DESIGN OPEN SYSTEMS

How Can Middle Branch Harbor in Baltimore be Designed as an Open System?

Qian Deng, Master of Landscape Architecture, Thesis
School of Architecture, Planning and Landscape Architecture
College of Architecture, Design and Construction
Auburn University, 2012

ACKNOWLEDGMENTS

This book is a summary of my thesis research for the Master of Landscape Architecture at Auburn University. This one-year research is not only the first crowning of my achievements in the field of Landscape Architecture but also representa the beginning of my Landscape professional career.

This book is dedicated first and foremost to my parents, without their love and encouragement and support, I would not have been able to complete my master's degree education in United State and motivate myself to fulfill my dreams to be good landscape architect.

To my boyfriend Long Huang- Thank you for filling my life with love, joy and help. You are as much a part of this book as I am!

This project would have been impossible without the support of our thesis professor Rod Barnett. Thank you Rod for helping me to build my confidence and authority in the theory and practice of landscape architecture with your broad knowledge and insight and for your helping me to persist in building strong theoretical frame work through keeping deep into a higher level of research and design qualities.

I would also like to thank my other advisors, Jacqueline Margetts and David Hill for their never ending constructive criticism and helpful advice concerning both my project and life at large.

And last, I would thank all of my classmates and friends, for their encouragement, care and support which leaves me with precious memories of Auburn.

TABLE OF CONTENTS

INTRODUCTION

Coastlines are critical to the ongoing health and vitality of human settlements. Most people live in cities now, and many major cities worldwide are located in sensitive coastal environments. These metropolitan ecosystems are under increasing threat from urbanization: pollution, subdivision construction, and transit corridors, industrial and commercial development. Conversely, urban systems are threatened by natural forces such as hurricanes and flooding. As a result of these interactive processes, the edge condition between land and sea has become a critical factor in urban design. The big issue is how to create waterfront conditions that promote biodiversity and resilience at the same time as providing appropriate environments for the millions of people who live and work in these conditions.

[A THEORETICAL FRAMEWORK] WHAT IS AN OPEN SYSTEM?

Based on systems theory, an open system is a system that interfaces and interacts with its environment, by receiving inputs from and delivering outputs to the outside. Open systems possess permeable boundaries that permit interaction through which new information or ideas are readily absorbed, permitting the incorporation and diffusion of viable, new conditions. As Prigogine shows, open systems can transform themselves into structures of increased complexity. Dissipative structures receive their energy from outside. The jump to new forms of organization that characterize systems are the result of fluctuations amplified by positive feedback loops.

An urban landscape system is a complex system - interconnected networks of processes(or functions) and structures(or elements) whose behavior is generally described as nonlinear, unpredictable, dynamic, and adaptive, and is characterized by regular emergence of new phenomena and the ability to self- organize. Such a system has the capacity for resilience and long- term adaptation to change, and thus for ecological, cultural, and economic viability. For example, following a sudden disturbance, an ecosystem reorganizes to "renew" itself and regenerate to a similar or perhaps different state-- one that may be more or less desirable to the humans that inhabit it. Immediately after a disturbance, biodiversity at many scales is critical: the abundance, distribution, and diversity of an ecosystem's structures(e.g., species) and functions(nutrient cycling) determine its ability to regenerate and reorganize itself, and influence its future pathway.

In landscape architecture, open systems theory was developed into new strategies applied in urban development from the 1990s. Landscape architecture practitioners like Allen, Corner and Koolhaas developed urban landscape design strategies that took account of the unpredictable and open-ended character of urban systems, and used it to generate design proposals that were flexible and adaptive.

PROJECT ABSTRACT

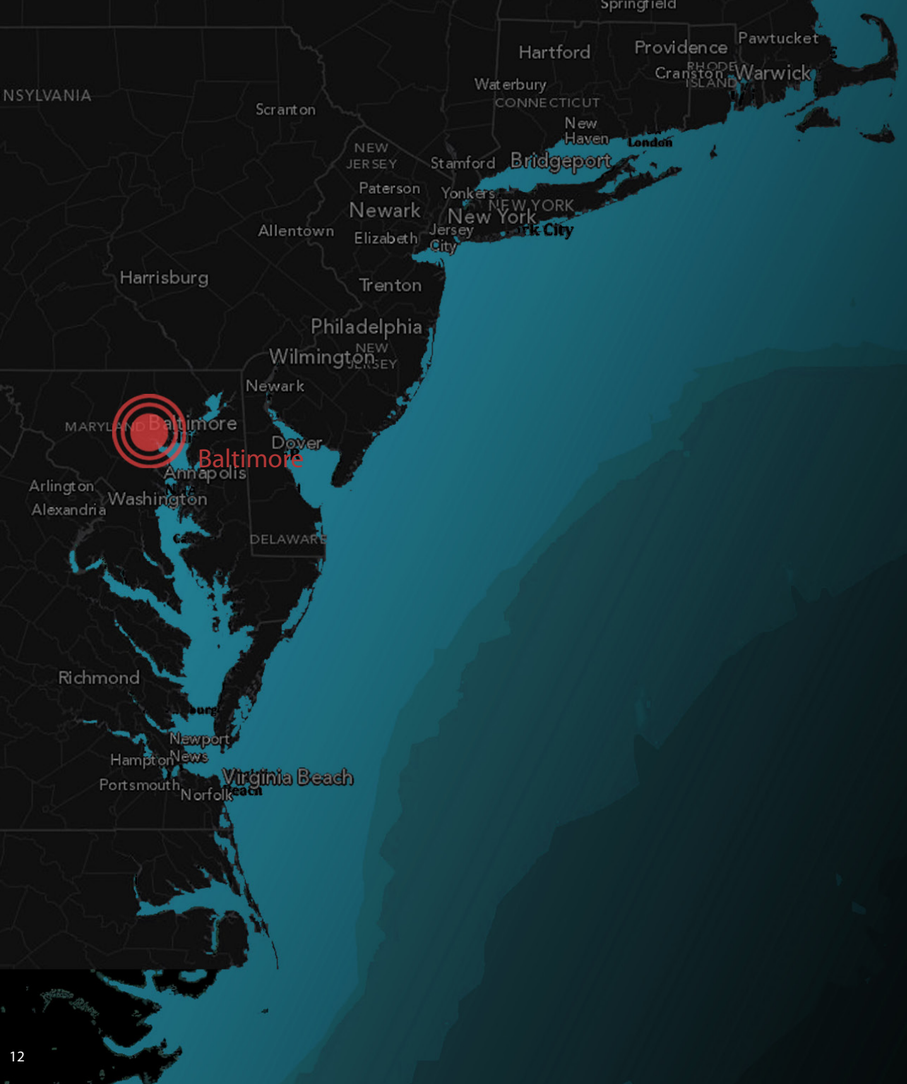
This thesis researches the potential of an open systems approach to the design of urban coastlines. Open systems are created and informed by the matter- energy that continually flows through them. A crucial feature is their ability to deal with disturbance. Open systems do not just recover well from disturbance (hurricane, pollution, commercial development)but actually integrate it and evolve to more complex levels of operations. An important component is the feedback mechanism that enables new conditions to influence the material and organization structures of the system, thus entrenching resilience.

The thesis investigated a series of complex coastal landscapes in Baltimore, MD by design an open system of landscape structures and process through a chain of wetlands, estuaries, river deltas and pebble beaches all of which are either developed or semi- developed. These new landscapes are then tested against a range of possible disturbances (flooding, economic decline and inappropriate urban development) to ascertain whether they will exhibit the degree of resilience- openness- necessary to reorganize into novel terrains that increase the potential for human and nonhuman inhabitation. The success of the designed landscapes therefore lies in their ability to exhibit both environmental and social adaptability through the development of new feature by means of bottom- up causation.

This research shows that resilience to urban and natural disturbance can be designed into coastal landscape for the betterment of all species and the habitats that support them.

CHAPTER 1

MAPPING CONTEXT



1.1 Location of Baltimore, MD

BALTIMORE CITY

Baltimore's fortuitous location on the northern Chesapeake Bay has been at the heart of its social and economic development. Water-related industry quickly developed around Baltimore harbor, and when tracks for the nation's first railroad were laid there in 1829, the thriving port city increased both its accessibility to other cities and its attractiveness to immigrants and investors.

Through careful city planning and cooperation between public and private investors, Baltimore has entered the ranks of America's "comeback cities" in recent years. Its downtown business district has been transformed into a mecca of sparkling new hotels, retail centers, and office buildings. But Baltimore has not wholly exchanged its traditional working-class image for high-technology polish. Many of its urban renewal programs focus on the preservation or renovation of historical buildings and neighborhoods amidst new construction. For example, its wildly popular Oriole Park at Camden Yards offers state-of-the-art amenities in a turn-of-the-century style baseball stadium. Nicknamed the "charmed city," Baltimore has become a top tourist destination. (City-Data. Com)

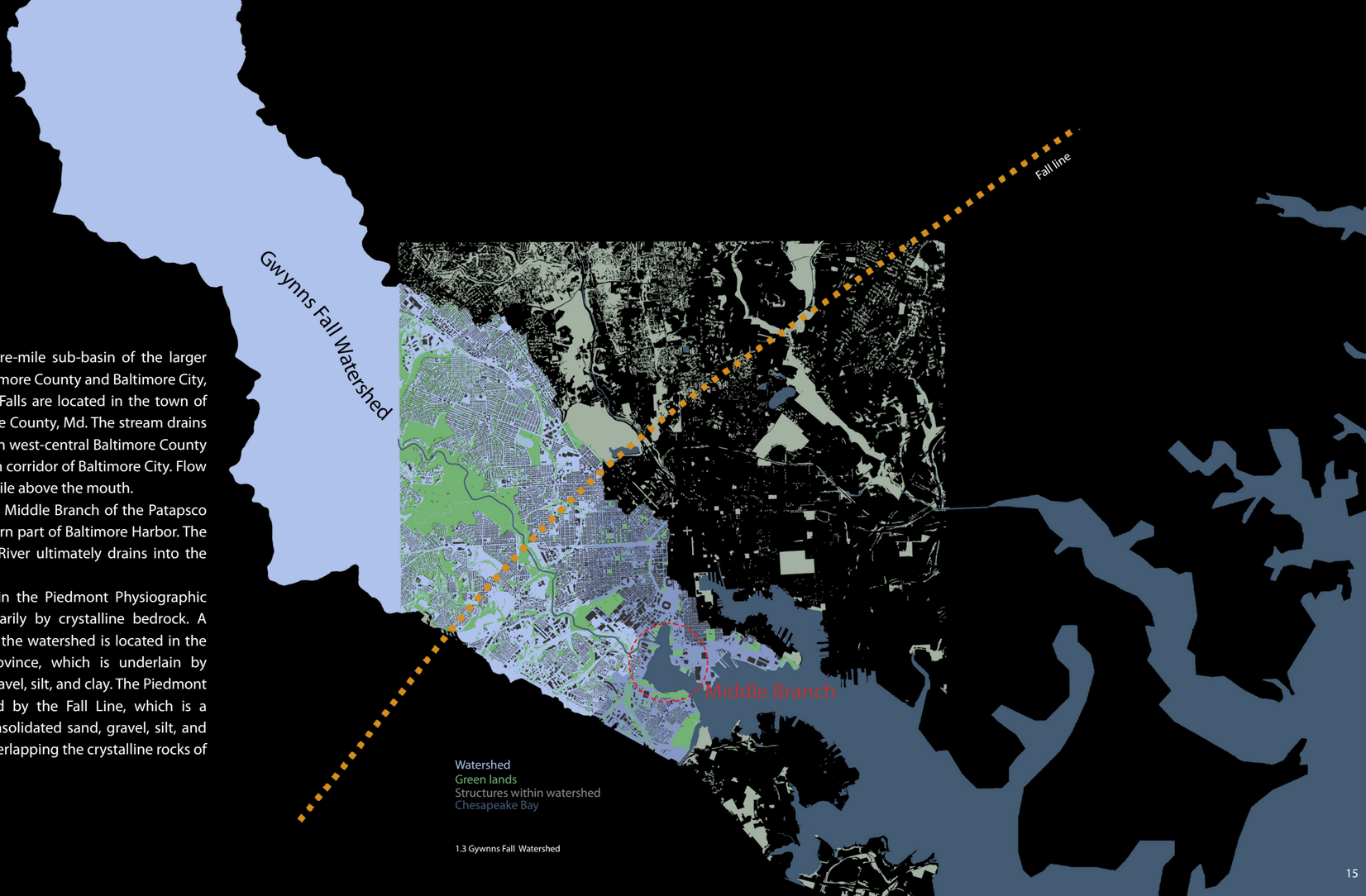
Hydrologic Characteristics

Gwynns Falls drains a 66.5-square-mile sub-basin of the larger Patapsco River watershed in Baltimore County and Baltimore City, Md. The headwaters of Gwynns Falls are located in the town of Glyndon in west-central Baltimore County, Md. The stream drains several residential communities in west-central Baltimore County before entering the southwestern corridor of Baltimore City. Flow becomes tidal approximately 1 mile above the mouth.

Gwynns Falls discharges into the Middle Branch of the Patapsco River, which comprises the western part of Baltimore Harbor. The Middle Branch of the Patapsco River ultimately drains into the Chesapeake Bay.

The watershed lies mostly within the Piedmont Physiographic Province and is underlain primarily by crystalline bedrock. A small section near the mouth of the watershed is located in the Coastal Plain Physiographic Province, which is underlain by unconsolidated layers of sand, gravel, silt, and clay. The Piedmont and Coastal Plain are separated by the Fall Line, which is a transition zone where the unconsolidated sand, gravel, silt, and clay of the Coastal Plain begin overlapping the crystalline rocks of the Piedmont (Fenneman,1938).

1.2 Watershed map



1.3 Gywnns Fall Watershed

MIDDLE BRANCH HARBOR

The Middle Branch has always been Baltimore's lesser known harbor. Located less than one mile south of the Inner Harbor, it is completely different in character. Where the Inner Harbor is compact and deep water, the Middle Branch is expansive and shallow. The Inner Harbor consists of a bulkheaded shoreline, with an extensive brick promenade. People are physically separated from the water. The Middle Branch has limited bulkhead areas. The Inner Harbor has no identified habitat areas; the Middle Branch has some of the best waterfront habitat in the City. Masonville Cove, along the estuary's southern shore, is one of the best waterfowl staging areas in the State of Maryland. Both harbors suffer from water pollution, trash and the challenges of contaminants left over from former industrial developments.

The lands adjacent to the shores of the Middle Branch have gone through many changes, from farmland and resorts to heavy industry. The Middle Branch is now poised for a major rebirth. The majority of the older industrial uses occupying the shoreline are either vacant or are being relocated. The Middle Branch has not experienced this many opportunities for change since the 1800's.

From 1920's, industry takes over the waterfront and the Middle Branch is virtually forgotten as a recreational, environmental and ecological resource until the 1970's.

In the 1970's Baltimore began its first renaissance, establishing the now famous Inner Harbor out of abandoned shipping piers. At that time the City also began the revitalization of the Middle Branch, establishing the 1978 Middle Branch Park Plan.

Throughout the 1980's and 1990's, the remaining industrial and recreational uses had an awkward relationship, neither really complementing nor harming the other. The Carr Lowry Glass Company and BGE Gas processing facility partnered with the City to create vegetated buffers along their shoreline to improve habitat in the area, but the facilities could not allow public access to their waterfront because of safety and security concerns.(Baltimore City Department of Planning, 2007)

1.4 Study Area

1.5 Middle Branch Harbor Landuse Map

1.6 Existing Ecological Map

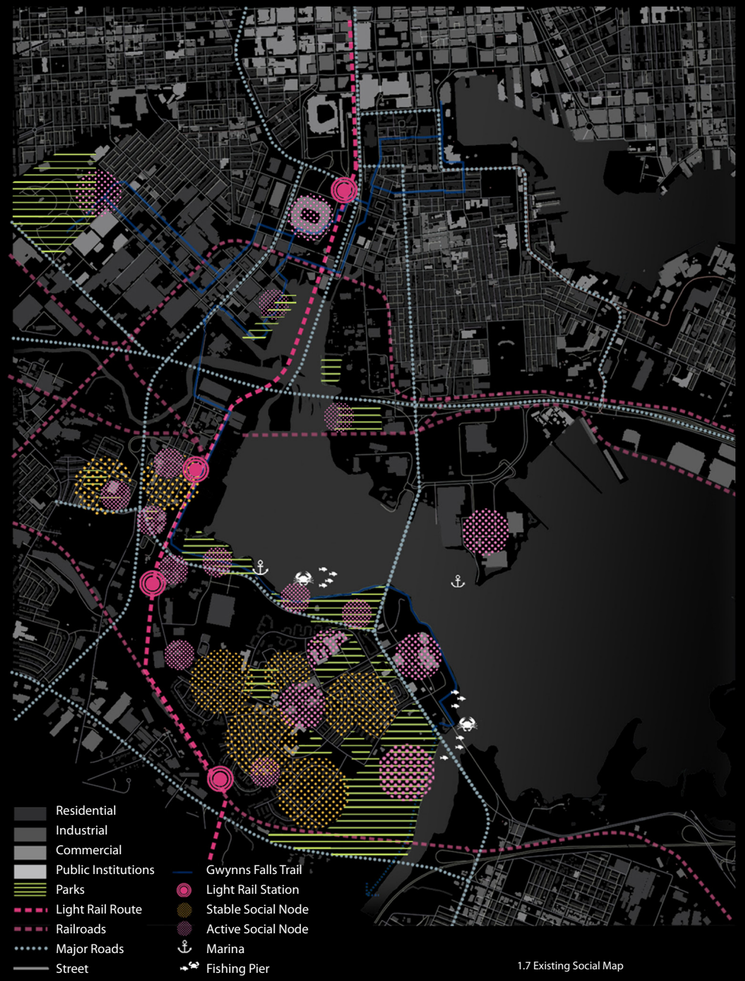
EXISTING ECOLOGICAL CONDITION

ECOLOGICAL VALUE The Middle Branch is affected by the entire Patapsco River watershed which covers portions of Baltimore City and County. The Middle Branch connects habitats in the Patapsco Valley State Park system, Gwynns Falls Leakin Park, Reedbird Park, Masonville Cove, Swann Park, and the Fort McHenry wetland marsh. On an international level, many bird and fish species use the Middle Branch as a rest stop and feeding area during their annual migrations.

HABITAT CONDITION

- Submerged Aquatic Vegetation(SAV) - Provide habitat for a wide variety of beneficial species. Bay grasses and bottom have harmed by habitat Nutrient and sediment runoff. The growth of SAV limited by the untreated sewage overflows and storm water run-off containing soap, motor oil, heavy metals, road salts and deicers, and animal wastes contaminate and cloud the water.
- Forest Cover - The removal of forest cover for development and the resulting fragmentation of forest has reduced habitat for migrating and native bird species.
- Wetland marsh– Areas of wetland marsh are located along the water edges of the western shore. There is also wetland marsh along the shoreline of the northern Middle Branch. Wetlands also exist at Fort McHenry and along Hanover Street and at Masonville Cove. Over 240 species have been counted here, these birds use the Middle Branch and the surrounding area to gather food, breed, nest and refuel on migrations.

CONTAMINANTS The Middle Branch and adjacent water bodies, including the Baltimore Harbor, are listed as degraded by the Maryland Department of the Environment. Historic industrial land uses and contaminated sediment washed in from watershed streams have contributed to the severe contaminant level. It is believed that much of the contamination has been encapsulated under cleaner sediments.



1.7 Existing Social Map

EXISTING SOCIAL CONDITION

COMMUNITIES The existing neighborhoods span the Middle Branch geographically, historically, and in their character. Along the west shore, Westport is situated behind the industrial waterfront, physically separated from the water. The community is divided in half by I-295, and is ringed by heavy industrial uses along its northwestern edge including Patapsco Excavating Company and Wimpey Minerals, U.S.A. These uses create dust and truck traffic.

The community of Cherry Hill sits behind the southern shoreline. Cherry Hill has seen the demolition or impending demolition of hundreds of public housing units, opening the door for new development in 1990s. Public schools, library and affordable houses are provided for for low- and moderate- income families.

TRANSPORTATION The Middle Branch and its communities are both served by transportation systems, and separated by them. There are three major highway systems and three major railroads traversing three sides of the estuary. Combined with local arterial roads, much of the waterfront is either physically or psychologically separated from the existing communities by these systems.

PARKS & ACTIVITES

- Sculling and Canoeing
- Fishing/Crabbing
- Walking/Biking
- Baseball/Softball/Football/Soccer
- Small parks and playgrounds

Gwynns Falls River

Migration flyway

Inner Harbor

Patapsco River Watershed

Highways

Carroll Camden industrial district

Migratory & native bird habitat

Fish spawning habitat

Industrial district

Swann Park

Industrial & commercial mixed district

Electricity distribution transformer

Westport neighborhood

Fish spawning habitat

Post industrial brownfields site

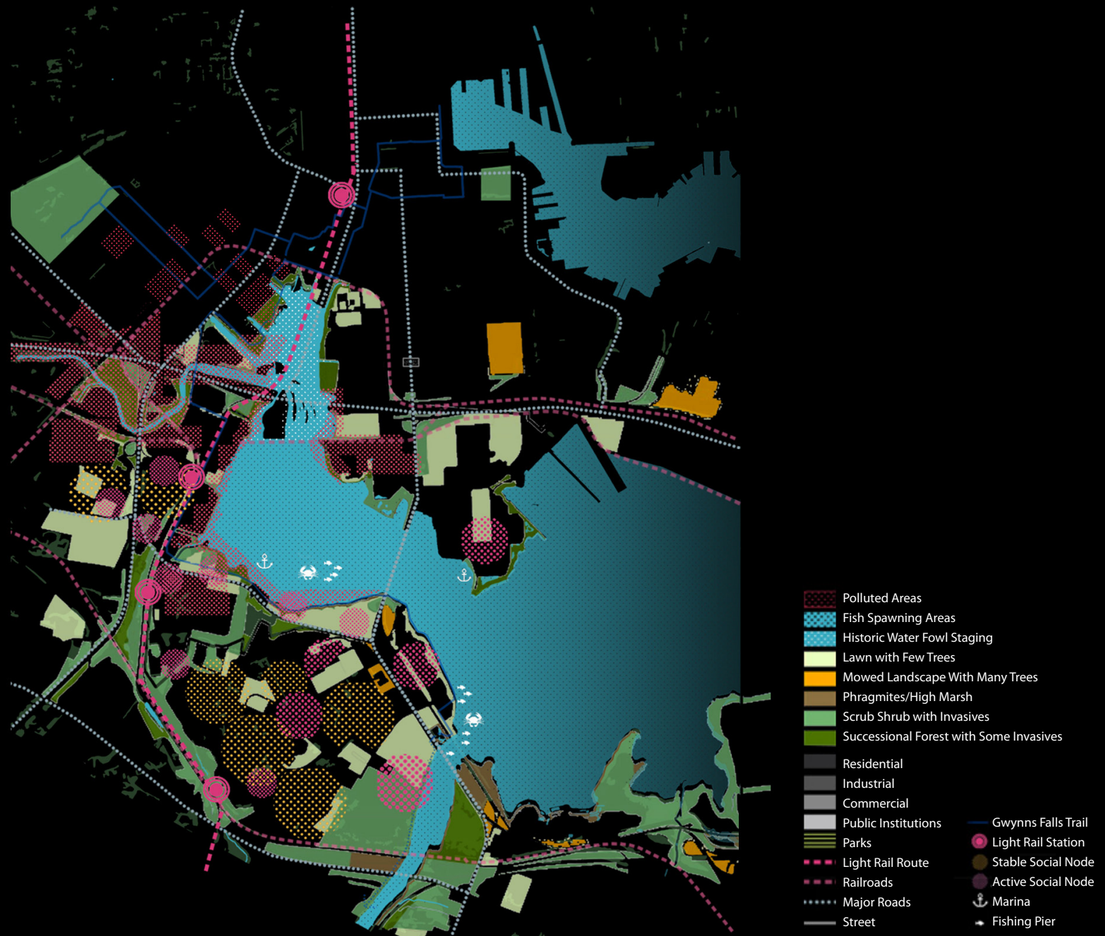
Migratory &native bird habitat

Middle Branch Park

Marina

Fishing piers

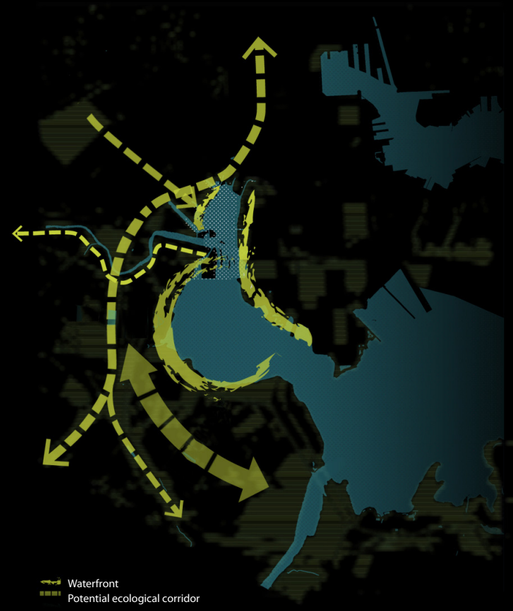
1.8 Existing Habitat



1.9 Existing Map

EXISTING ECOLOGICAL CONDITION +

EXISTING SOCIAL CONDITION



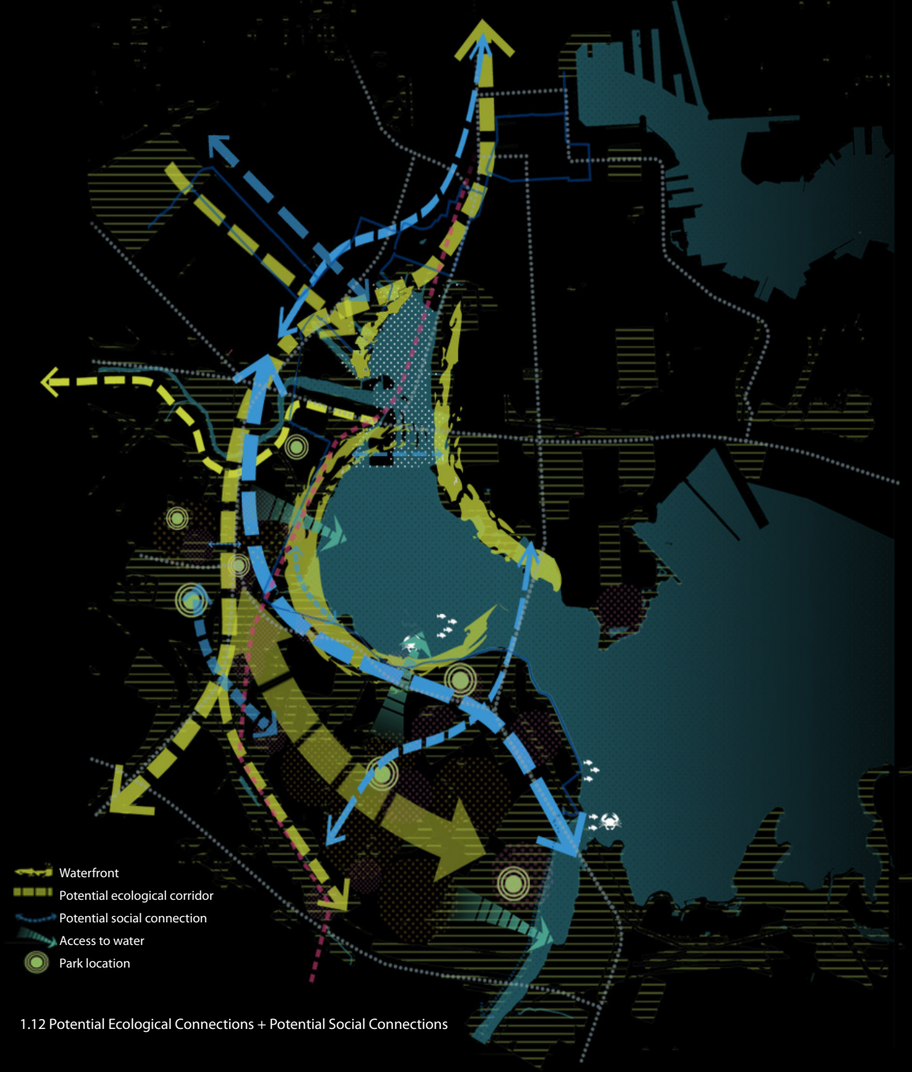
1.10 Potential Ecological Connections

1.11 Potential Social Connections

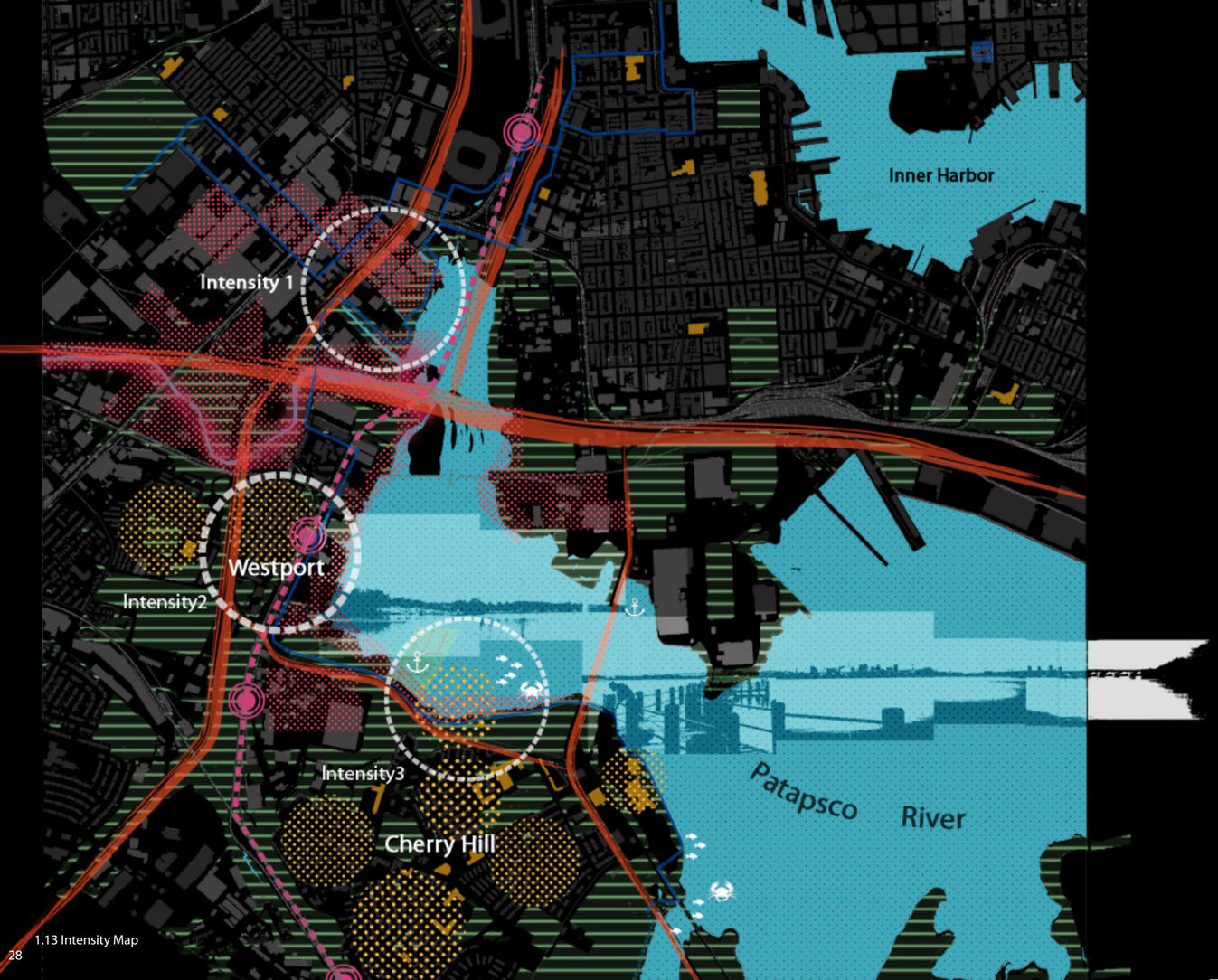
COMPONENTS AND CONNECTIONS

The open systems are complex systems in which components are connected by networks of feedback loops operating at different levels, different scales and different rhythms. (Barnett, 2010).

Based on the existing conditions, the connection maps define potential spatial ecological and social relationships that become part of urban landscape systems. These systems function together through a network of ecological corridors, social paths and destinations, enabling integrated feedback loops to operate in the urban systems, laying down a foundation for openness.



1.12 Potential Ecological Connections + Potential Social Connections



1.13 Intensity Map

INTENSITIES

Intensity 1
Estuary wetland
Floodplain
Brownfield
Industrial site
Contamination
Arterial transportation

Intensity 2
Demolished waterfront industrial
Contamination
Light rail station
Westport community
Regenerated ecology

Intensity 3
Historic Cherry Hill communities
Waterfront park
Public institutions
Contamination
Arterial transportation

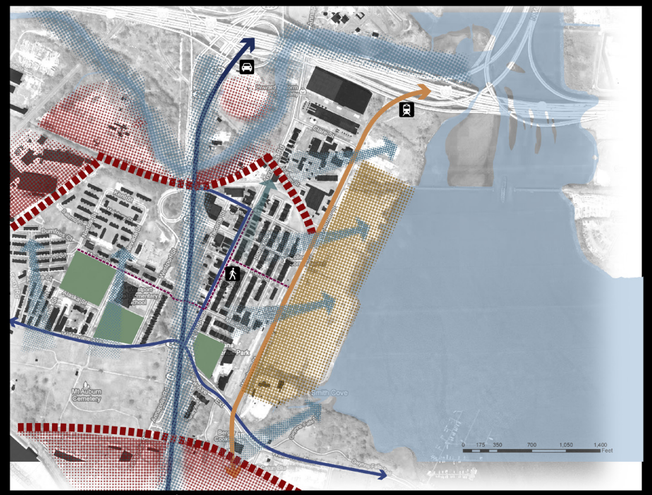
Intensities are several crucial locations around Middle Branch Harbor; they are the most complex intersections formed by overlapping different components that play important roles in defining the characters of Middle Branch Harbor. These components come together to create a sensitive and dynamic urban system. An intensity may develop in a situation of dilemma, such as regenerated habitat on an abandoned contaminant site or on an industrial sites built within a floodplain.

Intensities become the potential investigation sites would be explored more deeply and designed more specifically instead of investigating the whole harbor as one site, while the overlapped components performed as opportunities or barriers in the future design.

CHAPTER 2

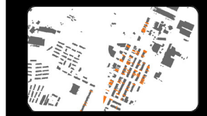
DESIGN INVESTIGATION

A. PERFORATED MEMBRANE PLATFORM AT WESTPORT



A.1 Westport Existing Condition

Contaminants resources



Degraded community

Intensity 2- WESTPORT
Demolished waterfront industrial
Contamination
Light rail station
Westport community
Regenerated ecology

Point Source Pollutions from operating or former industries

Nonpoint Source Pollutions from air and runoff

New habitats regenerated on the post industrial site

Because of the economic development, the industrial and transportation infrastructure occupied the waterfornt. At this design investigation, the light rail road platform was chosen as the site. The elevated railroad forms a blockage for ecological migration, social circulation and community safety. It is a common issue happens in the most waterfront city. The challenge is how to create connections by breaking this blockage to enhance access to waterfront and encourage ecological migration.

Site

Explore " OPENNESS"

This is an experimental design which explores the possibility of connecting the degraded waterfront open space with the existing urban fabric by creating a landscape infrastructure. By making this connection, the people of Westport will take advantage of the new opportunities it provides.

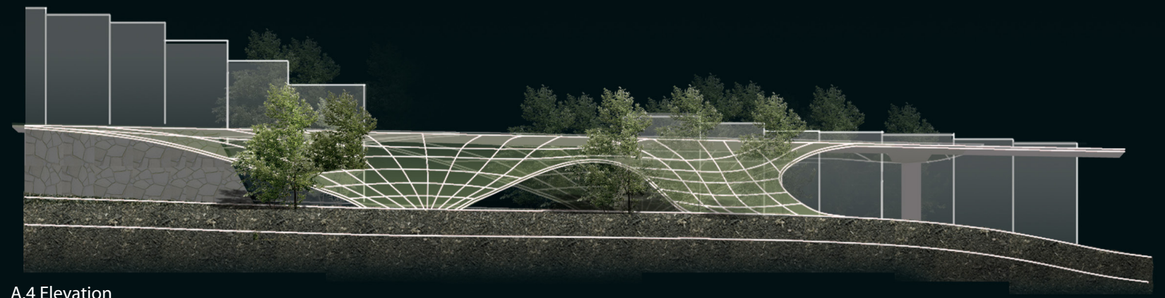
N

0 15 30 60 90 120 Feet

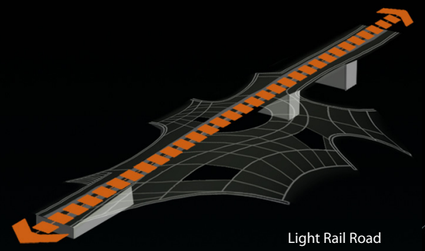
Conceptual Plan

A.2 Membrane Platform Plan

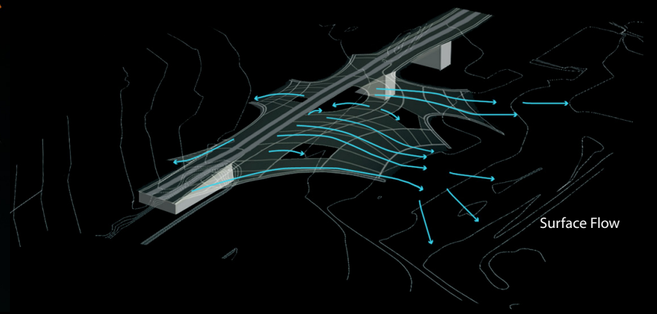
A.3 Conceptual Perforated Membrane



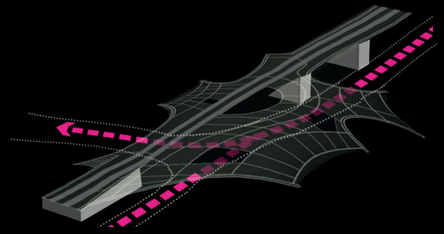
A.4 Elevation



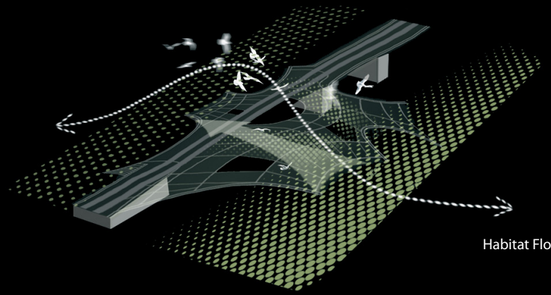
Light Rail Road



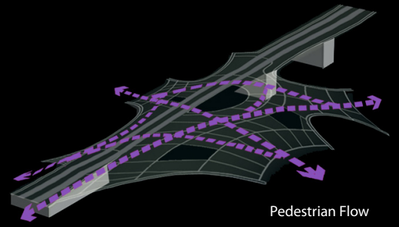
Surface Flow



Vehicle Flow



Habitat Flow

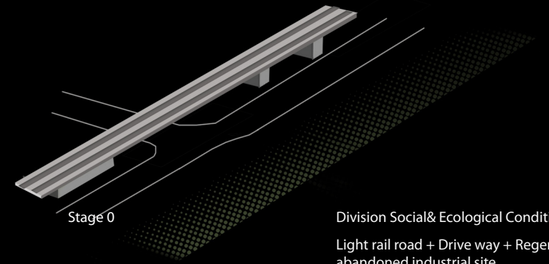


Pedestrian Flow

ESTABLISH POTENTIAL RELATIONSHIP + ENCOURAGE FUTURE SUCCESSION

The membrane platform generates the potential relationships, enhances human activity spaces and wild life habitat across this functional landscape.

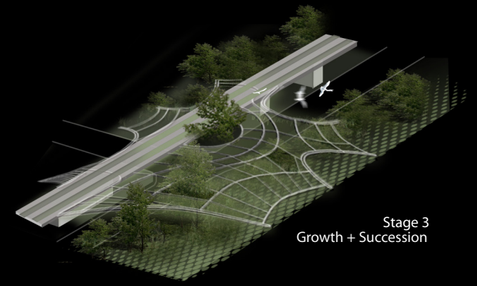
A.5 Potential Relationship Diagram



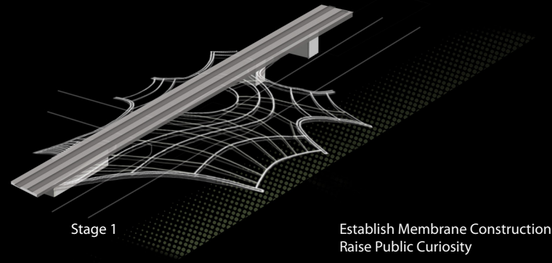
Stage 0

Division Social& Ecological Condition

Light rail road + Drive way + Regenerated habitats on abandoned industrial site

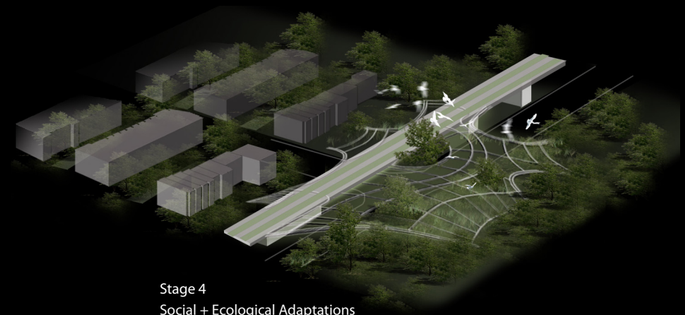


Stage 3
Growth + Succession

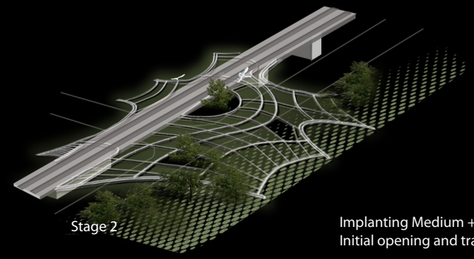


Stage 1

Establish Membrane Construction
Raise Public Curiosity

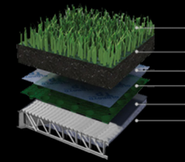


Stage 4
Social + Ecological Adaptations
Habitat and wildlife evolution
New social network



Stage 2

Implanting Medium + Seeding
Initial opening and transition

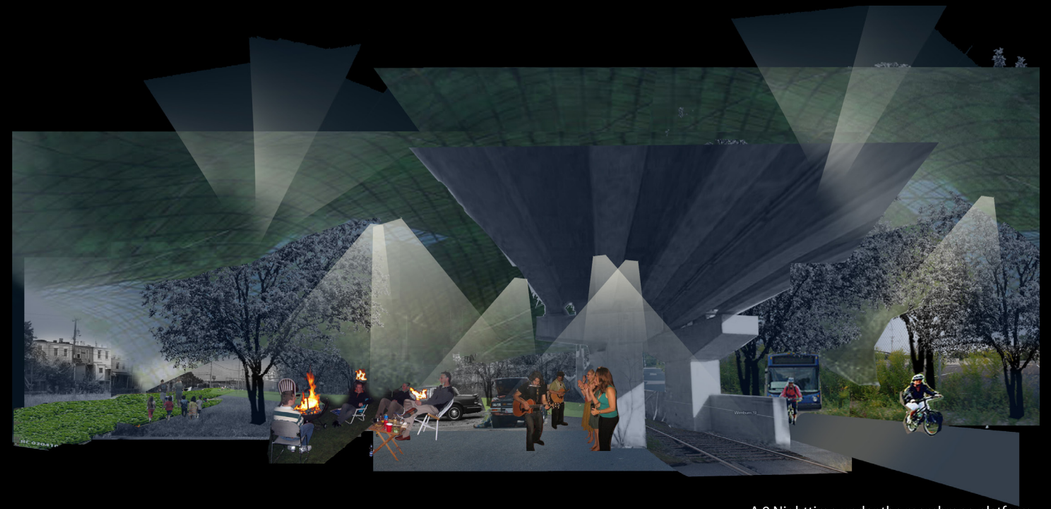


Structure detail of membrane

A.6 Development Stages

A.7 Membrane Ideogram

A.8 Daytime under the membrane platform



A.9 Nighttime under the membrane platform

This functional landscape infrastructure, a membrane platform, achieves the goal of creating new access to the waterfront; the transportation corridors are no longer barriers in the effort of bringing people back to water. Furthermore, the membrane platform established an innovative ecological path to encourage the migration of regenerated habitat from the abandoned waterfront site to the neighborhood, and also created potential public spaces for enhancing multiple human activities.

This a design investigation is based on the identification of a series potential relationship within the existing urban system. The membrane platform removes blockages by creating connections. Connectivity is the primary goal in any open system design. Socially and ecologically rich, the membrane platform performed a highly open scenario, involving ecological and social flows continuously interacting with a constructed urban system. There are two open processes embedded through time, ecological succession and human contribution and participation. These two processes are connected by a feedback loop. Feedback is a characteristic of any system in which the result, affects the input of the system, thus altering its operation.(Barnett, 2007). A successful ecological succession and migration would act as positive feedback to catalyze neighborhood ecological enrichment and public attraction, while too much human activity or lack of maintenance would be a negative factor to constrain ecological adaptation.

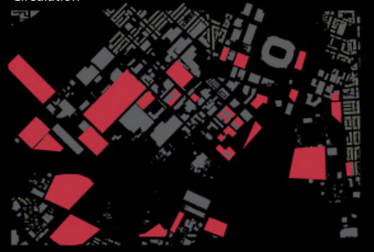
B. CARROLL CAMDEN INDUSTRIAL DISTRICT REVITALIZATION

Site

Circulation

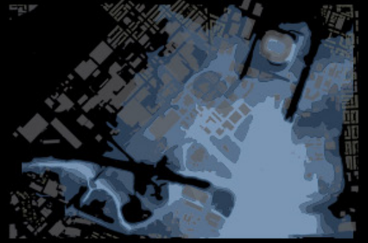
Landmarks

Landuse



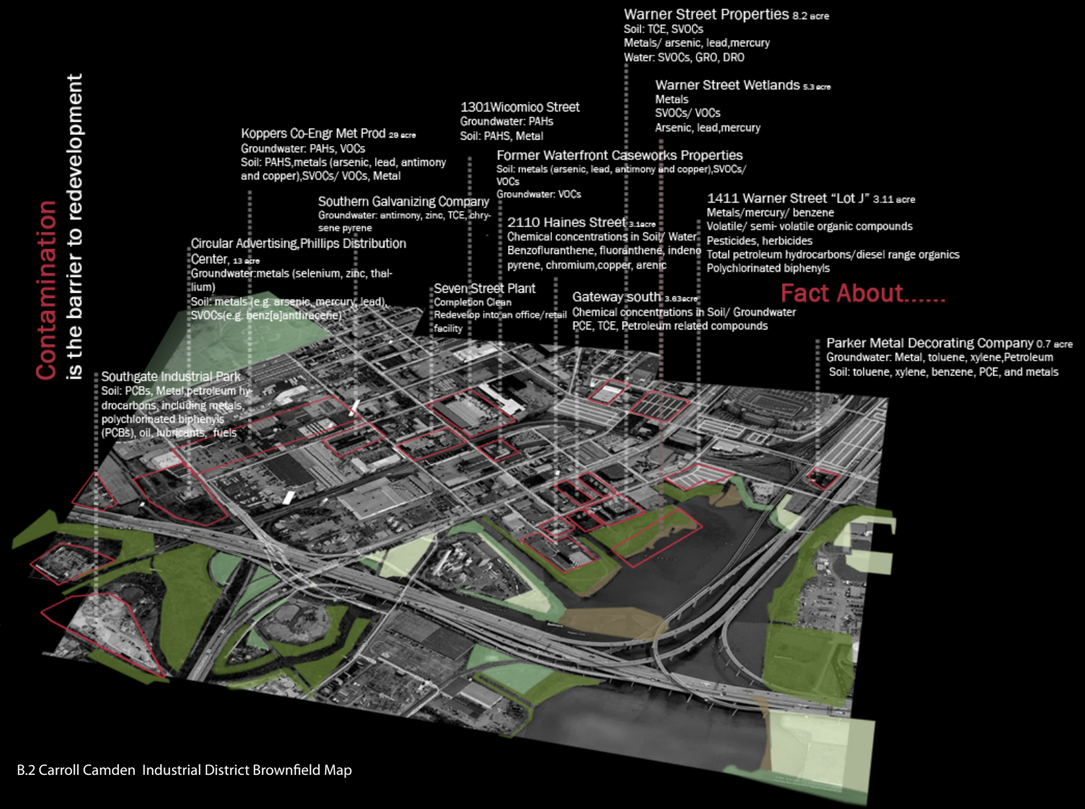
Brownfield sites

Vegetation



Stormsurge

B.1 Carroll Camden Context Map



B.2 Carroll Camden Industrial District Brownfield Map

Brownfield is an "abandoned, idled, or under-used industrial and commercial facility[y] where expansion or redevelopment is complicated by real or perceived environmental contamination" (U.S. Environment Protection Agency 1997). Therefore, by definition, contamination is the barrier to redevelopment.

The study "The Legacy of Contamination and the Redevelopment of Inner-City Industrial Districts" (Marie Howland,2002), indicates that after the mid 1990s, contaminated parcels are selling, and the market has adjusted to contamination by lowering sales prices through tracking all sales, the selling price, length of time on the market and presence of contamination in one industrial area of Southwest Baltimore. At the same time, some ignored problems of older industrial areas also impediment to central city redevelopment, such as outdated parcel sizes, inadequate roads for modern truck access, and aging infrastructure, incompatible land uses, and unrealistic assumptions about the land's possibilities.

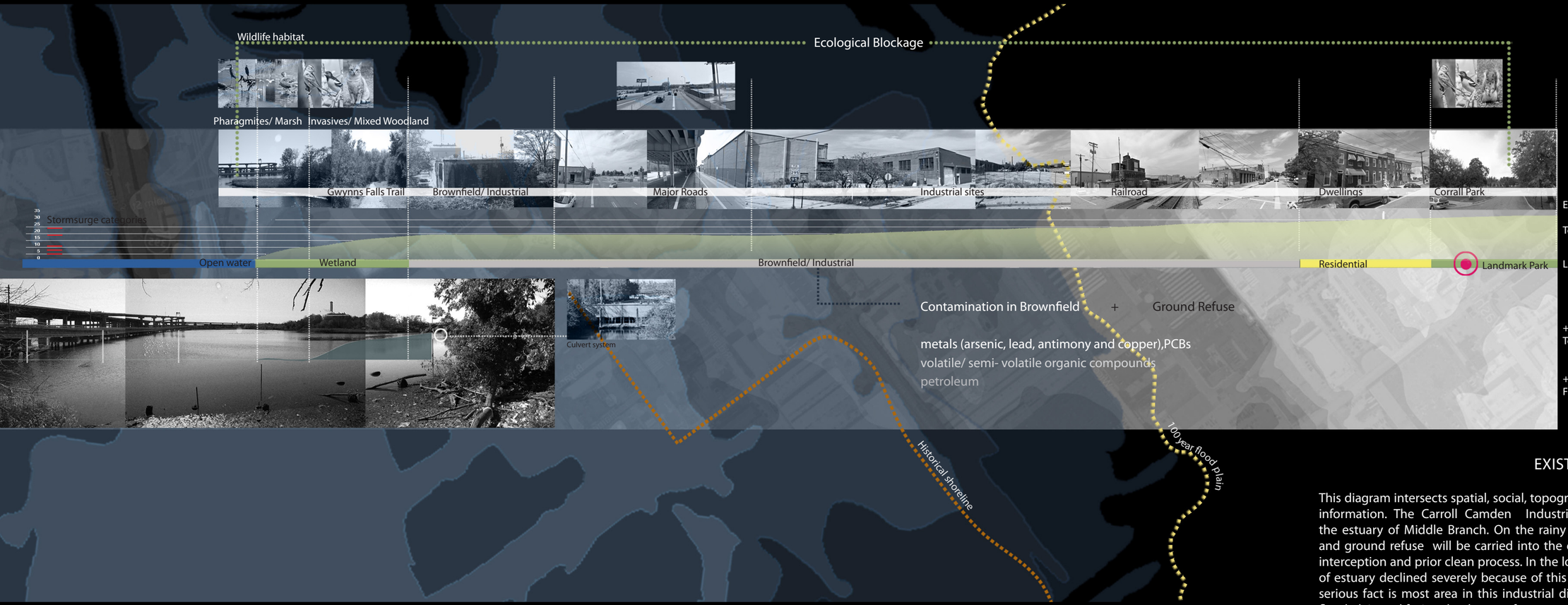
So the brownfields are viewed as a significant barrier to the redevelopment of urban industrial parcels. The remediation work would necessarily take account into the further design.

Brownfiled Remediation Criteria

Proximity to water body +Contamination level
Proximity to residential +Contamination level
Proximity to public transportation +Contamination level

Such as:
Prevent hazard to human health and wildlife health:
Proximity to water body+ high toxic
Proximity to residential + high toxic

Provide education/ display opportunities
Proximity to residential + low toxic
Proximity to transportation + low toxic



EXISTING CONDITION

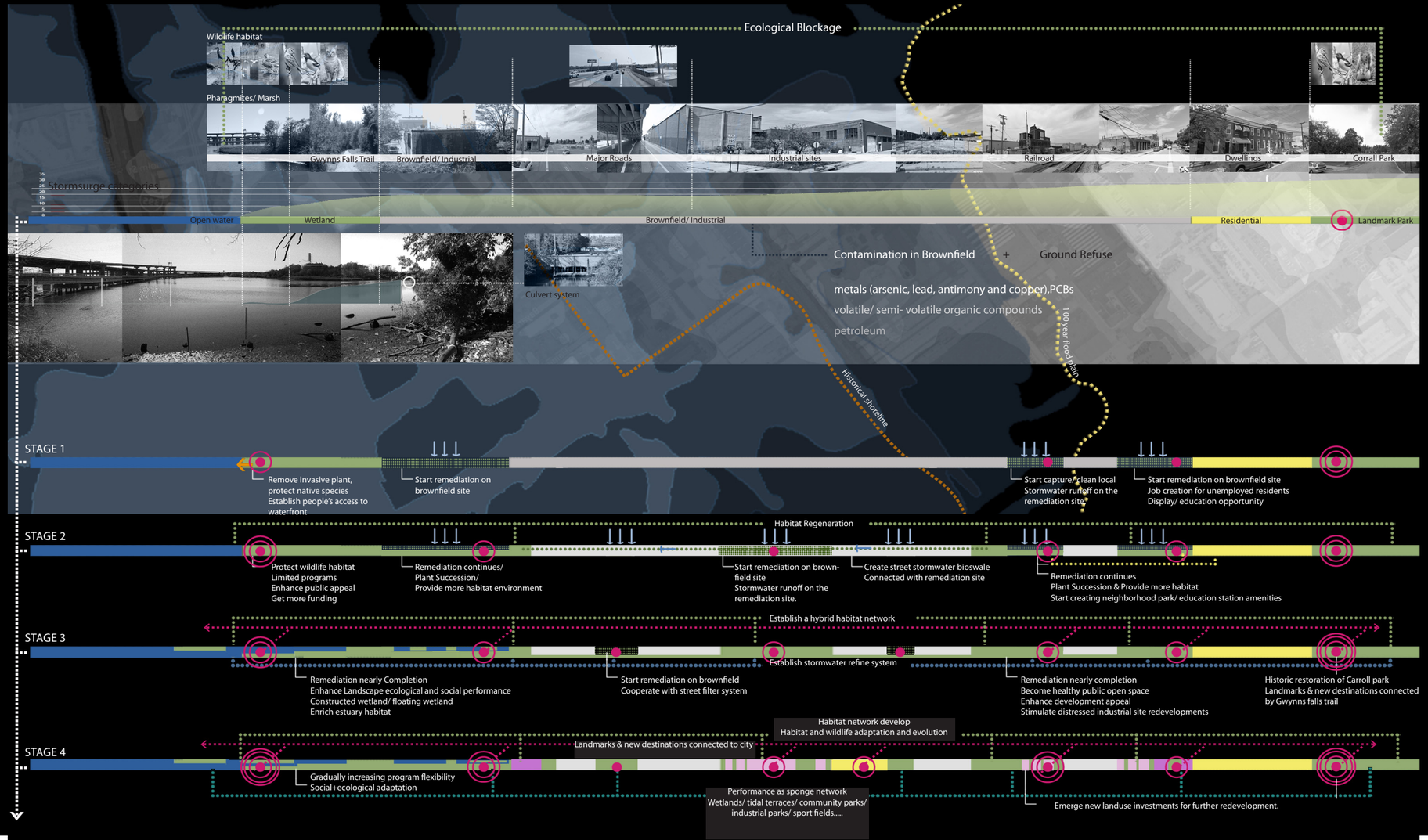
This diagram intersects spatial, social, topographical and landuse information. The Carroll Camden Industrial District adjacent the estuary of Middle Branch. On the rainy days, contaminants and ground refuse will be carried into the estuary without any interception and prior clean process. In the long term, the health of estuary declined severely because of this situation. The more serious fact is most area in this industrial district is with in 100 flood plain and facing the threats of stormsurge.

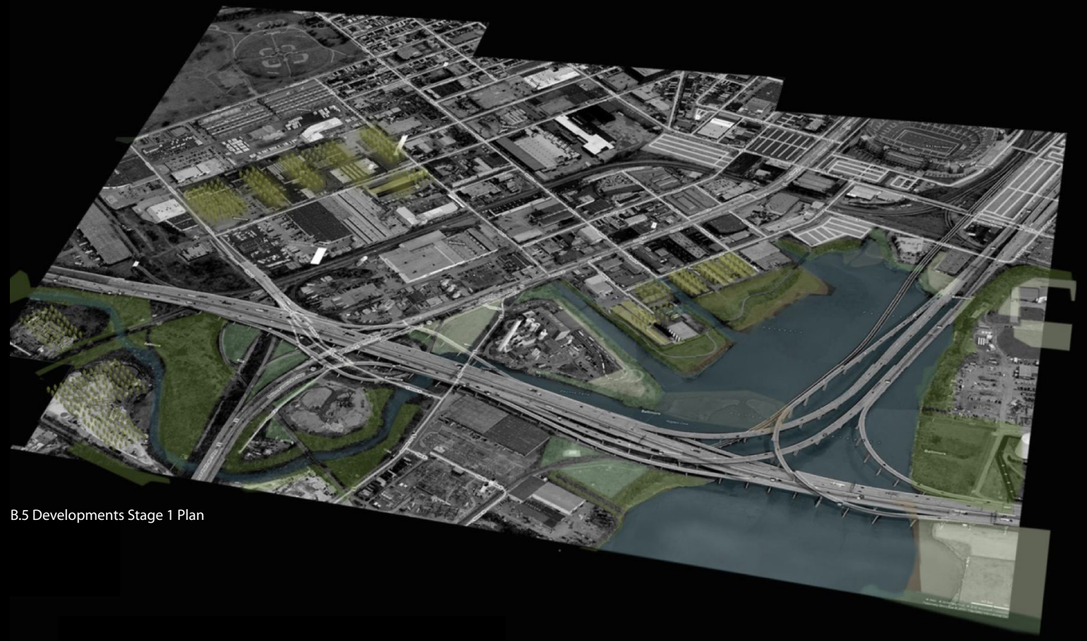
B.3 Existing Condition Investigation

DESIGN PROPOSAL:
SECTIONAL STRATEGY OF REMEDIATION BY STAGES

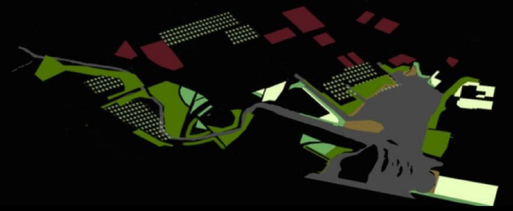
This strategic framework allows Baltimore to establish a remediation mechanism to fix the health of both the ecology and economy by stages. A phytoremediation and hydrological network applied to the Middle Branch estuary can remediate and regenerate brownfields, provide a new logic for stormwater, filter urban surface flow and contribute to the city's effort to improve the water quality of the polluted Middle Branch Harbor. Over time, the system, can extend into surrounding neighborhoods and connect to the regional ecology, thus broader social, cultural, and ecological viability and invent new hybrids.

B.4 Design Proposal Diagram

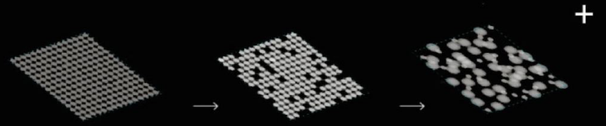




B.5 Developments Stage 1 Plan



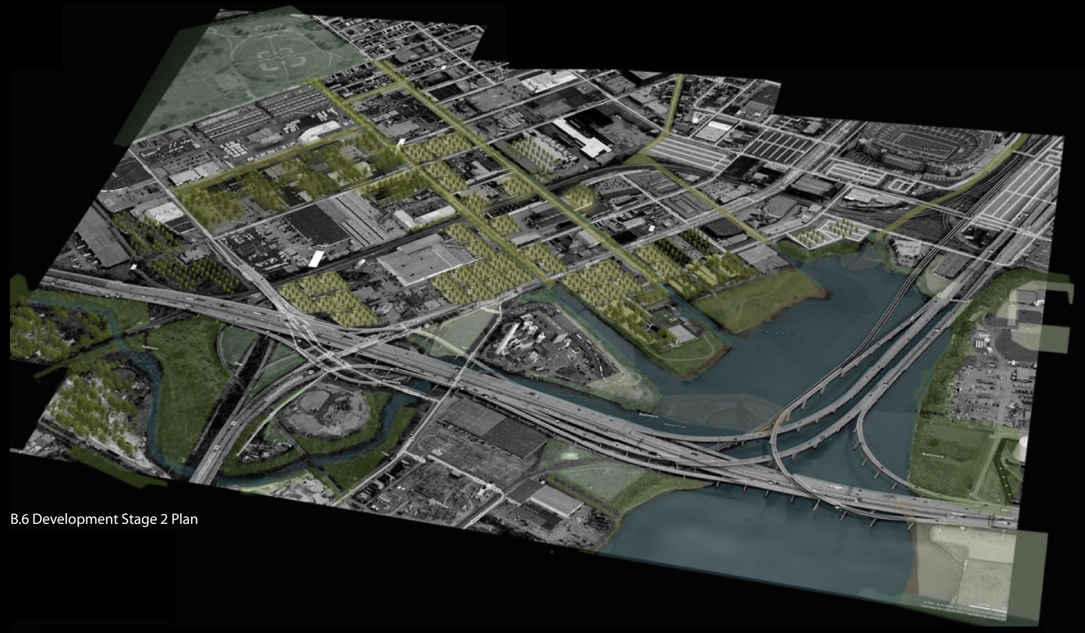
Existing Habitat + Brownfield + Phase 1 Remediation



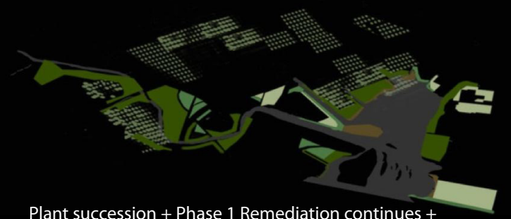
Plants succession

STAGE 1 1-5YEAR

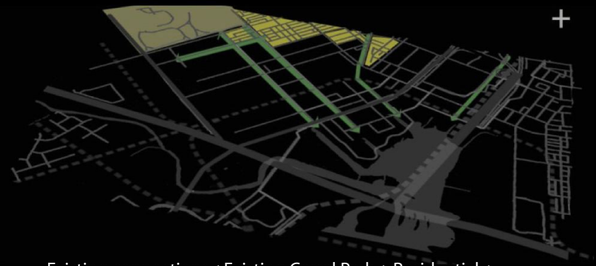
- Phytoremediation on brownfield sites
- Allow Plants succession & adaptation
- Change plants species for phytoremediation process based on the contamination level data observation
- Trap & clean stormwater runoff by plants



B.6 Development Stage 2 Plan

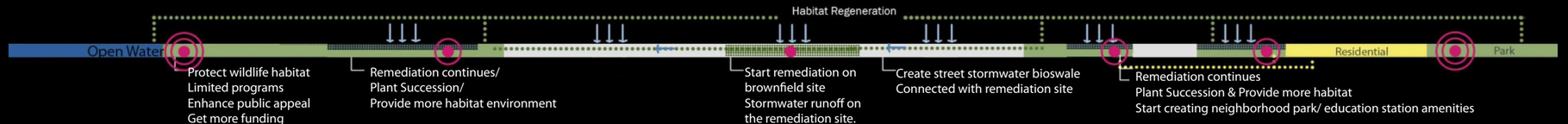


Plant succession + Phase 1 Remediation continues +
Phase 2 Remediation

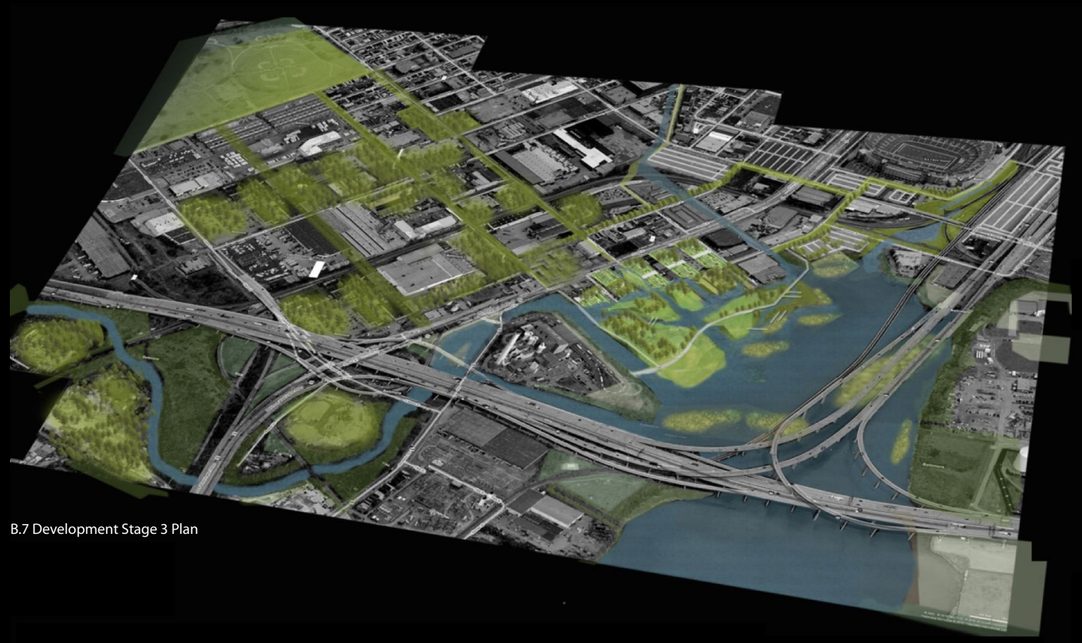


Existing connections +Existing Corral Park + Residential +
New street water filter connections

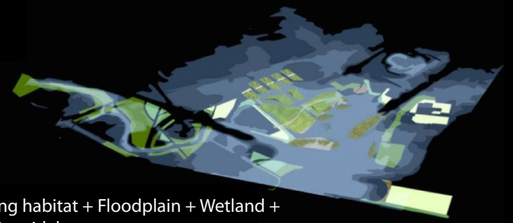
STAGE 2 3-8YEAR



- Phytoremediation continues + Phase 2 phytoremediation
- Plants succession & adaptation
- Control invasive plants and promote native plants that have the function of phytoremediation
- Brownfield sites connected by street green infrastructure
- Enhance waterfront accessibility



B.7 Development Stage 3 Plan

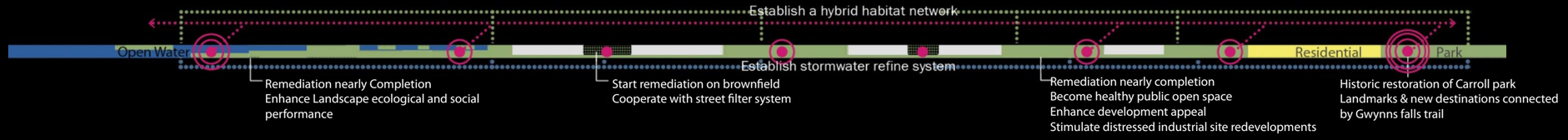


Existing habitat + Floodplain + Wetland +
Riparian tidal terraces

Existing bike trail + New bike/ pedestrian connections with water front

- Remediation nearly completion; enhance development appeal
- Enhance ecological and social performance
- Topographical shifts at the waterfront for adaptation with water level changes
- Optimize multiple transportation accessibility

STAGE 3 5-15 YEAR



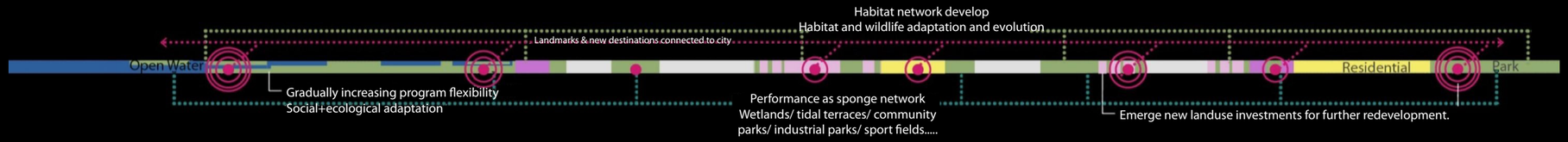
B.8 Development Stage 4 Plan

Install new landuses for residential/ retail/ education/ sport field/ landscape corridor

Connect with regional ecosystem and urban context

- Social + ecological adaptation, gradually increasing program diversity and biodiversity
- Phytoremediation site works as sponge network for absorbing water
- New development maybe take place in this district. At the same time introduce new feature interventions in the open system for future resilience and adaptation with disturbances.

STAGE 4 15-25YEAR



CO- EVOLUTION PROCESS

The remediation approach applied as an open system injects sequential and open ended processes and involves long-term potential events into this area. It catalyzes and coordinates a diverse initiative that lays frame works for future development. The complexity of this open system is reflected in variable states of flexibility and diversity of its social and ecological systems.

The remediation system can create an ecological network overtime to fix the ecological migration blockage for Gywnns Fall watershed formed by the industrial district, not only reserving rich estuary habitat but also enriching local habitat by regenerating landscape on the former toxin site.

With the application of this remediation process, the brownfields gradually transform into clean lands with higher capacity, providing potential economic value and social value, creating opportunities for future investment or alternative landuse and boosting regional economic development. Additionally, the whole process involves public contribution and participation to help adjacent communities reengage with sites that have existed as barriers.

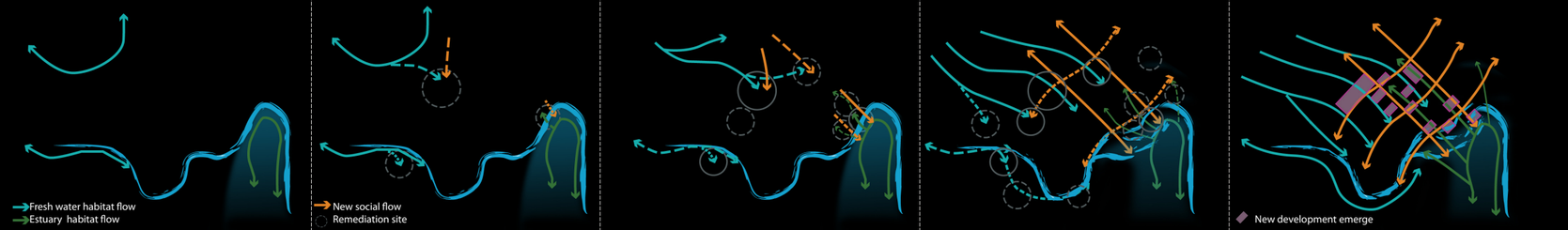
Program chart

HT=Historical tour
DL=Degrade land
WT=Walking Trail
RH=River habitat
MH=Marsh habitat
BH=Bird habitat
PB= Planted buffer
NI=New investment
GI=Green industrial

NJ=New job provided
AW=Access to waterfront
BO=Bird observation
RO=Remediation observation
PR=Phytoremediation
IC=Invasive control
PF=Public fund
HPP= Habitat preserve program
MP=Mobile program

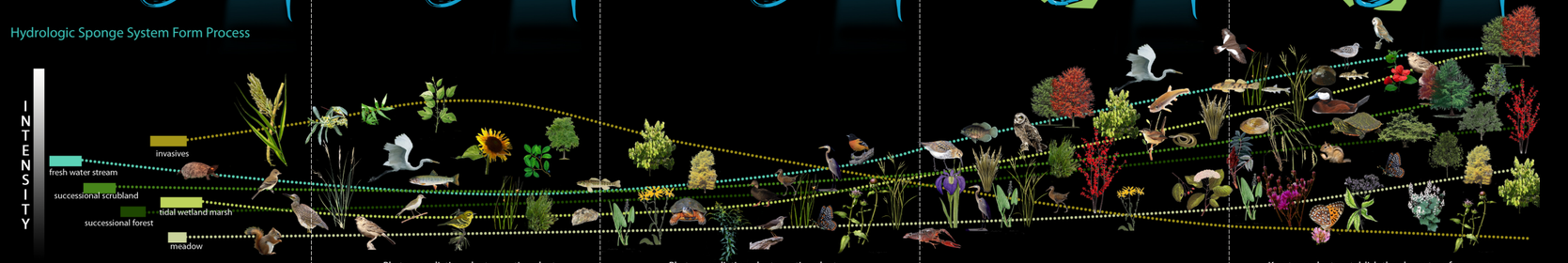
HI=House value increasing
SE=School education
PW=Public green work
SF=Sports field
NO=New opens pace
NP=Native plants community
WC=Runoff cleaning& collection
HD=Housing development
OL=Outdoor library

LR=Land value rise
MH=Multiple wildlife habitat
EF= Enhance fish habitat
RR=Restaurant/retail
CG=Community garden
PD=Plants diversity
FS=Fish Spawn
MR=Material recycle
WR= Water recycle
NC=New types of commercial



Open Flows Interaction in Time

Hydrologic Sponge System Form Process



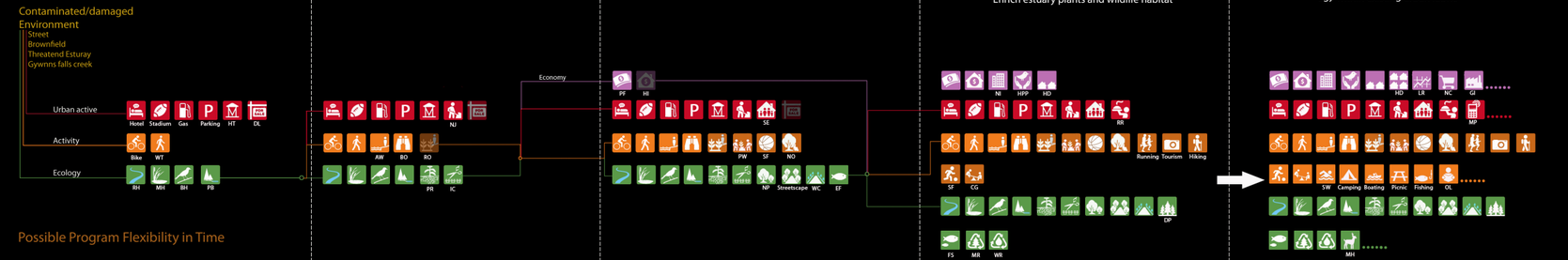
Phytoremediation plants + native plants
Preserve native wildlife habitat

Phytoremediation plants+native plants
Preserve native wildlife habitat + attract new wildlife habitat

Native plants create green infrastructure urban framework
Enrich estuary plants and wildlife habitat

Keystone plants establish the character of open space, street, tidal, estuary zone. Continue establish regional ecology within existing urban fabric

Habitat Diversification in Time



Possible Program Flexibility in Time

B.9 Co-Evolution Diagram

C. INTERVENTION DESIGNS

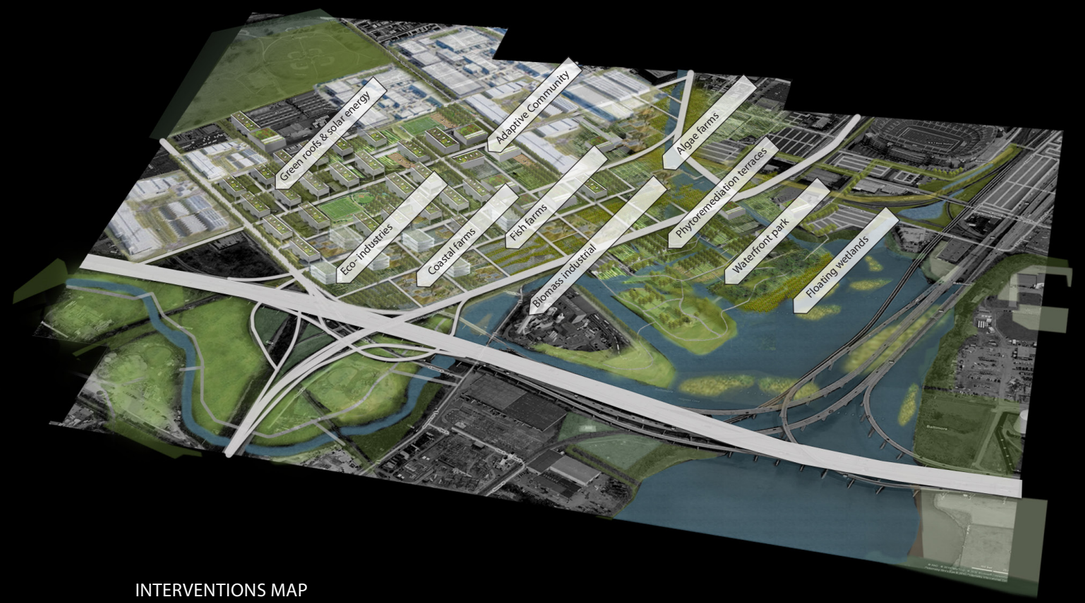
Designing open systems enable an understanding of how the city can move towards a more organic model of open-endedness, flexibility, resilience, and adaptation and away from a mechanistic model of stability and control. In other words, urban systems are now open systems that behave in ways that are self-organizing and that are to some extent unpredictable. Changes are built into living systems; they are characterized in part by uncertainty and dynamic changes. A crucial feature is their ability to deal with disturbance.

This project requires design strategies that are open-ended. Rather than focuses on pre-determined outcomes for city, the goal of design open systems is to set up conditions for a wide range of uses and appropriations for the city, both for those we can imagine now and those we cannot.

In this chapter, three intervention designs developed in Carroll Camden Industrial District will be tested against a range of poosible disturbances that are key to the Middle Branch Harbor. It will explore their ability to deal with disturbances and show evidences that it is more reasonable to facilitate, rather than (attempt to) prevent disturbances from happening.

Three interventions are:

- Phytoremediation terraces
- Adaptive community
- New Industrial development



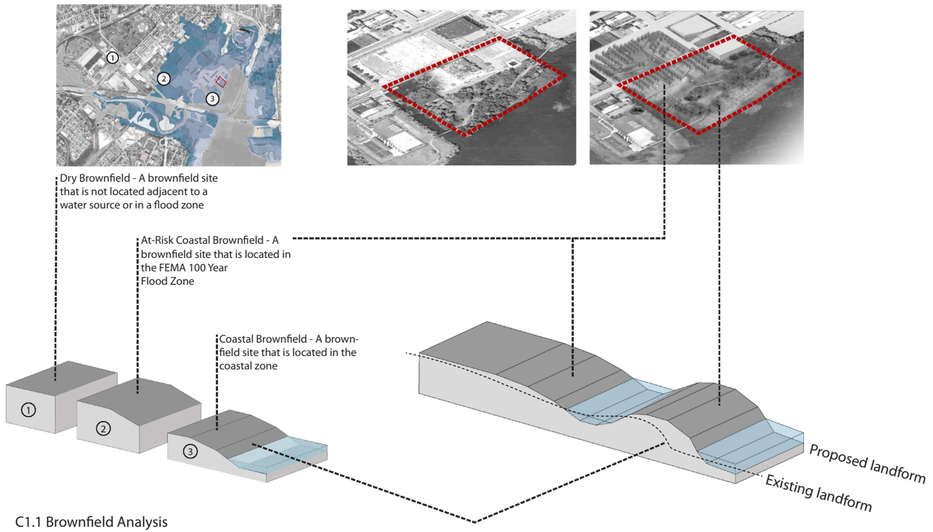
INTERVENTIONS MAP

C1 PHYTOREMEDIATION TERRACES

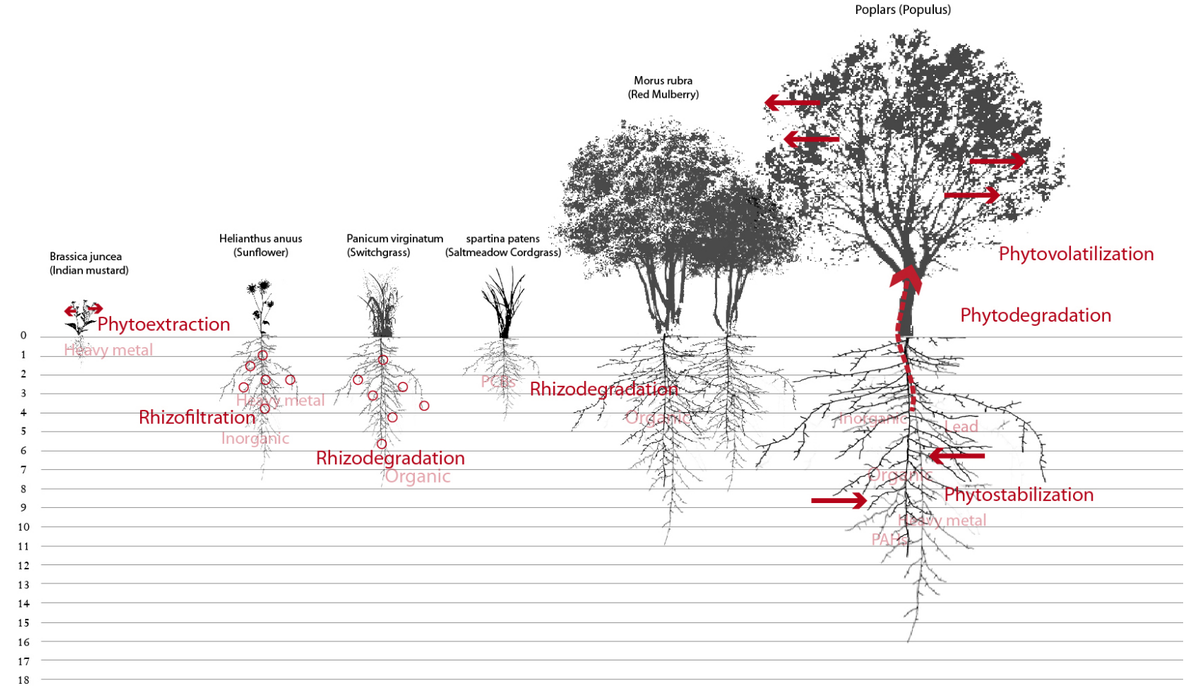
A brownfield, as defined by the EPA, as a former commercial or industrial site, the future of which is affected by real or perceived contamination.

Brownfields are found in the city of Baltimore's industrial and commercial sectors which include buildings such as abandoned factories, manufactories, dry cleaning facilities, and gas stations. The contamination found on these sites can include hydrocarbons (oils and fuels), pesticides, heavy metals (lead, nickel, etc.), and asbestos.

Based on the location relationship with the estuary, the brownfields Carroll Camden Industrial District could be divided into three types: Dry Brownfield, At- Risk Coastal Control Brownfield and Coastal Brownfield. So with the process of remediation, the land will be also facing tidal flux and the flood threaten.



C1.1 Brownfield Analysis



C1.2 Phytoremediation Diagram

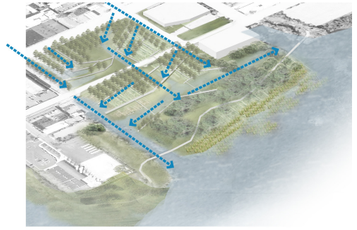
VARIOUS PHYTOREMEDIATION PROCESSES

Phytoremediation is considered a clean, cost-effective and non-environmentally disruptive technology. it is potentially the least harmful method because it uses naturally occurring organisms and preserves the environment in a more natural state.

1. Phytohydraulics grove
2. Storm water collection stream
3. Phytoextraction terrace
4. Path way
5. Storm water channel
6. Floating wetland
7. New planted tidal marsh land

C1.3 Phytoremediation Terraces Plan

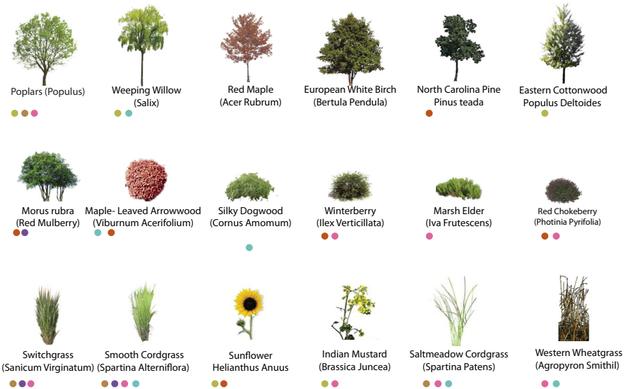
The phytoremediation terraces sets up as a initial condition for the future development. It performs as a soil and water cleansing system at this stage. However, it provides an easily accessed and recreational waterfront park.



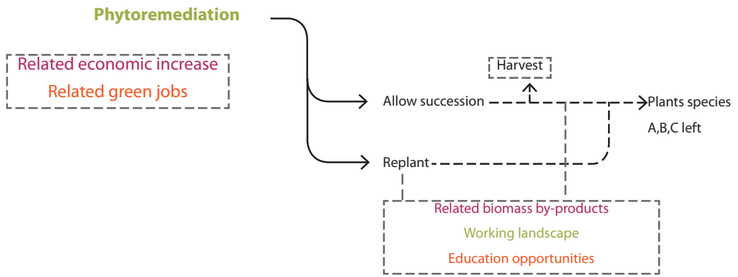
C1. 4 Water flow diagram

C1.5 Phytoremediation Terraces Sections

TYPICAL PLANTS

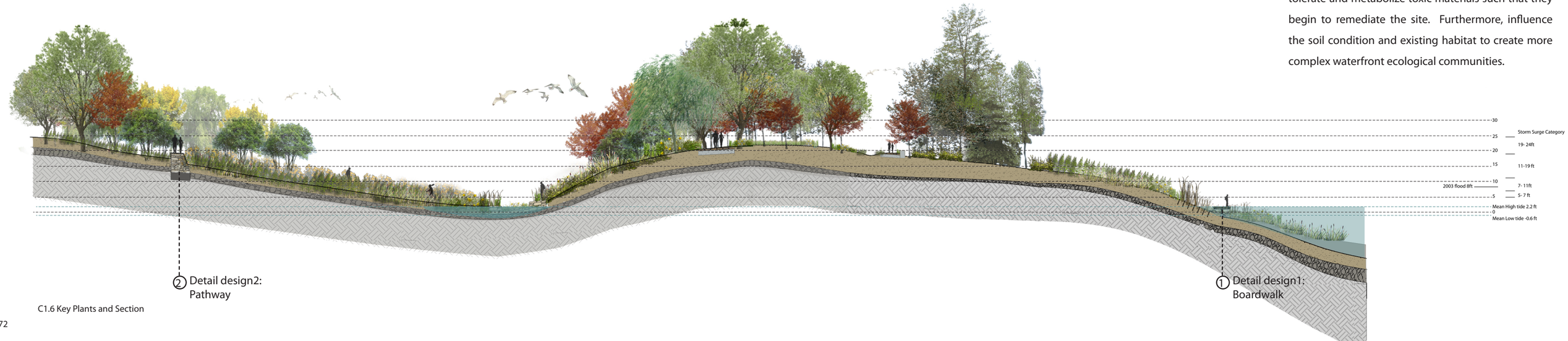


- Plant Process Heavy Metal/ Lead/Mercury
- Plant Process PAHs
- Plant Process VOCs/SVOCs
- Plant provide food
- Fresh to salt marshes/Salt Tolerance
- Flood Tolerance/Erosion Control

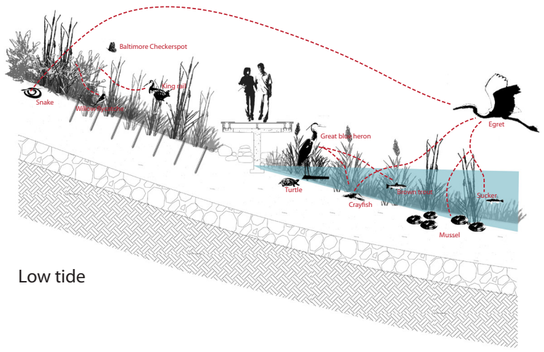


The plant species were chosen based on the three criteria: target contaminants, the tolerance ability with salt and the tolerance ability with stormwater.

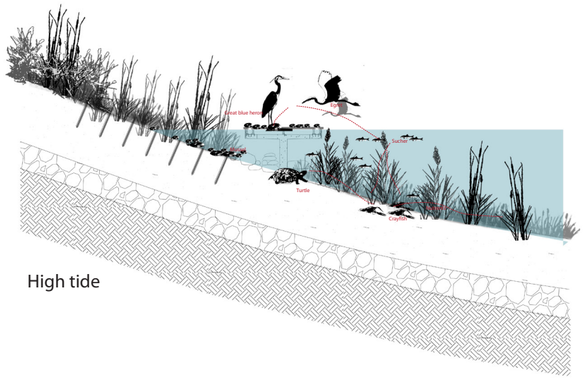
Along with the phytoremediation process involves a long-term adaptation, the plants will thrive in the long term through responding to each situation, such as high toxic levels in the soil or water level change. The most adaptable plants are able to rapidly colonize disturbed and moderately contaminated sites; they can often tolerate and metabolize toxic materials such that they begin to remediate the site. Furthermore, influence the soil condition and existing habitat to create more complex waterfront ecological communities.



C1.6 Key Plants and Section

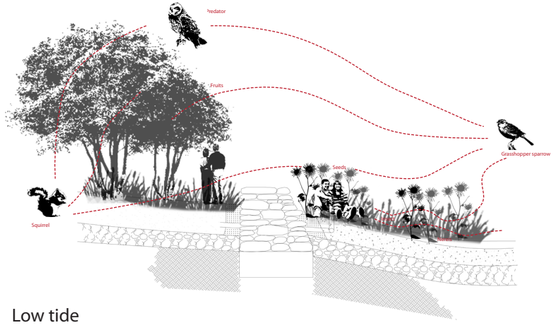


Low tide



High tide

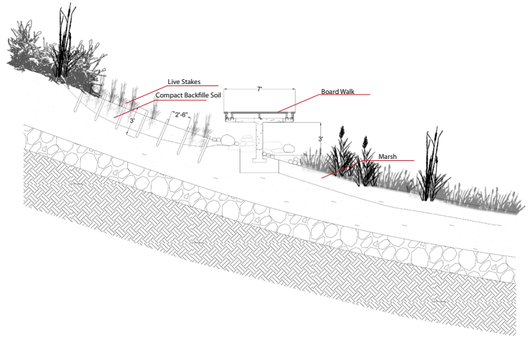
C1. 7 Relationship between human, boardwalk, water, wildlife

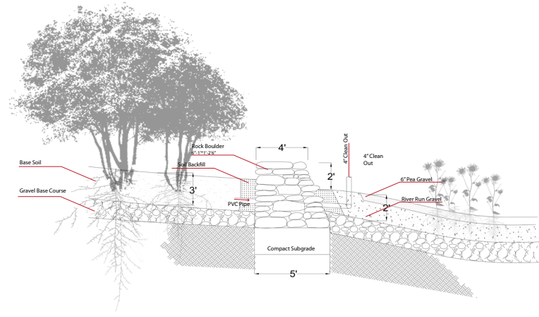


Low tide

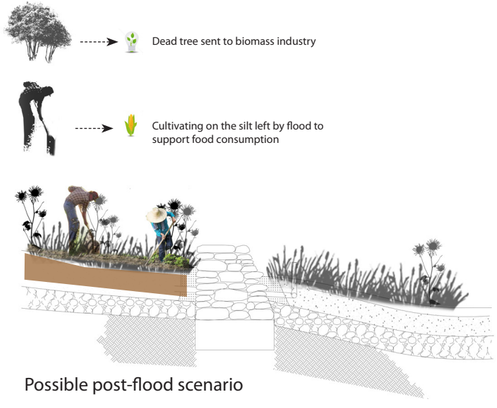
High tide

C1.8 Relationship between human, pathway, water, wildlife





C1.9 Construction Details

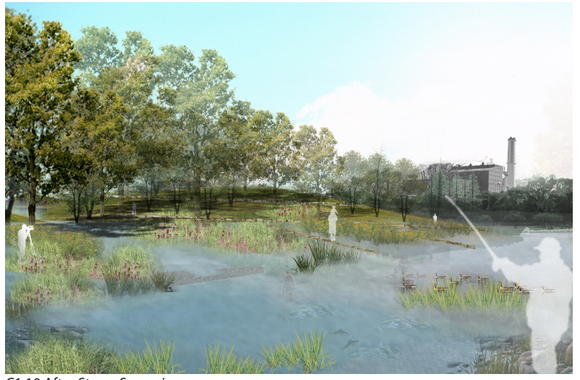


Possible post-flood scenario

The application of open systems as design approach embraces the challenges and opportunities posted by the paradox of dynamism: a dance between ephemerality and permanence. The long term plant adaptation could be looked at as a permanent process; the changes of everyday ecological flow showed here would be understood as an ephemerality phenomenon.

The crucial thing for design is creating opportunities to promote dynamism and provide more potential for social and ecological adaptation.

C1.10 Mean High Tide



C1.10 After Storm Scenario

C1.11 Engaged New Programs and Infrastructures

PEOPLE ADAPT WITH SEA LEVEL RISE

The phytoremediation terraces is a hybrid of ecological function and social adaptation in the context of remediating an urban place.

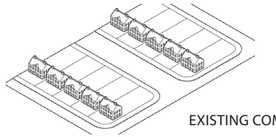
As a process-oriented tool, phytoremediation takes a long time on the site. The time dimension can be turned into an advantage, each stage of the cleaning process has a distinct character while performing remediation and simultaneously creating green infrastructure to support a full range of social and recreational activities, and ecological life for a long time: nesting sites, fishing piers, vibrant meadow habitats, wetland habitats and shady groves.

Therefore, it is a working landscape on one hand-repair the physical ecological function by cleaning the site and the city as it grows. On the other hand, it is an mechanism which are able to adapt with flood. Stormwater channels can perform as detention and retention area when it has storm or flood. Wetland plants here are able to root in water and withstand flooding. Furthermore, potential activities and new infrastructure will also emerge by facilitating regular safe flooding, rather than pre-empting any flooding and risking a catastrophic flood.

C2 ADAPTIVE COMMUNITY

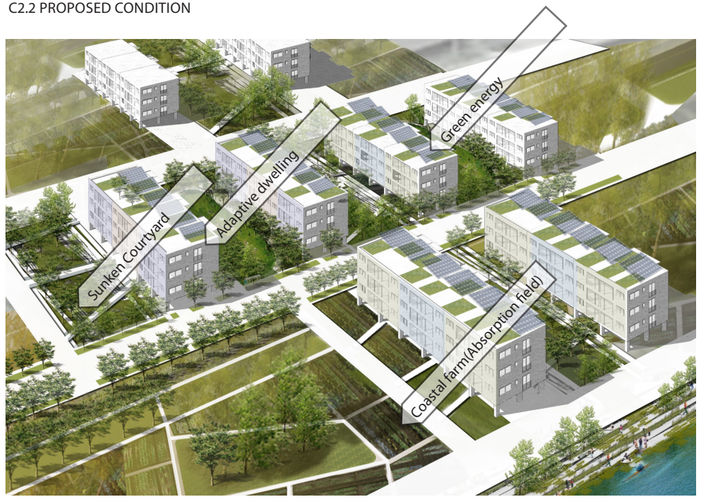
Designing with open systems enables us to control and take advantage of flooding in a more effective way without shutting the city down. New prototypes of human living systems need to be developed to face the fact that the city could flood . This section shows designs for several propositions for human living systems that provide the potential for adaptable responses when flooding happens, low-rise lifting dwellings, functional courtyards, coastal farms. All of these endeavor to create a flexible and adaptable living model.

C2.1 FLOODING SCENARIO

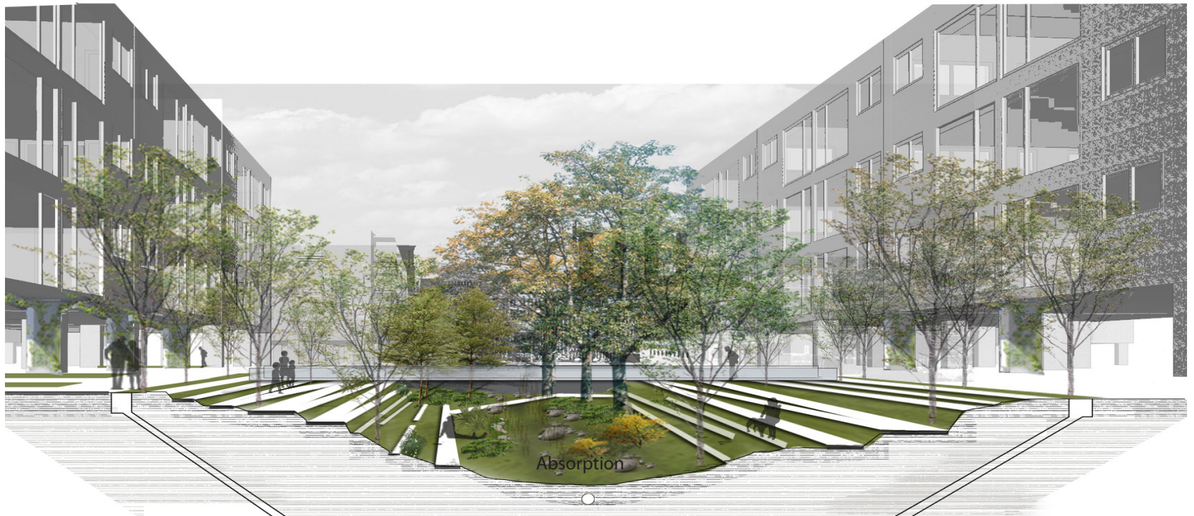


EXISTING COMMUNITY CONDITION

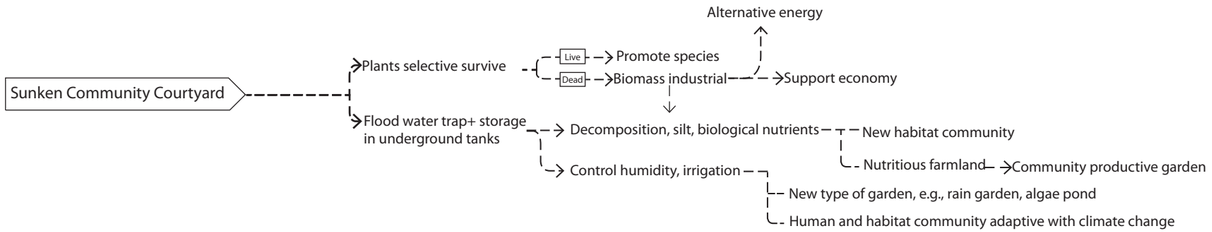
C2.2 PROPOSED CONDITION

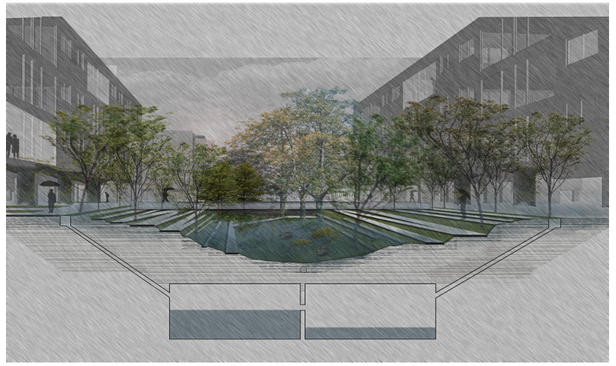


C2.3 FLOODING SCENARIO

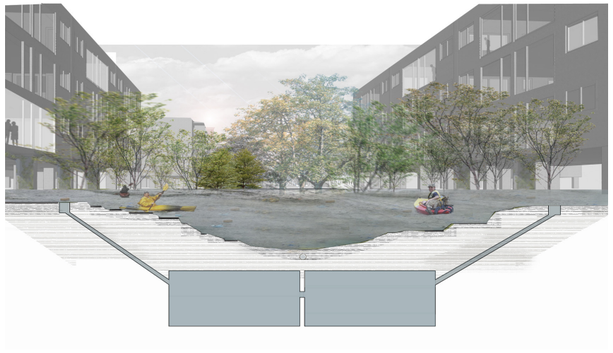


Initial conditions for courtyard

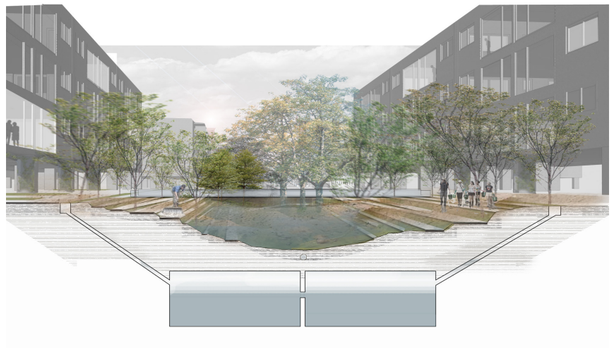




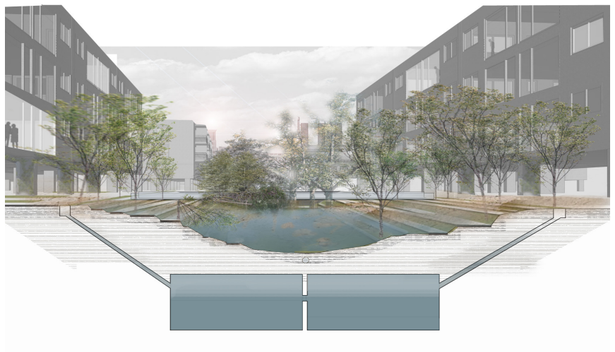
Storm



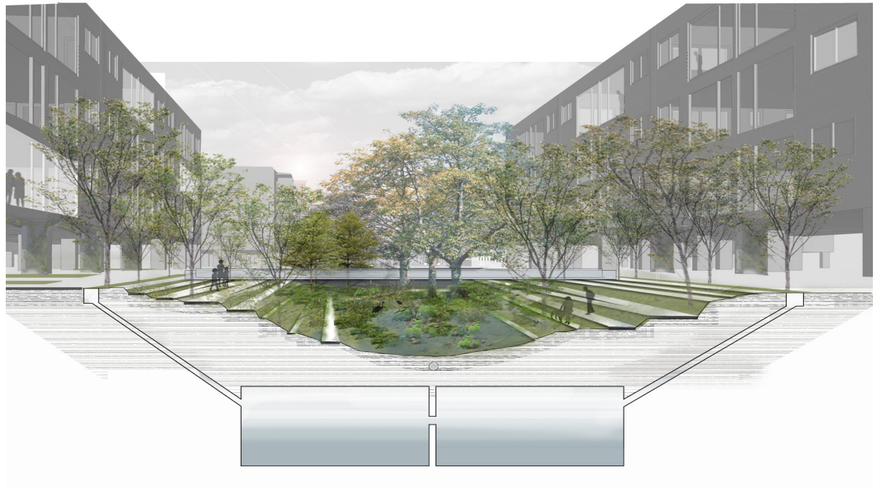
or
Hurricane



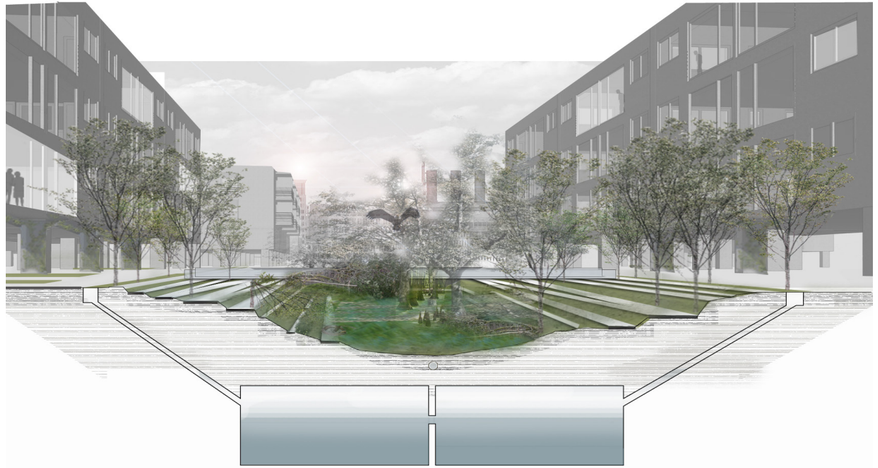
Silt may left by flood



Process of adaptation



Possibility 1
Rain garden



Possibility 2
Swamp

C2.6 Possible results

Possibility 3
Community working field

Ecosystems have multiple possible operating states and may shift suddenly from any one of them, even in the small scale like the courtyard. Following a sudden disturbance of flood, the micro ecosystem in sunken community courtyard can reorganize to “renew“ itself to a similar or perhaps different state. Based on the degree of toxicity, volume and lasting period of water, the toxic tolerance, pumping capacity of the trees and different scenarios will show on the site.

Designeing the courtyard as open systems can reveal natural cycles such as seasonal floods and regenerate natural processes—by cleaning and filtering rainwater or replenishing soils through arrested erosion and deposition—and do so as they intersect with social activities here. The merge of ecological and social temporal cycles links the activities of everyday life and the unique water events of Baltimore city. People can experience the dynamic bio-physical aspects of the environment instead of resisting it. Nature is not out there, but in here, interwoving into the human urban conditions. Hydrology, ecology and human life are intertwined.

C3 NEW INDUSTRIAL DEVELOPMENT

There is no question that there are series on-going forces working as disturbances shaping the operation of urban systems, such as disturbances from climate change and economic change. The former design investigations have shown the possible responses with the climate change in the aspects of both ecology and human settlement.

This section is going to explain the potential industrial uses by exploring the Estuary ecological potential for economic reuse of former phytoremediation terraces and the imminent economic shift in eco production.

Criteria for industry redevelopment:

Ecological friendly--No more pollution
Can preserve or enrich regional habitat

Social friendly -- Proximity to community
Easy to access
Performance multifunctional to support social programs

Market friendly-- Support local markets demands

Sustainability -- Reuse and recycle in production process
Easy to shift to alternate uses when economic depression.

C3.1 Industrial Plan

Urban Orchard/Farm

A proposed production urban landscape integrated urban environment amenity, local food markets and communities.

Algae Open Pond

Algae are the fastest growing plant organisms in nature and have the ability to convert large amounts of carbon dioxide (CO_2) into oxygen. Algae are used in food, animal feed, cosmetics, pharmaceuticals, and biofuels. They can also be used for carbon sequestration and bioremediation of waste and waste water.

Open Aquaculture Systems: Sticks, ropes, racks and cages (passive feeding)

The culture of numerous shellfish species is carried out in systems open to natural waterways. The main species cultured with these methods are mussels and oysters. As these species are filter-feeders, they are capable of extracting nutritional requirements from the water column, with no fish meal being added.

Biorefinery Plant

A biorefinery transforms biomass derived from renewable raw materials into a wide range of commodities by the means of advanced biotechnological processes such as enzymatic hydrolysis.

The biomass comes from a variety of local sources such as trees, energy crops such as switchgrass and algae and agricultural products such as grain, maize and waste products such as municipal waste.

Woody Barrier Island

Vegetated barrier islands may be useful as recreational zones and estuary wildlife habitation or as storm surge and flooding protection. It would promote marsh growth, and prevent further erosion as well.

The island forms an open ecosystem accommodating with tidal changes.

Estuary Wetland

Wetlands offer a buffer zone to existing shore lines, preventing erosion and accommodating tidal changes. Wetlands have their own ecosystem, foster diverse species of plants and animals.

Open Aquaculture Systems: Sea-cage (active feeding)

Open sea-cage aquaculture refers to the rearing of aquatic species, within enclosures in natural waterways. Floating mesh cages are anchored to the seafloor and vary in size depending on the scale of operation and the species cultured.

Common species in Baltimore: yellow and white perch, croakers, eels and catfish

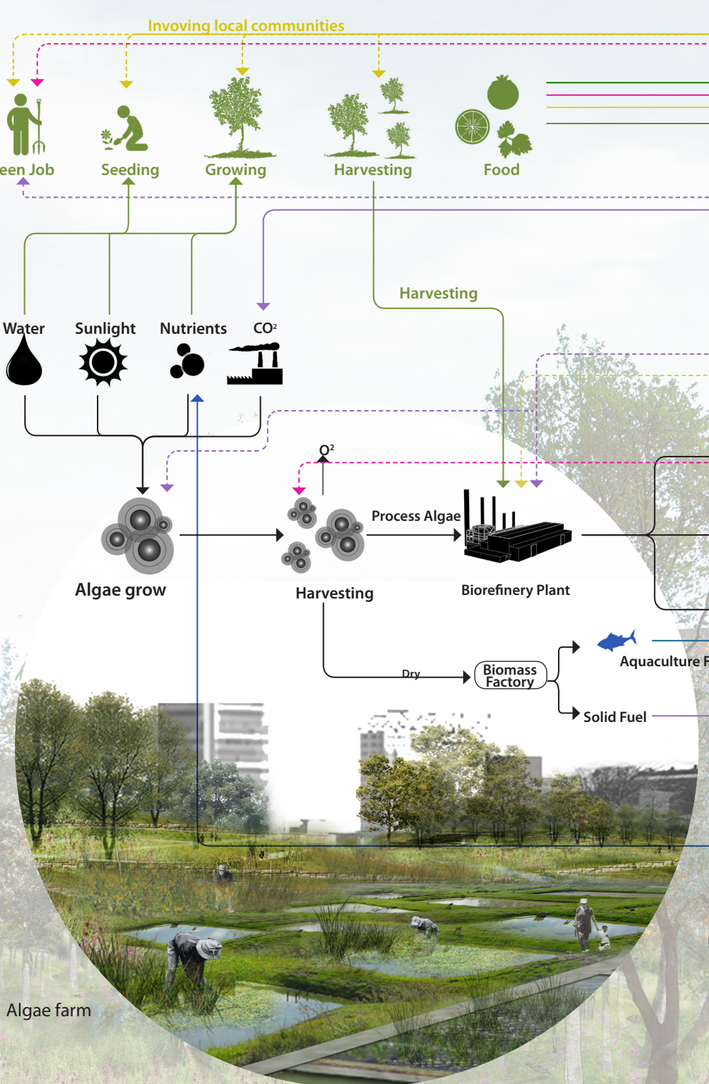
Aquaponics System

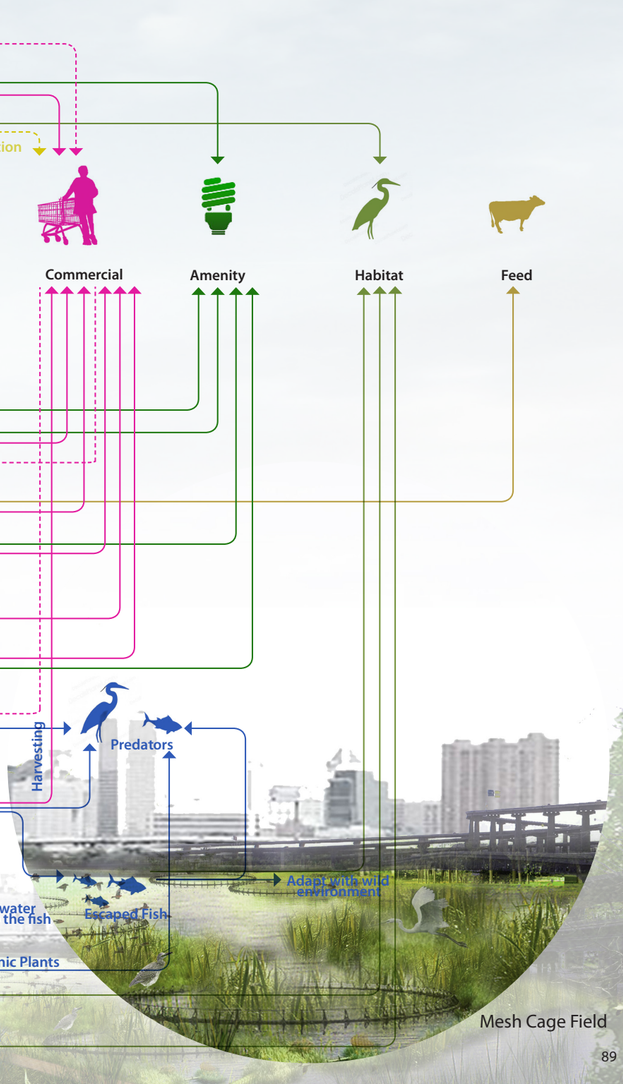
Aquaponics is the marriage of aquaculture (raising fish) and hydroponics (the soilless growing of plants) that grows fish and plants together in one integrated system. The fish waste provides an organic food source for the growing plants and the plants provide a natural filter for the water the fish live in.

Urban Orchard & Farm Field

By reusing former phytoremediation terraces, exploring the estuary ecological potential for economy, this intervention developed an idea to re-imagine the industrial areas within the site. It establishes a mixed use district that encourages connections between the established city and the waterfront as well as introduce a sustainable way of integrating urban landscape system, economy system and social system.

C3.3 Generation Process





CHAPTER 3

DESIGN MIDDLE BRANCH HARBOR AS AN OPEN SYSTEM

3.1Middle Branch Harbor Plan

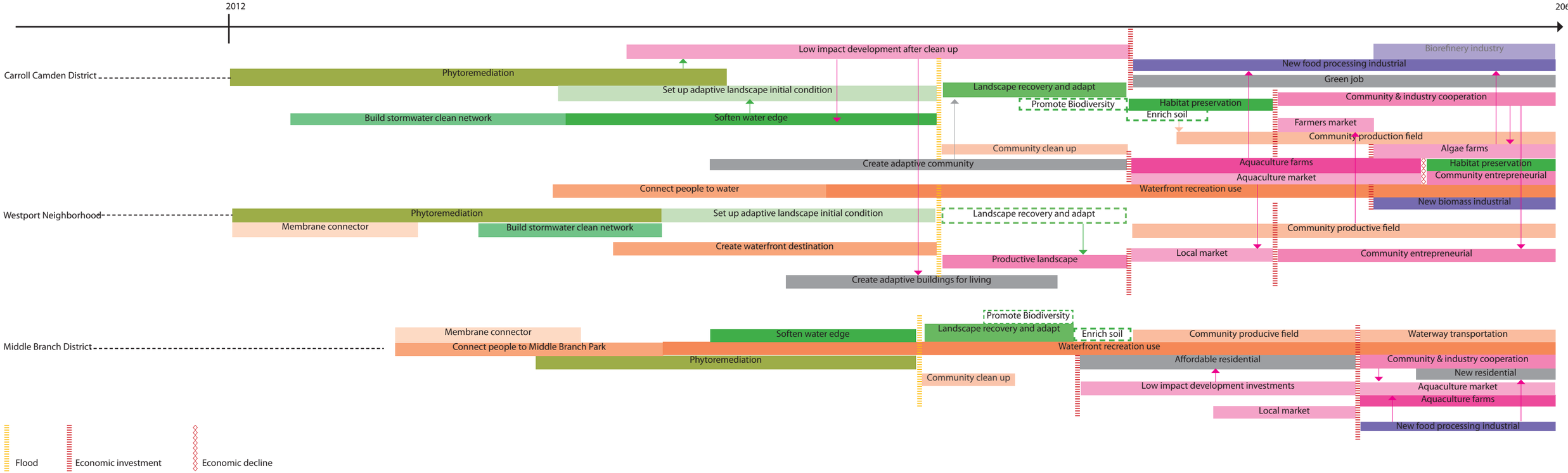
OVERALL PLAN FOR MIDDLE BRANCH HARBOR

The last part of this project is providing an overall vision for the whole Middle Branch Harbor based on lessons learned from pervious researches and design explorations regard of open systems. All design investigations can be developed in multiple locations around the harbor to achieve the goal of helping Middle Branch Harbor adapt with disturbances by building increased resilience in to the urban system.

The first phase of Middle Branch Harbor transformation is to prepare the ground of an emergent ecological infrastructure network. Remediate sites with highly adaptable plants to remove pollutants, clean stormwater and bring immediate transformations and beauty. Remediation fields in the Carroll Camden district can also applied on active or abandoned industrial sites in Westport and Middle Branch. Then by creating water cleansing infrastructure corridors in each district which connected to the wetlands around the harbor, it can clean surface run-off from neighborhoods. With the developing of the first phase, it provides basic habitat improvement, offers a safe network for migrating birds and other wildlife. All these can also attract attentions to the harbor, catalyze temporary cultural and social activities and will accumulate over years- new parks, educate events, ecological biking, bird observations productive gardens , and more. Once transport corridors create blockage in the system, the emergent green corridors will be the media to connect people to the water, and the membrane platform is also a good intervention of creating new ecological and spatial connections. The membrane platform can be built at Baltimore-Washington Pkwy., Westport railroad station and Waterview Ave at Middle Branch.

1.Carroll Park
2.Adaptive dwellings
3.M &T Bank Stadium
4.Productive estuary
5.Existing industry park
6.Biomass industry
7. Tidal wetlands
8.Westport waterfront park
9.Overlook bridge
10.Membrane platform/bridge
11.Phytoremediation field
12.Gywnns Fall River park
13.Sport fields
14.Middle Branch affordable community
15.Middle Branch Park
16.Middle Branch industrial park
17.Greenway

With achieving the goal of connectivity and remediation in both spatial and ecological aspects through adaptive and self- organize processes in the Middle Branch Harbor, all the area will be both opportunistic and catalytic: gradually creating new hybrids, programs and activities around the Harbor. Furthermore, understanding changes are built into living systems, a series of interventions can be introduced to better respond to disturbances: tidal wetlands can emerge at the water edge; adaptive dwellings can be build within floodplain in the Carroll Camden and Westport; and new eco-industrials can cooperate with local communities and commercial organizations at the estuary of Middle Branch Harbor and a former industrial area in the Middle Branch district.



POSSIBLE TIMELINE FOR MIDDLE BRANCH HARBOR

3.2 Timeline diagram

REFLECTIONS

Over the past two decades, there has been a gradual but fundamental shift in the way people understand ecosystems (and thus landscapes) in terms of their structure and function. Resilience, adaptation and disturbance have replaced stability, harmony, equilibrium and balance as the operative words in ecosystem studies. Conceptions of stable, climax plant and animal communities have given way to an understanding of disturbance regimes, emergent and resilient properties, and chaotic self-organizing systems(Meyer, 2008). Applying this theory for designing Middle Branch Harbor in Baltimore, reveals urban systems are dynamic, not static and can be designed for disturbance and resilience in order to help our cities develop the necessary capacity to meet the challenges of the future.

This project has addressed increasing the capacity of the Middle Branch Harbor for resilience by demonstrating the integration of an ongoing regeneration process that may be applied to degraded coastal sites. It has shown an adaptive way of reconnecting and settling people back to the water, a portrayal of the self-organization process after having undergone flooding and a way to reintroduce industrial uses to the estuary environment. This allows Middle branch Harbor to increase their abilities to better respond and adapt to the economic, social, and physical disturbances they will face as they confront the challenges of increasing energy scarcity, climate change, and economic change.

The extensive research, mapping, and design tests for the Middle branch Harbor provide evidence that there are enormous opportunities to cooperate with disturbances, rather than to resist them, through an open system design approach-- increasing its capacity and complexity in terms of the variable state of integration of the human living system, ecosystem and social system. It sets up conditions for a wide range of uses and appropriations, both for those we can imagine now and those we cannot in order to be viable immediately and for years to come.

However, some limitations of the project still exist. For example, the research, mapping, design, and texts contributed to this thesis evolved over a period of nine months this is far too little time to develop an in-depth understanding all of the complex dynamics ,physically,environmentally and socially, that are involved in the whole harbor area. This design approach developed from experiences and test results from one district of the harbor and was applied to the whole harbor area without sufficient tests on multiple locations, to some degree this may have overlooked specific qualities and opportunities belonging to other parts of the harbor.
Additionally, this design approach lacks practice, adaptive design must necessarily reply on an evidence or feedback -based approach. There is no real opportunity to help understanding how open systems respond to disturbances in a real way, and conduct small-scale experiments that can be observed to learn from it through making mistakes.

Last but not least, a greater level of research of local communities would allow greater focus to be placed upon specific, more realistic social and economic potentials for the adaptation of the site.

BIBLIOGRAPHY

Barnett, Rod. (2010) "A Ten Point Guide to Open Systems Theory"
http://www.rodbarnett.co.nz/pub/news/a-ten-point-guide-to-open-system/files/A_Ten_point_Guide_to_Open_systems_Theory.pdf

Barnett, Rod. (2010) "A Ten Point Guide to Disturbance in Landscape Architecture"
http://www.rodbarnett.co.nz/pub/news/a-ten-point-guide-to-disturbance/files/A_Ten_Point_Guide_to_Disturbance_in_Landscape_Architecture.pdf

Barnett, Rod. (2010) A Ten Point Guide to Initial Conditions
http://www.rodbarnett.co.nz/pub/news/a-ten-point-guide-to-initial-con/files/Ten_Point_Guide_to_Initial_Conditions.pdf

Barnett, R. (2005). "Artweb: A nonlinear model for urban development." Landscape Review 9(2): 26-44.

Czerniak, Julia, "Legibility and Resilience," In Czerniak, Julia and Hargreaves, George (ed.): *Large Parks*. (New York: Princeton Architectural Press, 2007, pp. 215-250.)

Lister, Nina-Marie (2007): "Sustainable Large Parks*:* Ecological Design or Designer Ecology?" In Czerniak, Julia and Hargreaves, George (ed.): *Large Parks*. Princeton Architectural Press, New York, pp. 35-57.

Meyer, Elizabeth K. (2008) "Sustaining Beauty. The Performance of Apperance A manifesto"
http://www.arch.virginia.edu/lunch/print/territory/sustaining.html

Pollak, Linda, "Matrix Landscape: Construction of Identity in the Large Park", In Czerniak, Julia and Hargreaves, George (ed.): *Large Parks. (*New York:Princeton Architectural Press, 2007, pp. 87- 120.)

Waltner- Toews et al.,eds, The Ecossytem Approach. (New York: Columbia University Press.
Watson, Donald, *Design for Flooding: Architecture, Landcape, and Urban Design for Resilience to Climate change.* (New York: Wiley, 2010)
Russ, Thomas, *Redeveloping Brownfields. (*New York: McGraw-Hill Professional, 2010)

Corner, James, "Ecology and Landscaoe as Agents of creativity," in George Thompson and Frederick Steiner, eds., *Ecological Design and Planning.* (New York: Wiley, , 1997)

Charles Waldheim, ed., The landscape Urbanism Reader(New your: PrincetonArhitectural Press,2006)

U.S. Army Corps of Engineers, Baltimore District, Hurricane Storm Surge Map
http://www.nab.usace.army.mil/hes.htm

Howland, Marie, "The Legacy of Contamination and the Redevelopment of Inner-City Industrial Districts ", University of Maryland, July 18, 2002.

Howland, Marie, "What Makes for a Successful Brownfield Redevelopment? Three Baltimore Case Studies" , University of Maryland, July 21, 2002.

Baltimore City Planning Commission, "WaterQualityHabitat", 2007.

USGS, University of Maryland, Baltimore County and the Institute of Ecosystem Studies, Index of Hydrologic Characteristics and Data Resources for the Gwynns Falls Watershed, Baltimore County and Baltimore City, Maryland, Baltimore, Maryland, October 1999.