Use = 33.5%
    b. Green Spaces = 28%
    c. Mixed use = 16.1%
    d. Residential Use = 14.7%
    e. Industrial Use = 7.4%
4) Take development pressure off of undeveloped land
5) Improve and protect the environment (providing wild life habitats and nature conservation)[28]

The previously mentioned benefits can also be applied to Puerto Rico since, through a careful selection of vacant and unused properties that are causing a certain harm, the EPA grants funding specifically for the revitalization of brownfield sites to help local governments and communities. The targets are municipalities that have multiple affected sites and have properly completed reports of each to be considered for funding, an example of a chosen one is the Municipality of *Naranjito.* They received $300,000 Brownfield Assessment Grant to assess the sites with potential hazardous substances and are causing contamination, plan clean-ups, conduct possible reuse plans, among others.[48] There are few municipalities that have completed reports or simply are not fond of the process to address their public nuisances. For this the *Junta de Calidad Ambiental* created a state inventory to share the possible brownfield sites by municipality and also a reuse

[48] Environmental Protection Agency *EPA Brownfield Funding Announced for Naranjito, Puerto Rico.* Region 02, 2019, 1

program to transform the spaces. To this date, having contacted the JCA, the inventory of possible brownfields in the island is in current development, having provided the exact location and status of abandonment in fifty municipalities. According to *Melvin Menendez*, there are only two employees (*Mariangely Aleman* and *Omar Santiago*) that have the task to identify possible brownfield sites in every municipality. If any non-profit, municipality or community group is interested in acquiring a site, they can visit their website to see the owner's information and location. To provide the information, they have received funding from the EPA to create this inventory, yet, according to Melvin, the funds become scarce to target their goals. They are working without assured money and lack of staff while having a developed program for the reuse of the sites (*Programa de Redesarrollo y Limpieza Voluntaria de Propiedades con Trasfondo Historico*) that has not been put to use. Once it is in operation, it will encourage the redevelopment, rehabilitation and cleaning of properties that are abandoned or inactive due to contamination, with the intention of giving them a beneficial and productive use.

Since the JCA inventory is currently under development, the EPA provides the tool EnviroMapper for public access to identify assessed brownfield sites, yet it is not updated. According to Zolymar Luna, an EPA Environmental Engineer, there are 170 brownfield sites in the island. Not all have contaminants that endanger, this is why they pass through a rigorous procedure of investigation to clearly identify the ones whom are a potential risk and upload them to the main database (that will soon be available for public view). The majority have been assessed and cleaned from contaminants in a relative time period, but are in a current state of misuse since there aren't plans for reuse. Others were considered for reuse purposes but they were not carried out because of lack of funding, change in political parties and not being a priority project. Furthermore, some are found in historic sites from the 19th century that caused an environmental impact and are in the present abandoned and misused.

The agriculture-based economy was the base for the establishment of over 570 Sugar Centrals between 1870 and 1920. These new plants possessed a very modern economic and industrial organization, were enormous in scale, and were a symbol of the kind of change that the North Americans forged in Puerto Rican life.[49] The Sugar cane industry, with a majority of foreign owners and African slave labor, promoted the transformation of the rural landscape of Puerto Rico, due to the deforestation of the fertile coastal plains and the demolition of the herds and ranches. The lands were bought, leased and transformed into colonies and in "towns within a town" to supply the sweet product.[50] Modernizing Puerto Rico, specifically in the South, implied the alteration of a topography that responded to the interaction of more than 20 types of ecosystems. Slowly but surely, these industries became huge gray footprints that affected the air, water and soil quality.[51]

An example of a historic sugar cane industry in the south coast, that became a hot point for 6 brownfields, was the Hacienda Central Aguirre found in the border of *Guayama* and *Salinas*. The Foreign Company from Boston acquired the site to establish a company town divided in two sectors: The North American and the Puerto Rican to house the employees. The racism and division between both populations was also present in the wages and treatment. This was very present in the memory of *Eriberto Cintron*, a welder of the industry for over thirty-five years. He claimed that not only did the Americans treat poorly the Puerto Rican employees, exposing them to dangerous contaminants such as asbestos, but also damaged the surrounding lands without a care in the world to the environmental impact it was causing. He claimed that, at the time, they weren't worried about the environment, they were focused on a strategical location for a port,

[49] Sidney Mintz, *TASO Trabajador de La Caña*, 2001, 82

[50] Nahira Montcourt, *Memoria Viva: Las Centrales Azucareras de Puerto Rico*, *Noticel*, 2019, 1

[51] Deborah Rodríguez, *Javier Blanco Cestero, Arquitecto de El Paisaje Puertorriqueño*, 2020.

proximity to the railway to transport the goods, and a large land to generate an income solely for the *hacendados* of the plant. The useless and unproductive parts of land were considered *Manos Muertas* and were forgotten. With passing time, it is now an abandoned property of the DRNA and it is not accessible to the public nor a safe site. The following images show the current state of the Industry and the surrounding community:

Figure 4: Photo montage taken by author, October 10,2020. Central Aguirre Port, Guayama

Figure 5: Images taken by author, October 10, 2020. Central Aguirre, Guayama

Figure 6: Left image taken by author, October 10,2020. Central Aguirre House, Guayama. Right image retrieved by https://www.wmf.org/prohect/central-aguirre-historic-district

The following image shows the Central Aguirre Community locating the six brownfield properties:

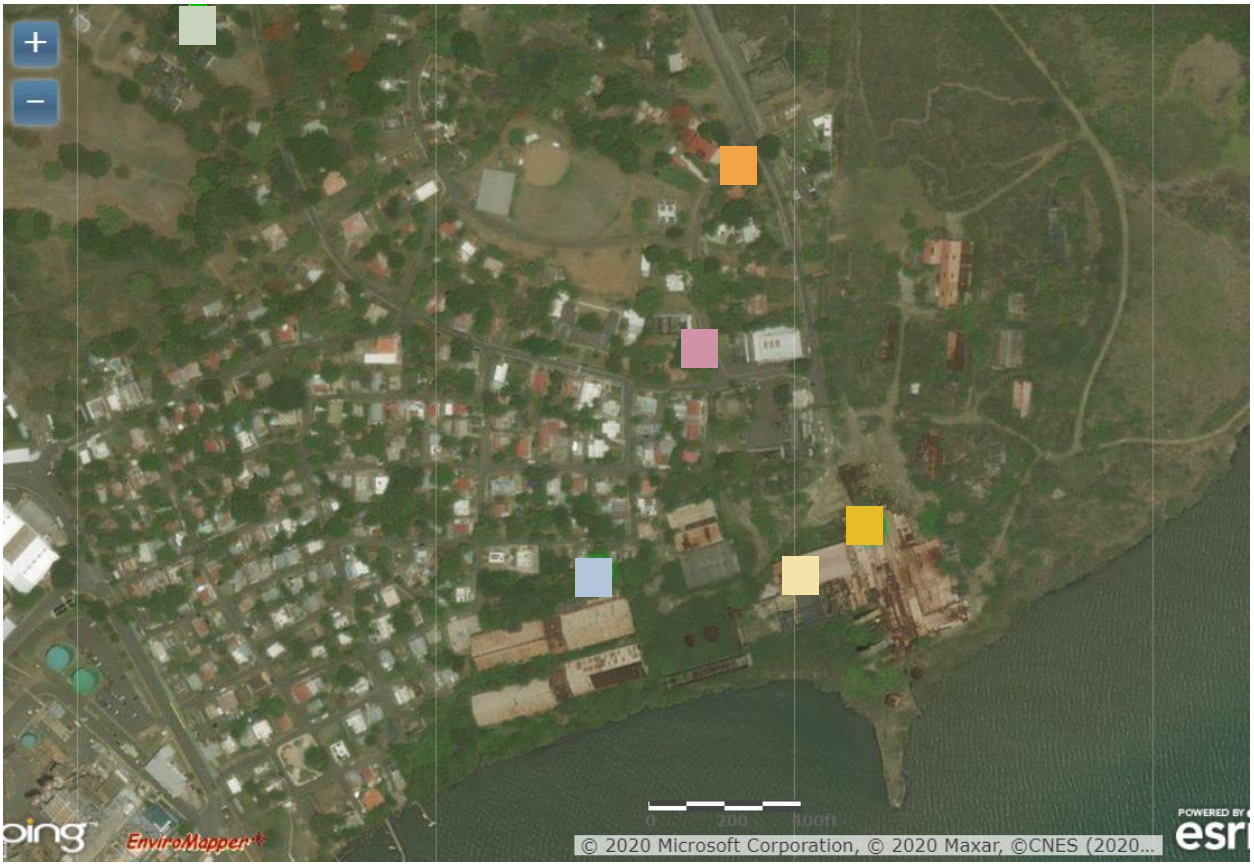


Figure 7: Image retreieved from EnviroMapper, October 8,2020

Aguirre Ice Plant: ABANDONED

Aguirre Caribe Store: Good conditions, it being used by several programs such as *Veterano*

Aguirre Main Office Building: COULD NOT ACCESS

Garage and Fire Station: COULD NOT ACCESS

Aguirre *Hacienda Vieja:* COULD NOT ACCESS

Aguirre Hospital: ABANDONED, yet painted

Due to the DRNA ownership of the Sugar Central of Aguirre, access was denied to enter. According to Eriberto, people find their ways to enter but are not safe. The urge to see what was behind the iron gate was very much present.

The agriculture-based economy was later replaced by factories and petrochemicals rapidly. In the 1950's and 1960's, the establishment of petrochemicals in the island were the sign of the progress of a modern industrial era. The oil refinery Caribbean Petroleum Corporation (CAPECO) in *Bayamon*, opened in 1955, was originally built as petroleum storage and distribution facility for gasoline, fuel oil and jet and diesel fuel to the Electric Power Authority *Palo Seco* and San Juan Power Plant. It was situated in an open land of 179 acres and a total of forty-eight storage tanks for the fluids.[52] On October 23, 2009 a memorable yet devastating event took place in the corporation, an explosion that led to a large fire due to the overflow of gasoline of one of the tanks, caused seventeen petroleum storage tanks to burn and cause unimaginable damage to wildlife, bodies of water, protected species and the health of the surrounding communities. 30 million gallons of petroleum were released that night, and was not a surprise due to the chain of negligent acts from the company and federal agencies. A similar devastation occurred recently in Beirut, Lebanon where thousands of lives where affected due to the toxic gasses.

According to the U.S. Chemical Safety and Hazard Investigation Board (CSHUB), nearly 200,000 gallons of gasoline were released causing irreversible environmental impacts, adding air pollution, deforestation, soil erosion and contamination.[40] Furthermore, they discovered that the company had registered eighteen previous spills, exposing the lack of regulations regarding the handling and storage of fuel by federal agencies[53]. Several lawsuits later, CAPECO declared

[52] Verónica Fontanals, *CAPECO Disaster, Puerto Rico*. Environmental Justice Atlas, 2017, 1

[53] Omayra Sosa, *Revelan Lo Que Pasó En Caso CAPECO, Seis Años Después*. Centro de Periodismo Investigativo, 2015, 1

bankruptcy and left without solely cleaning and repairing the damages caused by the accident, the Environmental Protection Agency (EPA) took the responsibility and cleaned the area.

Currently, PUMA Energy has taken over the facilities that appear to be in optimum quality for their services. For this reason, it does no longer appear in the EnviroMapper of EPA. The following images show the conditions:

Figure 9: Images taken by author, October 6, 2020. Road to CAPECO Company, Bayamon

Figure 8: Images taken by author, October 6,2020. Lateral and front views of CAPECO Company, Bayamon

Also, a part of the industrial boom in the 1960's was the 800-acre oil refinery Commonwealth Oil Refining Company (CORCO), between *Penuelas* and *Guayanilla,* started operations in 1963. It had the capacity to produce gasoline, diesel, propane, butane, petroleum, among others, and eight petrochemical plants. Located in the south of the island, the Electric Power Authority (AEE) easily supplied CORCO through *Costa Sur* and, likewise, the company provided petroleum for them. As part of their workplan towards a "sustainable development" in terms of managing the fuels, they wrote the manual *Un Balance Vital* that explained their methods

and actions to properly conserve the environment without causing any gas related harms.[54] Yet the industry, in the 1970's, affected the waters and fishes by disposing hot water over 140 degrees Fahrenheit and oil, causing the death of thousands of fishes, being the only source of income for fishermen. Furthermore, the company polluted the nearby beaches and the excessive amounts of smoke and propane gas caused for 20% of the population of *Guayanilla* that surrounded CORCO, suffered lung damage.[55] In 1982, the company closed, leaving behind a huge ghost town of blackish chimneys and disused iron labyrinths that, even today, continue to spew their toxic remains on nearby communities. According to EPA, to this day, land, air and aquifers are still contaminated with chemicals.[56] No further plans were made for the re-use of the site, containing 9 brownfields, and it is currently in abandonment. The following images show the conditions:

Figure 10: Images retrieved, October 11,2020, Construcción de la refinería CORCO en Peñuelas, Puerto Rico, año 1969, Gerardo Ayala and from http://www.elsuralavista.com/. Past and Present of the CORCO refinery

[54] Commonwealth Oil Refining Company, *Un Balance Vital*, 1970, 3

[55] Mario Vissepo and Carlos Ortiz, *Puerto Rico Film from the 1970's*, 1977

[56] Benjamin Torres, *El Vertedero de Puerto Rico*, *El Nuevo Día*, 2017

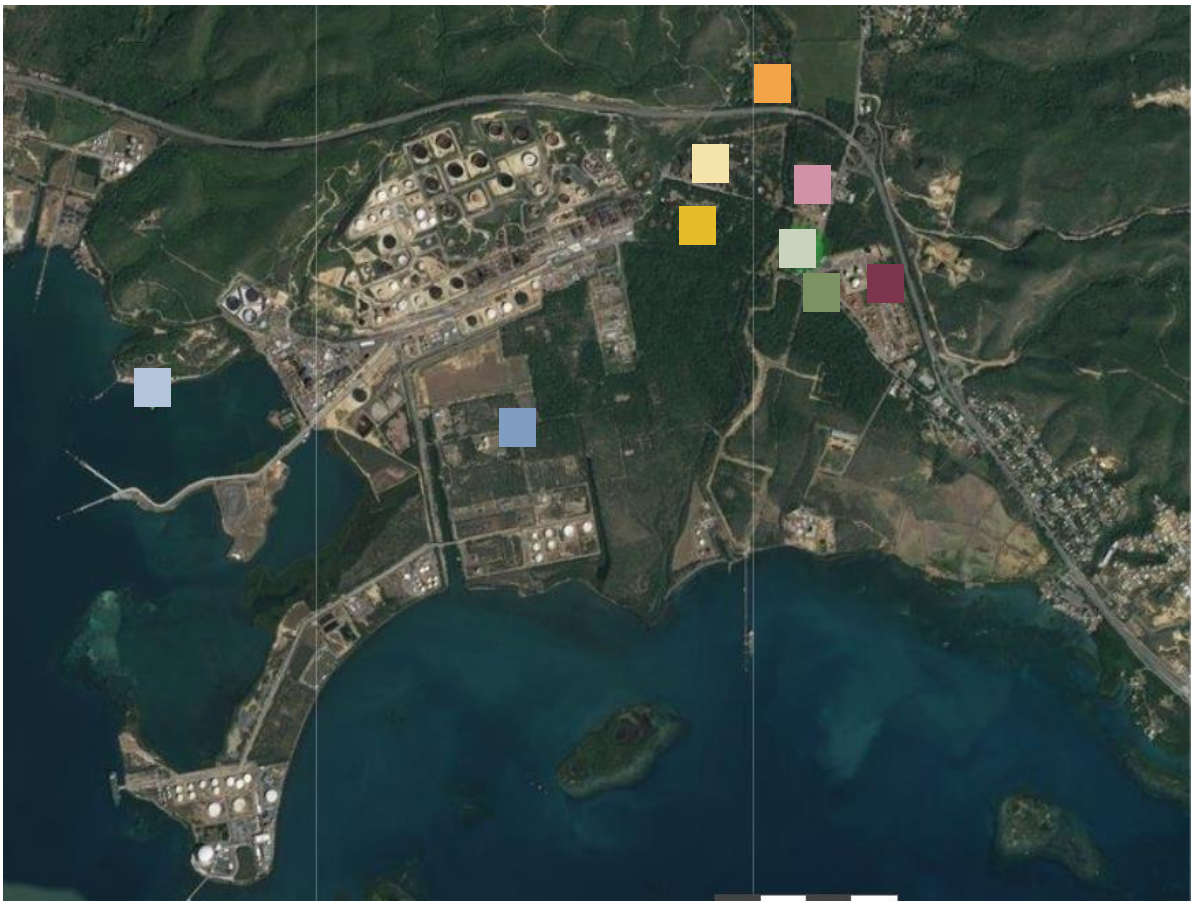


Figure 11: Image retrieved from EnviroMapper, October 8,2020

Ponce Salts Industries: Assessment has not started

Gulf Chemicals (AroChem): Assessment is in progress

Hercor Chemical Corporation: Assessment is in progress, poor contaminant control

Oxochem: Assessment has not started

Caribe Isoprene: Assessment has not started

Chevron Gas Station: An industrial petrochemical with large unused parcels

PR Olefins: Assessment is in progress

Union Carbide (*Peñuelas* Technology Park): Assessment has not started

Texaco Industries Inc.: Petroleum Lubricating Oil and Grease Manufacturing, Assessment is in Progress

Having seen the negligence industrial waste discharges causing brownfields in the examples previously mentioned, it is hard not to acknowledge the vast consequences abandoned properties and vacant lots can provoke: contaminated sites endangering the health of people and biodiversity, water accumulation attracting pests, damage in the near natural areas, among others, are just a few of the negative impacts. It is a plague that has affected urban areas island-wise that continuously affect public security, economic development, the environment and property value.

Of course, the example of the CAPECO Corporation is a hopeful one that is currently being reused as a gasoline plant for PUMA Energy, thanks to the interest in the damaged site. This demonstrates that interest in the forgotten, abandoned and contaminated, though very rare to see, does opens doors to possible developments for companies, municipalities and communities. This also includes reinvigorating historic sites that have and are surrounded by brownfields that prevent the passage and use for residents and visitors. The government may have the access control, but the community must have the motive and interest in transforming their history. This and many other reasons are why the planification and management of new gray infrastructure must go hand in hand with green infrastructure, not destroying desired terrains nor obviating assessed brownfield sites that are ready to be redeveloped.

We must not forget the amount of land that is badly used and later forgotten, they can be hidden gems waiting to resurge.

Chapter 3: Towards a needed change

In the past two chapters, we have seen the importance and value of nature, the need for reforestation, the damage of abandoned properties and examples of brownfield sites in the island along with their history and environmental impacts. Knowing that the assessed brownfield sites can be redeveloped for environmental and community benefits by eliminating environmental threats and can promote environmental justice by protecting natural resources while also limiting urban sprawl[57], we must take into consideration a green infrastructure plan for the restoration and transformation of them. They are part of ever-changing landscapes that must be properly cared for since they are constantly evolving by natural phenomenon, man-made activities and negligence that may lead to disastrous consequences that could have been prevented through proper management. Furthermore, upon the reality of the pandemic caused by the COVID-19 virus, it is imperative to have suitable, healthy and safe spaces for the enjoyment of people and for the survival of ecosystems. That is why there is a needed change to plan adequately the location and process of new designs that do not affect the surrounding environment nor community.

Now the question is: What are design steps and strategies that can allow a proper and safe interconnectedness between green and gray infrastructure? The steps to follow start by identifying the scope or magnitude of the project, such as targeting the needs of a municipality, region or community. The available resources and needs must be matched in order to determine the scale. It is important to consider that smaller interventions may be more simple, economical and in tune with local needs.[58] Also, for purposes of this investigation, the focus will be toward a

[57] Anna Cich, Hava Blair, Joe Mahowald, and Martha Faust, *Benefits of Brownfield Redevelopment in Minnesota*, 2018, 4

[58] María Juncos, *Infraestructura Verde y Nuestros Parques*, 2005, 72

selected community with assessed brownfield sites and with the presence of nearby ecosystems. Of course, during the design process, the integration of the community must occur to know their thoughts, desires and preoccupations that may be targeted.

Secondly, identifying near ecosystems that could have been or were previously damaged such as bodies of water, coastal and land forests, flora, fauna, among others. Also, an assessment of identified needs that occur due to the improper management of the ecosystems, such as floods, quality of water and air, contaminated vegetation, etc., and the recognition of protected areas by legal provisions (conservation of natural reserves), critical areas for vulnerable species and areas of landscape value or historical preservation also form a vital part of the process.[59]

Furthermore, the degree of integration and interaction between the natural resources of the area and the surrounding or near gray infrastructure must be evaluated. The quantity and use of small parks, pathways and recreation areas should be analyzed to know if the community frequently access them or if they do not. The status of these resources should also be taken in consideration such as their conditions, if they are in a state of abandonment and if they lack certain elements such as shade, seating and/or amenities.

The strategies, that can allow a proper and safe interconnectedness are the following:

Choosing the proper vegetation: If there is a forestry presence, it must be imperative to know their conditions and possible contamination of the vegetation. This may lead to reforestation purposes choosing specific native plants that attemper the site conditions and can resist natural phenomenon, while providing: shade for residents, habitats and food sustenance for wildlife, appealing colors and textures, tropical fruits for human and wildlife consumption among others.

[59] María Juncos, *Infraestructura Verde y Nuestros Parques*, 2005, 72

Creation of greenways: Identify focal green points (parks, forests, ecosystems) for linkage through greenways or corridors for strategical pedestrian access. To ensure the survival of green areas, they should be connected to strengthen their ecological conditions and to provide designated paths for cycling and walking trails for public use. This strategy will permit the conservation of biodiversity, the protection of natural resources and the reduction of contamination and temperature levels. Furthermore, the paths will lead the observer to have a direct experience with the natural surroundings, strengthening its relationship with nature. An example of the effectiveness of greenways are ecological corridors, such as *El Corredor Ecológico de San Juan*, that connect various ecosystems through marked trails and to designated spaces for public enjoyment.

Placement of signs: An important measure to highlight is the placement of signs to guide the visitors and to raise public awareness of the distinct ecosystems and biodiversity that can be found. Without accessible information nor path indicators, it will be very difficult for people to approach the environmental incentive. An example that reassures the importance is the *Bosque Urbano San Patricio* in *Guaynabo*, a forest that lives in the midst of urban development that forms a part of green infrastructure, yet does not have signs that lead visitors towards the entry. Not being from the area, it was quite difficult to know which way to go (even with the help of maps) because the paths were not clearly identified. The only guide was the massive forest that stood out, giving an idea that in one of the roads was the entrance to the space. This is why visual information and location of signs is indispensable.

Mitigation of waters: Due to reality of living in an island that is susceptible to hurricanes, designing stormwater elements that can minimize, retain and mitigate entering waters can ensure public safety and proper drainage[60]. Examples of these are: Permeable pavements (allow the movement

[60] Environmental Protection Agency, *Green Infrastructure in Parks: A Guide to Collaboration, Funding, and Community Engagement*, 2018, 3

and drainage of stormwater using distinct materials such as crushed stone paths), Underground stormwater storage systems and tanks, Rain Gardens (vegetated areas that specifically target run off waters), Bioswales (vegetated swale that filters the waters), among others. Also, instruments such as the National Oceanic and Atmospheric Administration (NOAA) which present diagrams and maps that indicate the Sea level rise and coastal flooding impacts, can help visualize the design elements and specific vegetation to implement.

The recently mentioned steps and strategies incentivize the exaltation of the environment through several tools to further purpose the conservation of the natural and historical heritage of the chosen space. These helped me establish parameters to carry out the design of a green infrastructure plan in an assessed brownfield site. The following are:

- Brownfield site in abandonment and/or appropriated by nature
- Brownfield site near a community
- Site near ecosystems or natural reserves
- Site that has suffered deforestation, has contaminated vegetation or none at all
- The location also presents other environmental problems to attend (ex.: floods)

Having discussed the parameters with EPA Environmental Engineer Zolymar Luna, we were able to sort through the vast quantity of brownfield sites and choose three terrains that can be eligible for a green infrastructure plan. The sites are the *Hacienda Central Aguirre* in *Guayama*, *El Valadero* in *Cataño*, and four near brownfield sites in *Ponce*.

1) *Hacienda Central Aguirre*: On October 10, 2020 I had the opportunity to visit the historic site of the Sugar Mill, composed of the Aguirre Community, various historic houses and abandoned infrastructure. The access, of what was known in the past as *El Porton*, was within reach and lead directly to the Central. Sadly, the direct access to the Central was blocked by closed iron gates, yet what could be seen was improper management of the

historic site. The historic structures that were on the other side of the gates were part of the 6 brownfield sites in the area and were in complete abandonment surrounded by grasslands. Since access was denied, the only complete view was the port (Fig. 5, pg. 31). It may be a potential site for design development since it is near natural ecosystems, such as the ocean and rivers, and also natural reserves. According to several residents, the area does not constantly flood when it rains, if there is a tsunami alert, they can be affected. According to the Sea Level Viewer from NOAA, if the sea rises four feet above (the approximate estimate in the next five years), the community will not be affected as shown in Fig. 12:

Figure 12: Image retrieved from NOAA Sea Level Riser Viewer, October 12,2020

Since flooding is not an urgent environmental problem to assess, the residents also shared their desire to access the historic sugar industry safely without impediment of the DRNA, but they fear that is closed due to the contaminants that were present in the structures affected the vegetation.

2) *El Valadero*: Located in Cataño, *El Valadero* is an assessed brownfield site, found in the top part of the sector, that was used as a shipyard for the Government Port. In addition to that terrain, there are 3 near brownfield sites which are an abandoned gas station, old train station and a vacant lot, shown in Fig. 13:

Figure 13: Image retrieved from EnviroMapper, October 11,2020

El Valadero: Assessed site

Old Train Station: Assessed site, the ruins remain in a separate lot next to a parking building.

Vacant Lot: Assessment has not started

Gulf Gas Station: Assessment has not started

The community that surrounds the brownfields is found in the ocean, with no buffer between the sea and land. Also, there is a lacking presence of vegetation and coastal forests to help mitigate the entering waters. According to the Sea Level Viewer from NOAA, if the sea rises

only one foot, the community will immediately be affected. This shows another environmental problem that must be attended if it is chosen. The following images present the area with only 1ft. of sea level rise:

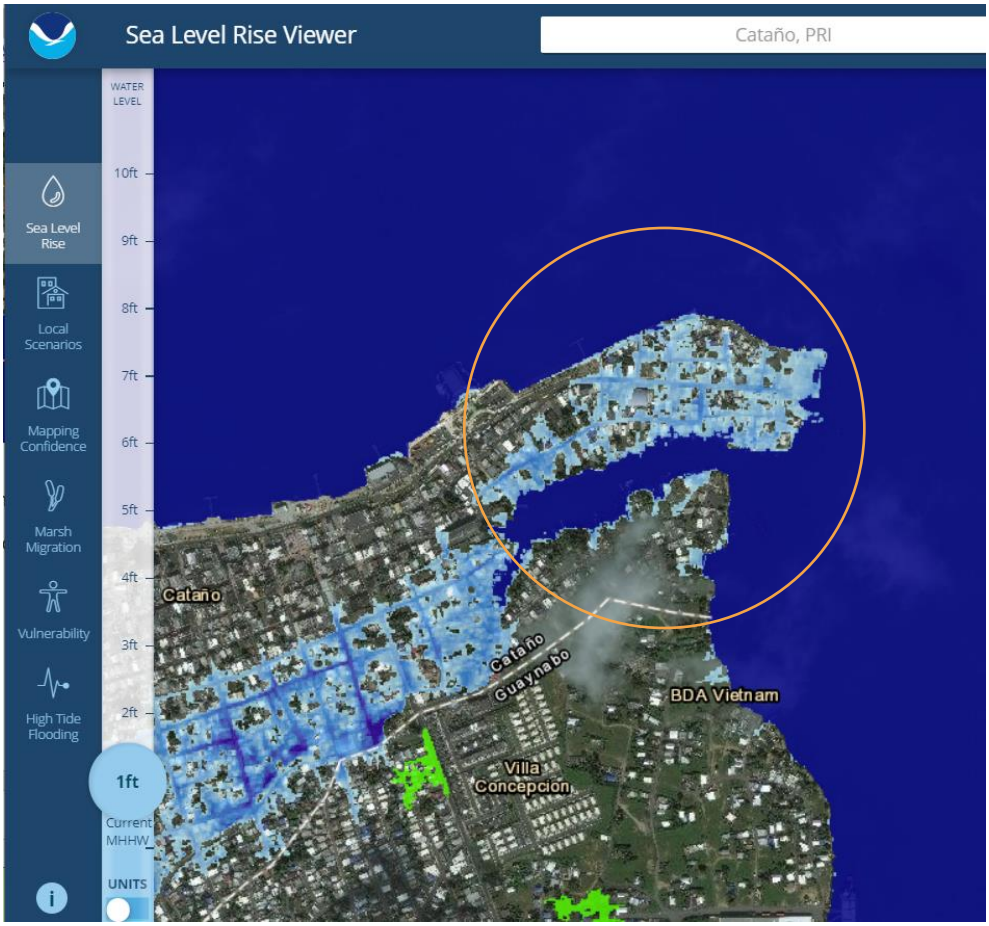


Figure 14:Image retrieved from NOAA Sea Level Rise Viewer, October 12,2020

3) *La Playita* Sector: Located in the south coast in Ponce, there are four brownfield property sites in Salmon Street (an abandoned all male school from the 1970's, industry building, a metallic shop from the 1930's and cleaners) that are near the ocean, a river, few vegetated areas and approximately three vacant lots that were public spaces. Being Ponce one of the south municipalities that abounds in brownfields, these specific four sites meet with the parameters established for the project. The following image presents the brownfield sites and if they have or have not been assessed:

Figure 15: Image retrieved from EnviroMapper, October 11,2020

- Small Residential Property: Assessment is in progress
- *Edificio Vasallo*: An abandoned metallic shop from the 1930's, Assessed site
- *Antiguo Colegio Ponceño de Varones*: Assessment is in progress
- Hollywood Cleaners: Assessment has not started

In addition, according to the Sea Level Viewer from NOAA, if the sea rises three feet, the nearby communities will be affected by the entering waters directly from the sea and from the river that is found on the left. As the previously mentioned possible site in *Cataño*, the floods caused by hurricanes, constant rain and sea level rise will affect dangerously communities. With the proper management and designation of coastal forests, as part of the green infrastructure, it can help not only with the floods but also for the environment. In Fig. 16 demonstrates the previously mentioned:

Figure 16: Image retrieved from NOAA Sea Level Rise Viewer, October 12,2020

The previously shown sites can be considered for the implementation of a green infrastructure plan that will be a part of the design project. Each present environmental concern that can be handled accordingly. Thus, the formulation of a design program must meet the steps and strategies towards the bettering of ecosystems and access to them for communities. The program should be able to attend the brownfield, redeveloping it to be an Environmental and Education Center that will be the starting point to access the greenways and paths towards the ecosystems. In case the historic site of *Aguirre* is chosen, the center will still be focused towards the education with environmental purposes, yet it will also highlight the history restoring the abandoned properties. The center will have amenities for the community and visitors, designated areas for

view enjoyment, cycling trails, pedestrian paths and greenways leading to certain ecosystems. The goal is to raise awareness of the protection of nature by leading visitors to have a direct connection with it in their current context. It is meant to be driven and lead by community leaders to benefit all whom want be a part of.

Chapter conclusions:

The importance of nature in rural and urban contexts and viewing the massive destruction that we are causing to it was the motor for this investigation. Living in one of the greenest municipalities in *Puerto Rico*, being *Cayey*, nature has always had a special place in my heart and I wanted for this Thesis to express just that. Knowing that there are laws that protect ecosystems yet are not carried out because of lack of funding, disinterest and/or abandonment, leads to point that communities and non-profit organizations are the ones who must carry on their backs the care and management of ecosystems. The small incentives are effective but not enough. The abundance of public nuisances affects not only the biodiversity life that surrounds them, but also the safety and life of communities. This is why new developments should occur in abandoned sites that were once used, such as brownfields, to bring back life and opportunities for new growth. The investigation demonstrated that Architecture can be in a consonant and safe relationship with nature, but is has to be deliberately and carefully planned for it to not be a stepping stone.

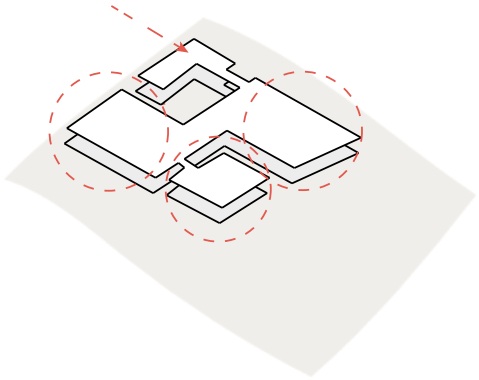
Thanks to interviews to the EPA, the JCA, professionals in environment and management, and residents from a certain community, they helped me towards the creation of this document that will be my guide in the entire design process. Hopefully, this initiative sparks curiosity and engagement of the chosen community, since it has certainly caused a spark in me.

Chapter 4: Precedents

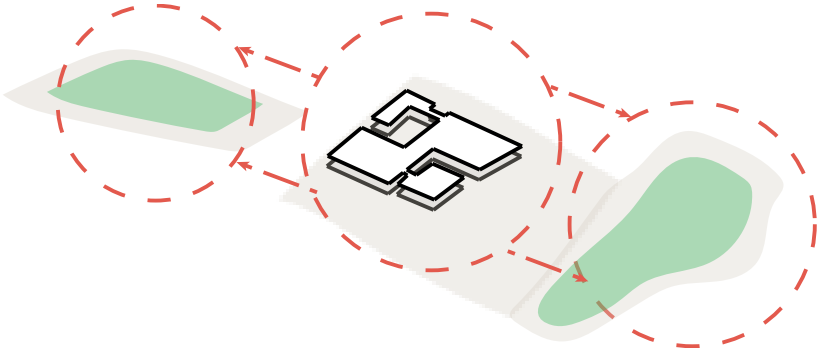
The objective of this proposal is to reuse abandoned brownfield sites to become an Civic Center that will be the starting point to access greenways, ecosystems and amenities. The program will consist of: multipurpose rooms: (Activities, workshops, etc.), designated sight-seeing areas, designated area for a community garden, amenities, parks with water mitigation functions: rain gardens, “bioswales” and greenways (permeable pavements).

The strategies are:

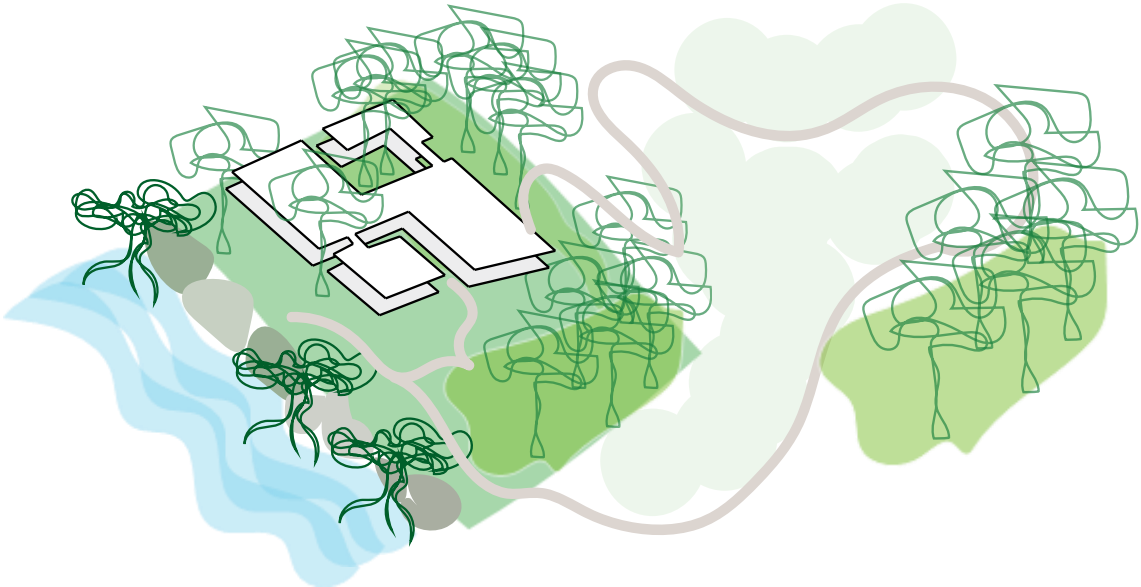
Provide multipurpose spaces



Integrate public parks



Incorporate native vegetation, integrate nearby ecosystems and trace paths (greenways)

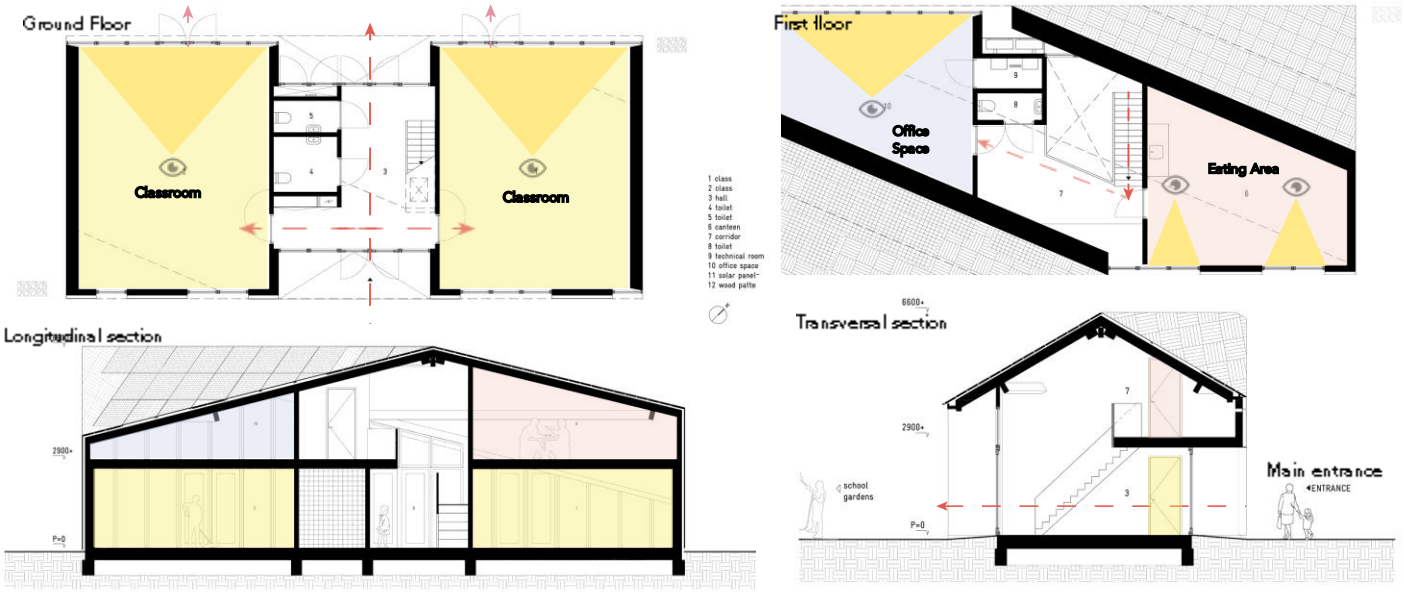


The following precedents will identify certain strategies to maximize their architectural efforts in relation to the surrounding environment. The first one is the Nature and Environment Learning Centre in Amsterdam. The architects are Bureau SLA designed the center in 2015. Being 281 square meters, it is located amidst gardens that belong to the nearby school. The center provides spaces for classrooms and workshops, also for offices and eating area. All of the spaces view the outside greenery, despite the angle of the roof, which has optimal orientation towards the sun that favors the production of clean energy through solar panels.

Figure 18: Image retrieved from Archdaily, December 6, 2020

Figure 17: Image retrieved from Archdaily, December 6,2020

The following analysis of the architectural drawings demonstrate the views and main circulation:



The second precedent is *Raices* Educational Park in Colombia, designed by Taller *Piloto Arquitectos* in 2015. Located between the urban city of Guatape and a nearby forest, the park, which is 653 square meters, is the transition that leads visitors from the urban context to a rural scenario. In addition to having two public parks, it also has spaces for workshops and training that have a direct view to the forest. To exalt the surrounding vegetation, the multiuse of cement blocks that permit the access of natural light and air, is the main material that is used throughout the structure. It is a center open to all that welcomes visitors to a different experience where nature is the protagonist.

Figure 21: Image retrieved from Archdaily, December 6, 2020

Figure 20: Image retrieved from Archdaily, December 6,2020

Figure 19: Image retrieved from Archdaily, December 6,2020

The following analysis of the architectural drawings show the program, main circulation, views and shade:

Figure 23: Image retrieved from Archdaily, December 7,2020

Figure 25: Image retrieved from Archdaily, December 7,2020

Figure 24: Image retrieved from Archdaily, December 7,2020

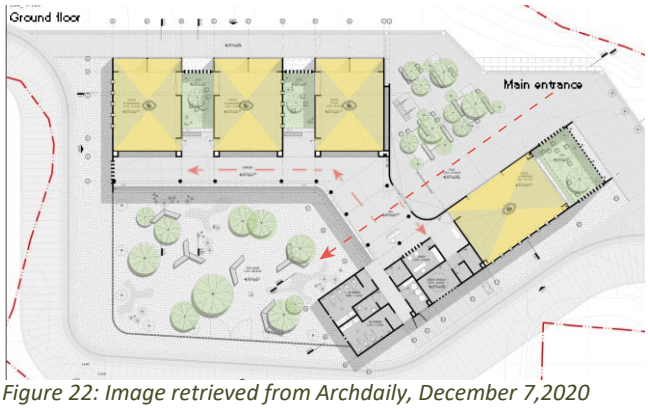


Figure 22: Image retrieved from Archdaily, December 7,2020

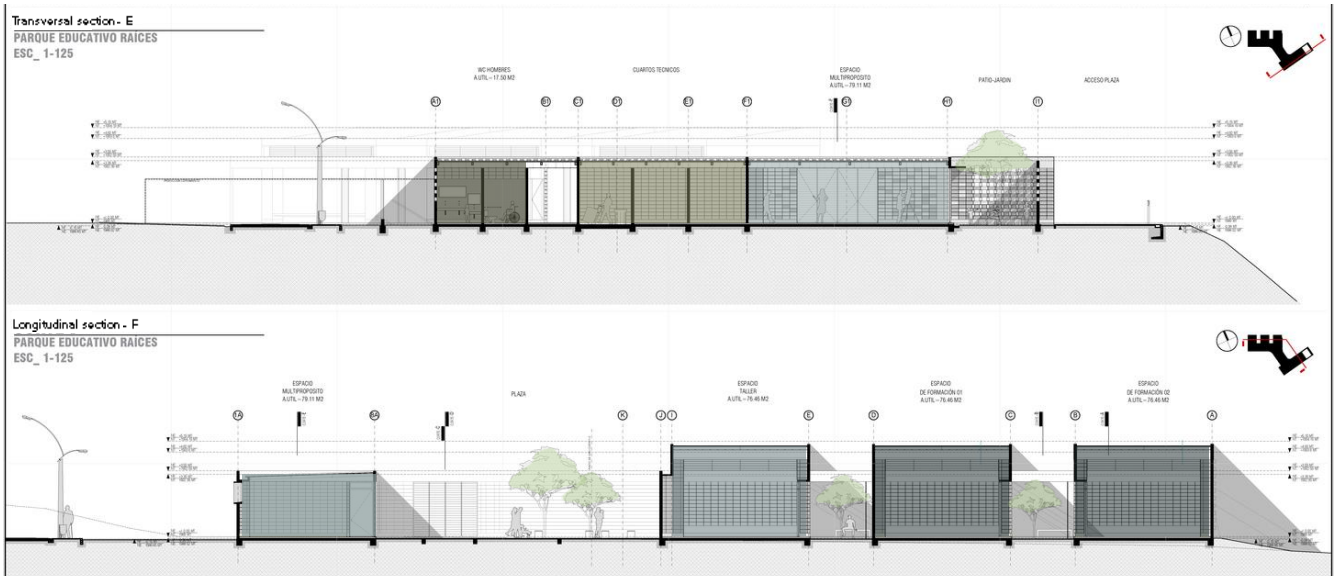


Figure 26: Image retrieved from Archdaily, December 7,2020

The third precedent is the Naples Botanical Garden Visitor Center in Florida, United States. It was designed by Lake | Flato Architects in 2014 in a land of 14,000 square feet filled with six gardens, a lake, and various amenities. The center is the starting point to access the paths that lead to the restored green areas and gardens. The entrance leads to a ticket center that directly accesses the traced paths to ensure the safety and enjoyment of the visitors. The tour then later ends in the Café. The material that is used throughout the center is natural wood that permits the views of the vegetation and the presence of natural light and air.

Figure 28: Image retrieved from Archdaily, December 8,2020

Figure 2[illegible] December [illegible],2020

Figure 27: Image retrieved from Archdaily, December 8,2020

The following analysis of the master plan and ground floor show the program, main circulation, views and the designated path:

Figure 30: Image retrieved from Archdaily, December 8,2020

Figure 31: Image retrieved from Archdaily, December 8,2020

The fourth precedent is Casa Jalipita in Tabasco, Mexico. The restoration and programmatic redesign of the historic house was by *"DAFdf Arquitectura y Urbanismo"* in 2014. The architects decided to repurpose it into a touristic destination that provides multiple recreative events, garden space, workshops, etc. What was salvageable of the structure was restored, since it was in a delicate condition. Colors and textures where then added to exalt the present architecture; which is seen in the façade and in the floors. Once tourists enter through the front door, it is the starting point to access indoor and outdoor multiuse spaces. The first thing they contact nature at a distance inviting them to explore the outdoor activities.

Figure 33: Image retrieved from Archdaily, December 10,2020

Figure 32: Image retrieved from Archdaily, December 10,2020

Figure 34: Image retrieved from Archdaily, December 10,2020

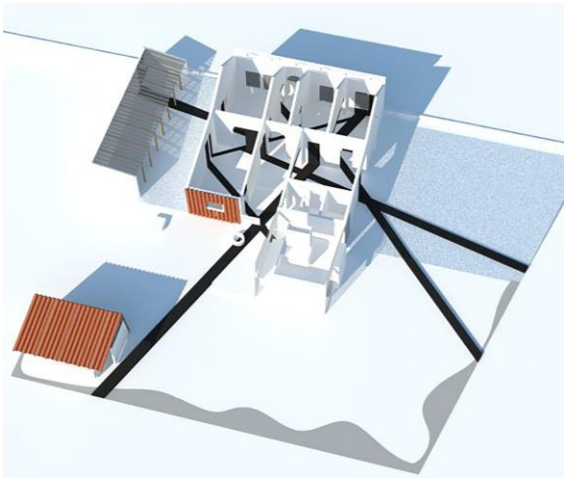


Figure 35: Image retrieved from Archdaily, December 10,2020

The following analysis shows the axis that starts in the entrance and leads to the outdoors. It demonstrates the directions led by the floors to the multiple spaces inside and out the structure. Also, it presents the use of natural materials for the outdoor kitchen, which serves as a buffer between structure and nature:

Figure 36: Image retrieved from Archdaily, December 10,2020

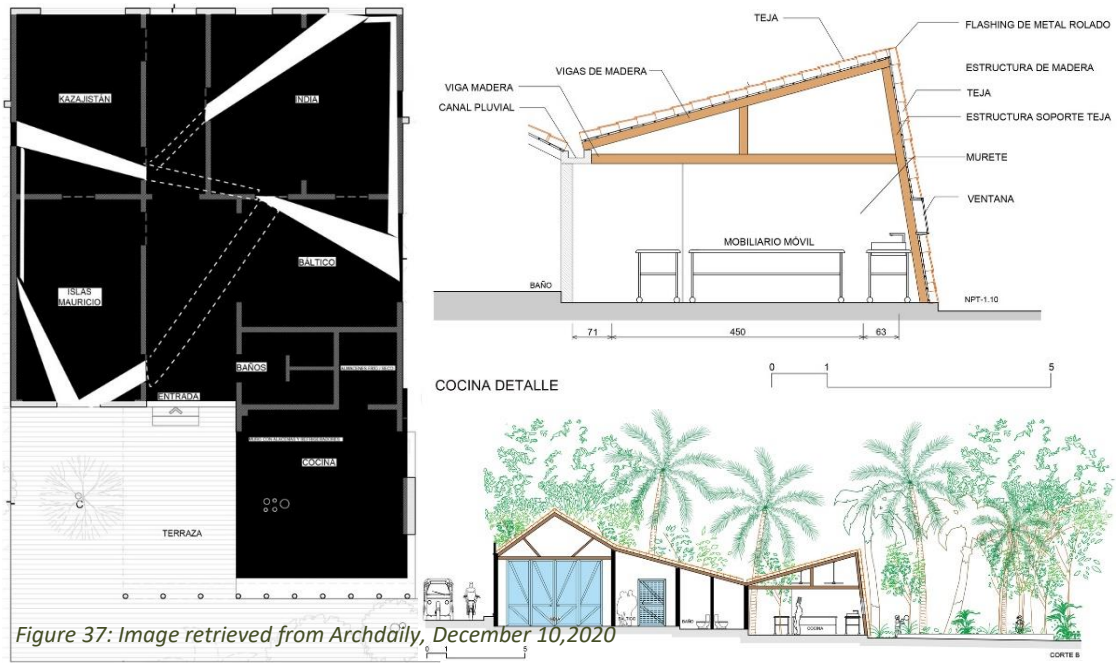


Figure 37: Image retrieved from Archdaily, December 10,2020

The precedents previously discussed showcase distinct strategies that fit their programs very well. The various uses of material, being natural or historic, played a fundamental role when it came to extend to the vegetative presence. In addition, the axes direct a circulation that directs the local or tourist to the multipurpose spaces while having direct contact with ecosystems.

Nature was a part of each project, unifying the designs with its textures, colors and benefits. Having studied each precedent, I'm positive that they will help my upcoming design journey to shape the Civic Center with an eco-focus in the Playita Sector.

Final conclusions

This research has delved into the current crisis of our environment that is often left aside in new developments. By just "adding a few more trees" to design projects does not mean that it will help the delicate conditions of the surrounding environments. Choices such as what type of vegetation is suitable for the space that will also benefit the community and what technologies can be integrated to mitigate environmental causes need to be carefully interspersed. The choices lead to strategies that preserve ecosystems, while providing safe spaces for the sake of the present and future of communities.

The investigation demonstrated that Architecture can be in a consonant and safe relationship with nature, but is has to be deliberately planned for it to not be a stepping stone. This is why landscape strategies will be of utter priority to appropriately integrate nature and the historic structure. Further visits to the site will be made to analyze the structure and evaluate its condition to make decisions regarding its total use. Since the importance of a pro environmental consciousness starts by educating, the proposed Civic Center will have an eco-focus, while also being a green lung for the Playita sector. Interviews will be planned to the nearby communities to see their interests and ideas for the redevelopment of the chosen brownfield.

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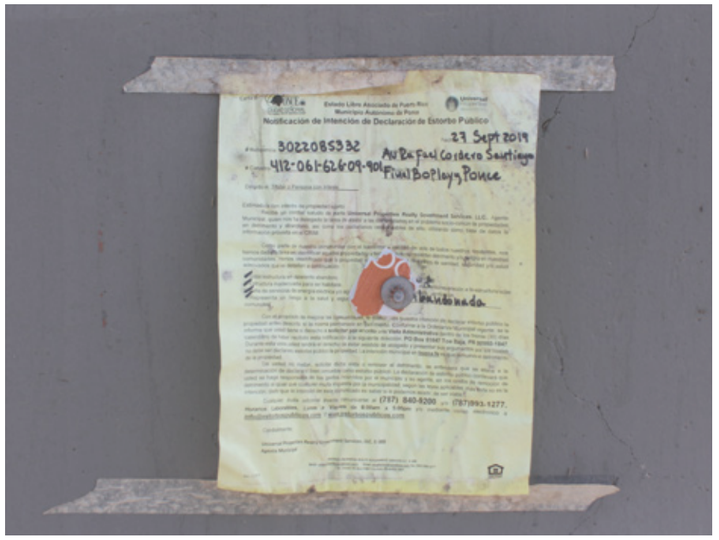
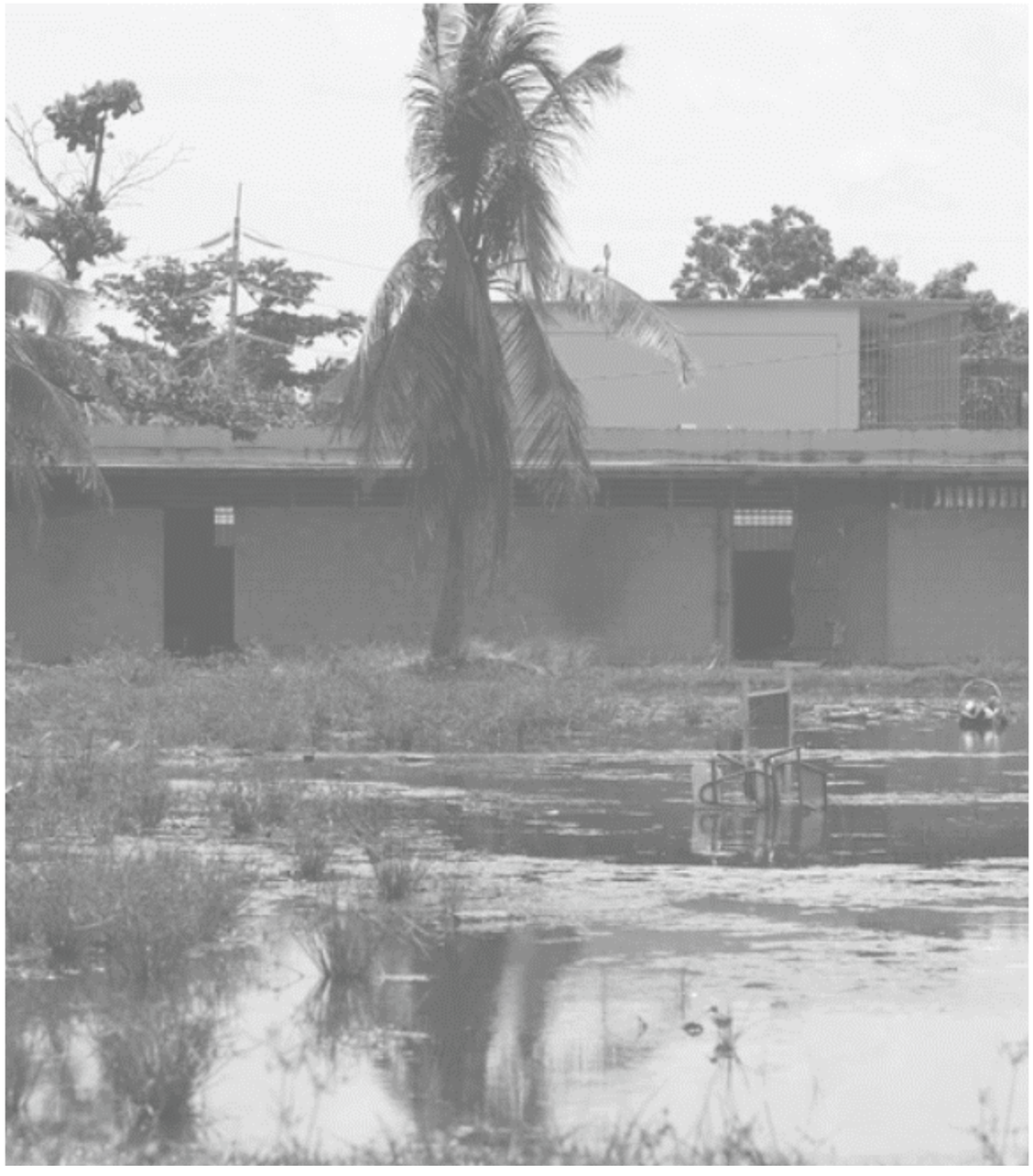
Transforming the forgotten

Promoting pro-environmental awareness



Carolina Zoé Claudio Reyes
ARQU 6314 001

Introduction

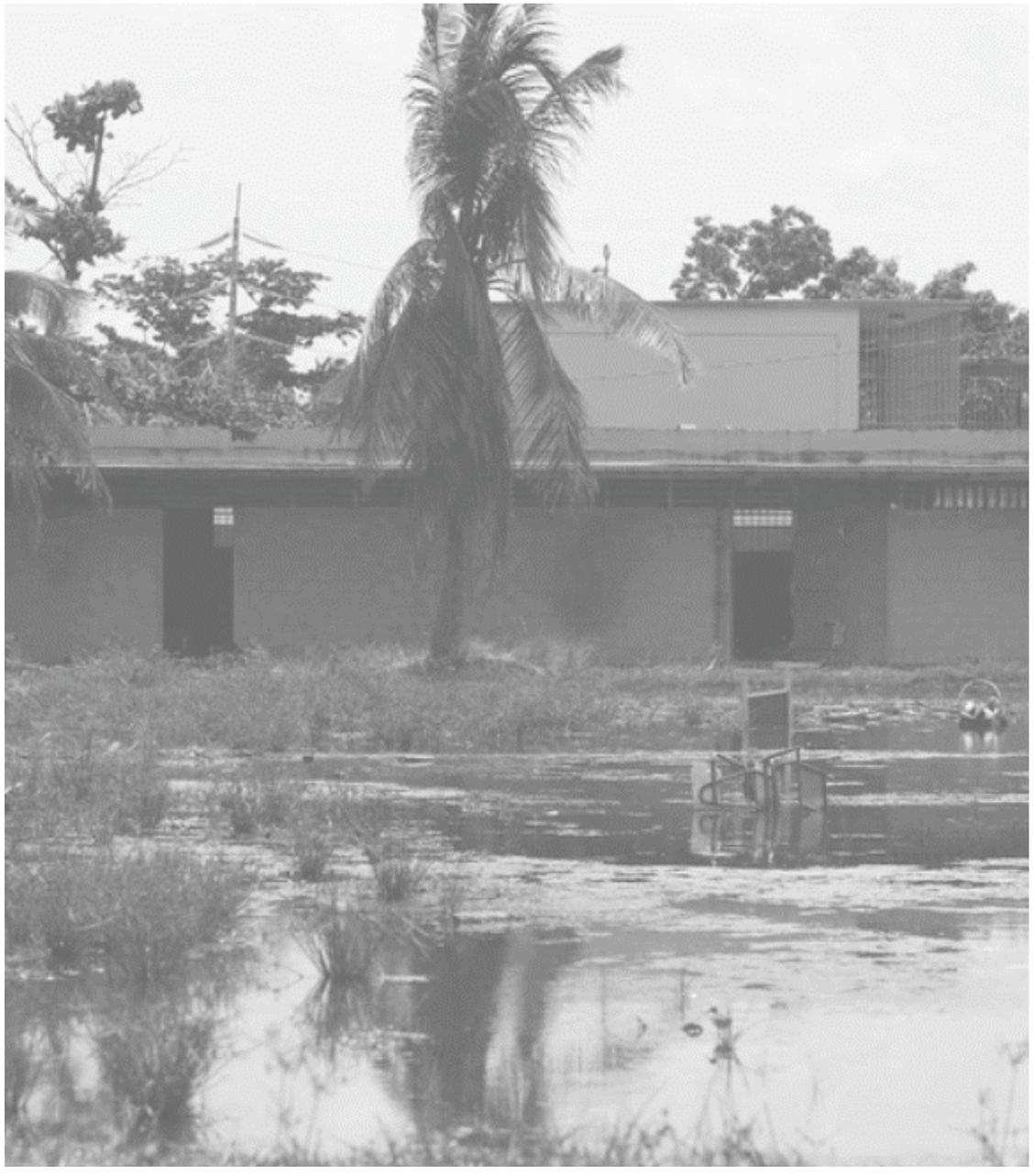


Nature being a fundamental part of life is degrading at a vast pace due to erroneous human activities and practices, causing a pressing need for its survival.

Abandoned public properties and lots abound in nature-less environments where only concrete prevails. Slowly but surely, the green creation finds a way to take back what was once its home but in a toxic remain.

This leads to unsecure spaces that are not safe for the enjoyment of communities and are not healthy for the growth of natural species.

Problem



Problem: Unsafe abandoned properties abound in the island, not being secure for the use of communities nor natural habitats.

Question: Can abandoned properties become a part of a green infrastructure system to promote a pro-environmental consciousness?

Hypothesis: Manage the mishandled for it to be integrated to a green infrastructure system, interconnecting environmental spaces and amenities for public use

Theoretical Framework

Principle readings

Environmental Degradation	Reinforce a pro-environmental conciousness	Environmental strategies	Human impact Brownfields	Parameters for possibles properties
Climate change Deforestation	Importance of the environment Laws and entities that endorse its protection	Green Infrastructure Smart Growth	Urban Sprawl Industry impacts Brownfields in P.R.	Estrategias de diseño para reusar el brownfield escogido
“The Green New Deal” – Jeremy Rifkin “Climate 101: Deforestation” – Christina Nuñez	“Brundtland Report”-UN “The New Urban Agenda” - UN Agenda 2030 - UN	“Infraestructura Verde y nuestros parques” – María Juncos “Hacia el Desarrollo inteligente – 10 principios y 100 estrategias para Puerto Rico	“Brundtland Report” - UN “Los estorbos públicos en Puerto Rico” – Luis Gallardo “Environmental Contaminants often found at Brownfield Sites” - EPA	Reuse Possibilities for Brownfield Sites - EPA

Methodology and objectives

Phase 1

- Investigate **environmental pollution** – due to deforestation and urban sprawl
- Importance of **a pro-environmental awareness** – global effort / local application
- Laws and entities that are working for a better environment

Phase 2

- Emergence of **abandoned properties** and their impact .
- Study **brownfields**
- Use the EPA internet tool Enviromapper to identify brownfields island wide

Phase 3

- Design strategies
- Set up parameters to choose a posible site .
- Analize and see if there are environmental issues of the three chosen sites

Redevelop brownfields

Reforest

Awareness

- **Emphasize** the importance of caring for our environment
- **Expose** negligence and mismanagement tow the treatment of green spaces
- **Study** brownfields and their environmental impact

Chapter 1: Knowing our endangered environment

Investigate environmental contamination

Human factors are the main contributors of environmental contamination

- Since the industrial era, the need for land became necessary, causing the destruction and degradation of the environment.

Importance of a pro-environmental awareness

Ennvironmental education should be fundamental and given to all for the proper care of our environment

Environmental conservation is a worldwide incentive and must be driven in a local application

For an efficient and dignified quality of life, the value of green spaces is a determining factor for an economic vitality, this is why all of the funds must not go solely to grey infrastructur

Concepts to define:
- Green infrastructure
- Smart Growth

Laws and entities working towards a better environment

Law on Environmental public policy – Law 416 - 2004

Program of Reforestation, administration and conservation of living resources in the administration of natural resources
– Law 195 (of DRNA)

- Only 1% of public funds are for the management of the green infrastructure

- 28% of public funds are for the management of gray infrastructure

Non-profit pro environment organizations:
- Para La Naturaleza
- Fundación Puertorriqueña de Conservación
- Organización Pro Ambiente Sustentable
- Among others..

Interview to Dr. Pedro Rivera

Arborist

EN EL SUR

“Tirado a pérdida” el Parque Julio Enrique Monagas de Ponce

“La comunidad tiene que actuar, no podemos contar con el gobierno ya que el medio ambiente no es su prioridad. La gente tiene que apoderarse de las áreas protegidas antes de que las perdamos por completo debido a una planificación peligrosa.”

“La naturaleza es necesaria en todas partes, la educación ambiental y la gestión adecuada deben llevarse a cabo para salvar nuestra isla ”.

Chapter 2: The environmental impact of abandoned properties

Investigate the impact of abandoned properties

Consequences of abandoned properties:

- Endangering the health of people and the environment
- It affects public security
- Acumulation of water that attracts pests

Causes and consequences of brownfields

Contaminated buildings or grounds that can potentially be dangerous due to neglect, negligence and/or legal disputes

However they can be reused thanks EPA programs such as:

- Toxic Release Inventory Program (TRI)
- Brownfields and Land Revitalization Program (BLRP)
- Center for Creative Land Recycling (CCLR)

Brownfields in Puerto Rico

Interview to Zolymar Luna (Local Project manager of brownfields EPA in P.R.)

Interview with the director and those in charge of the JCA inventory

In Puerto Rico, there are 152 brownfields (according to the EPA website)

- EnviroMapper: locates a total of 170 brownfields

Initiative de la Environmental Quality Board (JCA) in realtions of brownfields:

- **State inventory (under development)**
- Reuse program
- 54 assesed municipalities

Some are found in abandoned historic sites such as:

- **Sugar industry:** Central Aguirre (6)
- **Petrochemicals:** CAPECO (site complete) y la CORCO (9)

Chapter 3: Towards a necessary change

Design strategies and parameters for the sites chosen

To carry out the restoration and transformation of the property duly evaluated and cleaned:

- Identify the scope or magnitude of the project
- Identify nearby ecosystems
- Degree of interaction in green spaces (public and private)

The strategies that can allow an adequate and secure interconnection are the following:

- **Reforest:** Choose proper native vegetation
- **Creation of greenways:** Link public parks

- **Guides:** Placement of information
- **Water mitigation:** Permeable pavements, rain gardens, placement of vegetation, etc.

- **Adequate lighting:** Sense of security

Identify and evaluate brownfield sites that meet the chosen parameters

To choose from the possible properties, the following was established:

- Abandoned and/or taken over nature

- Near a community

- Near ecosystems, natural reserves and/or protected areas
- Site that has poor vegetation, contaminated vegetation by chemicals or has no vegetative presence at all.
- The property presents other environm problems that must be addressed

Three were chosen:

- **Hacienda Central Aguirre:** Guayama (6)
- **El Valadero:** Cataño (4)
- **La Playita Sector:** Ponce (4)

Hacienda Central Aguirre: total of six brownfields

Visited

Abandoned and/or taken over nature

Near a community

Near ecosystems and natural reserves

Site possibly has contaminated vegetation

The area does not frequently flood

The area will not be as affected by the sea level rise

Chapter 3: Towards a neccesary change

Identify and evaluate brownfield sites that meet the chosen parameters

Valadero : total of four brownfields

Was not visited

In a state of abandonment
Near a community
Near ecosystems and natural reserves
Poor vegetative presence in the area
The area does get flooded most times
It will be affected by the sea level rise
There isn't a buffer between the sea and land

La Playita Sector: total of four brownfields

Visited three times

Two in abandonment
Near a community
Near ecosystems
Poor vegetative presence in the area
The area does get flooded some times
The entering of the sea water can be managed

Program and Precedents

We chose a brownfield in the Playita Sector in Ponce

- In a state of abandonment / taken over by nature
- Near a community
- Near two public parks (west and east)
- Near ecosystems
- The waters can be mitigated

Program

Reuse the brownfield for it to be a **Civic center for environmental education** that will be the starting point to access the green trails and walkways towards the ecosystems.

It will have spaces for workshops, multiuse spaces, bike rental, gardens space for small businesses, etc.

Chapter 3: Towards a necessary change

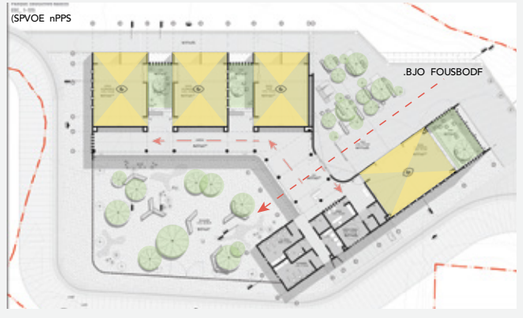
Program and Precedents

Casa Jalapita – México
Architects : DAFdf Arquitectura y Urbanismo
Year. 2014
3,282 sq.ft.

- Restored historical house
- Eco touristic destination
- Near a community
- Multiuse spaces (recreative events)

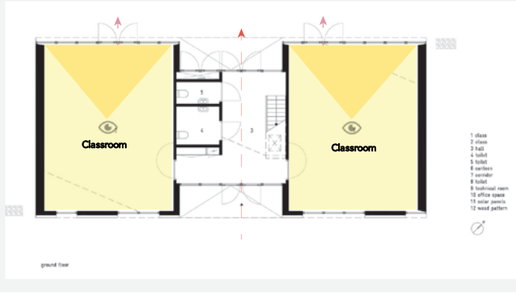
Raíces Educational Park – Colombia
Architects : Taller Piloto Arquitectos
Year. 2015
653 sq. ft.

- Near a community
- Near a forest
- Workshop spaces
- Multiuse spaces
- Access and direct view to the vegetation
- Connection between rural and ecosystem



Nature and Environment Learning Centre –
Amsterdam
Architects : Bureau SLA
Year. 2015
281 sq. ft.

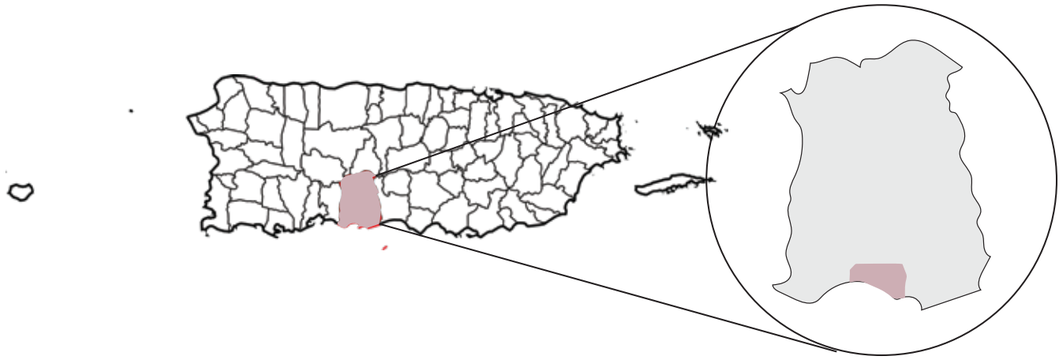
- Workshops and classroom spaces
- Access and view to gardens
- Agle for solar orientation (solar panel placement)

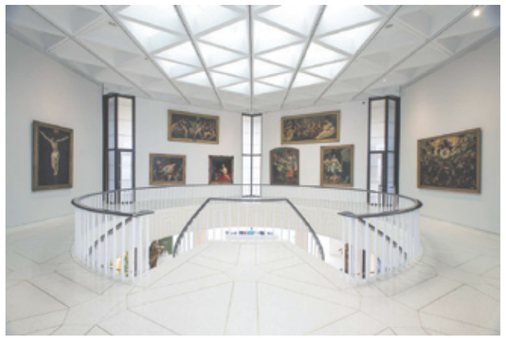


Analysis diagrams

PONCE

History and attractions





Known as the Pearl of the South, the City of the Lions and the popular term “Ponce es Ponce, lo demas es parking”, this municipality is the second largest one in the island with a total of 31 neighborhoods. It was named after the first governor of Puerto, Juan Ponce de Leon and declared, in October 27, 1992, the first autonomous municipality. It occupies 116 square miles in land area and has a population of 166,327 (established in the 2010 Census).

It has many touristic attractions and locations such as “Parque de Bombas”(built in 1882) in “Plaza Las Delicias”, “La Guancha” were visitors can enjoy fried staple delicacies with a Caribbean sea view, the Art Museum located in the heart of the town, Serralles Castle, “Hacienda Buena Vista”, historic houses and mini museums, among others.

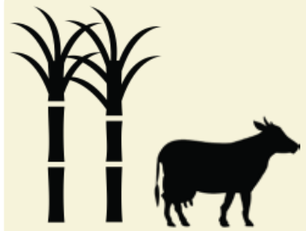
The flag represents the colors of the “Parque de Bombas” with their mascot: the lion. It was designed by Mario Ramirez, a resident from the municipality. Since April 28, 1967 they celebrate the day of the flag.

Site analysis | Sector La Playita, Ponce

Historic analysis - Timeline

1670

Residents of the area erected a parish dedicated to “Nuestra Señora de la Guadalupe”. The small hamlet would become the nucleus of what would be the Playa sector.



1692

Ponce was founded as a village with economic activities such as livestock, crops, tobacco planting, leather industry, among others. Ponce became one of the most important economic and cultural centers in the southern area.

1752

The entire Ponce coastline was covered with forests that were later used to extract wood. The Playa sector was a thick forest of palm trees. There were only about 115 houses.

1818

Don Alejandro Ordoñez, mayor of Ponce from 1816 to 1818, drew the first known plan of the municipality. It presented the orthogonal layout of streets, oriented from South to North and from West to East.

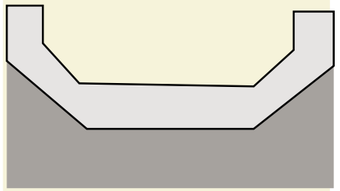
1820

A terrible fire causes the destruction of most of the houses. This led to a new urban planning that: widened the streets and created wide orthogonal blocks.

Source: “Evolución Urbana de Ponce” - Miguel A. Sánchez

Site analysis | Sector La Playita, Ponce

Historic analysis - Timeline



1867

A new constitution stated the implementation of the spanish style in urban planning. In the corners of intersections, a diagonal cut (“chaflanes”), had to be made to improve circulation and to facilitate visibility of the carriages.

In 1877, by Royal Decree of Alfonso XII, Ponce was elevated to the rank of a city.

1877

1880

The steam train that connects the two urban centers (the heart of the city and the Playa Sector) of Ponce is inaugurated.

The first map of the Playa Sector is made, distinguising an orthogonal structure composed of large warehouses.

1886

1899

In January 25, 1899 the event known as “fuego del polvorín” occurs causing the loss of eight firefighters. The fire destroyed homes and took lives.

Site analysis | Sector La Playita, Ponce

Historic analysis - Timeline

1936

Settlements arise on the other side of the Portuguese river.

In 1962, the Historic Zone was established. The Hostos avenue of joins the two historical centers of the city, the metropolitan center and the town of La Playa.

1962

1980

In the second half of the 19th century, a government plan was stated to begin with the construction of roads in the island. It permitted for San Juan, the capital city to connect with the second most important municipality in the south, Ponce.

As part of the revitalization plan for the city, a total of 2,500 historical buildings were preserved in the Historic Zone.

1989

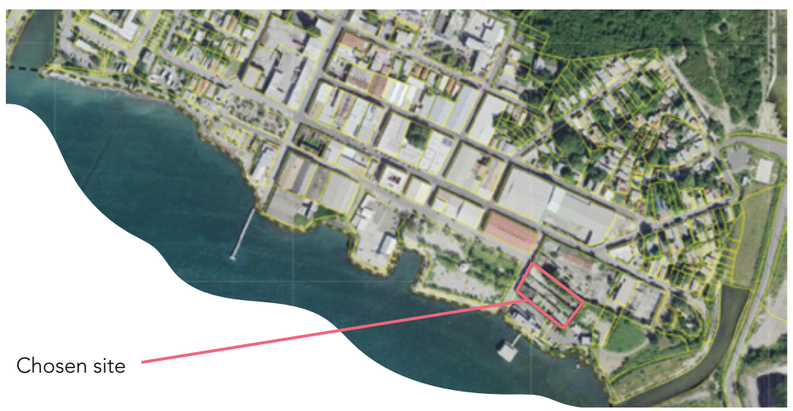
2004 - 2009

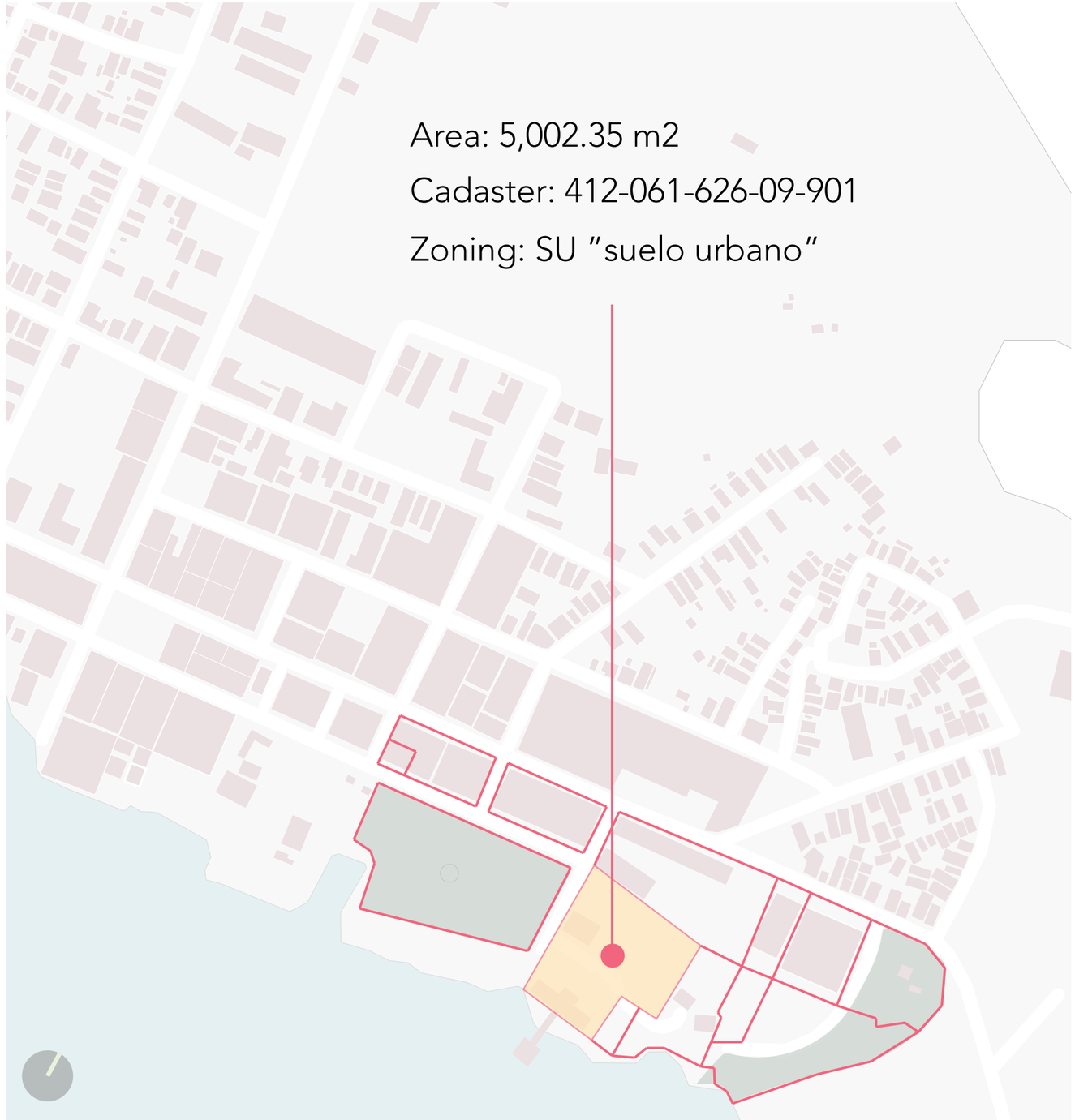
The Historic Zone suffered an economic crisis that led to the closure of 85 local shops and small businesses. The economic state slowly recovered with the passing years.

Site analysis | Sector La Playita, Ponce

Territorial limits and zoning

Source: “Catastro Digital”, GIS

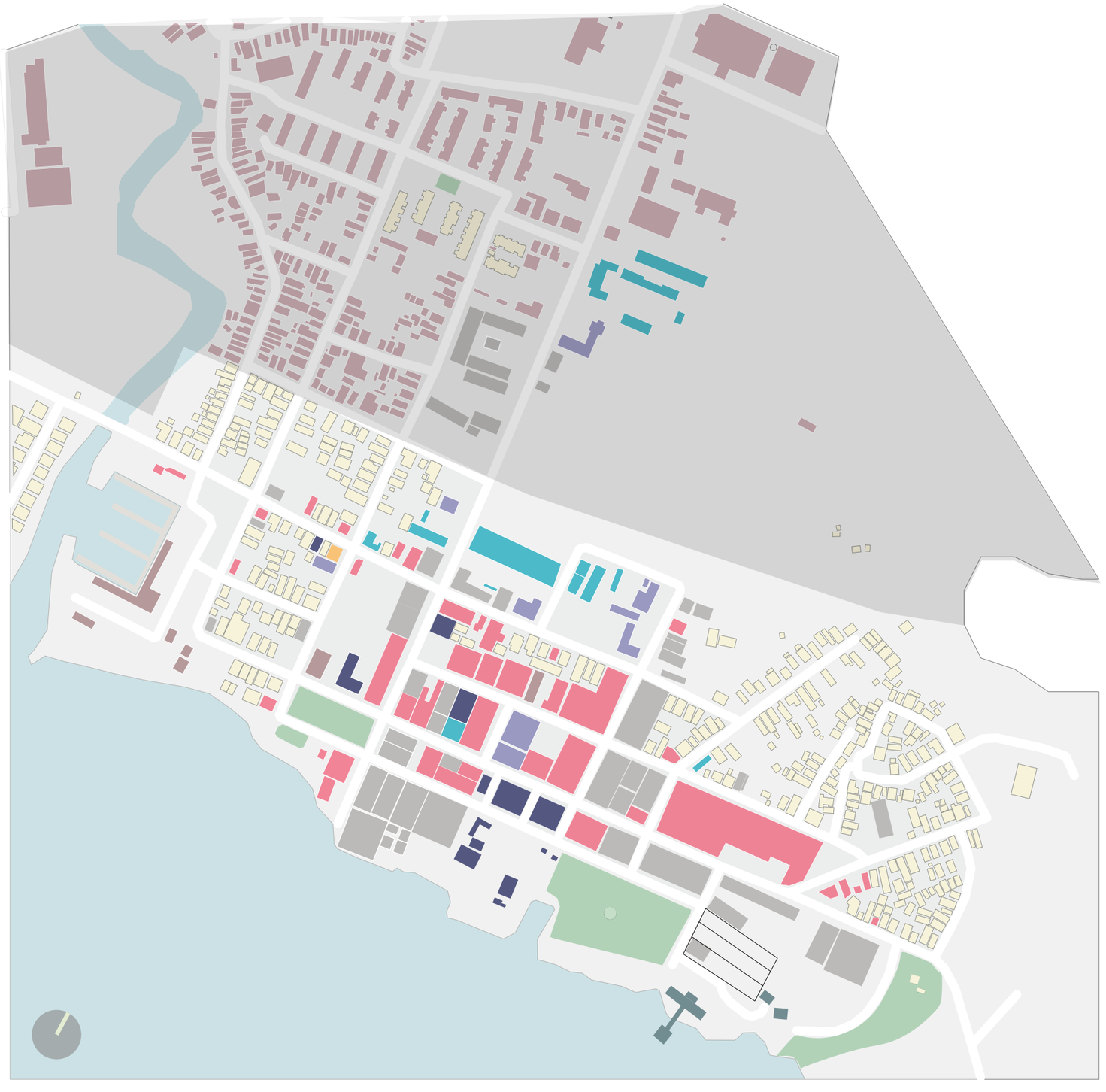




Site analysis | Sector La Playita, Ponce

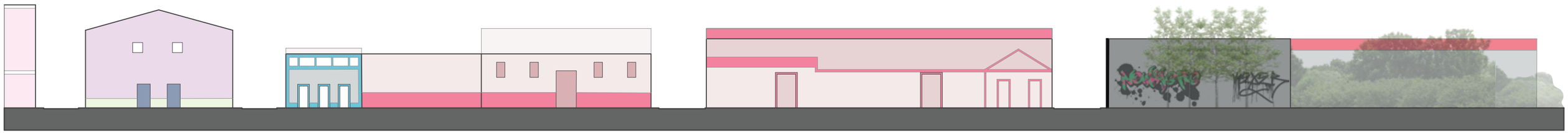
Uses

- Institutional / Public Administration
- Commerce
- Vacant / Abandoned
- Educational
- Financial and Insurance establishments
- Religous
- Health
- Communal services
- Housing
- Housing and Commerce
- Cultural services / tourisim
- Parks / Plazas



Site analysis | Sector La Playita, Ponce

Longitudinal and Transversal sections of the current state

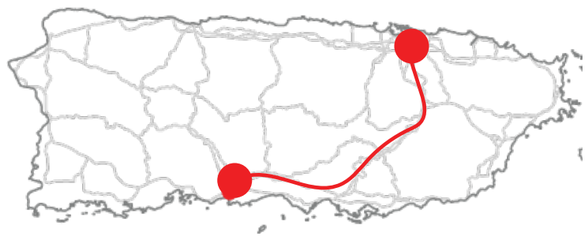


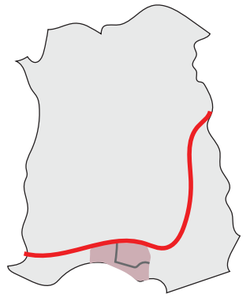
Section AA - Scale 1/32”

Section BB - Scale 1/32”

Site analysis | Sector La Playita, Ponce

Vehicular circulation





Primary streets:

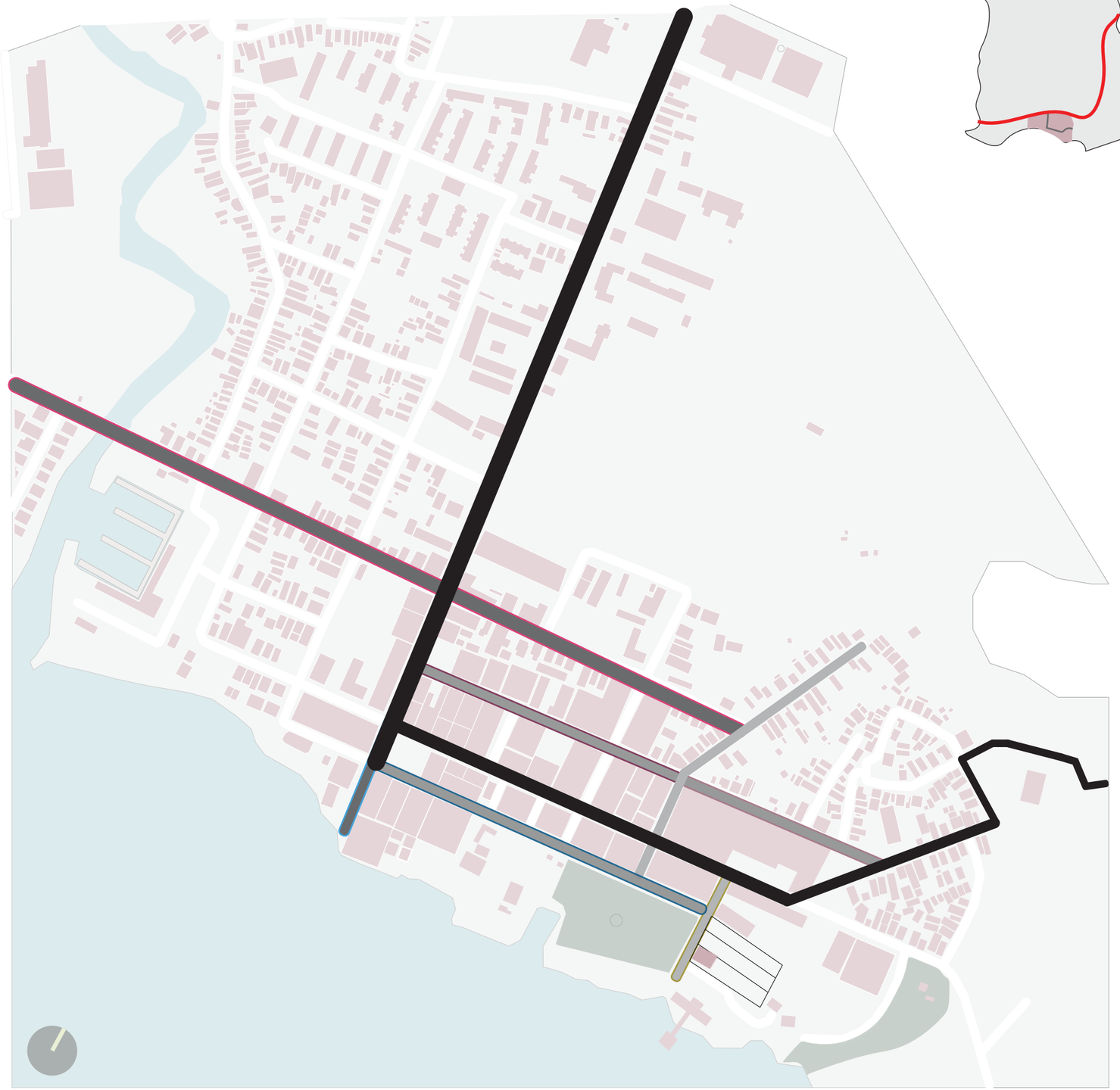
- Highway Luis A. Ferre / Expreso 52 (Two way)
- Carr. 123 / Av. Hostos (Two way)

Secondary streets:

- Av. Padre Noel (One way)
- Av. Hostos (end)
- Morena Street (One way)
- Mirasol Street (One way)
- Bonaire Street (Two way)

Vertical secondary streets:

- Ramon R. Velez Street (Two way)
- Cruz Street (Two way)



Site analysis | Sector La Playita, Ponce

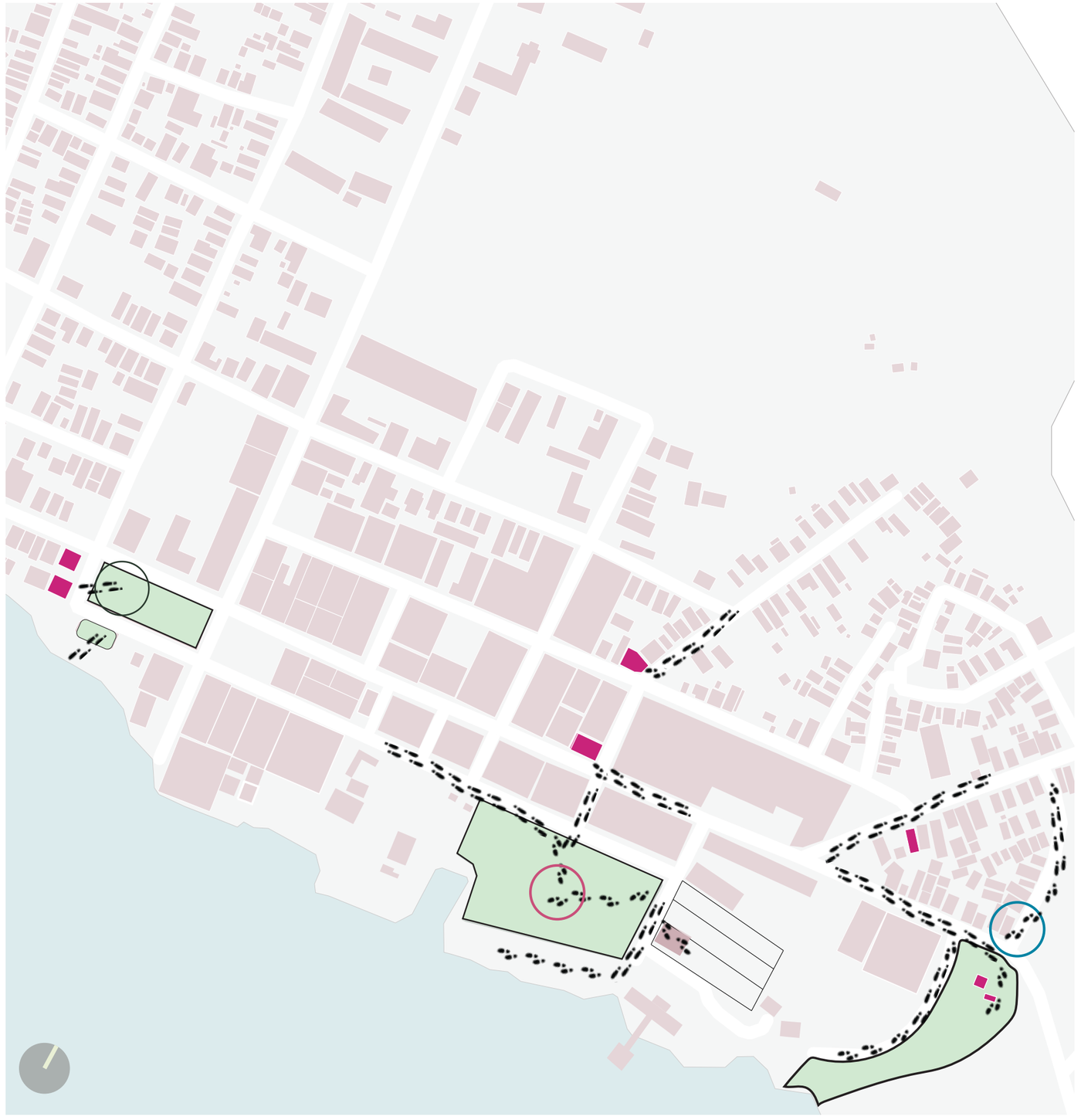
Pedestrian circulation

Views of pedestrian trails

Residents and visitor steps

Commerce points where people where mostly seen
- Bahias Rest.
- Café Lucero
- Sin Tenedor 787
- El Truco Bar

Public parks where people where seen
- Plaza 65 de Infanteria
- Passive Park Enrique González
- Park “La Moca”

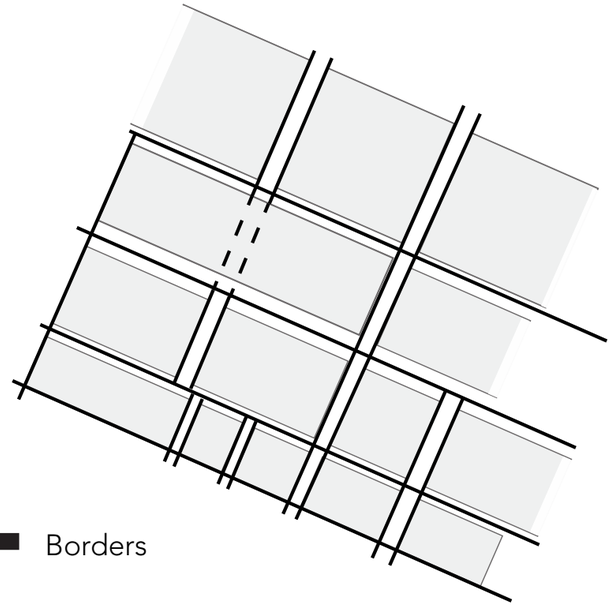


Site analysis | Sector La Playita, Ponce

Pedestrian Trails and Borders

Pedestrian trails

Views of pedestrian trails



Borders

Orthogonal order

Node - Higher frequency (vehicular)

Site analysis | Sector La Playita, Ponce

Images and Shapes and figures

1886 - Playa sector

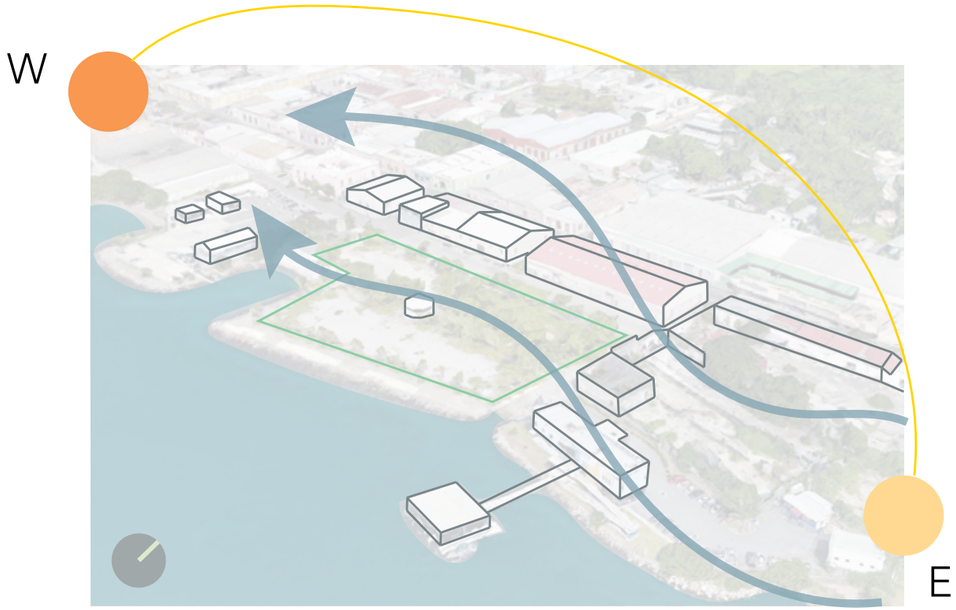
1930

1994

2019

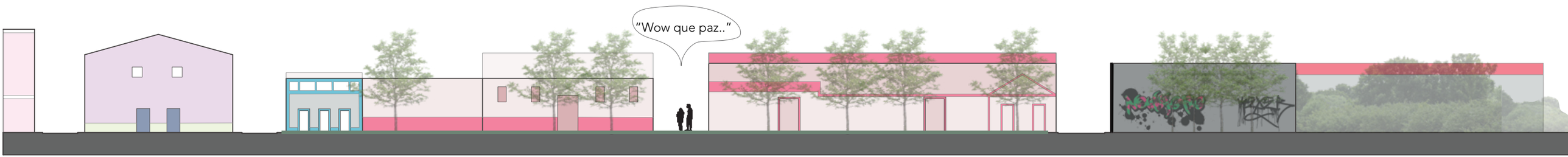
Site analysis | Sector La Playita, Ponce

Sun and winds orientation + Sounds + Artificial lighting



Sun and winds orientation

Sound: 0 to none, peaceful as said by Hiram



Site analysis | Sector La Playita, Ponce

Vegetation, topography and site views

The topography in the sector is rather minimum. There is only one level identified found in the Enrique Gonzalez public park. The Ucar tree and the “Café de Indias” trees were identified in parks.

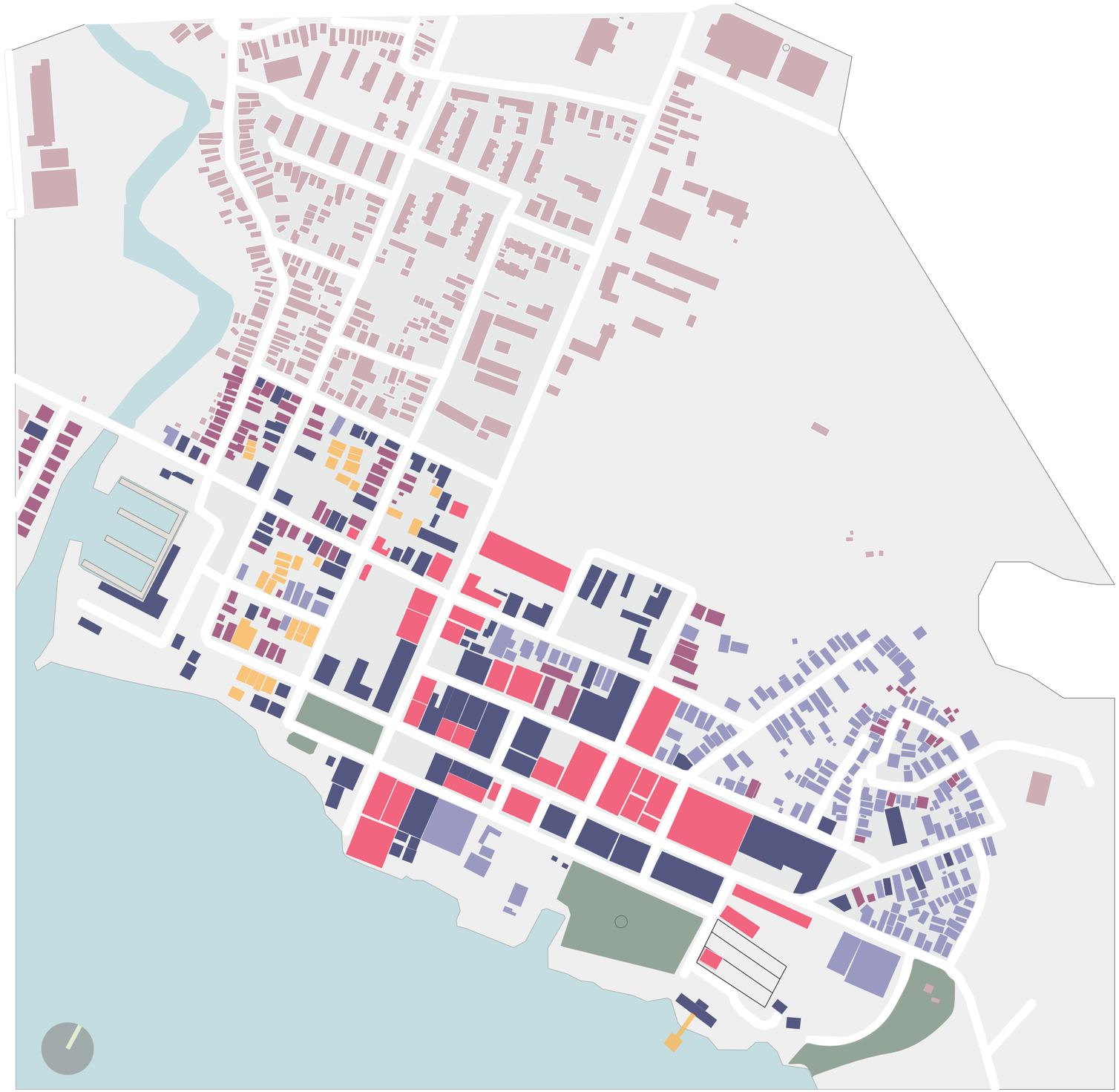
Section AA

Site analysis | Sector La Playita, Ponce

Techtonic and Materials

Since the Playita Sector is a part of the historic past of Ponce, most of the grand buildings were made with brick. They were orginally built for storage, distilleries and commerce. Nowadays, some are being used for commercial and storage purposes, others are in a state of abandonment.

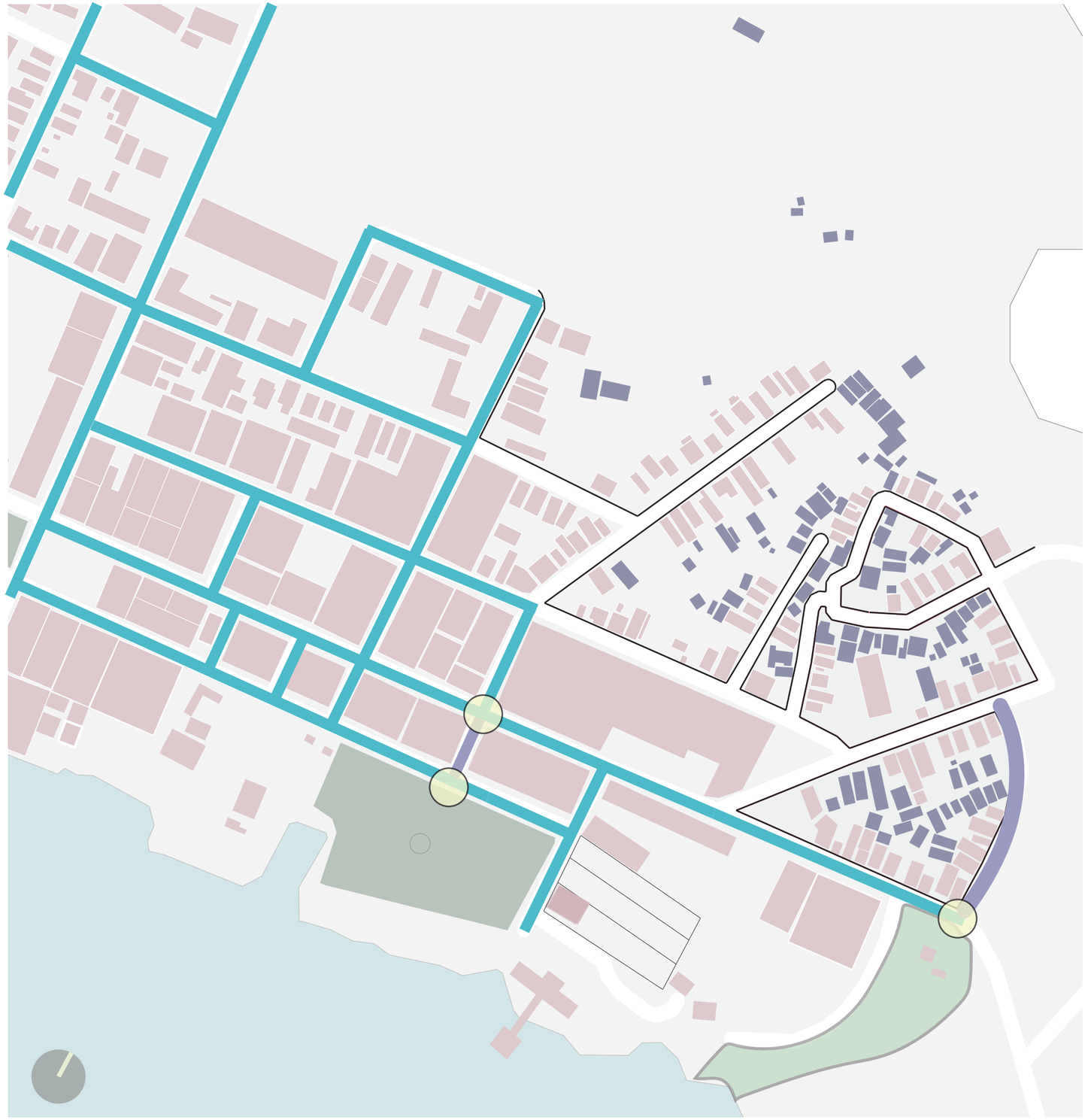
- Concrete
- Brick
- Zinc
- Wood
- Wood / Zinc Roof
- Concrete / Wood / Zinc Roof



Site analysis | Sector La Playita, Ponce

Pattern Language

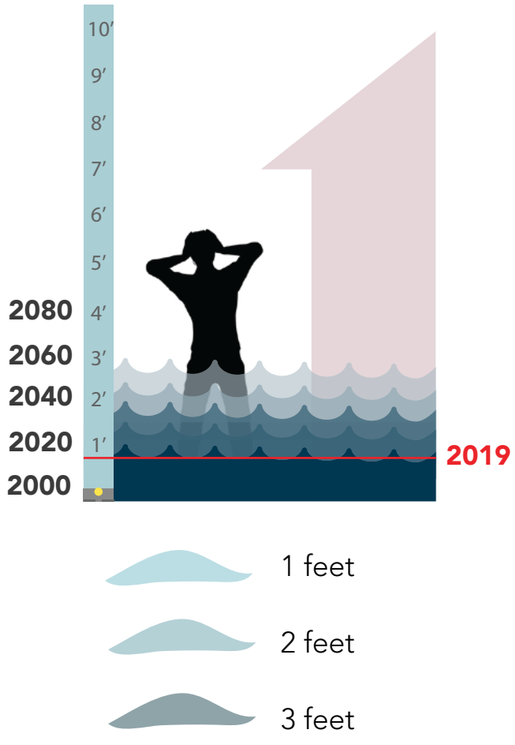
Patterns define layouts and limits of towns and communities. In the Playita Sector, the presence of six patterns are identified, according to Christopher Alexander's guide. This helps to study from a bird's eye the organization of the sector.



Site analysis | Sector La Playita, Ponce

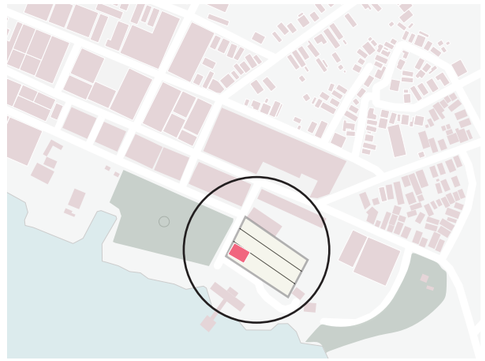
Rise in sea level - floods

Sea levels are changing all over the planet and although a natural variation is foreseeable, an increase above the average is observed globally. The main factors contributing to the current change are due to the thermal expansion of the oceans, the warming of the surface and the melting of glaciers. According to NOAA and NASA, every 20 years one feet of water will rise.



Site analysis | Sector La Playita, Ponce

Short Story: The spirit of the place

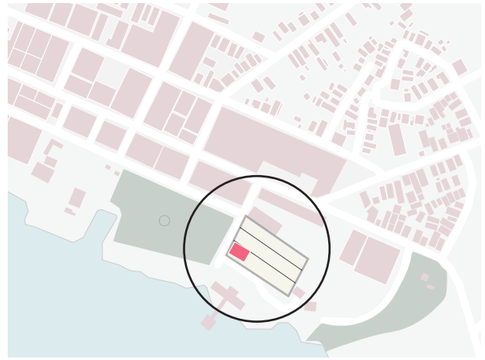


It seemed as if I was in a ghost town where only nature was my companion. Palm trees danced with the wind, bushes lurked in every corner and the dried soil welcomed me to the Playita Sector. History was seen through broken walls and fallen roofs. Culture was seen through artistic portrayals. But, were was life?

Through the streets and paths I walked, in search for contaminated sites that could bear life once again. I had hope.
Then, a historic portal led me to what it seemed as an endless lot that screamed to be rescued! The green presence took over the place and had a clear message for me:
BRING LIFE AGAIN.

Site analysis | Sector La Playita, Ponce

Strengths / Opportunities / Weaknesses / Threats



Strengths:
- Historic sector with vasts possibilities
- Location of the site: near two public parks, close to the sea, near the Maritime Unit, near upcomming businesses.
- A main street passes through the sector.

Opportunities:
- A lot of abandoned buildings and sites for reuse possibilities
- Manage and plan appropriate vegetation
- Integrate the historic materials found
- Involvement of near communities

Weaknesses:
- Big amount of abandoned buildings
- Close to the sea: flood and tsunami risks
- Poor vegetation and management

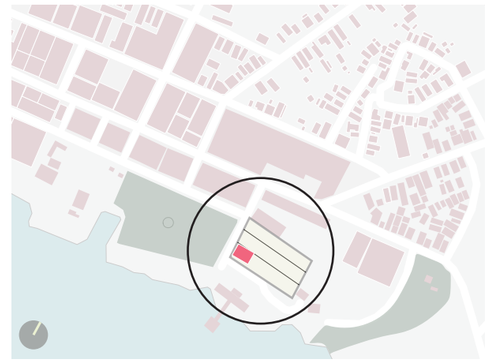
Threats:
- Close to the sea: sea level rise

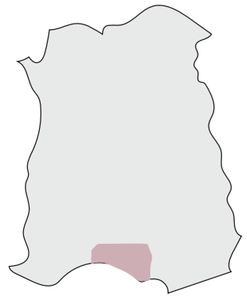
Program

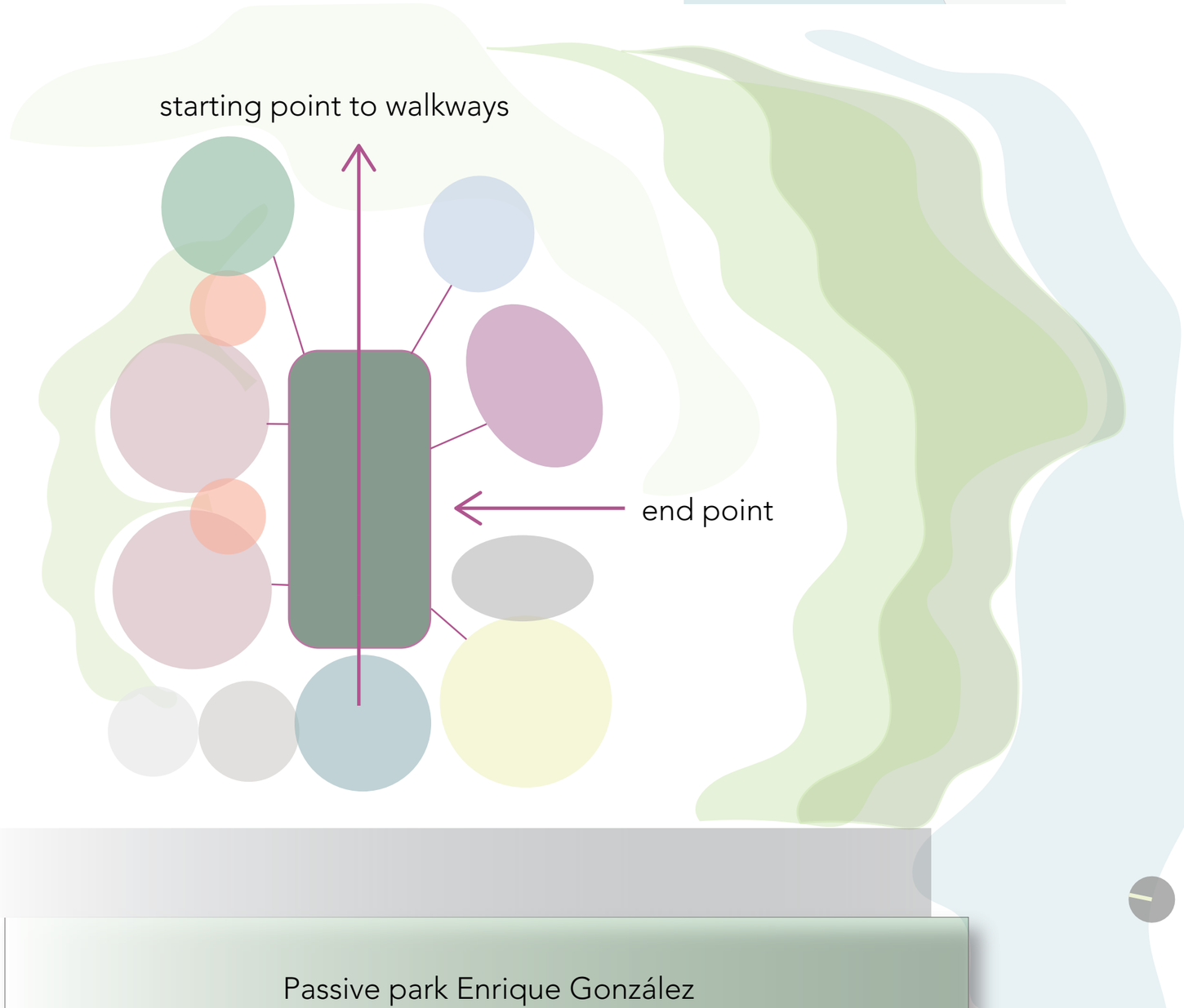
Sector La Playita, Ponce

Civic Center “Eco Enfoque”

- Lobby
- Courtyard
- Workshop (multipurpose room)
- Storage
- Vivarium
- Multipurpose room (fairs, expo)
- Office
- Bathrooms
- Electrical / Mechanical / Storage
- Orientation point / Bike rental
- Cafe







Partí

Sector La Playita, Ponce

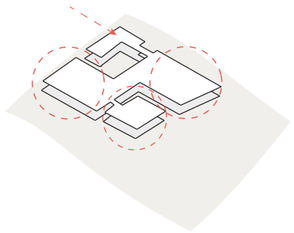
Eco Enfoque Civic Center

Existing walls
Permeable pavement
Resurfacing

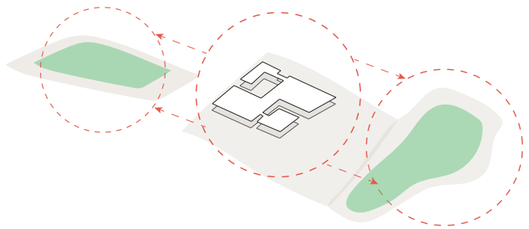
Area: 5,002.35 m2
Cadaster: 412-061-626-09-901
Zoning: SU "suelo urbano"

Strategies:

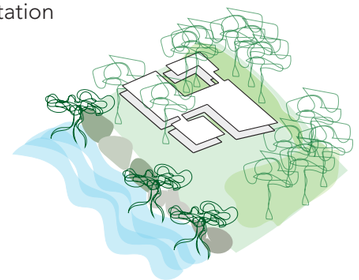
Multiuse spaces



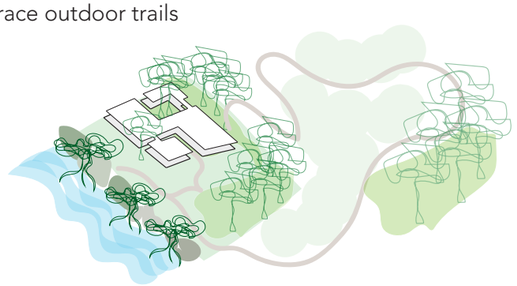
Integrate near public parks

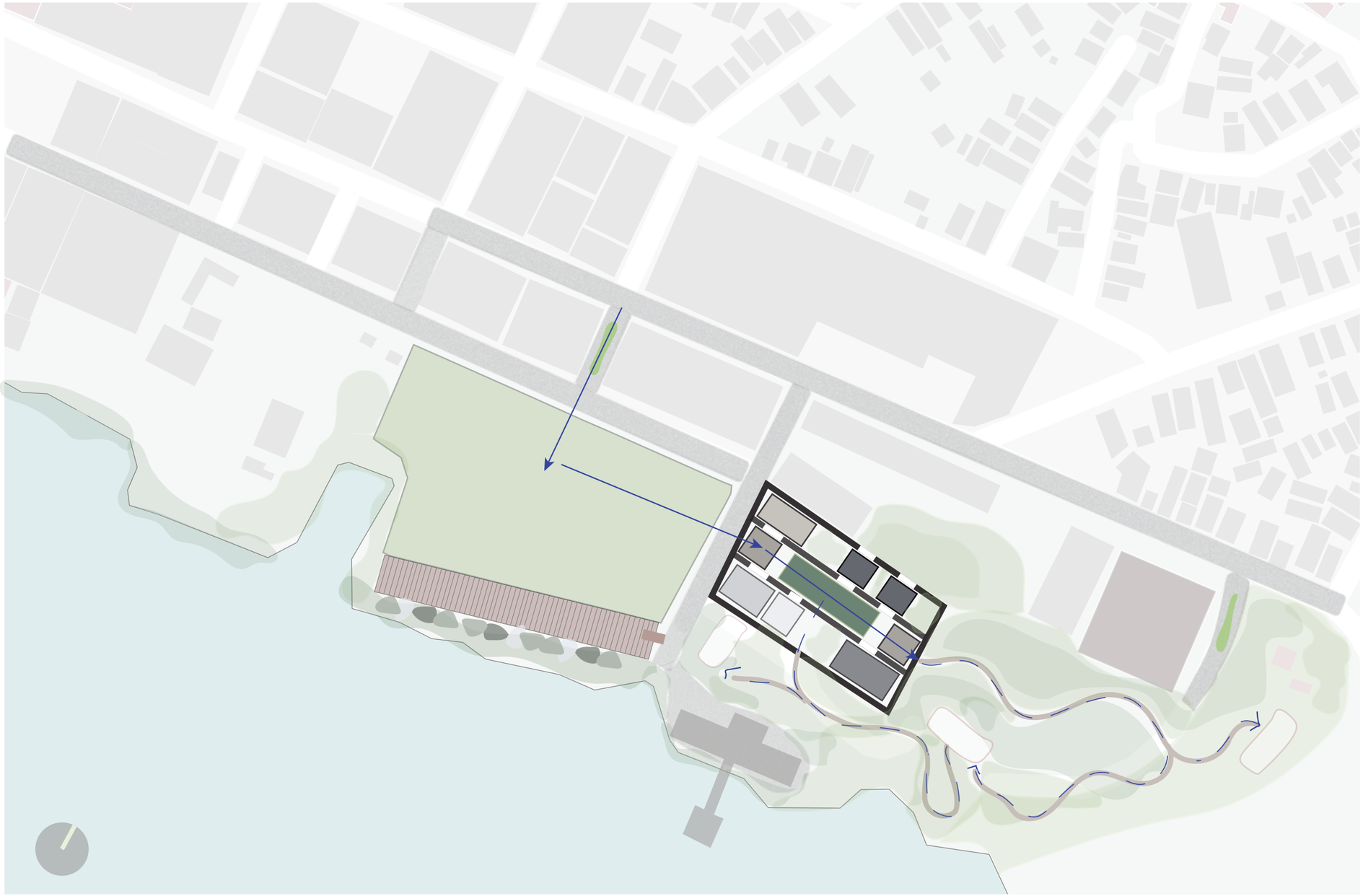


Incorporate near ecosistems and plant native vegetation



Trace outdoor trails

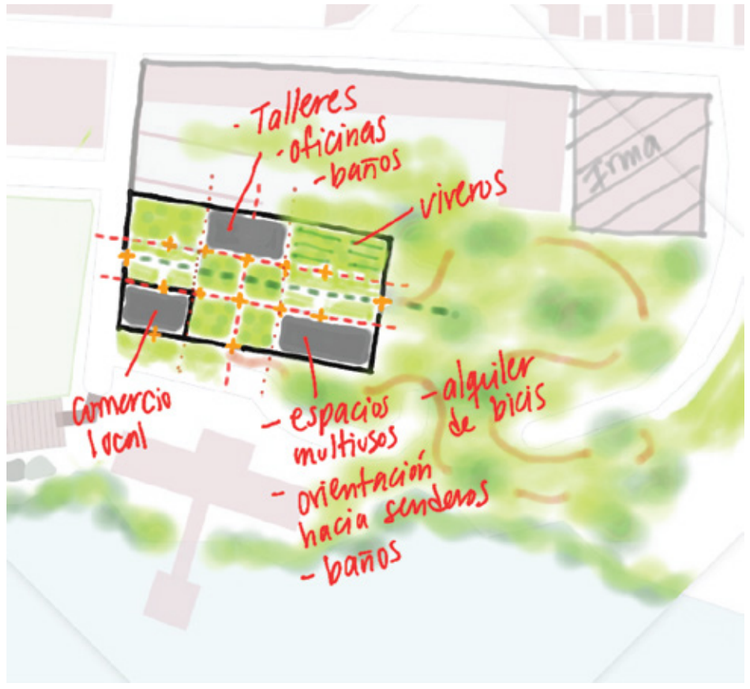


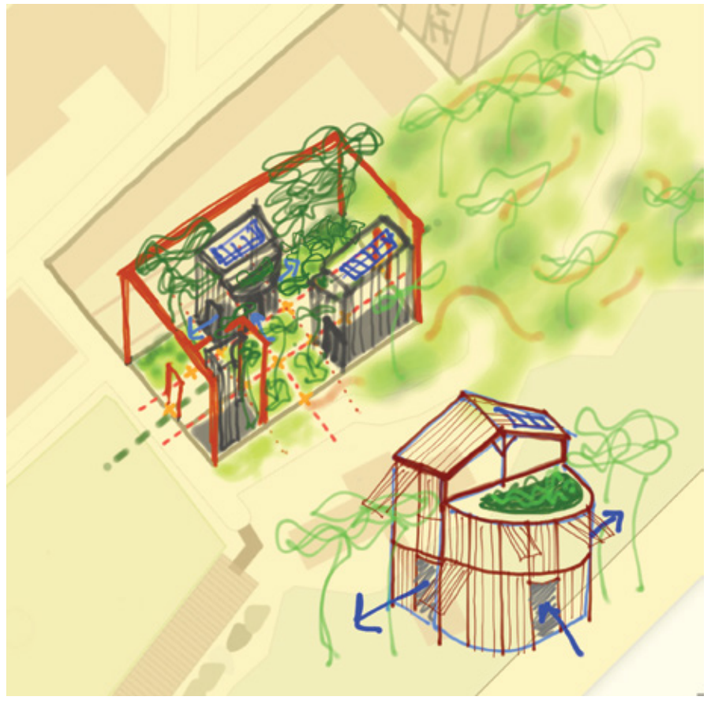


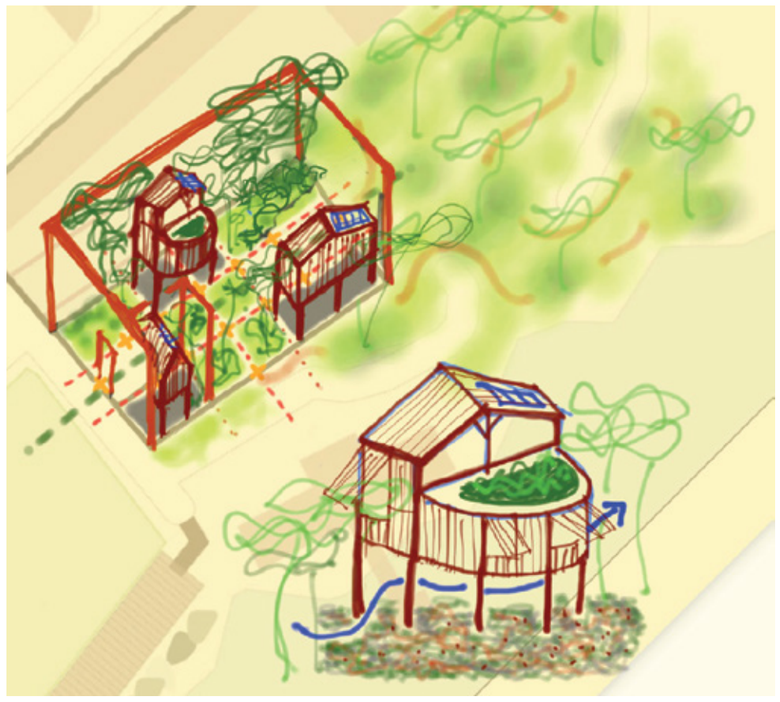
Now we are ready to transform
the forgotten..

Current state of the site

Sketches of the design process







Pavillion volumetry process

Structural demolition of historic walls

Scale N/A

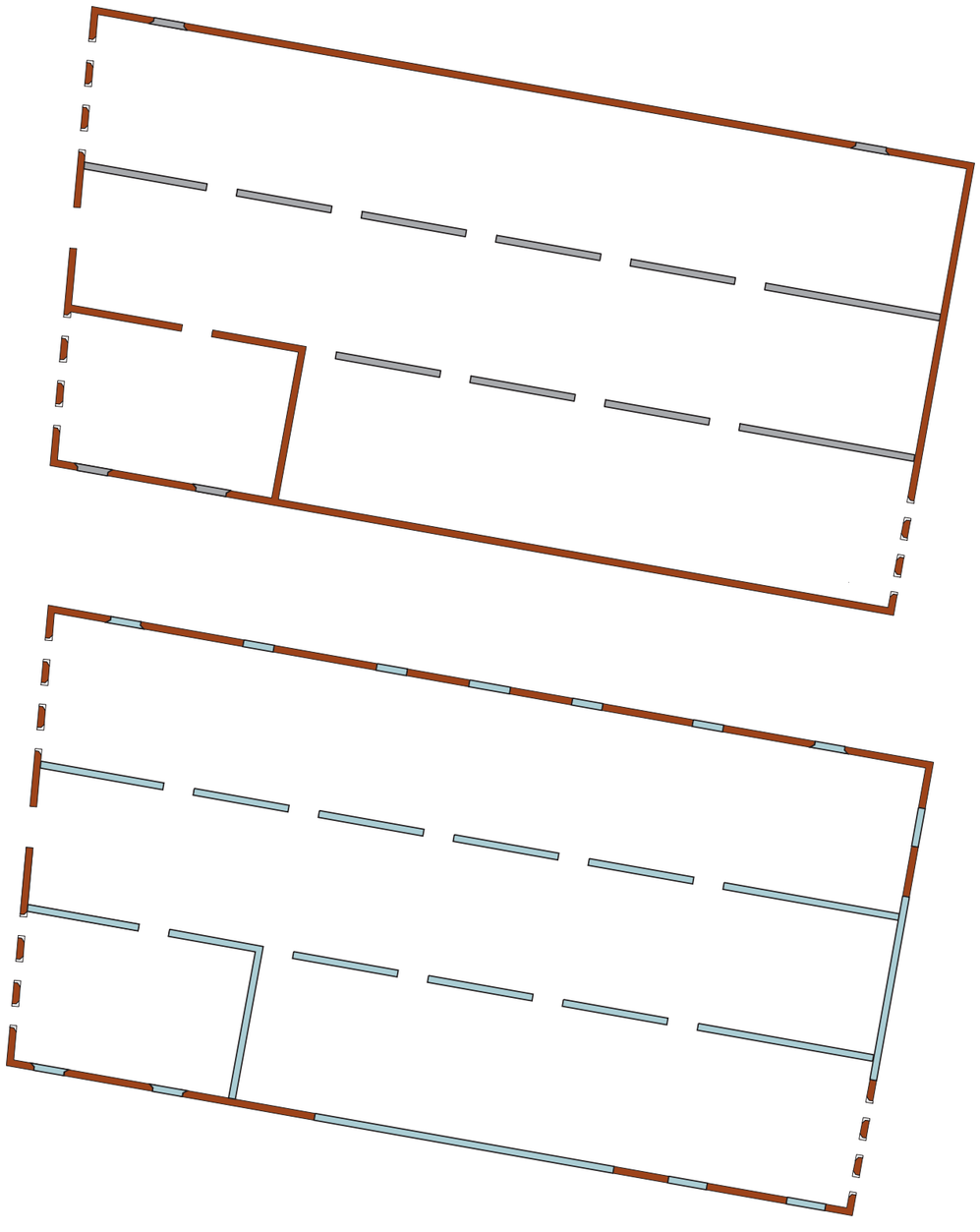
1950

Historic

Added

Stays

For demo



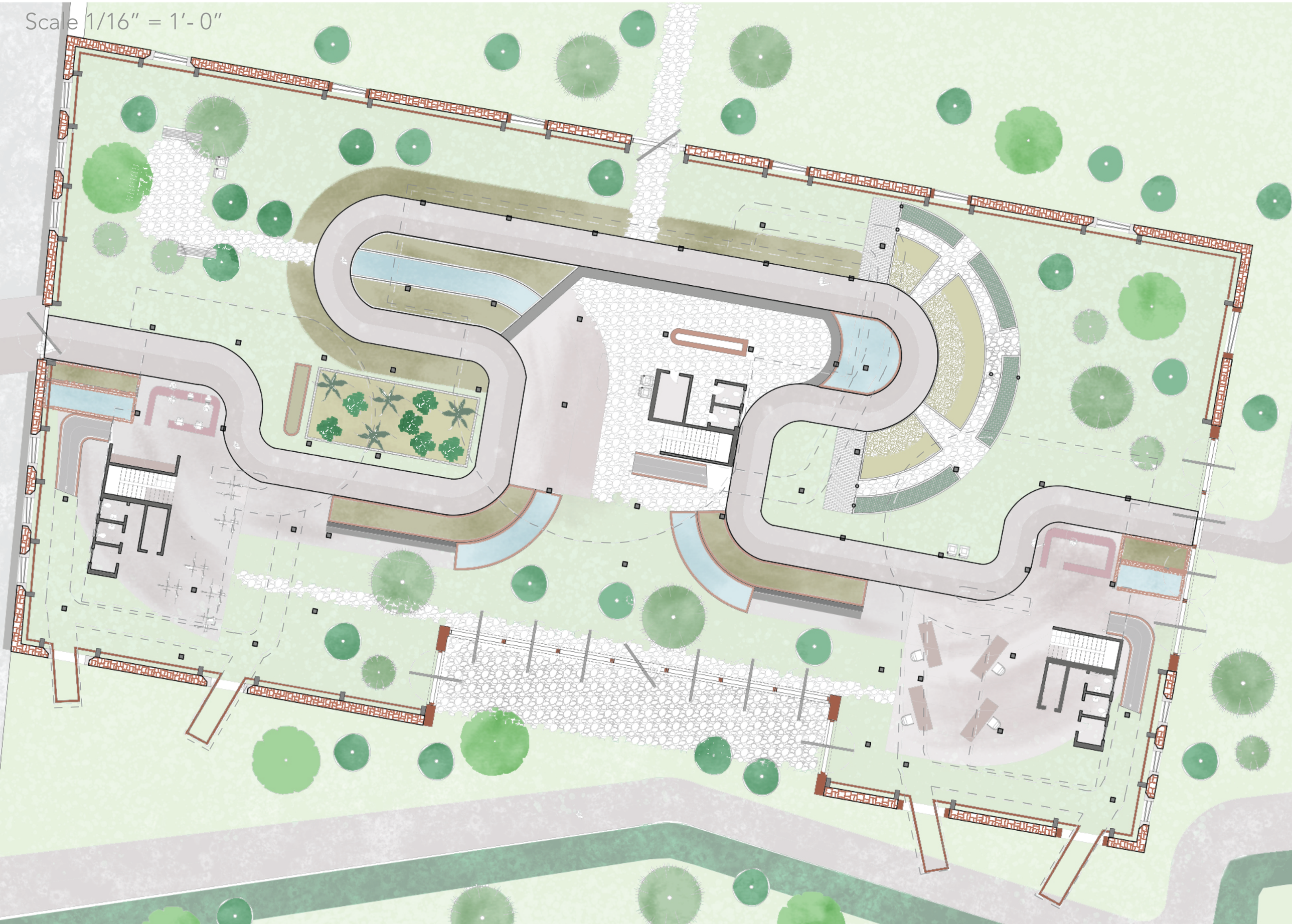
Master plan

La Playita Sector, Ponce

Scale N/A

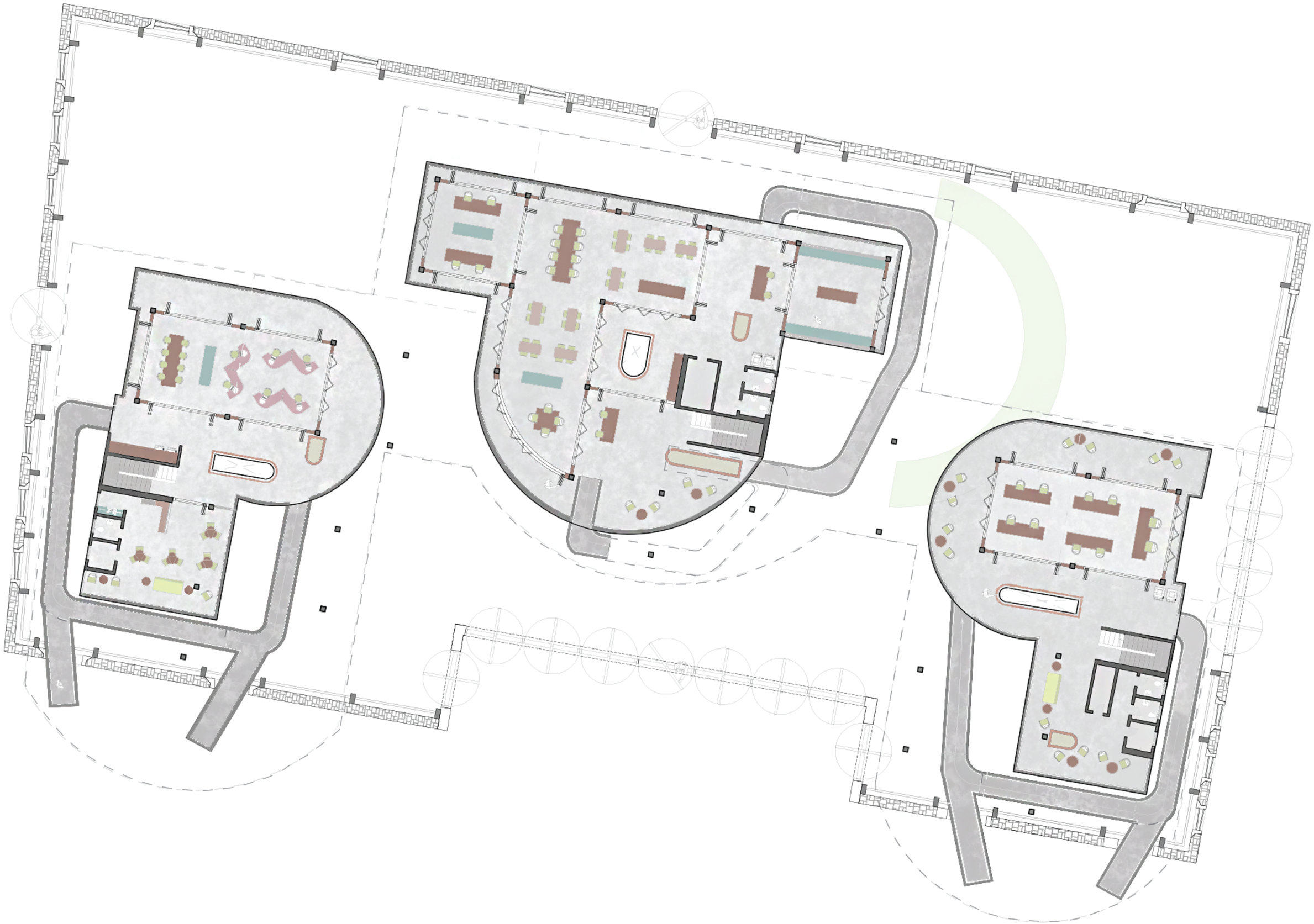
Ground floor

Scale 1/16" = 1'- 0"



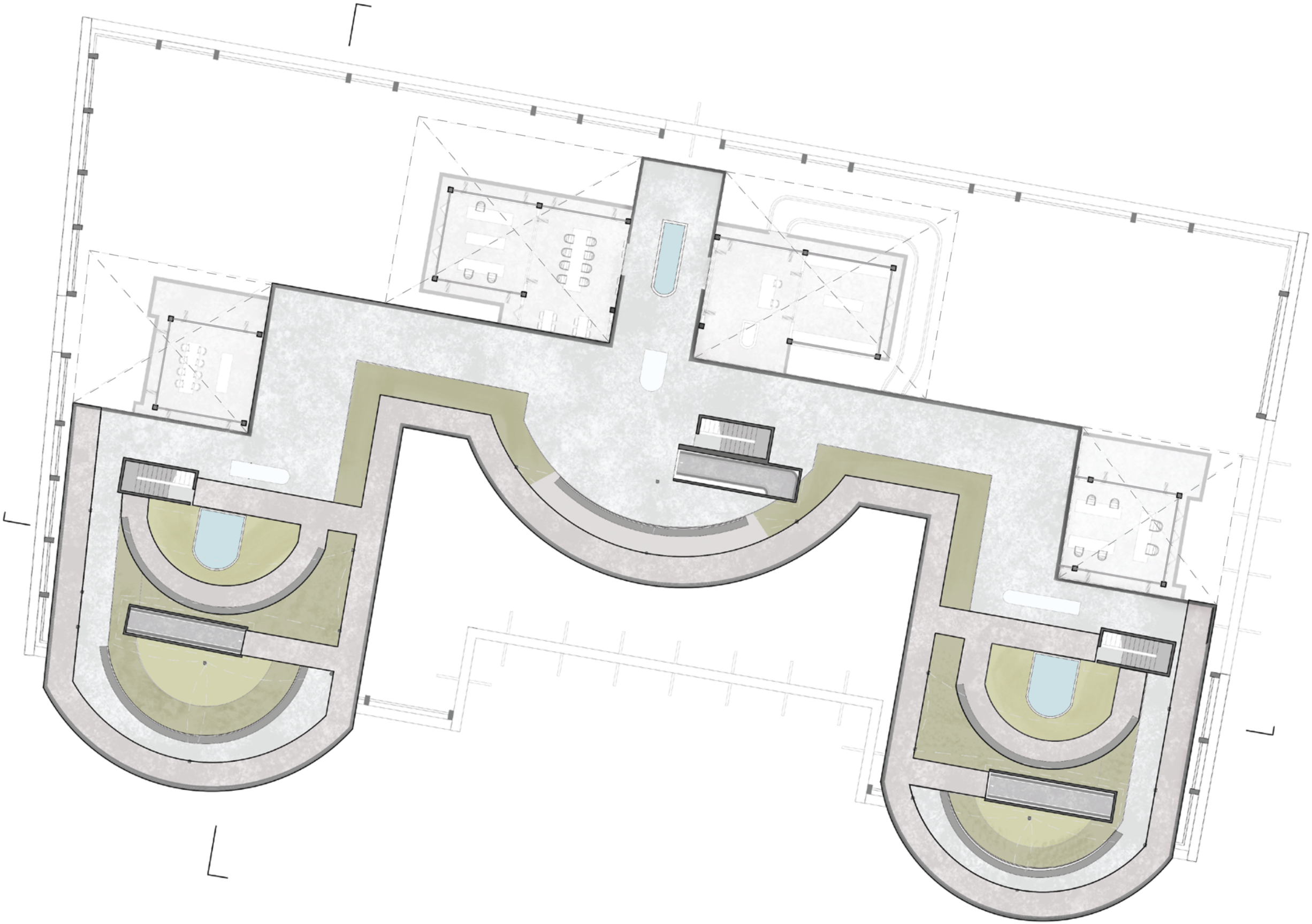
First floor plan

Scale 1/16” = 1’- 0”



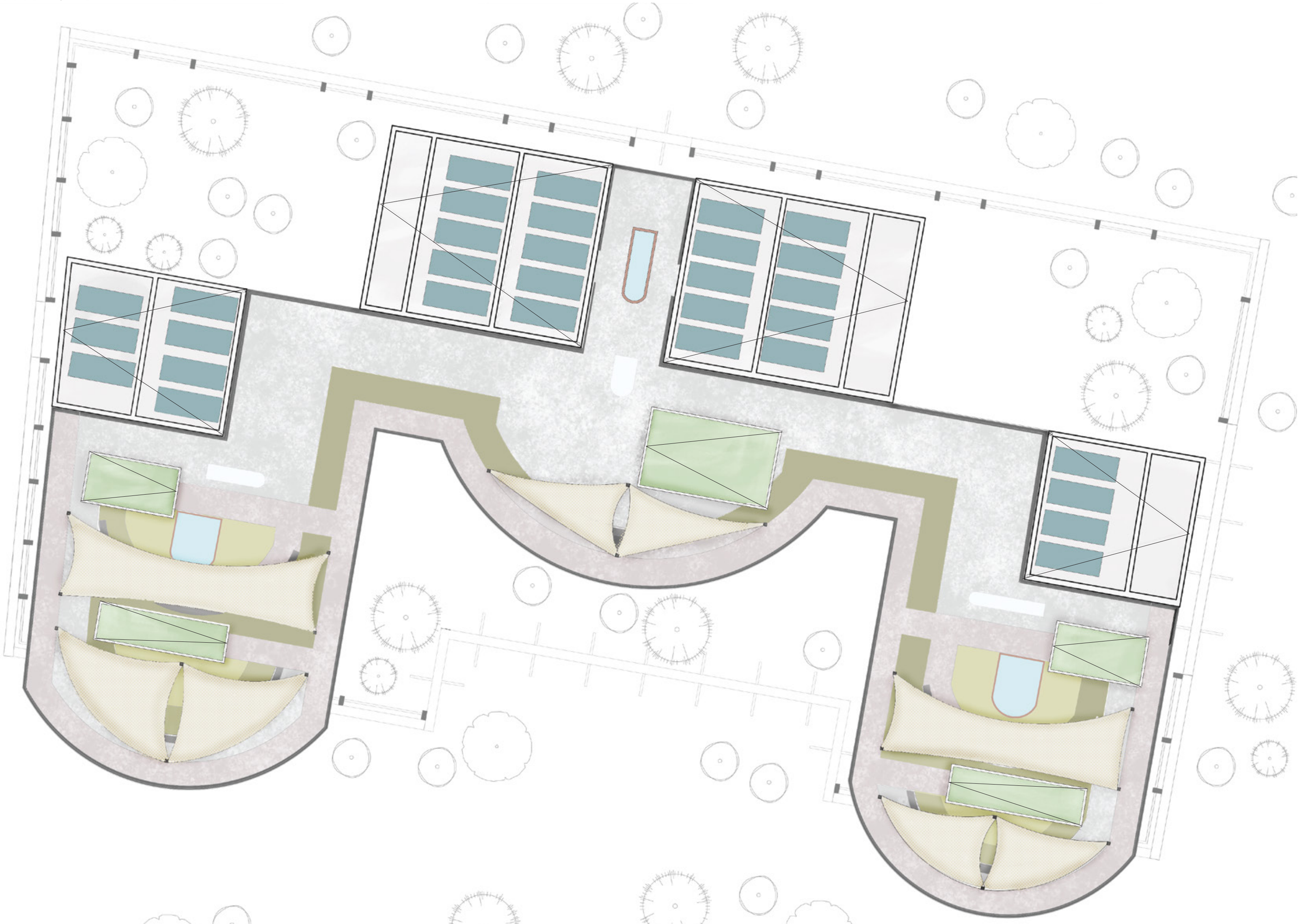
First roof plan

Scale 1/16″ = 1′- 0″



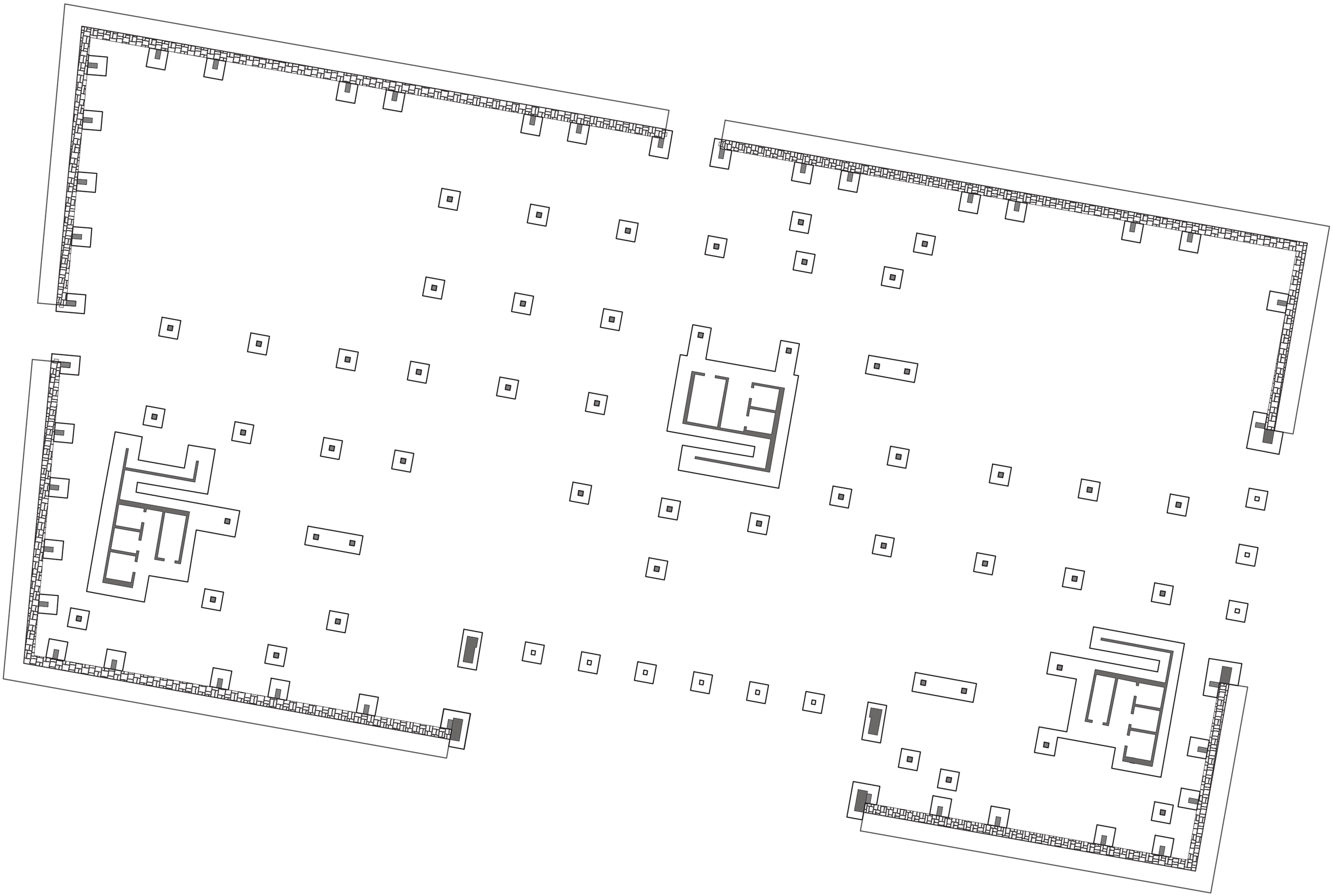
Second roof plan

Scale 1/16" = 1'- 0"



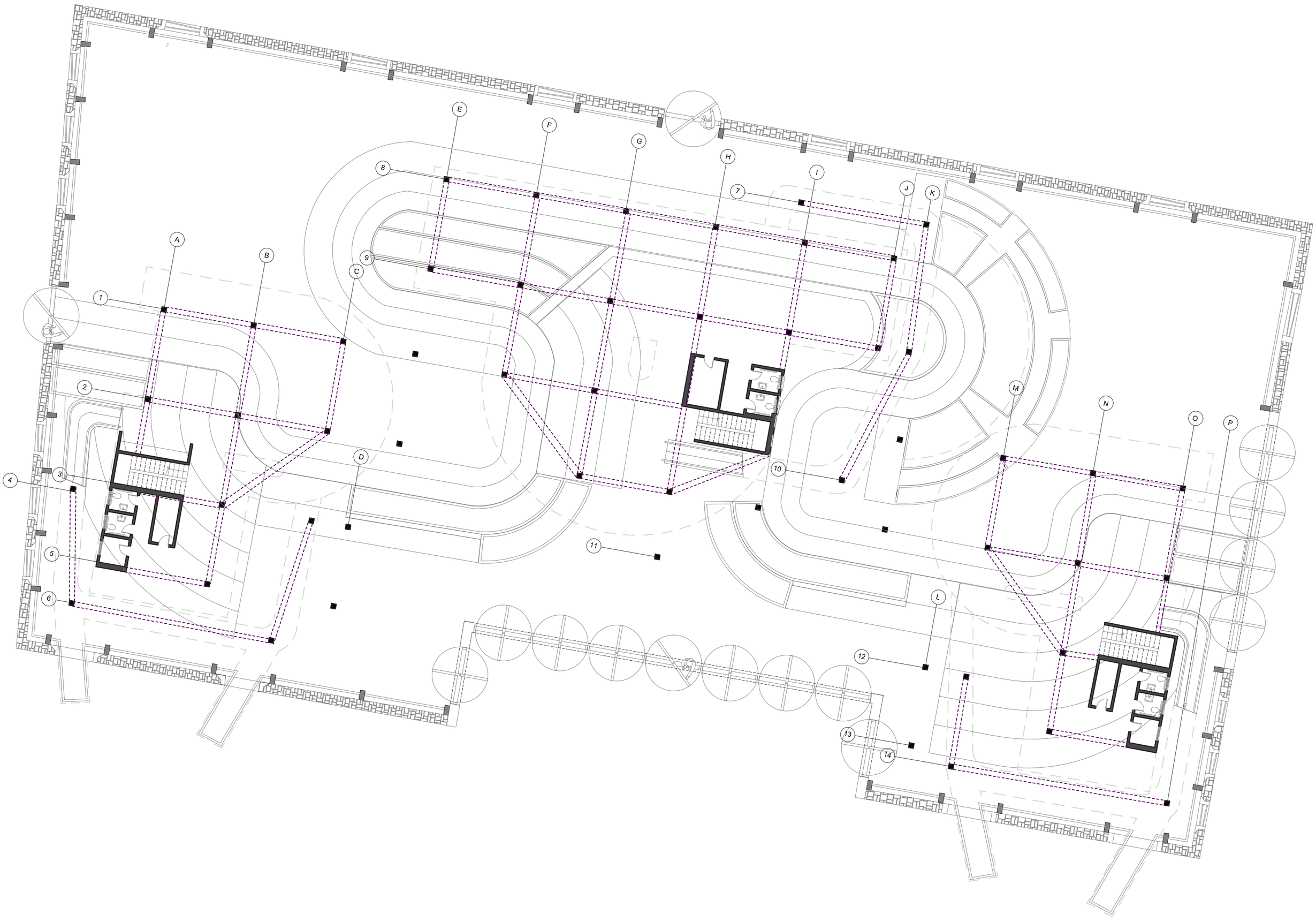
Foundation plan

Scale 1/16" = 1'- 0"



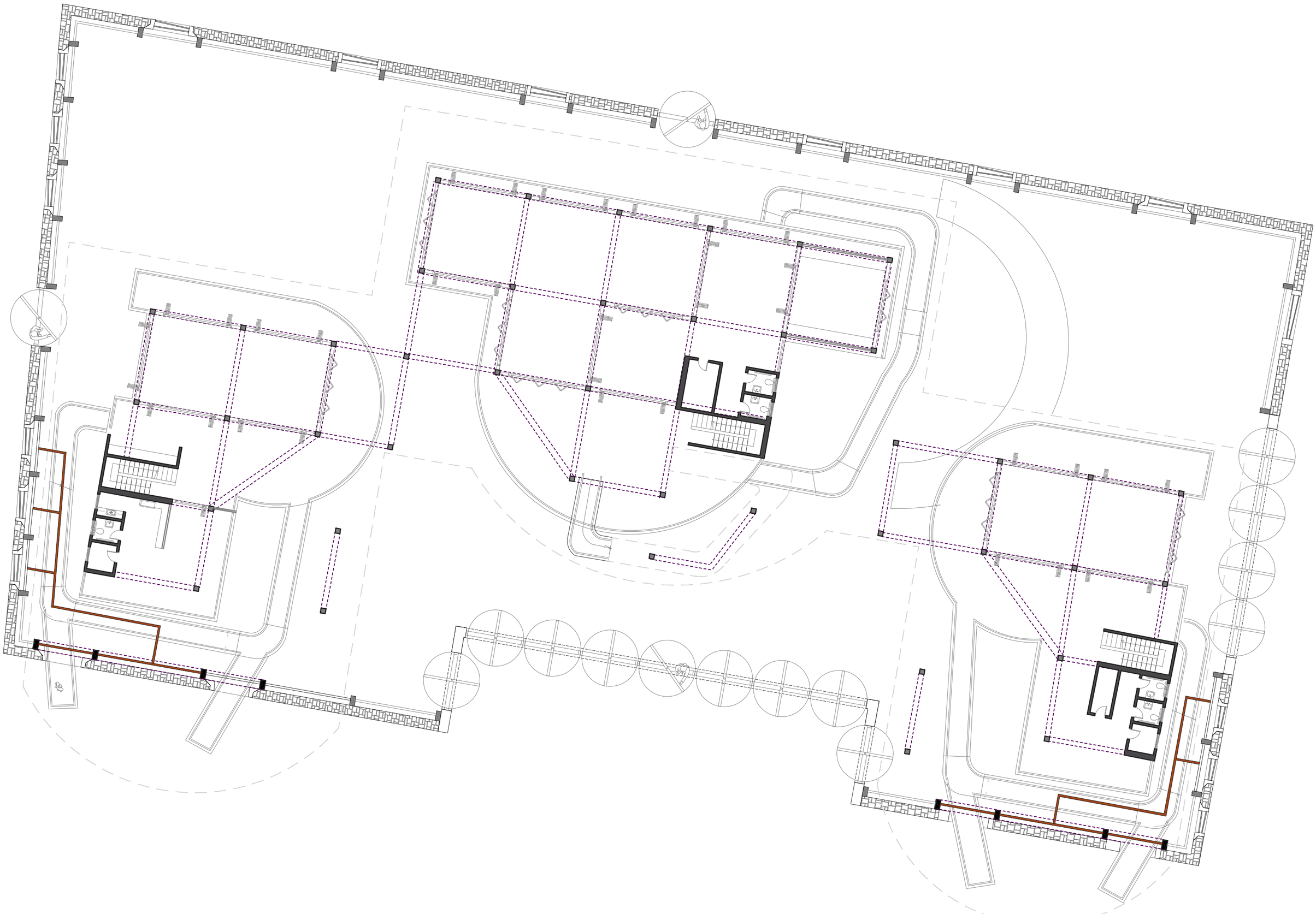
Structural plan - Ground floor

Scale 1/16" = 1'- 0"



Structural plan - First floor

Scale 1/16" = 1'- 0"

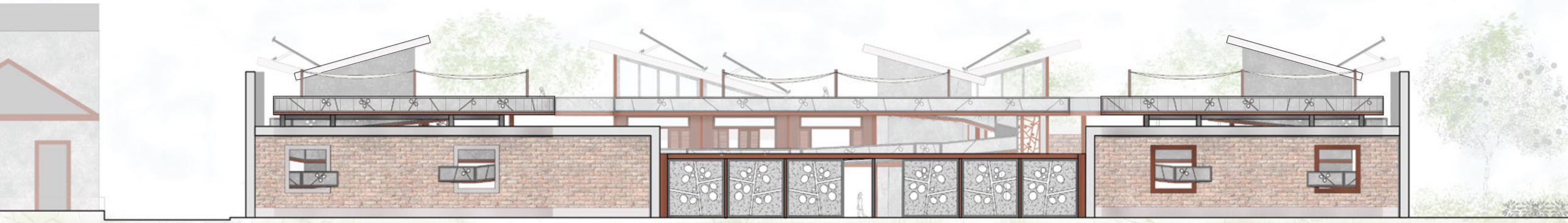


North elevation

Scale 1/32″ = 1′- 0″

South elevation

Scale 1/32" = 1'- 0"



East elevation

Scale 1/32″ = 1′- 0″

West elevation

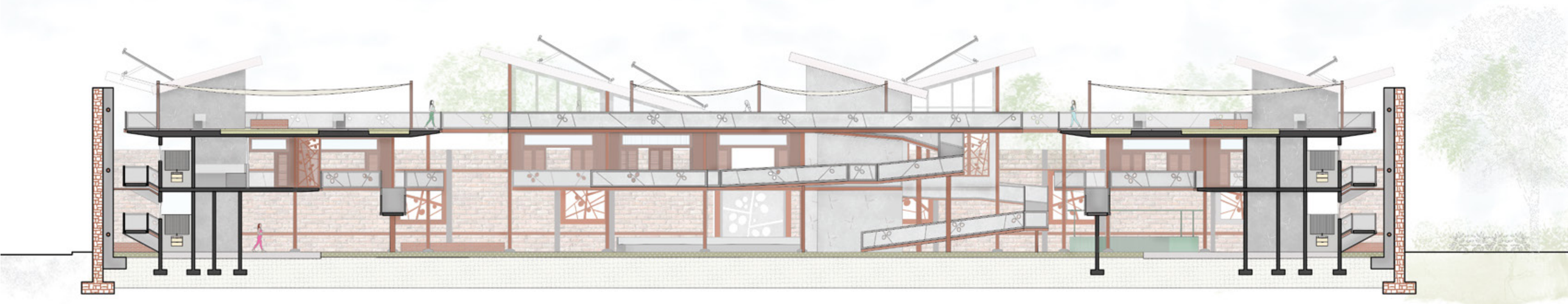
Scale 1/32″ = 1′- 0″

Transversal section

Scale 1/32″ = 1′- 0″

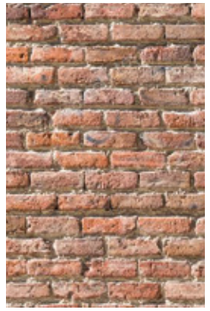
Longitudinal section

Scale 1/16″ = 1′- 0″

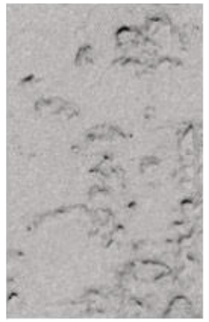


Wall section and materials used

Scale 1/4" = 1'- 0"



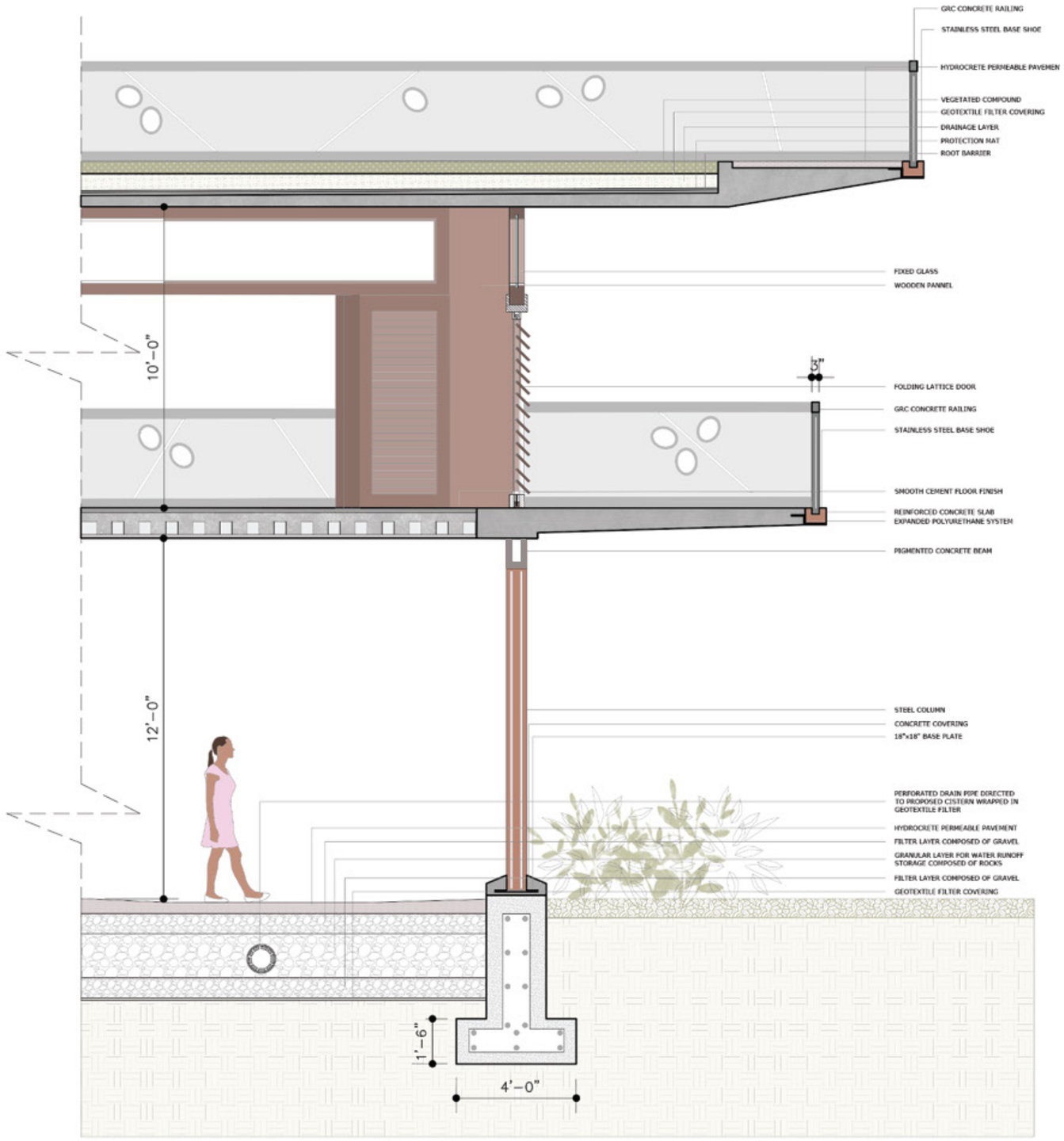
Brick (Historic walls)



GRC = "Glass Reinforced Concrete"

Corten steel = treated with a permeating liquid and good maintenance

Wood



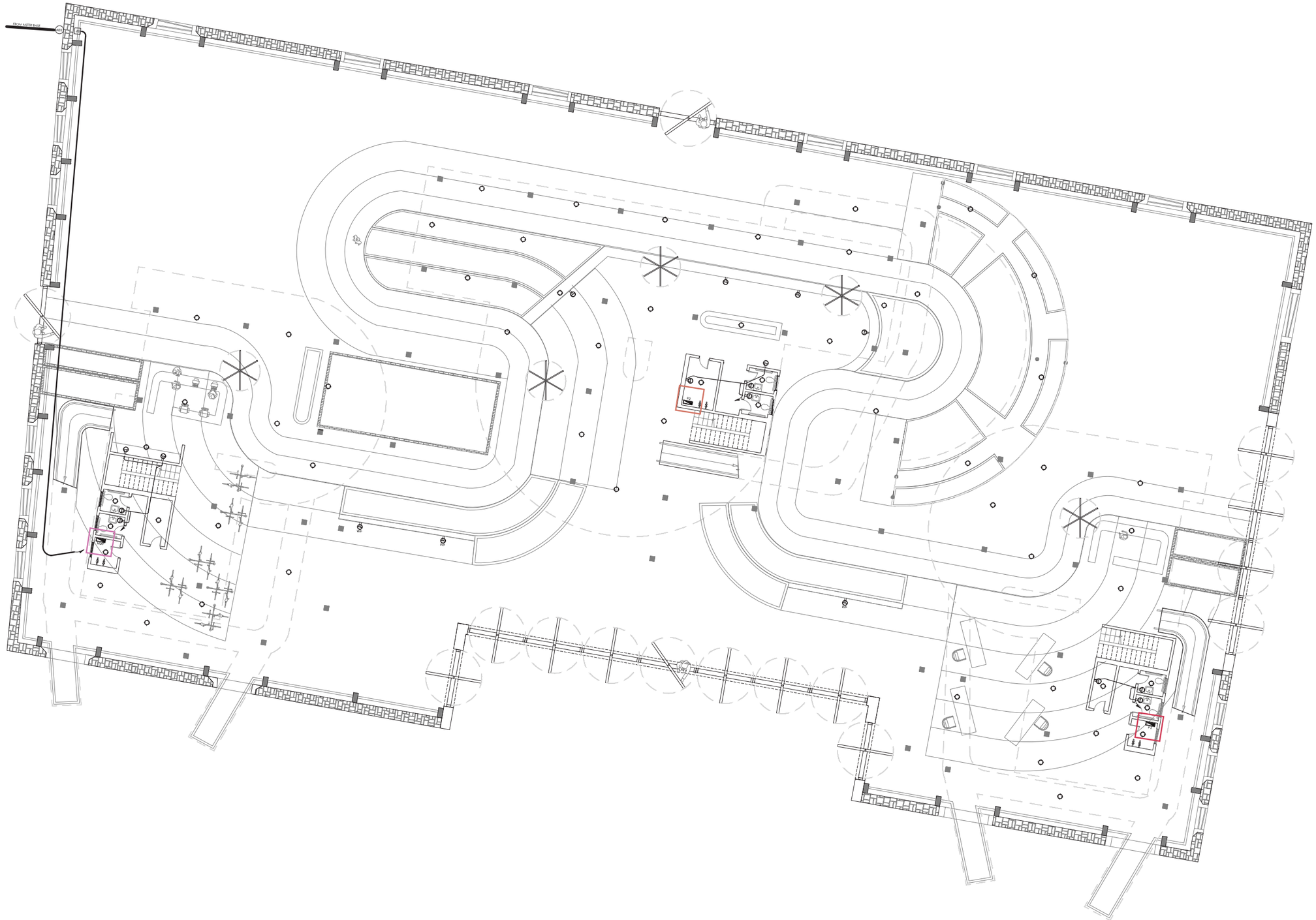
Electricity diagram

Scale N/A

Main distribution panel

Second panel

Third panel



Emergency exits and accesibility diagram

Scale N/A

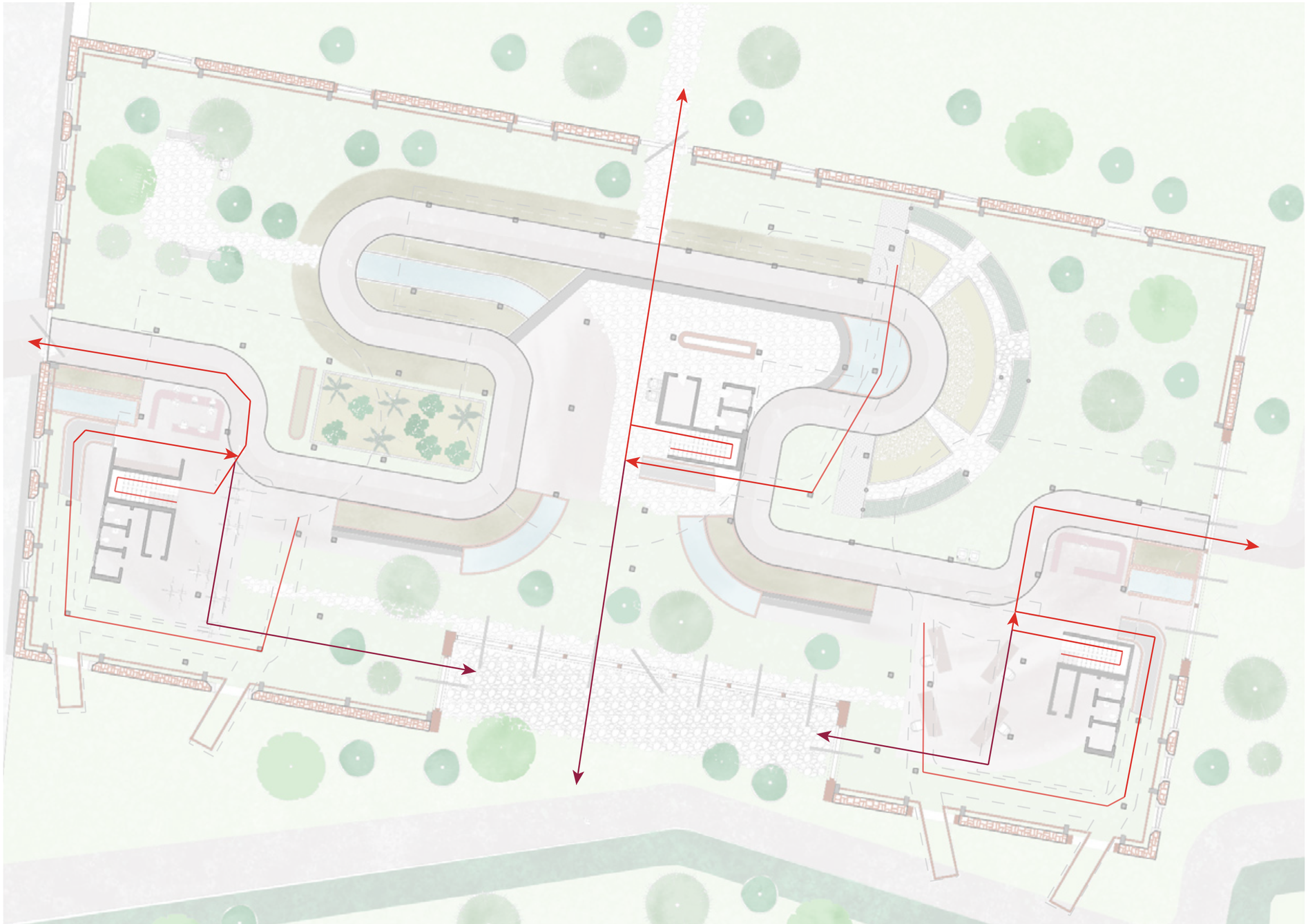
Main exits

Secondary exits

Max. occupation:

Pavillion 1: 27 people
Pavillion 2: 70 people
Pavillion 3: 43 people

Total: 140 people



Rainwater collection and placement of cisterns diagram

Scale N/A

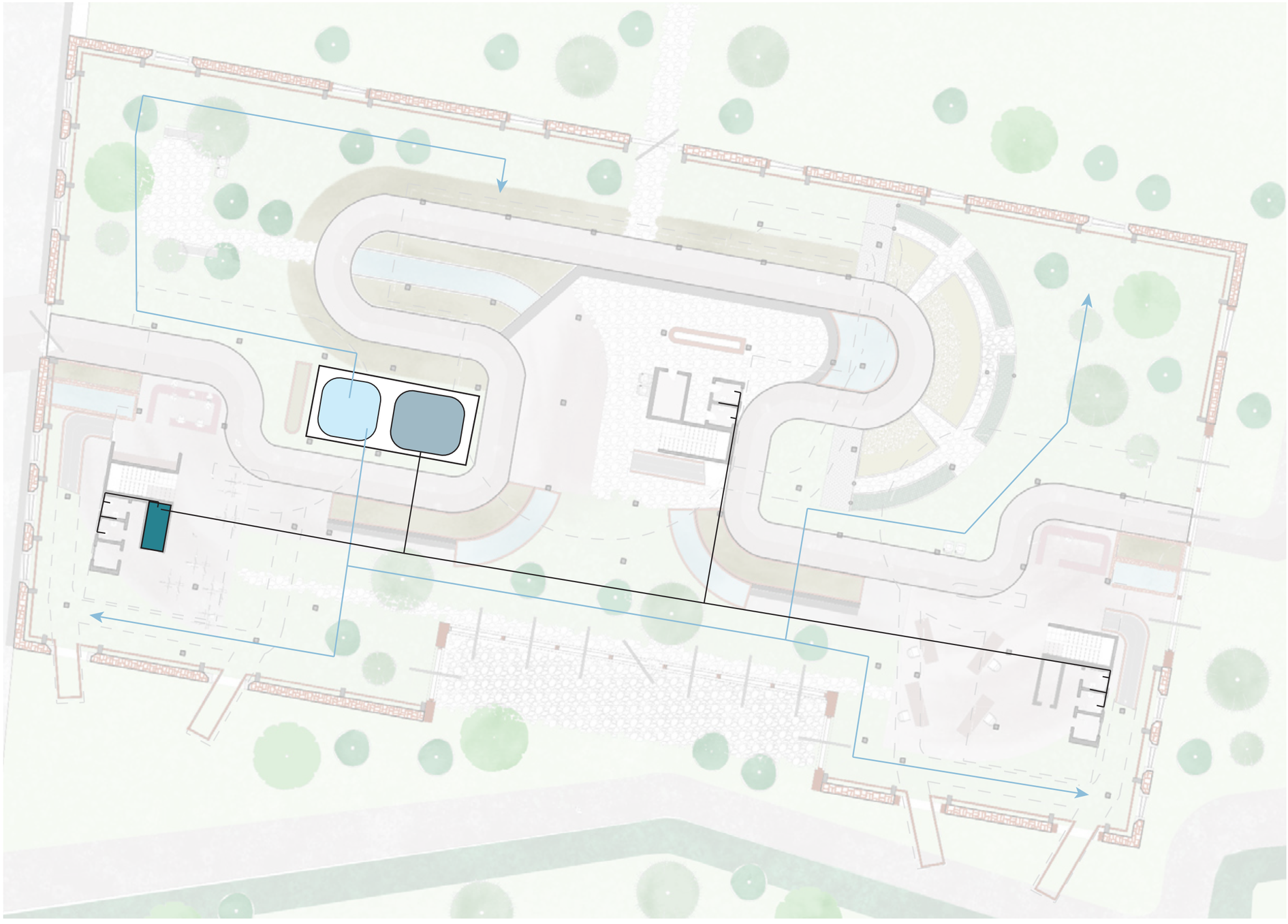
Rain cistern for irrigation systems

Main cistern

Bombs room

Irrigation system

To supply pavillions



Master plan

West view

View from the Enrique González park

Proposed vegetation

Guayaba

Guanabana

Emajaguilla

Interior view - West

Main entrance - Pavillion 1 First level

Multiple accesses

Cycling lane

Pedestrian path

Low mobility access

South facade

View from the Enrique González park

East facade

View from walking trails

Interior view - East

Vivarium and community garden - Pavillion 2 First level

Phytoremediation plants

Anthyllis Vulneraria

Lupinus Albus

Brassica Juncea

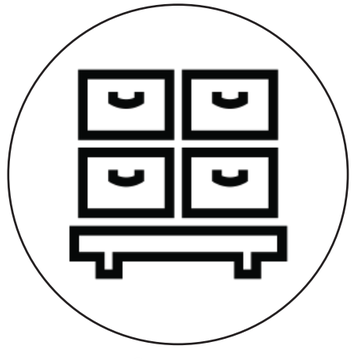
Interior view

Receiver and workshops - Pavillion 2 Second level

Services in Pavillion 2

Workshops

Multiuse spaces



Storage

Cost estimate

Departure	Area	Unit price	Subtotal
A Acquisition of the site	5,002.35m2	$400.00	$2,000,940.00
			Subtotal A: $2,000,940.00
B Demolition	1,261.5p2	$6.00	$7,569.00
C Works in site	34,170p2	$300.00	$10,251,000.00
D Braiding system	542p2	$225.00	$121,950.00
E Structure	20,479p2	$45.00	$921,555.00
F Finishes / Facades	14,170p2	$55.00	$779,350.00
G Mechanical	10,180p2	$10.00	$101,800.00
H Plumbing	9,560p2	$8.00	$76,480.00
I Electrical	9,560p2	$15.00	$143,400.00
			Subtotal B: $12,403,104.00
			Subtotal A & B: $14,404,004.00
			Contract requirements (30%): $4,321,201.00

TOTAL: **$18,725,205.00**

Let’s rescue the forgotten
Let’s connect with nature
Let’s respect creation