Recycling Houston

Bringing synergy between improving water safety, reducing energy consumption and reinforcing living quality in suburban

P4 Report, January 2015 / Song-Ya Huang, 4317645
Msc Urbanism, Faculty of Architecture, TU Delft
Delta Interventions / Mentors: H. Meyer, N. Tillie

Tittle: Recycling Houston
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Song-Ya Huang, 4317645
songyahuang@gmail.com

Delft University of Technology
Master of Architecture, Urbanism and Building sciences
Urbanism track
Delta Interventions

Mentor: H. Meyer, N. Tillie

P4 Report
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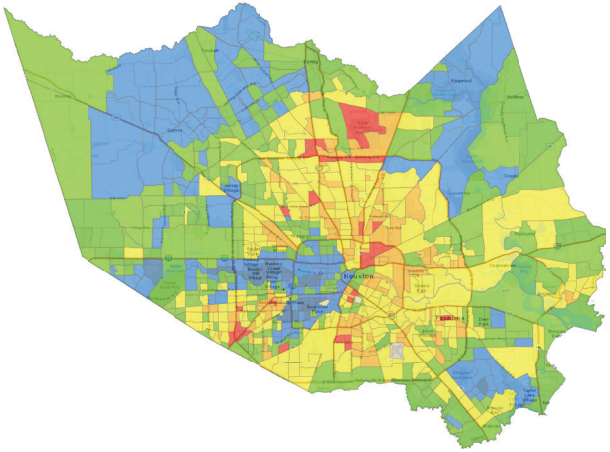
Downtown

Very rich neighborhood

Typical suburban

Very poor neighborhood



- Harris County: Percent under poverty level

  - 0% - 10%
  - 10.01% - 20%
  - 20.01% - 30%
  - 30.01% - 40%
  - 40.01% - 50%
  - 50.01% - 72%

(source: http://mcimaps.com/)

Motivation

A friend, Emmanuel Oni, who was born and lived in Houston for 25 years, and living in New York currently, once told me his perception of Houston. " Basically, there are four types in Houston. They are **downtown**, the high-rise cluster, **very rich neighborhood**, **very poor neighborhood**, and the majority is the rest, typically **suburban**. I must, but really don't like to drive in Houston, especially after living in New York. Even when I'm very close to the place I'm going, it's hard to orientate myself. Most of the suburban looks almost the same. Everywhere is similar house with lawn and highway in the background." Emmanuel pointed out some very interesting urban phenomenon: the extreme mono-centric economic structure, the segregation of the social-economical classes, the fast-developed suburban that need to reinforce the identities, and the highly automobile dependence.

Growing up in the dense Asian country (Taiwan), the life in suburban is very unfamiliar, interesting and questionable for me. Why the big private open space (lawn) is needed, why don't use the parks? Isn't it very inconvenient and expansive to use the car to everywhere, even grocery? Without the public transportation, how can the kids go out before they can drive a car? But currently, the data from U.S. census bureau shows in last year: someone moved to Houston from elsewhere in the U.S. every 9.5 minutes. Which means the suburban living style attractions are much more than disadvantages. And I'm curious to discover and experience these kinds of suburban living qualities.

The suburban life style has it's advantage but also results many issues for Houston. The energy consumption is a significant one. Texas flourishes because of the oil production and is also the biggest energy consumer in the U.S. The oil highly affected urban structure of Houston. The urgent question nowadays is how the city can be transformed in this post-oil era? Climate change, which is interconnected with energy use, is also a threat for Houston. Flooding is a worry for Houstonians for over 100 years, but it gets more serious in the recent decades.

In this project, I want to focus on the research for the three major issues of Houston: energy consumption, water safety and living qualities. And I will try to bring up some suggestions for **How Houston urban structure can be transformed in this post-oil era** by integrating the three aspects: energy, water and living qualities, especially in the suburban.

Chapter 2 Problem field


NEED
$$
INCOME
TAX
DON

Houston context/ Historical perspective:
The city based on oil

Foundation of Houston: Railroad, oil and ship channel

Houston was established by the Allen brothers at the confluence of Buffalo and White Oak Bayous in 1836. At first, it was just 147 swampy acres in the middle of nowhere. In 1850s, because of its location, Houston became the railroad hub to transport inland products, cotton majorly, to the port of Galveston and Beaumont. Railroad networks grew bigger onwards. In 1890s, Houston was already the railroad center of Texas. After the huge storm in 1900, which destroyed almost entire Galveston including the port, Houston ship channel was constructed and took over the shipping business from Galveston. At the same period, oil was discovered in 1901. Railroad, oil and ship channel became three major factors influencing urban development in Houston.

Railroad network was the backbone of urban growth in Houston. In the 1940s, automobiles started to become the major transportation. Most of highways were built alongside railroads, and they reinforced the developments rapidly. The size of Houston grew into double in this period. Urban pattern in Houston is basically following the "Jefferson Grid", especially in the early development. (see the Houston wards map from 1920, p.12) Since oil was discovered and ship channel was constructed, energy (oil) and exports are engines drive the economy in Houston until today.

1836

The Allen brothers founded a new city at the confluence of Buffalo and White Oak Bayous.

1900s

The city grow to approximately 9 square miles and had a population of 44,000.

- 1901 Discovered oil

1910s

The population expanded beyond the central core, the city annexed area along the ship channel for controlling navigation and wharfage.

- 1914 Ship channel constructed

1940s

The city expanded double of it's size and reached nearly 600,000 population.

- 1942 Ship industry and medical center estabilised (because of WWII)
- 1948 First highway was constructed (reaching Galveston)

- The maps show the urban growth of Houston. Infrastructure lines are the current situation, only used to indicated the location (source: City of Houston, Planning & Development Department)

Energy shapes the economy, environment and society

The report, 2015 Houston Employment Forecast, published that the region now ranks as the top U.S. export gateway, overshadowing New York, Los Angeles, Seattle and Detroit. A study by the Brookings Institution found that the number of export-supported jobs likely exceeds 400,000 today. The U.S. Bureau of Economic Analysis estimates that mining (in Houston, almost entirely oil and gas extraction) and energy industry (chemicals, refining, oil field equipment manufacturing, fabricated metal products, pipelines and engineering) accounted for $186.6 billion, or 38.1 percent of Houston's GDP, in 2013.

While Houston grows strongly in the economic perspective, oil also influences other sides of Houston significantly. Job opportunities and relatively low living cost continuously attracts huge population not only inside U.S. but also oversea. Fast expansion (almost without limits from geographic features) overwhelms nature environment. The cheap oil price also affects the human behaviors on transport. This kind of sprawl urban form and the high car-usage shape Houston as a high automobile dependence city today.

1950s

By the end of the decade, Houston was 350 square miles with nearly 1 million residents.

- 1956 Lake Houston is created to supply fresh water

1960s

Several important annexations took place in the 1960s, such as expansion of Lake Houston and international airport

- 1961 NASA established

1980s

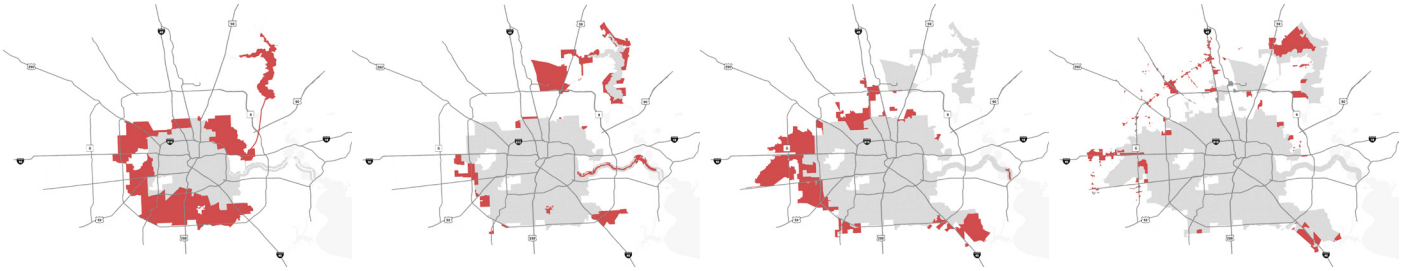
Throughout the 80s, annexation was considerably more limited than it had been in the past. But still, the city's population had grown to 1.6 million residents

- 1974 Oil crisis

2000s

Despite slower growth in size, the city's population continues to grow. In 2012, more than 2.1 million people called Houston home.

- 1999 Texas law governing annexations changed and general purpose annexation became more difficult.



Houston context/ Societal perspective:
The most sprawling, least dense, most automobile dependent major city in America

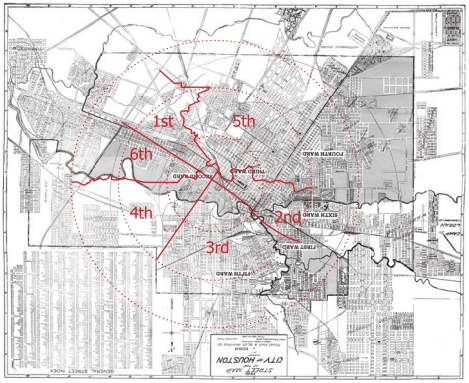
Wards of Houston: legal entities in the past, cultural entities today

When the city of Houston was founded in 1836 and incorporated in 1837, its founders—John Kirby Allen and Augustus Chapman Allen—divided it into political geographic districts called "wards." The ward system, a precursor to today's City Council districts, was a common political tool of the early 19th century, and is still used in some American cities. Historically the wards reflected geographic boundaries, without consideration of the population density within the wards. Betty Chapman, a historian, said "They really were mixed societies in the early days. Where you worked dictated where you lived, not who you wanted to live around."(City Savvy Online, 2008)

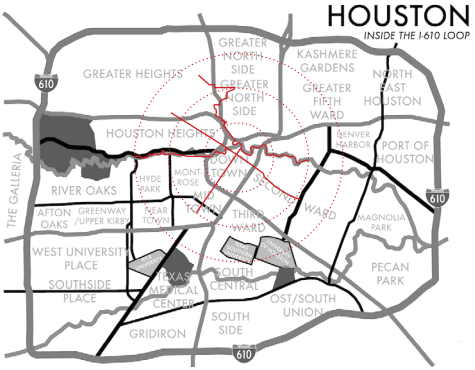
The City of Houston abolished the ward system in the early 1900s. While the wards no longer exist legally, area residents still identify certain communities, especially that have been a part of the city since incorporation, as being "wards" of the city. The ward identification appears on signage and in casual conversation from Houstonians. Will Howard, an assistant manager of the Texas and local history department of the Houston Public Library, said during that year "They are cultural entities today, not legal entities, and like any culture, they are almost obligated to change." (Houston Chronicle, 2004)

Todays, the wards become a more obvious division in the societal aspects. If we compare to the racial/ethnic distribution map on the next page, it can be seen that each wards has their majority groups.

- Left: Street map of the City of Houston, 1920 (source: Texas Map & Blue Printing Company)



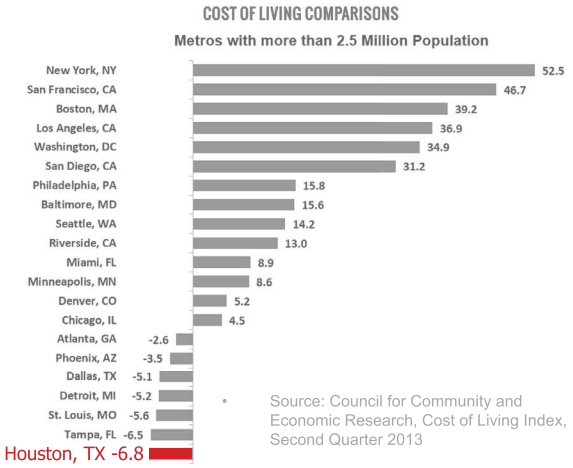
- Right: Current neighborhoods in Houston(-source: Urbane, www.mapurbane.com)



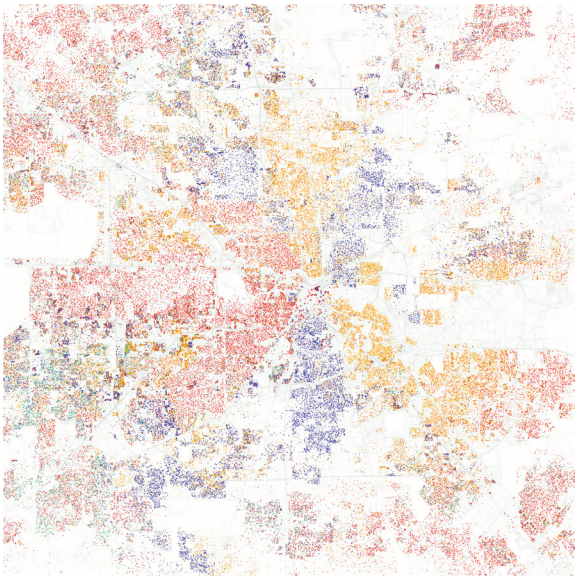
Expanding city: attractions of living in Houston

The Houston-The Woodlands-Sugar Land Metropolitan Statistical Area (MSA) added more residents last year than any other U.S. metro area. That's according to the U.S. Census Bureau's recently released estimates. The New York-Newark-Jersey City metro area ranked second in population growth while the Dallas-Fort Worth-Arlington metro ranked third. Someone moved to the region from overseas every 20.6 minutes, while someone moved to Houston from elsewhere in the U.S. every 9.5 minutes. No racial or ethnic group represents a majority of the population. (Anglos comprise 38.8 percent of total population; Hispanics comprise 35.9 percent; Blacks 16.7 percent; Asians 6.7 percent; other and mixed races 1.9 percent.)(U.S. Census Bureau, 2013)

In U.S., New York and Los Angeles represent the two opposite sides of living style. Some people enjoy living in dense mixed-functions urban areas with convenient public transport systems. Other people like to own a bigger house with nice yard for kids to play in. For the people who are attracted by Houston, here is some main factors. The flourishing economy provides job opportunities. Although comparing to the income in New York, the salaries are lower. But if people also consider the living cost, they can actually save more money and afford to buy their own houses in Houston.



• Source: Council for Community and Economic Research, Cost of Living Index, Second Quarter 2013

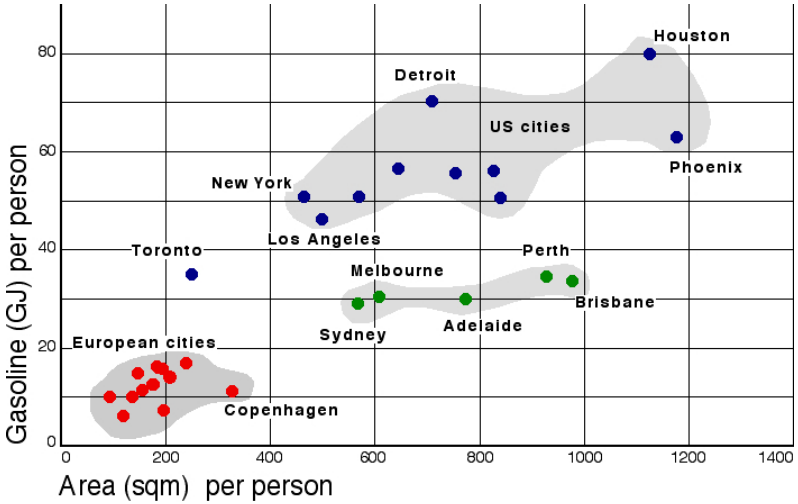


• Map of racial/ethnic distribution in the city of Houston, 2010 census. Each dot represents 25 people. Red dots represent White people, orange dots represent Hispanic people, blue dots represent Black people, green dots represent Asian people, and gray dots represent other people (source: Data from Census 2010. Base map © OpenStreetMap, CC-BY-SA)

Houston suburban: the most sprawling, least dense, most automobile dependent major city in America

While population keeps pouring into Houston, the city also shows the warming welcome to the people. Comparing to other suburban area, such as Los Angeles, Houston has relatively loose regulations in urban development, especially in previous decades. Highways support the suburban to grow further. People are used to drive 2-3 hours everyday to work (also because of the traffic jams). The data shows that 77% of the people drive alone to work everyday, 10% carpool, and only 2% use public transportation. (Census Bureau's 2012 American Community Survey)

The suburban does have it's living qualities, but also results serious urban issues for Houston. "The relative intensity of land use in the ten US cities is clearly correlated with gasoline use overall and in the inner and outer areas. The strongest relationship is with the population density in the inner area… These patterns suggest that urban structure within a city is fundamental to its gasoline consumption" (Newman & Kenworthy, 1989, p.25).



- Suburban in Houston (Source: https://www.flickr.com/photos/nelsonminar/5343099039/)

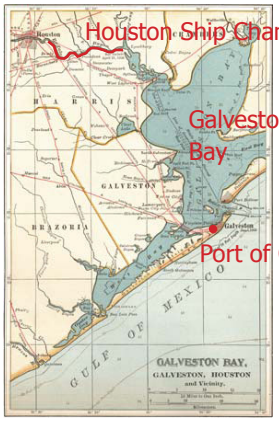
- Downtown and suburban (Source: http://3.bp.blogspot.com/)

- Source: Newman and Kenworthy, 1989, Gasoline consumption and cities: a comparison of US cities with a global survey

Houston context/ Geographic perspective: The bayou city

Where the city was born: Buffalo bayou

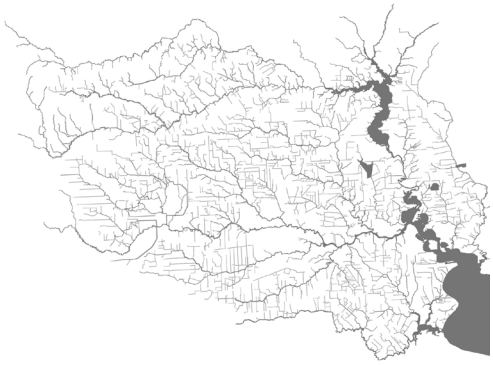
Houston was established by the Allen brothers at the confluence of Buffalo and White Oak Bayous in 1836. The Bayous provides the transportation in the early years. People's life was highly related with the water in that period. After the port of Galveston was destroyed by the storm in 1901, people decided to protect the exports by moving into the edge of Galveston bay. Houston ship channel was constructed and opened in 1914. It locates at the month of Buffalo and White Oak bayous. Industries started to occupy the waterfront onwards. Today, the water is more disconnected with the urban fabric, especially near the ship channel.



- Source: Map of Galveston Bay, Houston, and vicinity (c. 1900), from the 10th edition of Encyclopædia Britannica.

- Houston, 1891 (Source: Perry-Castañeda Library Map Collection)

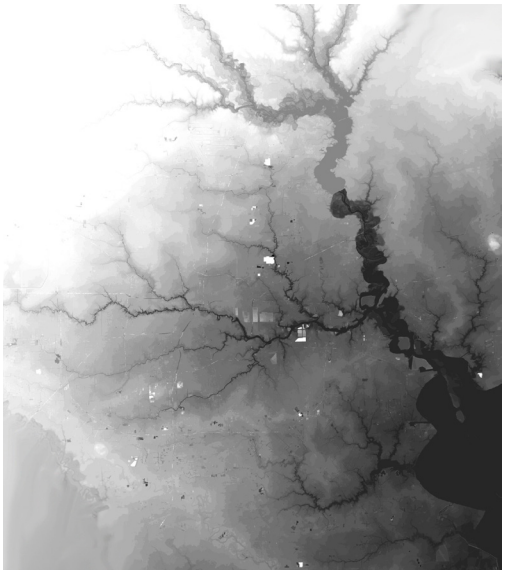
- Natural and man-made drainage system in Harris County (source: Susan Rogers, Super Houston)

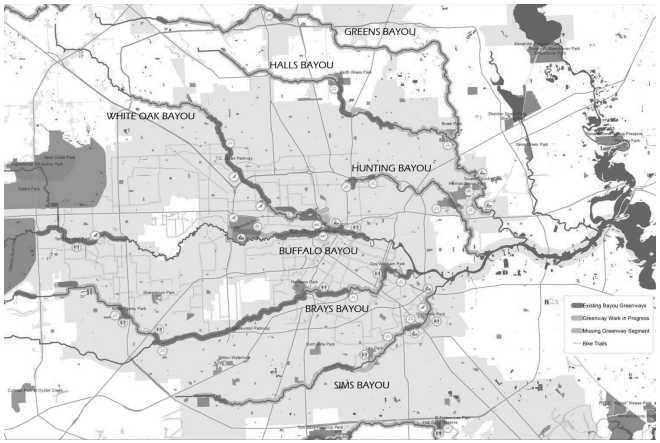


Flat plain and water system

Houston is located on a flat plain with intertwining bayous. There are 2047 km of natural water system. The flat plain and heavy rain result another man-made city networked with 2285 km of drainage ditches and channels. Because of the small height different, the water are mainly very shallow and slow. The fresh water supply is supported by the lakes locating on the upper stream of Galveston watershed.

- Galveston water shed height map (Source: GIS datafrom Texas A&M)



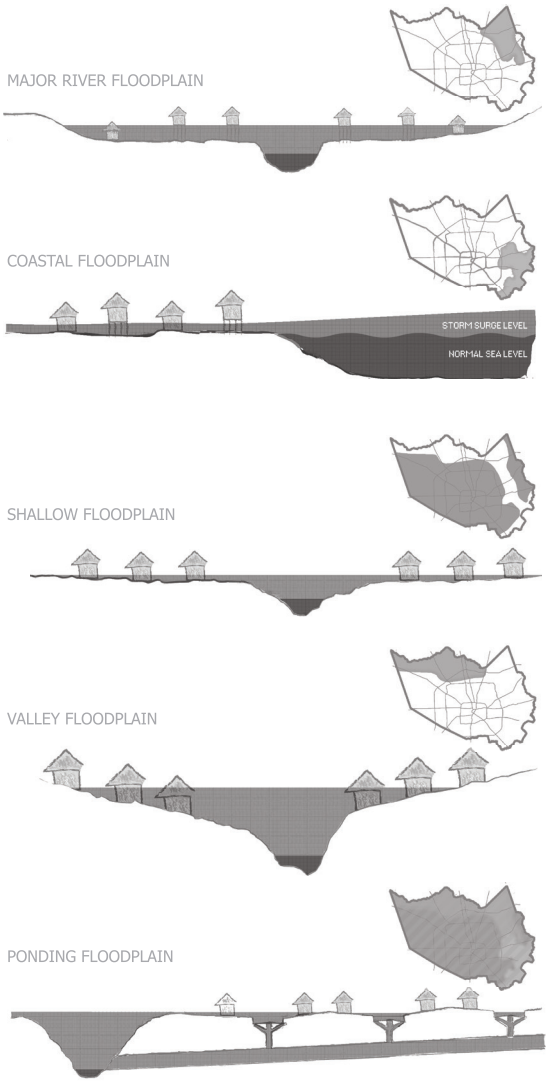


- Bayous in City of Houston (Source: Houston Park Board)

Living with water: flood risk

Life of houstonians are highly effected by water. Because of the geographic features, almost every properties are facing the flooding risks. According to the locations, there are several types of floodplains.

- Major river floodplain: It's a specific area at the east-north side. The floodplain is large, deep and swift. The flood conditions may last a week or more.
- Coastal floodplain: Coastal flooding happens when unusually high tides or hurricane surge occurs. It can flood low-lying structures.
- Shallow floodplain: It exist throughout much of the county and affect thousands of residences and business. When the channel capacity is exceeded, flooding begins, but lasts hours, rather than days.
- Valley floodplain: It's generally located in the northwestern portion of the county. Flooding can be very deep and extends for a few days.
- Ponding floodplain: This type of flooding doesn't restricted to any one area of the county. When intense local rainfall exceeds storm sewer or roadside ditch capacity, the water can pond in streets deep enough to flood residences that are not even near a creek or bayou.

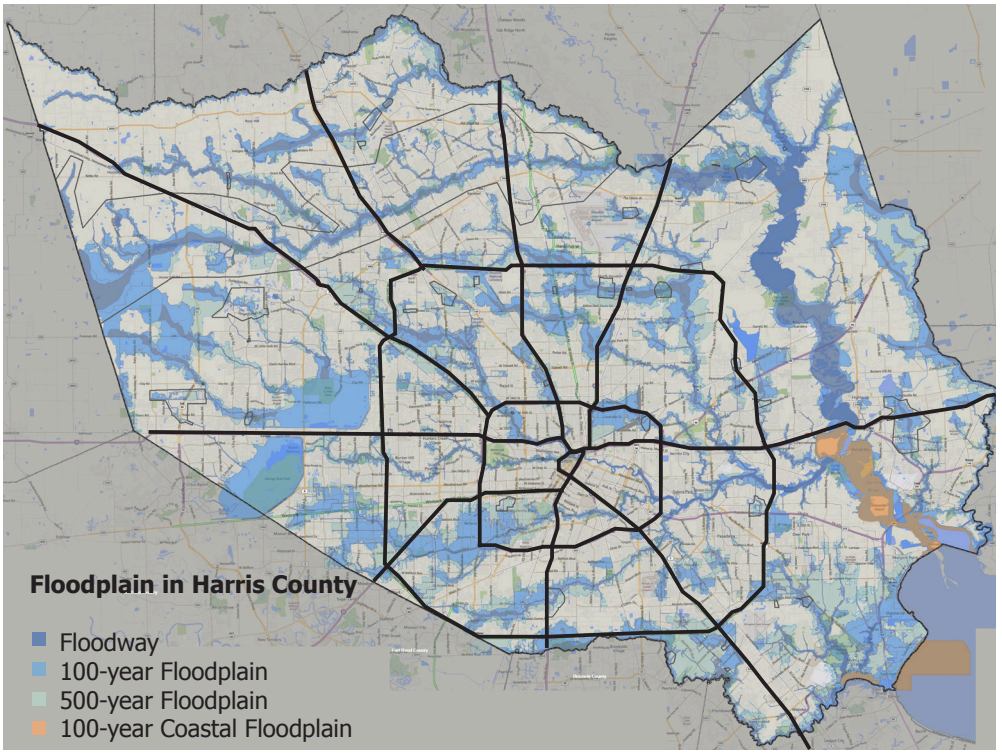


• Floodplain types in Harris County (Source: Harris County Flood Control District, 2015)

Problem definition 1:
Flooding with heavy rainfall

Flat plain and heavy rainfall result the city with 4332 km of drainage ditches, channels, and bayous, but they are still not efficient to protect the city from flooding. During Tropical Storm Allison in 2001, the deluge of rainfall flooded 95,000 automobiles and 73,000 houses throughout Harris County. Tropical Storm Allison destroyed 2,744 homes, leaving 30,000 homeless with residential damages totaling to $1.76 billion. (National Hurricane Center, 2001)

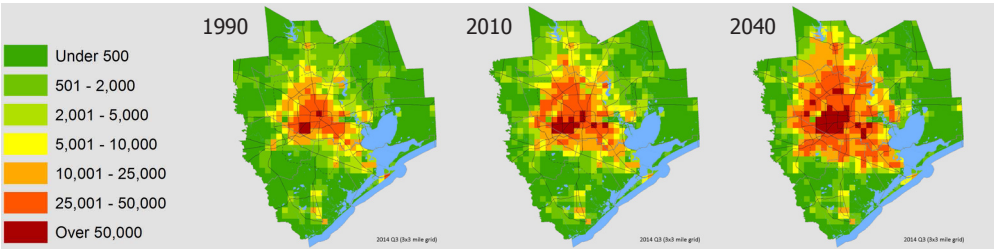
- Houston downtown during Tropical Storm Allison



- Floodplain in Harris County (Source: http://mycity.maps.arcgis.com/)

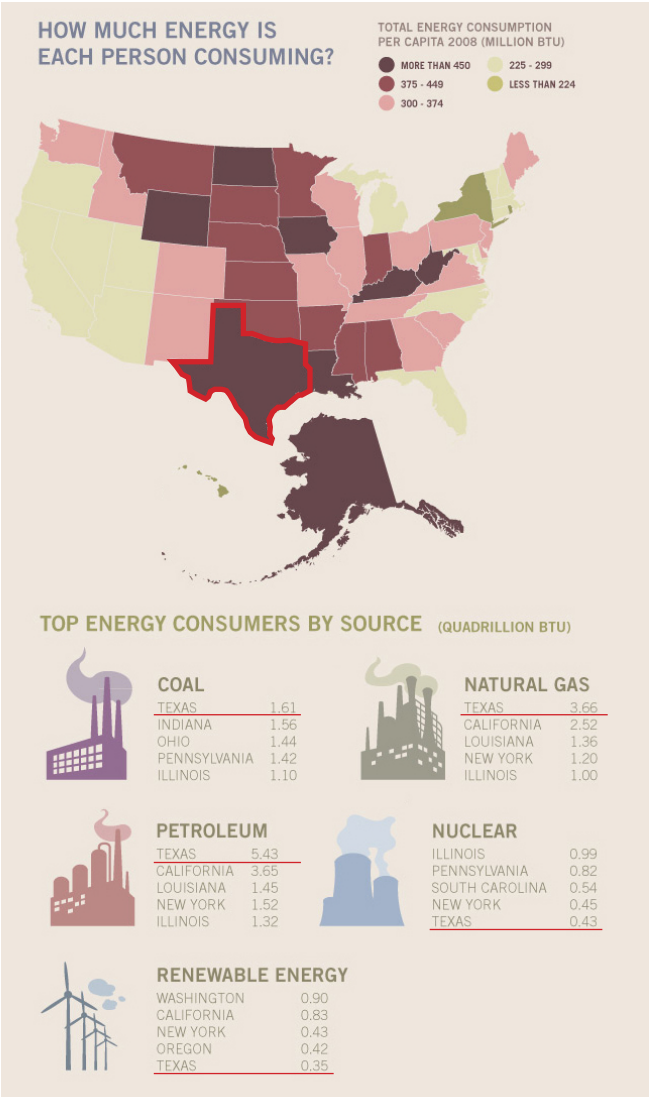
Problem definition 2:
Rapid population growth & urban sprawl

"While oil made Houston boom, a more complicated set of factors made it sprawl. State annexation laws allowed the city to aggressively absorb surrounding areas… Meanwhile, it's always been cheaper for developers to build horizontally than vertically, and because Houston faces few physical impediments such as rivers, lakes or mountains…there isn't any physical reason stopping them. "It's all about land availability and cost…." says Ric Campo, CEO of the national real estate firm Camden Property Trust, based in Houston. "(Governing, 2013)
Historically, Houston has been viewed as "the most sprawling, least dense, most automobile-dependent major city in America." But an annual survey in 2014 from University's Kinder Institute for Urban Research pointed out in that half the residents of Harris County, of which Houston is part, would prefer to live in an area with a mix of development, including homes, shops and restaurants as opposed to a single-family residential area. Not only people having the wills and also government is trying to move toward denser and more livable urban life by proposing an endless list of plans and policies. But still, Houston is looking for a stronger solution and vision to "go urban".



- 2040 population growth and urban sprawl prediction (Source: United States Census Bureau, 2014)

Problem definition 3:
High energy-consumption



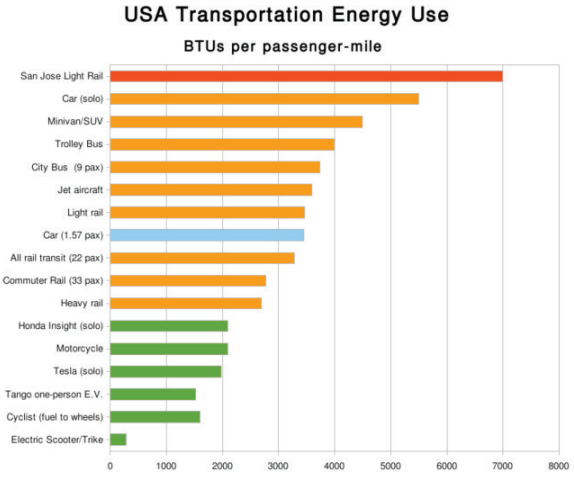
American consumes over 20% of the world energy while the population is only 4.33% of the world. Texas is the biggest energy consumer in the total energy use, and also has highest energy consumption rate per person. Cooling /heating system and transportation are the two main factors of personal consumption, which strongly depend on the coal, natural gas and petroleum, the non-renewable resources. Although Texas is recognized as the oil state, the renewable energies should get more attention in future development.

- Statistic evidence of high energy-consumption in Texas (Source: http://magazine.good.is/)

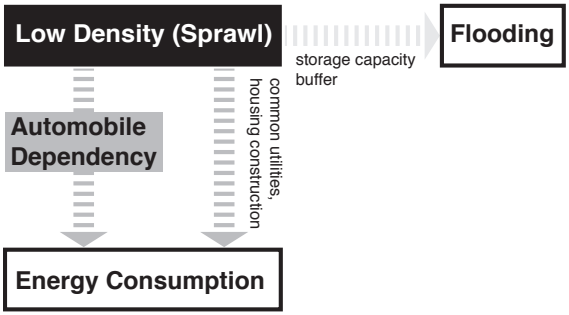
Interrelations between three challenges

Theoretically, if the density is more centralized, the energy consumption and flooding issues can be improved. The intensification process is critical. What is the suitable density for Houston? What kind of relation between built area and landscape? What is the efficient transport system according to the context? In a recent study from Brad Templeton indicates that public transportations are not more efficient than cars in lots of American cities. Instead, he says "we would get more efficient by pushing small, fuel efficient vehicles instead of pushing transit, and at a lower cost."

Theoretical framework in the next chapter will review the theories and methodologies, in order to find ideal intensification strategies for Houston. The smart answer to these questions should be an integrated system that takes also future trends and techniques into account.



- USA Transportation Energy Use (source: http://www.templetons.com/brad/transit-myth.html)



Chapter 3

Opportunities
& project aims

Opportunity / Bayou Greenway:

It was in 1912 that Arthur Comey, a visionary urban planner, laid out a master plan for Houston where its park system is organized around its bayou corridors.

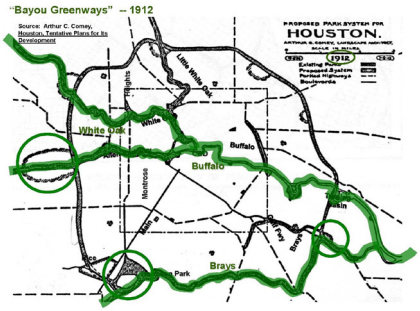
"The bayou city of Houston is in store for one of the largest parks projects in the nation. As of now, the major bayous are disconnected from one another and leave many communities without access to green space. Houston has 75 miles of trails along the major bayous but has the potential to expand the trails to 150 miles in the city, connecting 77 parks with linear greenways along the banks of its bayous. Nearly 60 percent of all Houstonians would live within 1.5 miles of one of these parks or trails." (Houston Park Board)

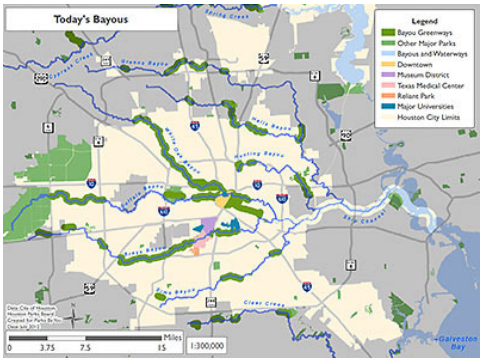
"Ours is a city where currently the automobile creates our geography. We are connected by huge ribbons of concrete and pavement as far as the eye can see. Yet inside the concrete sprawl, we must create parallel connections at the human scale. …We may have a sprawling city, but the sprawl of our city is powerfully matched by the sprawl of our waterways." (Houston Water Board)

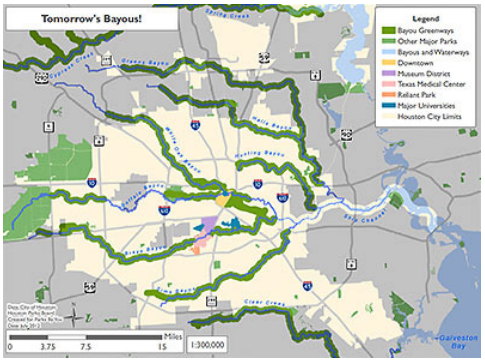
There are the main aspects that Houston wants to tackle with this project:

- Alternative transportation for commuting, ex. Hike and bike trails
- Wet-bottom detention areas flood prevention
- Natural water purification and runoff reduction
- Recreation opportunities
- CO2 sequestration
- Increasing property values along the corridor

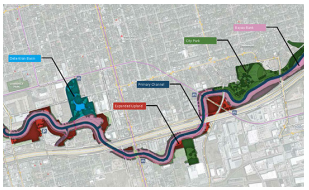
- Master plan from Arthur Comey, 1912 (source: Houston Park Board)

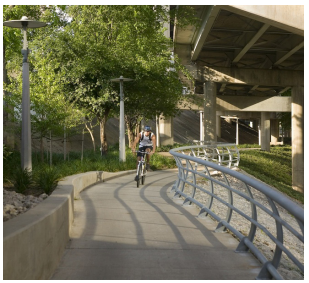






- The two maps show the Greenway project the area alongside bayous into continuing green corridors (Source:Houston Parks Board)





- The plan shows how the Greenway project will connect the open space along bayou (Source: Houston Parks Board)

- Photos show the section of buffalo bayou near downtown(Photo credit: http://www.flickr.com/photos/23910074@N07/8592296523/

Opportunity / Recyclable urban elements: Parking lots, vacant lots, un-used public space

A major part of the strategies for intensification in this project focus on a better use of the existing built-up areas or in other words to 'build the city inwards'. Here are the three main urban elements that are considered with high potentials to be recycled.

Parking lot

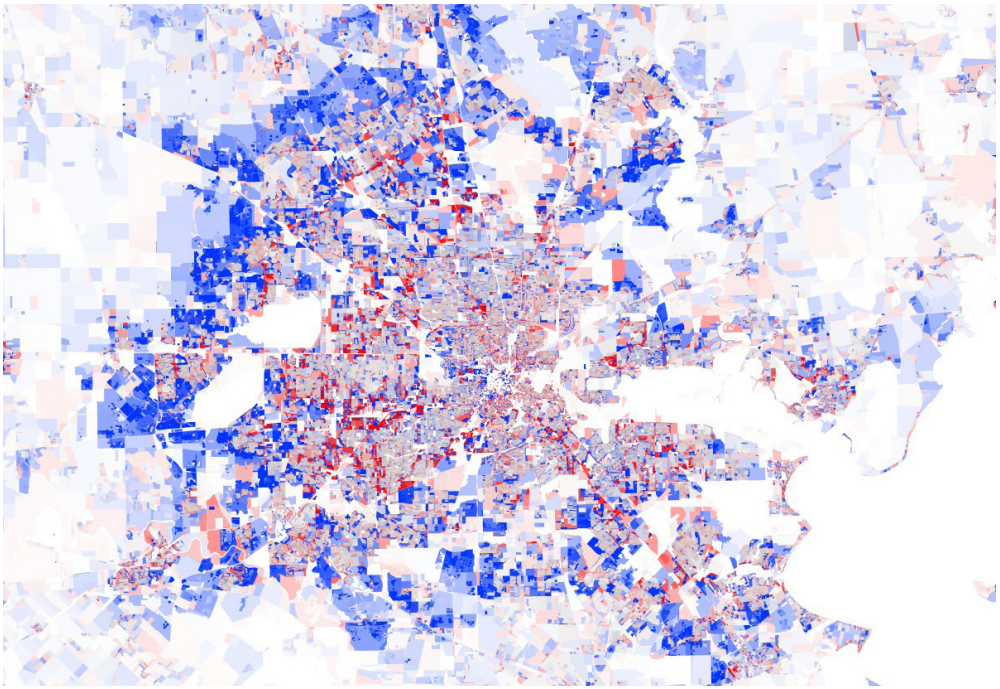
The bottom graphics in the next page show the incredibly high percentage of land is occupied by the parking in the downtown Houston. This situation also happens in the other parts of Houston, while the parking need is actually lower than the provided parking space.

Vacant lot

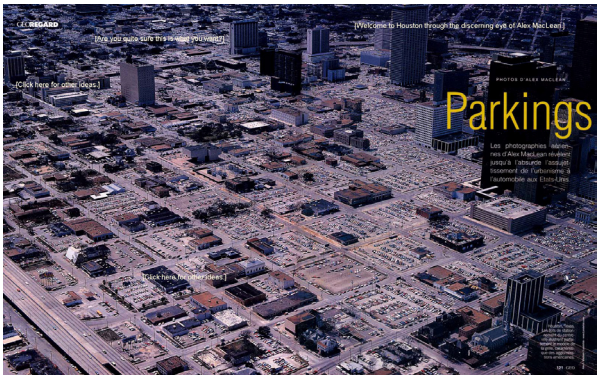
The top map in the next page points out that while the city is still expanding outwards, some existing built areas are losing the population. Lots and buildings become vacant, espacially inside the second loop.

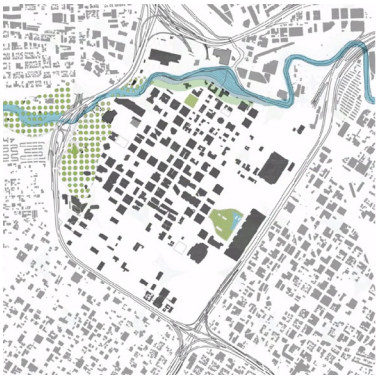
Un-used public space

While Houston is depending on a huge amount of motorways, the spaces alongside infrastructures are often only used as buffer. There are high potentials to provide other functions to support the nearby neighborhoods. This kind of un-used publics can also be found along the water system, rail tracks, etc.



- Houston population change 2000-2010: Blue indicates the it increased more than double, red is decreasing ,and gray is stable (map credit: Stephen Von Worley at DataPointed)



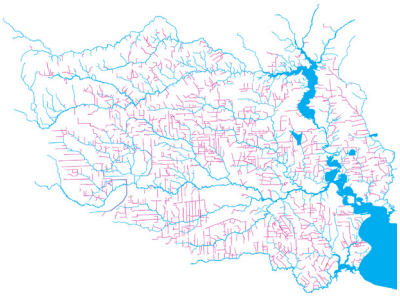


- Right: the map shows downtown Houston when taking out parking spaces(Source: Shuffle City)
- Left: downtown Houston(Photo credit: Alex Maclean)

Project aims

The Bayou Greenway project is mainly considering about the natural drainage system (blue), bayous, for improving the flooding damage from heavy rainfall. If we also take the man-made system (pink), ditches and channels, into consideration, the city can have a stronger water protection (from 2076 km to 4332 km). In the project, I will elaborate from this point and discus how the water system can be transform into not only performing as flooding protection but also combine with the energy deduction and production network. And how the water and energy system can reinforce living quality, especially in suburban.

The project will try to achieve the objectives in three scales: neighborhood, district and city. In neighborhood scale, living qualities and cultural circumstances in suburban (why suburban is so attractive for people) are considered in the first place. Then the aim goes to transforming the recyclable urban elements with integrated design interventions that can reinforce the existing qualities while water safety and energy production are also increased. In district scale, neighborhood interventions are translated into prototypes, and used as common strategies over the district. With these neighborhood strategies, urban systems and flows (energy, transportation, water, open space, etc.) are adjusted to be more sufficient. Intensification possibilities are also discussed according to the urban structure. In city scale, the design strategies are summarized from the previous scales into more general principals that can apply on the similar area over Houston. The conclusion of the project is to provide a city vision including water safety and energy, in order to have a better consideration in this post-oil era.



• Natural and man-made drainage system (map credit: Susan Rogers, Super Houston)

The feasibility is also an important consideration when discussing these changes in Houston. As I mentioned in the previous chapters, investments (both governmental and individual) are highly focused in some particular areas, which means economic-social conditions gap is significant when comparing different suburban in Houston. The design strategies in this project are also considered in different development levels. Some strategies are more focused on how the people can improve their living environment individually with small changes and low budget. Other strategies will try to integrate the potential values for energy and water, in order to attract bigger stakeholders to participate.

Relevance

Scientific relevance

Climate change which is interrelated with flooding and energy consumption in on the high agenda for not only urbanists but also many professions in other fields. Being a high automobile dependent city and facing serious flooding risks, Houston suburban is an ideal model to do the integrated research on intensification with water and energy aspects. This project is trying to review the current theories from different fields. By discussing Houston suburban, the aim is to coordinate the theories, data and my observations to provide overall remarks for the integrated research on intensification, energy and water. The research is focusing on Houston but still shares common issues with other suburban areas over the world.

Societal relevance

The selected site of this project is especially focuses on the suburban area with serious flooding problems and low economic-social conditions. One of aims in the project is to provide strategies for the area that is neglected by the government or investment flows. With more considerations, small individual changes can also have big influences for their living environments.

Chapter 4

Research question
& Methodology

Research question

Main research question

In the intensification process, how to recycle existing urban elements and integrate them with bayou systems in suburban areas to bring synergy between reducing energy consumption and reinforcing living quality in Houston?

The main research question can be elaborated into three sub questions that focus on three different processes and result in three intended end products:
1 intensification strategies and urban structure of the whole project area
2 prototypes set-up in three themes: residential lot, water and public space
3 three local scale interventions based on three kinds of prototypes.

Sub questions & methodologies

1 How to intensify the suburban area by transforming the bayous and urban structure to reduce flooding risk and provide alternatives for individual automobile use?

- Area analysis (mapping) in three categories: living quality, water safety and energy
- Setting up objectives for future urban systems based on area analysis
- Intensification potential analysis based on theoretical framework
  - Spacemate: categorizing land development typologies
  - Mixed Use Index (MXI): identifying potential areas for intensification
- Strategic plan: translating the intensification model and data from Newman (2006) into the project location

2 How to transform the suburban neighborhoods into mixed-use centers that can reinforce the living qualities, provide water storage capacity and still preserve the neighborhood characters?

- Area analysis to identify the common typologies in three categories: residential lots, water system and public space
- Data collection to provide scientific threshold for water storage capacity, energy production and reduction
- Prototypes design based on building morphology and energy consumption research, case study and site visit
- Scenarios of prototypes (different developed levels): Spacematrix

3 What are the prototypes of water interventions and urban forms that can be concluded from the neighborhood interventions and elaborated further based on different scenarios and neighborhood characteristics?

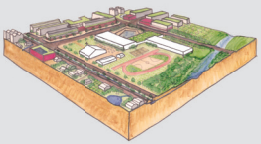
- Mapping and observing to understand the neighborhood characters and existing qualities.
- Research-by-designing to test how to transform the prototypes to existing sites.
- Implementing two scenarios in each sites to discuss the result (ex. energy production amounts) and factors (ex. density, stakeholders) in different developed levels.

Project framework

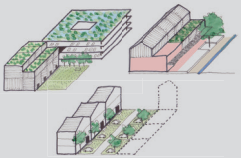
Context & Challenges

Analysis & Strategies

Design Demonstration



Design Principles



Outcomes & Visions

Methodologies from theoratical review

New Urbanism

Transit-Oriented Development (TOD)

Smart Growth

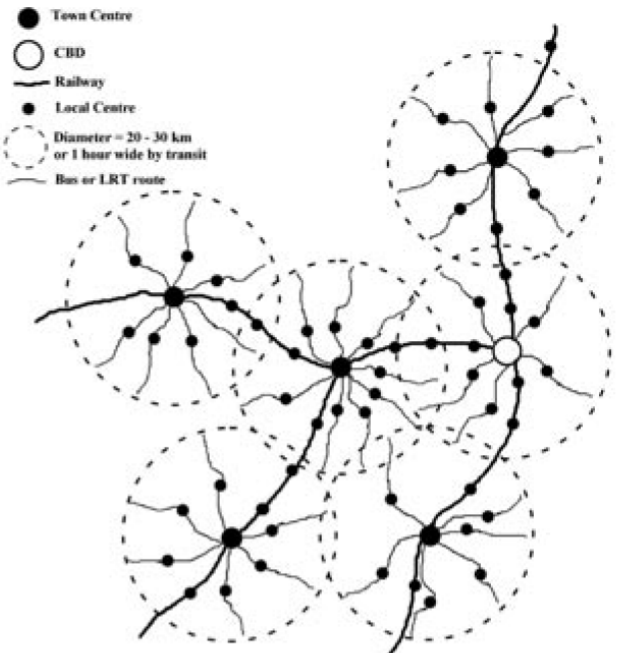
Walkable Urbanism

Sustainable Development

Traditional Neighborhood Design (TND)

Main theoratical references: Regional strategies

Recontructing a automoblie dependent city



- A Conceptual Plan for Reconstructing an Automobile City (Source: Newman & Kenworthy, 2006)

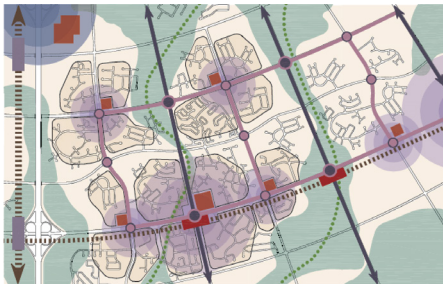
- Ped Sheds for Different Scale Center: The Local Center is defined by its 10- minute Ped Shed and the Regional Center by its 30-minute radius (Source: Newman & Kenworthy, 2006)

Regional sector mapping

Step 1:
Determine sprawl repair domains

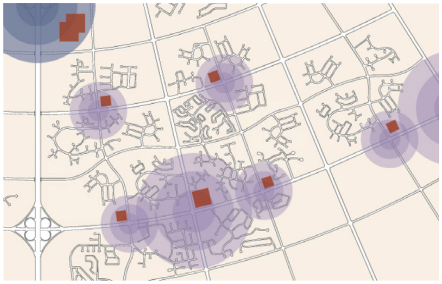
Step 3:
Prioritize commercial and employment nodes

Step 5:
Assemble sector map



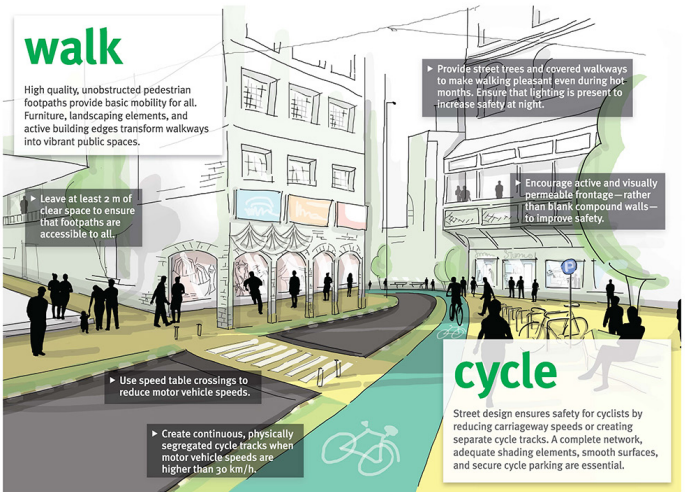
Step 2:
Delineate preservation and reservation area

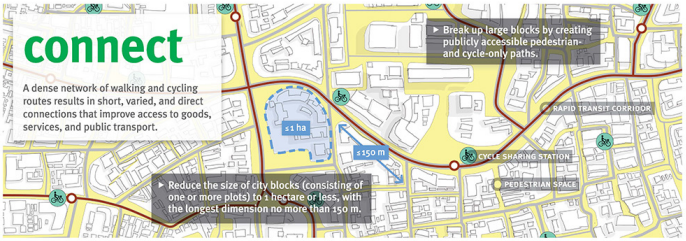
Step 4:
Identify sprawl repair targets

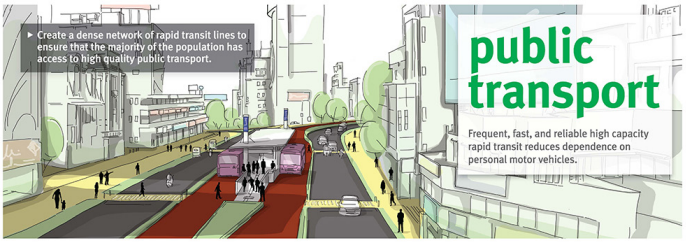


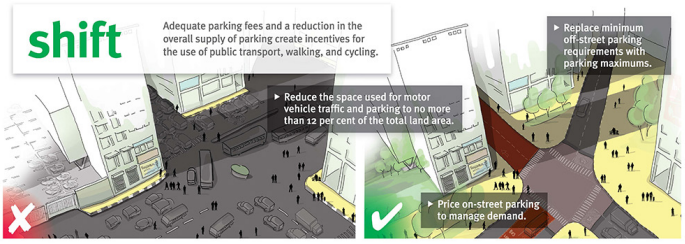
- Source: Sprawl repair manual, Tachieva, 2010

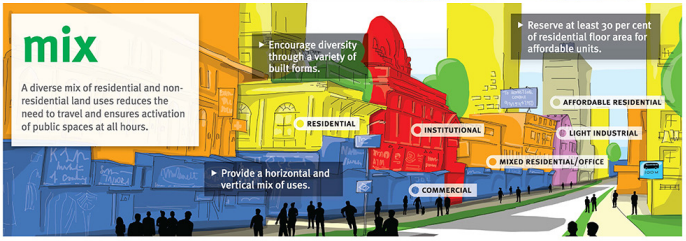
Main theoratical references: Design strategies

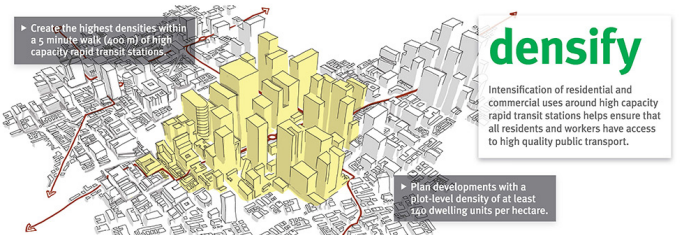






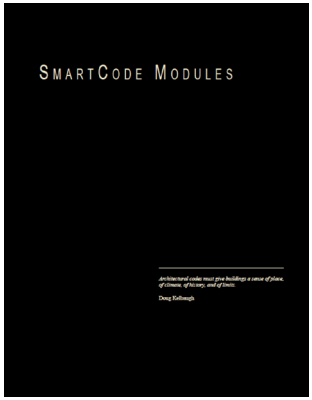




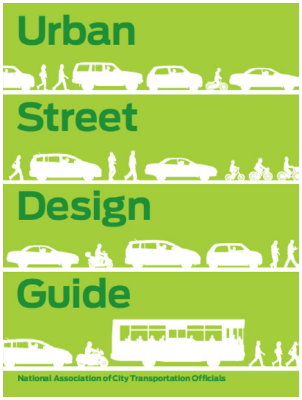


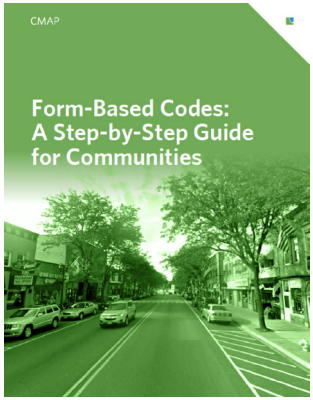
- Source: https://www.itdp.org

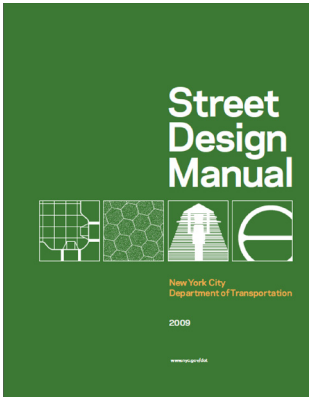

SPRAWL
REPAIR
MANUAL
GALINA TACHIEVA


SmartCode Modules
Doug Kelbaugh


ITDP
PRINCIPLES OF
TRANSIT-ORIENTED DEVELOPMENT

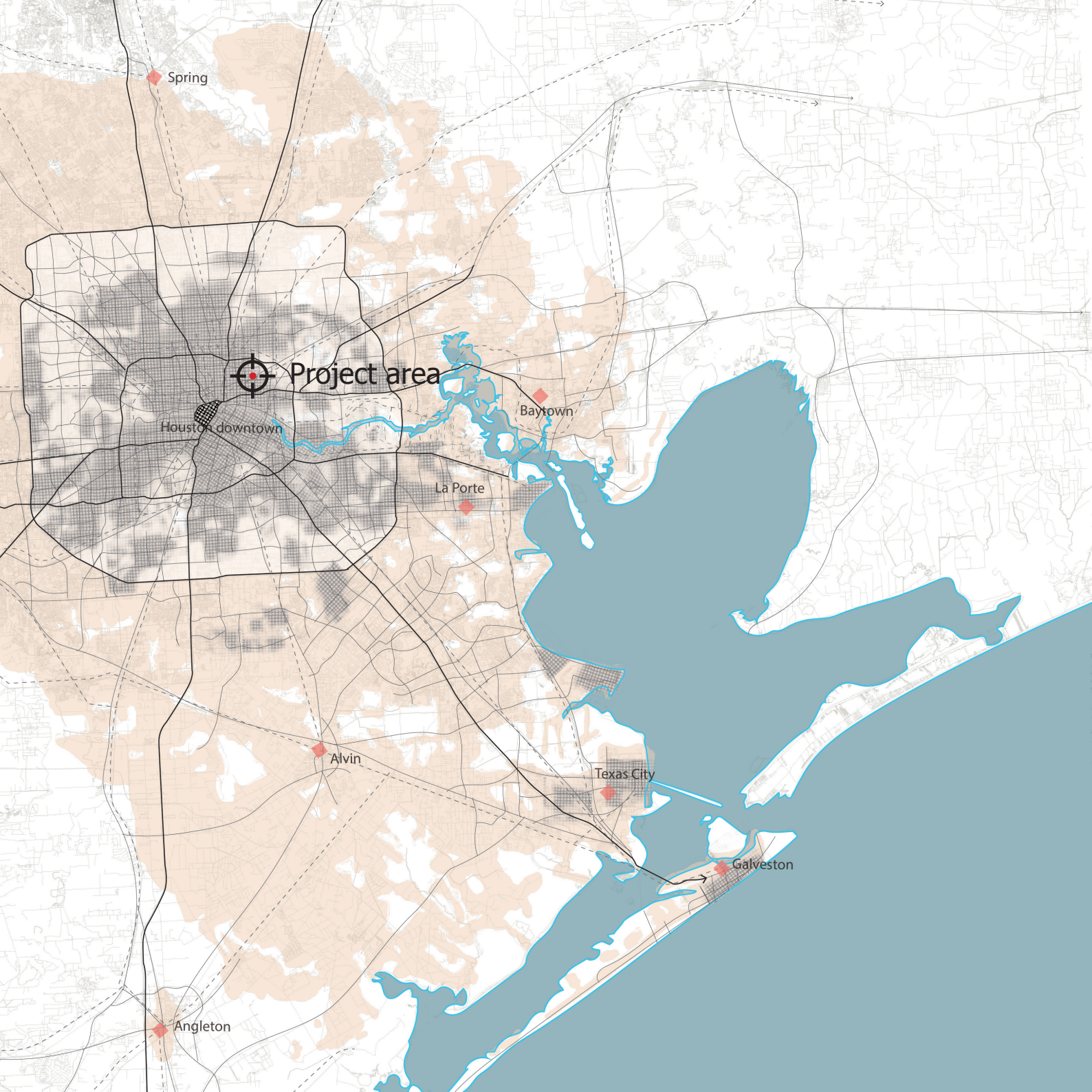

Urban
Street
Design
Guide
National Association of City Transportation Officials


CMAP
Form-Based Codes:
A Step-by-Step Guide
for Communities


Street
Design
Manual
New York City
Department of Transportation
2009

Chapter 5 Spatial analysis


Galveston
Galveston Bay
Houston Downtown
Ship Channel
I-610 (The Loop)
Hunting Bayou


Spring
Project area
Houston downtown
Baytown
La Porte
Alvin
Texas City
Galveston
Angleton

Project area

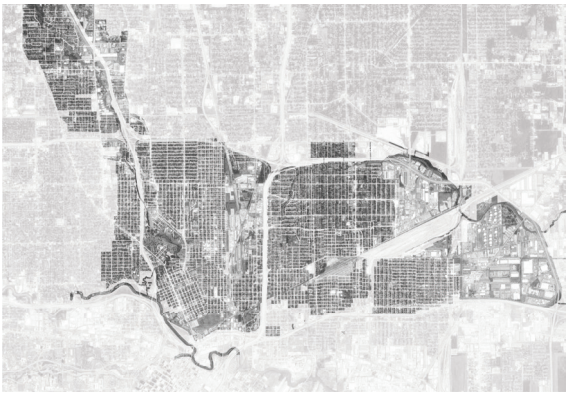
Why Here

In the central part of Houston, there are sevarel bigger floodplains. They are basically following Brays Bayou, White Oak Bayou and Hunting Bayou. Brays Bayou locates at the west side within the most wealthy district. Houston Medical Center, the biggest medical center in the world, is in this area. The flooding issues already have a lot of focuses. This project chooses the north side of Houston along Hunting Bayou and Little White Oak Bayou, in order to not only tackle the flooding but also the other issues in the more vulnerable area.

Rotterdam

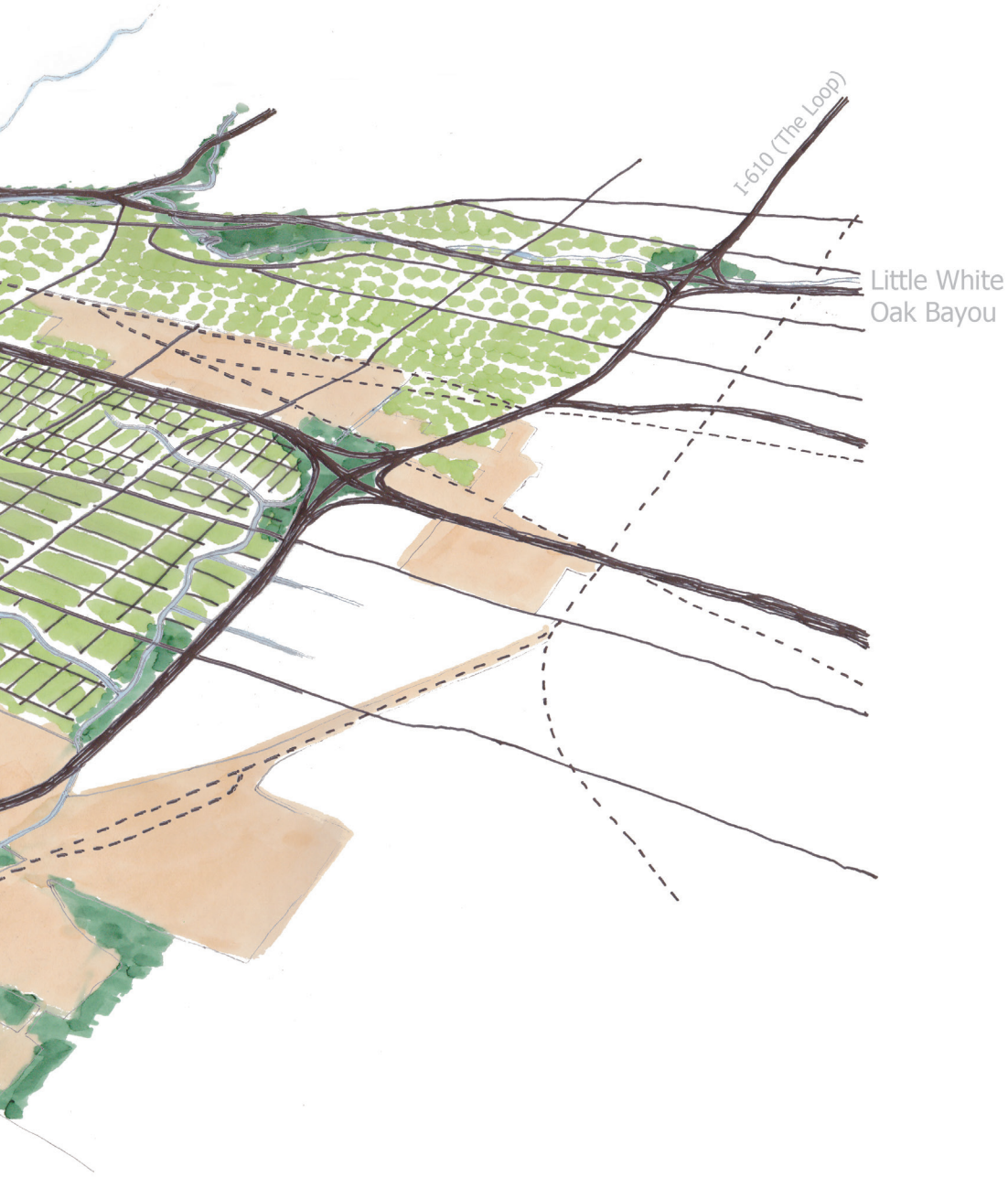
13.20 km

Site



14.25 km


Galveston
Galveston Bay
Houston Downtown
Ship Channel
Hunting Bayou



residential block

floodplain

industrial zone

existing commercial strip

open space

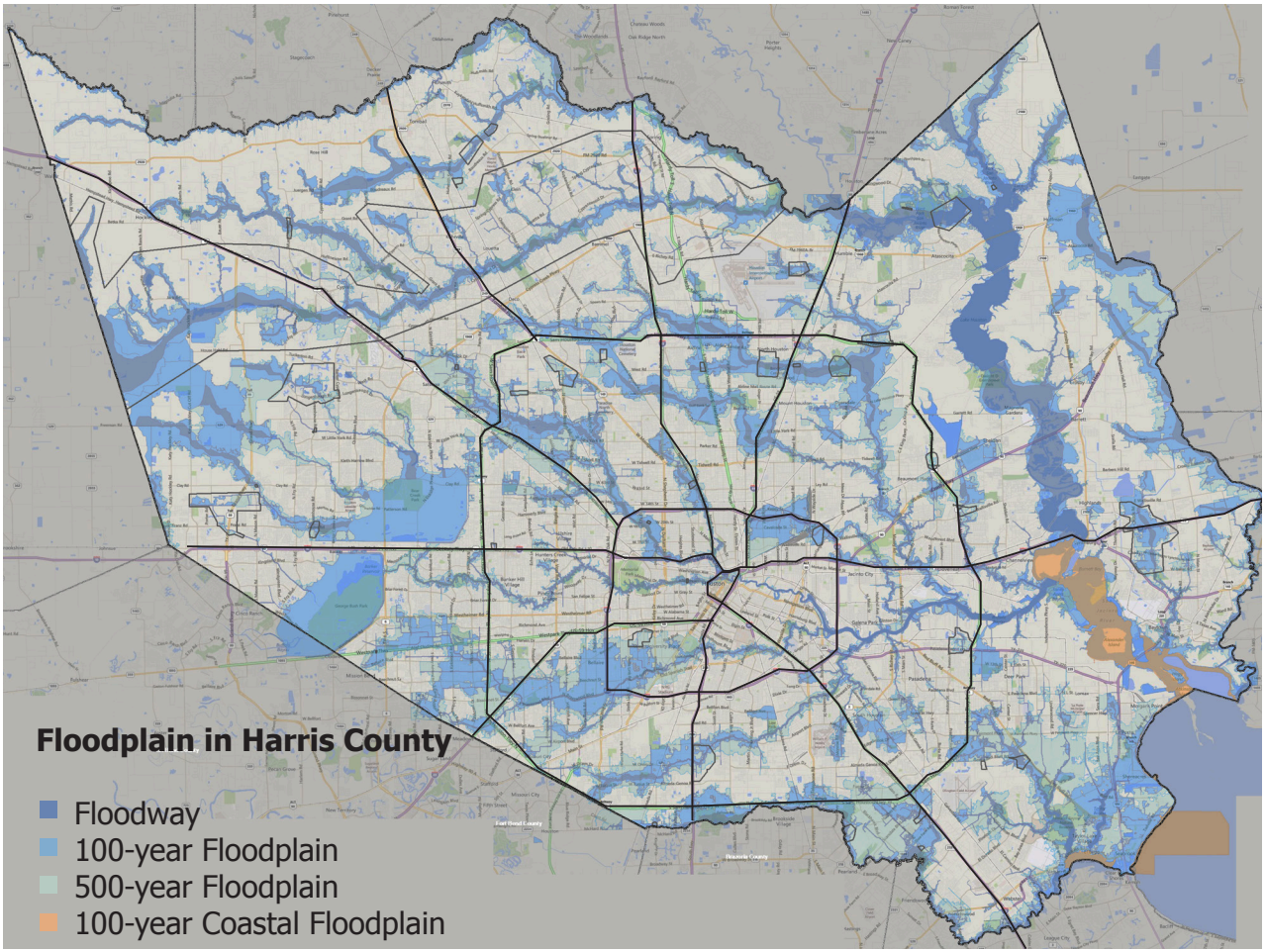
greenway

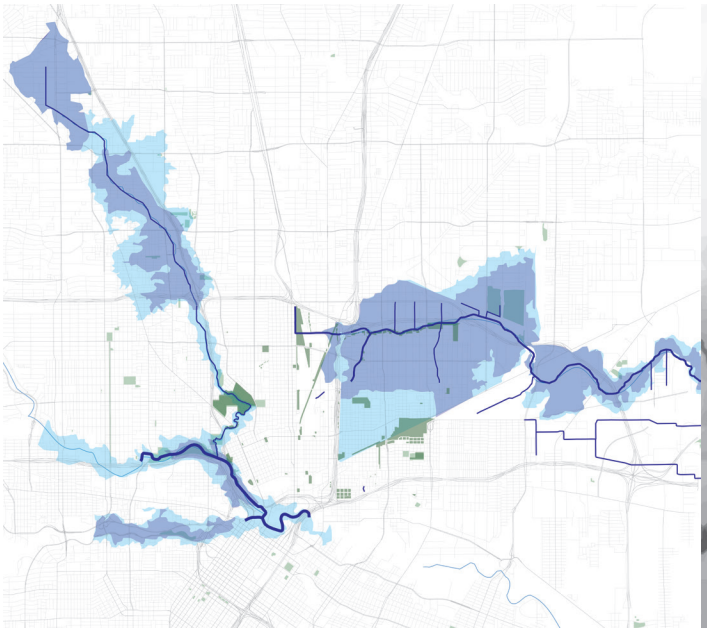
intensification center

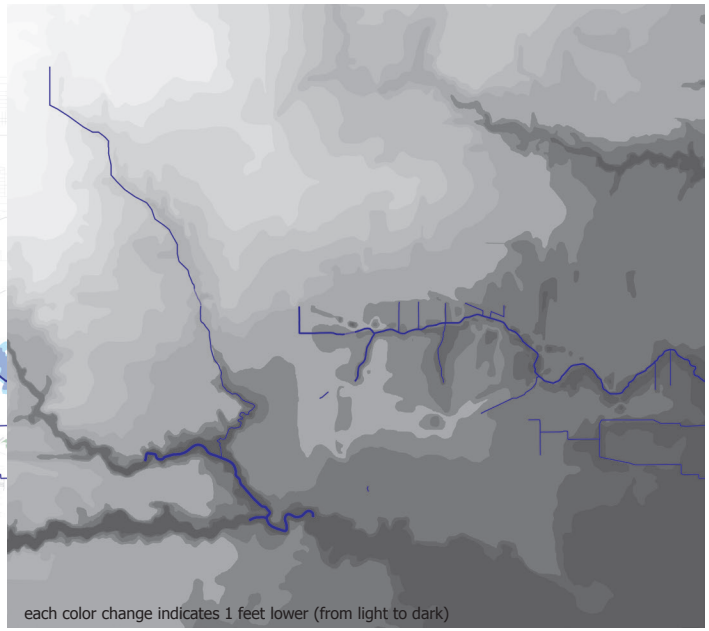
intense commercial strip

commercial strip

Flooding risks



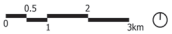




Water and open space

The two bayous are almost parallel with the highways with some bigger open space in between. There are two major floodplains. These floodplains are formed by the height difference.

Legend

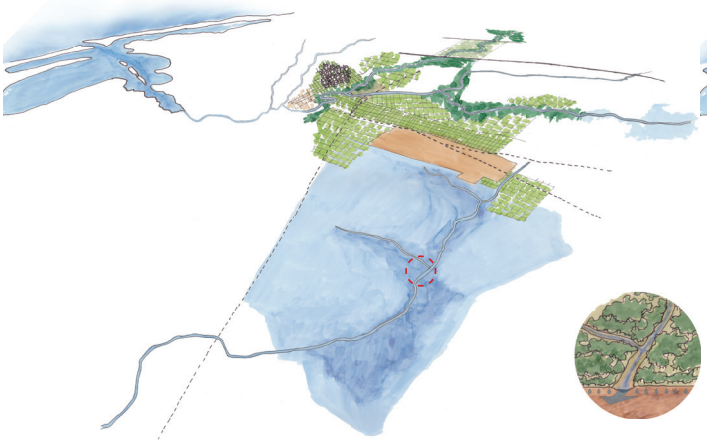


500 years flood plain

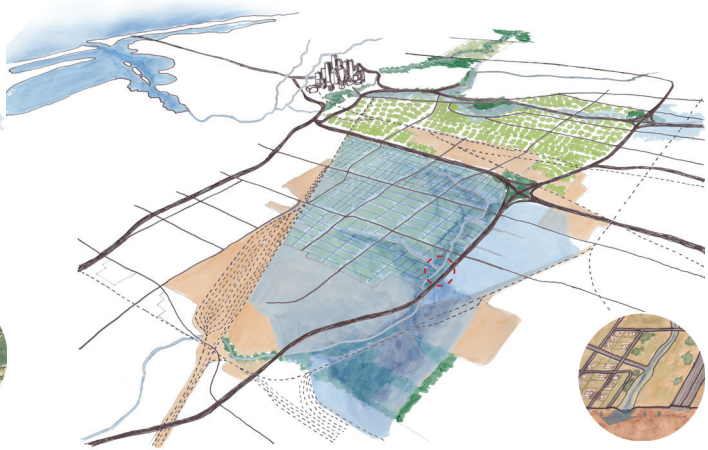
100 years flood plain

open space

Cause of flooding



Houston North, 1920



Houston North, 2015

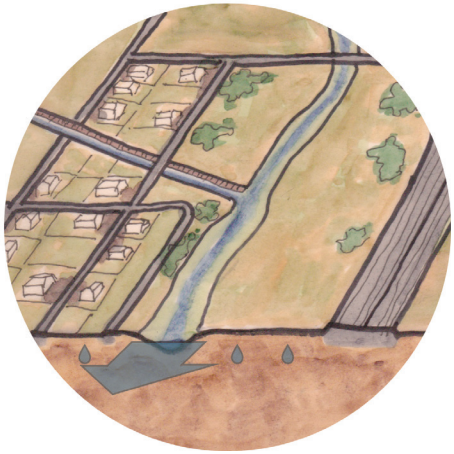
Flooding during Trapical Storm Alison 2001

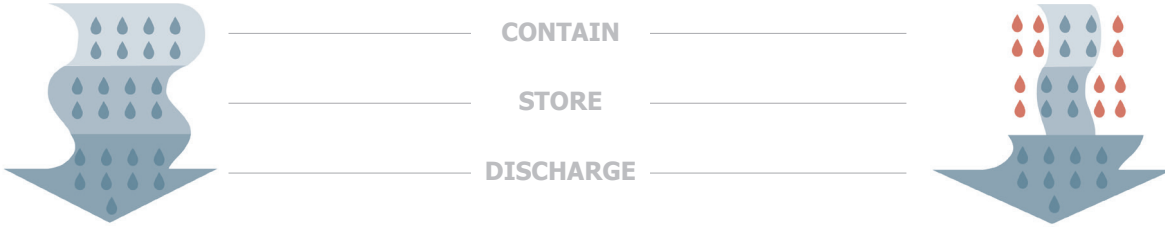
Flooding during heavy raining day

Soil profile
H1: 0-18cm_silty clay loam
H2: 7-20cm_clay
H3: 50-180cm_clay

Depth of water table: 16-48cm

Saturated hydrologic conductivity
(Ksat): 1.5mm/hr





Before urbanization

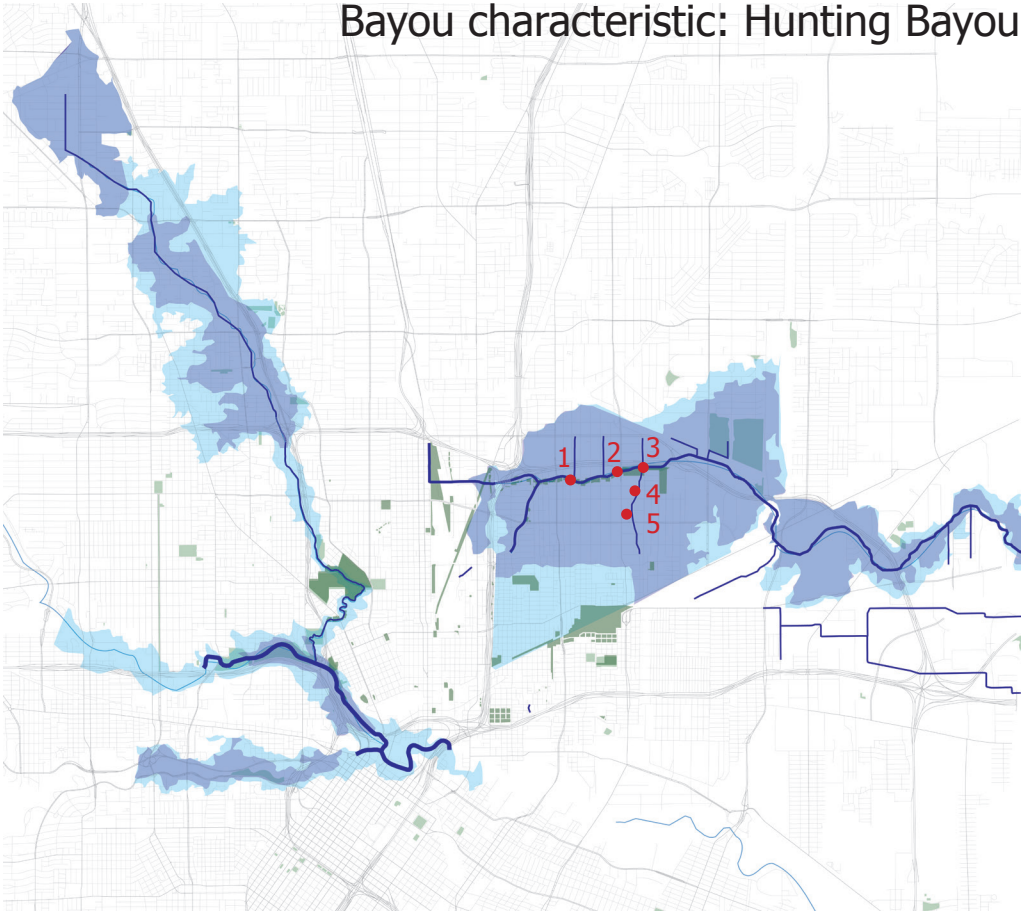
Balanced water system in the natural condition

Current

Discharge capacity increased by concrete river bank

Flooding still occurs because of insufficient permeable ground to contain, store and transport water to the water way

Bayou characteristic: Hunting Bayou



1
The upper stream of Hunting is different from Little White Oak Bayou. It is deep and wide. The waterfront is developed as a park, but people don't really use it.

2
The bayou becomes less deep and wide when it goes east.

3
The intersection of Hunting bayou and it's branch.

4
The branch is canalized, and it goes through the neighborhoods with very small buffer in between.

5
Crossing between branch and main road. It's about 2.5m high and 8m wide.


2


3


4


4

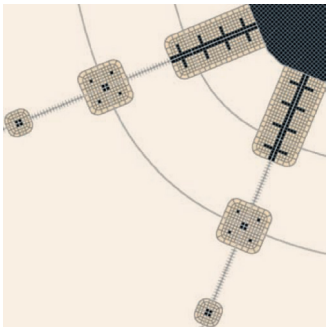

5

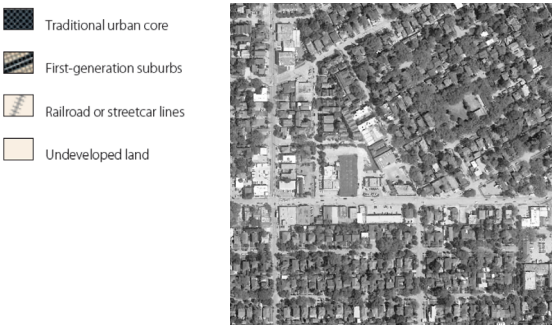

5

US suburban types

Generation1:
Pre-war suburbs

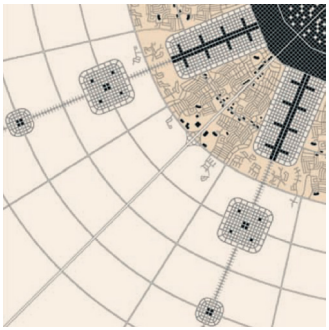
- In the U.S., the first suburbs sprang up in the nineteenth century along the newly built railroad lines
- Compact, middle-class communities assembled around stations (were modeled after the suburbs built in England in the eighteenth century)

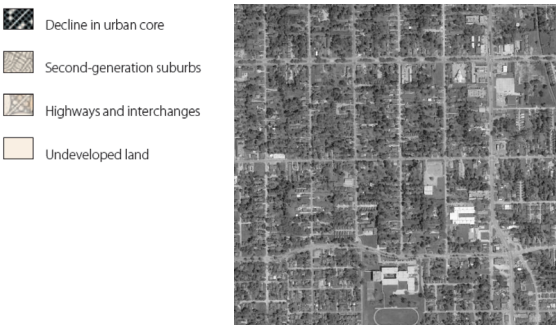




Generation2:
Post-war suburbs

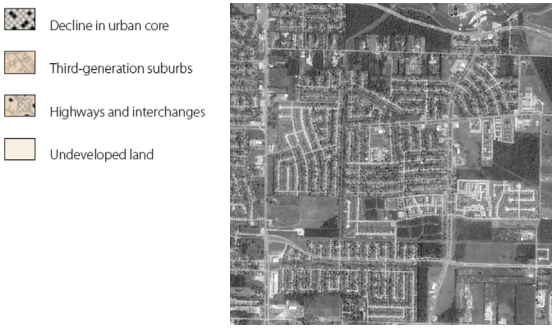
- Started in the 1920s, but flourished after the end of World War II
- Single-use, low-density development spurred by new incentives from the federal mortgage system and the increase in automotive infrastructure and use.



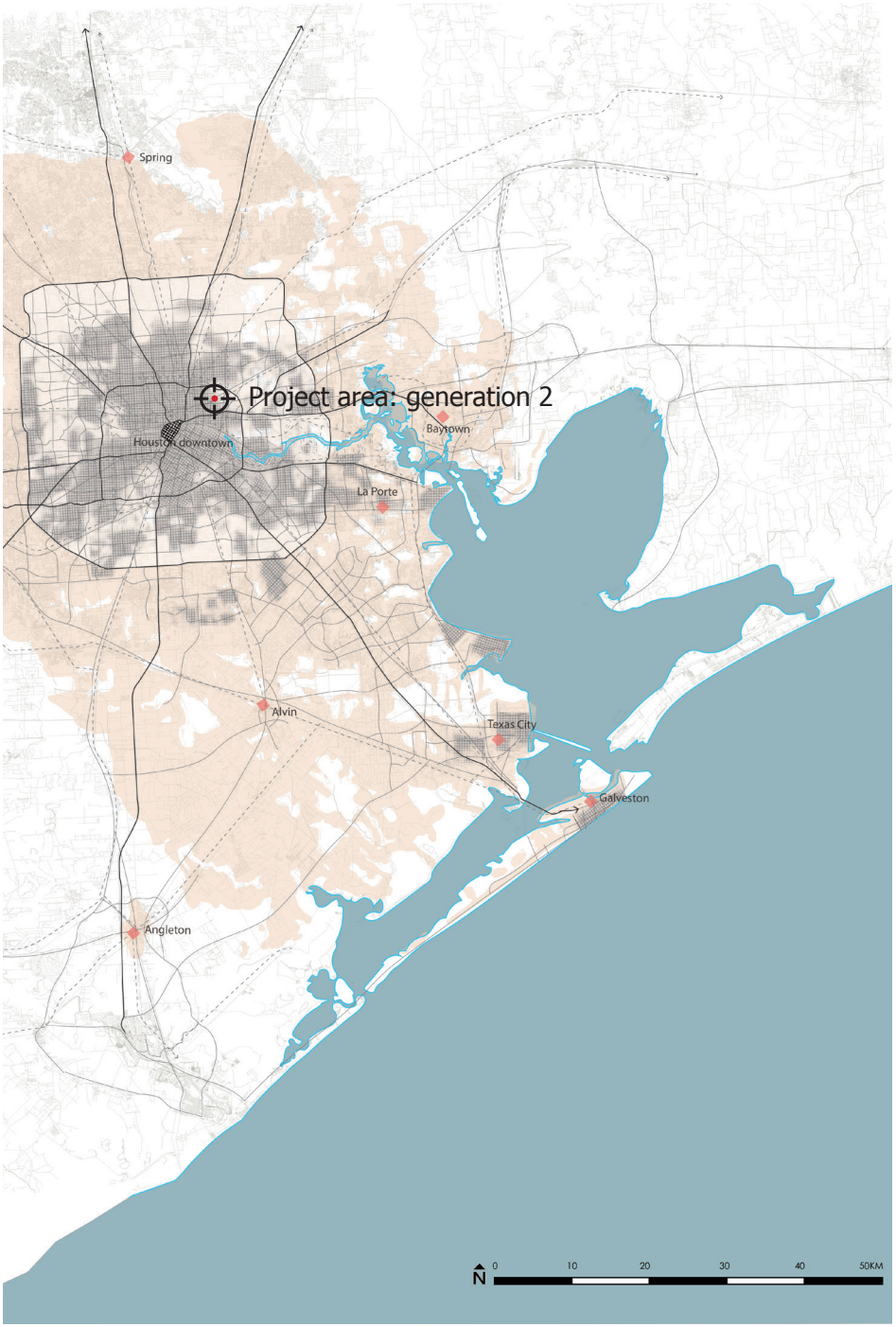


Generation3:
Late 20th-century exurbs

- flourished from the 1980s through the early 2000s
- highly competitive and in good physical shape, due to owners' associations
- reachable only by automobile



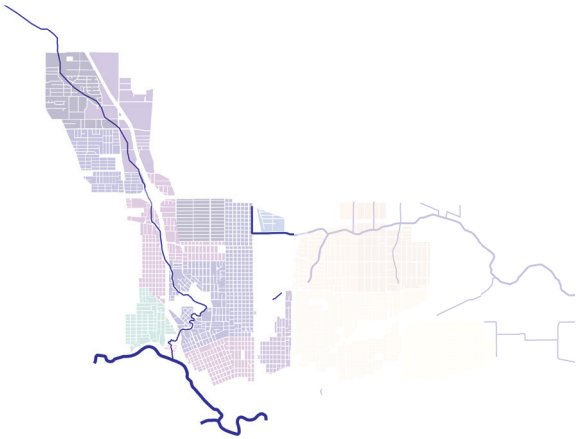
• Source: Sprawl repair manual, Tachieva, 2010


Spring
Project area: generation 2
Houston downtown
Baytown
La Porte
Alvin
Texas City
Galveston
Angleton
N
0
10
20
30
40
50KM

Neighborhood analysis

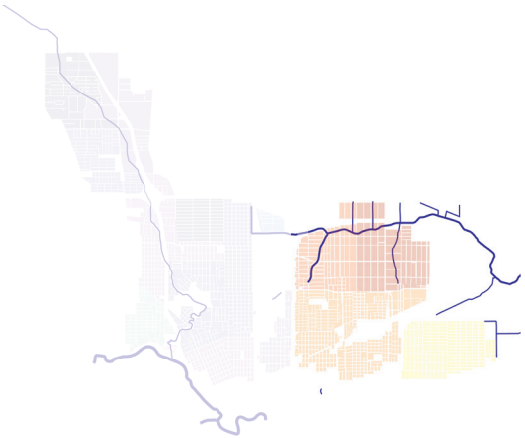
West side

The neighborhood conditions are better than east side, especially the west-south area(green). The single houses are the majority (bottom). There are some exceptions, such as gated communities (top) and new community development (middle).



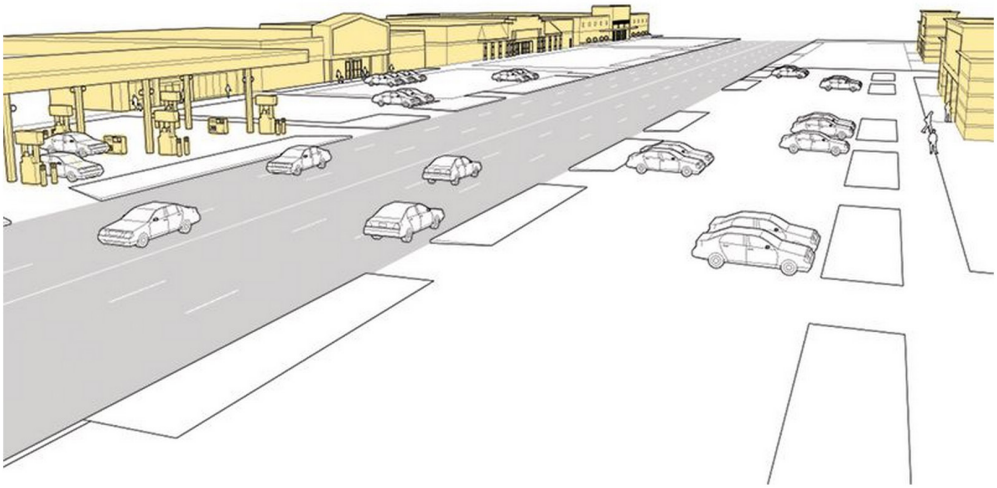
East side

Most of neighborhoods on east side are covered by the floodplain. The social-economic conditions are almost the lowest comparing with other parts of Houston. The density is also lower, and a lot of residential lots are vacant, especially near the water ways. Most of the housings are 1-2 floors single houses(top &middle), but there are also multi-family houses (bottom).

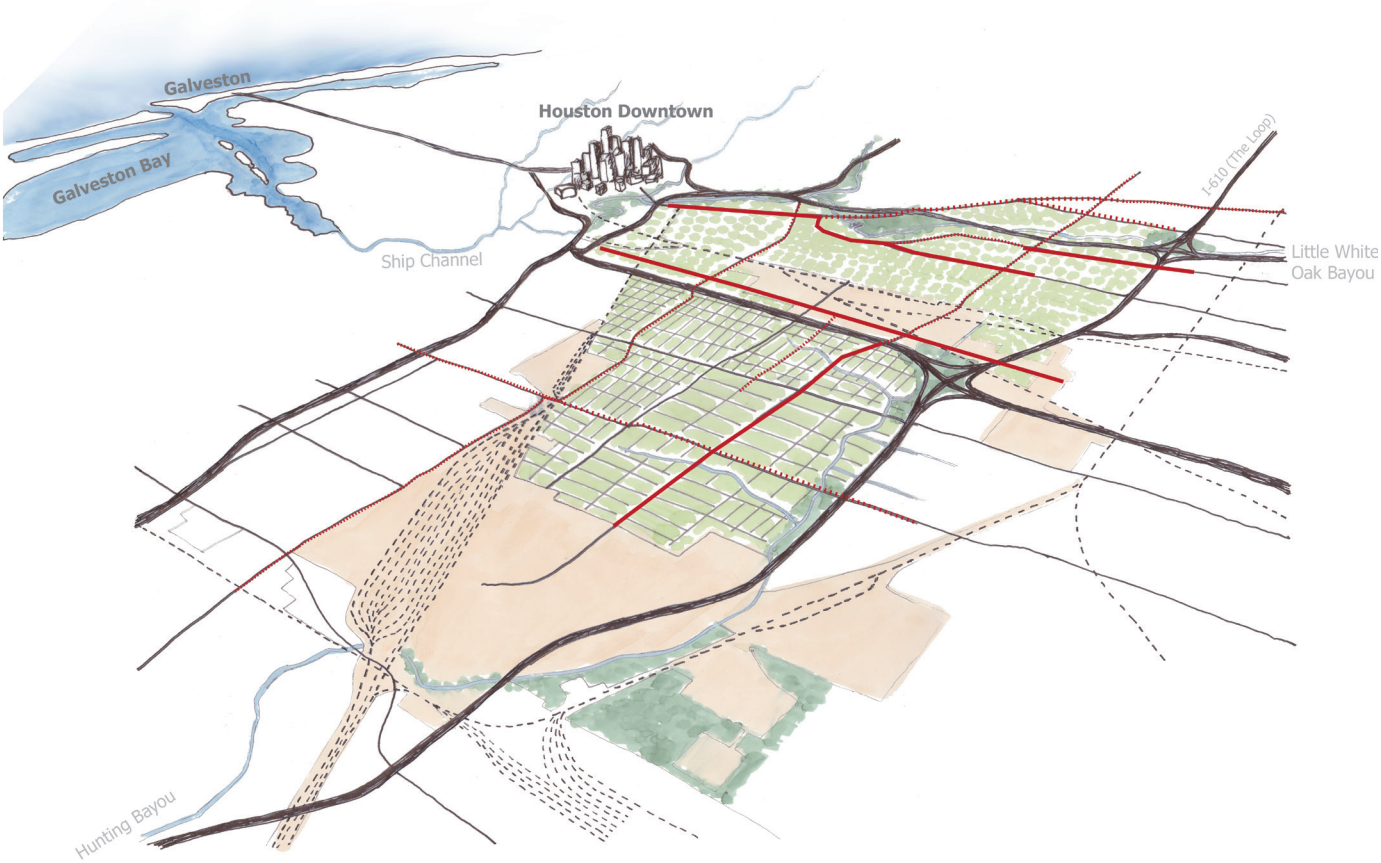


Intensification potentials

- Underperforming open space
- Vacant lot
- Commerical property



- Source: Urban Street Design Guide, National Association of City Transportation Officials, 2013

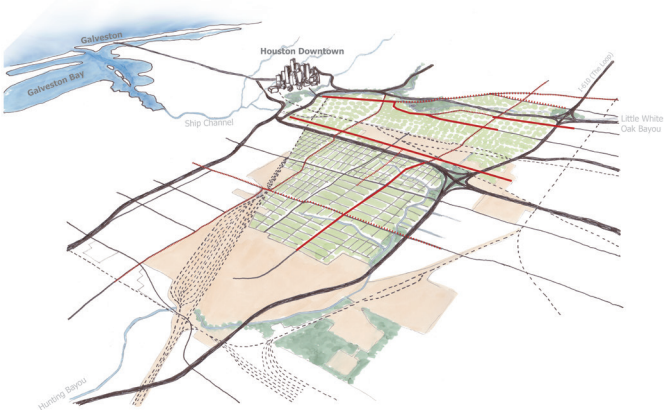

Galveston
Galveston Bay
Houston Downtown
Ship Channel
I-610 (The Loop)
Little White
Oak Bayou
Hunting Bayou

Chapter 6 Strategies & prototypes

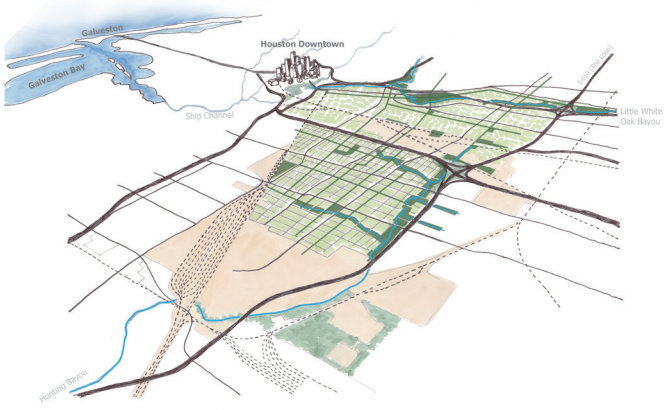

S. SMITH 09

Regional strategies developing steps

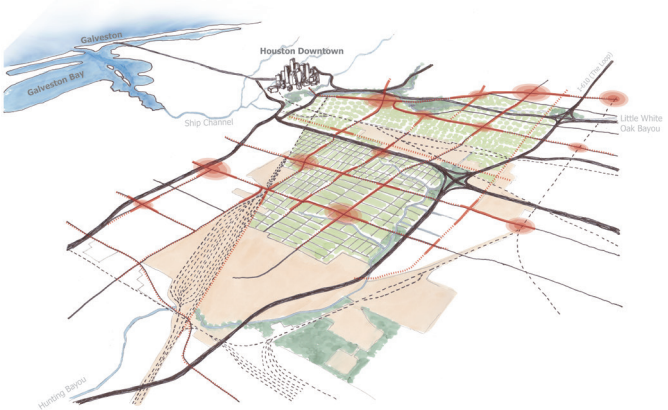
Step 1:
Existing amenity analysis



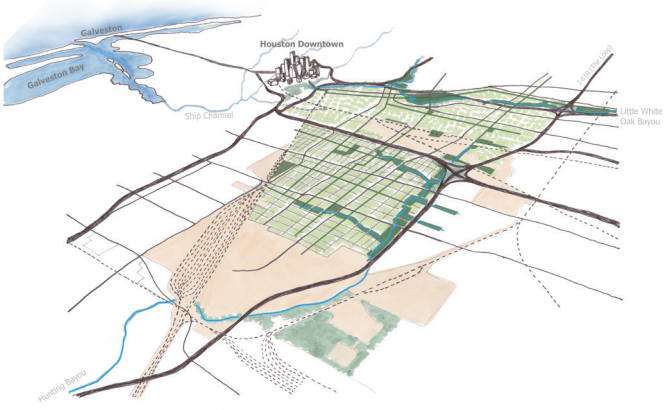
Step 2:
Defining preserved areas



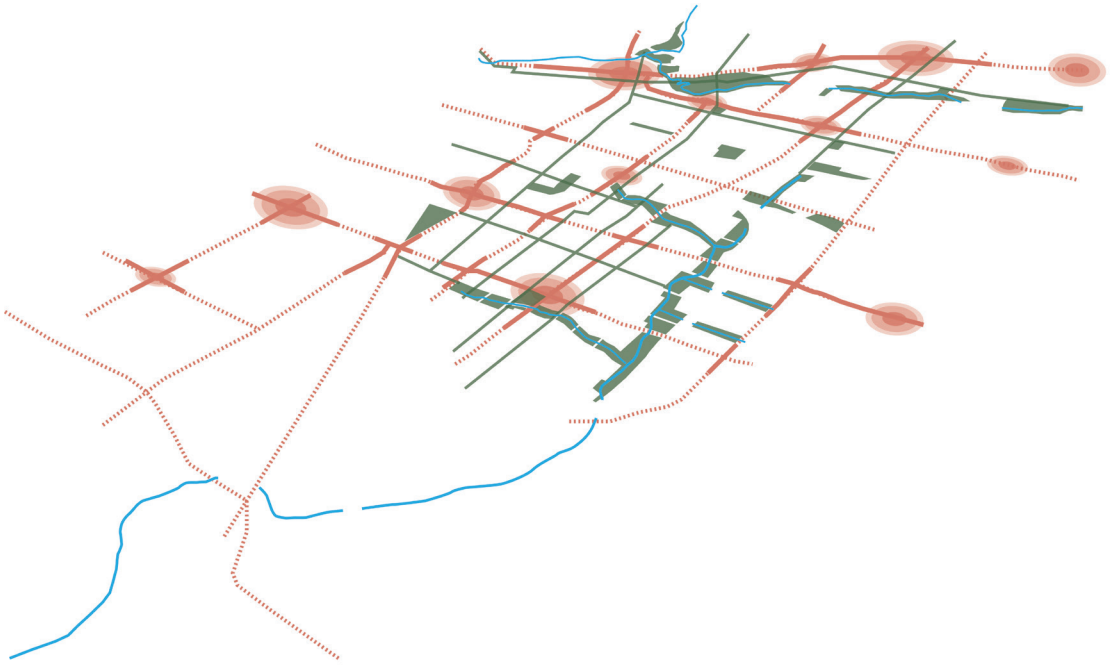
Step 3:
Densification center



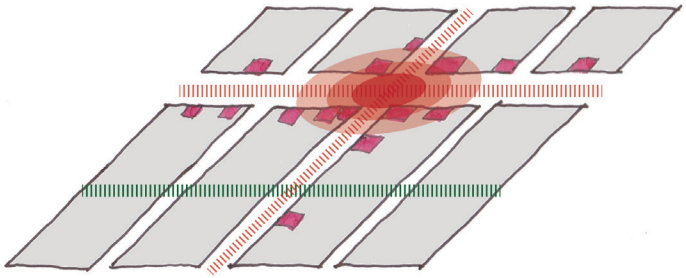
Step 4:
Providing secondary greenway



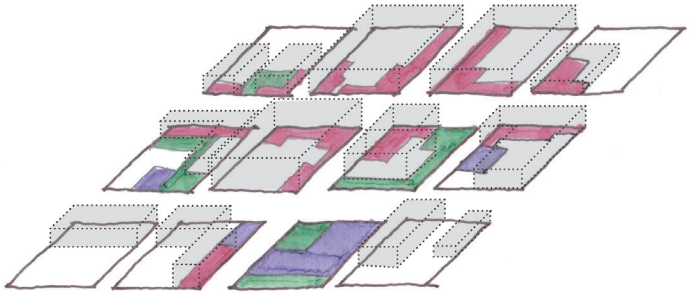
Step 5:
New urban structure



Green & Red axis:
backbone of intensification



Target:
intersection of commercial strips

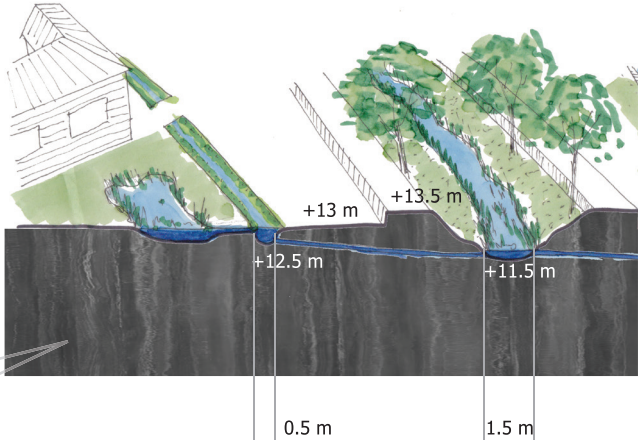


Reduced block size
Continuing & centralized commercial
Organized public facilities & open space
Real estate value +++

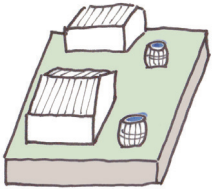
Regional vision 2040

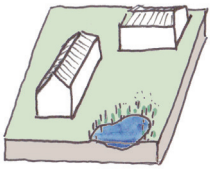
Water strategies & toolbox

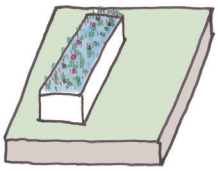
Add 2 layers to support existing system: lot & street profile

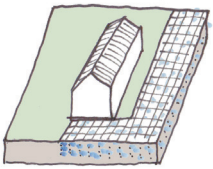


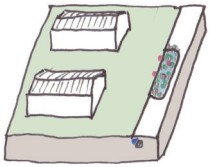
Water toolbox: Lot

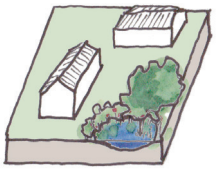

water barrel


pond / spare

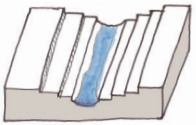

green roof

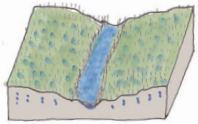

porous pavement

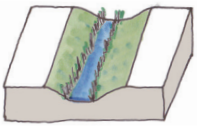

bioswales

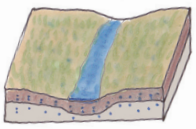

rain garden

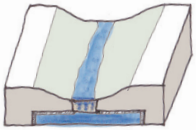
Water toolbox: Secondary greenway


flexible water level

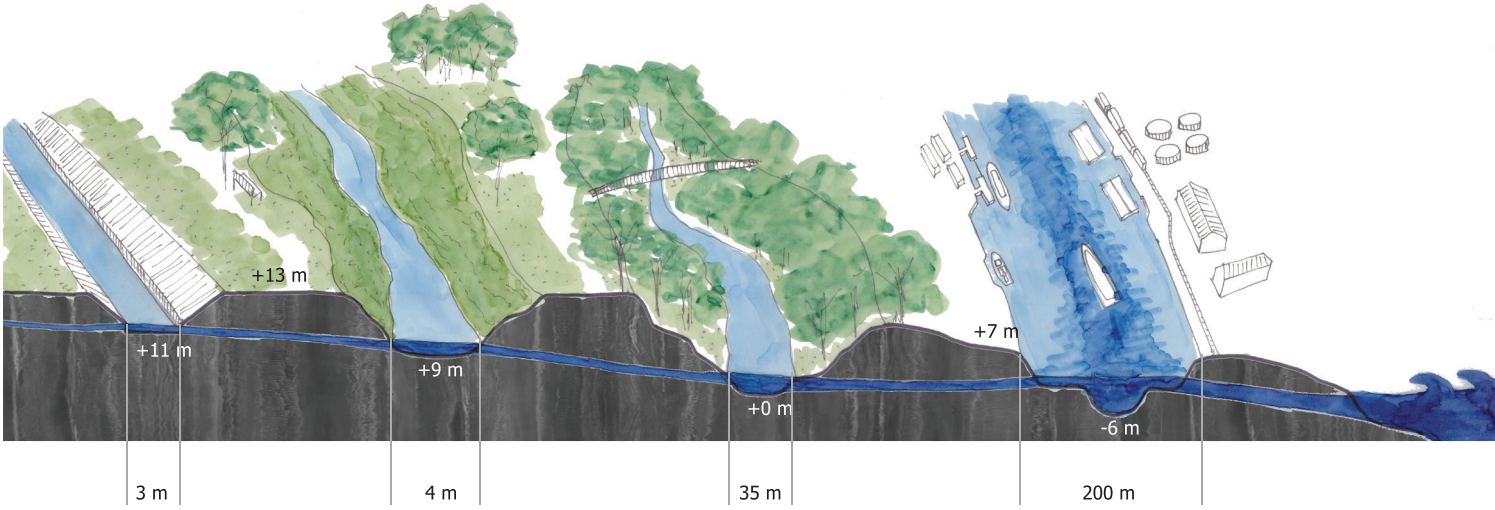

flexible water level + infiltration


helophyte filter


soil filter

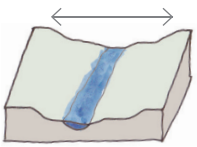

underground water storage

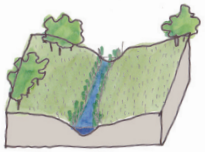
Existing water system hierarchy

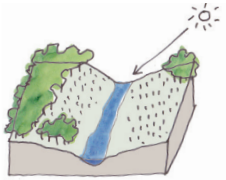


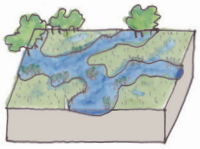
5 Hunting Bayou branch **4** Hunting Bayou **3** Buffalo Bayou **2** Ship Channel **1** Galveston Bay

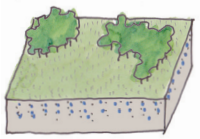
Water toolbox: Bayou

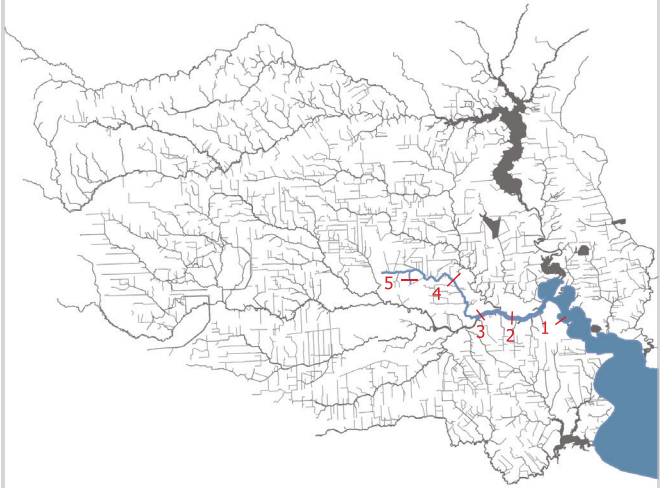

enlarge buffer


remove concrete bank


sunlight for water quality

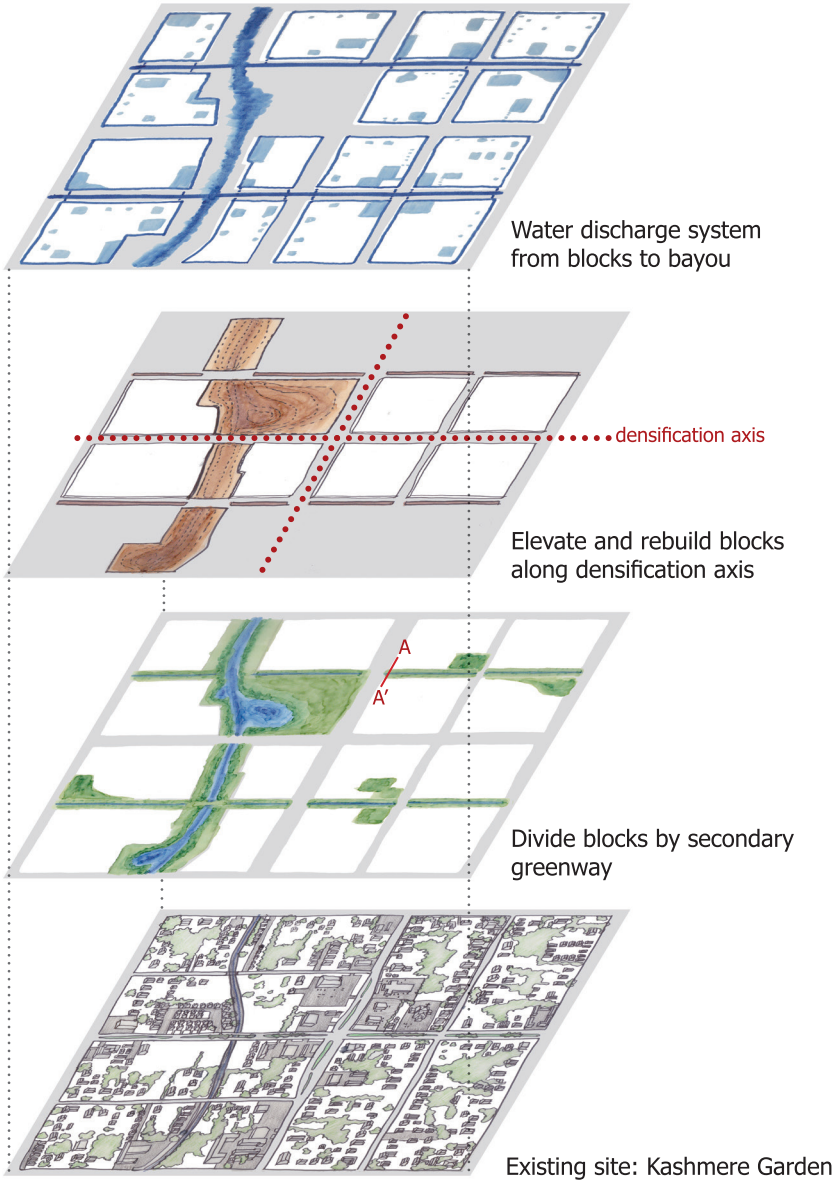

wetland

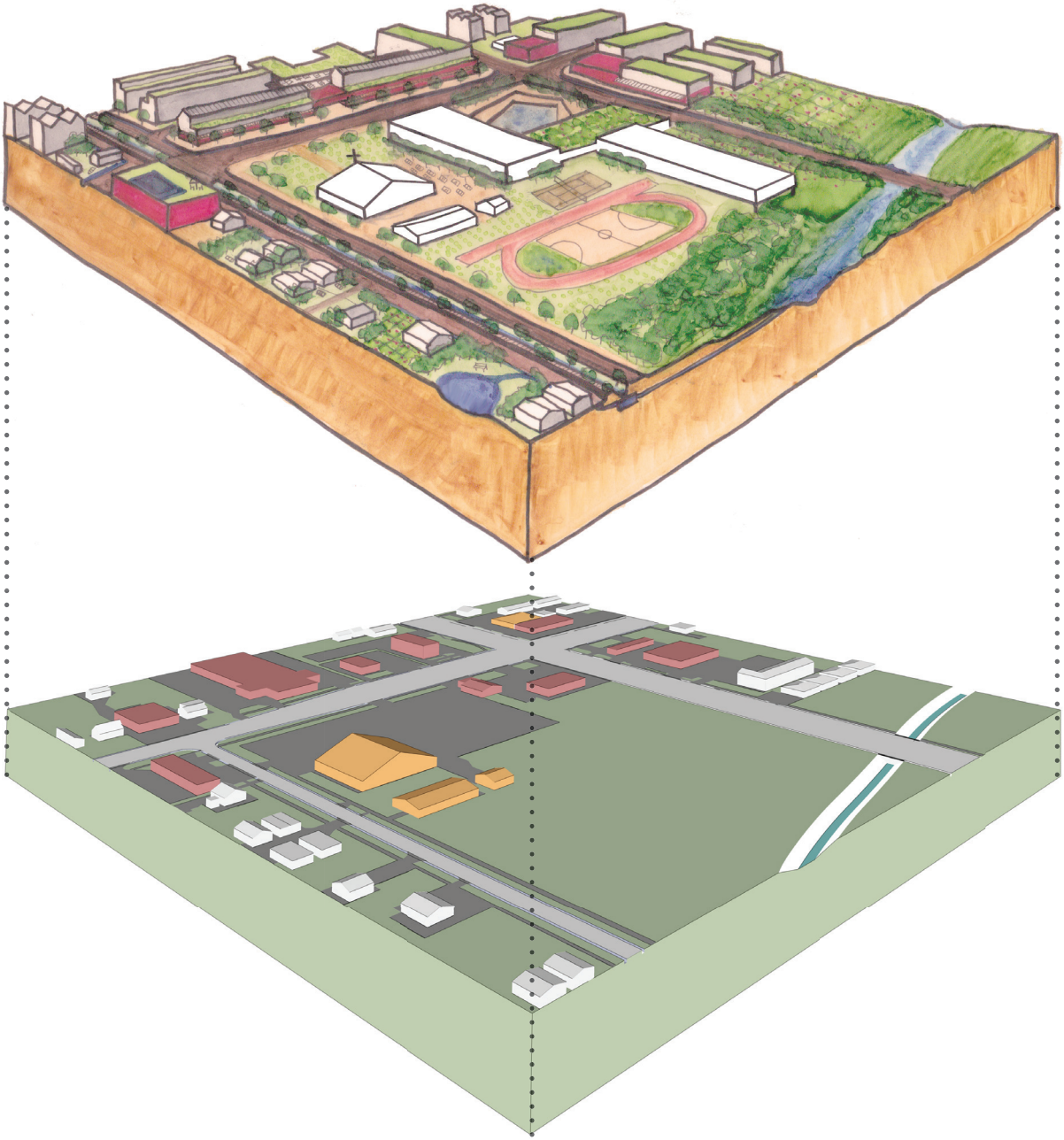

infiltration grass-land



Chapter 7 Interventions & scenarios

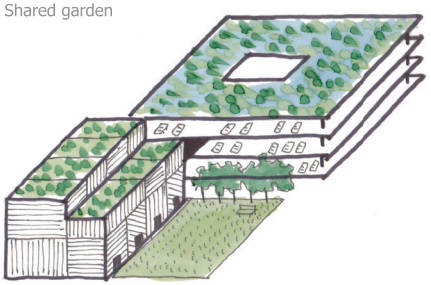

G SMITH


Water discharge system
from blocks to bayou
densification axis
Elevate and rebuild blocks
along densification axis
A
A'
Divide blocks by secondary
greenway
Existing site: Kashmere Garden



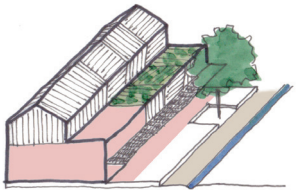
Apartment Community

+ Varieties of unit size & type
+ Common parking building
+ Shared garden



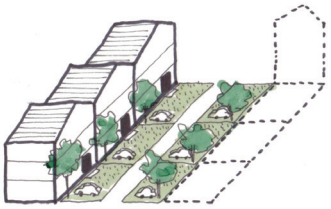
Commercial Strip

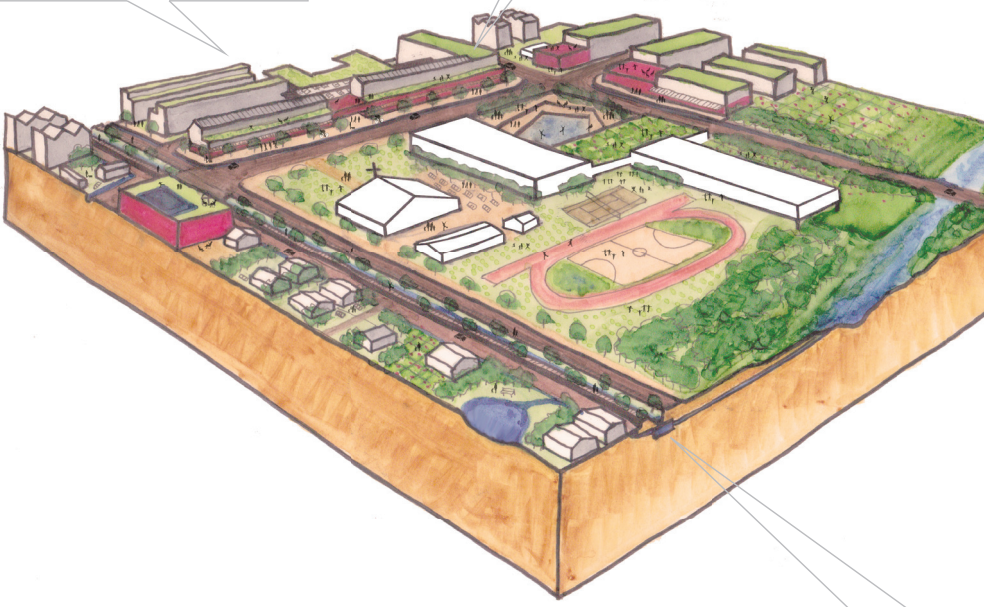
+ Continuing shaded sidewalk
+ Public terrace

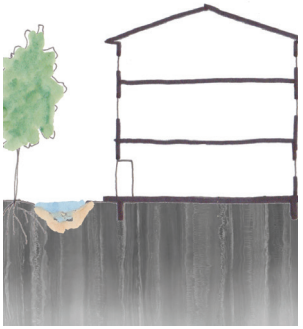


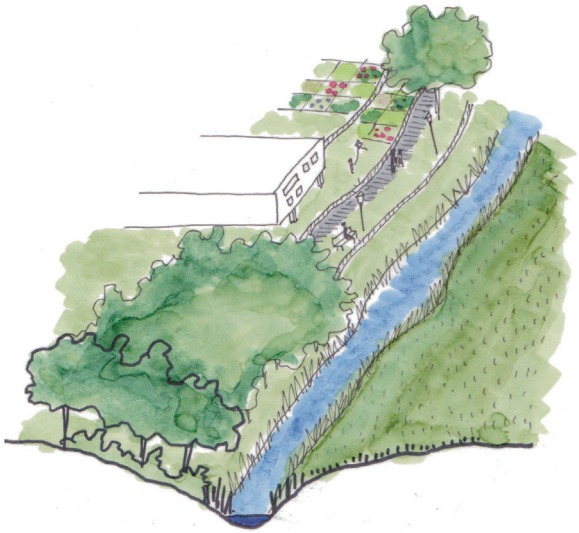
Row House

+ Private garden
+ Limited parking space



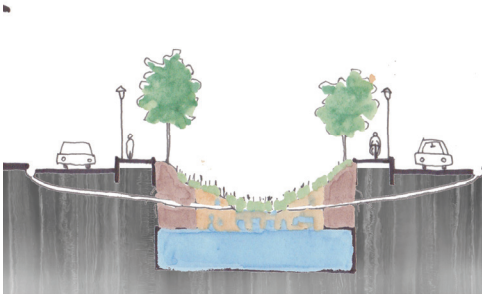






Bayou water front

+ Flexible water level with functions. ex. linear park, argriculture
+ Extend open space into urban fabric
+ Provide enough sunlight to increase water quality
+ Arrange public faclities near water front

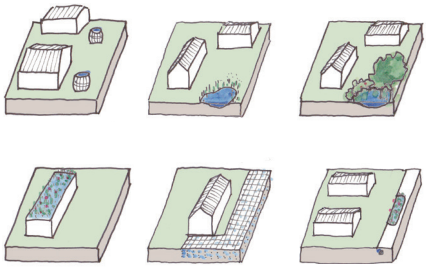


Commercial Strip

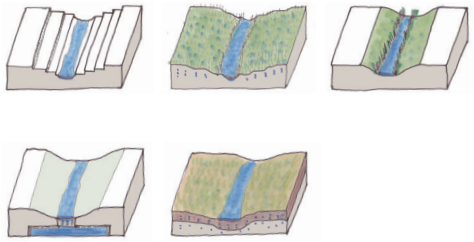
+ Continuing shaded sidewalk
+ Public terrace

Water toolbox

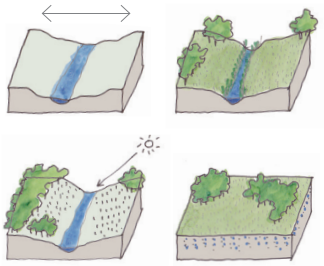
Residential lot



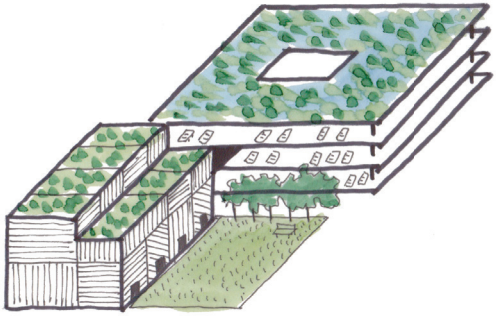
Secondary greenway



Bayou

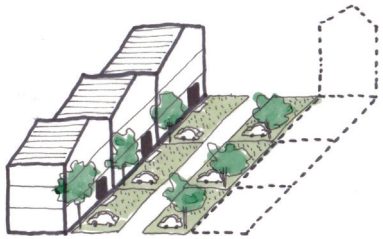


Principles: urban form



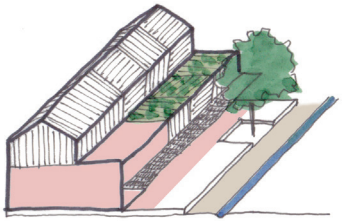
Apartment community

+ Varieties of unit size & type
+ Verticalised parking
+ Shared garden



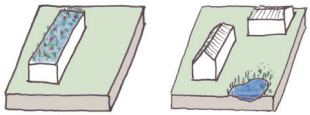
Row house

+ Private garden
+ Limited parking space



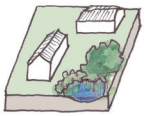
Commercial street

+ Continuing shaded sidewalk
+ Public terrace

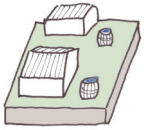


green roof

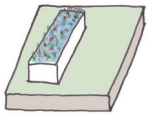
pond / spare



rain garden

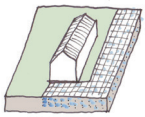


water barrel



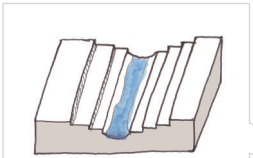
green roof

bioswales

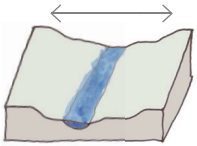


porous pavement

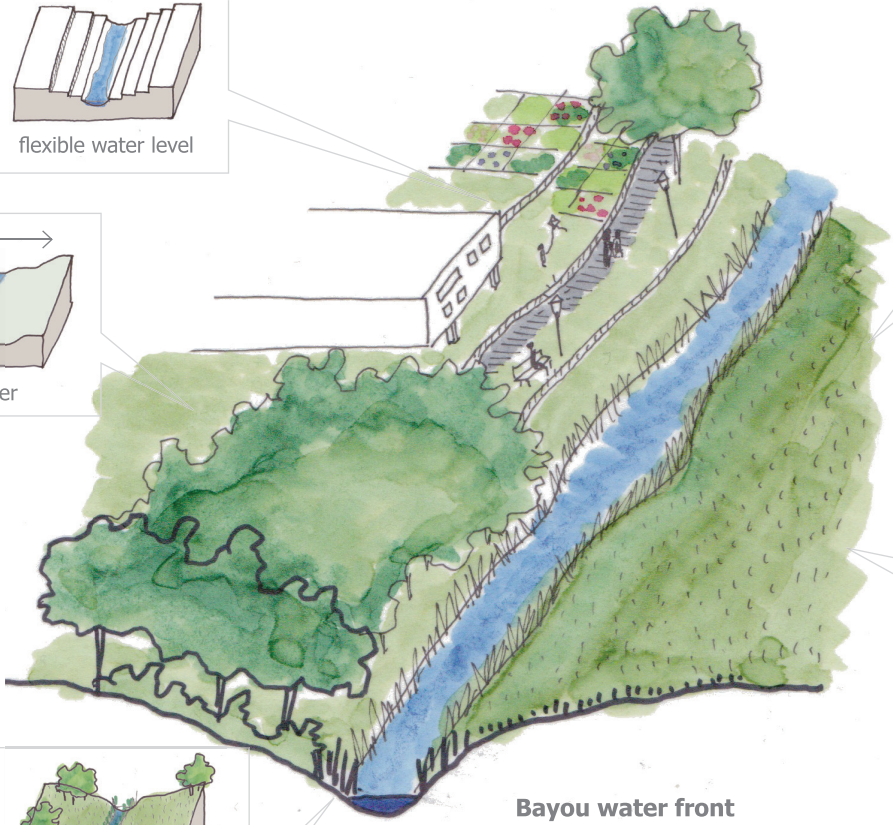
Principles: water front

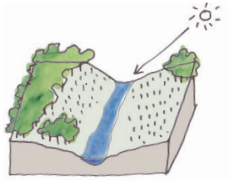


flexible water level

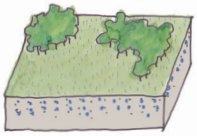


enlarge buffer

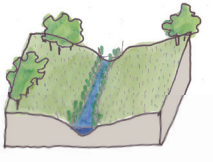




sunlight for
water quality



infiltration grass-
land



remove
concrete bank

Bayou water front

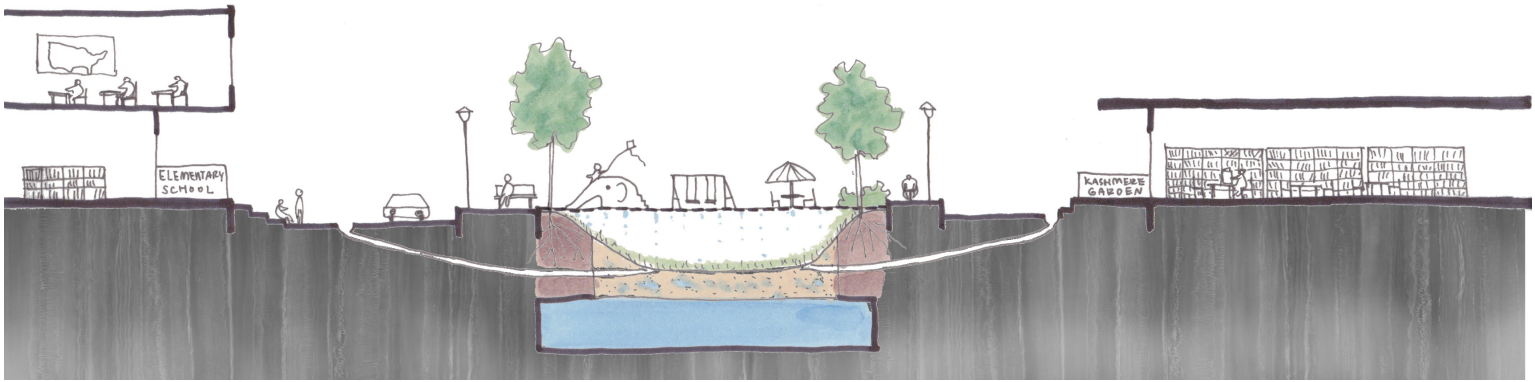
+ Flexible water level with functions. ex. linear park, argriculture
+ Extend open space into urban fabric
+ Provide enough sunlight to increase water quality
+ Arrange public faclities near water front

Secondary greenway

"A good environmental image gives its possessor an important sense of emotional security."

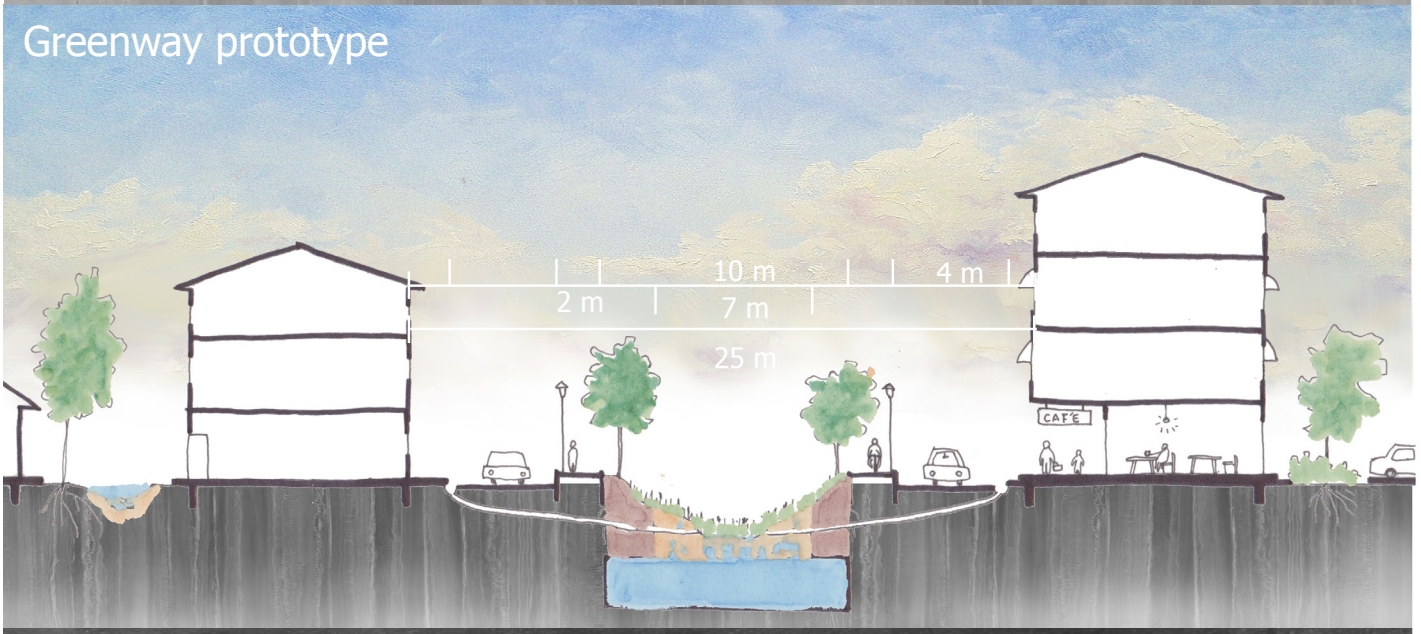
--------- Kevin Lynch

Greenway variety

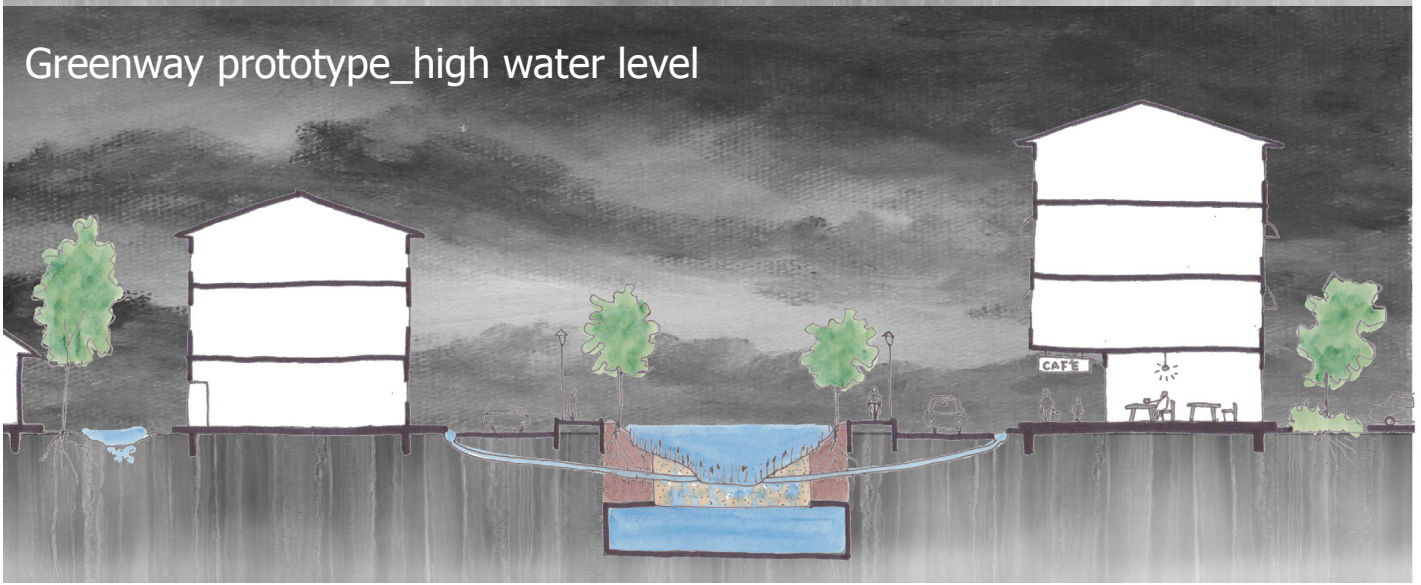


Section AA'_existing

Greenway prototype

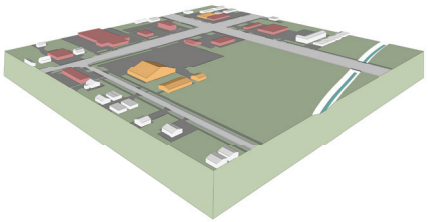


Greenway prototype_high water level



Outcomes

Existing



V.S.

43 x 20

Population

16 x 20

Housing

8000m² x 1.5

Commercial

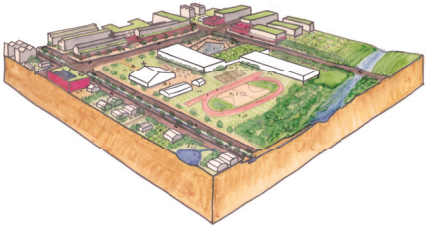
2350m³ x 4

Water storage

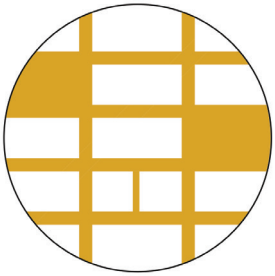
Population and amenities need to be further calculated within the bigger region to estimate if they are sufficient to form a regional center and support public transportation network

Without taking discharge into account, the water storage capacity is sufficient to contain the heaviest rainfall for a day (maximum rainfall: 11.78 cm/per day)

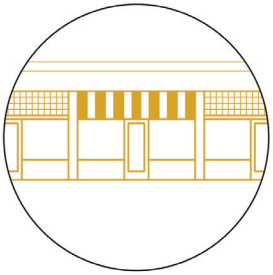
Design



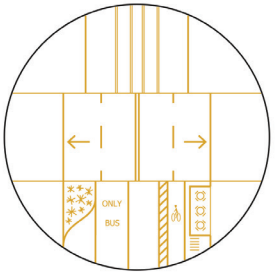
Scenarios: flexibility of street



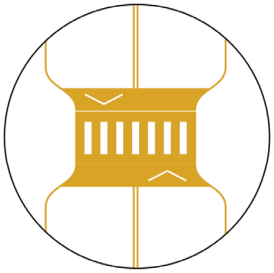
Streets Are Public Spaces
Streets are often the most vital yet underutilized public spaces in cities. In addition to providing space for travel, streets play a big role in the public life of cities and communities and should be designed as public spaces as well as channels for movement.



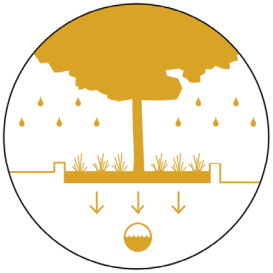
Great Streets are Great for Businesses
Cities have realized that streets are an economic asset as much as a functional element. Well-designed streets generate higher revenues for businesses and higher values for homeowners.[1]



Streets Can Be Changed
Transportation engineers can work flexibly within the building envelope of a street. This includes moving curbs, changing alignments, daylighting corners, and redirecting traffic where necessary. Many city streets were built or altered in a different era and need to be reconfigured to meet new needs. Street space can also be reused for different purposes, such as parklets, bike share, and traffic calming.



Design for Safety
In 2012 in the U.S., over 34,000 people were killed in traffic crashes, which were also the leading cause of death among children aged 5–14. These deaths and hundreds of thousands of injuries are avoidable. Traffic engineers can and should do better, by designing streets where people walking, parking, shopping, bicycling, working, and driving can cross paths safely.

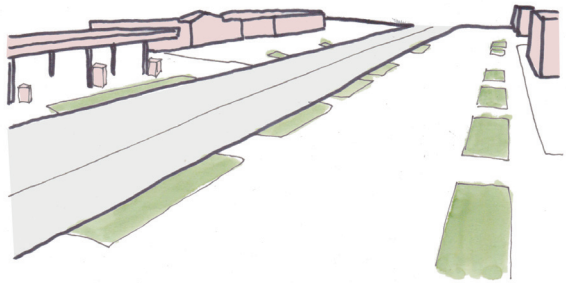


Streets Are Ecosystems
Streets should be designed as ecosystems where man-made systems interface with natural systems. From pervious pavements and bioswales that manage storm-water run-off to street trees that provide shade and are critical to the health of cities, ecology has the potential to act as a driver for long-term, sustainable design.

Act Now!
Implementing projects quickly and using low-cost materials helps inform public decision making. Cities across the U.S. have begun using a phased approach to major redesigns, where interim materials are used in the short term and later replaced by permanent materials once funding is available and the public has tested the design thoroughly.

• Source: Urban Street Design Guide, National Association of City Transportation Officials, 2013

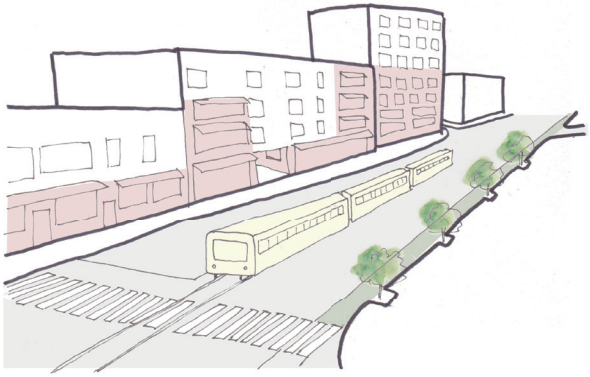
Emphasize on street design



Existing commercial strip

Greenway street profile

Town center

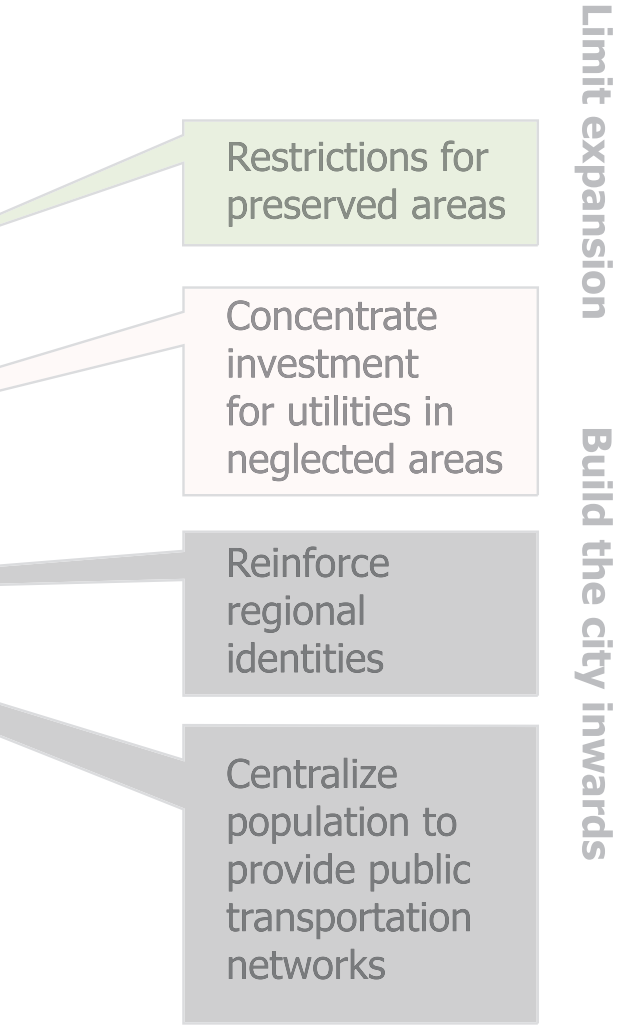


Regional center

Chapter 8 Conclusion


#Fox26ForLife

Harrie County vision


Limit expansion
Build the city inwards
Restrictions for preserved areas
Concentrate investment for utilities in neglected areas
Reinforce regional identities
Centralize population to provide public transportation networks

Reflection

Relevance

Scientific relevance

Climate change which is interrelated with flooding and energy consumption in on the high agenda for not only urbanists but also many professions in other fields. Being a high automobile dependent city and facing serious flooding risks, Houston suburban is an ideal model to do the integrated research on intensification with water and energy aspects. This project is trying to review the current theories from different fields. By discussing Houston suburban, the aim is to coordinate the theories, data and my observations to provide overall remarks for the integrated research on intensification, energy and water. The research is focusing on Houston but still shares common issues with other suburban areas over the world.

Societal relevance

The selected site of this project is especially focuses on the suburban area with serious flooding problems and low economic-social conditions. One of aims in the project is to provide strategies for the area that is neglected by the government or investment flows. With more considerations, small individual changes can also have big influences for their living environments.

Further research

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E SMITH

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