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WATERLINE:  
the future of alluvial urbanism in New Orleans

by

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ABSTRACT

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Throughout the history of New Orleans the paradigms of mechanical and fluid were projected as opposing modes of thought in the attempts to render the inhospitable dynamic site suitable for urbanization. The city's devastation in hurricane Katrina is a reminder that the top-down infrastructural practices have failed to freeze the unstable ground and may have increased the city's vulnerability by encouraging unlimited growth. A reconstruction strategy that perpetuates a mode of occupation irreverent of the fragile geographical reality will inevitably lay the groundwork for future disasters.

This thesis seeks to develop an alternative vision by surrendering a high-risk area in the city to the fluvial landscape. As a system of passive water management controls interspersed with islands of resilient program, the new territory will be a catalyst for the city's recovery between major catastrophic events by alleviating seasonal flooding and operating as a bio-remediation filter for toxic runoff.
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The Waterline is a dreaded symbol of structural destruction, erosion of life and sign of death, literally and figuratively stained upon the walls as blatant, graphic reminders of the unique environmental site conditions, its true geological condition, fading, painted over and forgotten too soon, compressed by man's distorted lifetime scale of time, obscuring a scale wider than human vision yet marked upon each individual house incapable of adapting to the city, but begging New Orleans to become proactively more flexible and adaptive to the brute force of the Waterline.
Introduction

This project emerged in the year and a half following hurricane Katrina, with empathy, little preconception, as a set of intuitive steps developed through a wide interdisciplinary research, travel and formal experimentation.

My initial interest was provoked by unlimited possibilities in the highly contentious atmosphere surrounding the reconstruction of devastated New Orleans. "The most anticipated natural disaster in the US history" seemed to have a silver lining, a small window when the empty city could be re-imagined and reoccupied with a higher degree of intelligence about its setting.

New Orleans embodies the essence of alluvial urbanism. There is no other city where the effect of natural pressures on the urban form is so extreme. A city is shaped in the collision of material forces, those of European territorial colonization practices in the city planning traditions and violently fluctuating landscape of the Mississippi’s deltaic plain. One's fixed logics are structured to offset the permutations of the other through overbearing measures of separation and containment. Resentment of liminality, uncertainty of the ground’s material state in the city’s psyche led to conceptualization of this territory in terms of polar distinctions: dry v. wet, control v. withdrawal, development v. environment, all v. nothing. To maintain the land-water dualism and keep New Orleans an island of dry land in the marsh cost unprecedented hydrological modifications to the landscape throughout the city's history. From the moment of its designation as the capital of the French Colonial Empire through the Spanish domination and finally in the hands of the US Army Corps of Engineers the ever-expanding levees, drainage and navigation networks irreversibly altered the hydrology of the region, but never succeeded in curtailing its flux.
It is now apparent, that the city will keep stretching the limits of its technologically contingent reality. But in the aftermath of Katrina it can no longer afford to take for granted the outmoded infrastructural practices, that stem from the mentality of being at war with nature. Instead, it has to start developing strategies for coexisting with flux, and that means finding a resonance with the rhythm of the fluvial cycles and imagining, that the political city grid, the technical web and the fluvial landscape do not always have to operate antagonistically.

Locating the site within a city open to the spatial implications of such vision was the first step toward a specific formulation of the project. A high-risk, low-priority area in the middle of New Orleans, outside of contextual constraints of the historical neighborhoods, yet fully integrated into the city's orderly footprint and dense infrastructure, proved to be laden with potential, when it came to re-conceptualizing the familiar occupational strategies. Perhaps, it is sites like this, that hold a key to the future resilience of the metropolis.
Chapter 1
The full costs of Katrina to New Orleans will never be known. The estimates of 1500 deaths and the aggregate monetary loss including property, economic and emergency assistance in the access of $50 billion do not cover the extraordinary social disruption in the uprooted communities and environmental devastation to the fragile wetland habitats.¹

Outside the human perspective the disaster event is nothing extraordinary; it is simply a part of a cyclical redefinition of the continent's edge. The system achieves equilibrium in a series of dramatic shifts within a span of each year. The sea will advance by eroding the fragile coastline in a storm surge, the river will rebuild it with the silt, clay and sand, deposited in a yearly flood.

Even in the absence of flooding, the river channel is an incredibly dynamic entity that builds and destroys its banks slowly by shifting the curvature of its meanders gradually or by switching to a brand-new path in a singular catastrophic event. With the third largest watershed in the world stretching over 41 percent of the Continental United States, The Mississippi River has inundated its lower

Climatologically the point of the river’s discharge in the collision zone between the dry Northern and moist Southern air masses is a hot spot for severe storm activity. Over the last hundred years, 887 storms have been recorded, 40 have seriously threatened New Orleans and about 10 caused extensive destruction.³

Hurricanes developing over the Atlantic strike the Louisiana Coast with a mean frequency of two every three years, the ones that are category three or higher average once a decade.⁴ Katrina served as the latest reminder of that statistic.
A cyclical activity on a much slower geological scale is responsible for creating the very landscape on which the city stands today.

Around 5,000 to 6,000 years ago a large climatic shift and sea level change drafted the continent's edge within 10 to 15 feet of its present state. At the same time, the river and its distributaries started adding land to the coastline by discharging silt and sand into the sea. On average, the Mississippi River would sustain an active delta lobe for 700 years and when the sediment buildup would block its path, abandon it for a new one.5

Remarkably, at this moment we find ourselves in the middle of the next potential catastrophic switch. The shortest link to the Gulf with the steepest gradient wins, and as the Balize lobe south of New Orleans regresses, the Atchafalaya River 120 miles to the west of New Orleans is actively building such a link toward the Gulf of Mexico.

By cutting off flows to Baton Rouge and the Port of New Orleans a full shift of the river would severely damage the seaborne trading and industrial economy
of Louisiana and the United States. The natural process has been delayed by human intervention, so well accounted for in John McPhee's "The Control of Nature: Atchafalaya." The U.S. Army Corp of Engineers implemented a series of measures over the second half of the 20th century designed to divert and maintain a constant low volume flow from the Mississippi to the Atchafalaya and to prevent a sudden course change in case of a flood. When a flood of relatively moderate magnitude almost destroyed it in 1973, the three additional control structures were added as reinforcements. Despite the 1973 near-collapse of the project, the Corp openly and arrogantly declared: "the Army Corp of Engineers can make the Mississippi River go anywhere the Corp directs it to go".6

Most geologists believe, that the capture of the full stream of the Mississippi River into the Atchafalaya is as inevitable as the historic catastrophic shifts of the Yellow, Mekong, Indus, Po, Volga, Tigris, Euphrates and Nile rivers... and it can happen any time.
Topography of Louisiana. If subsidence and global sea level rise continues (without taking into consideration human behavior or the Mississippi River changing its course), cream colored areas will be at or below sea level by the end of the 21st century. Black dots, benchmarks that will reach sea level by 2050; gray dots, benchmarks that will reach sea level by 2100.

Meanwhile, the sea advances towards the city by slowly reclaiming the unconsolidated ground of the young coastline. The Gulf waters rise at the rate of about 100 to 200 mm per century, reflecting the global trend, and projections are made for a two- to four-fold acceleration over the next hundred years. Land subsidence in combination with the rising sea level will be responsible for lowering the elevation of the Greater New Orleans Area by about 5 meters in the next 100 years, which for the city struggling under the current conditions will bring the danger of total inundation.

The subsidence phenomenon of South Louisiana is not restricted to the coast, but stretches inland for hundreds of miles. It is particularly well explained in the McCulloh, Heinrich and Good’s report “Geology and Hurricane-Protection Strategies in the Greater New Orleans Area.” According to their findings, it operates at three scales or three depths- the surficial, the subregional and regional.

Subsidence on a regional scale happens as a natural consequence of movement along geologic faults and sagging of the earth’s crust under the enormous weight of sediment deposits reaching thicknesses of 30,000 feet or more.

Subsidence on the subregional scale occurs due to the dewatering and compaction of fine-grained sediment, it is largely augmented by local subsurface hydrocarbon and groundwater withdrawals.

Surficial subsidence is primarily man-made. Engineering measures that confine waterways and drain swamps in Southern Louisiana prevent replenishment by sediment influxes and facilitate further soil compaction.

The three types of subsidence are additive in their effect on New Orleans sinking ground. The natural processes causing subsidence are not likely to stop and even if the human offending activity can be mitigated in the future, what the centuries-long alterations to the land have set in motion can not be undone.
A coastal city's sinking elevation and a shrinking buffer of wetlands, renders it more and more vulnerable to the hurricane landfall. Subsidence lowers the protective infrastructure of levees, roads and bridges, while wetland erosion drastically diminishes resistance to storm surges.

The coastal marshes have been disappearing at staggering rates. Louisiana loses an acre every 35 minutes, 24 to 118 square miles per year (the loss during hurricanes Katrina and Rita combined is responsible for the record high number). From 1932 to 2000 it has lost 1,900 square miles, by 2050 700 more could be gone, roughly the size of the greater Washington D. C. and Baltimore area.11

The response to the severity of the problem had not taken place until the Federal Coastal Wetlands Planning, Protection and Restoration Act of 1990, eventually culminating in the "Coast 2050" planning effort by private citizens, local governments, State and Federal agencies as well as the scientific community. The plan would restore 25 to 30 square miles of wetland over the next 50 years at the cost of $14 billion.12
Unfortunately a single hurricane season of Katrina and Rita wiping out a hundred square miles of marsh demonstrated the inadequacy of scope in the human restoration efforts such as Coast 2050, particularly if they are not properly funded. It became apparent that changes of geologic proportions no longer required geologic timeframes. Also, the focus on reversing the effects of hydrological modifications to the land by a set of new hydrological modifications as a sound flood-prevention strategy drew tremendous criticism from scientists. In his testimony in front of the U. S. Congress Roy Dokka, a noted authority on the geology of the region, criticized the “fallacy of the wetland-centric approach” in trying to preserve the economy and communities of South Louisiana:

The “disease” leading to coastal land loss in South Louisiana has been attributed generally to processes operating within the marshlands of the Mississippi River delta. The deteriorating wetlands are the most graphic symptom associated with this "disease", and unfortunately, it has been further reasoned that it is also where the disease is located...Mitigation strategies such as outlined in Coast 2050 and by the Louisiana Conservation Authority are therefore designed to treat the symptom. Existing plans lack appreciation of the extent and magnitude of subsidence processes operating today...Although building wetland by mimicking nature (water and sediment diversions) is by itself a good thing to do based on its own merits (e.g., enhancement of various habitats), the plan has been oversold to the public through unsustainable claims of substantial hurricane protection and flood control benefits.

In the opinion of Dr. Dokka, the only viable way to protect communities and critical infrastructure at this stage of the game would be higher, “ocean-proof” protection walls strategically interspersed throughout the Coast. The alternative option is total retreat. In contrast, the latest scientific and engineering consensus presents an integrated approach which combines multiple lines of defense: engineering works with sustainable coastal landscape as a flood defense system, for New Orleans in particular. Increasingly there is willingness to view the perpetuation of settlement at the coast as a "systems problem".

When speculating about the future coexistence of natural, industrial and social environments in South Louisiana, it is important to point out that parallel to the volatile cyclical interactivity of water and land in the Gulf Coast, social environments of considerable density such as New Orleans operate with their own cyclical logic when challenged by their natural setting.

In general theorizing of urban recovery after a major natural disaster there thought to be four stages, each consecutive period lasts ten times longer than the previous one.\textsuperscript{15}

"The \textit{emergency period} is characterized by search and rescue, emergency shelter and feeding, the establishment of order, the clearing of major arteries, and the draining of floodwaters.

Before this period ends, the \textit{restoration period} is started, where the repairable essentials of urban life are restored.

And well before this stage is over, \textit{replacement reconstruction} begins to provide the infrastructure, housing, and jobs for the destroyed city and pre-disaster population, followed often by a \textit{commemorative or betterment reconstruction}, when large, often government-financed projects memorialize disaster, mark post-disaster improvement and serve future growth."\textsuperscript{16}

\textit{cyclos of urban recovery}

\textit{emergency reconstruction}

\textit{replacement reconstruction}

\textit{restoration period}

\textit{population in New Orleans}

\textit{flood events in New Orleans}

\textit{sources:}
In its 288-year history, New Orleans has had 27 major river or hurricane-induced disasters at a rate of one about every 11 years. A pattern in which the city would respond after each event would combine rebuilding and expansion of infrastructure and housing (with redistribution of the poor population to the lowest elevations) with rebuilding and raising of the levees.¹⁷

Over time, as the growing New Orleans exerted a greater demand on its setting, the recovery cycle from regular inundation got transformed. The duration of recovery grew more and more undetermined and the restoration, replacement and commemorative stages essentially underwent a collapse into one comprehensive effort at self-preservation.

In research projections reconstruction after Katrina will take 8 to 11 years, full recovery up to 20 years. By overlapping the tail end of recovery from hurricane Betsy of 1965, Katrina may have indefinitely expanded the recovery cycle for the city as we enter into a decade of elevated hurricane activity.¹⁸
From the historical perspective on long term pattern of societal responses to hazard events, New Orleans is not unique. On the contrary, it is representative of the "safe development paradox- in which increased safety induces increased development leading to increased losses".

In their study R. W. Kates, C. E. Colten, S. Laska, and S. P. Leatherman quoted reconstruction research that showed the following:

Over the long term, societies reduce consequences to relatively frequent hazard events (e.g., return periods of 100 years or less) through improved technology and social organization. However, the reduction in risk to relatively frequent events may increase vulnerability to major hazard events (e.g., return periods of 100 years) resulting in catastrophes characterized by large loss of life or property, major population loss, and out-migration, and even societal collapse.

In New Orleans the continuous rebuilding of the levees and drainage improvements led to the increase in urban development and an eventual large-scale catastrophe when the technology failed.

It was stated in the same study, that the disaster event usually accelerates the pre-disaster trajectory of urban growth and economic development. For New Orleans, the city whose population and economy has been in consistent decline for decades, this spells inevitable downsizing of the overextended metropolis.

The data presented in this chapter frames the following dilemma: New Orleans represents the will to re-urbanize the fastest disappearing coastline in the world. The fact that we are finally aware of the full extent of the problem hardly puts us in control. The storms frequency will increase and their impact will be magnified by both natural and man-made geological transformations. It seems that here, in South Louisiana, geological timeframe has been compressed to a lifespan of a city, sometimes even to a lifespan of a man. The elevated pulse of the landscape will order the frequency of the city's destruction and rebirth. Societal recovery cycles after fits of destruction will begin to overlap with one another; the unlimited growth confronted by unlimited hazards will produce a state where recovery never ends.
The idea of "betterment" entered public debate in the earliest stages of recovery after Katrina. In a presumably doomed from an environmental standpoint situation, betterment may constitute overcoming the constraints of a familiar recovery cycle- marginal infrastructural improvements as a fallback to recreate the city as it was before.

In the scope of an urban proposition, the way to interfere with the cycle itself is starting to insert environments within the city, whose cyclical behaviors operate vis-à-vis the predictable pattern. These new territories would have to be more resilient, so they rebound faster themselves, and in that they become a catalyst for the long recovery periods between catastrophes in the context of their placement.
Chapter 2
The Mississippi River natural levees at 15 feet above sea level are sites for early settlement. Soils of the levees, an abandoned distributary channel, and relict beach sands provide firmer footings for construction.

- Pleistocene clays are considered bedrock here, white contours depict their layering underneath New Orleans. The distance from the surface to this layer ranges between 40 and 100 feet.
- Swamp and marsh flats are comprised of soft mud and peat, they remain unsettled and undeveloped until well into the 20th century.

The first grided settlement on the natural levee

The project site emerges in the examination of historical superimposition of urban control systems on the geologic conditions underlying the New Orleans area. Parts of the same continuum, they set up systems of primary and secondary surface differentiation. At the locales where the two systems are in misalignment with each other, conflict in the social strata is generated, and consequently is generative to uncovering hidden potentialities of those locales.

First, the ground itself is the material imprint of continuous change in the buildup, abandonment and erosion of the river’s distributaries. The differentiation of the land consists of ridges, natural levees of these channels, and plains, flat marshes in-between.

The section through the geological layering of greater New Orleans reveals bowl-like condition shaped by the two prominent ridges— the Mississippi River levee, elevated 15 feet above sea level, and Metairie ridge, a parallel ridge of land lying more than 5 feet above sea level. Those features together with the natural drainage line of Bayou St. John, strategically linking the river and the lake, determined the thrust of initial urban development.
expansion along the natural levee

further expansion along the levee, drainage lines become city streets
Second, the ground’s artificial differentiation came from material ways of separating water and land, a.k.a. the “morphologies of containment”. They gave life to the city in three fundamental ways: by preventing floods, facilitating drainage and permitting navigation, while spatializing desires for stasis and control.

levee walls

Levees emerged as the first set of flood prevention measures to tame the fertile plain for agriculture and settlement. Responsibility for their construction shifted from land owners to the state, and ultimately to the federal government, that mandated the Army Corps of Engineers to oversee their design and maintenance. Today 3,410 miles of levees have been completed in the Lower Mississippi Valley and 2,786 miles are in place to grade and section.\textsuperscript{21}

Even under the central command, massive levees are flawed barriers, subject to overtopping and under-seepage. First of all, their height is historically determined by the latest high-water stage and that always underestimated the next flood, secondly, their foundation traverses soils of organic fill and sand.\textsuperscript{22} Their uneven density promotes seepage, differential settlement and ultimately breaching. The scale of levees implementation led to the alteration of the superbly complex hydrology of the region, resulting in the sinking and deterioration of the very land they were protecting. To make matters worse, in New Orleans the efficiency and safety of levee construction was undermined by a tradition of political patronage. In the end, unrealistic expectations of levees reliability pushed development forward, causing increased losses with each consecutive breach.

The levees tectonic frame makes the spatial awareness of hazard in the city two-fold: on the one hand, the perception of the inside-outside condition induces an amnesia of the forces inherent in the landscape, on the other hand, particularly in the aftermath of a natural disaster, the perception of the frame as an imperfect barrier suspends the sense of human agency and opens minds to more complex modes of inhabitation.
introduction of mechanical drainage pumps starts expansion towards the lake, Industrial Canal is completea


principal physiographic and topographic features of the New Orleans area

**drainage canals**

A framework for the urban patterning in New Orleans is infrastructural at the core: an artificial hydrological network underlies the socio-political grid. Initially, the system was set up as a thicket of incisions, radiating from the river for agricultural irrigation and drainage. These shallow canals relied on minimum gravity and ensured dryness in a continuous cycle of the slow removal of water from the elevated river banks into the low lying back-swamps. Once the extent of the city had reached the edge of the marsh, standing bodies of urban runoff to the north plunged it into a sanitary crisis that was not resolved until the institution of improved drainage techniques at the turn of the 20th century. First, the sewerage and drainage systems were separated, secondly, the invention of mechanical pumps allowed to collect and move the water excess from the rain and a shallow water table against gravity, out of the bowl-like condition, into the Pontchartrain Lake. Interestingly, levees made it more difficult for the city to remove water by exaggerating its topographic profile.

Aside from the fact, that never-ending pumping contributed to severe surficial subsidence already underway, once again, the true problem with the system resided with the effect on policy and public perception of its infallibility. Enormous jump in the city’s growth after the introduction of mechanical pumping came in two waves. In the first period (1900-1950) it promoted lakeward residential expansion and in the second (1965-2000), in combination with the post-Betsy doubling of the levee system, it spawned suburban growth to the edges of the lake and navigation canals. Under the illusion of security in the new mechanical landscape no concessions were made to the menace of floods. Vast expanses of residential suburban development employed cheap construction with shallow foundations, making the future recovery more difficult.
completion of ICW and MRGO canals, expansion of perimeter levees


pre-Katrina urban footprint

navigation canals

Impossibility of the city's environmental citing was offset by its inevitability as a strategic node in the confluence of the seaborne commerce with the Mississippi River traffic. Navigation maintenance around New Orleans ensured its role as a gateway to the oceanic trade and till this day a status of a second largest port facility in the country. Powerful navigation interests have successfully lobbied Congress to authorize deepening of the existing waterways to accommodate modern vessels as well as dredge a whole matrix of new channels in order to shorten transport routes through the marsh. Unfortunately, a national mandate to promote shipping efficiency underestimated its destructive future impact on the local environments. The three most significant projects were triggered by world wars and visions of unlimited economic benefits of improved connectivity and port traffic increase.

Inner Harbor Navigation Canal (Industrial Canal) would create a navigable link between the Mississippi River and the Pontchartrain Lake with a promise of boosting the port capacity up to 100%, since it short-circuited the entrance from the delta by many miles and added cargo handling areas along its shores. Promises never materialized to that extent, largely due to the fact, that the 74 foot-wide original lock, a point of transfer from much higher waters of the river to the lower waters of the lake, was too narrow to accommodate wider barges; other traffic would stall for days.

Intracoastal Waterway (ICW) is an inland shipping lane between Texas and Florida. Its New Orleans section, dredged in the 1930-s, partially coincided with the Mississippi River Gulf Outlet (MRGO) a.k.a. Mr. Go.

Mr. Go shaved 37 miles off the original route through the Mississippi delta. Yet the expectations to redirect high volumes of international barge traffic never payed off, instead, the legacy of Mr. Go is that of an environmental disaster.
"The U.S. Corps of Engineers speculates that the loss of land in the area due to the excavation of the channel, soil erosion and habitat shifts due to increased salinity approaches nearly 3,400 acres of fresh/intermediate marsh. More than 10,300 acres of brackish marsh, 4,200 acres of saline marsh, and 1,500 acres of cypress swamps and levee forests have been destroyed or severely altered. Expanded tidal amplitude and duration from the land loss has increased increasing the flooding risk to interior portions of the parish."  28

During hurricanes Mr. Go forms a funnel that drives the storm surge straight towards New Orleans, which earned it a nickname of a "hurricane super-highway". As with Betsy in 1965, Katrina's surge pushed the waters from three directions until the pressure created the first devastating levee breaches of the storm in the mid-section of the Industrial Canal that once again obliterated the Lower Ninth Ward and flooded the Desire/Florida Area. 29 The multi-million dollar maintenance dredging of Mr. Go has since been halted. But the scar on the land, that had tripled in width since its initial excavation, is not going away and will continue to endanger the city with every hurricane season.
The historically high-risk sites, such as the ones at the intersection of the Mississippi River, the Industrial Canal, and Mr. Go., problematize the top-down, large scale infrastructural interventions in the framework of addressing future natural, socio-political and economic pressures in New Orleans. It is difficult to say, how well the rebuilding of the local levees to a higher standard, if it ever occurs, will protect the adjacent low-lying areas. As I have shown, the city may no longer regard the local lines of defense as reliable flood protection. Long-term encroachment of the sea, local subsidence and deteriorating drainage pipelines almost guarantee the periodic unwanted water presence on these sites.

In the format of this thesis I welcomed the challenge to develop a constructive and creative aspect of this reality into a viable proposal for such sites.
a view looking South at the Central Business District and Mississippi River Bridge from the confluence of the Industrial Canal and MRGO
aerial map of eastern New Orleans with an elevation map overlay of the project site (everything from blue to red is below sea level)
I focused on an extended linear site in East-Central New Orleans, that runs along the Florida Avenue Canal and is delineated by Bayou St. John in the West, Industrial Canal in the East, highway 610/IH-10 in the North and historical downtown neighborhoods in the South. The site's limits encompass areas with the thickest and the thinnest temporal dimensions of the city's fluvial history, a bayou, the place of its birth, a drainage line, the means of its subsistence, and a navigation canal, the origin of its demise. Bayou St. John is a product of geological formations, the Industrial Canal, on the other hand, is an artificial line drawn through the swamp in a recent past in a pure act of will to exploit the usefulness of the land. Here are a few reasons why the Florida Avenue site presents an interesting challenge in the context of undergoing reconstruction:

Historically, the area resisted urbanization due to its vulnerability to floods from runoff and storm surges.

Because it is "the bottom of the bowl", it has a strong presence of gravity-based drainage and sewerage networks. Florida Avenue Canal is an open-faced drainage bloodline with 3 out of the city's 22 pumping stations. The Canal's strong linear presence has an organizing potential.

Urbanistically, the site's character is ill-defined, it is an edge and a middle ground at the same time. On a positive side, the absence of preservationist influence opens it up to new morphologies.

Due to its proximity to the container storage and warehouse docks of the Industrial Canal, it is a transitional zone from the predominantly small-scale, 'single family home' residential grain of the city to the infrastructural scale of the port, which presents an ample opportunity to experiment with an intermediate urban scale.

Most likely, the reconstruction of this area will be a low priority for the city. It is bound to either return to its pre-Katrina distressed residential communities,
further endangering the returning population, or be abandoned as usable property all together. A danger of creating a derelict vacuous zone right in the middle of the historical city calls for strategies that will maintain urban continuity through both social and infrastructural fields.

Perhaps, the infrastructural role of the site in maintaining hydro-connectivity may be utilized to promote urban connectivity as well, in a new kind of territorial occupation. To start shaping an amorphous idea into an operative language, I first tried to map the site in such a way, that the natural, technological and social aspects are understood as extensions of each other. Their alignments in simultaneous reading allowed me to specify the nature and locality of an intervention.
An elevation map reveals that topographic features above sea level are augmented by human intervention or are man-made altogether, as in the case of the landfill mound, concrete-reinforced waterfront port facilities and the slightly elevated train depot.
The bottom image shows the subsidence rate in New Orleans generated from radar satellite data. The average rate ranges from 6 to 29 millimeters per year (the red spots represent the areas sinking the fastest). Among the fastest sinking areas are the ones hardest hit by hurricane Katrina. Above, subsidence rates overlay produces a likely scenario for future elevations at the site.
A - Arsenic
Arsenic may be so widespread in the New Orleans area because of past use of arsenic-based pesticides, trash incineration, leakage from industrial sites and the use of building materials pressure-treated with chromium-copper arsenate. Alternatively, the arsenic may have been in the sediment at the bottom of Lake Pontchartrain and distributed throughout the city with the floodwaters.

Health Hazards: cancer of the bladder, skin and lungs, birth defects, cardiovascular disease, skin abnormalities, anemia and neurological disorders

B - Benz(a)pyrene
The high levels of benz(a)pyrene found in the sediment may be due to the numerous spills of petroleum products such as diesel fuel during the hurricanes, or can be due to historic contamination from burning of debris or petroleum.

Health Hazards: chromosome damage, cancer, immune suppression and risks to normal fetal development.

D - Diesel Fuel
The high levels of diesel fuel found in the sediment are likely a result of the many fuel spills that occurred during hurricanes Katrina and Rita. The sources of these spills ranged from submerged vehicles and gas stations to refineries.

Health Hazards: sore and peeling skin, kidney damage, increase blood pressure and decrease the ability of blood to clot.

L - Lead
The high levels of lead found in the sediment are likely due to past use of lead in paint and gasoline, or from leakage from industrial sites.

Health Hazards: neurological problems, high blood pressure and kidney damage, even very low levels of lead are known to harm brain development in children.
The soil map demonstrates some correspondence of geological elevations to soil types. Soils at the lowest elevations are least suitable for construction.

After Katrina the EPA tested New Orleans sediment for four toxic contaminants: arsenic, lead, diesel fuel and benzo(a)pyrene. A pattern of their distribution on this map indicates their concentrations in excess of EPA and Louisiana Department of Environmental Quality cleanup guidelines for soil in residential areas. It has been indicated that Katrina did not play a big role in contributing to that pattern. Nevertheless, dangerous concentrations of toxins associated with industrial runoff and the superfund landfill site create a grim prospect for residential reconstruction in these areas. The site of the project is where contamination may be worsened in particular through accumulation of toxins in regular storm runoff.
Population density before Katrina in the middle portion of the site indicates a rather uniform medium density pattern interrupted only at the points where the residential areas meet the highway and drainage infrastructure. In many cases this reveals that the infrastructure was cut through existing neighborhoods at a later date. On the other hand, there are blocks of higher density (former public housing developments) in the industrial zone towards the Canal. Neighborhood borders provide some clues as to the awkward scale and architectural character at the site – all the way along the Florida Avenue spine the neighborhoods make a North-South split, leaving mere traces of their identity at the edges.
One year after Katrina, the redevelopment activity consisting of property sales, acquisition of demolition and any other work permits by returning population presumably indicates the pattern of high priority reconstruction. If that is the case, the Florida spine is visibly of lower priority- at the lowest elevation, with the highest damage, lower rates of home ownership, lack of cherished historical landmarks, and the proximity to the unreliable Industrial Canal levees. Interestingly enough, faster rebounding is consistent with the geologically more stable, higher elevation areas.
So far, the planning initiative by the city of New Orleans has been organized as a bottom-up process. The 49 flooded neighborhoods each received a team of consultants in order to outline individual recovery plans to later bring them together into a semblance of cohesive city-wide rebuilding strategy eligible for federal dollars.32

Admittedly, this process operates under several major assumptions, not the least of which is the reliance on the wishful idea of a newly designed flood protection system able to withstand hundred-year storms. As a result, once again, the restoration of social infrastructure in the minds of the city can take
place in a self-referential manner, without accounting for the major shift in the complex interaction between the natural and man-made forces in the region. The scientific evidence of the city’s accelerated descent into the sea has not changed the mindset of its leaders, nor its population.

New Orleans has entered the predictable cycle of its own rebirth, with “Rebuilding the Familiar” as its true slogan. At the core of the neighborhood redevelopment plan is enforcement of zoning prior to Katrina- essentially the same land use map that has been modestly augmented by addition of retail space along some historic corridors and public facilities in the neighborhoods. The betterment stage of the recovery cycle has started right away, but so far, it failed to address the city’s fundamental restructuring along the lines of inherent resilience, rather, it operates on the scale of sidewalk improvements.

To complement the city’s inevitable organic return, I propose to institute a parallel planning strategy for the site, that without diminishing the importance of repairing social networks, defines the territory of operation through the strong morphological signatures of the natural and technological realities.
Chapter 3
The project becomes an investigation into the architectural spatial implications presented by incorporation of a fluvial landscape into an urban setting.

The area of the project seems to serve a synecdoche for the whole of the Louisiana Coast and as a counter to the dominant top-down infrastructure freezing of its dynamic processes. At the basis of my approach is willingness to give up some degree of control by surrendering considerable stretches of the site to the presence of water. This strategy augments the infrastructural capacity of the Florida Avenue drainage canal by constructing landscapes along its length that are able to absorb local unwanted hydrological fluctuations.
Pertaining to the integrity of the city, the system of constructed wetlands will be activated in three ways. As an excellent bio-filter, it will continuously treat the toxic urban runoff before it gets discharged into the canal and remediate local soils to make them suitable for any kind of human occupation. Also, it will be able to absorb the overflow of seasonal rains, alleviating potential damages to the surrounding residential areas. In the event of a Katrina-type catastrophe, it can provide islands of elevated ground, and thanks to the rebounding to its full level of activity shortly after the emergency period, not leave a void in its place, but maintain a territorial continuity with its context.
There are three scales and modes of operations that together orchestrate the fluvial processes of the project and its spatial effects.

The global design operations deal with setting up the perimeter of the constructed wetland basin. Its configuration and extents are determined by where the areas at the lowest elevation have the points of intersection with existing runoff management networks—active (storm sewer) and passive (surface flows). Regionally, the edge is modified to maintain continuity along vital urban corridors. Locally, finer adjacencies to the neighborhoods, port and transportation infrastructure determine sizing and programmatic content.
landscape's global configuration on the site
The site's technological mesh is completely integrated, and in many ways plays a crucial role in the functionality of the city's hydro-management networks.

As a sectional proposition, the new landscape will interfere with drainage, pressurized water supply and foul sewer, since two out of three are gravity-based. The new network will have to interject itself into the three-dimensional field of conduits in such a way, that without disrupting the sewer/water lines, it effectively amplifies drainage between the surface and the shallow storm sewer planes.
Planimetrically, the network of basins in a new landscape plugs into the branching organization of the natural watershed that collects and transports surface water from behind the Mississippi levee towards the Florida Avenue. At the sub-surface level, the system relieves the pipelines insufficient in their capacity to handle the storm runoff fast enough into a denser branching of surface detention.
Treatment Zone Layout for Hydraulic Efficiency

a measure of flow hydrodynamic conditions in constructed wetlands and ponds; range is from 0 to 1, with 1 representing the best hydrodynamic conditions for stormwater treatment.

The more detailed understanding of the system's operations comes from breaking it down into components- network into chains, chains into modules.

First I set up three scales of detention modules and shape them based on the principle of hydraulic efficiency: maximum elongation of the water path through the basin and avoidance of "dead zones" of possible stagnation.
fragment of the Waterline network diagram
Extended Detention Basins **(dry)**

L:W = 3:1 to 5:1
removal of 70% of suspended constituents in the sediment load
vegetation for erosion control, sediment entrapment
Wetland Basins/ Wetland Channels (wet)

Shallow, extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater.

1. Inlet Zone - sediment basin that removes coarse sediments
2. Macrophyte Zone - sequence of ephemeral marshes that biologically uptakes fine particulates and removes soluble pollutants
3. Bypass Channel - high flow, protects macrophyte.

L/W = 3:1 to 5:1
removal of 80% of suspended solids in the sediment load
vegetation for erosion control, sediment entrapment
open water - <50% of total area
Retention Ponds (wet).

Small artificial lakes with emergent wetland vegetation around the perimeter, designed to remove pollutants from stormwater. Solids settle in the permanent pool, wetland vegetation bench (littoral zone) provides aquatic habitat, enhances pollutant removal, reduces formation of algal mats.

L:W = 2:1 to 3:1
open water >50% of the total area

When modules are sequentially organized into chains, the landscape acquires an appearance of a soft gradient, that accepts up-and-down water table fluctuations without coming to a brink of insufficiency or failure in the urbanistic sense. The land-to-water ratio becomes more important in the context of vegetation it supports, as wetland plants are sensitive to the extended water depth fluctuations.
three water stages: normal, medium flood, inundation
layout of water detention basins on a fragment of the site
integration of urban grid with island patchwork on the fragment of the site
local sections through spatial adjacencies:

- max, min water levels
- scalar variations of the "hard edges"
- depth of the retaining walls
Rather than simply abandoning the city grid, I reterritorialize it into the new system. The field of detention basins gets interspersed with islands of elevated dry land, each roughly the size of a city block. The geometry of connectivity that emerges is driven by the regularities of the urban accessibility.

The process of differentiation creates a language of soft-scape and hard-edges, that construct shallow hollows/ponding areas, networks of connectivity, and raised program areas with hard program/buildings anchored to the hard edges. Architectural elements, in other words, emerge out of the landscape, they are grounded in their performance as part of the water retention system.

Sheet pile technology proposed for the "hard edges" - permanent retaining structures on the site

![Sheet pile technology](http://www.skylinesteel.com/products/sheet_piling/default.asp)

Steel sheet piles are long structural sections with a vertical interlocking system that creates a continuous wall. The walls are most often used to retain either soil or water.
detailed section through the sheet pile framing, with typical soil conditions

site sections
Built areas across the local patches read as continuous constructed fabric of a much larger scale and of a different character than the historic fabric of New Orleans neighborhoods. Perhaps, more reminiscent of the engineering installations, that maintain waterfronts in South Louisiana, the new hardscape is unapologetic about its monumentality and infrastructural appearance.

The individual spatial envelopes or building types are designed from below ground-up; they start with an infrastructural idea of a foundation. Differential settlement in the unstable ground is a great problem for building in New Orleans. Foundations for larger construction may reach depths of up to a hundred feet in search of firmer clay soils.

Integration of architectural foundation systems and infrastructural levy systems is the key technical problem through which the language of the built envelopes emerges. Waterline hardscape finds its tectonic expression in the steel sheet piling technology. Transcending its functional limitation to below-ground construction and to withstanding primarily lateral loads, a thin steel wall comes out of the ground to create a resilient framing system and an unyieldingly defiant architectural façade. An infrastructure to be domesticated...
This landscape conveys the waters, the steel walls stand proactively as resolute, defiant hulls, even keeled on properly loaded ships. the Waterline becomes adaptively reduced to a line or stain to show where the water has been, a line separating dry land and wet areas; a watermark left as a reminder for New Orleans on a seawall, indicating the height to which water has risen or may rise, tamed as common as, and benign as, a tidemark.
Sources and Notes
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Appendix
water module topography
water modules with various structural elements
land module configurations with structural elements
urban context vignettes
landscape fragment with retaining walls
landscape plan view with retaining walls