

BORROWED LAND

Reframing the relation between flood and drought adaptation
efforts with the built environment in New Orleans

Daan Rooze

Final presentation
31 January 2020

KATRINA: THE STORM WE'VE ALWAYS FEARED

The Times-Picayune



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FRIDAY, SEPTEMBER 2, 2005

HURRICANE

Los Angeles Times

THURSDAY, SEPTEMBER 1, 2005

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New Orleans Death Toll May Soar; Survivors Desperate; Looters Brazen



Mayor says thousands of bodies could be found in the city, where 90% of homes are submerged. Troops and ships are ordered into the region.

By SCOTT COLLINS, LEANNE HART AND STEPHEN BRADEN

NEW ORLEANS — The city's police and emergency officials worked desperately Wednesday to prevent looting and disorder as widespread looting continued for a second day and evening food shortages hit thousands of people.

Though the flooding appeared to stabilize, 90% of New Orleans' homes were under water, officials said. Repair crews are working to plug gaping breaches in the city's levees, but officials said they need more time to complete the work.

Federal officials dispatched National Guard, coast guard and U.S. marines to the Gulf Coast to assist in rescue and recovery efforts.

IN MISSISSIPPI: Dillon Chassey, 7, rode out Hurricane Katrina in Biloxi with his mother and father. The family lost virtually everything it owned to the storm. AP

COLUMN ONE

Squawking at Bird Flu Warning

■ A Thai rock star riles at the defense of conflict, saying instituting a ban and killing the fowl won't quell disease concerns.

By CHRISTOPHER ALLEN

BANGKOK, Thailand — It's an unlikely subject for a hit pop song. "Bird, bird, bird. Give the rooster a kick about, bird, bird. Protect that people!" blares the poppy tune from Thai television.

Water May Linger for Months



A WAY OUT: Hundreds gather in hopes of a ride out of New Orleans. New emergency routes opened to thousands of refugees, and others were underway to evacuate the city.

Trapped in an Arena of Suffering

"We're like animals," a mother says inside the Louisiana Superdome, where hope and supplies are scarce.

City pumps themselves are submerged, so officials must await nature's help. Delays already have local officials on edge.

By RALPH VARTANIAN

Despite the billions of gallons of water that have inundated New Orleans, officials say it may take three to six months to pump out the city, according to some experts.

Col. Richard Wagner, the corps' senior official in New Orleans, said that the estimate was based on pumping done as Hurricane Katrina approached and that it remained the corps' best estimate. He is directing the army's recovery efforts.

'HELP US, PLEASE'

IN THE DISASTER, CHAOS AND WHELPNESS RULE THE STREETS

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HURRICANE KATRINA: THE AFTERMATH

Floods Ravage New Orleans

Two Levees Give Way; in Mississippi, Death Toll Estimated at 110

New Orleans

Looting, Fires And a Second Evacuation



By Peter Wenzel and Ken Coates

NEW ORLEANS, Aug. 30 — This rescue was even more desperate than the first. As murky water swirled around their homes from levee breaks unleashed in the immediate aftermath of Hurricane Katrina, families that had hunkered down for Monday's storm were forced Tuesday to climb into their cars and then to their roofs in the hope of escape by boat or helicopter.

By City Executives and Peter Wenzel

NEW ORLEANS, Aug. 30 — Two levees burst Tuesday, flooding the city of New Orleans in the aftermath of Hurricane Katrina, which had already flooded much of the Gulf Coast from Louisiana to Alabama in one of the nation's worst natural disasters.

The New York Times

VOL. CLIV . No. 53,323 Copyright © 2005 The New York Times NEW YORK, WEDNESDAY, AUGUST 31, 2005 ONE DOLLAR

NEW ORLEANS IS INUNDATED AS 2 LEVEES FAIL; MUCH OF GULF COAST IS CRIPPLED; TOLL RISES



By City Executives and Peter Wenzel

NEW ORLEANS, Aug. 30 — Two levees burst Tuesday, flooding the city of New Orleans in the aftermath of Hurricane Katrina, which had already flooded much of the Gulf Coast from Louisiana to Alabama in one of the nation's worst natural disasters.

CITY IS OFF LIMITS

Pentagon Joins in the Effort — Bush Cuts Vacation Short

By JOSEPH B. TREASTER and N. R. KLEINFELD

NEW ORLEANS, Aug. 30 — A day after New Orleans thought it had narrowly escaped the worst of Hurricane Katrina's wrath, water broke through two levees on Tuesday and virtually submerged and isolated the city, causing incalculable destruction and rendering it uninhabitable for weeks to come.

Water May Linger for Months



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Sections

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National

It wasn't even a hurricane, but heavy rains flooded New Orleans as pumps faltered

By [Tim Craig](#)
August 9, 2017



NOLA READY

THE CITY OF NEW ORLEANS

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[Home](#) [Incidents](#) [August 5th Flood](#) [Heavy Rains and Flooding in New Orleans: Stay Safe and Clean Up](#)

AUGUST 5TH FLOOD UPDATES

SAT
AUG 05
2017

7:16 PM
AUGUST 5TH FLOOD

Heavy Rains and Flooding in New Orleans: Stay Safe and Clean Up

Heavy rains caused flooding across New Orleans yesterday, Saturday, Aug. 5. If your property was damaged, contact your insurer, document the damage, and clean up safely. If your home flooded and you need assistance, contact the American Red Cross at 504-620-3105.

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New Orleans

New Orleans under water: 12 years after Katrina, officials can't get it right

The city has seen rain almost every day since April - but pumps continue to malfunction as water board administrators offer wrong information

5 August, 2017











Contents

Problem Field

Analysis

Vision

Design Framework

Water System Design

Urban Design

Conclusions

Problem Field

Problem Field

Analysis

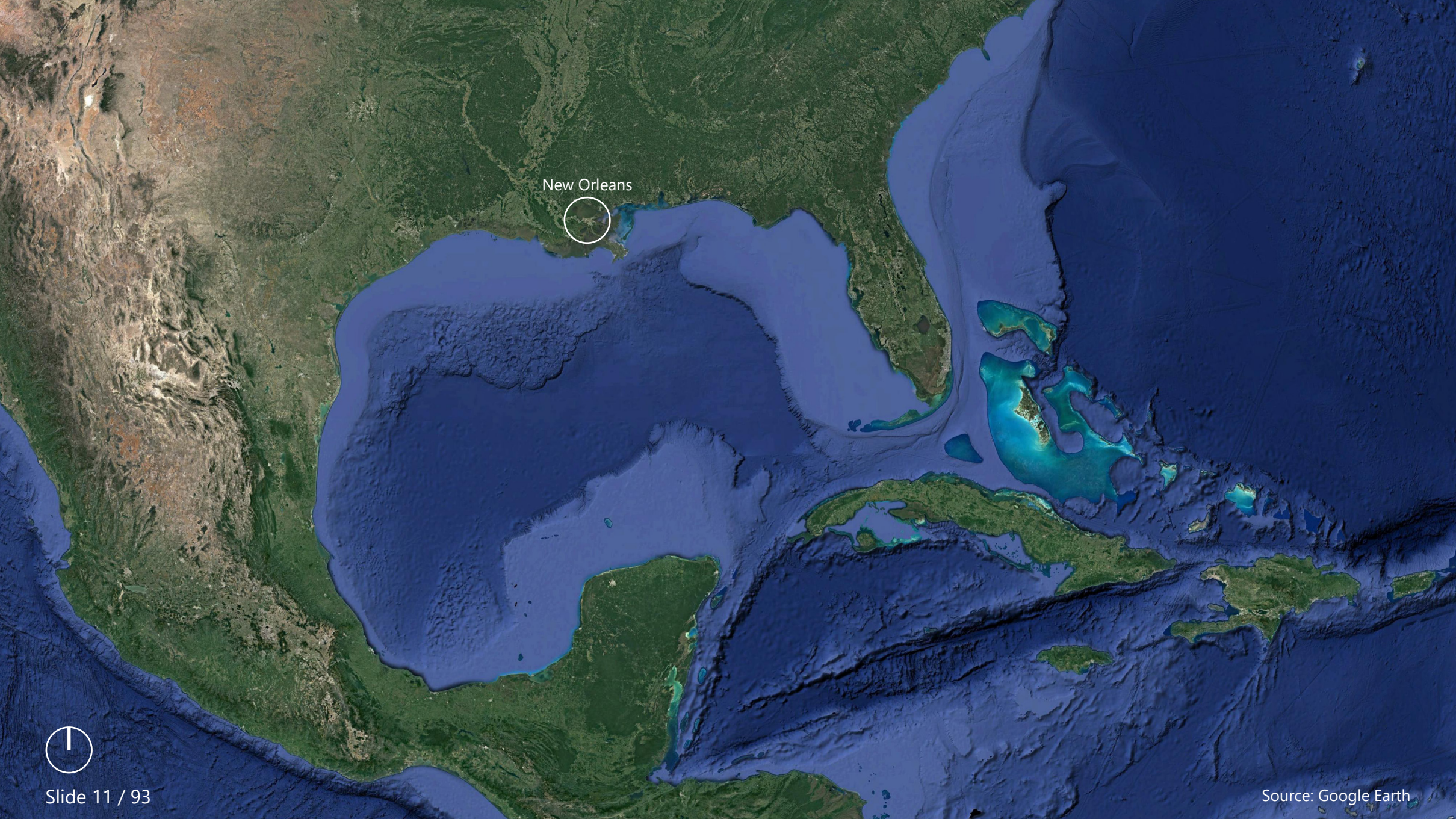
Vision

Design Framework

Water System Design

Urban Design

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New Orleans





Lake Pontchartrain

New Orleans

Gulf of Mexico





Jefferson Parish

Orleans Parish

Lake Pontchartrain

wetlands

wetlands

NEW ORLEANS

Mississippi River

St. Bernard Parish

wetlands

wetlands

Plaquemines Parish

wetlands

Project location

Orleans Lakeside sub-basin



Problem field

Urbanism

Socio-spatial concerns

Water management

Environmental concerns

Problem field

Urbanism

Socio-spatial concerns

Homogeneous zoning

Vacancy

Poor spatial quality

Poor accessibility for modes other
than automobiles

Inequity

Water management

Environmental concerns

Increasing peak rainfall

Longer dry spells

Subsidence

Sea level rise

Increasing frequency of hurricanes

Problem field



Pluvial flooding: rain event



Coastal flooding: hurricane

Problem field

FOCUS



Pluvial flooding:

rain event



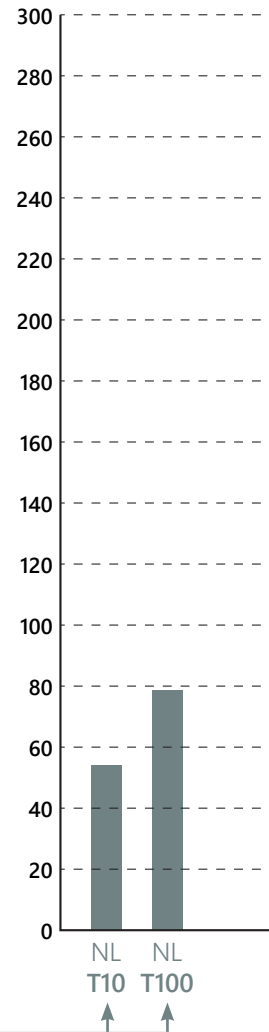
Coastal flooding:

hurricane

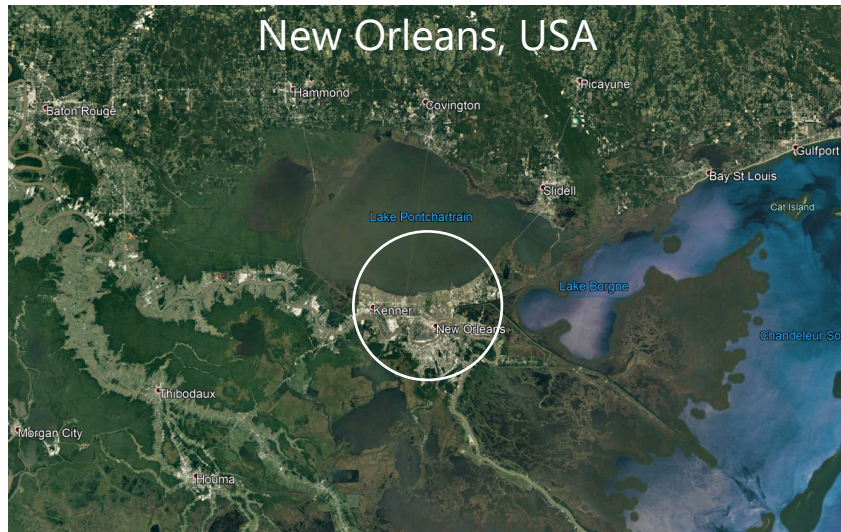
Problem field



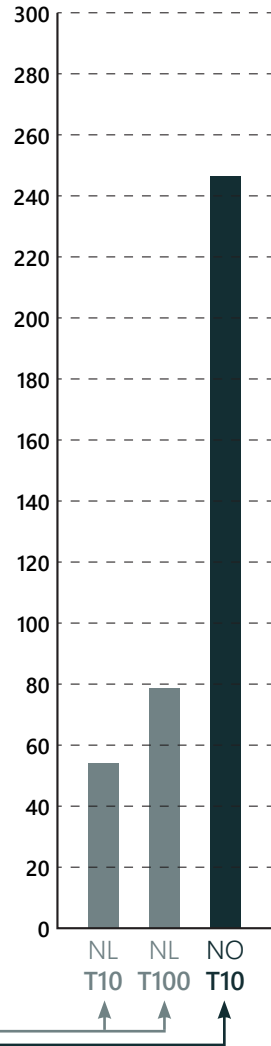
Rainfall depth in mm per 24 hours



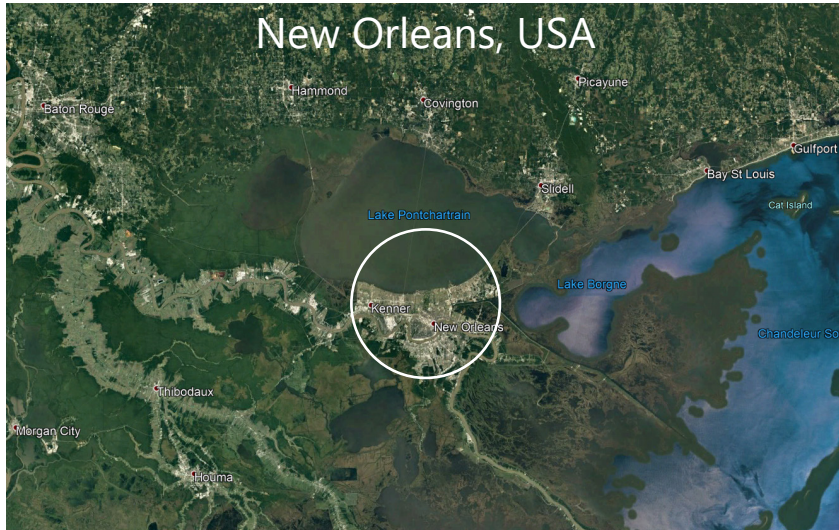
Problem field



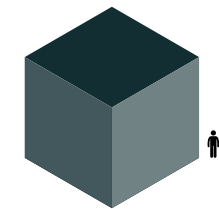
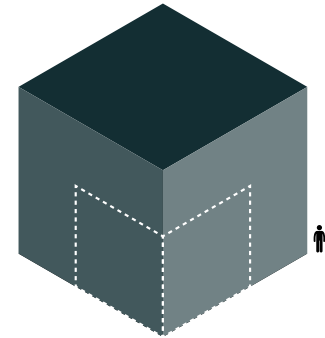
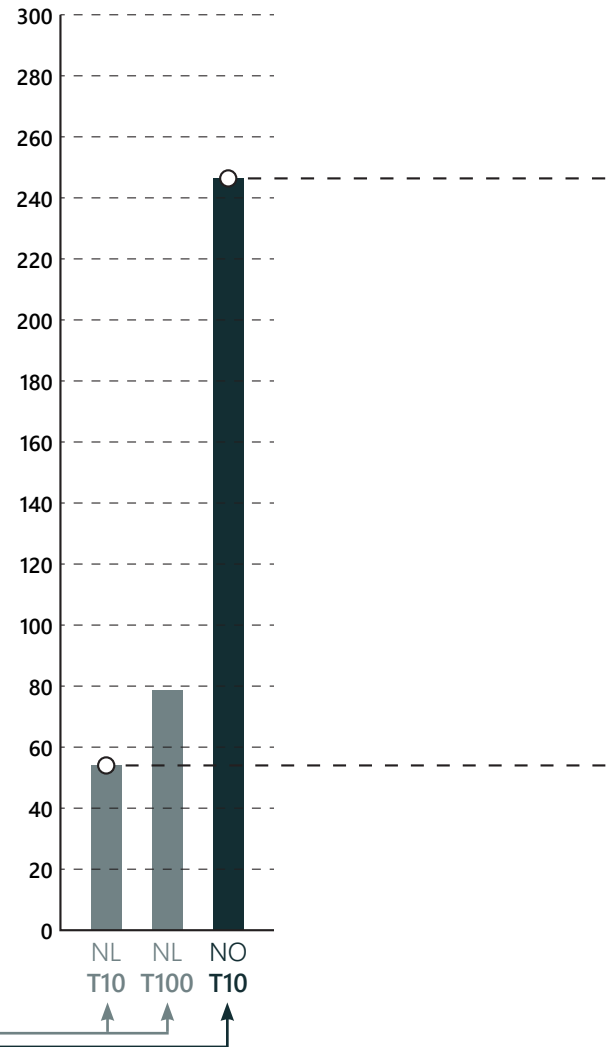
Rainfall depth in mm per 24 hours



Problem field



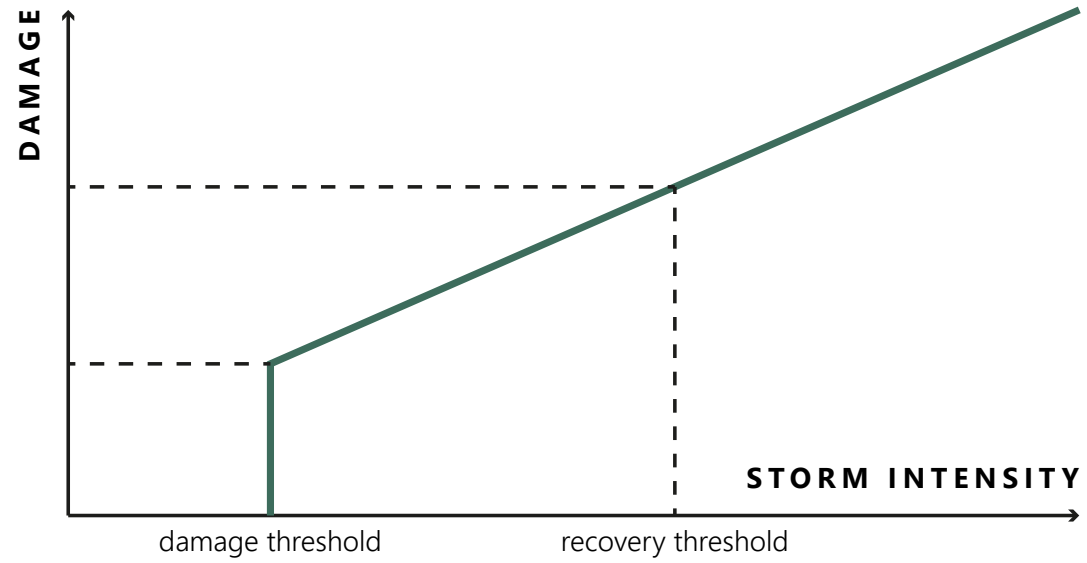
Rainfall depth in mm per 24 hours



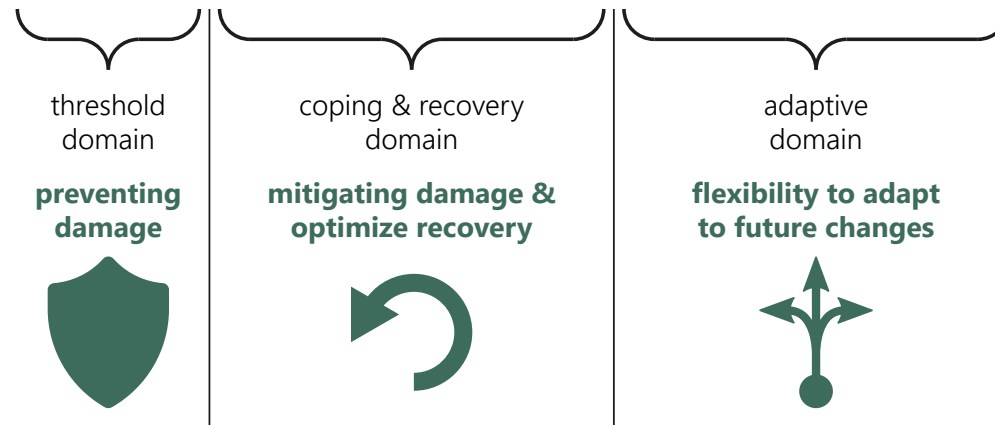
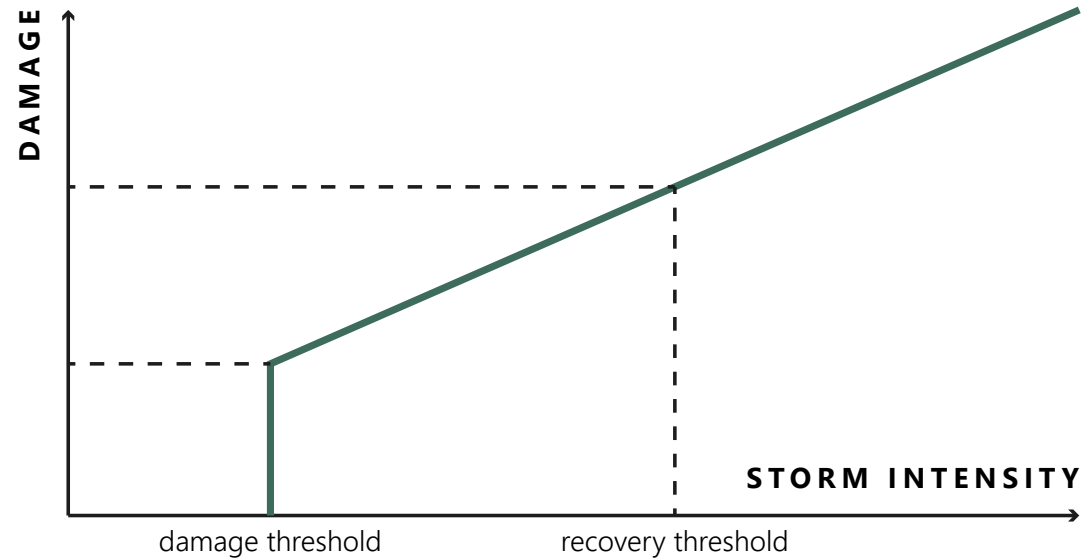
Research question

*How can Orleans Lakeside be made more **flood and drought resilient** by integrating **multi-layered resilience capacities** of the built environment, whilst safeguarding **consistent design of technical adaptation measures** within the urban space?*

Vulnerability theory



Vulnerability theory



Analysis

Problem Field

Analysis

Vision

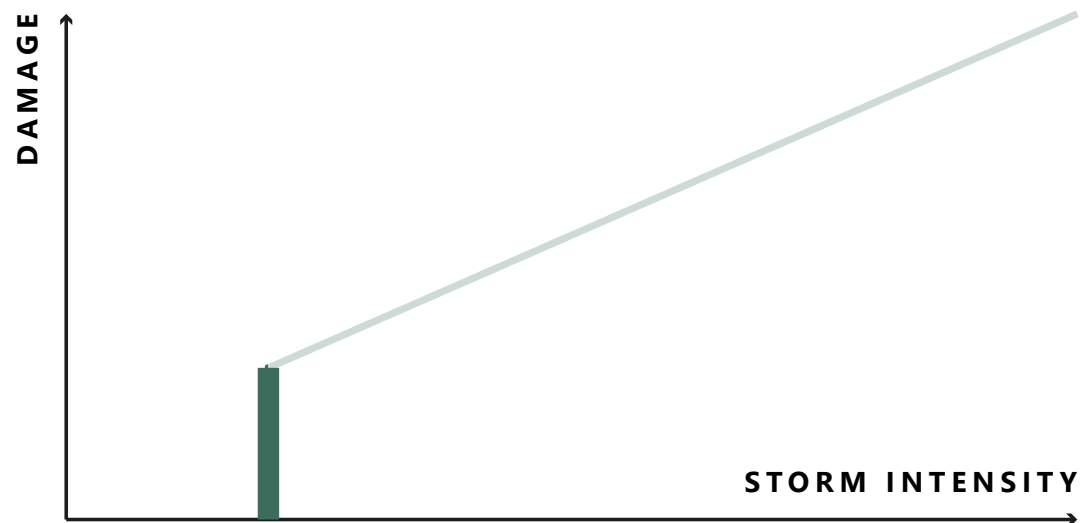
Design Framework

Water System Design

Urban Design

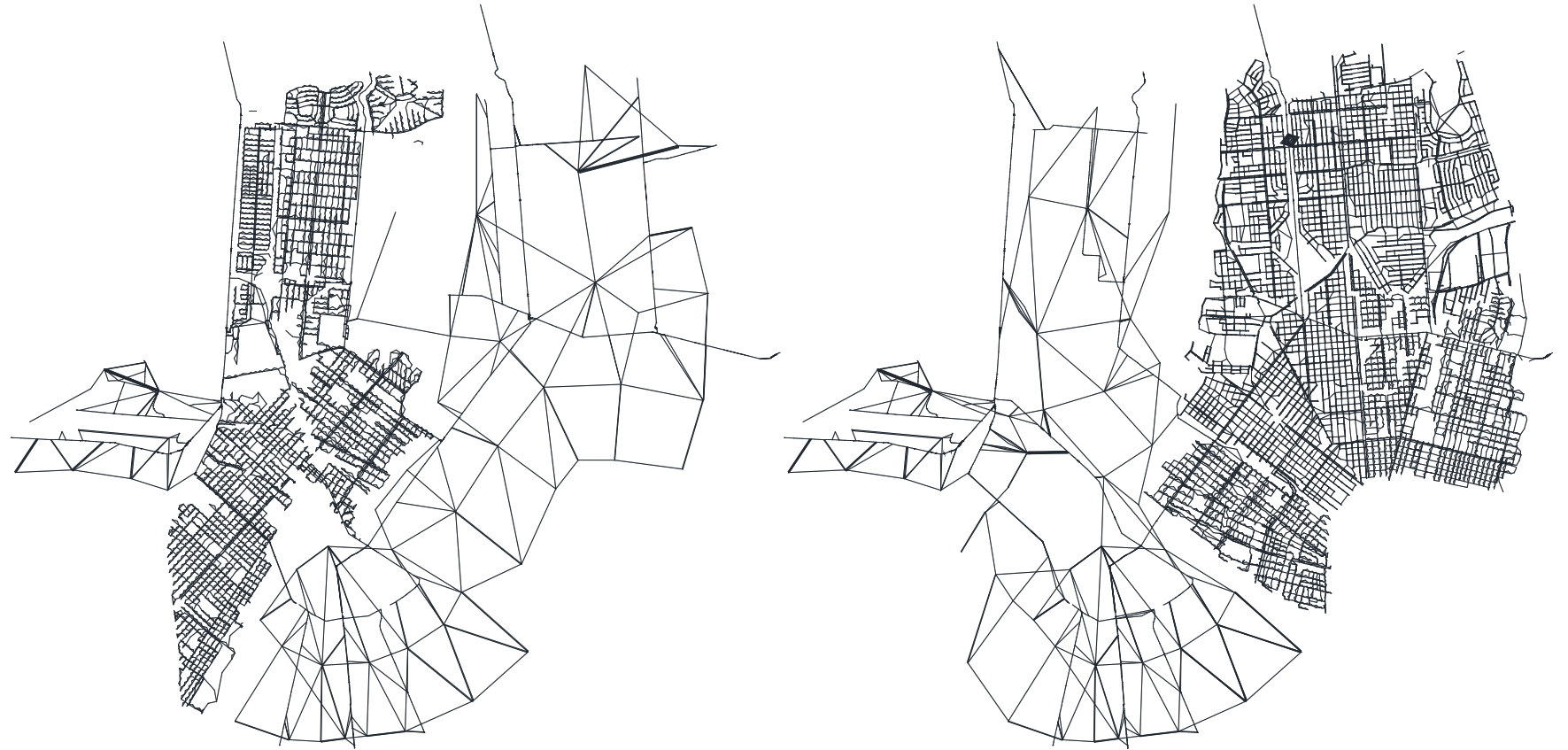
Conclusions

Threshold domain analysis



Threshold domain analysis

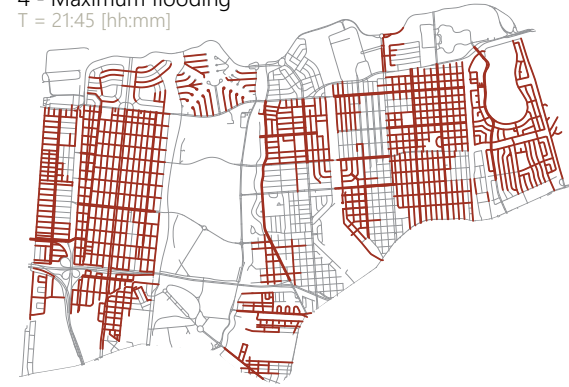
Modelling water storage



1 - Before precipitation event
T = 00:00 [hh:mm]



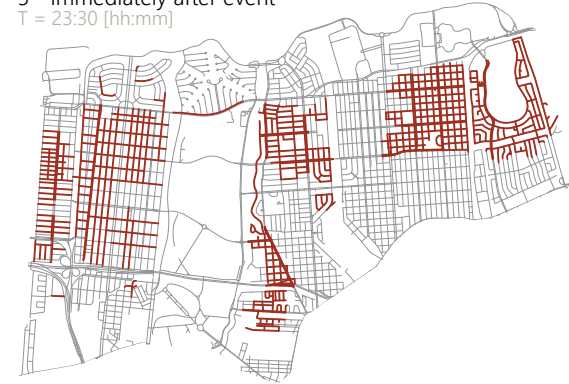
4 - Maximum flooding
T = 21:45 [hh:mm]



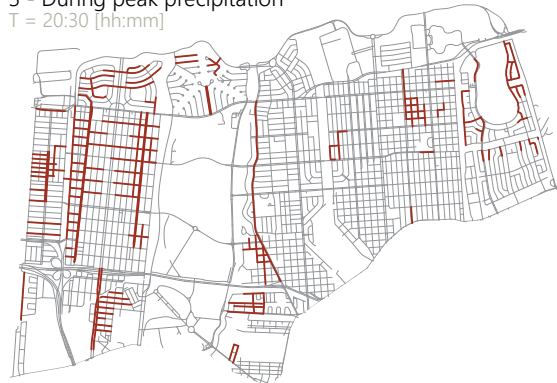
2 - Before final peak
T = 18:00 [hh:mm]



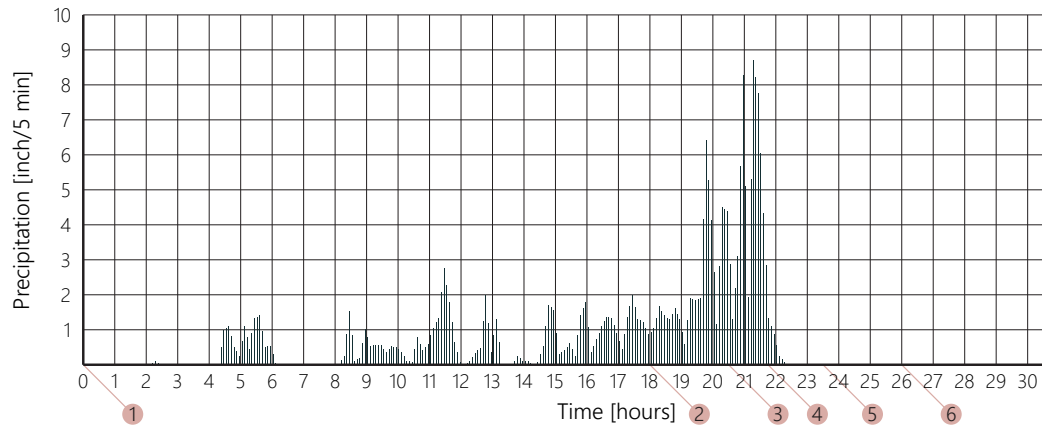
5 - Immediately after event
T = 23:30 [hh:mm]



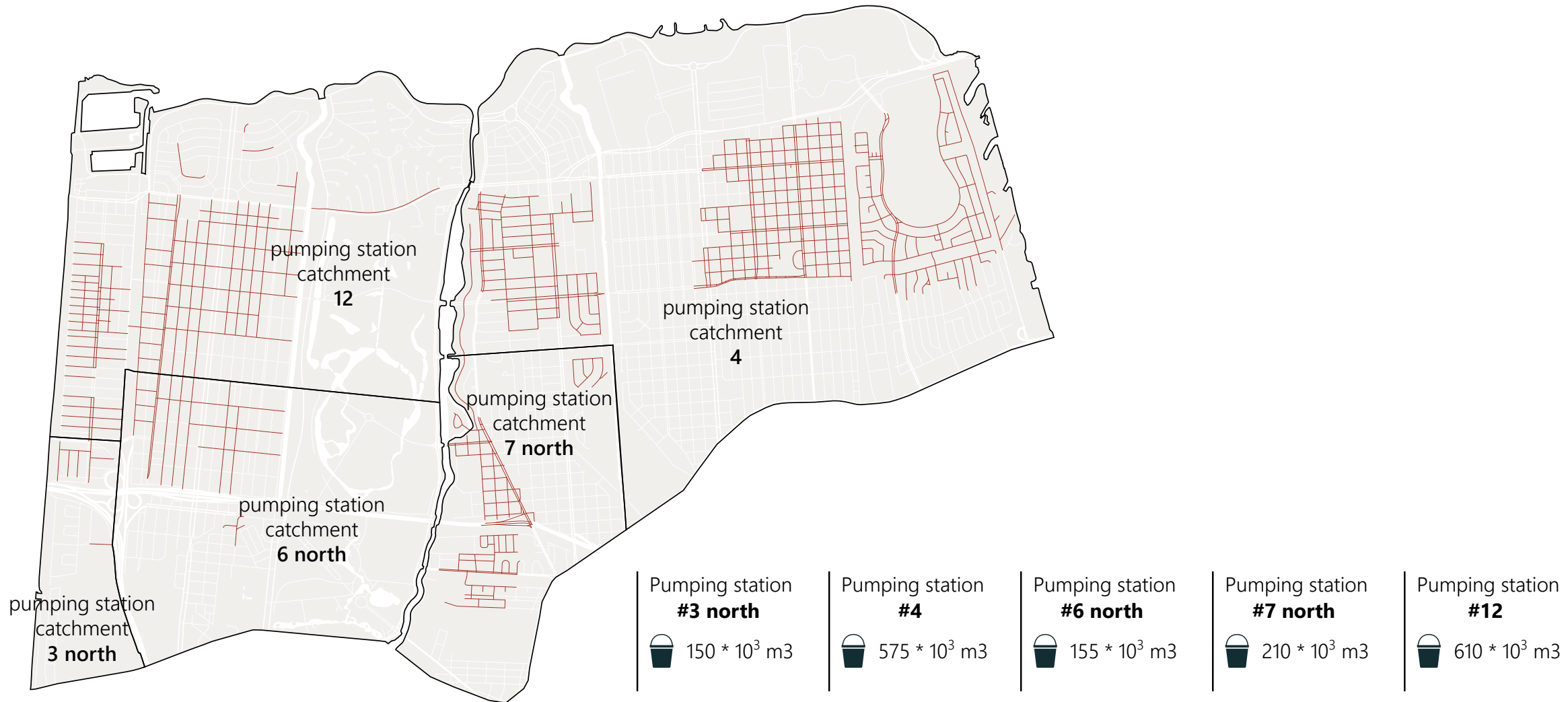
3 - During peak precipitation
T = 20:30 [hh:mm]



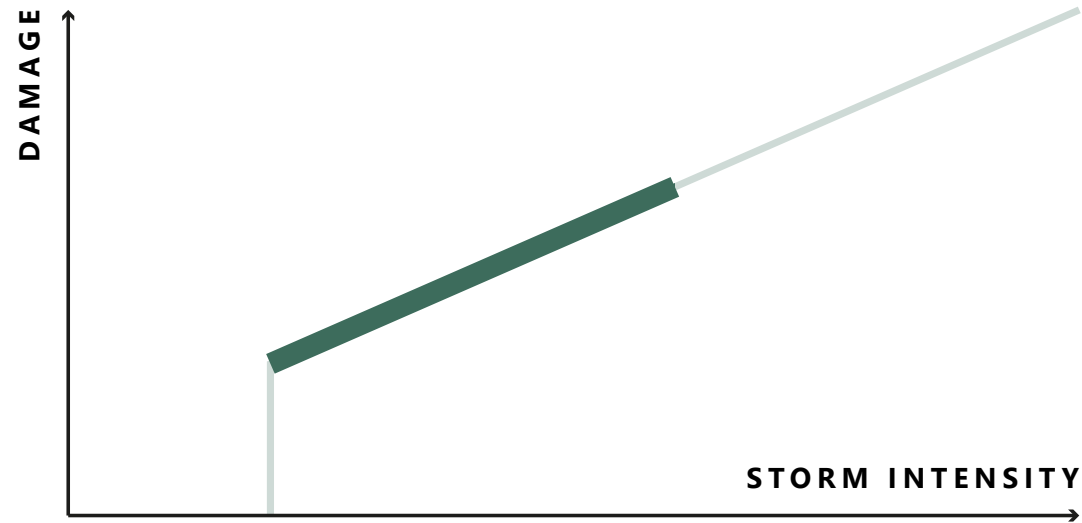
6 - Two hours after event
T = 26:00 [hh:mm]



Required water storage capacity per pumping station catchment



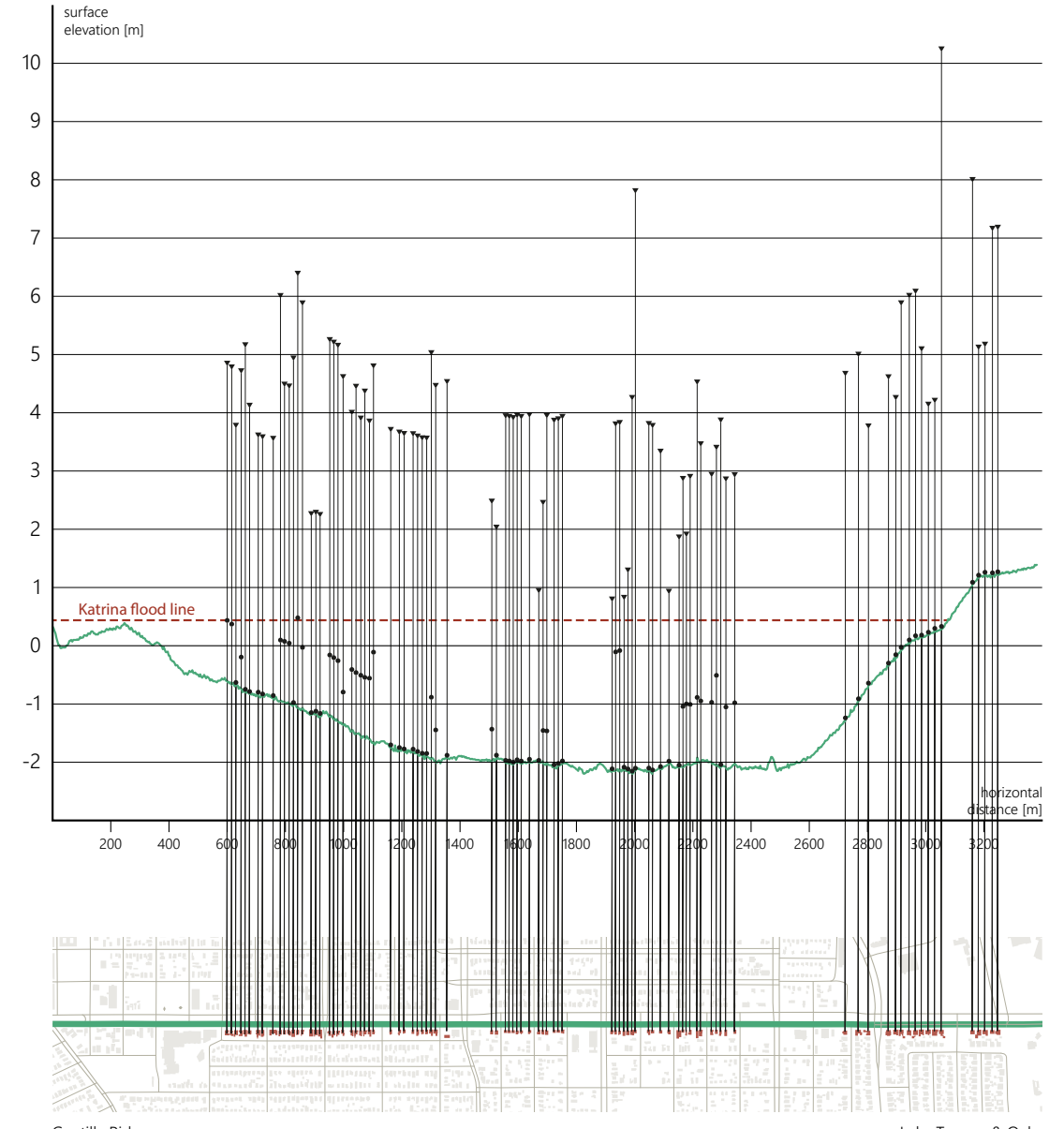
Coping & recovery domain analysis



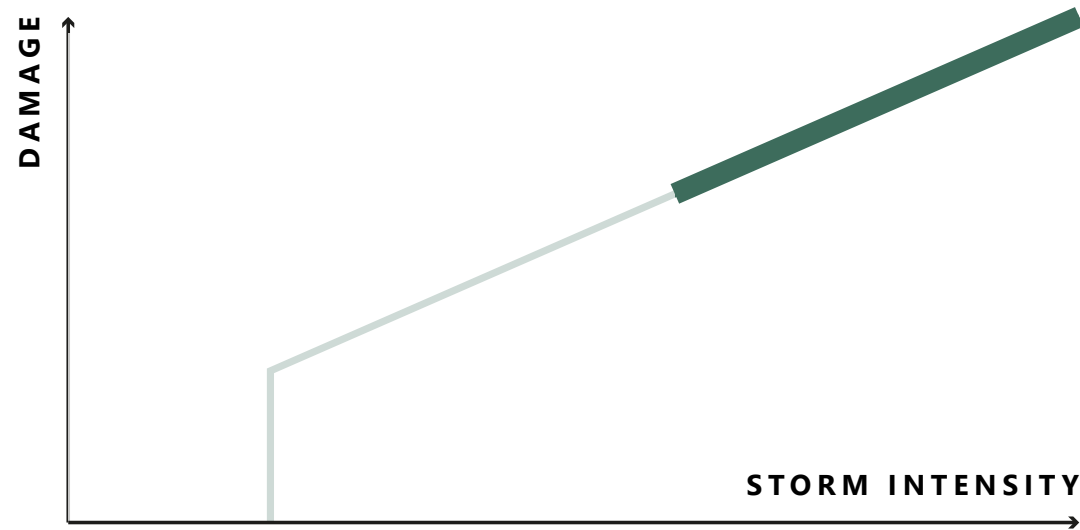
Coping & recovery domain analysis

Flood susceptibility & urban planning

- ▼ roof elevation
- first living floor elevation
- Surface elevation

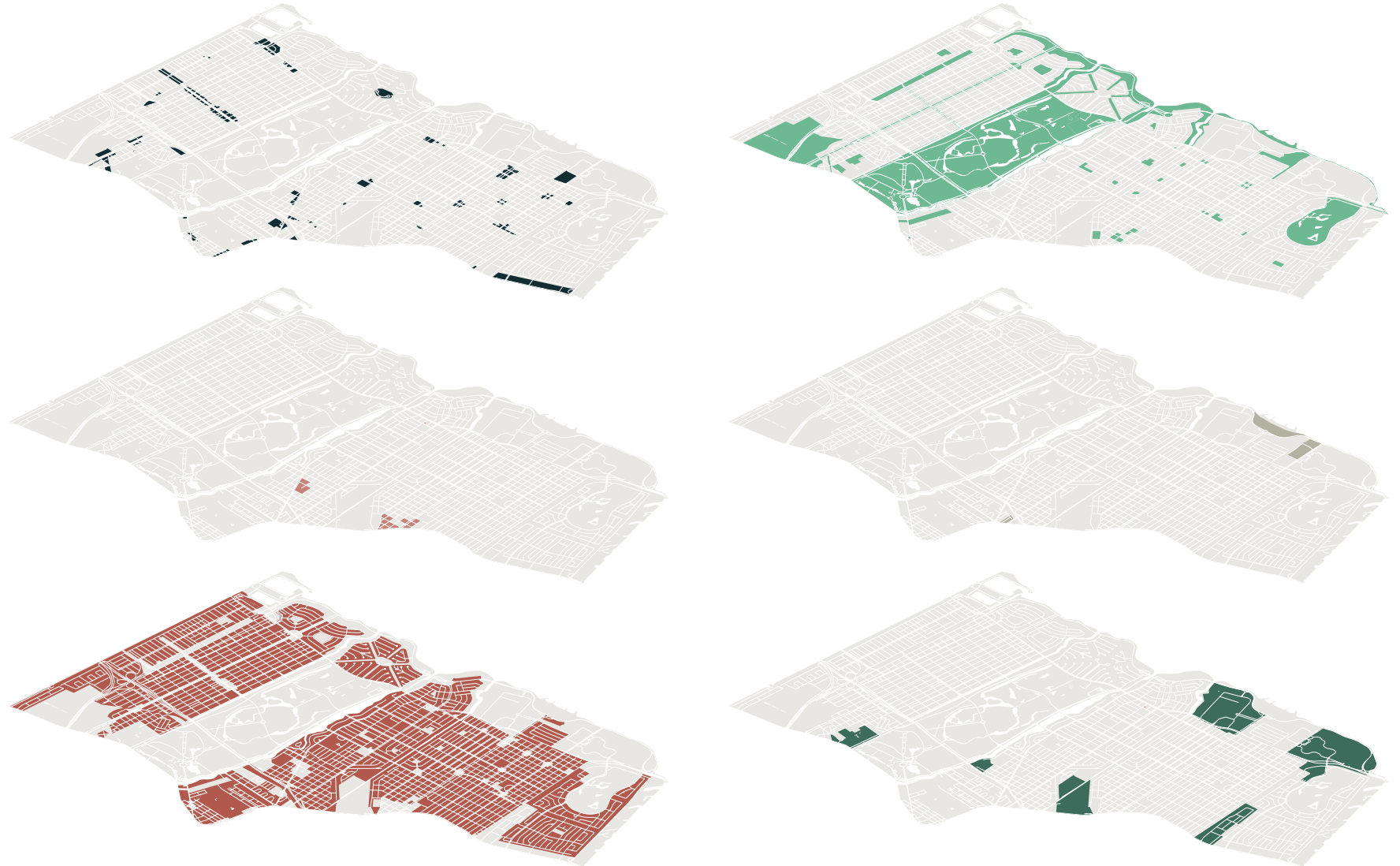


Adaptive domain analysis



Adaptive domain analysis

Functional diversity



- Residential
- Mixed use
- Commercial
- Educational
- Industry
- Open space

Vision

Problem Field

Analysis

Vision

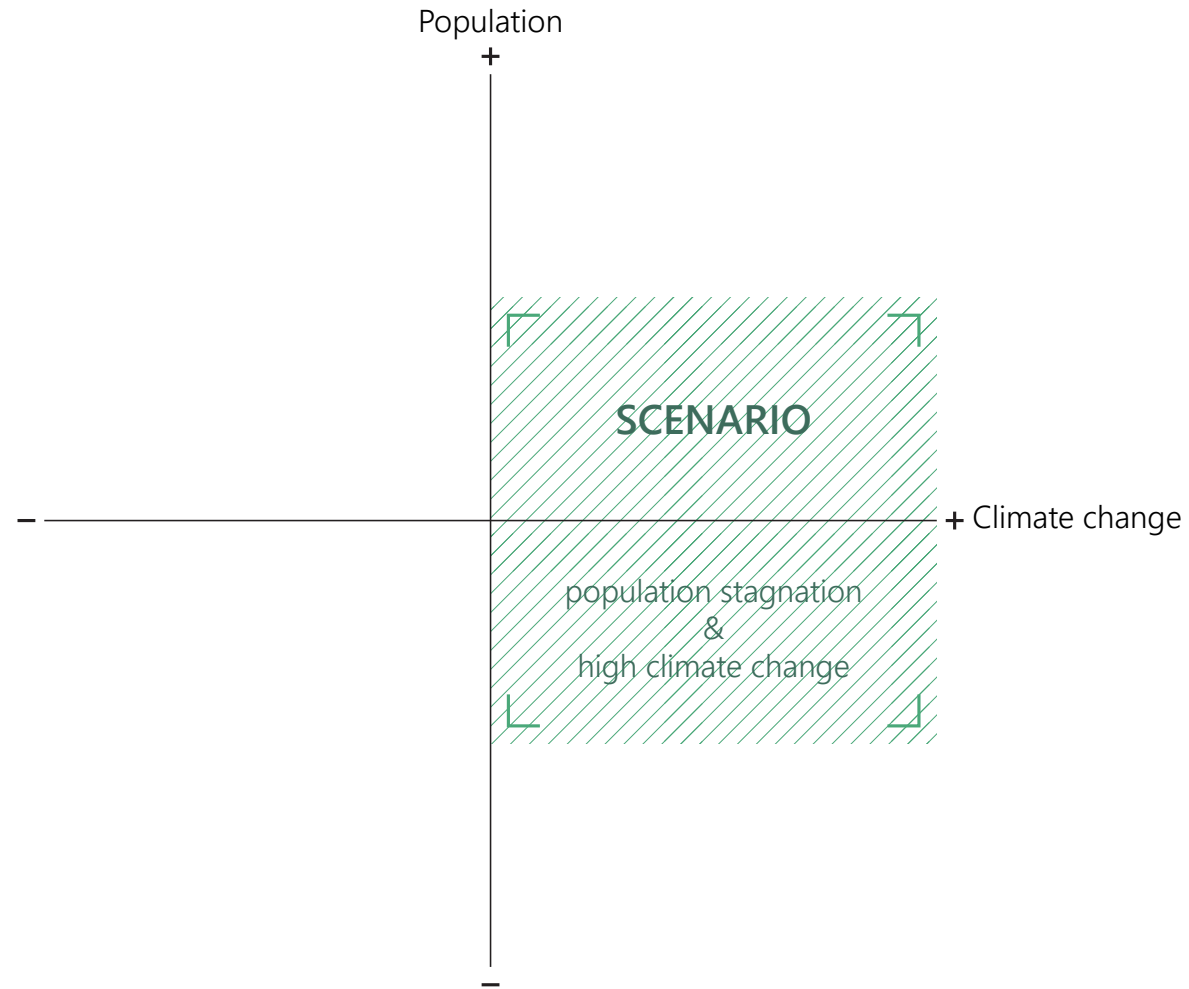
Design Framework

Water System Design

Urban Design

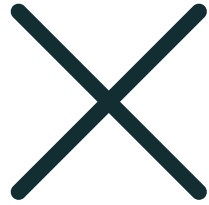
Conclusions

Scenario



Standpoint

Abandonist



Concessionist



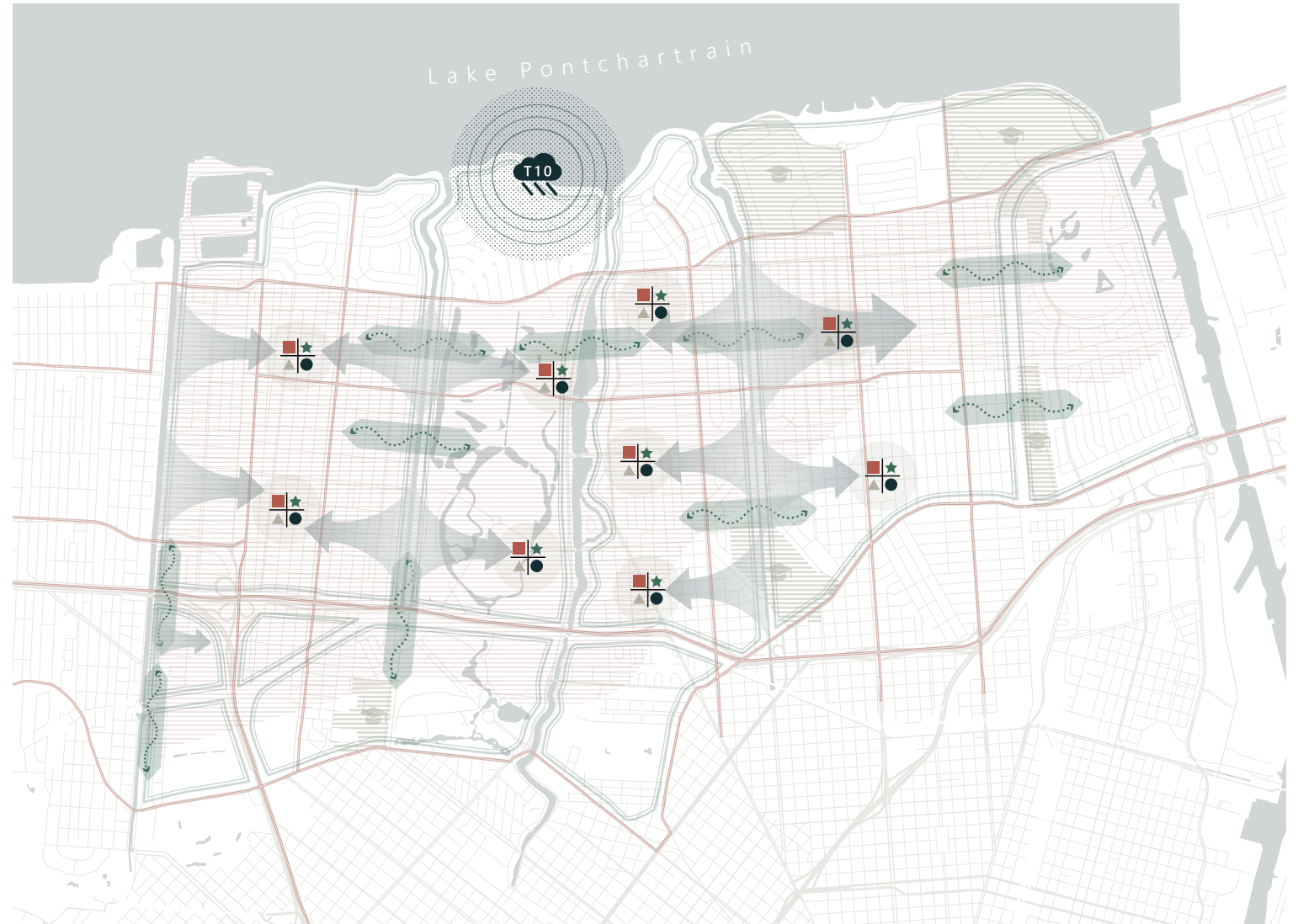
Conservatist



Respect built environment, but allow for bold interventions.

Vision

Use an improved water system as an accelerator for spatial development.



- ▶ Introduce water as amenity
- New connection
- ★ ● ▲ New functions
- 🏫 Leading educational role
- ☁️ T10 rainstorm
- 🏠 Area in need of local shelter
- 🛣️ Main road for evacuation

Design Framework

Problem Field

Analysis

Vision

Design Framework

Water System Design

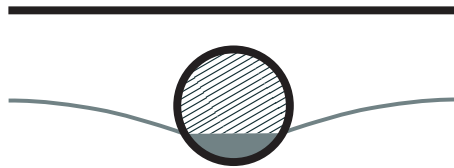
Urban Design

Conclusions

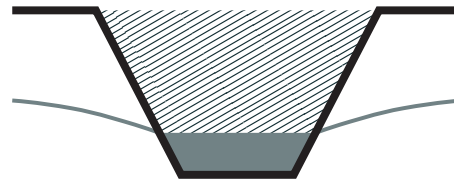
1. Hydrological design framework

Hydrological design principles

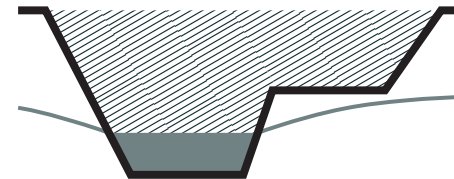
traditional drainage
minimal storage



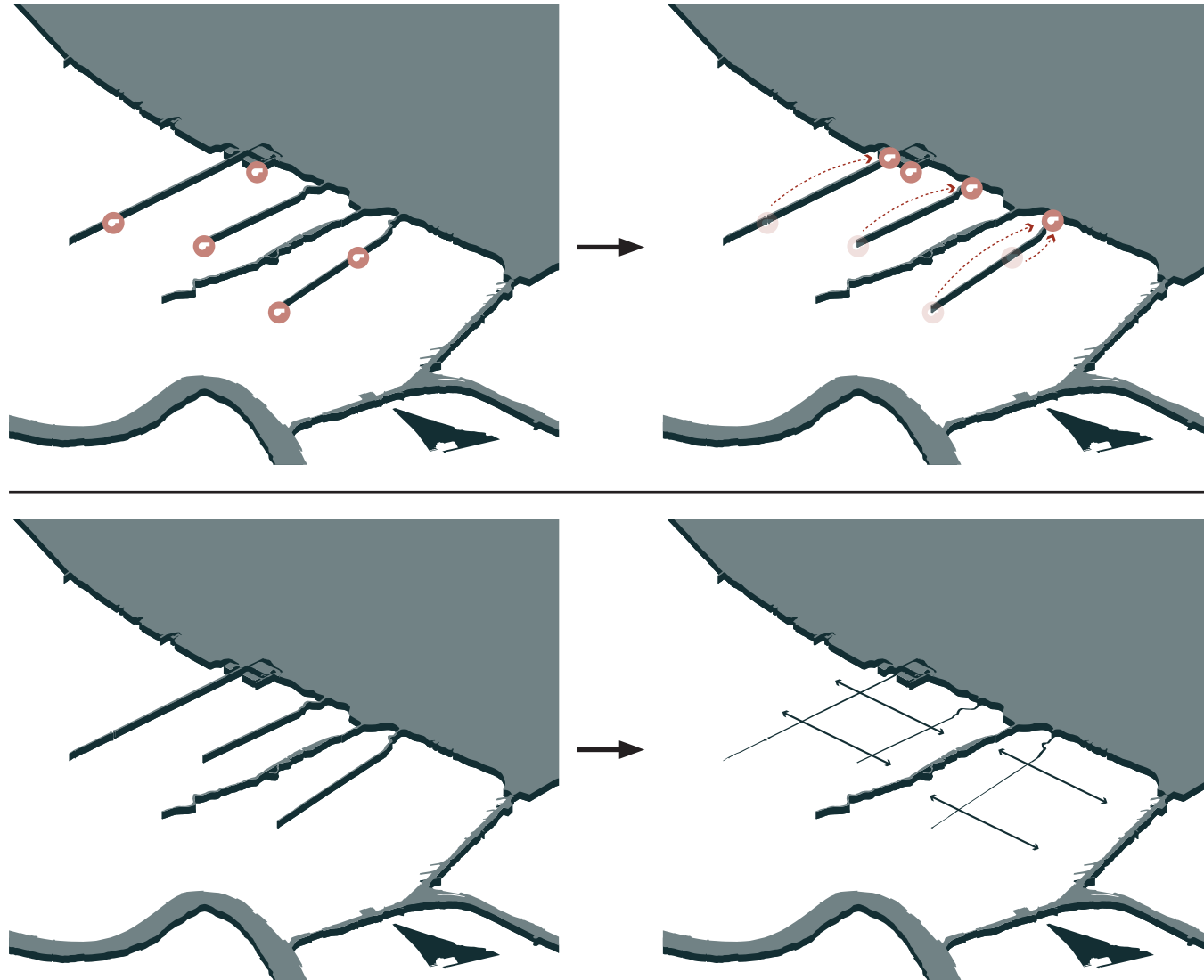
narrow ditch
significant storage



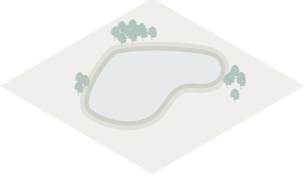

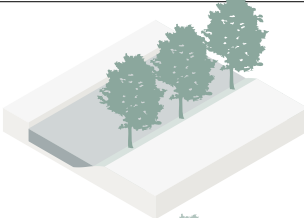
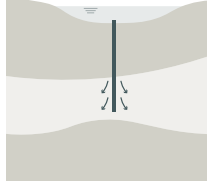
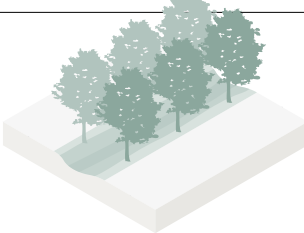
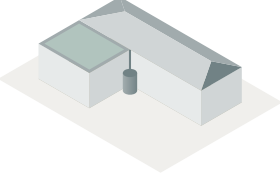
wide ditch
maximum storage



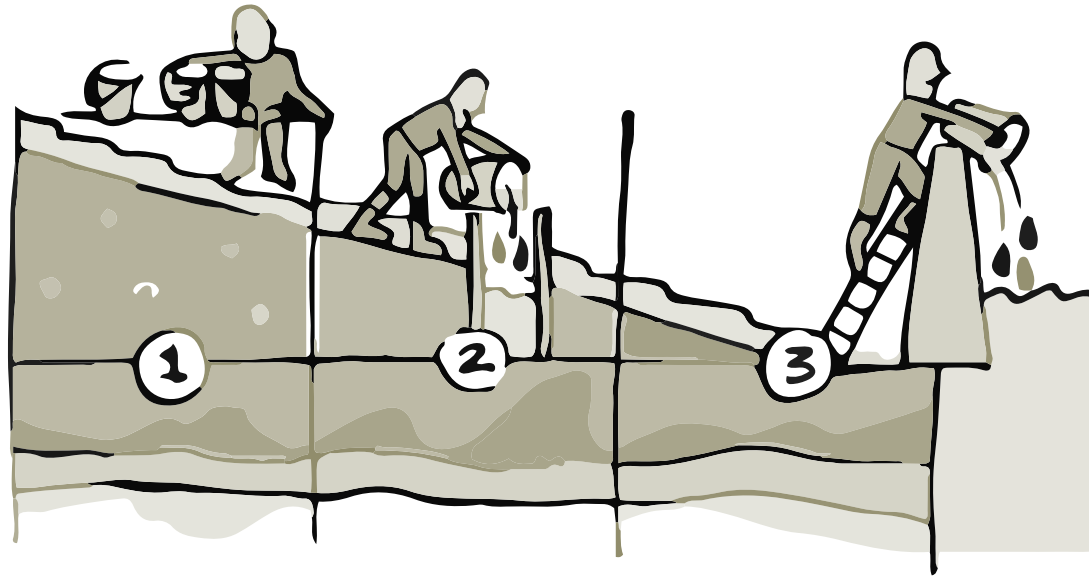
Hydrological design principles



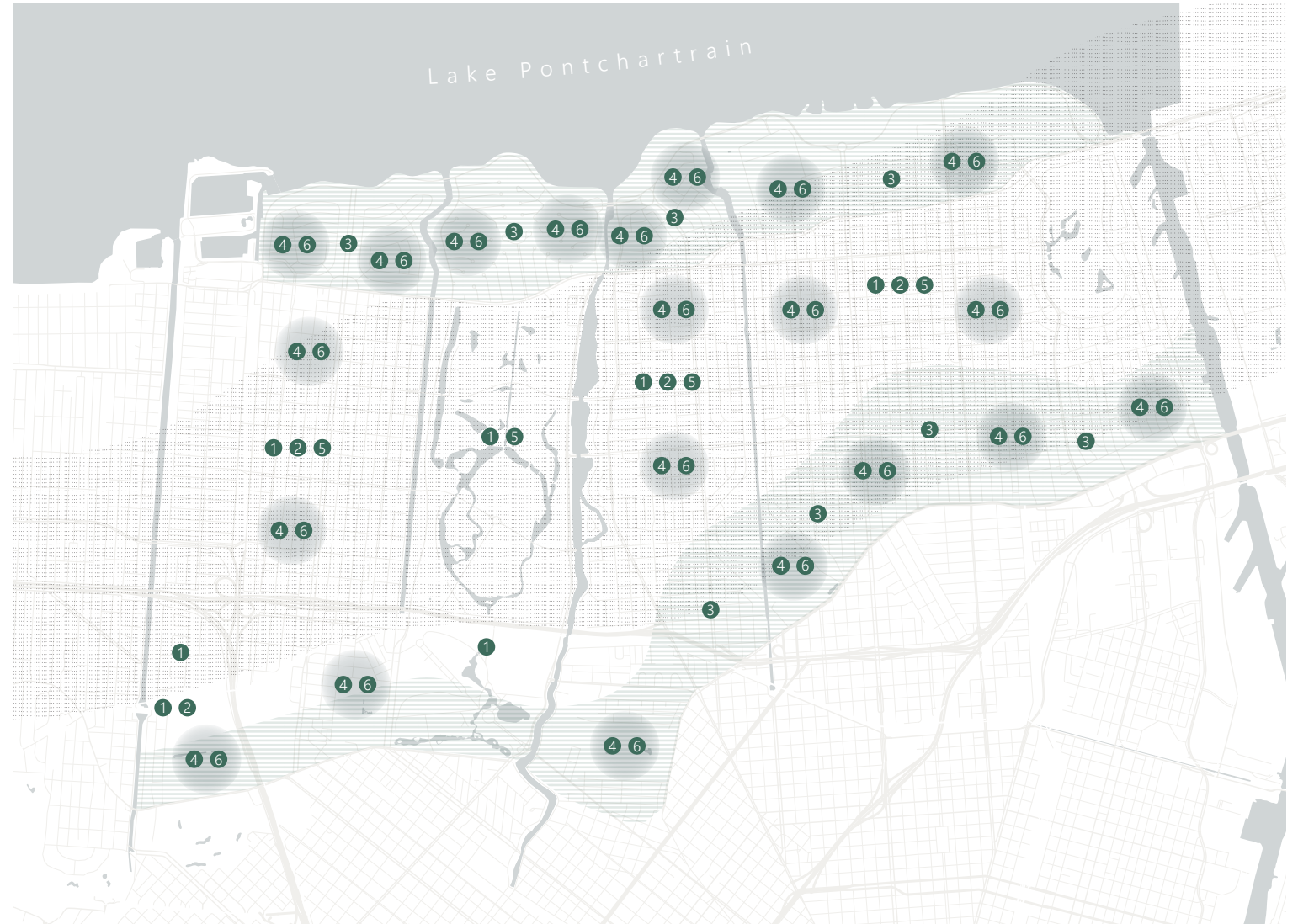
Hydrological design toolbox

Category	Elevation	Soil	Pair with element	Public / private	Category	Elevation	Soil	Pair with element	Public / private
 <p>Open water</p>	low	any	2 5	public	 <p>Green infrastructure facility</p>	any	permeable layer	3 6	public / private
 <p>Blue corridor</p>	low	any	1 3	public	 <p>Infiltration facility</p>	any	permeable layer (Pine barrier)	1	public / private
 <p>Green corridor</p>	high	permeable layer	2 4	public	 <p>Building-scale interventions</p>	any	any	4	public / private

Hydrological design principles



Hydrological design toolbox



- ① Open water
- ② Blue corridor
- ③ Green corridor
- ④ Green infrastructure facility
- ⑤ Infiltration facility
- ⑥ Building-scale intervention
- ≡≡≡ Zone for slowing water
- ⋮⋮⋮ Pine barrier sand

Specification of measures

	Category	Measure
1	Open water	Retention basin Constructed wetlands
2	Blue corridor	Open canal
3	Green corridor	Bioswale Grassed swale
4	Green infrastructure facility	Dry detention pond Rain garden Water square
5	Infiltration facility	Infiltration well Pervious pavement Infiltration boxes Infiltration trench
6	Building-scale interventions	Green roof Blue roof Rainwater harvesting Cistern

2. Connectivity design framework

Connectivity design framework



□ Difficult to cross border

↔ New connection





3. Spatial quality design framework

Spatial quality design framework



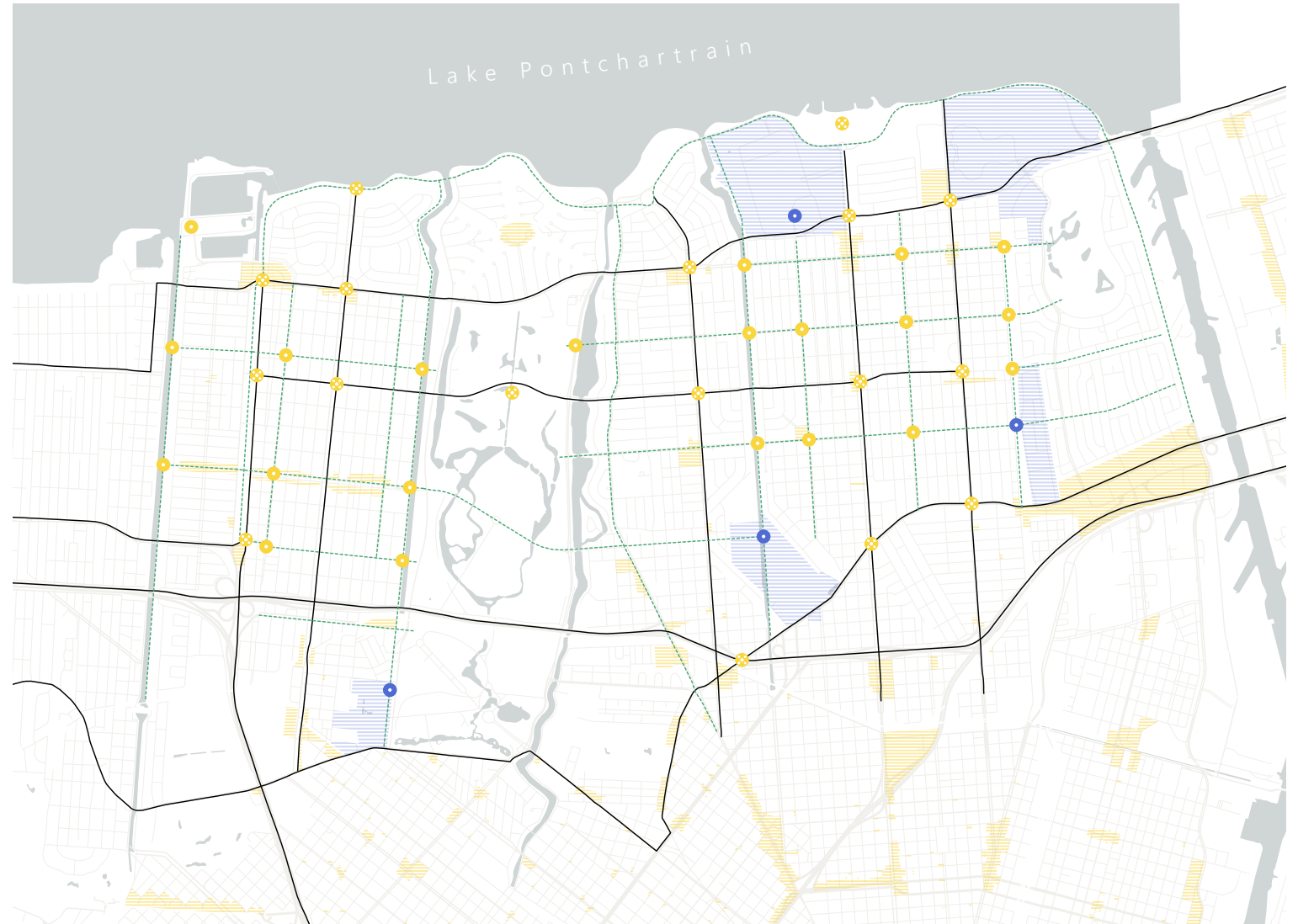
Spatial quality design framework



-  Open water
-  Increased density
-  Open streetscape
-  Closed streetscape

4. Functional design framework

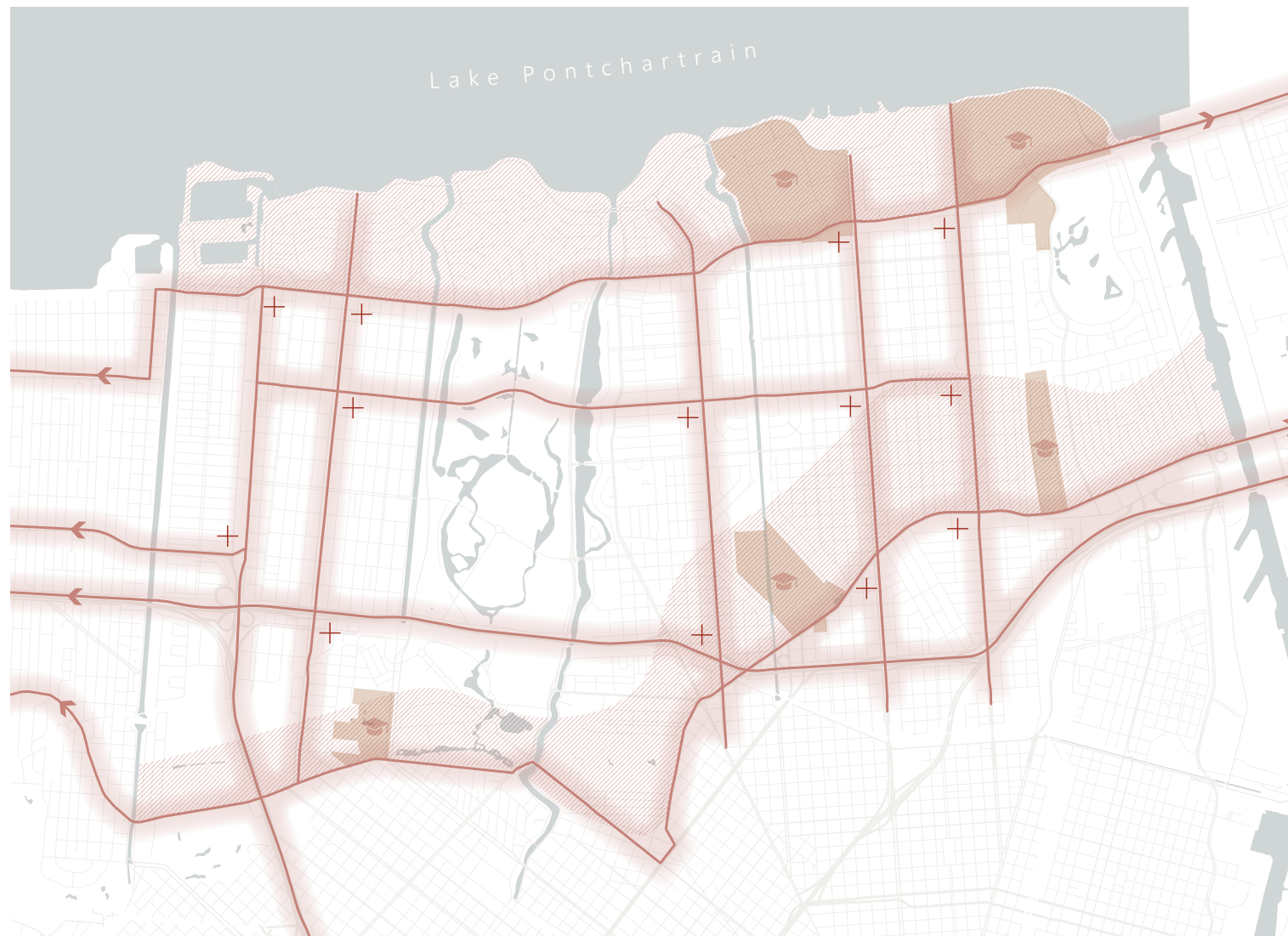
Functional design framework



- Major road
- - - Mid-level recreation routes
- ⊗ Regional function
- Local function
- Educational function
- ▨ Existing commercial functions
- ▨ Existing educational functions

5. Evacuation design framework

Evacuation design framework



- Major road for evacuation
- Local shelter near main roads
- + Locations for vertical evacuation
- High ground for sheltering
- Role of educational campus

Water System Design

Problem Field

Analysis Conclusions

Vision

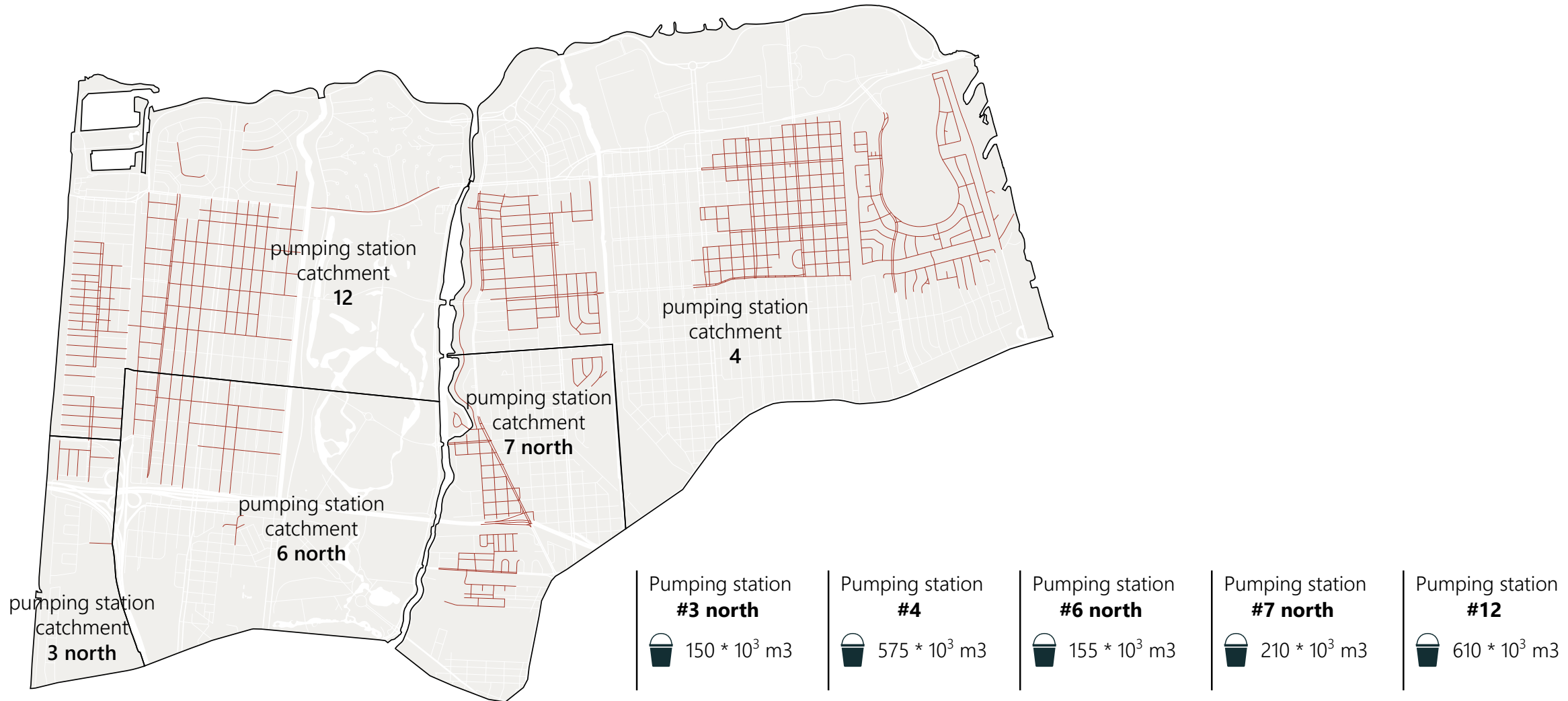
Design Framework

Water System Design

Urban Design

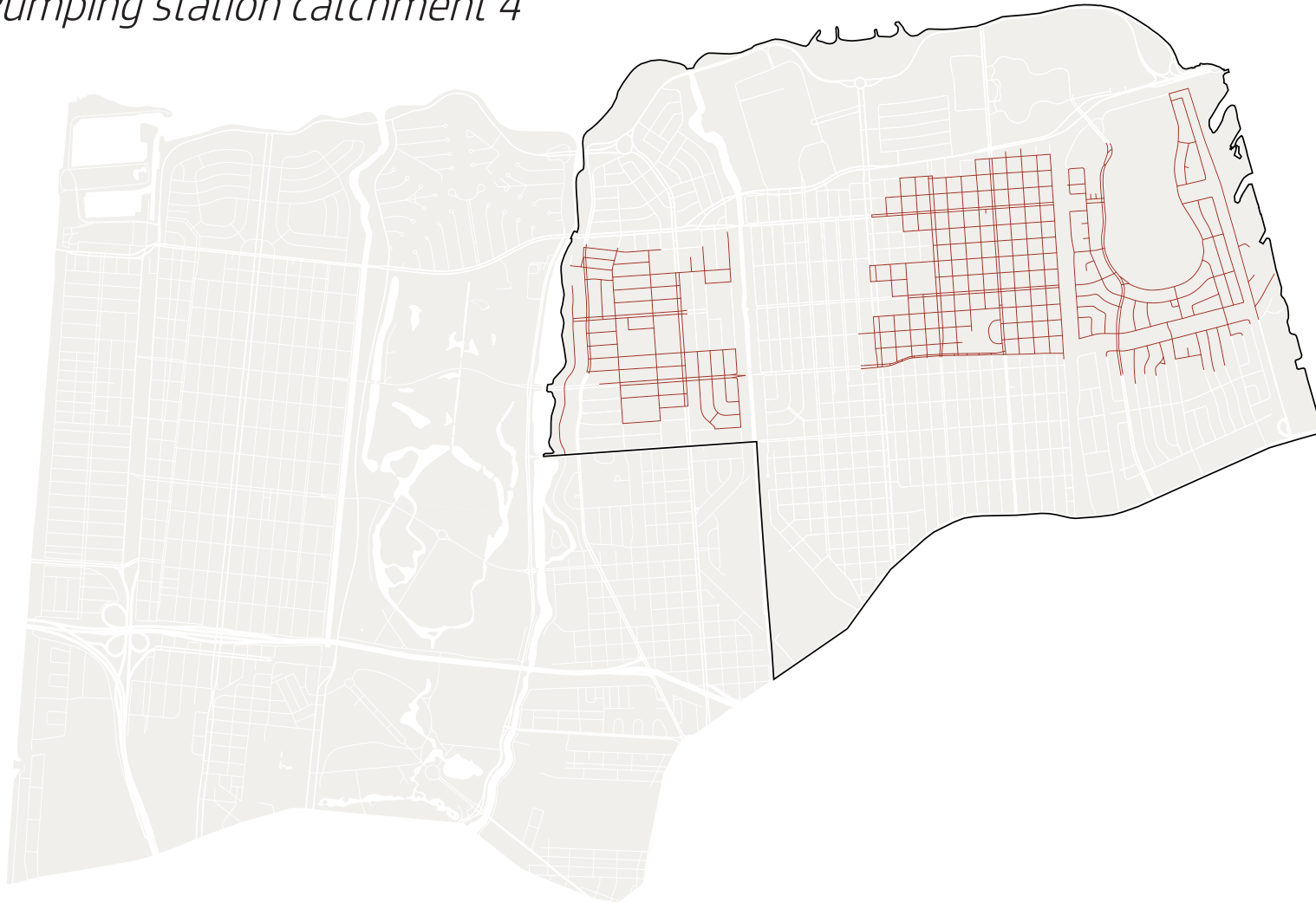
Conclusions & Recommendations

Water System Design



Water System Design

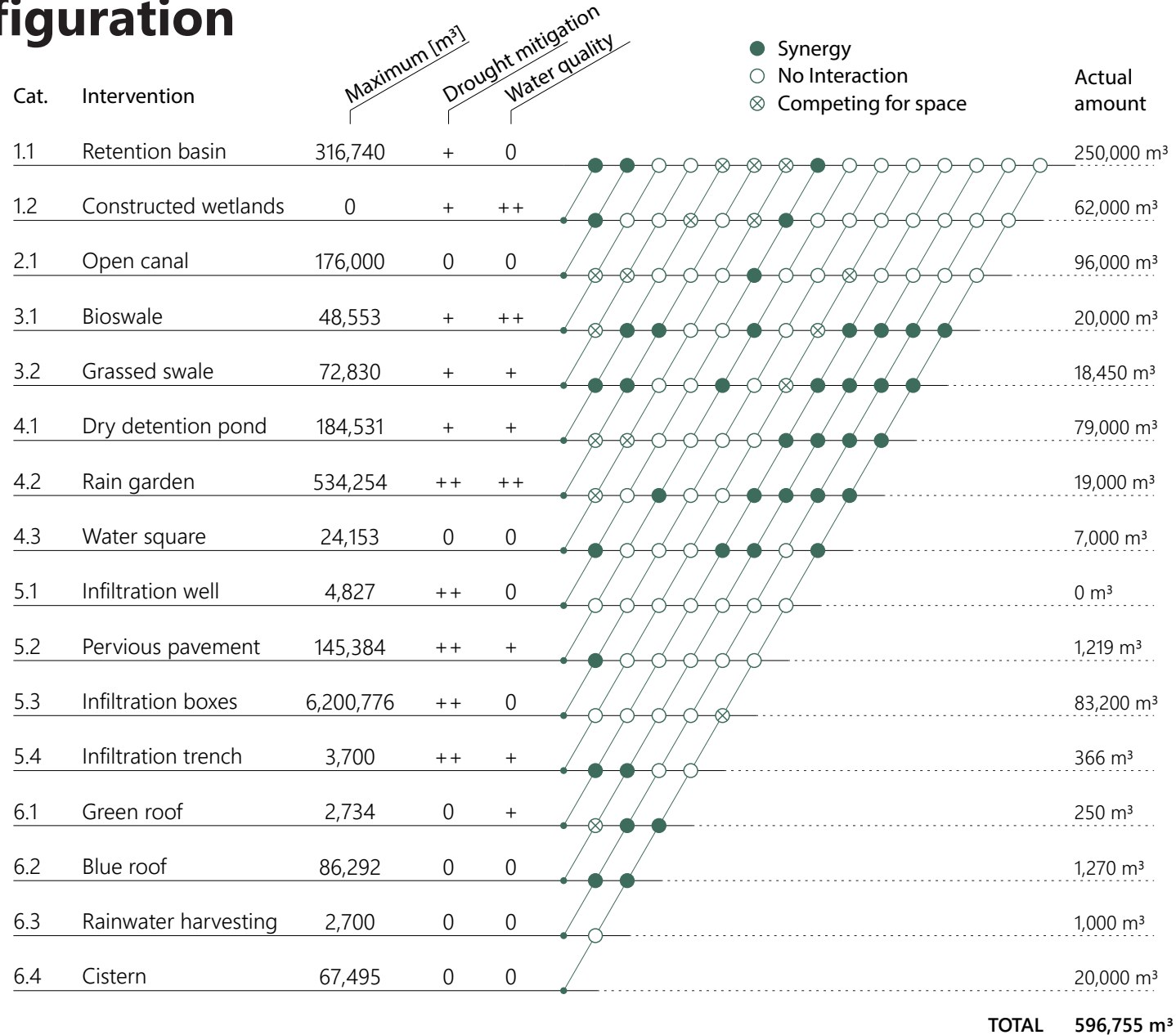
Pumping station catchment 4



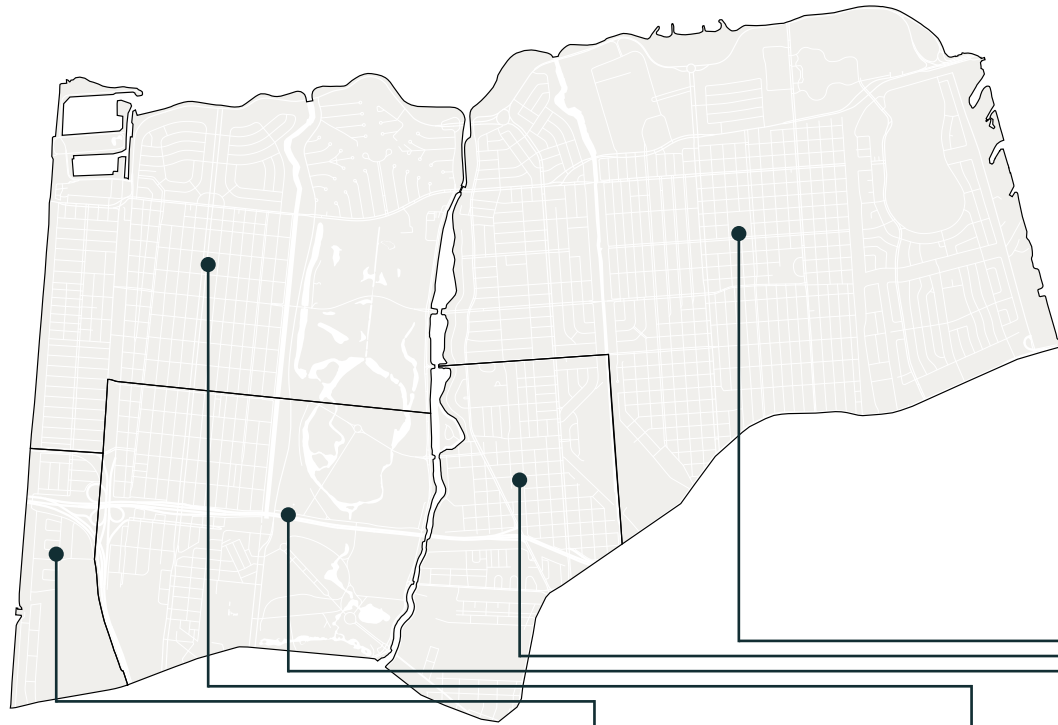
Design principles:

- Use vacant lots and public parks.
- Use wide boulevards.
- Give leading role to educational campuses.

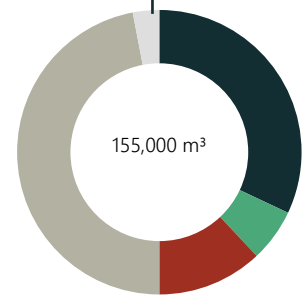
Measure configuration



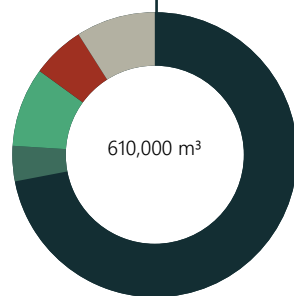
Measure configuration



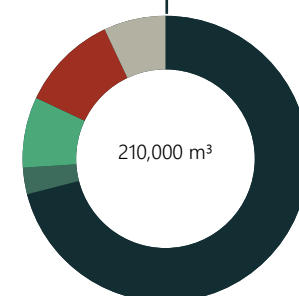
- Open water
- Blue corridor
- Green corridor
- Green infrastructure facility
- Infiltration facility
- Building-scale interventions



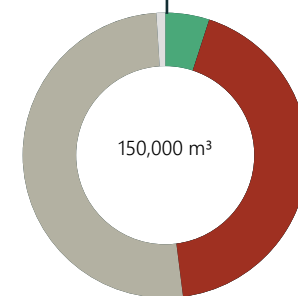
Pumping station 6 north



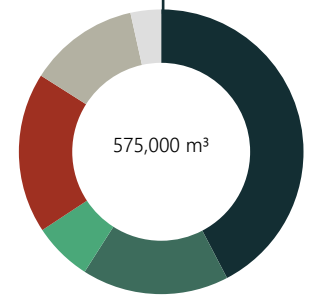
Pumping station 12



Pumping station 7 north



Pumping station 3 north





Pumping station 4

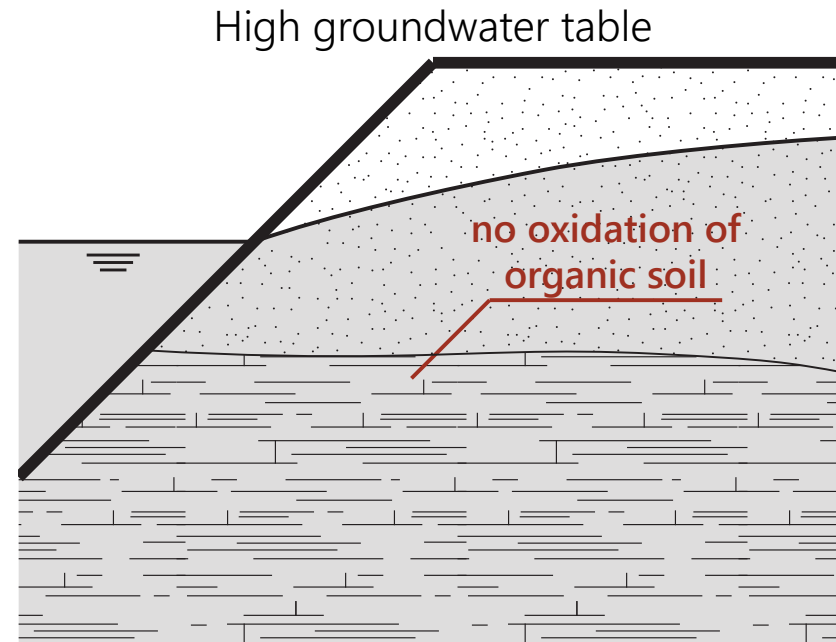
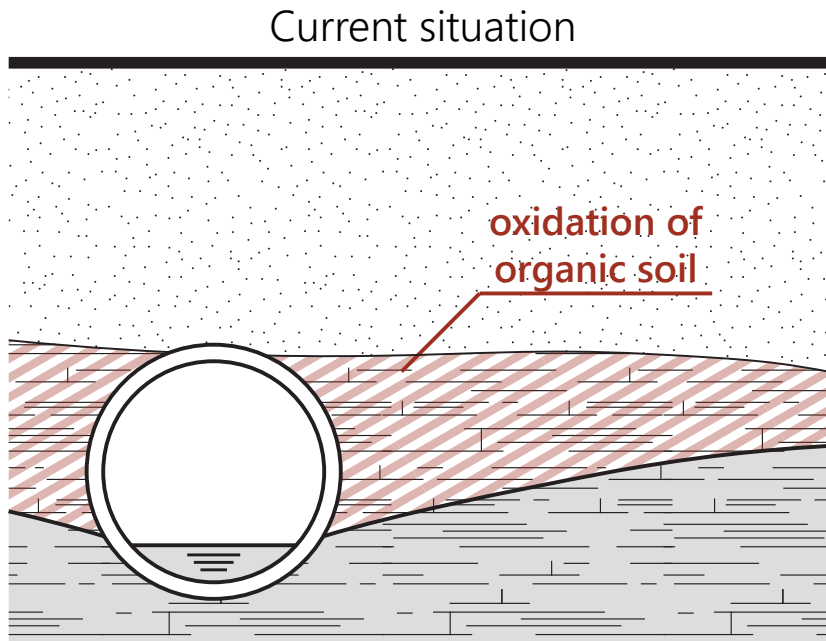
Lake Pontchartrain

- Retention basin
- Constructed wetlands
- Open canal
- Bioswale
- Grassed swale
- Dry detention pond
- Rain garden
- Existing or planned rain garden
- Water square
- Infiltration well
- Pervious pavement
- Infiltration boxes
- Infiltration trench
- Green roof
- Blue roof
- Rainwater harvesting
- Cistern



Subsidence mitigation

-  Non-organic soil
-  Organic soil



Subsidence mitigation

Lake Pontchartrain



Urban Design

Problem Field

Analysis

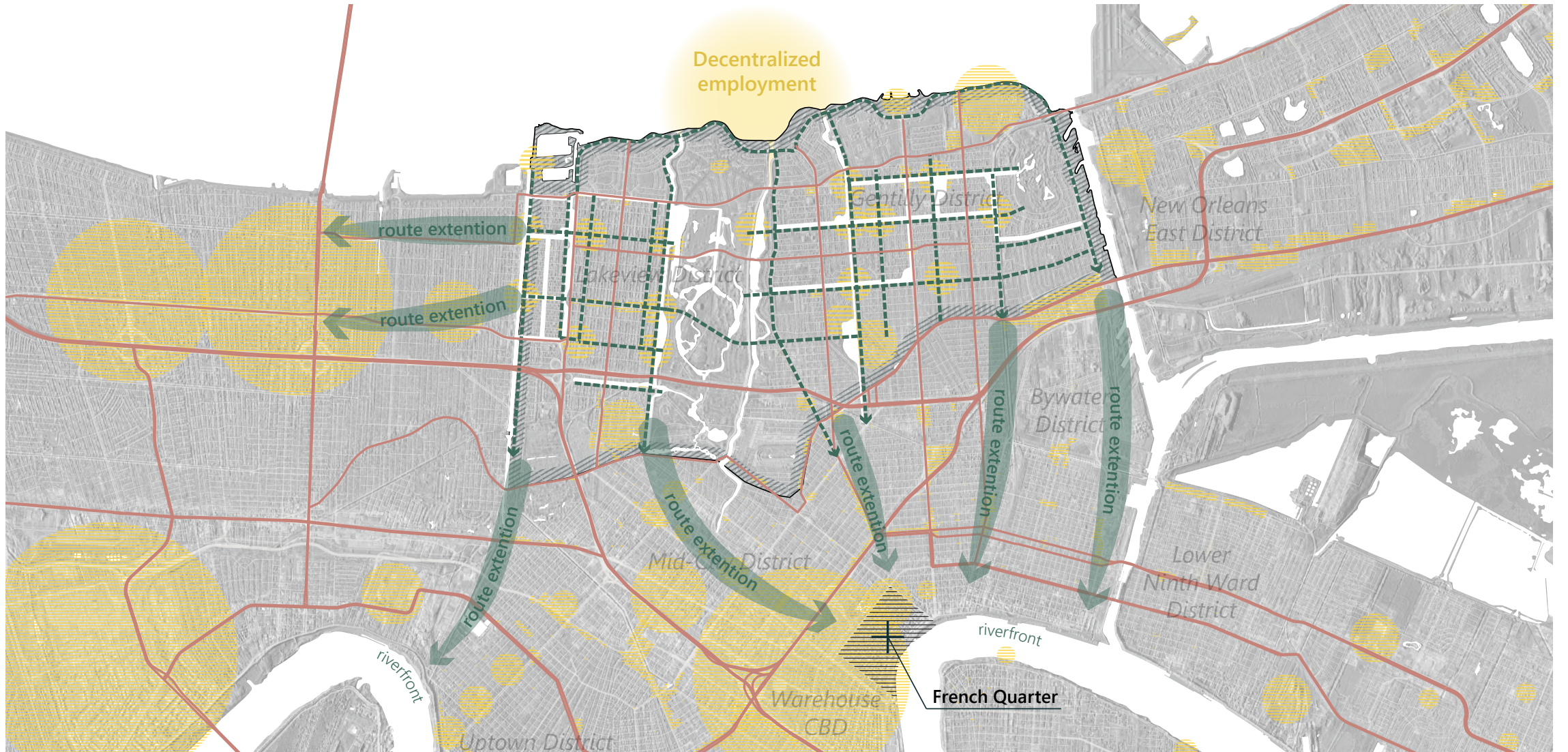
Vision

Design Framework

Water System Design

Urban Design

Conclusions



Lake Pontchartrain



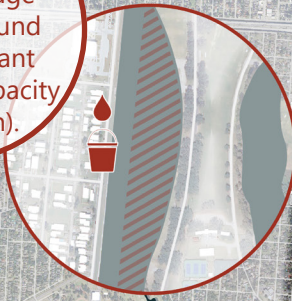
Improved connectivity with recreational routes.



Enriched programming decreases functional homogeneity.



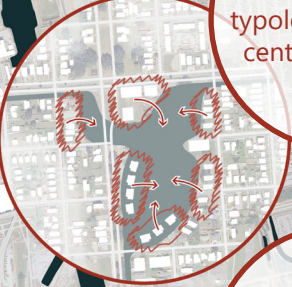
Permanent open water storage on low ground for significant buffering capacity (retention).



Temporary water storage on high ground and educational campuses (detention).



New living environment typologies that are centered around water.




Vertical evacuation on mounds in lower areas.



Urban Design

New living environments



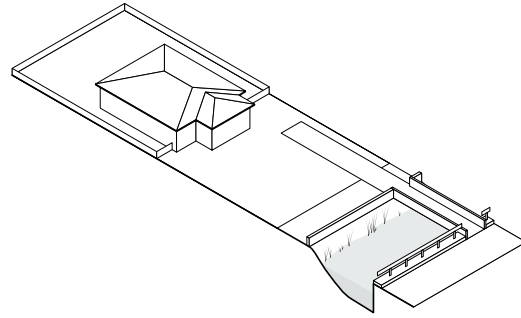
 Changed housing offer

 Open water

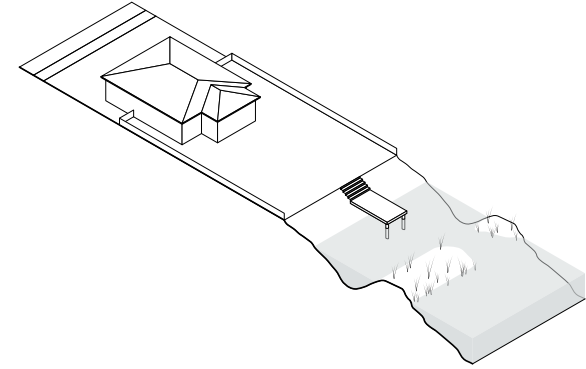
Urban Design

New living environment typologies

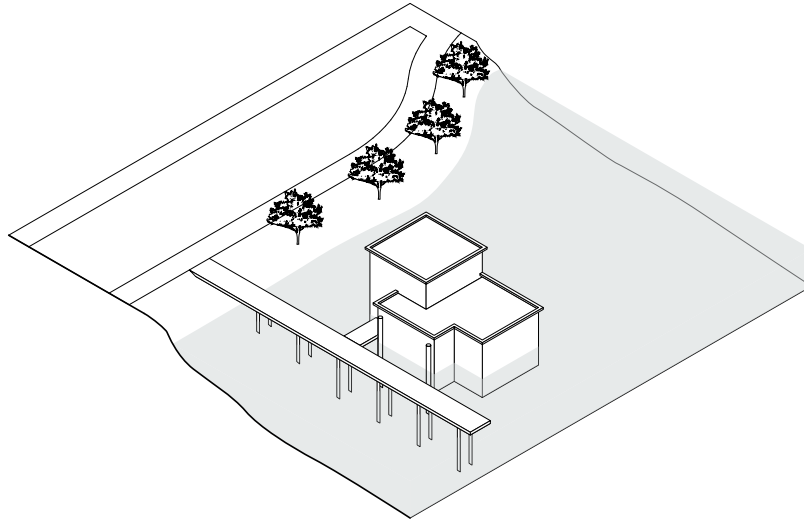
Canal



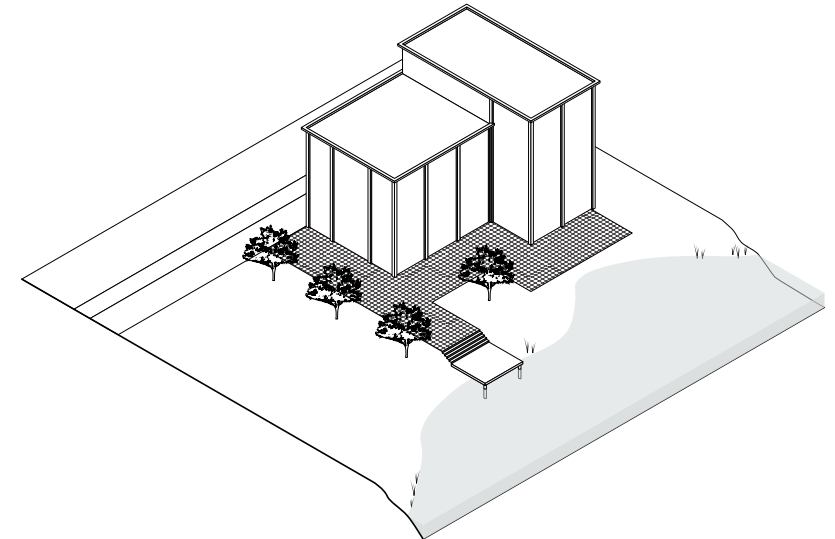
Open water access



Floating building



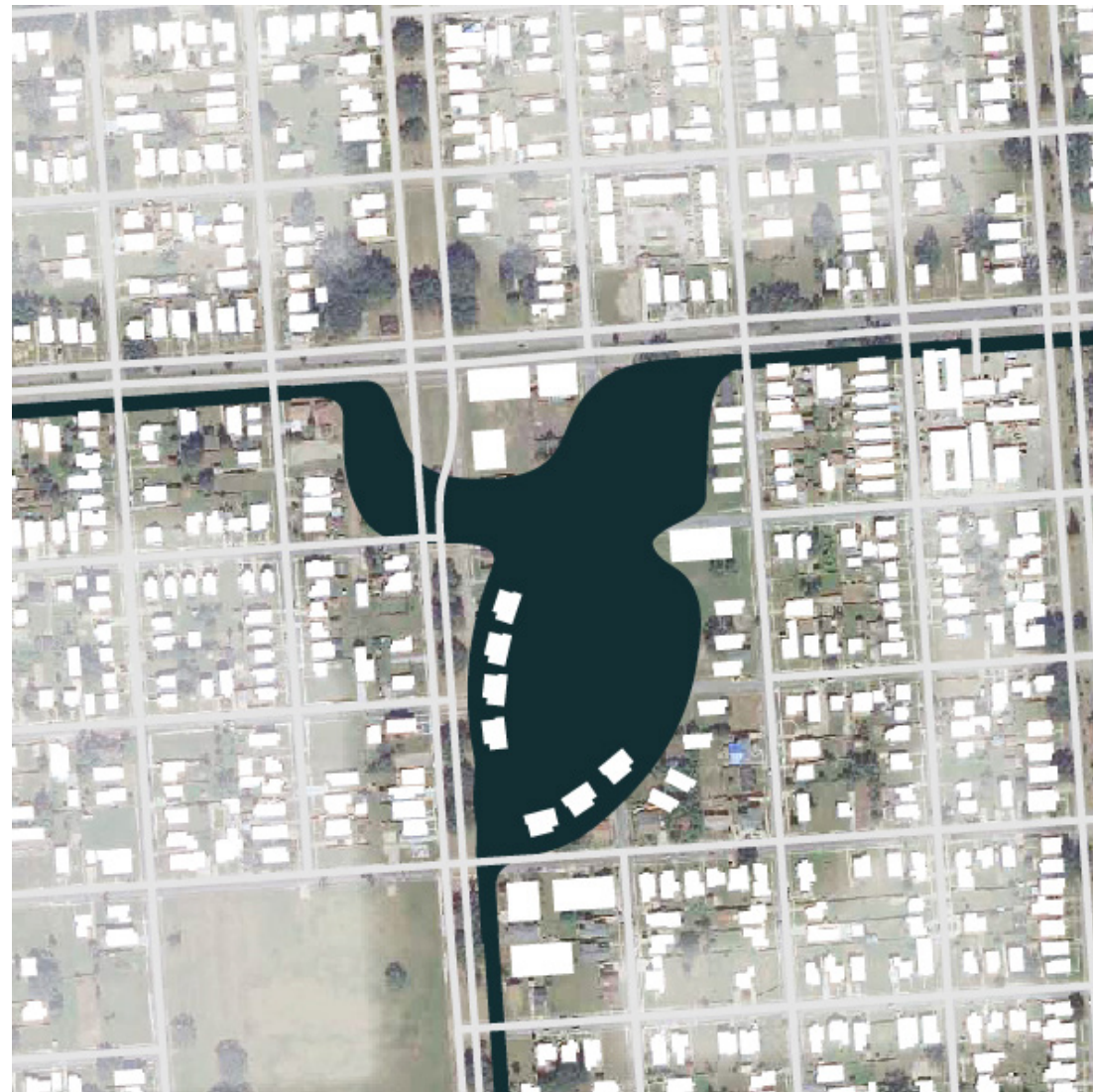
Waterside apartments



Demonstration project: St. Roch's Bayou



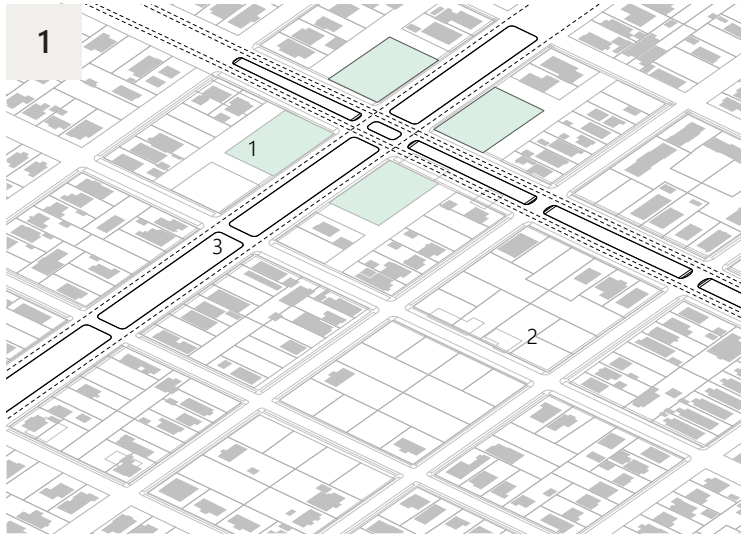
Demonstration project: St. Roch's Bayou



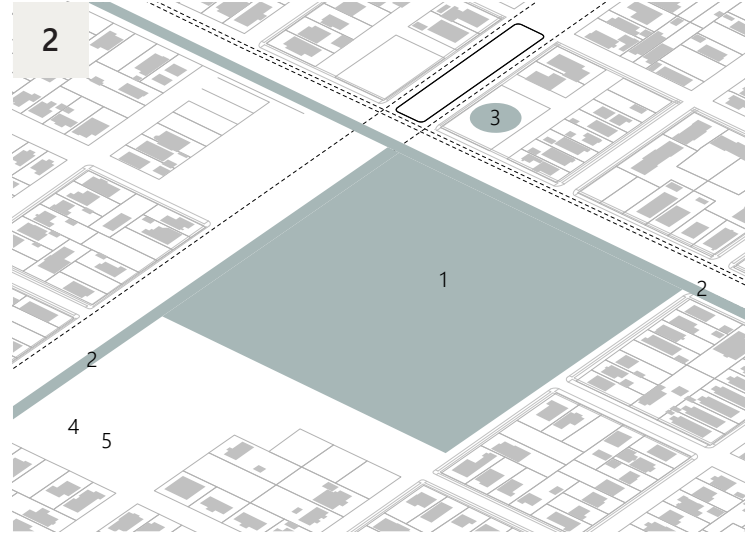
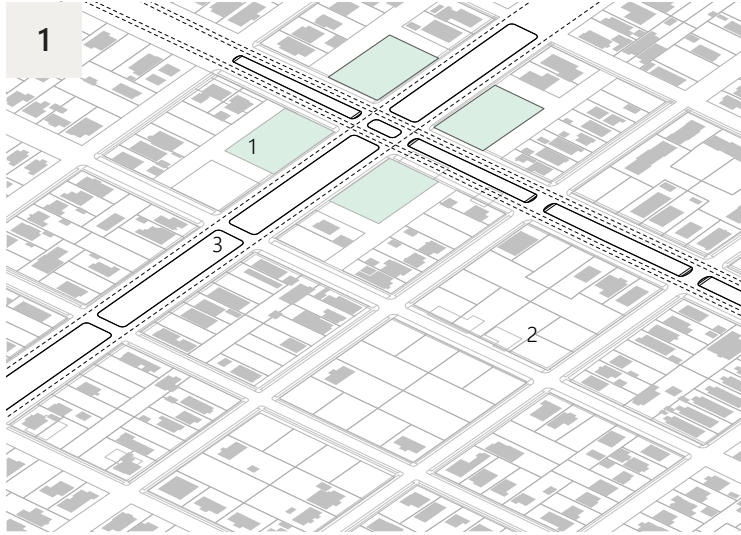
Demonstration project: St. Roch's Bayou



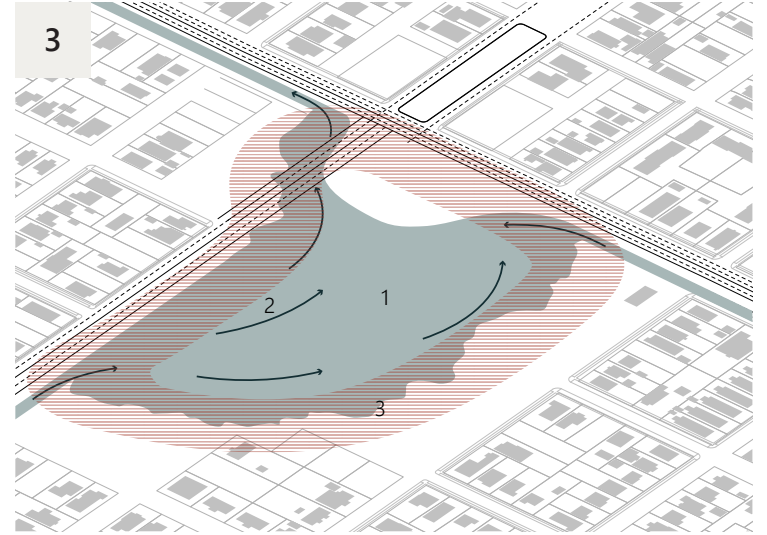
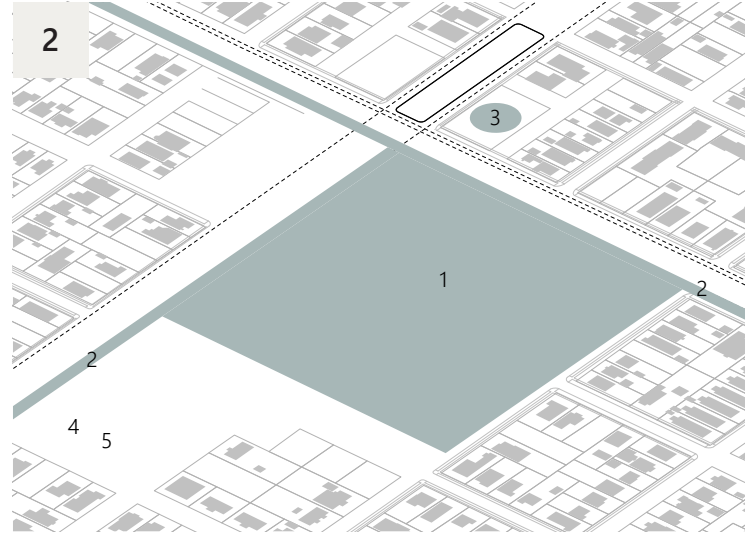
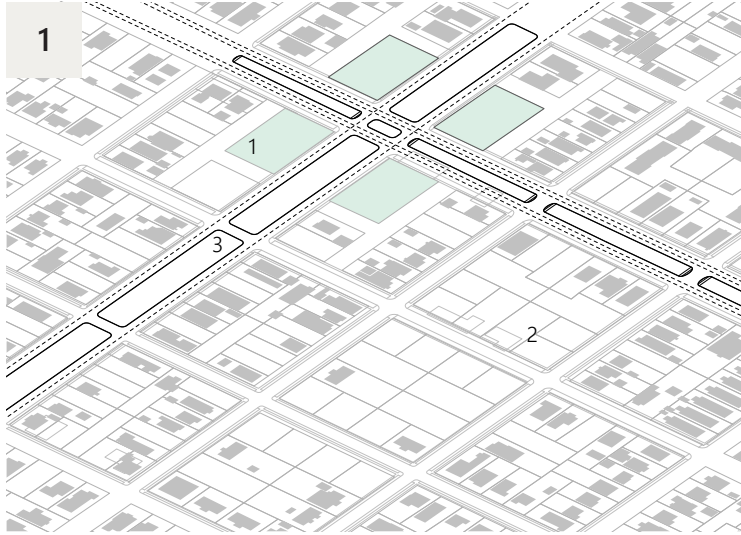
Form generation



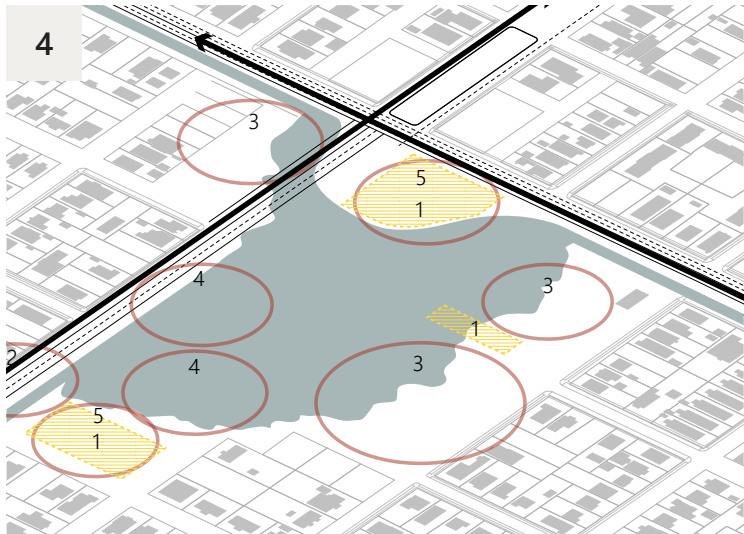
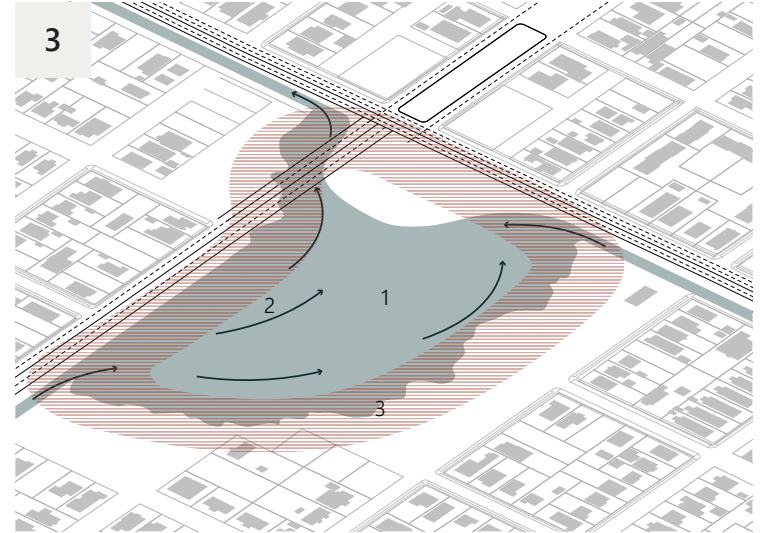
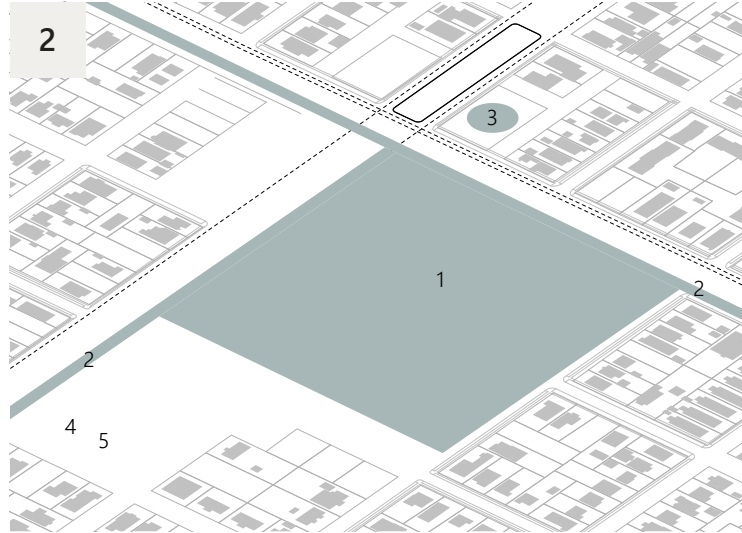
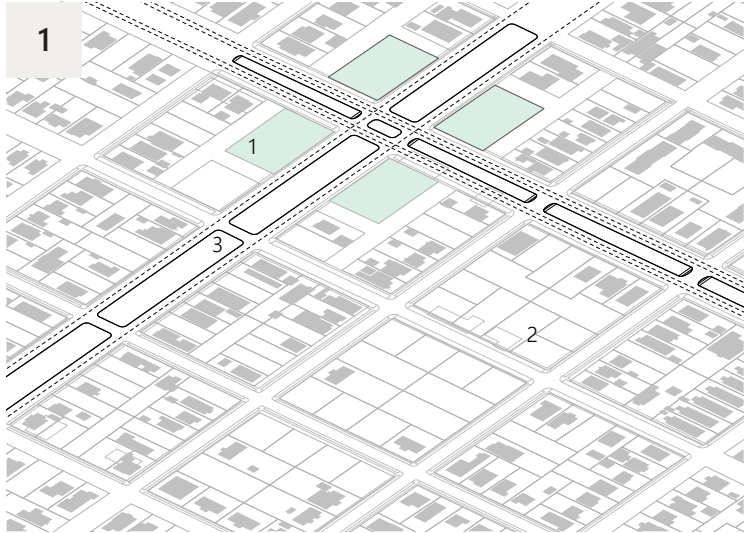
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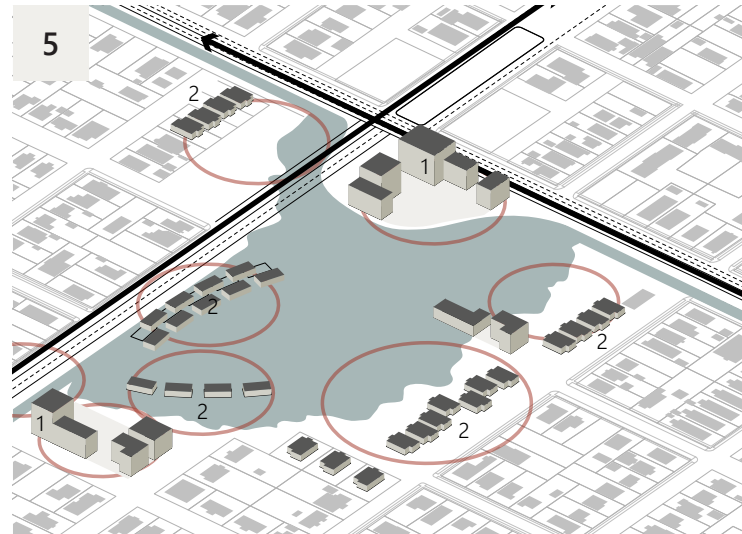
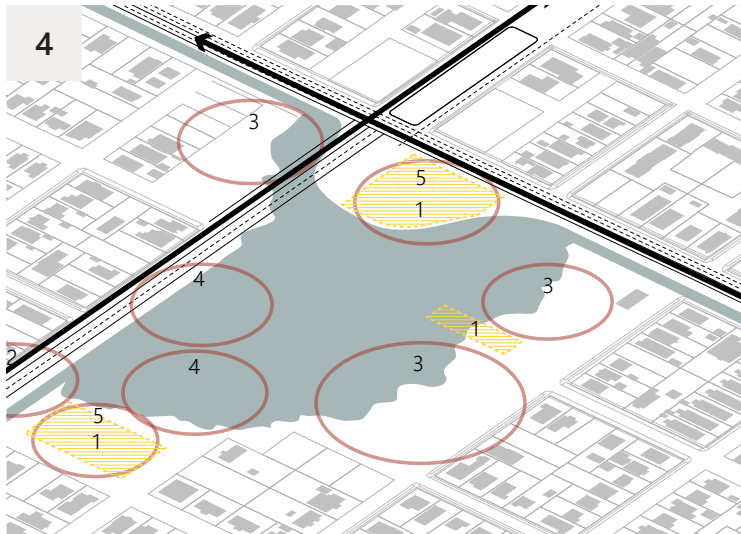
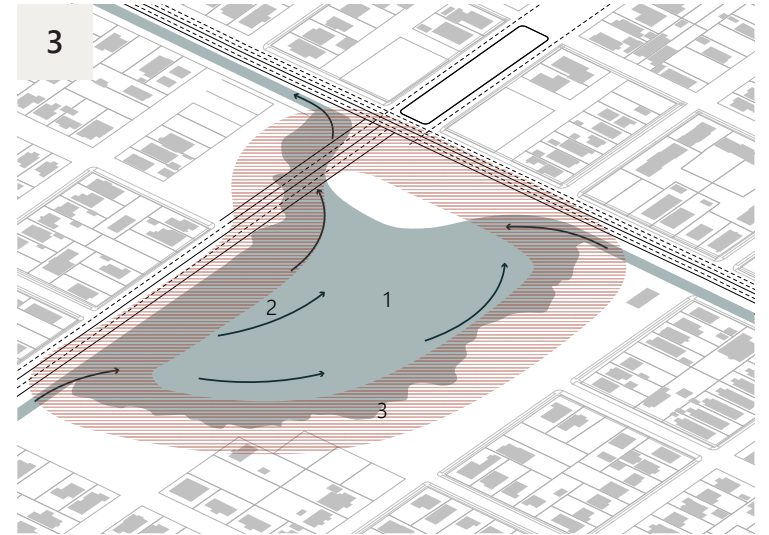
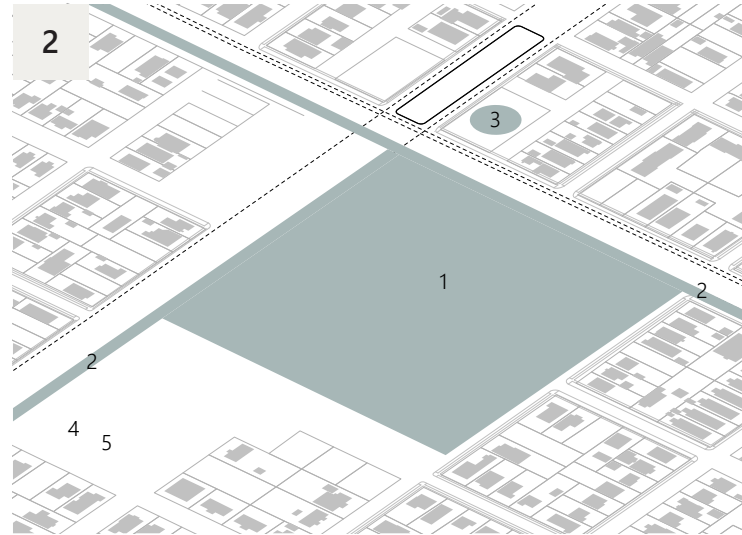
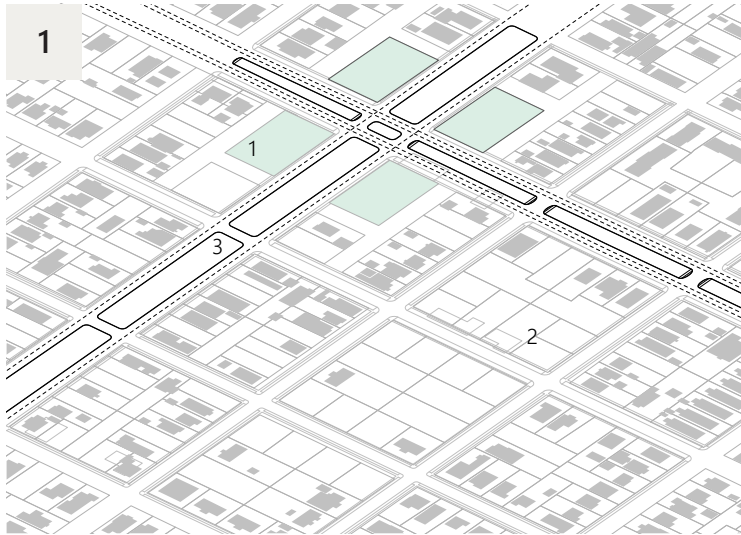
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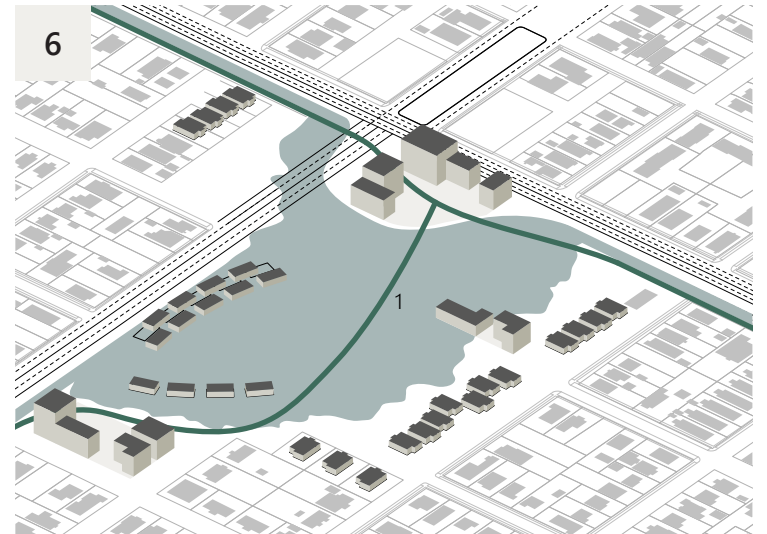
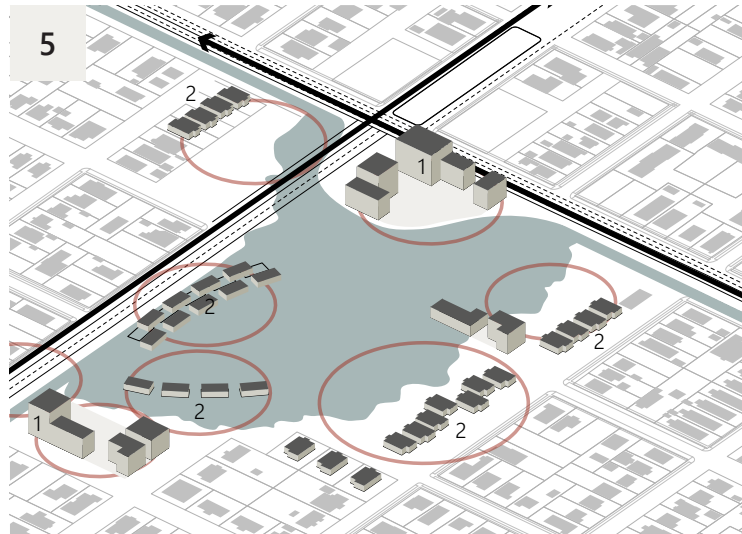
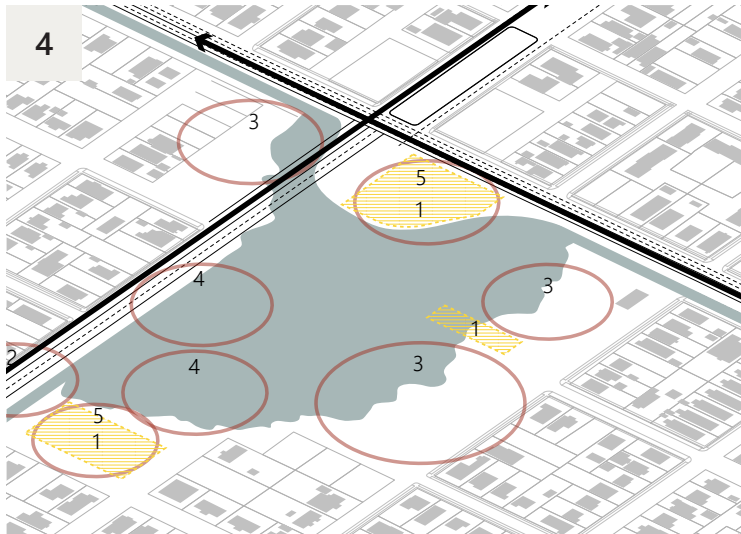
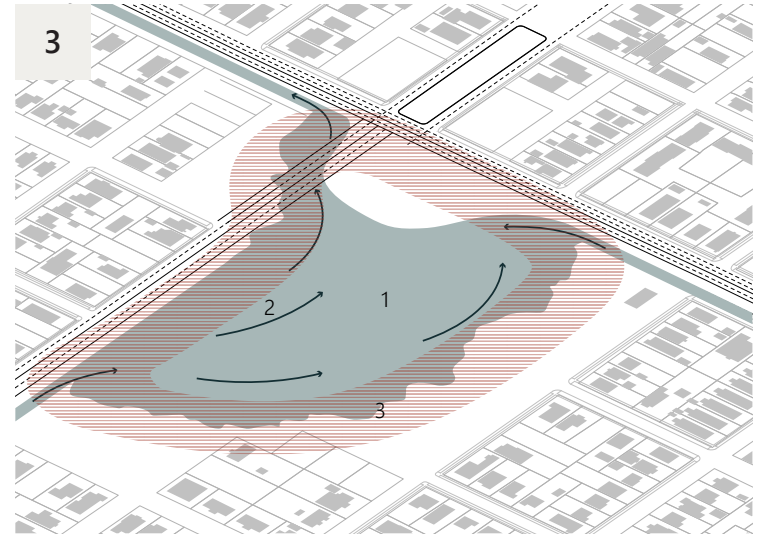
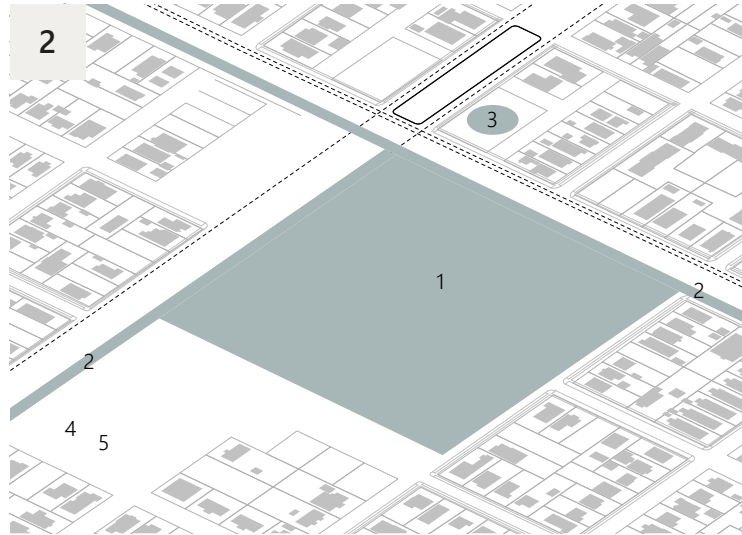
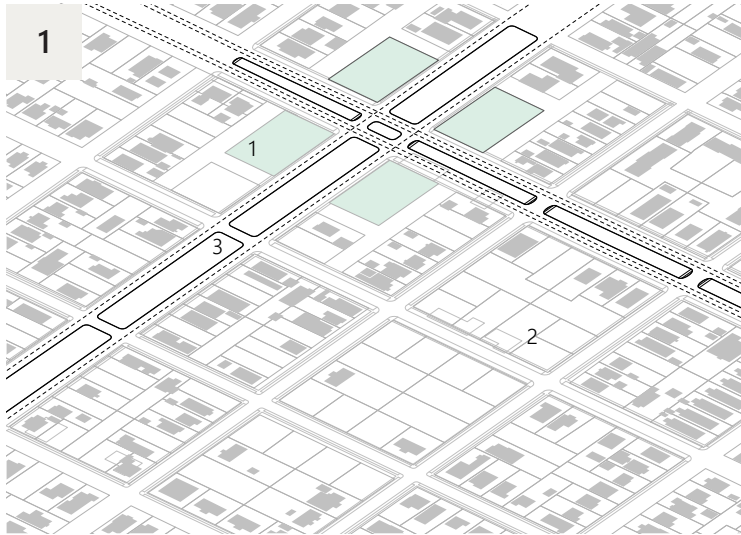
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Form generation

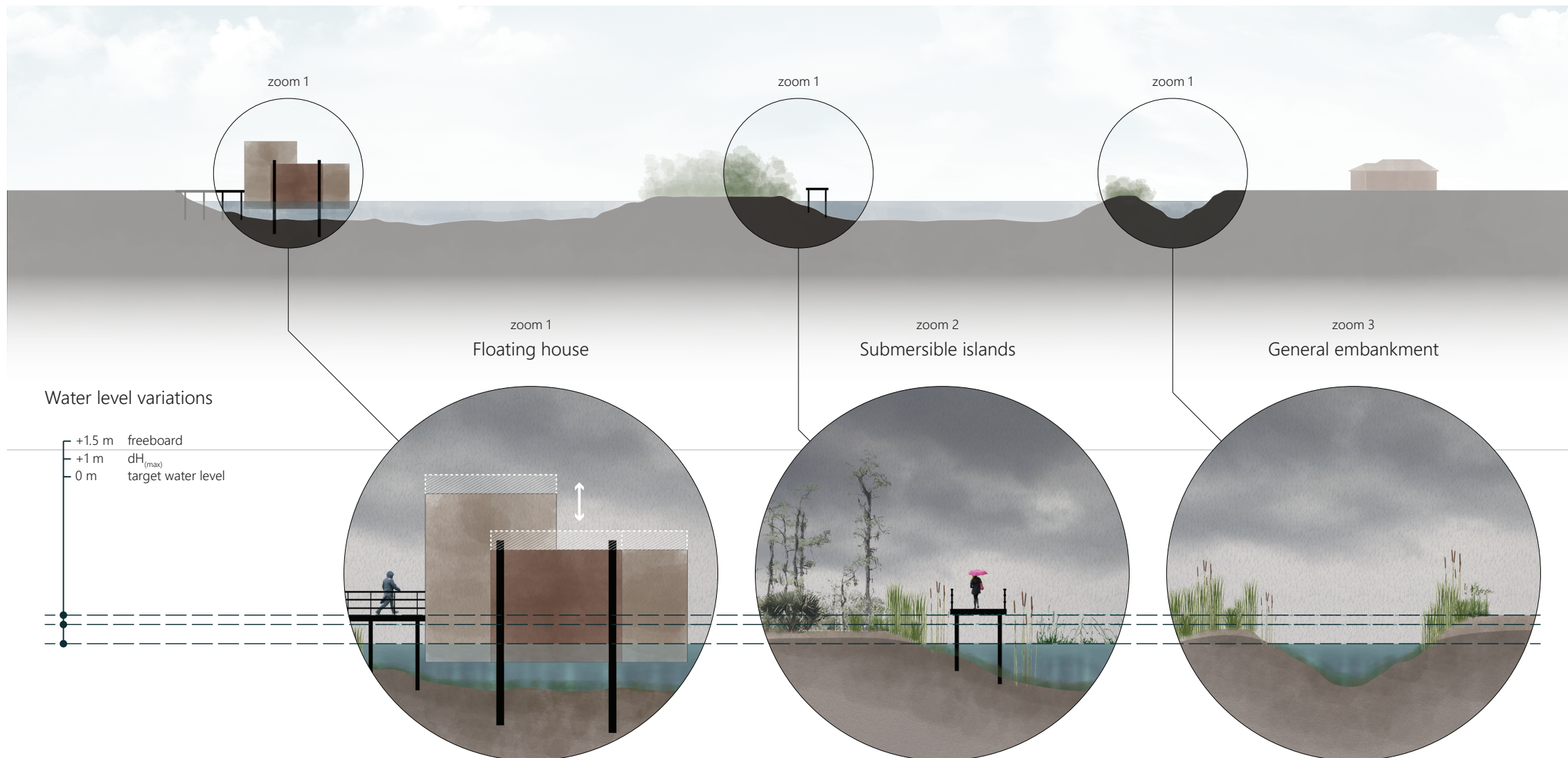


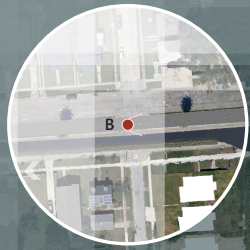
Form generation





Water level variations













- 1 Space for community activities
- 2 High quality public space at a human scale
- 3 Added commercial programming
- 4 Vertical evacuation
- 5 Mound above hurricane flood level
- 6 Freeboard = 1.5 meter, dHmax = 1 meter.



- 1 Open water access
- 2 Single family dwelling
- 3 Freeboard = 1.5 meter, dHmax = 1 meter.





- 1 Floating house
- 2 Waterside apartments
- 3 Natural embankments
- 4 Submersible islands



Conclusions

Problem Field

Analysis

Vision

Design Framework

Water System Design

Urban Design

Conclusions

Conclusions

*How can Orleans Lakeside be made more **flood and drought resilient** by integrating **multi-layered resilience capacities** of the built environment, whilst safeguarding **consistent design of technical adaptation measures** within the urban space?*

Conclusions

... only by totally reimagining the water system from an out-of-sight drainage system to a **water system revolving around open water**, Orleans Lakeside will be able to handle severe rainstorms.

... deploy a reimagined water system not only as a way to increase flood and drought resilience, but also act as **accelerator for spatial development**.

... to create **added value** (merger of interest) and address the **coping, recovery and adaptive resilience capacities**, the design connects improvements to the area's connectivity, quality of public space, programming and evacuation system to the new water system.

... conceive a **new form of urbanization** in Orleans Lakeside, one that is much more centered around water. Merge the new water-based urban environment with desired traditional American neighborhood qualities.

*How can Orleans Lakeside be made more **flood and drought resilient** by integrating **multi-layered resilience capacities** of the built environment, whilst safeguarding **consistent design of technical adaptation measures** within the urban space?*

Lake Pontchartrain



Thank you!

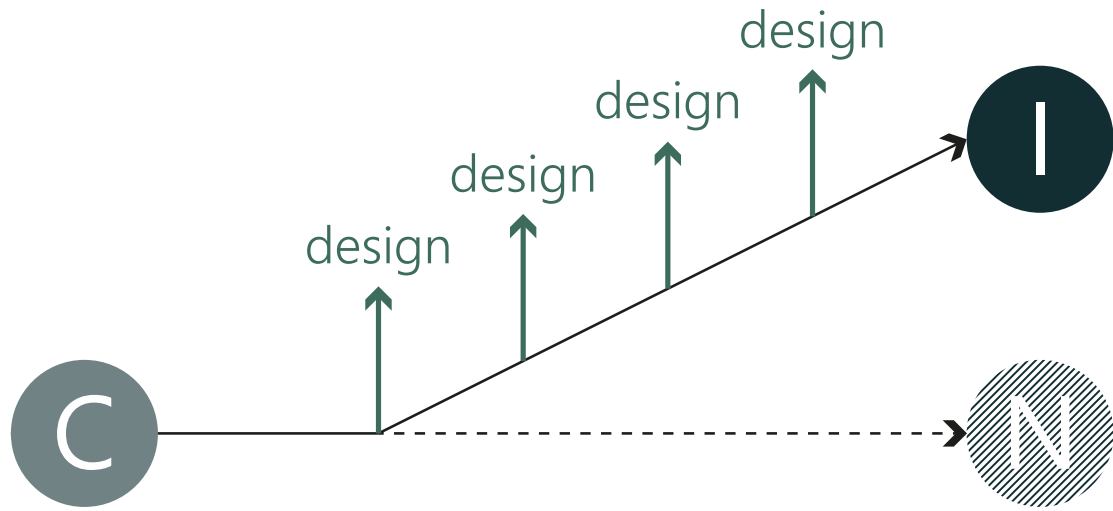
Appendix

Title

Water assignment determined by various models in m³.

Catchment	Water assignment determined with SWMM	Water assignment determined with UWM	Water assignment as determined by GNO-UWP
PS 3 north		150,000	122,000
PS 4	528,000	575,000	456,000
PS 6 north		155,000	65,000
PS 7 north		210,000	234,000
PS 12	871,000	610,000	412,000

Scenario & vision



Vision statement

Orleans Lakeside is to become more flood and drought resilient.

*Orleans Lakeside will be capable of successfully handling severe rain storms with a return period of ten years through **an improved water system which acts as an accelerator for spatial development**. Green-blue infrastructure projects introduce water as an amenity and reintroduce the city's geographical location of wetlands and bayous. In addition, these green-blue elements deliver a better spatial integration within Orleans Lakeside. Bold interventions and structural changes to the urban fabric make Orleans Lakeside better capable of dealing with uncertainties in the context of stagnation. Orleans Lakeside will be resilient to severe storms and hurricanes through means of spatial flexibility, as well as vertical evacuation for those unable or unwilling to leave. Strategic densification creates viable development potential with decentralized job opportunities and destinations for local and regional traffic.*

Measure maximization

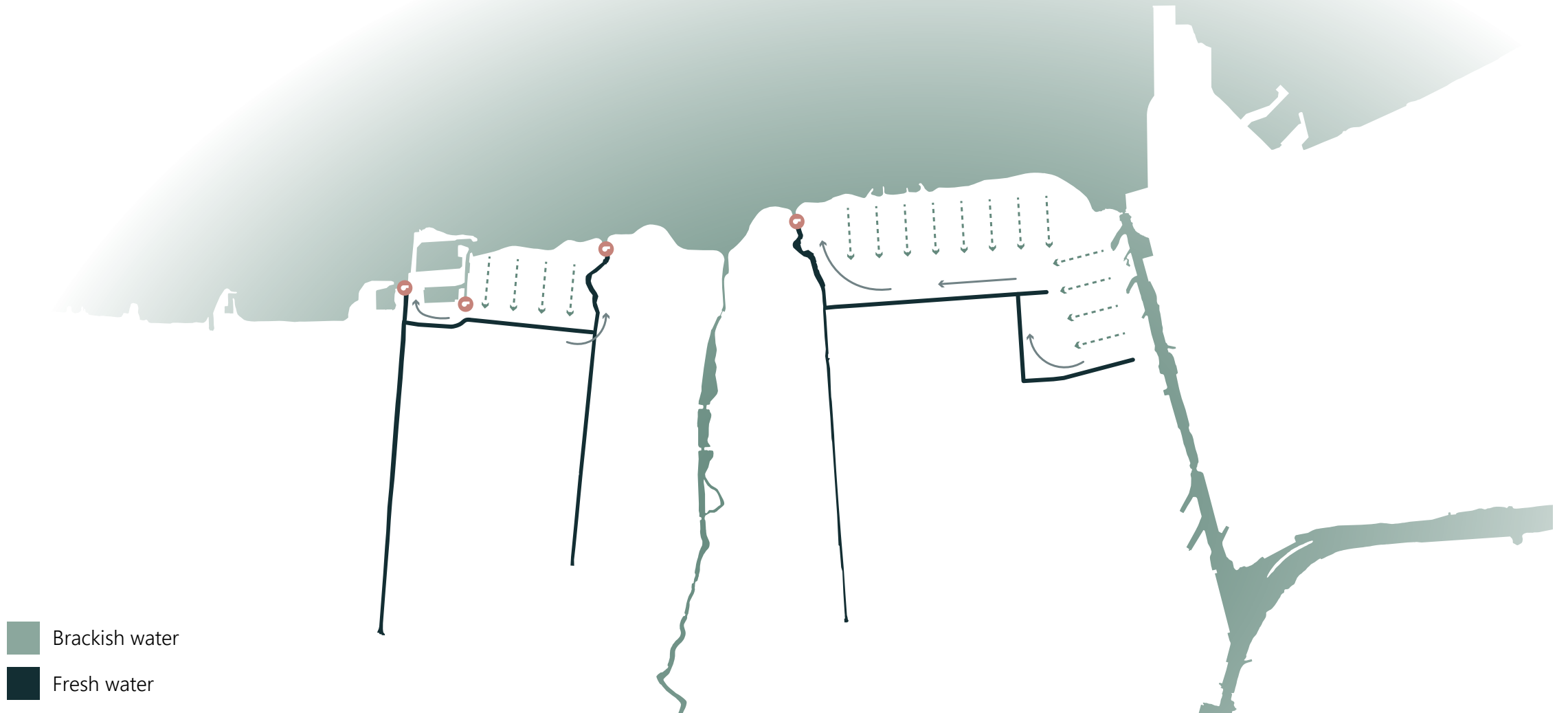
Cat.	Intervention	Available public area [m ²]		Available private area [m ²]		Available depth or freeboard [m]		Number of available entities [-]		Storage per unit [m ³]		Max. storage capacity (public)		Max. storage capacity (private)		Max capacity as % of water assignment		
1.1	Retention basin	316740	0	1	-	-	-	-	316,740	0		0		55.1				
1.2	Constructed wetlands	316740	0	-	-	-	-	-	0	0		0		0				
2.1	Open canal	176000	0	1	-	-	-	-	176,000	0		0		30.6				
3.1	Bioswale	242766	0	0.2	-	-	-	-	48,553	0		0		8.4				
3.2	Grassed swale	242766	0	0.3	-	-	-	-	72,830	0		0		12.7				
4.1	Dry detention pond	200153	0	0.5	-	-	-	-	184,531	0		0		32.1				
4.2	Rain garden	-	-	-	1592	300	-	-	512,600	21,654		21,654		92.9				
4.3	Water square	24153	0	1	-	-	-	-	24,153	0		0		4.2				
5.1	Infiltration well	316740	0	0.01524	-	-	-	-	4,827	0		0		0.8				
5.2	Pervious pavement	3705261	5834393	0.01524	-	-	-	-	56,468	88,916		88,916		25.3				
5.3	Infiltration boxes	3705261	5834393	0.65	-	-	-	-	2,408,420	3,792,356		3,792,356		1078.4				
5.4	Infiltration trench	242766	0	0.01524	-	-	-	-	3,700	0		0		0.6				
6.1	Green roof	271785	2446065	0.001	-	-	-	-	273	2,460		2,460		0.5				
6.2	Blue roof	271785	2446065	0.03175	-	-	-	-	8,629	77,663		77,663		15.0				
6.3	Rainwater harvesting	-	-	-	13499	0.2	-	-	0	2,700		2,700		0.5				
6.4	Cistern	-	-	-	13499	5	-	-	0	67,495		67,495		11.7				

Brackish seepage mitigation

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Brackish seepage mitigation



Recommendations

(1) Design

- Expand research with study on social feasibility. Integrating bottom-up initiatives and resolving trust issues between residents and government departments is key for the implementation.
- Although this plan incorporates a concise strategic component in which developers would carry a share of the financial burden, the majority of the financial responsibility still lies with the government. Conduct research in creative public-private cooperation models.
- Research the transferability of the design to other areas within New Orleans, such as New Orleans East. From a standpoint of implementation, this might be a more suitable place to start.

Recommendations

(2) Engineering

- Research the hydrological design implications for using a T25 (or higher) rainstorm.
- Include the hydraulic engineering discipline to create synergies with projects outside of the urban environment.
- Carry out extensive tests on green infrastructure to determine the actual contribution to the water assignment.
- Validate SWMM with actual measurements