

RICE UNIVERSITY

AGGRESSIVE BUFFER

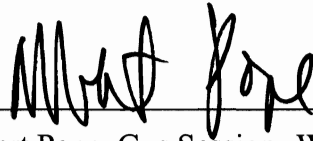
by

Tracy Catherine Bremer

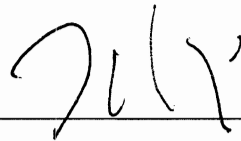
A THESIS SUBMITTED
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Master of Architecture

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ABSTRACT

This thesis exploits the latent opportunities that are found in buffer zones. While typical buffers are static, passive entities, this thesis treats the buffer as a territory that is able to act aggressively. The buffers' current function is to separate incompatible but adjacent zones of the city; however, as cities evolve over time, the buffer can become a catalyst, acting as an agent of transformation.

In Baytown, Texas, industry is effectively the nucleus of the city, serving as its black heart. However, the green buffer that surrounds this black heart suggests a possible future for Baytown in which the buffer expands not into the city as it has done historically, but rather into the former industrial zone, opening up a new realm of possibility. The result is a new type of urbanism in which a city is defined not by a dense core, but rather by a productive green heart that ties together the disparate urban enclaves that once served the city's industrial core.

ACKNOWLEDGMENTS

I would like to thank Albert Pope for his advice and support over the past year, for the lively discussions, and for pushing me to expand my boundaries. I am indebted to him for his insight and unique perspective, and for teaching me to always look at things with a critical but not judgemental eye.

Thanks to Andrés for his unwavering patience and support, for encouraging me to keep going, for staying up with me to help during the most difficult times, and for caring about this thesis as much as I did.

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I HISTORICAL PRECEDENTS

ACTUAL.....PROJECTIVE

1842 Beginning of Houston Ship Channel improvements

1847 Houston begins railroad improvements

1850

1852-1870 Haussmann's improvements in Paris

1899 Camillo Sitte publishes City Planning According to Artistic Principles

1902 Houston receives approval to become a deepwater port

1904 Letchworth Garden City is built
1918 The first refinery is built along the Ship Channel

1901-1917 Tony Garnier designs his Cité Industrielle

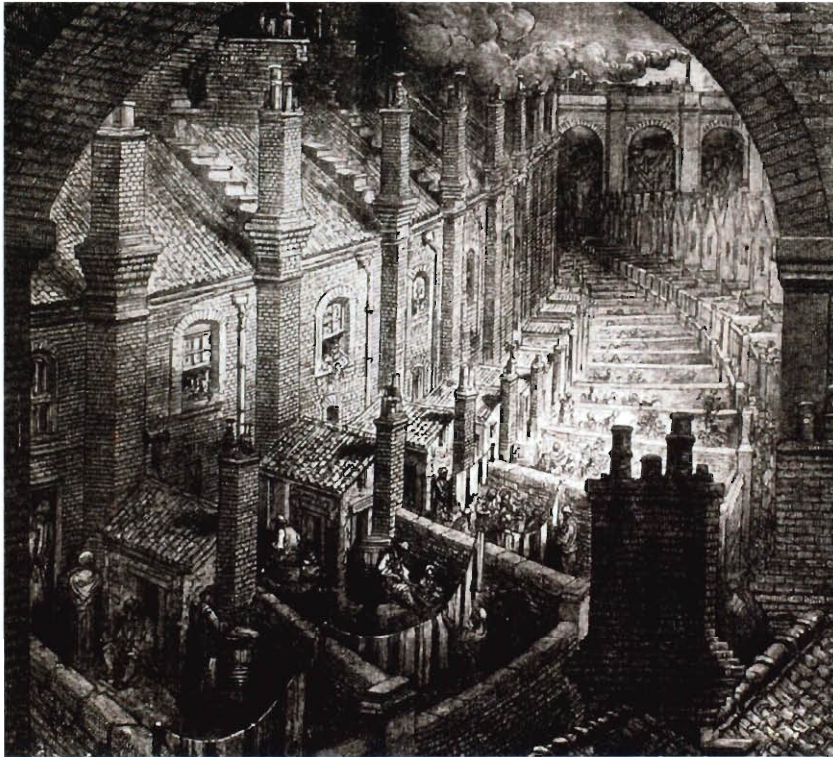
1902 Ebenezer Howard publishes Garden Cities of Tomorrow

1908 Los Angeles passes nation's first citywide use zoning law

1916 Manhattan's zoning resolution passes

1918 The first refinery is built along the Ship Channel





Gustave Doré, "London, a Pilgrimage."

THE EARLY INDUSTRIAL CITY

Perhaps the greatest contribution made by the industrial town was the reaction it produced against its own greatest misdemeanors...

—Lewis Mumford, *The City in History*

It goes without saying that the existence of the buffer is dependent upon the existence of industry. It can be said, then, that the buffer grew out of the industrial city of the nineteenth century. As Lewis Mumford points out, as large-scale factories were established, the need for a cheap and steady supply of labor dictated that they would be built close to large urban populations. These factories, in turn, attracted hordes of people from the countryside, bringing forth huge increases in the industrial city's population. This population increase led to a great need for workers' housing, which was constructed in any leftover space within the vicinity, creating squalid, overcrowded living conditions.

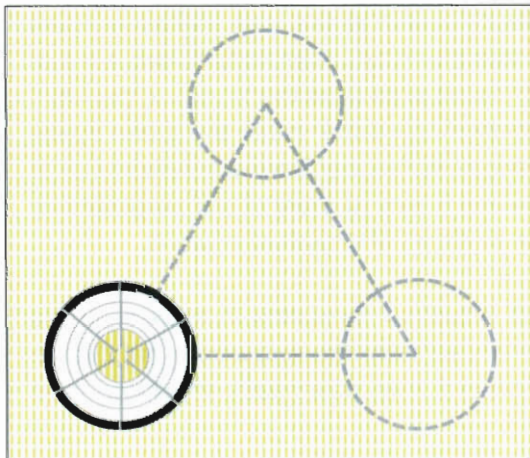
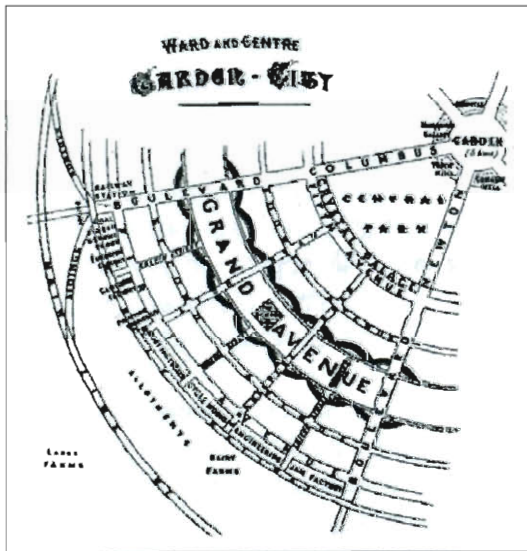
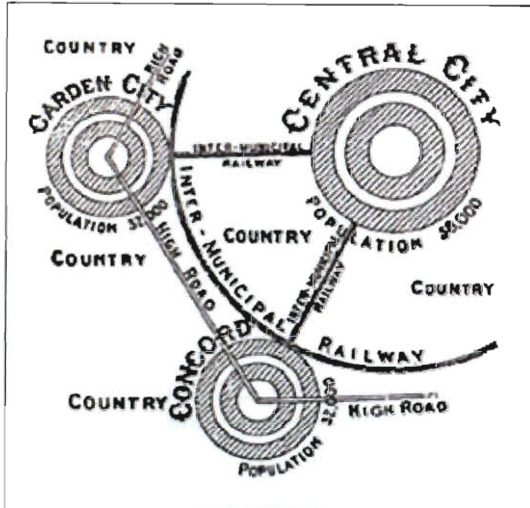
Another consequence of the new industrial city, in which factories took the place of urban centers, was what Patrick Geddes called "conurbation." This new city was characterized by immense areas of development with none of the urban centers that typically unify the residents of large cities.

The unhealthy and unsanitary conditions found in the new industrial cities brought about calls for new types of urban planning. Camillo Sitte was a major proponent of a "sanitary green," which he referred to as the "lungs of the city." It can be argued that this idea is the birth of the buffer zone, the green space that separates the more noxious functions of the city from the residential or commercial areas. This buffer can be seen in any number of the proposals for new urban developments beginning in the late 19th century onward.

The reaction against the cities of the industrial revolution is evident in the proposals for new cities that were developed from the end of the nineteenth century onward. All provided for industrial zones, now neatly separated from the adjacent city by a green buffer.

EBENEZER HOWARD: GARDEN CITY, 1902

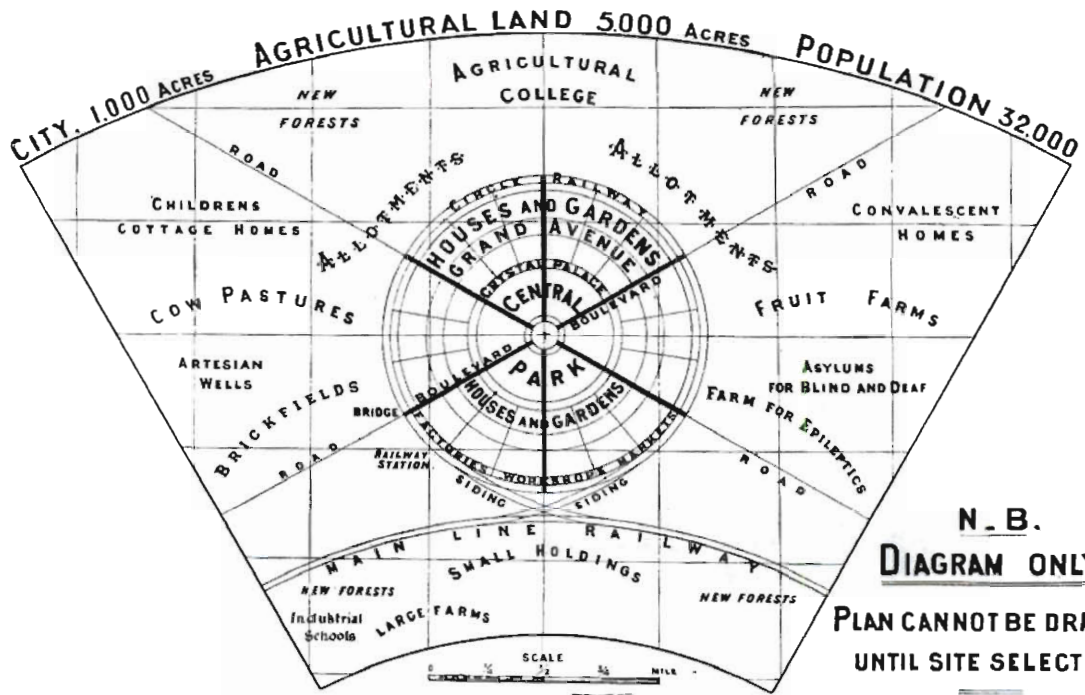
One of the first proposals to address the problem of urban growth was Ebenezer Howard's Garden City, first published in 1898. This proposal was highly schematic, as Howard intended it to be adapted to each particular site. However, one of the prominent features of the proposal was the separation of functions, later to become institutionalized in most Western cities as zoning. Also of note is the fact that Howard did not plan for expansion. He believed that if the city needed to grow, it should do so through means of a network, by establishing newer towns nearby, separated by green space. This would prevent polluted cities by limiting development within single module and thereby dictating that new development would be separated by buffer zone.



Top: Garden City network
Center: Garden City diagram, detail
Below: Garden City diagram

— N°2. —

GARDEN - CITY



N. B.
DIAGRAM ONLY.
PLAN CANNOT BE DRAWN
UNTIL SITE SELECTED



modular growth

mononuclear

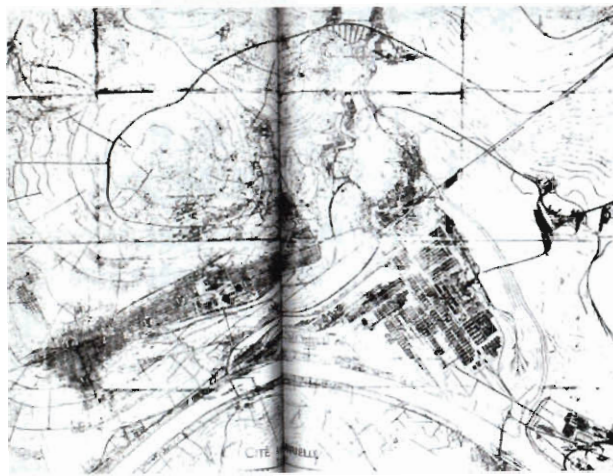
residential-industrial connection

light industry

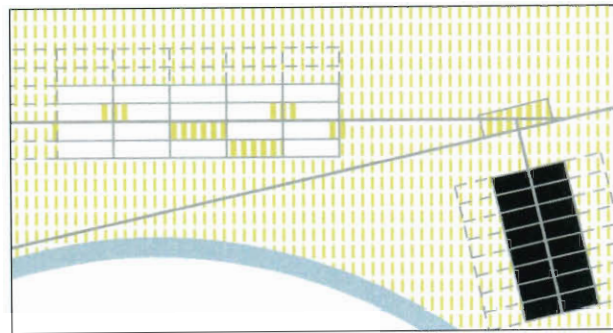
contamination isolation through distance

TONY GARNIER: CITÉ INDUSTRIELLE, 1917

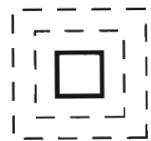
Shortly after Howard published his writings about Garden City, Tony Garnier published his work on the Cité Industrielle for the first time. He would continue to work on this project between 1901 and 1917. This project was similar in that it separated the city according to its various functions. However, the various functions or parts of the city were separated from one another by a green buffer. The gridded layout of the city allowed each sector of the city to expand independently of the others, with the urban functions remaining separate from the industrial functions.



Cité Industrielle, Plan, Tony Garnier



- Industrial
- Other urban functions
- Programmed open space
- Unprogrammed open space (may include agricultural lands)
- Future growth



simple growth



mononuclear



residential-industrial separation

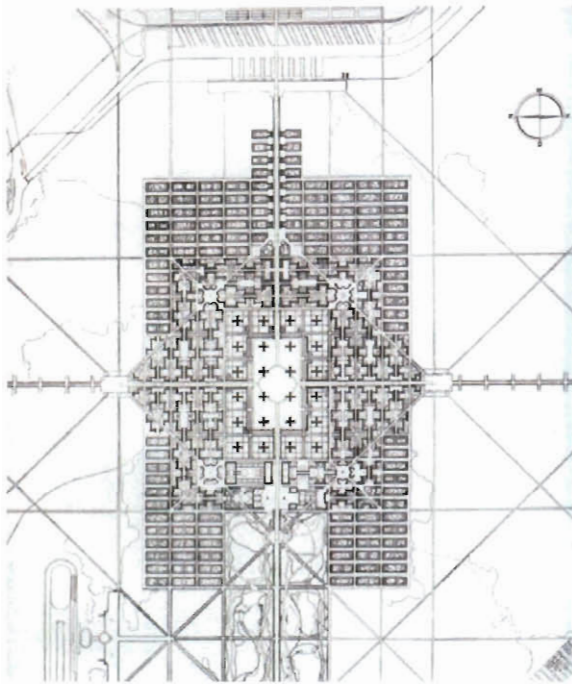


heavy industry



contamination isolation through distance

LE CORBUSIER: VILLE CONTEMPORAINE, 1935

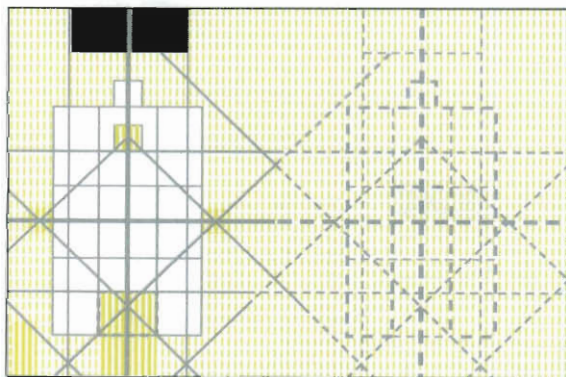







Ville Contemporaine, Plan, Le Corbusier.



Ville Contemporaine, Sketch, Le Corbusier.

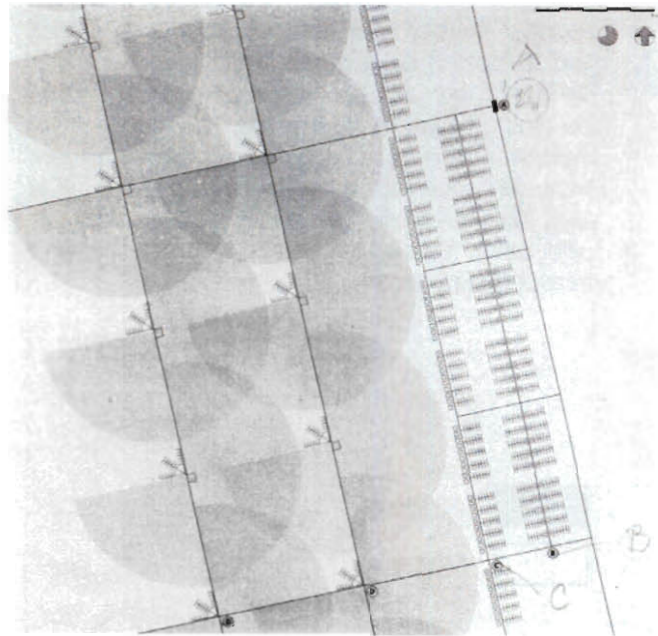
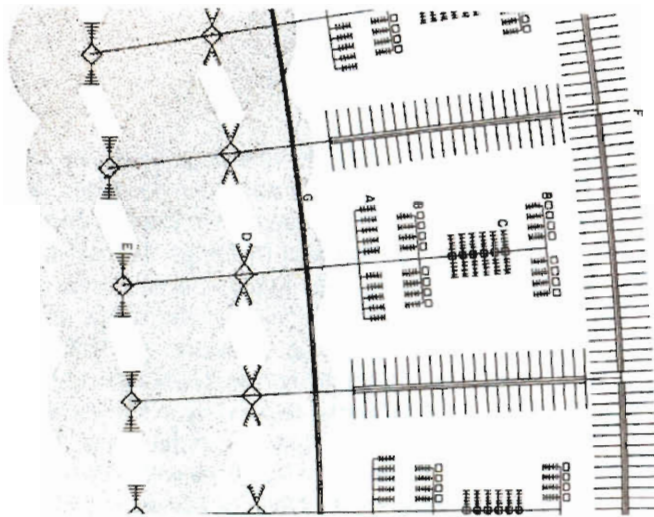
Le Corbusier designed his Ville Contemporaine as the embodiment of his ideas about city planning. He looked primarily at the congestion in existing cities, in terms of circulation and buildings themselves. He believed that the green space in cities should be preserved, and that cities at the same time needed to remain dense in order to confront increases in traffic congestion and population. For this reason, he proposed expanding in the vertical dimension rather than the horizontal. He also believed in a separation of functions within the city, creating skyscrapers for office buildings and mid-rise buildings for housing. Likewise, the industrial sector of the city is far removed from the city itself and separated by a green buffer. Le Corbusier designed this as a completed unit; in future iterations, however, he provided for independent expansion of each zone of the city, allowing them to remain separated even as the city grows. It is clear that this design for a city was a critique of older cities' inability to contend with new forms of transportation and industry.



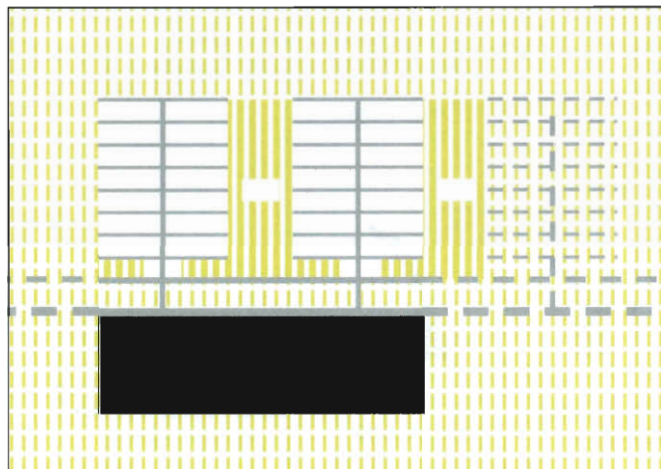
-  Industrial
-  Other urban functions
-  Programmed open space
-  Unprogrammed open space (may include agricultural lands)
-  Future growth



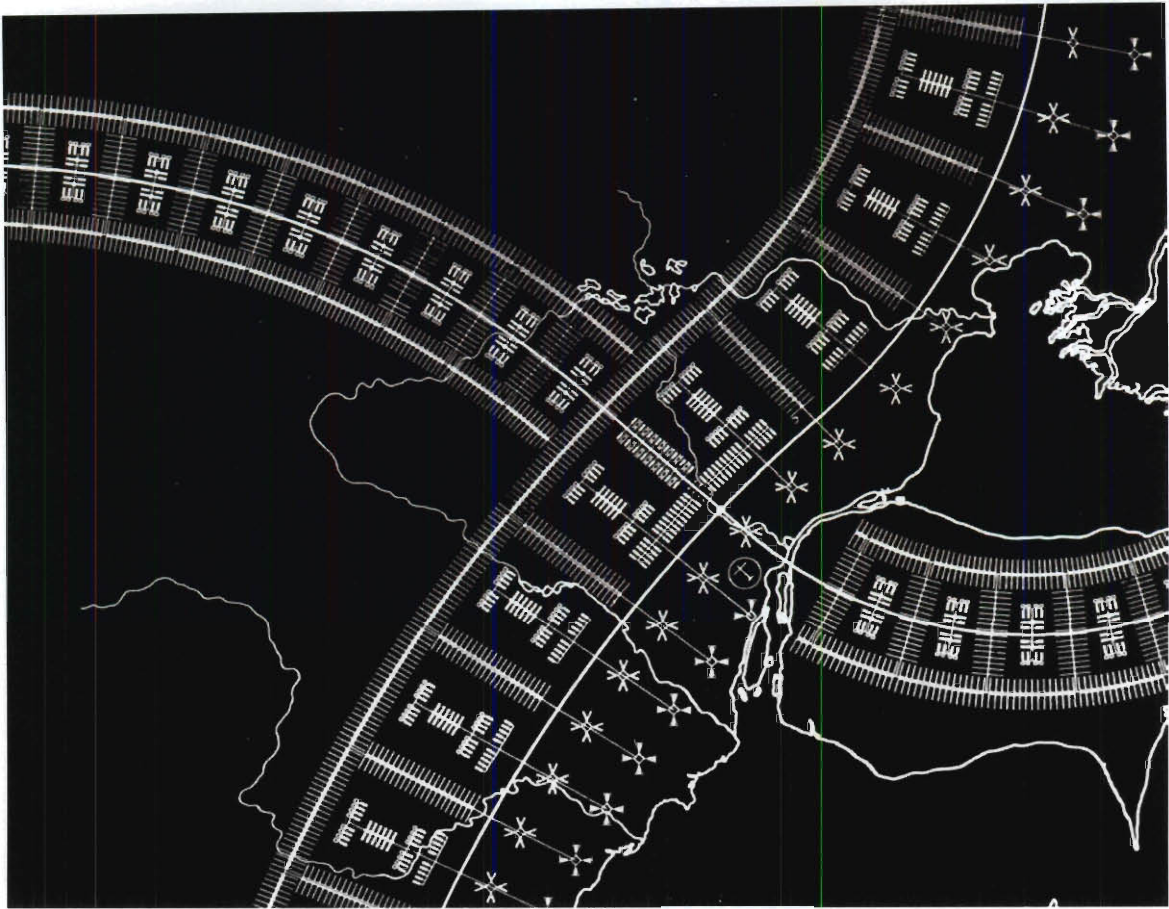
HILBERSEIMER: SETTLEMENT UNITS, 1945



Above left and left: Ludwig Hilberseimer, Smoke studies
Right: Ludwig Hilberseimer, Settlement units plan

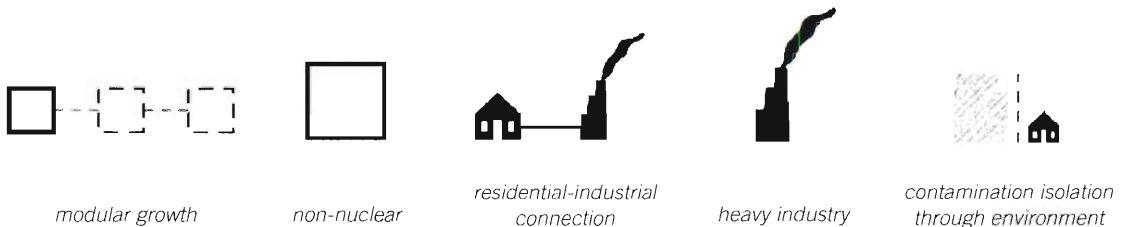


- Industrial
- Other urban functions
- Programmed open space
- Unprogrammed open space (may include agricultural lands)
- Future growth

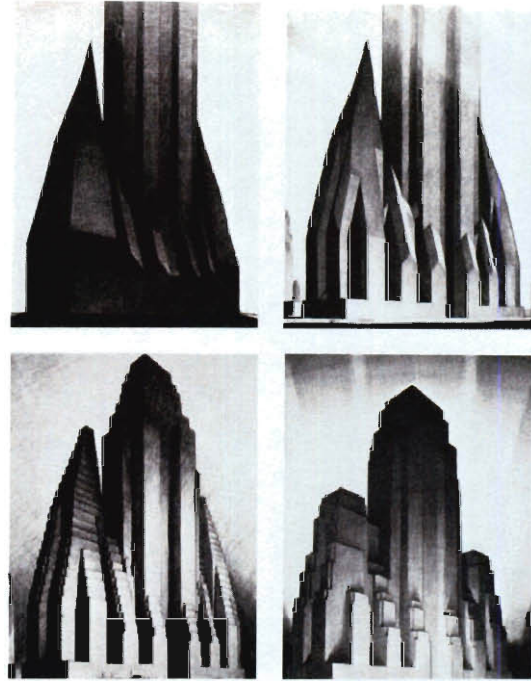


Hilberseimer expanded upon previous ideas of planning in his proposal for settlement units. These units employed a separation of functions, but were modular such that they could be expanded in a linear fashion and adapted to any site. In his proposal, the industrial zone was separated from the housing by a green buffer, though it was close enough that the residents could walk to their place of work. Additionally, each settlement unit was surrounded by a green zone.

Hilberseimer's studies were also unique because they took into account the effect of industrial pollution on surrounding residential zones. He performed numerous studies to determine how "smoke" could spread into surrounding areas and proposed that smoke studies be conducted for each site. Accordingly, one could determine the precise location for housing such that it would not be affected by the pollution of the adjacent factory.



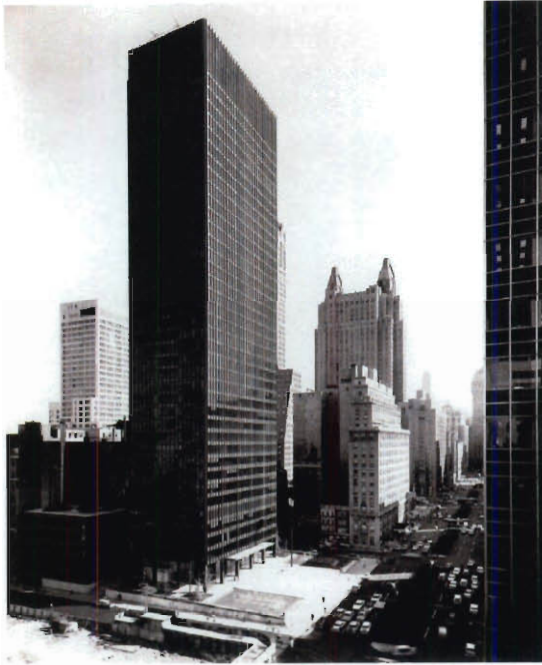
ZONING STUDIES



Zoning Studies, Hugh Ferriss

THE 1916 NEW YORK CITY ZONING REGULATIONS

As building technologies developed at the turn of the century, developers were able to construct buildings as tall as 500 feet. Because of the lack of regulations, these buildings generally took on the form of the lot upon which they sat, as a simple upward extrusion. The result of this was not only overcrowding, but a decrease in land value of the surrounding properties. Residents and business owners in New York feared that such an increase in the supply of building area within the city could in fact lower land values throughout the city. For these reasons, the city adopted zoning regulations in 1916. These regulations addressed both building envelope and land use, dividing the potential uses into residential, business, or unrestricted. While the regulations were focused on the protection of commercial properties within Manhattan, in the outer boroughs it was largely aimed to protect residential areas from overcrowding and noxious uses.



Seagram Building, Mies van der Rohe

THE 1961 ZONING REVISIONS

Though the 1916 zoning regulations were effective in many ways, they were criticized for a number of reasons. One reason was that its use zoning did not allow for an appropriate mixing of compatible uses. They often allowed residential areas to exist near areas considered to be “noxious,” while in some cases, allowing more lucrative uses such as residential or commercial to push out industrial areas. The new zoning regulations provided for more industrial zones, along with compatible combinations of uses. These combinations of uses allowed for gradual changes from “noxious” sites to residential or commercial sites, creating a buffer that may not have existed before the revisions.

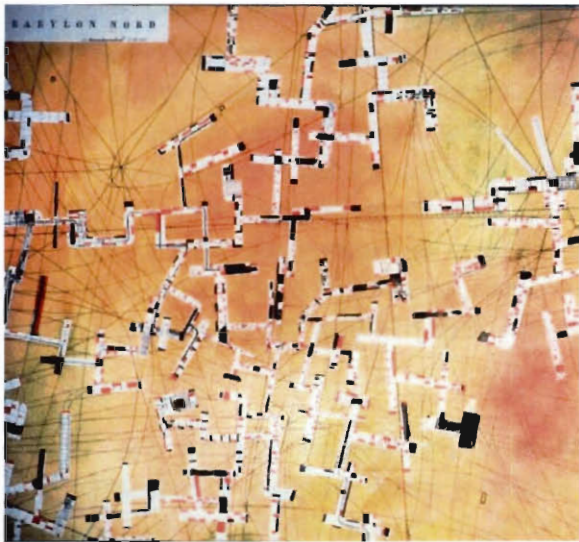
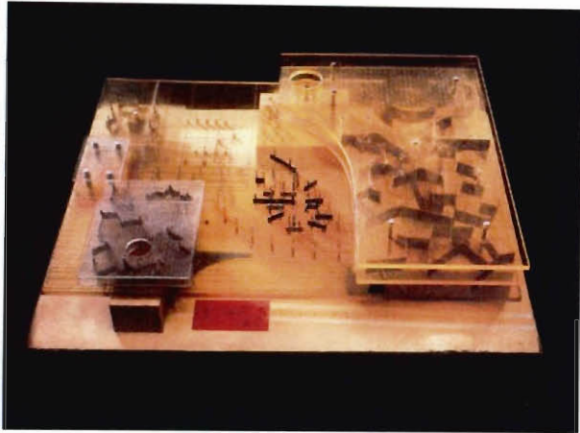
Today, New York City has lost a large amount of its industrial land. This is becoming more typical for other cities, as well, resulting in new parts of the city—both former industrial lands and their accompanying buffer zones—becoming available for new development. In the case of New York City, these new zones have most often turned over to commercial and residential uses.

THE CONTEMPORARY CITY

Despite planners' best efforts, the previous urban proposals were met with little to no success strictly in terms of their implementation. One reason for this is that they set about to design entirely new cities, rather than to intervene in existing ones. The zoning laws that many cities began to implement certainly relieved many of the problems of older cities; however, they did not solve them altogether. It was against this backdrop that Archigram, Constant, and others created their proposals for projects that would intervene in the existing fabric of cities.

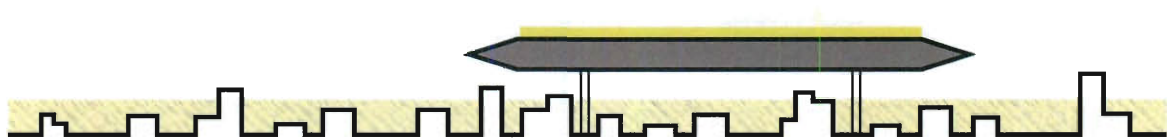
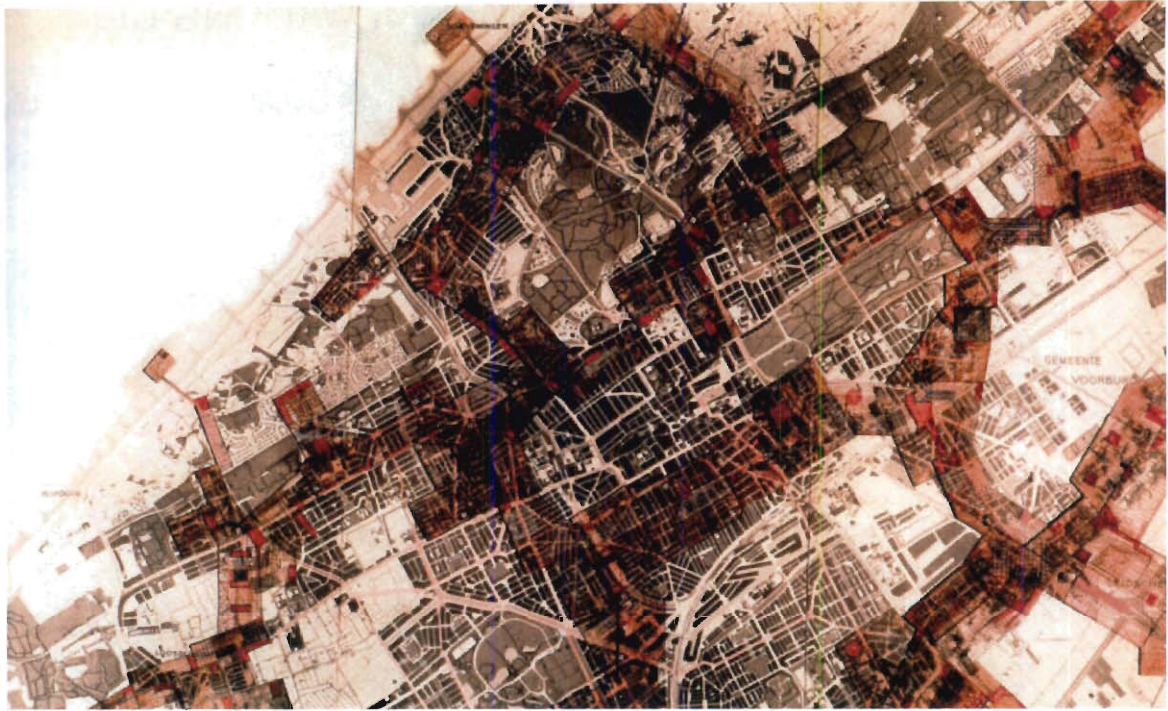
Contemporary cities continue to face a number of challenges with regard to their relationship with industry. In some, the industry remains, and as urban zones encroach upon industrial districts, they must determine how to accommodate their growing populations. This is the case in Amsterdam, which is contemplating relocating some of its industrial zones to more isolated districts. In other cities, the industrial functions are beginning to move out of urban centers, opening up new areas of the city for development. This is the case in Hamburg, which is in the midst of redevelopment plans for former industrial sites. In these cases and others, cities must now face the question of how to contend with these sites and what role they will play in the future development of the city.

Houston is at an interesting juncture in this question. On the one hand, urban functions have long been located in close proximity to industry, and some of these industries are attempting to alleviate this friction by creating buffers. On the other hand, with Houston's industry almost entirely involved in petrochemicals, it is inevitable that they will eventually cease to function, and Houston will have to determine how to utilize these leftover sites and the associated buffers that have been created.



CONSTANT: NEW BABYLON

Constant Nieuwenhuys, at one point a member of the Situationists, proposed New Babylon as an enclosed city that could accommodate the collective desires of a nomadic population in a never-ending *dérive*. This internal city was described as a “fortified place for protection against a hostile external world,” providing a diverse “variety of ambience.” Constant believed that because too much land in existing cities had been given over to uses such as traffic, these cities could no longer support social relations. Because of this, the new city would extend over the existing fabric of an entire region, expanding as driven by the desires of this population. The upward displacement of the ground plane would free up the lower level of the existing cities for circulation and public meetings while providing an additional open air surface along the top of the new city. Presumably, as the elevated city took over, the ground plane would be converted into an open green zone. Constant was operating under Team X’s theory that buildings are not to be understood as discreet units, but rather “as a form of landscape, a terrain on which social transactions take place,” and thus his city took on the nature of a network of circulation, rather than a series of buildings.



linear growth

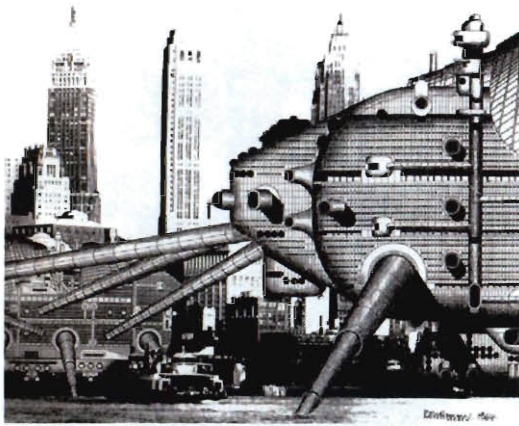


non-nuclear

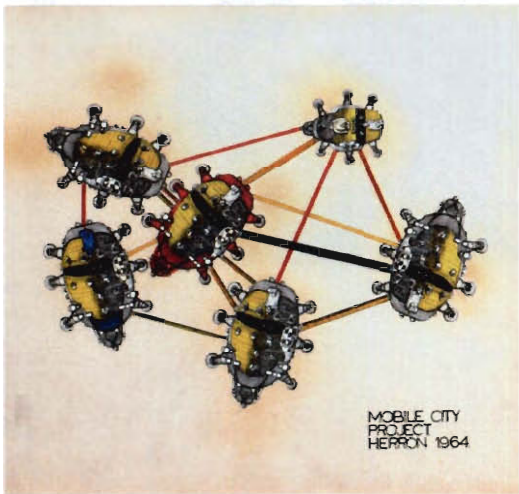


*contamination isolation
through enclosure*

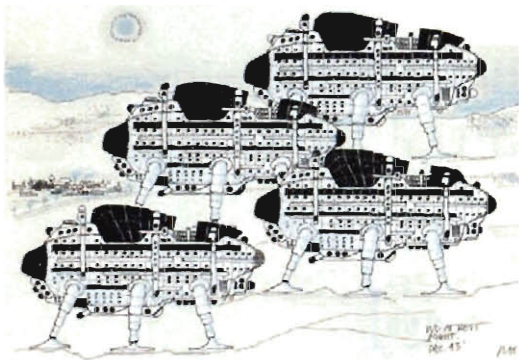
ARCHIGRAM: WALKING CITY

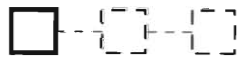
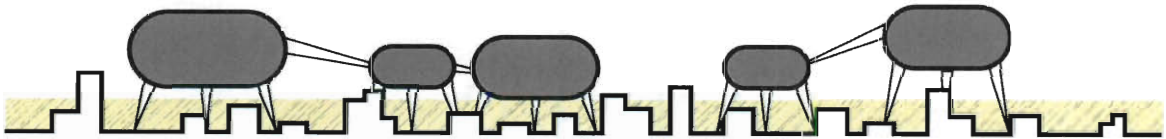


Archigram's Ron Herron proposed the Walking City as an escape from undesirable environmental conditions. As a large scale, mobile structure, Walking City could move toward more desirable environmental conditions, or to a place where resources are more abundant. The structures could also link together to form a mobile metropolis, and then disband when the connection to one another is no longer needed or desired. Walking City is similar to Constant's New Babylon when one considers it in terms of a city for a nomadic society. However, New Babylon still treats human beings as mobile subjects, whereas in Walking City, the architecture itself is the mobile subject.



Both of these projects represent a stark rejection of the ground plane and of an undesirable environment. Rather than attempting to fix the existing cities, both Constant and Archigram devise a tabula rasa by situating the new cities above the existing ground plane and its contamination. Like New Babylon, Walking City would eventually cause the existing ground plane to be converted to an unprogrammed, natural condition, similar to that of most buffer zones.





modular growth



mononuclear



contamination isolation through enclosure

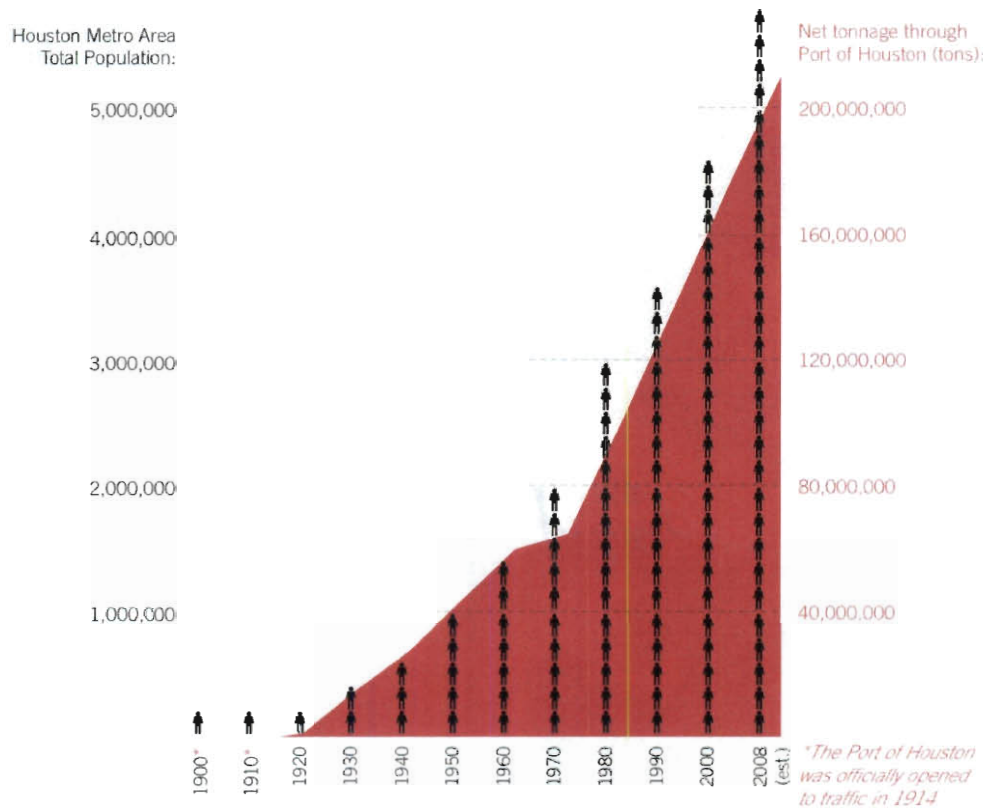
II SITE RESEARCH

THE HOUSTON SHIP CHANNEL

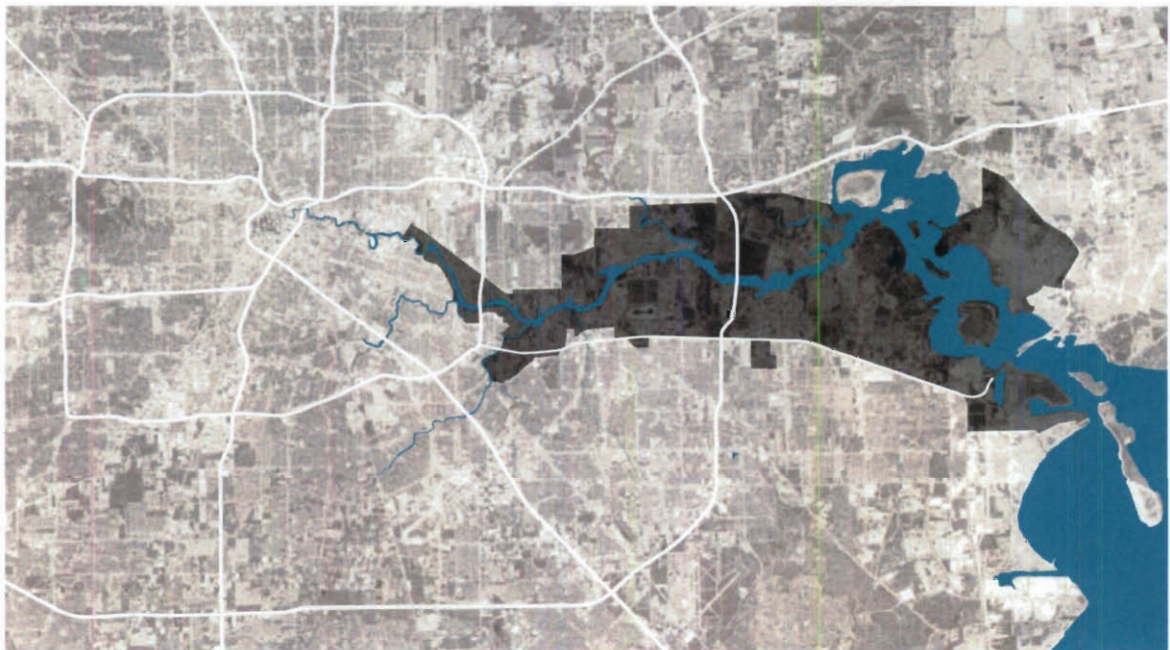
The Houston Ship Channel began was officially opened to traffic in 1914. The growth of the shipping port was accompanied by the establishment of a multitude of petrochemical plants along the length of the Ship Channel. These plants benefitted from a steady supply of water along with access to shipping and rail.

It goes without saying that the shipping and petrochemical industries provided an abundance of work to the city of Houston and almost single-handedly accounted for the growth of the city up until the mid-twentieth century. However, the growth of the city was uncontrolled by any centralized governance, resulting in conditions along the Houston Ship Channel that in some ways resemble the conditions found in the early industrial cities. Houston is a city without formal zoning, resulting in unmitigated adjacencies between residential areas and zones of heavy industry. Nowhere is this condition more prevalent than along the Houston Ship Channel, where residents must live with nuisances such as pollution, noise, and flare-ups from nearby factories and petrochemical plants. Air pollution in many neighborhoods exceeds the limits set by the Texas Commission on Environmental Quality, causing strange odors and, in some cases, illness. A recent study by the University of Texas School of Public Health has found an “association” between the ship channel and rates of childhood cancer, finding that children who live within two miles of the Houston Ship Channel are 50% more likely to have cancer than those living ten miles away.

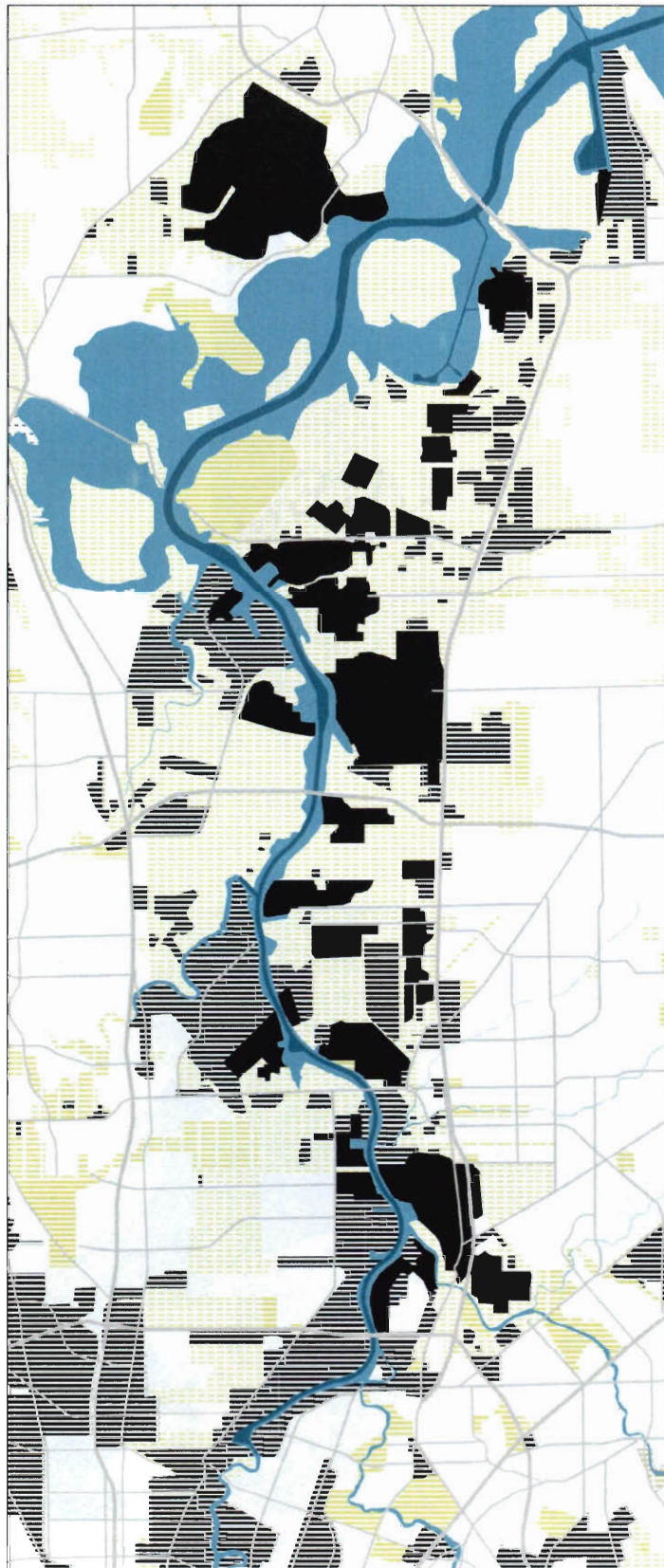
Aside from environmental hazards, proximity to the Ship Channel also causes undesirable urban conditions. Small neighborhoods are isolated from one another by large infrastructures and industrial sites, often creating problems of mobility. Many neighborhoods are marked by discontinuous streets, empty lots, and under utilized parks.



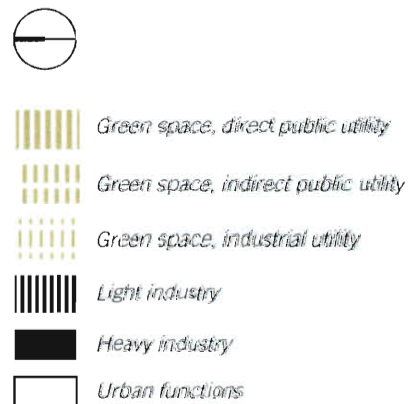
The Growth Of Houston's Population And Port

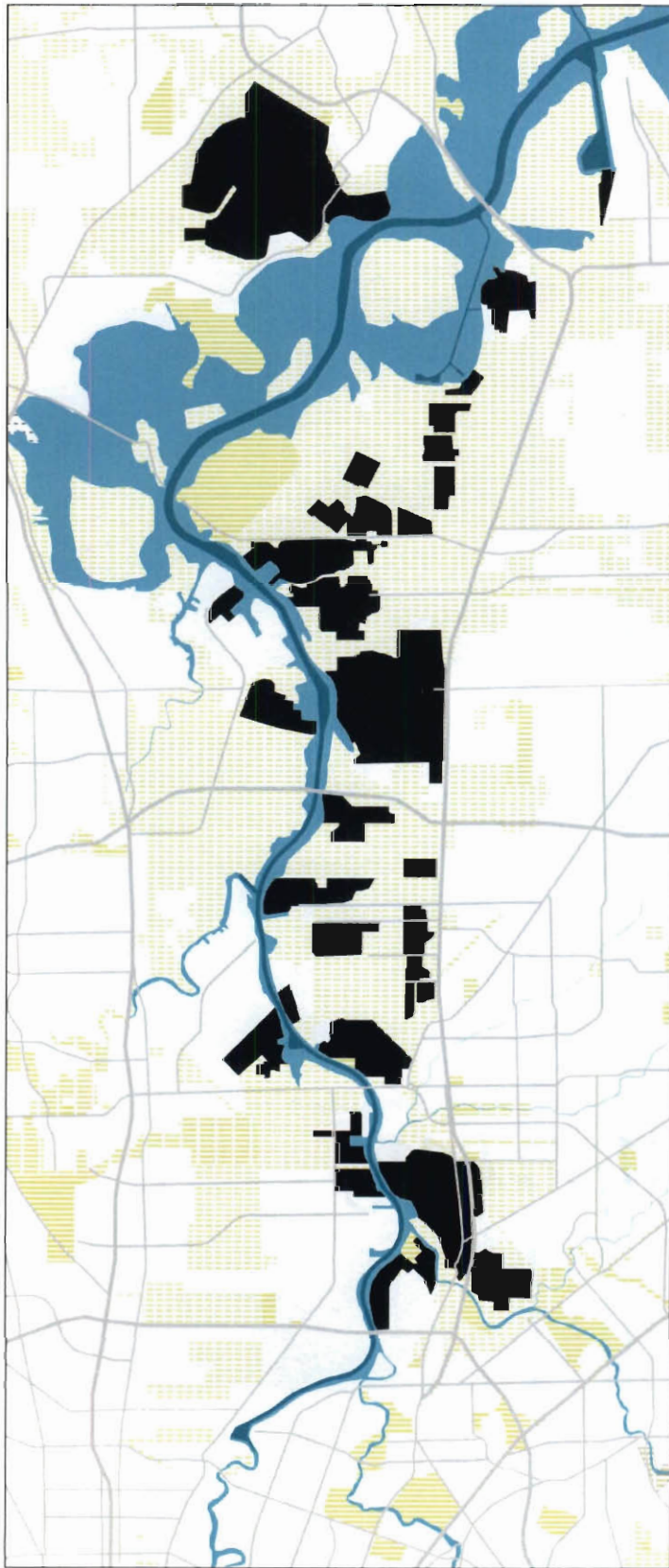


The Houston Ship Channel Industrial Zone



The uncontrolled growth of the Ship Channel and surrounding areas has resulted in a patchwork of industrial lands interspersed with various types of buffer zones and urban functions. Some of these buffer zones have programmed uses, such as parking, while some are left unprogrammed, either for purposes of a buffer, or as holding for future use.





The most abundant type of buffer zone exists in the form of fallow land. Nearly all of this land is unprogrammed and has been taken over by natural functions. This immense area of natural land within the city has profound potential as an untapped resource.





Public utility easement, Park Place subdivision



Port of Houston Authority dredge fill site



Vacant land owned by Exxon Mobil, Park Place subdivision



Sims Bayou

BUYOUTS

In order to mitigate the unhealthy conditions that affect residential zones located adjacent to refineries and petrochemical plants along the Houston Ship Channel, large corporate landowners in the area (primarily ExxonMobil) have been buying out residential neighborhoods since the 1990s. In many cases, these buyouts occur in order to prevent lawsuits.

One such example is the Allendale subdivision, a small neighborhood adjacent to Ship Channel industries, where 150 homes have been bought out so far. A second buyout site in the Ship Channel Zone is located in Baytown. Beginning in 1992, Exxon Mobil began to buy out residential properties that were adjacent to its Baytown petrochemical plant. As of 2005, it had bought out 400 homes.

While the buyout process may have good intentions, it has resulted in large areas of fallow land that sit empty and without purpose. In almost all cases, the company that has purchased the lots demolishes the houses and leaves the land open and unprogrammed. Inevitably, these tracts of land revert to a natural state. Although these lands become rich ecological zones, they do not serve any further urban function beyond that of a separation between residential and industrial zones.



ALLENDALE BUYOUTS



*150 homes purchased
50 remain within buyout zone*



House to be demolished within buyout zone



BAYTOWN BUYOUTS

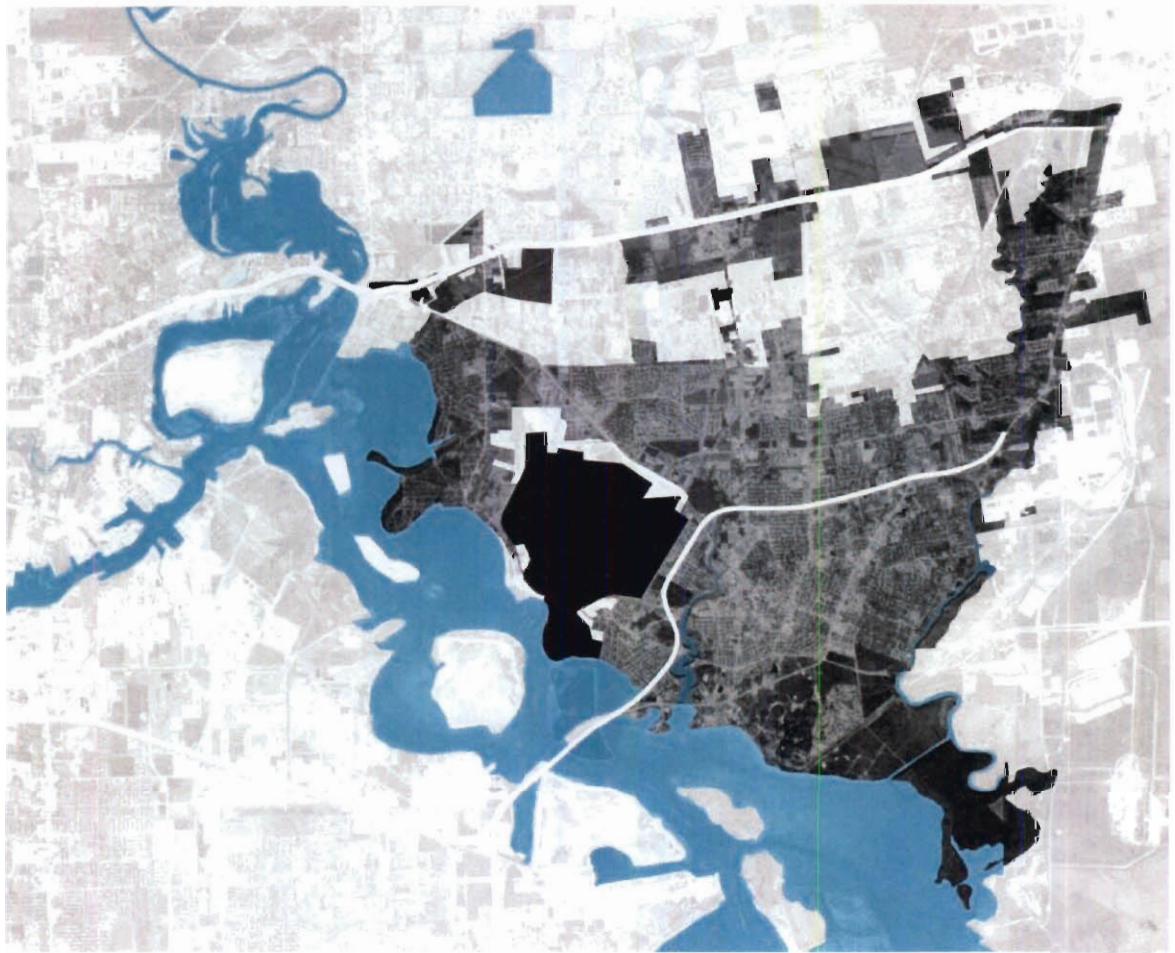
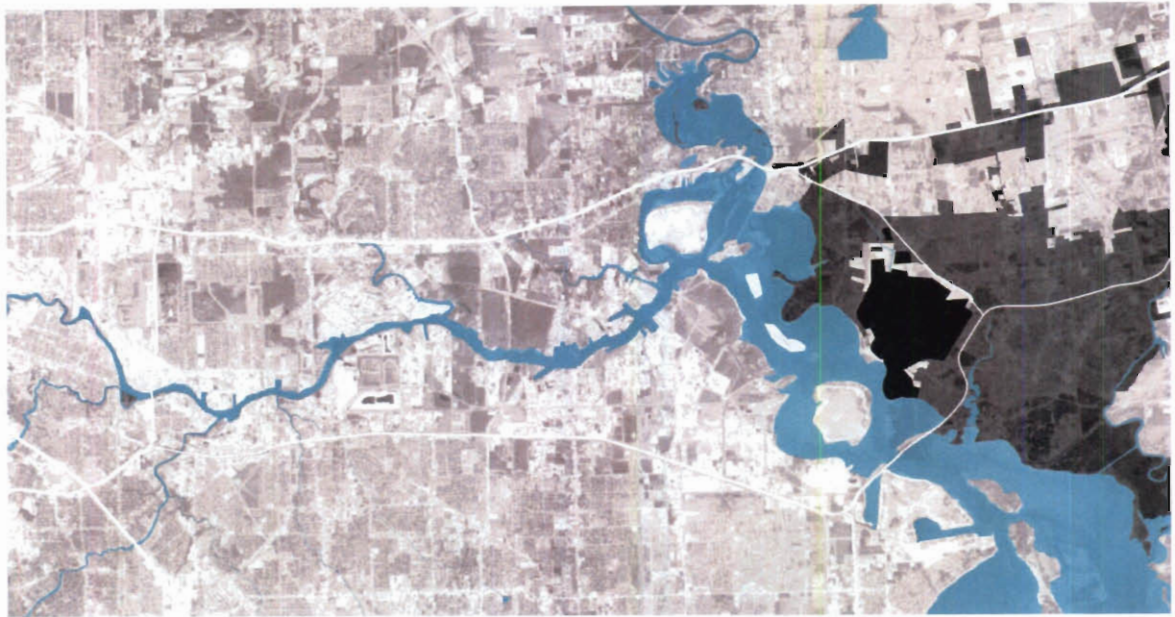
*400 homes purchased
310 remain within buyout zone*



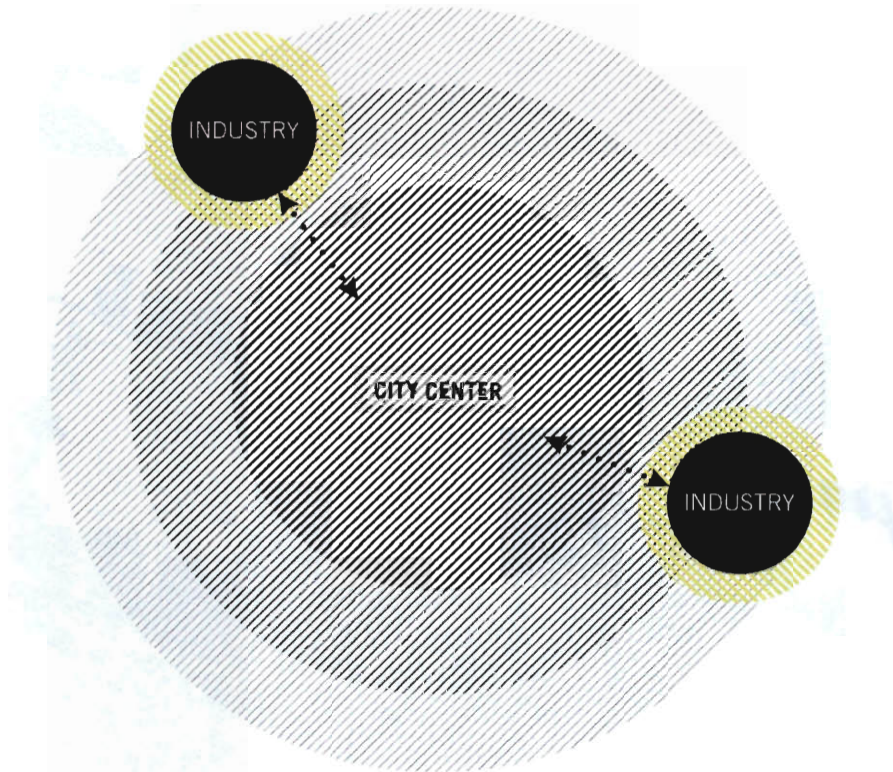
BAYTOWN

Baytown (originally comprised of the separate towns of Goose Creek and Pelly) developed alongside the 1916 discovery of oil at the Goose Creek oil fields and the subsequent establishment of the Humble Oil Refinery in 1919. As the refinery's capacity grew, so did the population of Baytown. Though Baytown's historic core is located just east of the refinery, the city has continued to grow in a piecemeal fashion around it. It in some ways has become similar to the industrial cities described by Mumford, in which "the factory became the nucleus of the new urban organism" (although clearly with a much lower density). Baytown, composed almost entirely of low-density urban enclaves (even its downtown fits this description), does not have an urban core, but rather an industrial one. This industrial center permeates nearly every aspect of the city's character, forming its black heart.

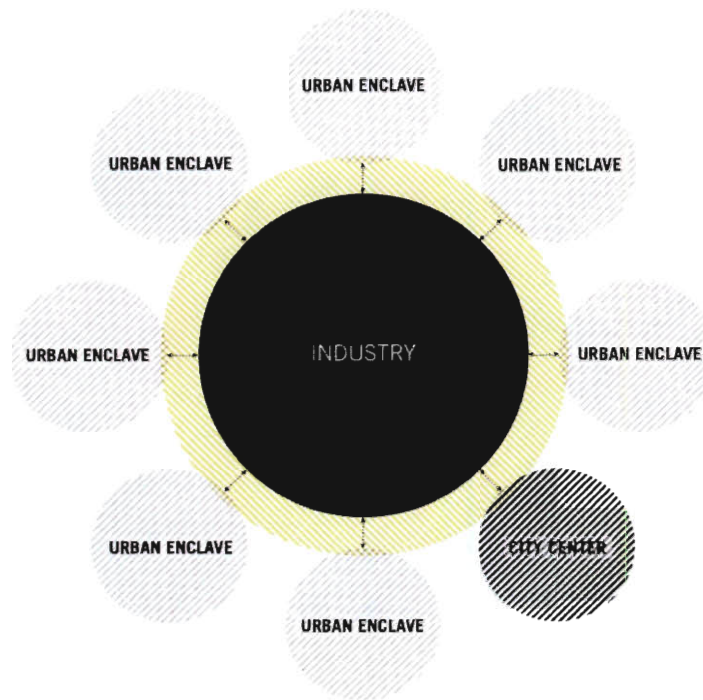
In the current state of the city, the black heart is now almost entirely surrounded by a green buffer that has expanded over time into adjacent neighborhoods. However, this black heart is vulnerable to the inevitable exhaustion of the supply of oil. Once this begins to occur, the buffer may begin to take on a more active role. Rather than act as a passive entity that protects the industry and the adjacent urban zones from one another, it can begin to move into the industrial zone, transforming it into a green heart. This new green heart will in turn provide Baytown with a new identity.



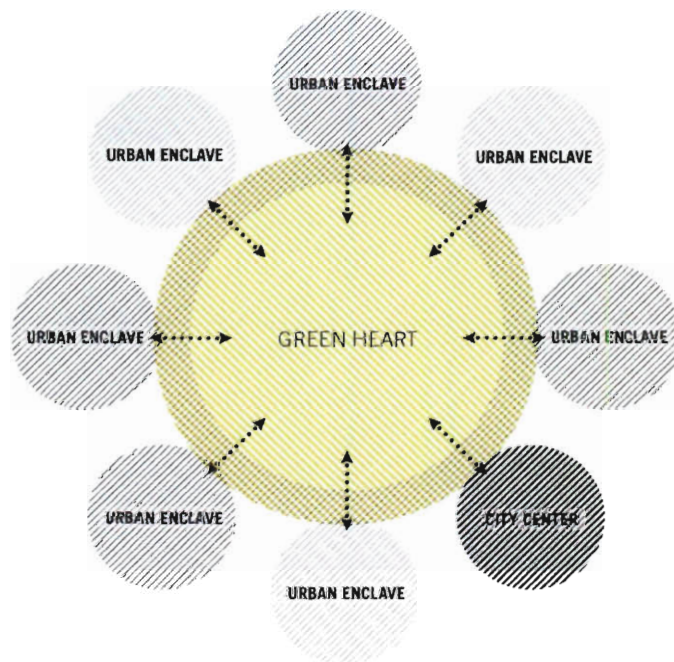
Baytown City Limits



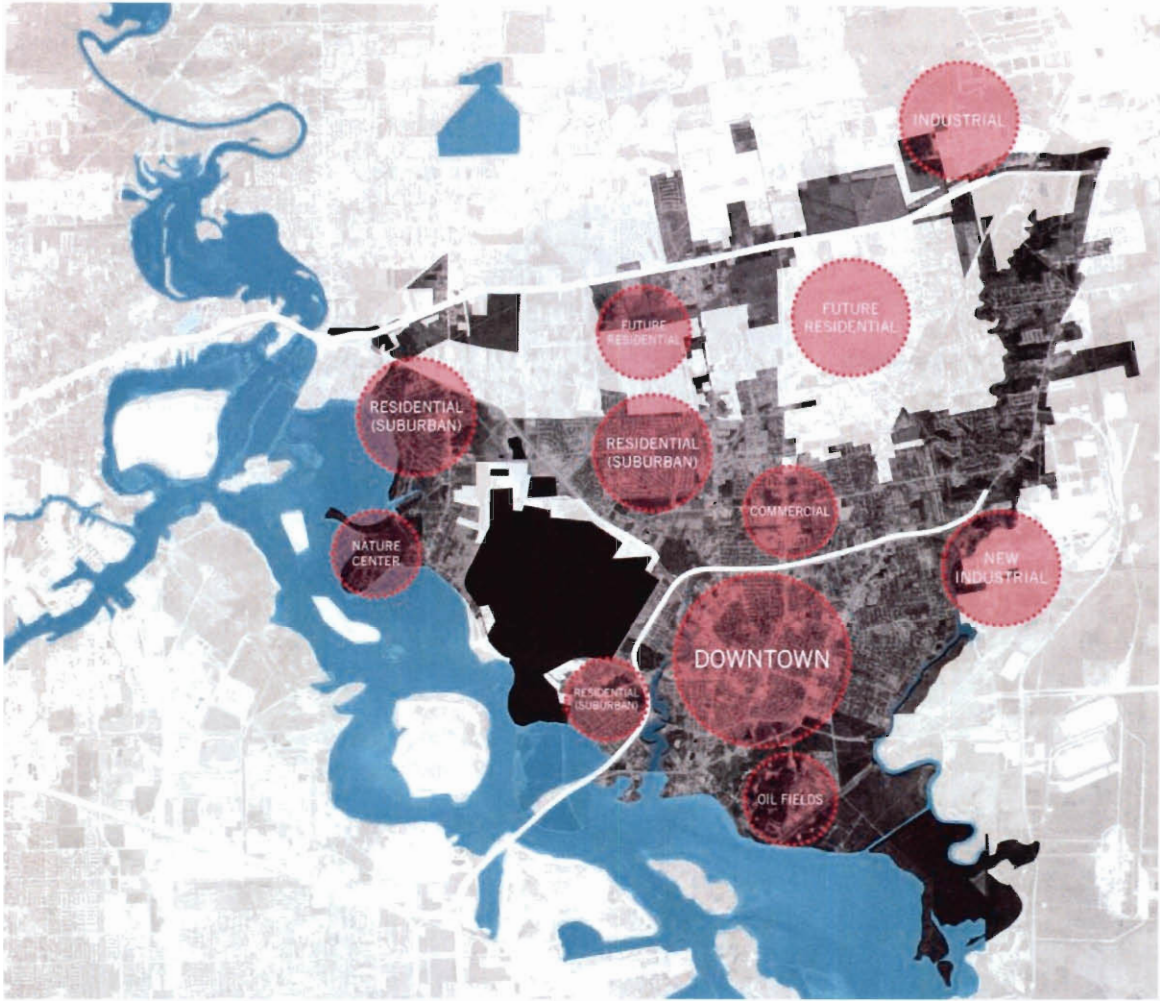
A "typical" city: dense urban core surrounded by suburbs with industrial zones acting as satellites along the periphery



Baytown: Industry forms the black heart of the city, surrounded by a green buffer and distinct urban enclaves



Baytown's future: The black heart has been converted into a productive green heart surrounded by a new type of buffer that will connect the urban enclaves



Baytown's industrial core and surrounding developments



Baytown's industrial core and projected buffer zones

III DESIGN STRATEGIES

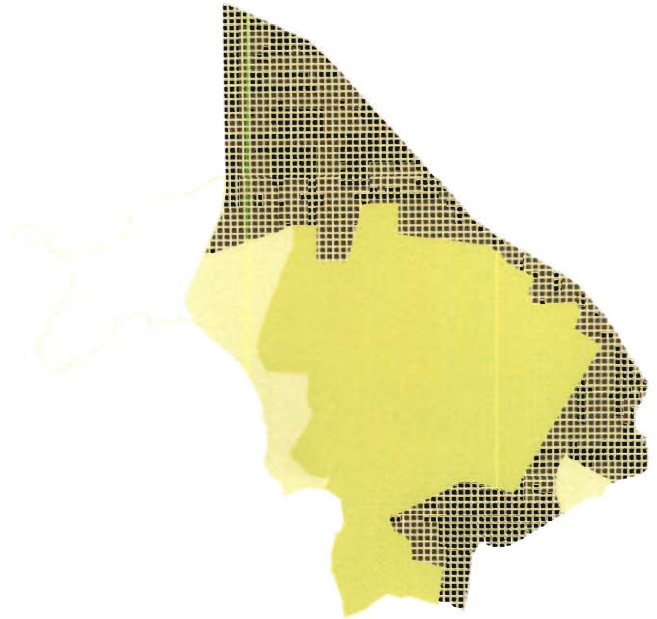


As a result of ongoing buyouts, a well-defined buffer surrounds Baytown's industrial core and continues to expand outward into the city. This buffer zone acts as nothing more than a wall, albeit an ecologically productive one, that does not allow for a relationship between the two.



However, as the petrochemical industry declines there is a new opportunity for buffers to move inward, taking over the industrial site. The buffers will take on a new role as an aggressive one rather than a passive one, acting as the agent of transformation in turning Baytown's black heart into a productive green heart.

The green heart supports the surrounding city and gives it a new identity, preventing it from becoming a monotonous plane of continuous suburban fabric.



Once the green heart is established, the surrounding city can expand into the original buffer zone, leaving the productive green heart intact.

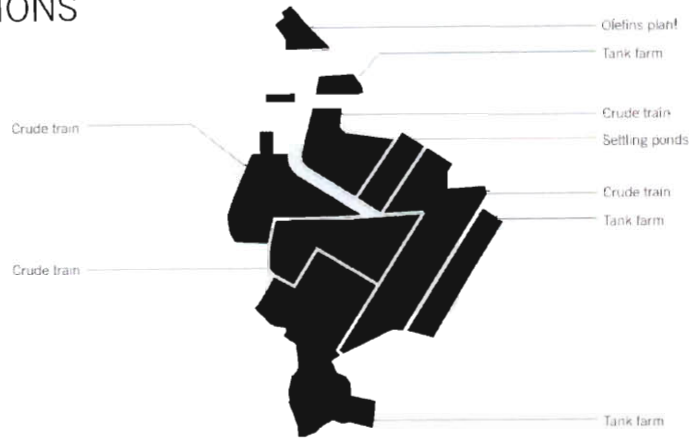
6 BUFFERS



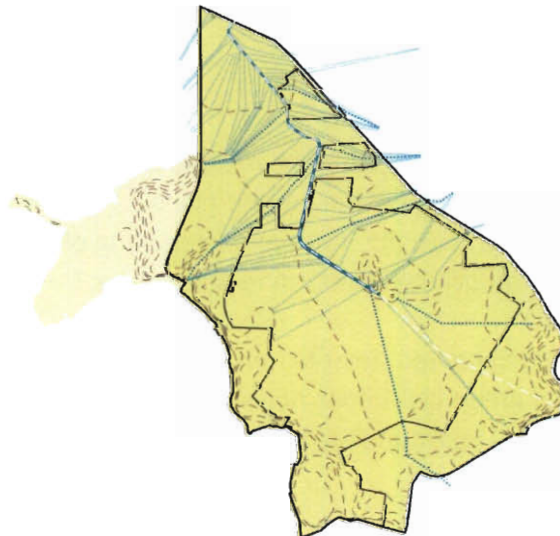
Through this process, the buffers will take on a new role that will join the adjacent urban conditions to the newly created productive green heart. Baytown's 6 buffer zones will each take on a new identity based on these conditions.

As the green heart is established, each of these buffers will affect the character of the green heart itself, creating distinct zones within it.

SITE CONDITIONS



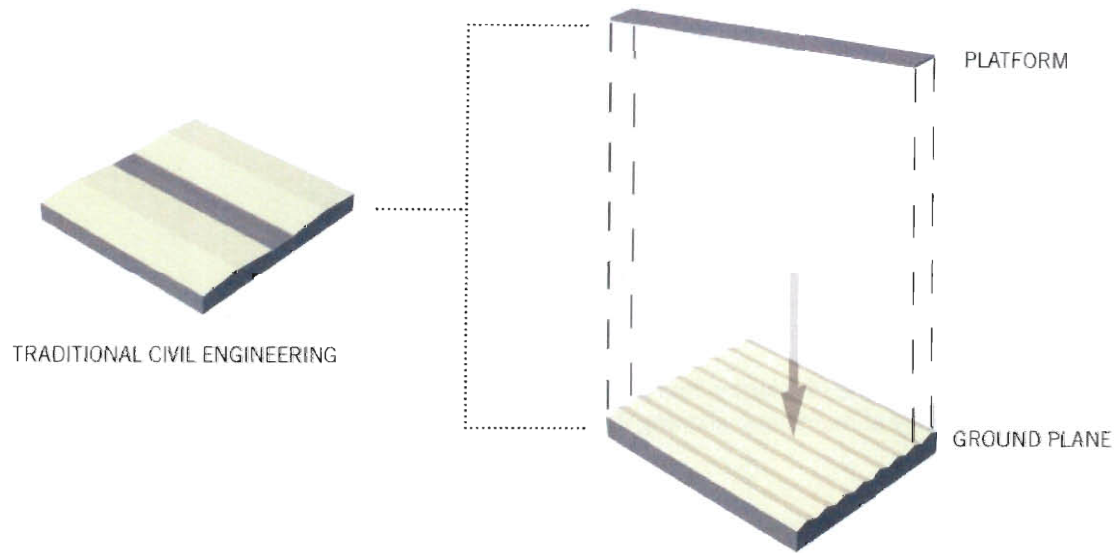
Refinery zones: the divisions within the refinery allow portions of it to be shut down independently of the others, allowing the green heart to be implemented in phases



Watershed: The site spans across two watersheds, draining into Goose Creek to East and South, and San Jacinto River to west.

Refinery is supplied with fresh water that comes from Lake Houston via a channel that runs along the highest point of the site. This channel has great potential for the productive green heart's functions.

SYSTEM COMPONENTS



In order for the buffers to create this green heart, one must reconsider traditional modes of development that tie urban infrastructures to the ground plane. This thesis proposes that the traditional ground plane is instead split into two parts, consisting of a corrugated ground plane and an overlaid platform infrastructure.

This separation is what allows the green heart to remain green—ground plane is not subservient to urban functions, green heart does not become merely an extension of the surrounding city.



PLATFORMS

The platforms are elevated above the corrugated ground plane and provide an artificial ground plane that defines a new datum that connects the buffers to each other and to the green heart.



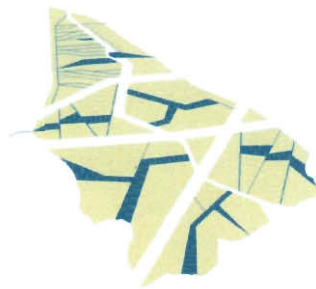
WET SPINE

The main structuring element of the site is the "spine." This is the channel that supplies water to the refinery, which is then extended along the site to provide irrigation to the site's new functions.



CROSS AXES

The secondary structuring elements of the site are the cross axes. These connect the buffers at the periphery of the green heart back to the spine and distribute water throughout the site.



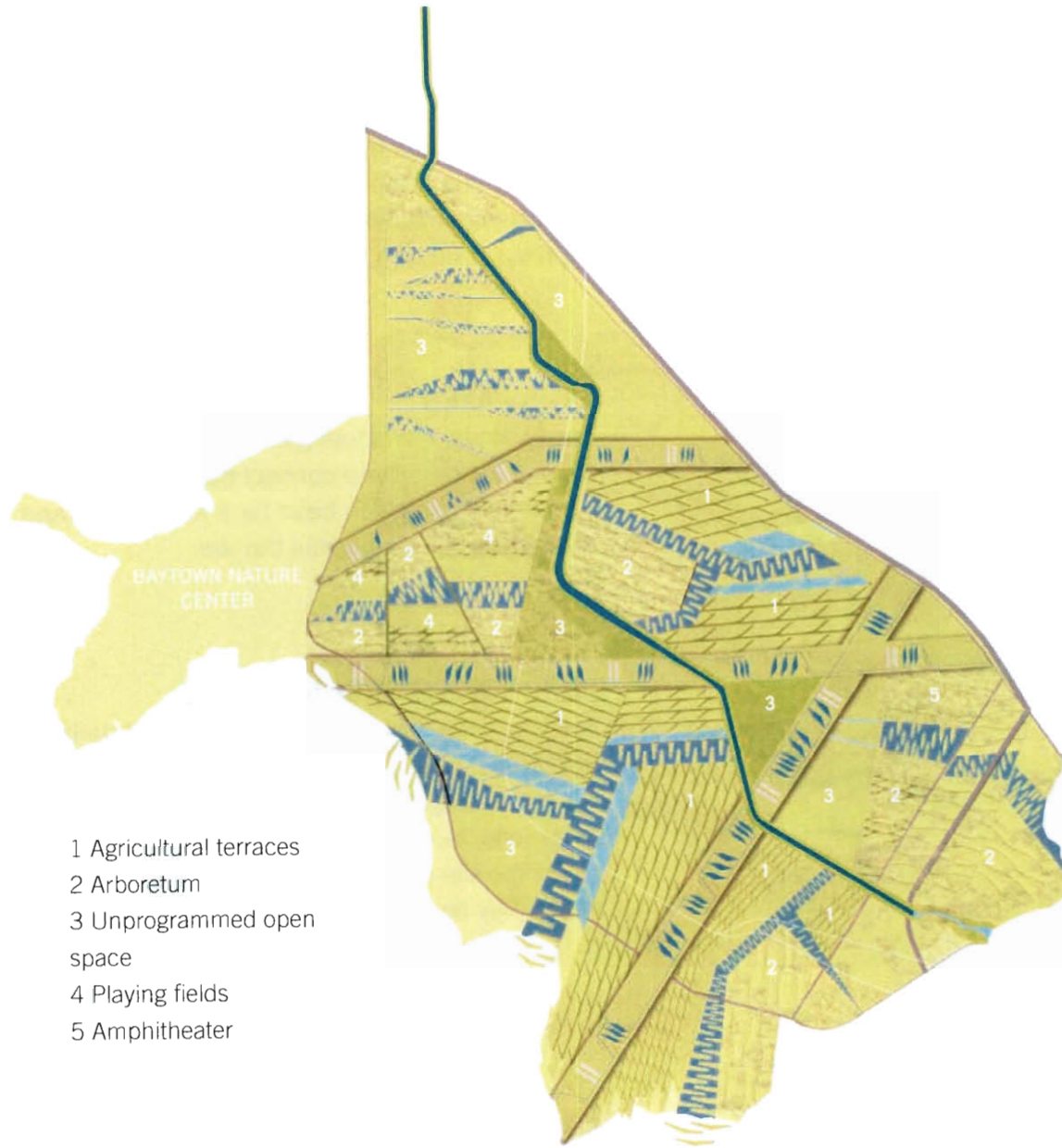
CORRUGATED GROUND PLANE

The ecological ground plane will be characterized by corrugations. These corrugations provide varying ecological, recreational, and agricultural conditions, all of which work together. They also divide the site into programmatic zones, each of which may be treated differently.



SUBSTRATE

ECOLOGICAL GROUND PLANE





RIDGES (water detention)

These corrugations set up the structure for the organization of the green heart. They are the first corrugations to be deployed and exist as elevated bars that stretch across the green heart. They contain contained aquatic programs including varying types of ponds.



INTERSTITIAL AREA (water movement)

The water from the structuring corrugations distributes water to the linear corrugations, which accommodate such programs as agriculture, arboretum, playing fields, etc.

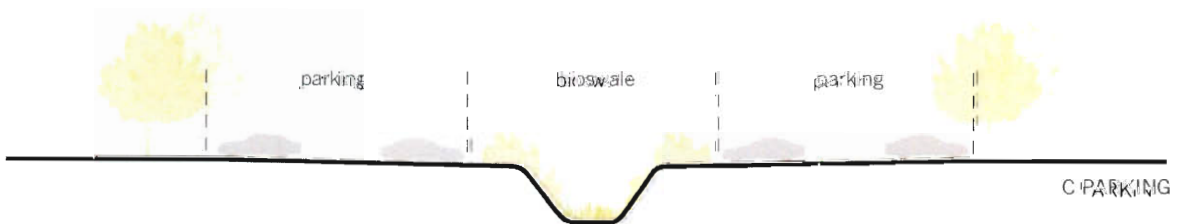
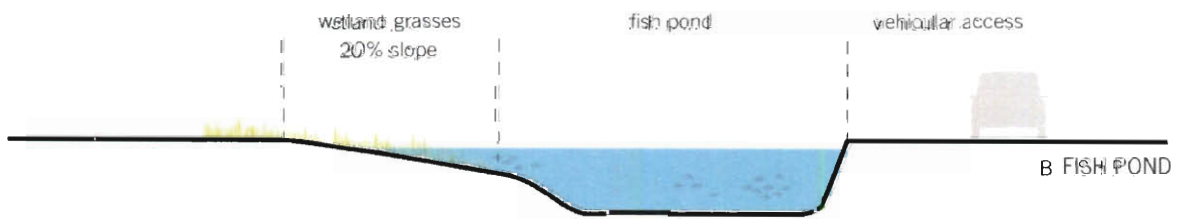
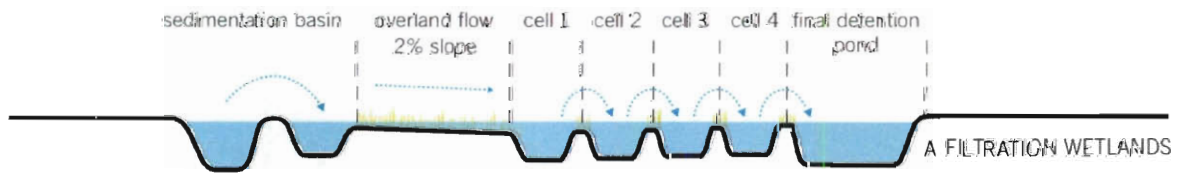
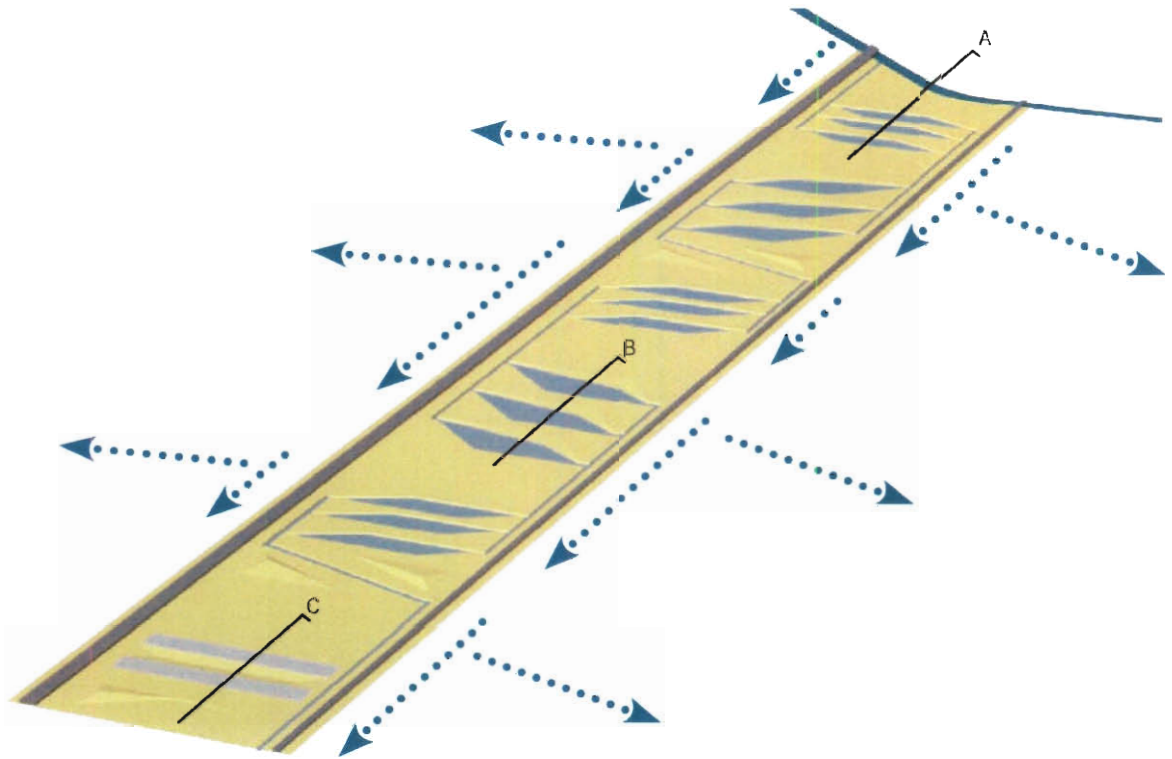


VALLEYS (water detention)

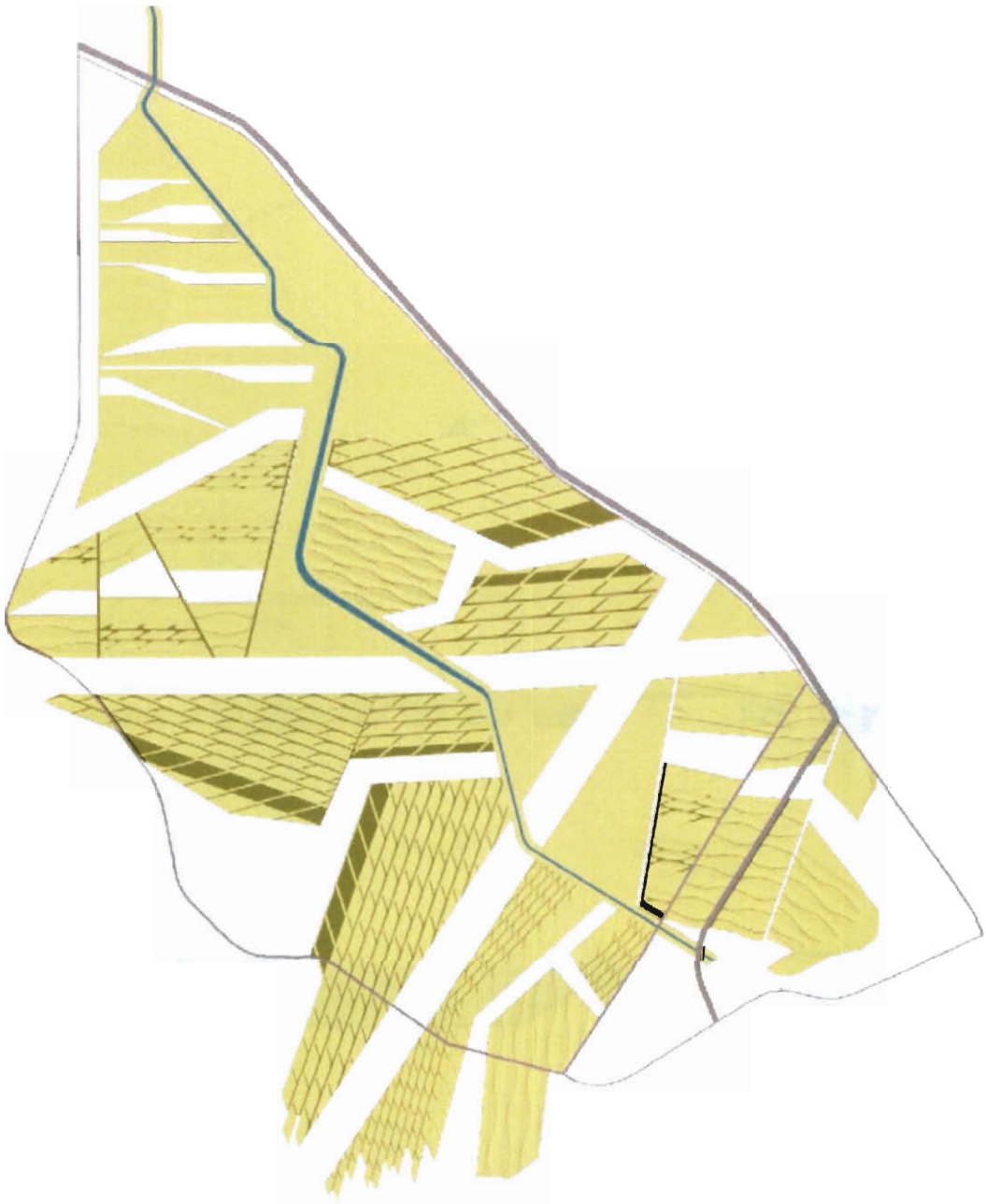
The runoff from the linear corrugations feeds into the terraced corrugations, allowing it to be filtered and either returned to the system or released into the bayou system.

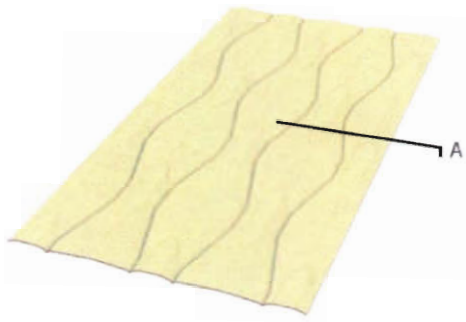
RIDGES



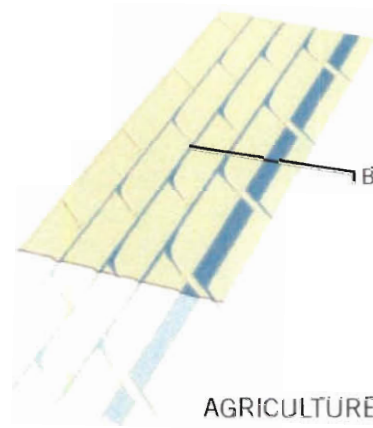


INTERSTITIAL AREAS

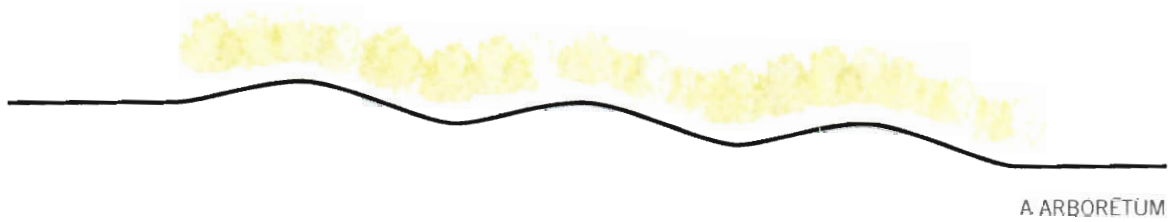




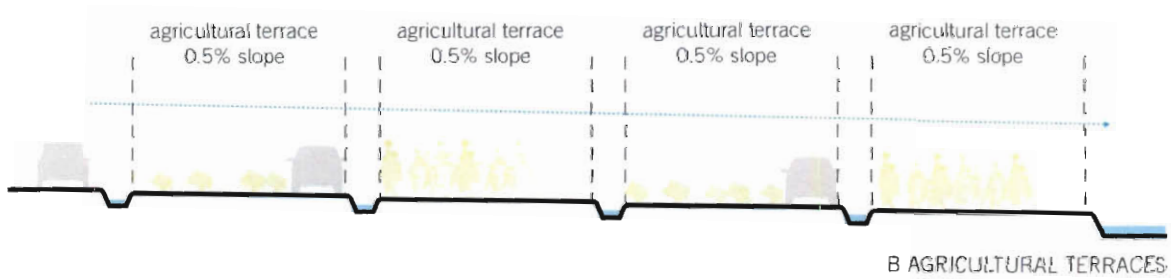
ARBORETUM



AGRICULTURE



A ARBORETUM



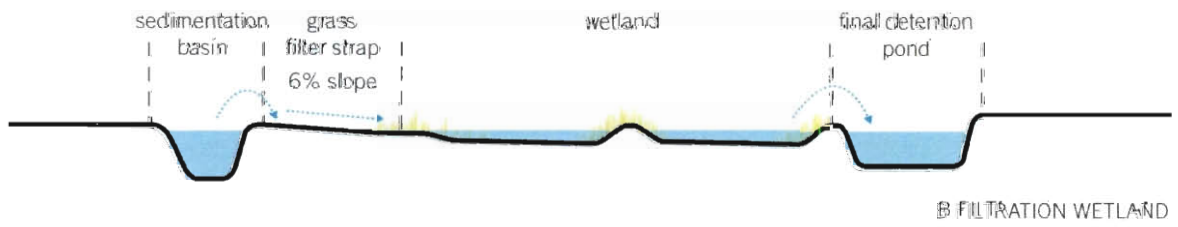
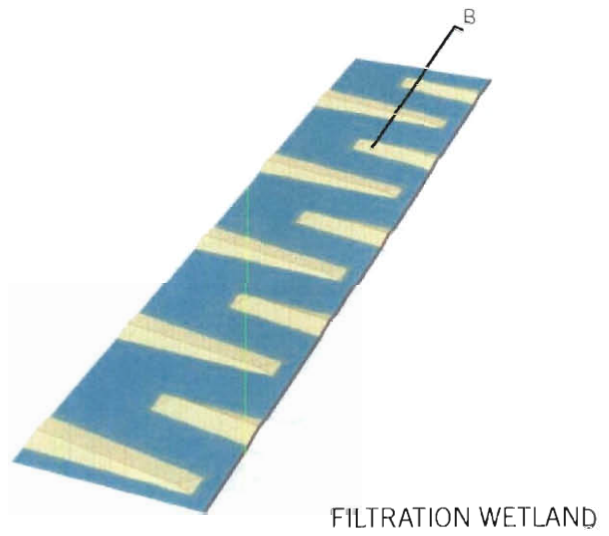
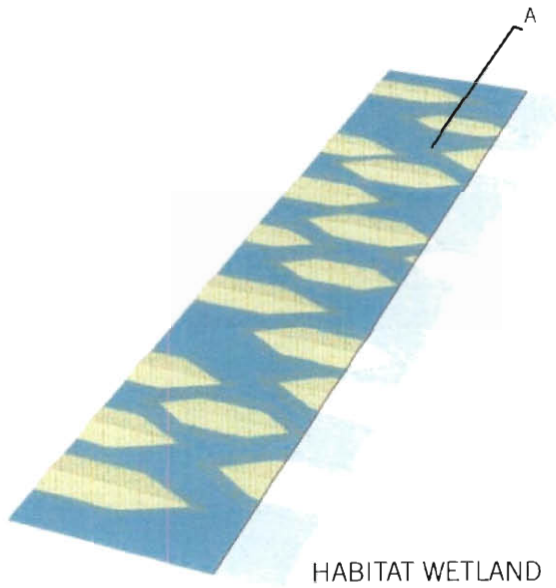
B AGRICULTURAL TERRACES



AMPHITHEATER

VALLEYS





ARTIFICIAL GROUND PLANE



CIRCULATION PLATFORMS

Circulation platforms provide connections within and between buffer zones and across the green heart. They also provide access to various locations within the green heart.

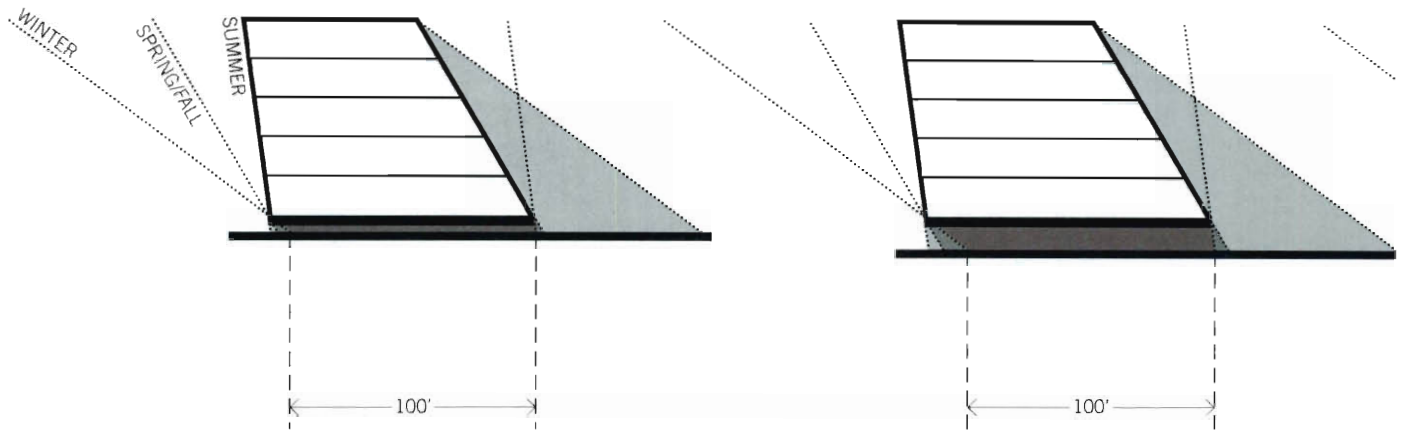
Additionally, the platforms contain the infrastructure that allows them to carry water and waste across the site.



Vehicular network



Bicycle and pedestrian network



INFILL PLATFORMS

The infill platforms span between circulation platforms to accommodate buildings and public spaces. The zoning envelopes of these buildings and platforms is designed to provide maximum solar exposure to the ground plane while still allowing for an urban plane to exist.

MULTI-FAMILY HOUSING _____

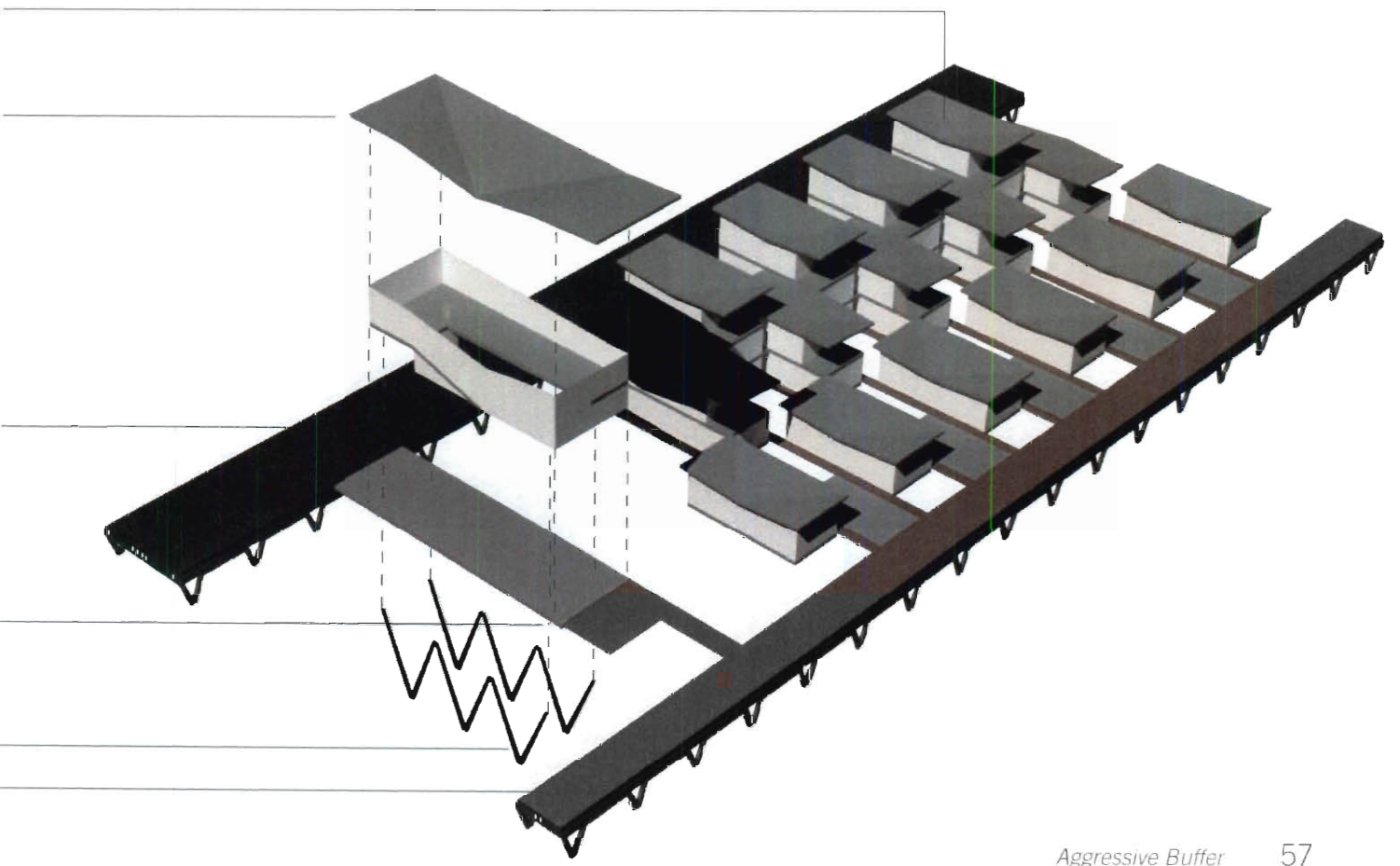
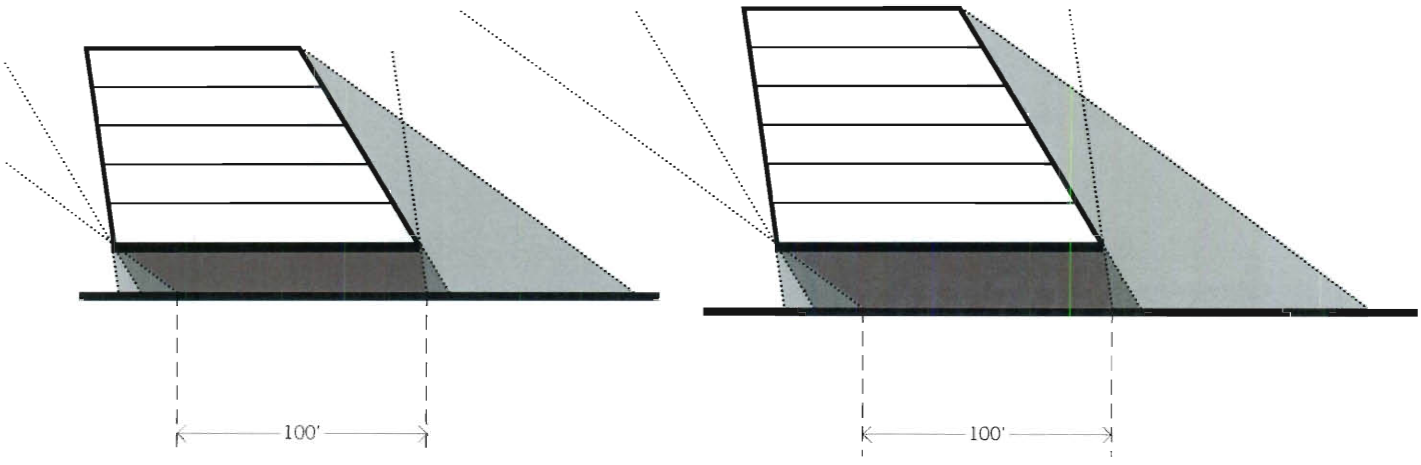
FACETED ROOF PLANE FOR WATER COLLECTION _____

CIRCULATION PLATFORM (VEHICULAR) _____

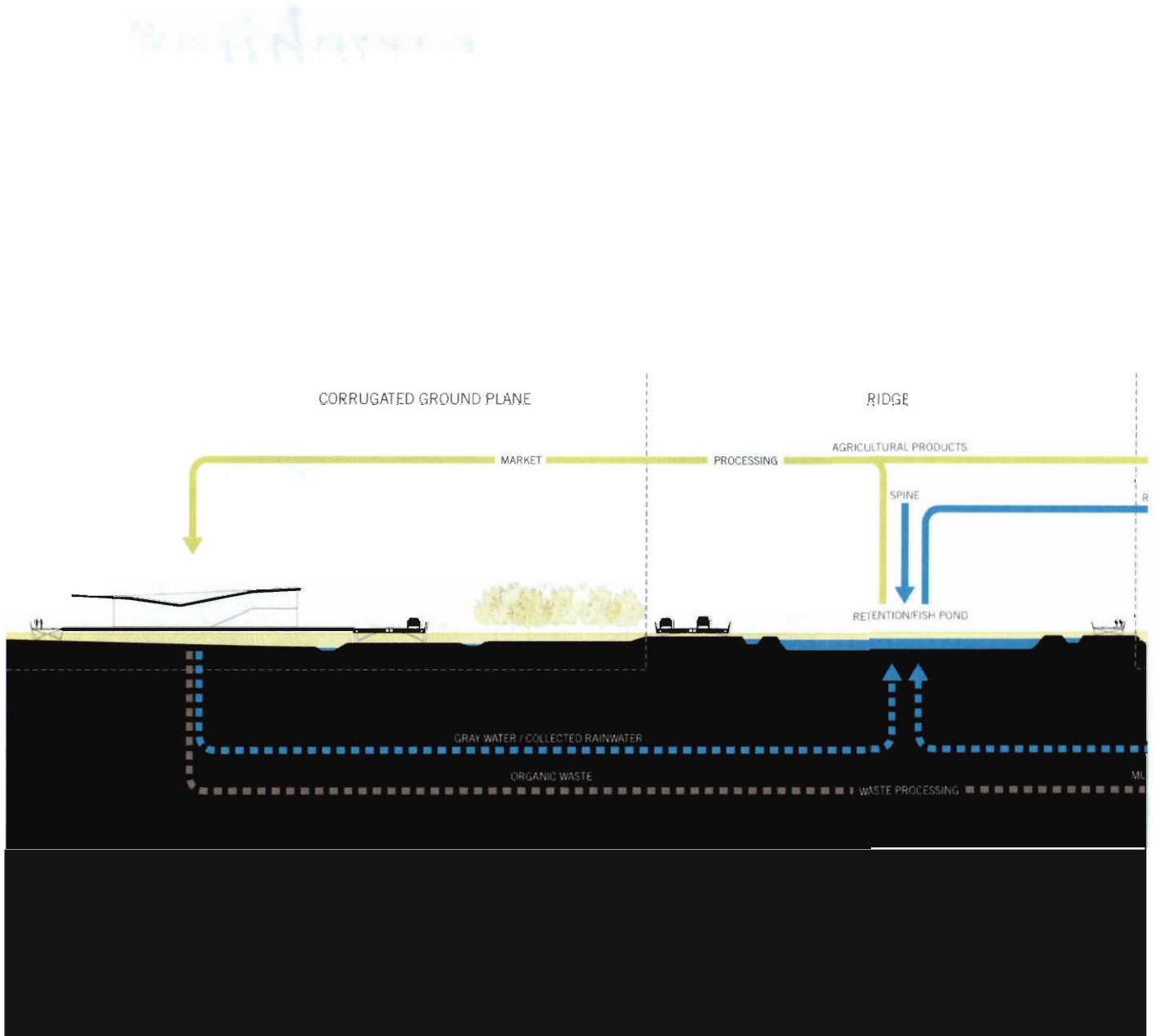
SPANNING PLATFORM _____

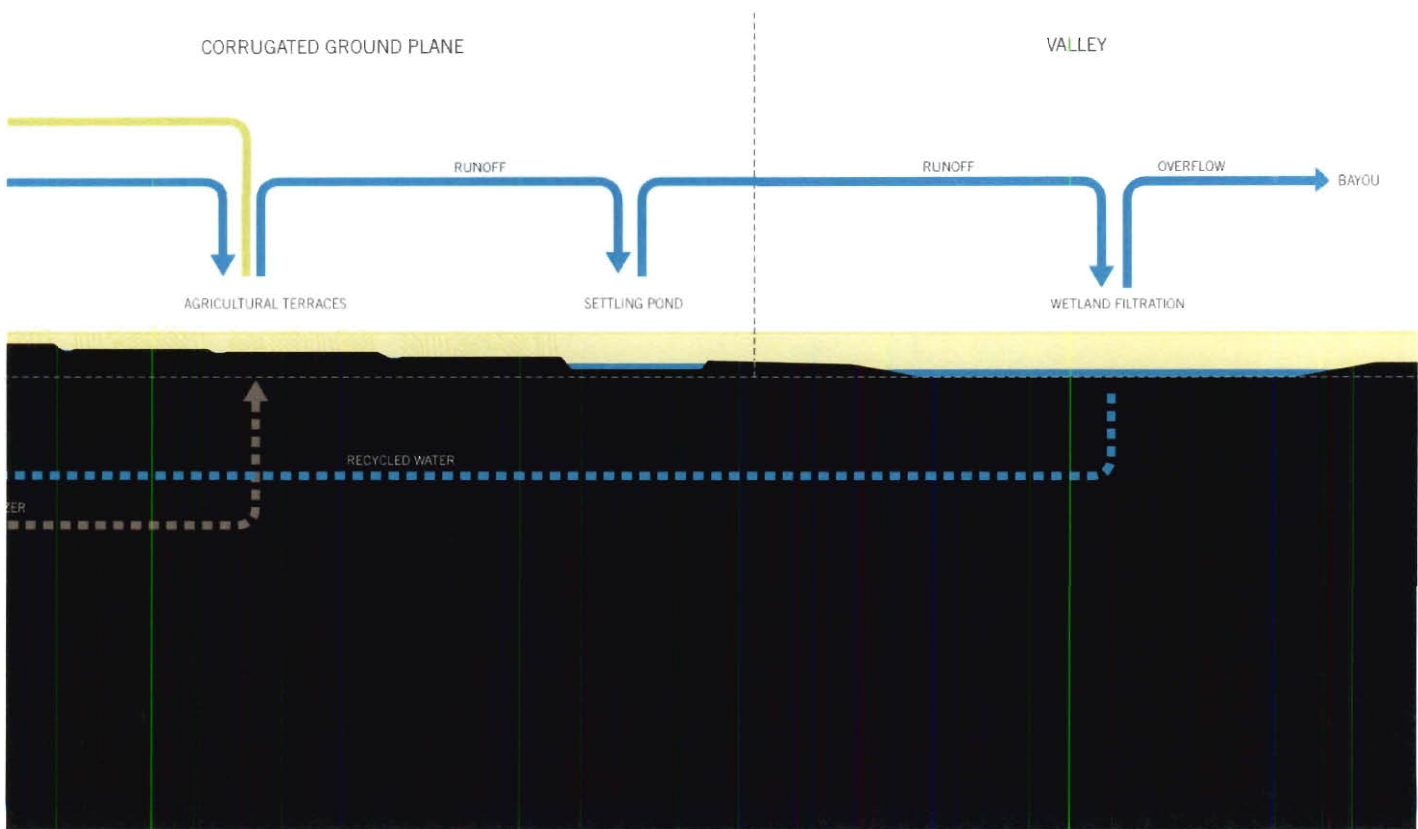
COLUMN STRUCTURE _____

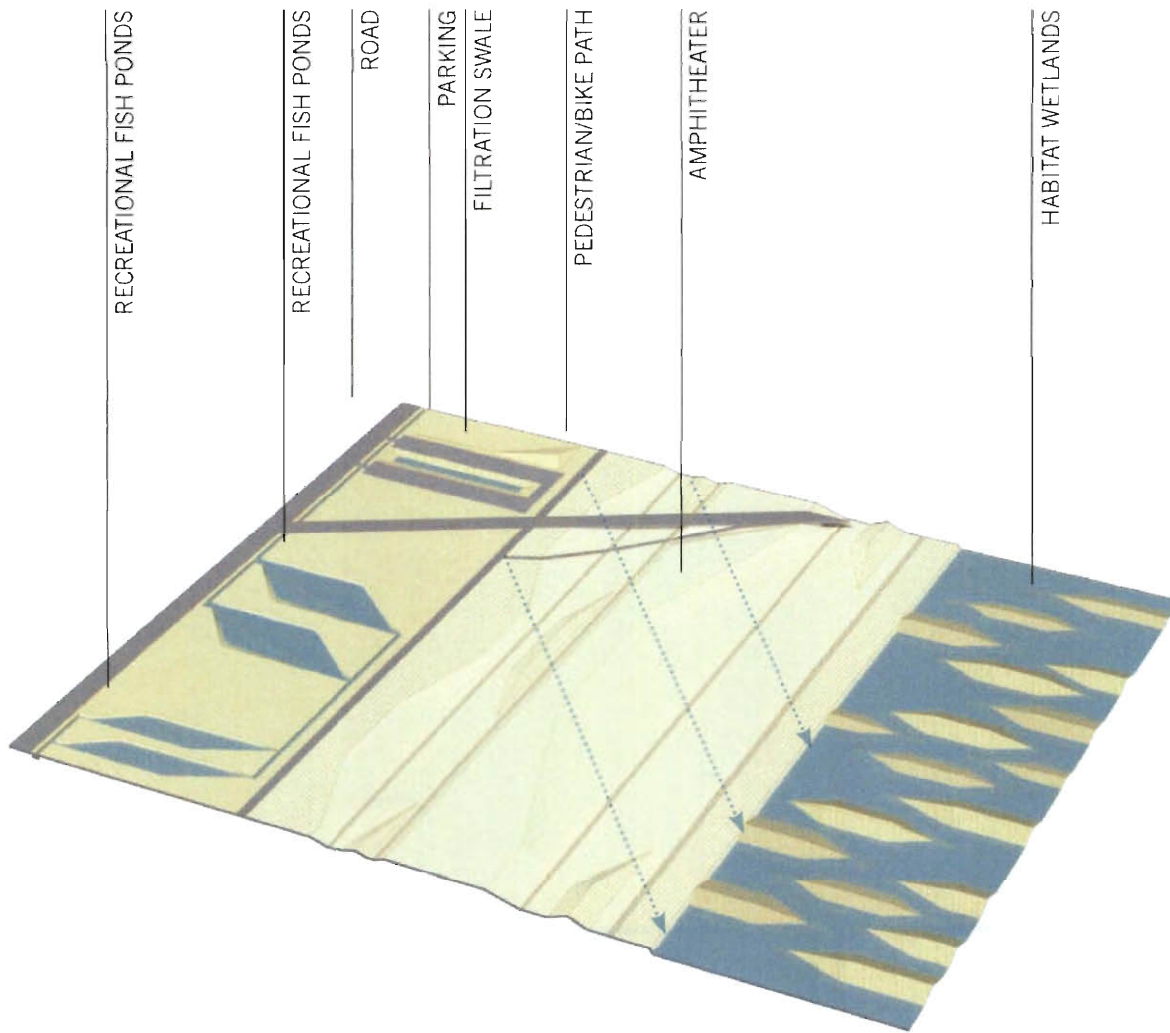
COLUMN STRUCTURE (PEDESTRIAN + BIKE) _____



SECTIONAL DIAGRAM

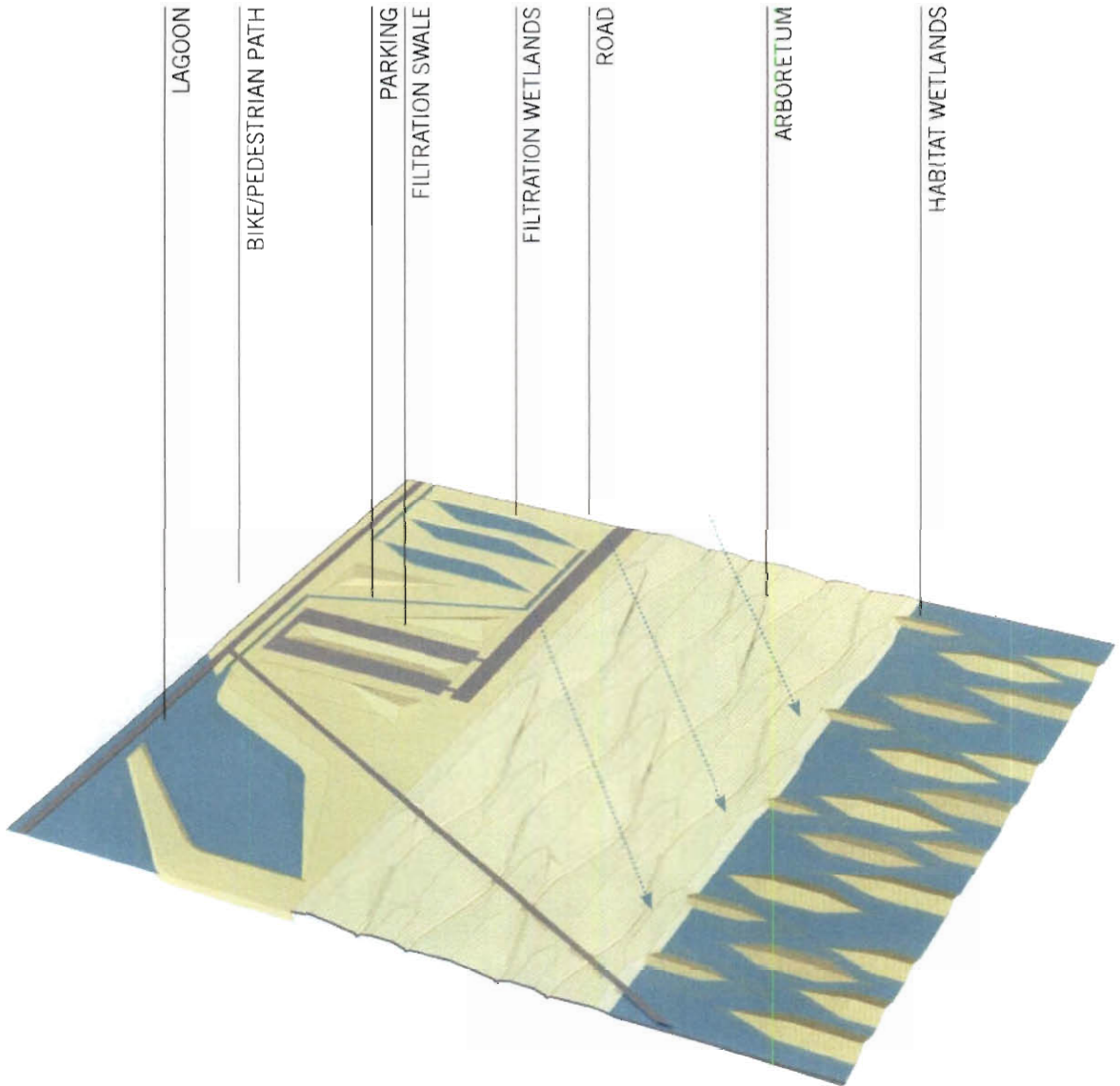




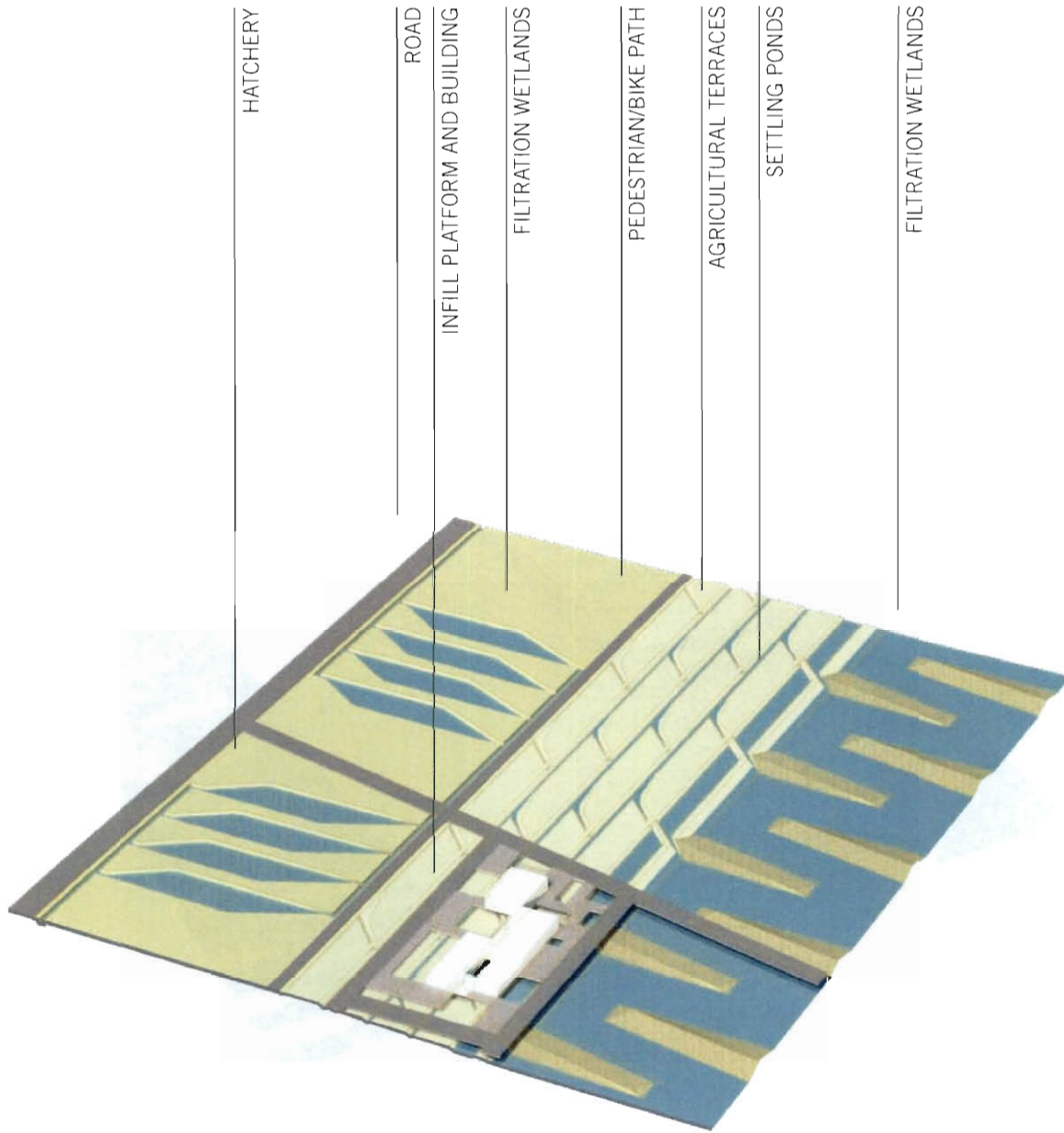


Amphitheater combination



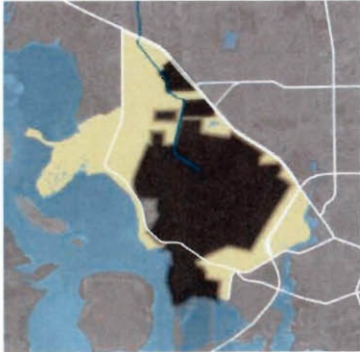


Arboretum combination



Agriculture combination

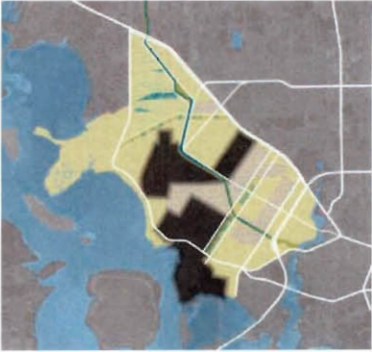
PLAN AND IMPLEMENTATION



2020



2035



2050

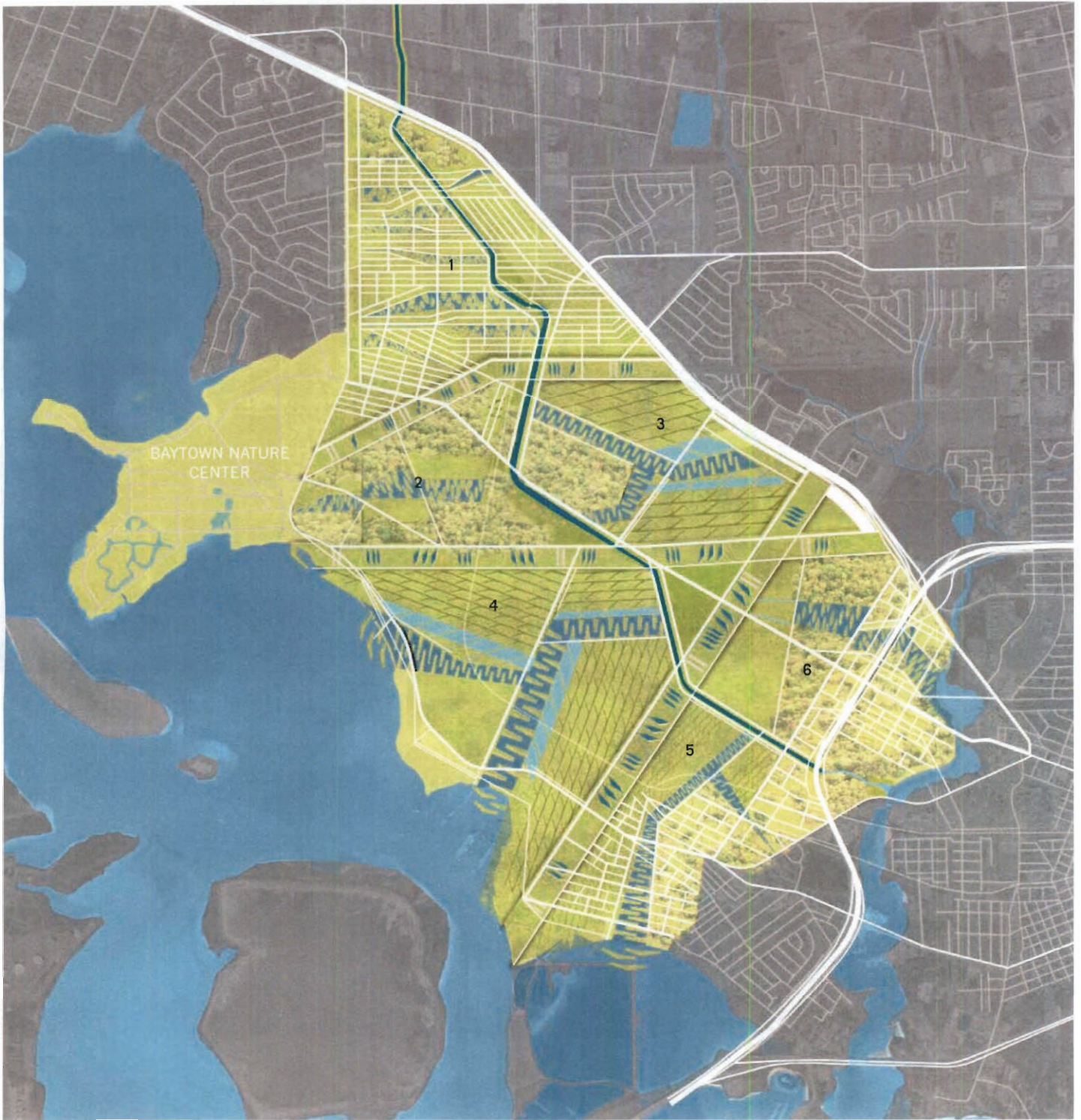


2065



2080

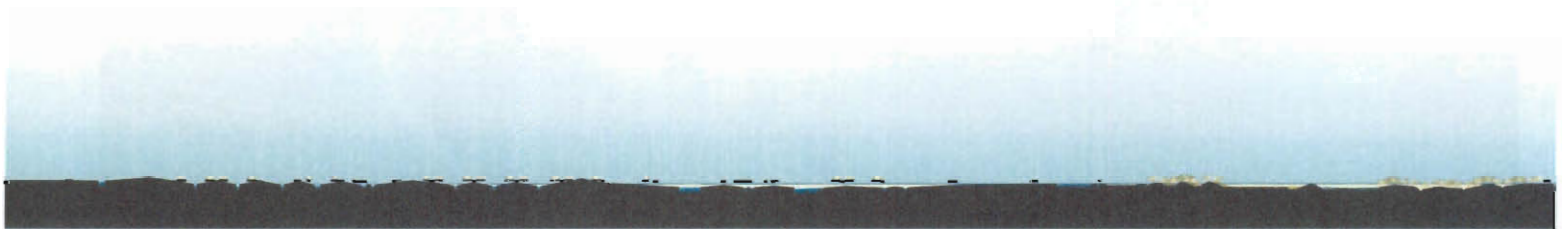
- 1 Residential
- 2 Recreation
- 3 Commercial
- 4 Coastal
- 5 Working
- 6 Cultural



2095



Rendered view, filtration wetlands and agricultural terraces



Section across site

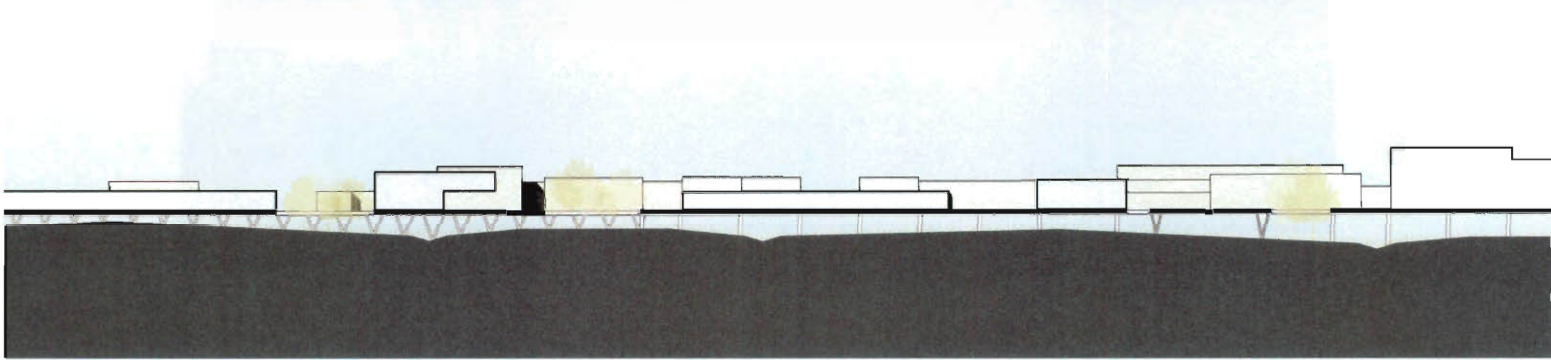
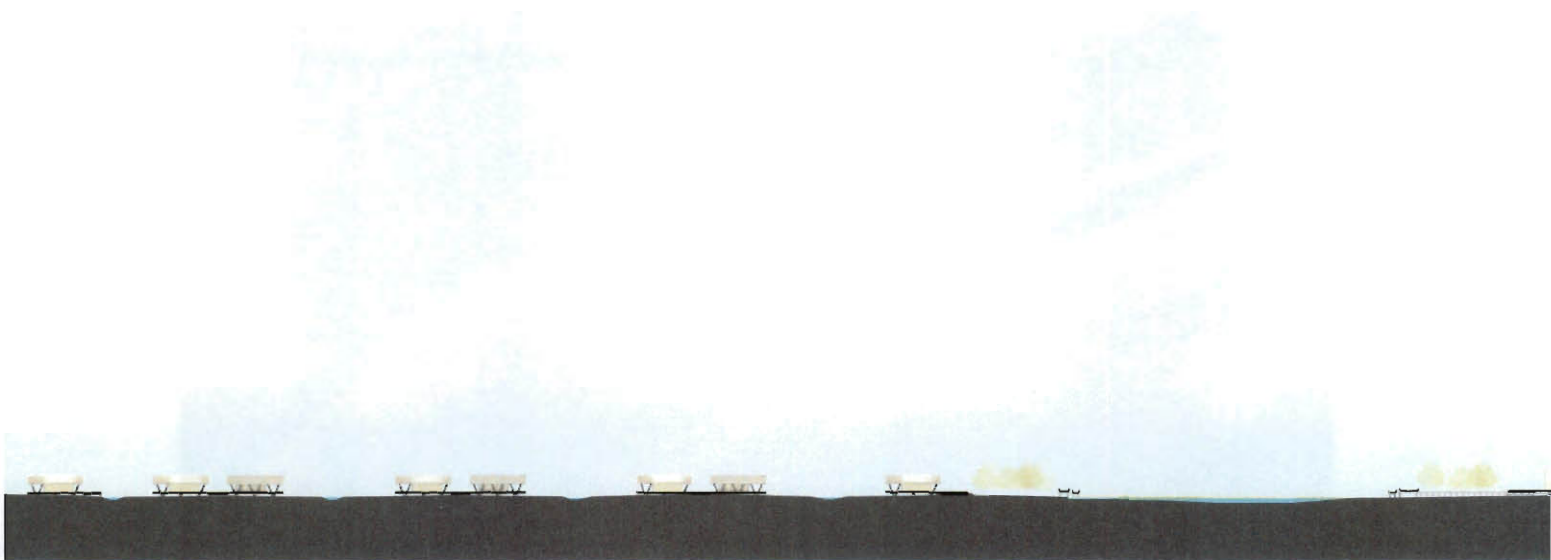


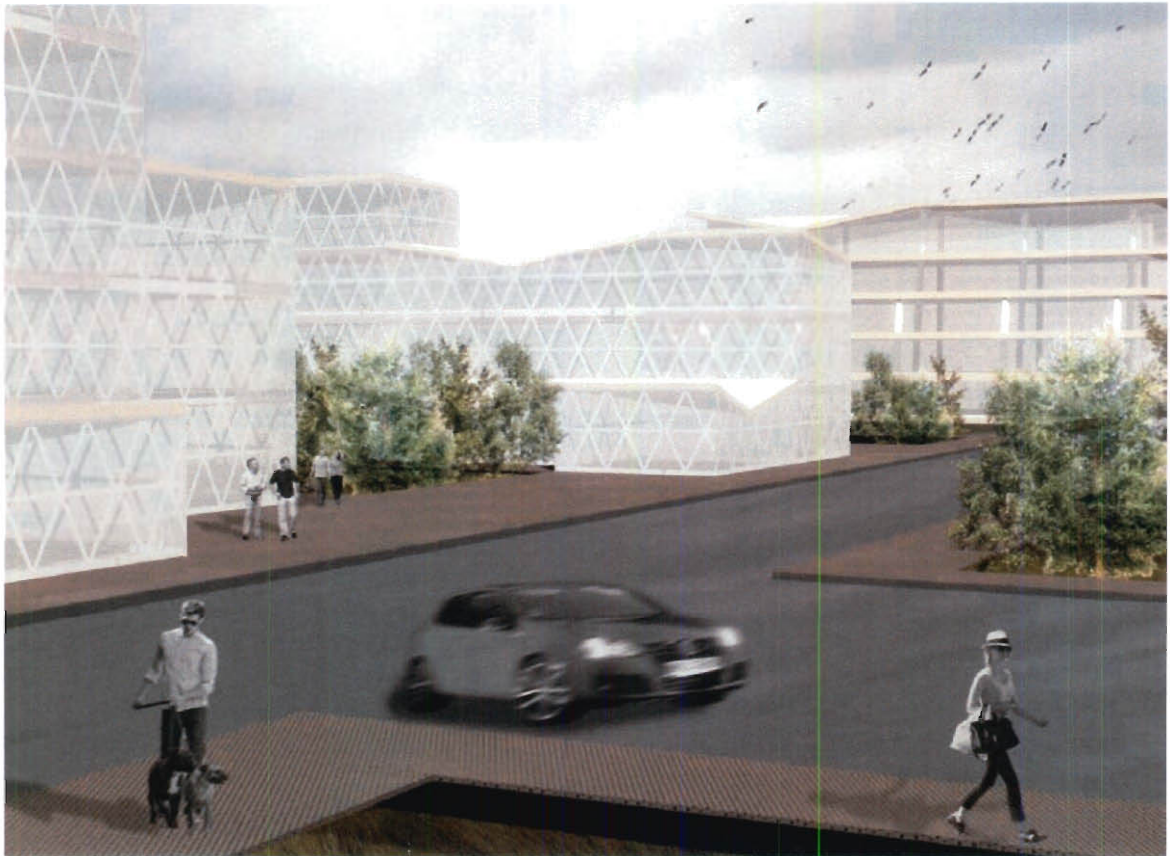


Rendered view, cultural zone



Rendered view, residential zone





Rendered view, working zone



Section, residential zone



Section, cultural zone

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