Greater New Orleans
# Urban Water Plan

# Urban Design

Waggonner & Ball *Architects*

October 2013

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September 2013

Water in the London Avenue Canal is hidden behind walls that are no longer part of the hurricane protection system.

# Background

## Greater New Orleans Urban Water Plan

In 2010, the State of Louisiana's **Office of Community Development - Disaster Recovery Unit** funded **Greater New Orleans, Inc. (GNO, Inc.)** to develop a Comprehensive, Integrated and Sustainable Water Management Strategy for the east banks of Orleans and Jefferson Parishes and St. Bernard Parish using federal Community Development Block Grant - Disaster Recovery funds from the **Department of Housing and Urban Development**. The study was developed over the course of two years by **Waggonner & Ball Architects** and a team of local and international, including Dutch, water management experts. The outcome is the Greater New Orleans Urban Water Plan, a vision for long-term urban water management in the 21st century, and effectively the first regional urban water plan of its kind in the United States. The Urban Water Plan provides a roadmap for better management of flood and subsidence threats, while creating economic value and enhancing quality of life. This plan seeks to work in tandem and create multiple lines of defense with the region's levee system and Louisiana's 2012 Coastal Master Plan.

## Greater New Orleans, Inc.

GNO, Inc. is the regional economic development organization that serves to coordinate, consolidate, and catalyze economic development activity in Southeast Louisiana. The GNO, Inc. mission is to create jobs and wealth in the Greater New Orleans community. The GNO, Inc. vision is for the Greater New Orleans region to fulfill its potential as one of the best places in the country to grow a company, and raise a family. GNO, Inc. supports a multi-faceted approach, including advocating for federal, state and regional policies and programs, to mitigate the effects of stormwater on the region's safety, quality of life and economic vitality. Moreover, GNO, Inc. is working with government, industry, economic development, and education partners to nurture and grow a vibrant emerging environmental industry sector that will create jobs and revenues locally while addressing environmental challenges in the region and nation.

## Waggonner & Ball Architects

Waggonner & Ball Architects is a broad-based architectural and planning firm with 30 years experience on a wide variety of projects. The firm is deeply invested in New Orleans' future as one of the nation's most resilient cities. Following Hurricane Katrina, Waggonner & Ball developed the Recovery Framework for St. Bernard Parish, the most devastated portion of the Greater New Orleans region, and generated plans for four of the thirteen planning districts in the Unified New Orleans Plan. The firm's water-focused work began shortly after Hurricane Katrina, with David Waggonner's trip to the Netherlands in early 2006 as part of a delegation led by U.S. Senator Mary Landrieu. After seeing first-hand the value of the Dutch approach to stormwater management and climate adaptation, Waggonner & Ball initiated a series of **Dutch Dialogues** workshops, co-sponsored by the **Royal Netherlands Embassy** and the **American Planning Association**. These collective efforts and extended interactions between Dutch and American architects, engineers, urban designers, landscape architects, city planners and soils/hydrology experts grew from the participants' unwavering belief that the Greater New Orleans region can survive, prosper, and grow only with a fundamentally different approach to urban water management. Many of the same parties continued this collective effort and formed the **Project Team** for the Urban Water Plan. A full list of firms, institutions, and individuals involved is included the "References & Project Team" section.

GREATER NEW ORLEANS INC
REGIONAL ECONOMIC DEVELOPMENT

Waggonner & Ball *Architects*

**Lake Pontchartrain presents opportunities for lakefront development.**

# Acknowledgments


### Louisiana Office of Community Development Disaster Recovery Unit (OCD-DRU)

In the aftermath of Hurricanes Katrina, Rita, Gustav, and Ike, the OCD-DRU commissioned the Louisiana Resiliency Assistance Program (LRAP) to establish a comprehensive collection of resiliency resources. The LRAP program is mandated to develop, house and disseminate planning efforts, resources and local best practices to promote, assist and build networks around resilience planning in Louisiana. As the state's central point for hurricane recovery, OCD-DRU manages the most extensive rebuilding effort in American history, working closely with local, state and federal partners to ensure that Louisiana recovers safer, stronger, and smarter than before.

### U.S. Department of Housing & Urban Development (HUD)

HUD is working to strengthen the housing market to bolster the economy and protect consumers; meet the need for quality affordable rental homes; utilize housing as a platform for improving quality of life; build inclusive and sustainable communities free from discrimination; and transform the way HUD does business. HUD's CDBG-Disaster Recovery grants are intended to confront housing, business and infrastructure needs beyond those addressed by other forms of public and private assistance.

GNO, Inc. and Waggonner & Ball Architects also wish to acknowledge the regional **Water Management Strategy Advisory Council**, made up of industry, government, economic development, and nonprofit leaders that guided the two-year process. A full list of the individuals and organizations involved is included in the "References & Project Team" section.

Finally, we would like to thank the **Royal Netherlands Embassy**, the **American Planning Association**, and **Senator Mary Landrieu** for their tireless dedication to seeing this effort through from its genesis to its completion.

Dutch *Dialogues*

Kingdom of the Netherlands

American Planning Association

*Making Great Communities Happen*

The Crescent City Connection welcomes visitors to the historic and commercial heart of Greater New Orleans.

# Report Organization

The Greater New Orleans Urban Water Plan is a set of reports with cross-referenced information as outlined below. All project information and links to related projects are also available online at **www.livingwithwater.com**.

**Vision** presents an overview of the Urban Water Plan.

**Urban Design** is geared towards planning and design professionals. This report tests water planning principles through design drawings at the system, basin, district, and demonstration project scales.

**Implementation** is geared towards policy-makers, water system managers, and other stakeholders interested in effecting change. The report presents the value and economic impact of the Water Plan and outlines an action plan for implementation that includes prioritization and phasing of proposed strategies, financing tools, policy and community action recommendations, existing jurisdictions and potential partners.

**System Design & Analysis** is a set of individual reports geared towards engineers and scientists that describes and analyzes the existing water system, and presents the envisioned framework of the integrated water system. The set includes the following reports:

| | |
|---|---|
| Water System Design | H+N+S Landscape Architects; Waggonner & Ball |
| Water System Analysis | Royal Haskoning |
| Ecological Services Metrics | Dana Brown & Associates; FutureProof |
| Groundwater Monitoring Network | Deltares |
| Atlas of Greater New Orleans | Deltares; H+N+S Landscape Architects |

**Demonstration Projects** is a set of individual reports geared towards potential implementers that includes schematic designs and cost estimates.

| | |
|---|---|
| Mirabeau Water Garden | Waggonner & Ball Architects; FutureProof |
| Lakeview Floating Streets | Bosch Slabbers Landscape + Urban Design |
| Lafitte Blueway | Bosch Slabbers; Waggonner & Ball |
| Elmwood Fields and Water Lanes | Robbert de Koning; Dana Brown & Associates |
| Canal Street Canal | Dana Brown & Associates |
| Eastern Water Walk | Dana Brown & Associates |
| Forty Arpent Canal Zone | Dana Brown & Associates |

**Design Districts & Urban Opportunities** is a set of individual reports geared towards planners and designers that elaborates further the urban design opportunities and district scale designs discussed in the Urban Design report.

| | |
|---|---|
| Metropolitan Park Zone | Palmbout Urban Landscapes |
| Palmetto Canal | Palmbout Urban Landscapes |
| Monticello Canal | Bosch Slabbers Landscape + Urban Design |
| London Ave. Canal Wetland Park | FutureProof |
| Hollygrove District | Bosch Slabbers Landscape + Urban Design |
| Lakeview District | Bosch Slabbers Landscape + Urban Design |
| Elmwood District | Robbert de Koning Landscape Architect |
| Veterans District | Robbert de Koning Landscape Architect |
| Jefferson Basin | Robbert de Koning Landscape Architect |
| Michoud District | Dana Brown & Associates |

**Resources & Urban Analysis** is a set of individual reports geared towards planners and designers that describes and analyzes the existing urban fabric and provides prototypical solutions replicable under similar topographic, geologic and hydrologic conditions.

| | |
|---|---|
| Urban Analysis | Palmbout Urban Landscapes |
| Roadway Retrofits | Dana Brown & Associates |
| Parking Retrofits | Dana Brown & Associates |
| Canal Vocabulary | Dana Brown & Associates |

# Contents

# Water and Urban Design

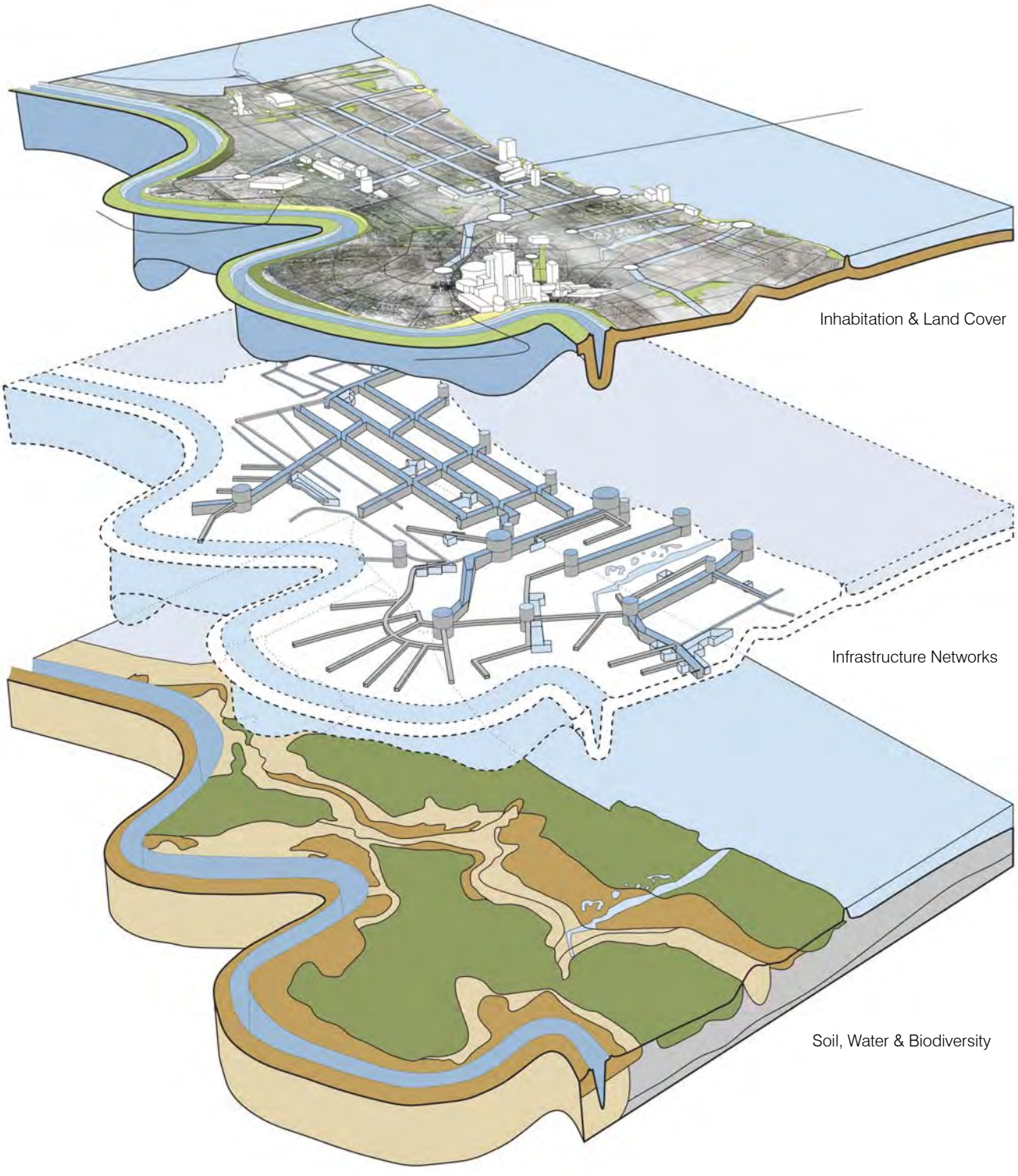
View of Greater New Orleans as a delta city, made more resilient with blueways, greenways, parklands, and integrated wetlands

# 1 Urban Design Overview

GREATER NEW ORLEANS

"What struck us most about New Orleans is that you are a city in a delta, just like Rotterdam. And that is both a problem and an opportunity. It's a situation that you can take advantage of — both for flood defense and as a structural element in city planning."

--Han Meyer, *Professor of Urban Composition, TU-Delft*




**Layered Planning Process**

Working from the ground up to determine how to integrate the natural flows of the landscape into infrastructure networks and the physical shape of our communities

# Vision for a Delta City

Greater New Orleans can be understood as an island, surrounded by the river, lake, and wetlands. The earliest dwellers settled on the high ground near the river and the ridges, with water as a place for commerce and a source of vitality. Now, however, the combination of climate, geography, and well-intended engineering has left the contemporary city vulnerable. The methods of drainage and water management conceived a century ago are outdated and inadequate as evidenced by ground subsidence, frequent localized flooding, and recurring water-related difficulties in the day-to-day activities of our citizens. It is time for a city surrounded by water and with over sixty inches of rainfall a year, to turn in a new direction that will sustain the city in the coming century.

This Greater New Orleans Urban Water Plan is a vision for sustainable delta urbanism in the 21st century and a reimagining of Greater New Orleans as America's preeminent delta city. The Urban Water Plan sets forth strategies for the east banks of Orleans and Jefferson Parishes and St. Bernard Parish to address flooding caused by excess runoff, subsidence caused by pumping of stormwater, and the poor environmental quality created by the ubiquitous concrete drainage channels throughout the region.

In this region, located in the fragile Mississippi River Delta, water is integral to sustaining healthy ecosystems. Our survival is dependent upon water: water beneath and around buildings, surface waters, and the wetlands and waterways that surround inhabited areas. Fittingly, for a city founded on the nation's most important river, the survival of New Orleans depends upon understanding and embracing water, after a century of attempting to remove all traces of water from the urban landscape.

## An Urban Water Plan

The Urban Water Plan provides a comprehensive and integrated approach to water management for Greater New Orleans. The Urban Water Plan addresses three basic issues:

1 Drainage systems are regularly overwhelmed by too much runoff.

2 Excessive pumping causes the lands to sink by lowering groundwater levels.

3 Critical water assets are wasted, hidden behind walls, buried underground, or pumped out of the city.

Within the Urban Design report, design projects at varying scales are presented. These range from system-scale canal networks, wetlands, and parklands to small-scale street retrofits. Each project provides solutions for managing soils, groundwater, and stormwater that are adapted to the particular place and geography of each site. Each is a means of testing general water and soil management principles that are introduced in the Vision report. Three basic goals underlie all of the projects:

1 Increase long term safety by reducing localized flooding and subsidence.

2 Create new economic and development opportunities with safe, attractive waterways and infrastructure.

3 Improve the quality of life for the region's residents by integrating clean, healthy, accessible water into public spaces and new development.

Each project represents a collaborative effort between architects, landscape architects, urban planners, hydraulic engineers, and hydro-geologists from the Netherlands and Greater New Orleans.

**Strategic Parklands**

Strategic parklands, one of the seven system components, can be integrated into the city as public assets that store stormwater and provide recreational amenities. Metairie's Wally Pontiff Park is an example of a strategic parkland.

## Integrated Living Water System

The integrated living water system is the basis of the Greater New Orleans Urban Water Plan. It is a new model for managing stormwater, surface water, and groundwater collectively, rather than as isolated phenomena. It works to slow, store, and use stormwater in order to reduce the region's dependence on pumping, and it provides for the circulation and recharge of surface water and groundwater. It consists of interdependent components developed from the existing drainage systems, and is designed to reduce flooding, slow subsidence, strengthen local habitats, improve water quality, and provide more vegetation, shade, and places where residents can make use of the region's many water assets.

The Urban Water Plan describes seven characteristic elements that join together the capacity of existing systems with those of the region's open spaces, soils, plants, and wetlands.

1 **Small-scale Retrofits** in streets, on individual properties, in parks, and in squares and plazas slow and store stormwater, catching and infiltrating water where it falls. Interceptor streets on high ground are a critical subset of small-scale retrofits.

2 **Circulating Canals** in the region's bowls and lowlands recharge groundwater and sustain local habitats. During wet weather, they continue to serve as drainage conduits.

3 **Strategic Parklands** at key junctures of the integrated living water system contain vast quantities of stormwater during heavy rains, while providing valuable open space and recreational amenities.

4 **Integrated Wetlands** located within strategic parklands and distributed throughout the region store and filter stormwater and dry weather flows. Existing wetlands are restored with treated wastewater and filtered stormwater.

5 **Integrated Waterworks** are the water treatment plants, drainage pumps, siphons, sluices, weirs, and gates that draw, redirect, and filter stormwater, surface water, groundwater, drinking water, sewage, and industrial wastewater. They are the components that establish the flows and rhythms of the living water system.

6 **Regional Monitoring Networks** for surface water and groundwater provide system managers with real-time data that are necessary to address immediate drainage needs and long-term trends in water levels and water quality, and to maintain higher water levels without compromising safety.

7 **Waterfront Development Zones** around key waterways and parklands anchor the development of higher-density, multi-use districts defined by urban water assets.

# Urban Design

The history of New Orleans continues to influence today's urban structure and character. From the French Quarter and riverfront villages situated on high ground along the Mississippi River to the more recently constructed suburban lowlands along Lake Pontchartrain, the regional landscape demonstrates the interweaving of street patterns with constructed and natural flows of water. These relationships are the basis for establishing Greater New Orleans as a delta city.

Surface features and infrastructure relate closely to subsurface infrastructure, the underlying networks of pipes and culverts below ground. These interweavings can become visible as blueways and greenways connecting through the region, creating a unique spatial quality for the region. Designed with an eye towards public use and revitalizing the region's distinctive neighborhoods, these new features can positively influence the quality of life for the region's residents and the future of Greater New Orleans.

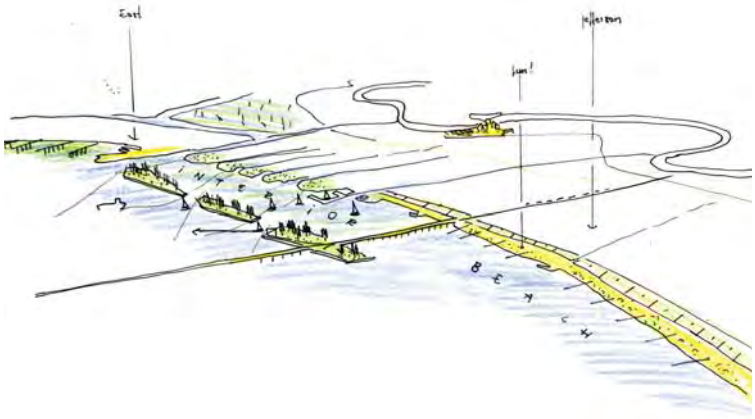
This Urban Design volume presents a compendium of projects combining the engineering of a sustainable water management plan and the design of a forward-thinking urban plan. Each design proposal comprises a concerted effort with interactions between scientists, engineers, and designers. New proposals for slowing, storing, and using water are put forth that not only offer solutions to water management issues but also improve the spatial cohesion and quality of the public domain. On a regional scale, the Urban Water Plan unifies Greater New Orleans into a more sustainable conurbation with a shared identity rooted in the region's history, soils, and water resources.

## Lake City

Lake Pontchartrain bounds the region to the north, and has long served as a place for fishing, boating, camping, camps and other regionally significant uses. Today, this important estuary presents opportunities for wetlands restoration, improved storm surge protection, water quality, and recreation.

## River City

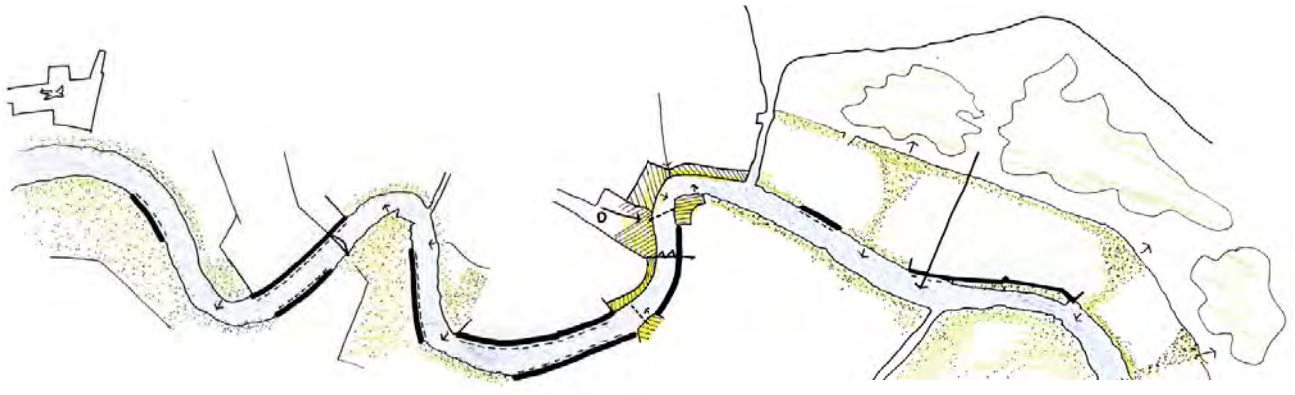
Thomas Jefferson noted in 1803 that whoever controlled the mouth to the Mississippi River commanded all river commerce into and out of the heart of America. Thus, acquiring New Orleans as part of the Louisiana Purchase was understood to be critical to national strategic interests. The Mississippi remains an important thoroughfare for the nation and for the region. Reorienting public life towards the river again will allow Greater New Orleans to make the most of its advantageous location.



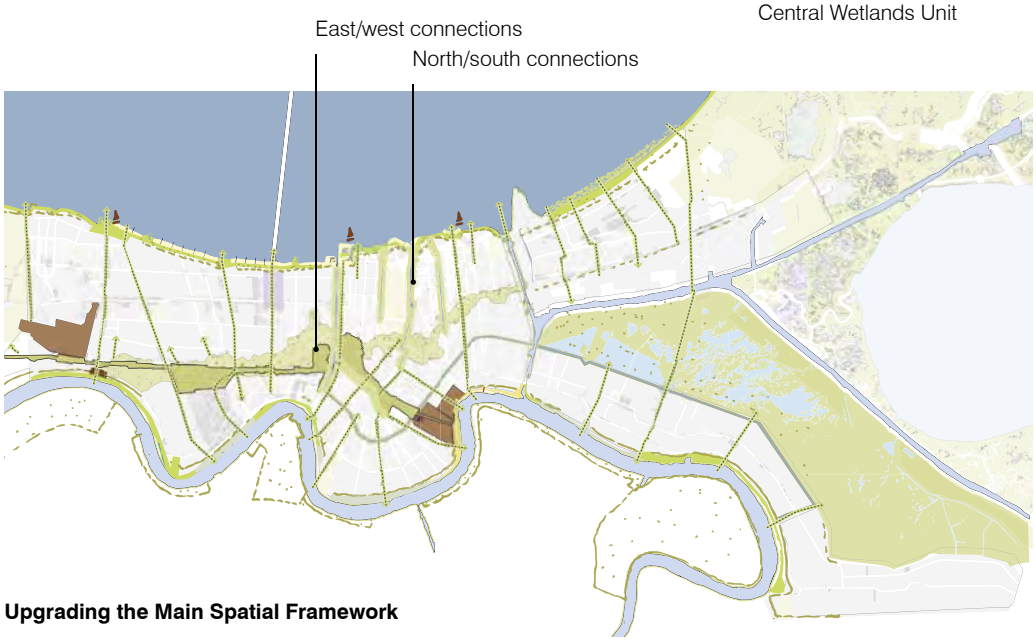
**Waterfront Identities**

Above: Linking surge protection and water recreation strengthens the region's lakefront.

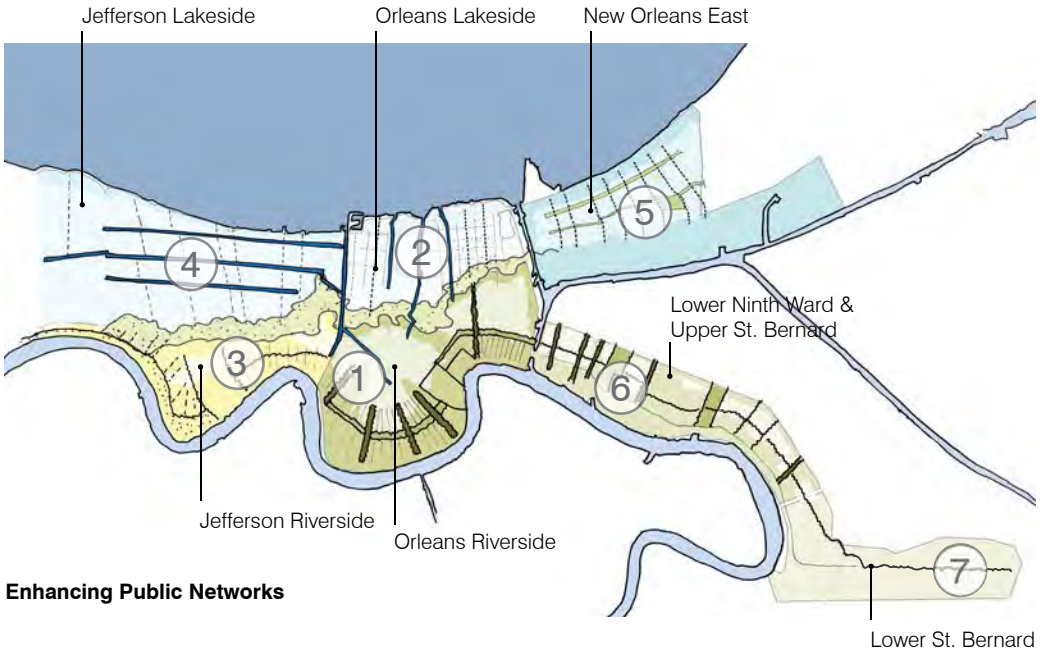
Below: The region orients itself to the river with a pattern of alternating commercial and recreational uses.




**Addressing the Delta**




**Upgrading the Main Spatial Framework**




**Enhancing Public Networks**

## Addressing the Delta

Within the Mississippi River Delta, a history of engineering projects effectively severed Greater New Orleans from the marshlands out of which the region was formed. The gradual transformation from an entirely engineered infrastructure to an integrated living water system that combines hard infrastructure with natural features and processes with ecologically-based urban planning can transform barriers into vital interfaces between inhabited areas and wetlands. This improves connections and access to the marshes and swamps that are so important to the delta landscape. Degraded wetlands within the hurricane protection system can be restored as regional assets and ecological buffers.

## Upgrading the Main Spatial Framework

Overlooked infrastructural rights-of-way and vacant parcels can be transformed into connective urban spaces. In many places, the drainage and transportation systems interrupt the urban grid, dividing and isolating residential and commercial zones. The Urban Water Plan proposes that these leftover spaces be redesigned for improved water management and regional connectivity, creating greater urban cohesion.

Lake Pontchartrain and the Mississippi River run parallel to one another, with Greater New Orleans existing between the two. Proposed enhancements for the Airline Corridor in Jefferson Parish can connect through the Claiborne Corridor in Orleans Parish to the Forty Arpent Canal in St. Bernard Parish, strengthening one of the primary east-west corridors that extends across the three parishes. Similarly, enhancing the riverfront, lakefront, and the Metairie/Gentilly Ridge establishes strong connections through the region that speak to the critical role each of those corridors play in shaping the region's history and present-day hydrology.

Enhancing north-south corridors along exisiting canals and bayous results in a rich blue-green network that connects the river to the lake, and between the major east/west corridors connecting city edges to the new east/west backbone.

## Enhancing Public Networks

Close analysis of Greater New Orleans reveals seven basic urban patterns, each offering distinct opportunities to address water issues, and for improving connectivity and the identities of neighborhoods. Each urban pattern is associated with a particular hydrological subbasin.

1 Orleans Riverside: tree-lined boulevards perpendicular and parallel to the river

2 Orleans Lakeside: a suburban grid, with outfall canals dividing the landscape

3 Jefferson Riverside: streets extending from the river to the Metairie Ridge, crossed by Airline Highway, Jefferson Highway, and River Road

4 Jefferson Lakeside: suburban residential neighborhoods within a grid of boulevards and canals

5 New Orleans East: residential neighborhoods built around lakes, and a pattern of alternating canals and major boulevards

6 Lower Ninth Ward & Upper St. Bernard: an extension of the historic New Orleans street grid into the Lower Ninth Ward, and the suburban street pattern of Chalmette, crossed by major east-west corridors

7 Lower St. Bernard: wetlands and rural communities arrayed along Bayou Road, which follows the historic Bayou Terre aux Boeufs out to the Gulf of Mexico

**GUIDE TO COLORS:**

**Basin**

a low-lying area surrounded by levees or floodwalls with water on the other side, also known in the Netherlands as a polder

**Design District**

a neighborhood or grouping of neighborhoods with similar soil types and hydrology, bounded by major infrastructure and natural features

**Demonstration Project**

a design proposal that applies water management principles at the scale of individual streets and properties

**Urban Opportunity**

urban design and ecological proposals that span across sub-basin, basin, and parish boundaries

# Design on Multiple Scales

The Urban Water Plan approaches water management and urban design at multiple scales. At a regional scale, there are proposals for interconnected blue and green corridors. These networks link across jurisdictional and infrastructural boundaries creating a more cohesive blue-green tapestry. The new regional identity relates directly to the system proposals as well as the underlying soil and water layers. The Urban Water Plan illustrates the potential of infrastructural innovations to enhance the spatial quality of the urbanized region.

Within the region, there are three hydrologic **basins** with boundaries and landscape features that influence water and urban design relationships: the Jefferson-Orleans Basin, the Orleans East Basin, and the St. Bernard Basin. Subbasins comprise the second-tier scale of urban design and planning. Subbasins are situated within a larger basin but exhibit distinct hydrologic and hydraulic characteristics. Within the Jefferson-Orleans Basin, the Metairie Ridge splits Jefferson Parish into two subbasins, and the Gentilly Ridge splits Orleans Parish into two subbasins. In the St. Bernard Basin, the Violet Canal splits the basin into upper and lower subbasins.

Within sub-basins, **districts** allow for a finer grain of planning, as a means of testing design principles in specific locations. Districts are defined in terms of neighborhoods, street patterns, density, landscape type, land use, and land cover. Design districts often are bounded by infrastructural lines and other geographic features. Each district provides a distinct set of typical conditions, that yields place-specific design solutions. District proposals are then replicable and prototypical within similar landscape types and urban features.

The finest-grain planning occurs at the **demonstration project** scale. Projects aim to improve a condition characteristic of a particular design district or landscape type. Projects address basic issues of water quantity, quality, and the role of water in public spaces. Location becomes especially important in that these projects can catalyze forms of investment. The showcased projects accrue benefits for all residents while also maximizing economic development opportunities locally and for the region as a whole.

Demonstration projects have been chosen according to their distribution throughout the regional area, ability to capture the greatest potential for water management goals, visibility in the public realm, accessibility of public assets, and for the measurable benefits that they can provide to residents. They are also selected for feasibility in identifying committed stakeholders, advocates and funding, the possibility for innovative design, planning, and engineering, and for their potential to contribute to a communal water identity.

There are additional studies of **urban and ecological opportunities** that span across basin boundaries. These studies look to strengthen connections between basins and subbasins as well as a shared regional identity, while respecting the conditions that are specific to each place. These opportunities include critical transportation, commercial, and industrial corridors, as well as the wetlands, ridges, and waterways that extend through the region.

**City on the Water**

Top: Cypress swamps are common wetland ecosystems in the areas surrounding Greater New Orleans.

Left: Historic waterways, such as Bayou St. John, are an important amenity for nearby residents.

**Crescent City Connection**

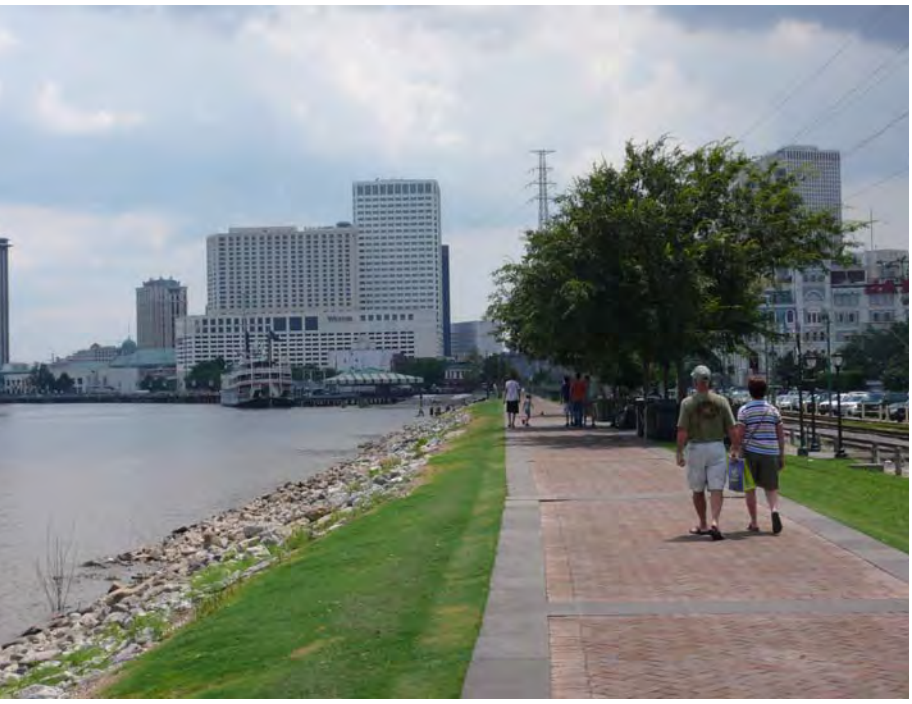
New Orleans was founded on the Mississippi River, which drains the continent's largest watershed.

# 2 Orleans Water Corridors

ORLEANS PARISH

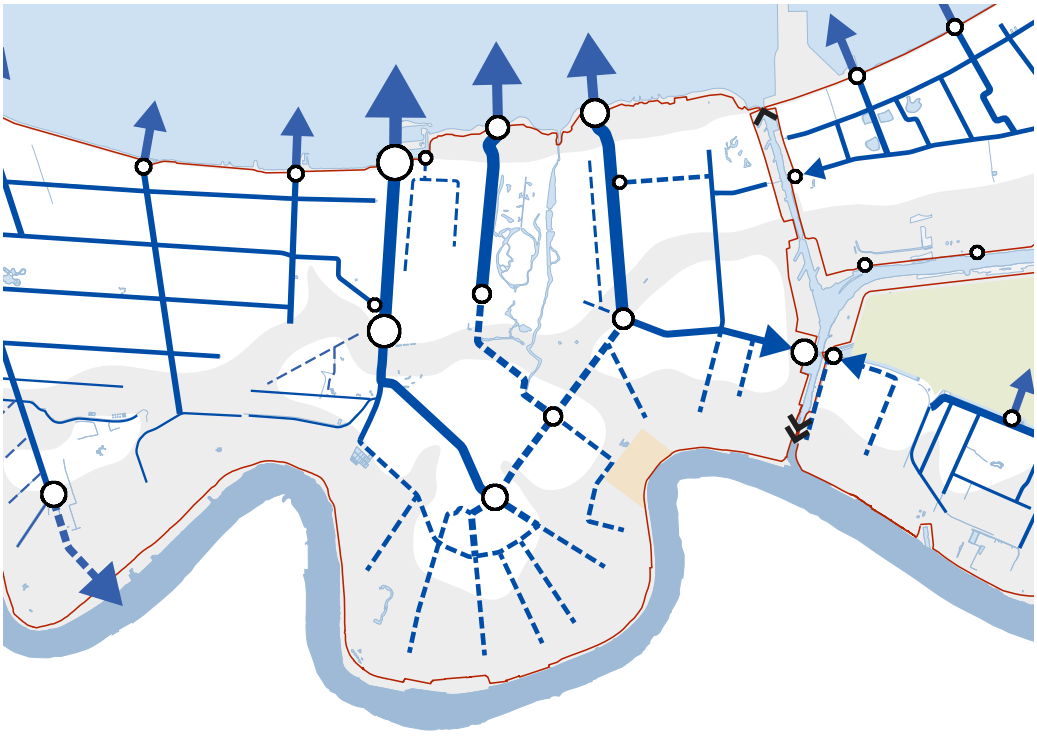
"What we do with this work will define this place for the next 100 years. If we do this work, our children, their children, and their children will be the beneficiaries."

—Ray Manning, *Architect and President Pro-Tem Sewerage and Water Board of New Orleans*



**Existing Landscape**

Clockwise from top left: Lafitte Corridor, Monticello Canal, City Park, Mississippi River Moon Walk



**Existing Drainage System**

Almost all stormwater in Orleans, upriver of the Industrial Canal, drains into Lake Pontchartrain. This creates problematic zones in bowl and lowland areas, and applies tremendous pressure on lakebound outfall canals.

# Orleans Parish

Bounded by the Mississippi River, the Orleans-Jefferson parish line, Lake Pontchartrain, and the Industrial Canal, the Orleans portion of the Jefferson-Orleans Basin features high ground along the river, with radial streets that run perpendicular to the curve of the river, gradually descending until they reach the Gentilly Ridge. Following the drainage of the backswamps in the city's bowls and lowlands, suburban expansion extended from ridge to lake, demarked by a rectangular suburban grid. These more recently settled neighborhoods are now among the city's lowest-lying areas.

## River Edge and Urban Backslope

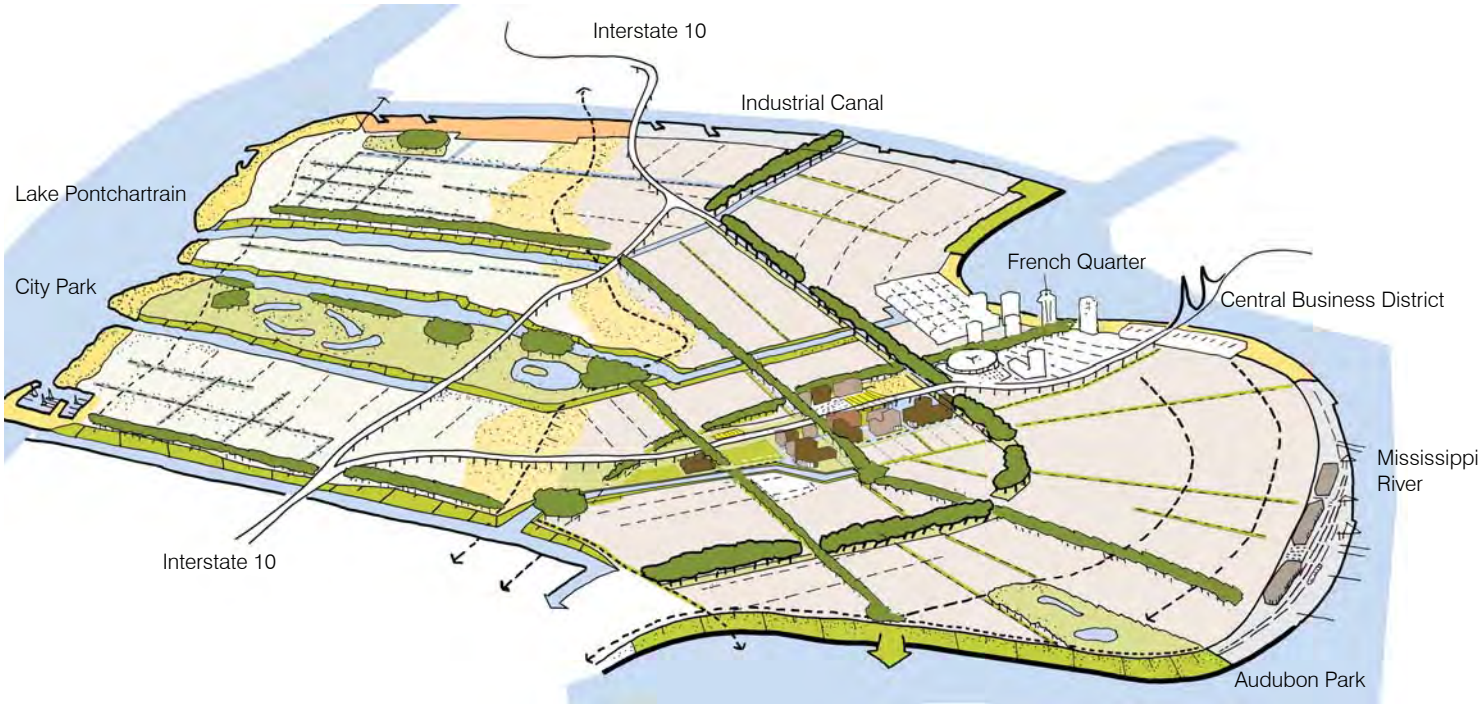
Today, streets on the Mississippi River levee's backslope form a distorted grid that echoes the curves of the river, with perpendicular streets extending inland into the bowl. The river edge is the highest ground because of the natural levee created by annual flooding when the river flowed freely. Since little undeveloped or vacant land remains in these oldest parts of the city, largely impervious surfaces contribute large volumes of runoff that quickly enter into street-side catch basins. This causes localized street flooding along the backlsope, and also exacerbates drainage issues further downslope.

## Bowl Landscape

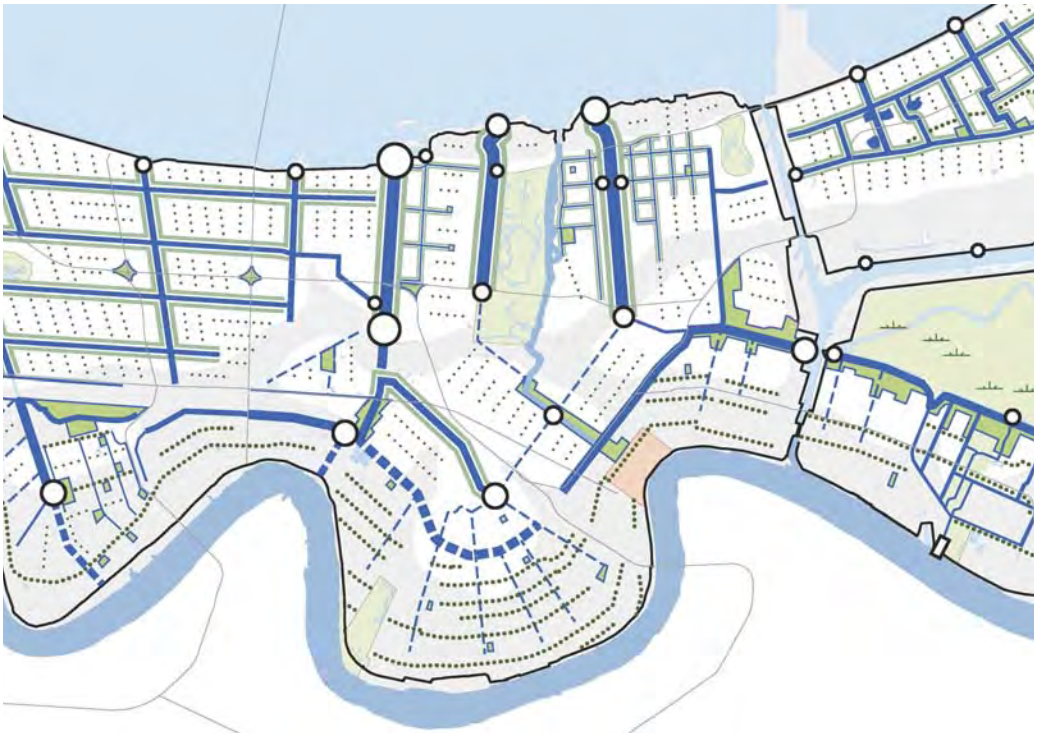
Between the backslope of the river levee and the Gentilly Ridge lie the bowls of the city. Formerly uninhabited due to swampy conditions, the area became developable after the invention of the Wood Screw Pump. However, in order to keep these lands from flooding, every drop of rainwater must be pumped over the ridge to the lake. Overwhelmed drainage systems often lead to flooding, since surface water naturally flows downslope to these lowest elevations.

## Lowland Landscape

By the 1940s, urban expansion converted the former marshlands beyond the Gentilly Ridge into suburban neighborhoods. Due to subsidence, these areas now are at elevations lower than water in the outfall canals that cut through them. Stormwater that enters the subsurface network flows towards internal pump stations, only then to be pumped into the outfall canals that drain into the lake. If overburdened, these outfall canals pose a threat to the surrounding areas, a fact shockingly demonstrated following Hurricane Katrina. These neighborhoods, already having subsided up to five feet, will continue to sink farther below sea level as long as the water table is constantly lowered by pumping.




The Urban Water Plan proposes the restoration of the city's canals to prominence as historic water corridors, each of which provides the city's residents with access to new water-based amenities in the form of blueways, greenways, water plazas, and parklands. A finer grain of investment—in the form of street retrofits and strategic adaptations of vacant lots and underutilized public rights-of-way—reduces localized flooding, improves soil stability, and provides environmental benefits to every neighborhood in the city.



**Proposed Living Water System**

The new drainage system splits the basin into two subbasins. The Claiborne Corridor forms the backbone of the riverside subbasin, and transports backslope runoff to the Monticello and Florida Canals, where strategic parklands can store and filter stormwater before it is pumped into the river and Industrial Canal, respectively. Outfall canals continue to drain stormwater into the lake.

# Orleans Water Corridors

By dividing the flow of stormwater between two subbasins, the Urban Water Plan proposes a more efficient infrastructure and an attractive identity for Orleans. Reducing flood risk begins first, though, with smaller measures on the backslope and in the bowls of the city. Individual properties and streets can be designed to slow water before it enters the subsurface drainage system. With the insertion of rain gardens and bioswales, stormwater can nourish historic live oaks and newly planted vegetation, and infiltrate into the ground. Planted curb extensions offer opportunities for stormwater storage, reducing localized flooding. Pervious pavement allows stormwater to soak into the ground, reducing total runoff. Larger-scale water storage features on underutilized properties and vacant lots provide an additional factor of safety.

## Split at the Ridge

A new waterway along Claiborne Avenue and an expanded Florida Canal become the backbone for the riverside subbasin, carrying stormwater to the Mississippi River and the Industrial Canal rather than towards the lake. This reduces the flow of water from the backslope and bowl into the city's lowland outfall canals.

## Lowland Network

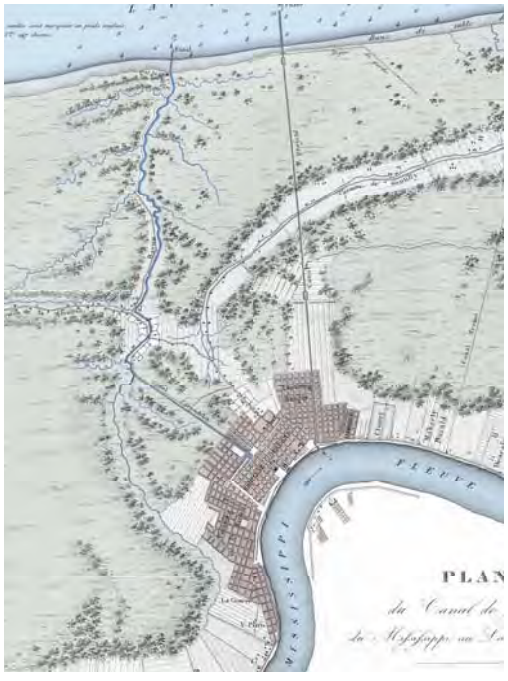
With less pressure on the lowland outfall canals and new pump stations at the lakefront, system managers will be able to lower water levels in the outfall canals to reduce risk to surrounding neighborhoods, so that the floodwalls on either side of the canals can eventually be removed. With widened and planted canal edges that expand storage capacity and filter stormwater, each of the canals can become publicly accessible blue-green corridors that promote public interaction with the water in place of the current condition where water is hidden behind blank, high concrete walls. Water from the lake will circulate through the outfall canals, entering via Bayou St. John during dry weather.

Slowing the rate of subsidence is crucial for a sustainable lakeside subbasin. The outfall canals anchor and nourish a network of smaller-scale canals. These are woven into the street grid, making use of neutral grounds and public rights-of-way. Planted with trees and enhanced with pedestrian walkways, these circulating canals alleviate flooding, recharge groundwater, and serve as neighborhood amenities. Existing "roller coaster" roads, buckled by differential rates of subsidence, can be transformed into "floating streets," where pervious concrete rests upon a more stable subbase that stores and infiltrates stormwater.

# Lafitte to Lakefront

Early French settlers founded New Orleans on the banks of the Mississippi River, a short portage from Bayou St. John and Lake Pontchartrain. In the 19th century, the Carondelet Canal enabled the flow of goods and people between the bayou and the Vieux Carré. Investing in the Lafitte Blueway and the city's primary outfall canals as park zones and public spaces reestablishes that historic connection and revitalizes the entire city.

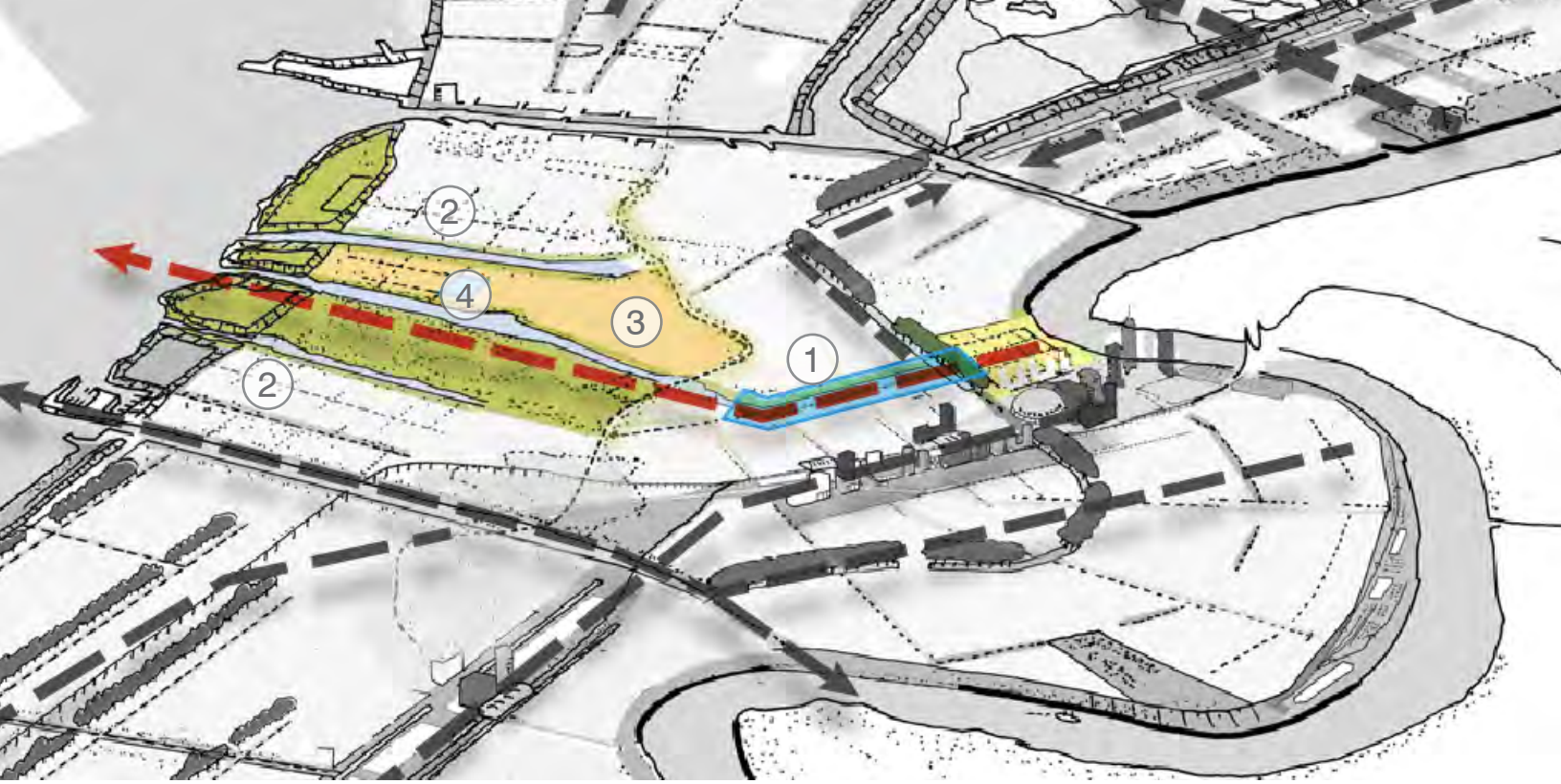
Water features, open parkland, and wetlands along each of these waterways provide critical storage capacity and water sources for the city's water networks. They are also amenities that serve residents from the French Quarter and Mid City to Lakeview and Filmore (Gentilly), where the 25 acre Mirabeau Water Garden provides a model for lowland water management.




**Historic Connection**

The excavation of the Carondelet Canal completed water passage from Bayou St. John to the French Quarter.

Image courtesy of David Rumsey Map Collection

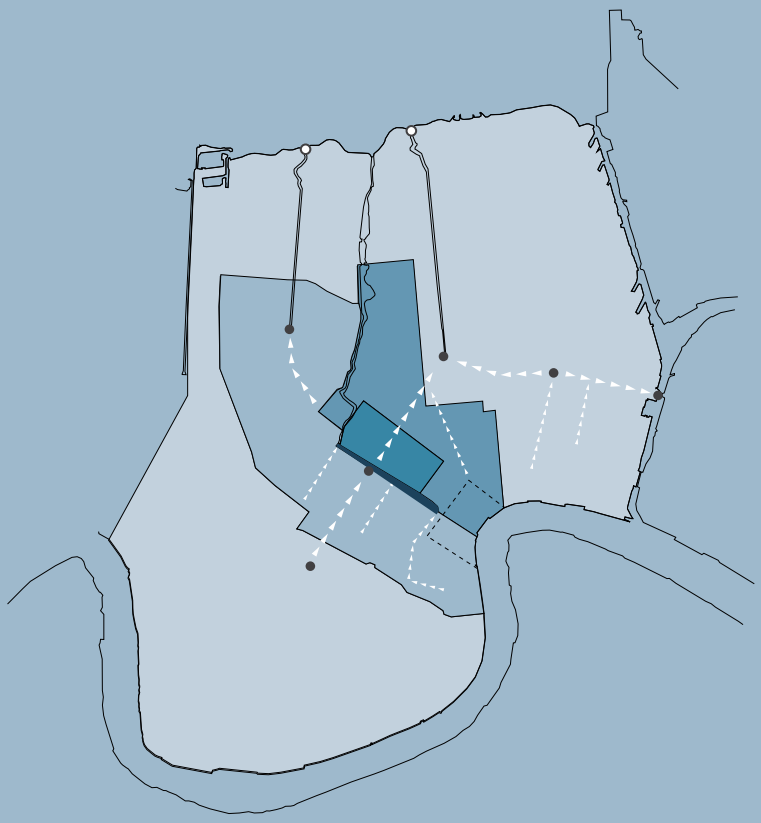



1 The proposed **Lafitte Blueway** recalls the historic gateway that once connected the bayou to the French Quarter via Bayou St. John and the Carondelet Canal.

2 The **Orleans Avenue and London Avenue Outfall Canals** can redefine the character of lowland neighborhoods as attractive and publicly accessible waterways.

3 **Filmore District (Gentilly)** is a representative lowland district, where circulating canals in neutral grounds can store and infiltrate water.

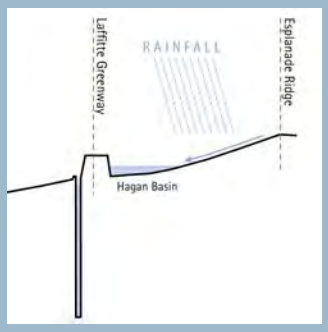
4 A large parcel can be designed for memorialization, education, filtration and recreation for the neighborhood and the region at the **Mirabeau Water Garden**.



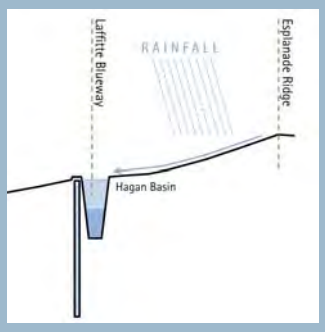
**Catchment Area**

The Lafitte Blueway will directly benefit neighborhoods to the north, storing runoff rather than allowing it to flooding street and homes. The Lafitte Blueway will also lessen the load on pump stations that drain water into the Orleans and London Avenue Outfall Canals.

**Existing Section**




**Proposed Section**




**Water Assignment**

The Lafitte Blueway provides 35-50 acre feet of storage on its 42 acres, which is 50-70 percent of the adjoining neighborhoods' water assignment (water that cannot be handled with current pumping capacity for a 10-year storm.)

**Cost Estimates**

Estimated costs are provided for each demonstration project. The cost below is for the first phase of construction. It includes civil engineering and stormwater management features, but not landscaping costs.

| Design Component | Cost |
|---|---|
| Bayou St. John to Broad Street | $ 16,554,306 |

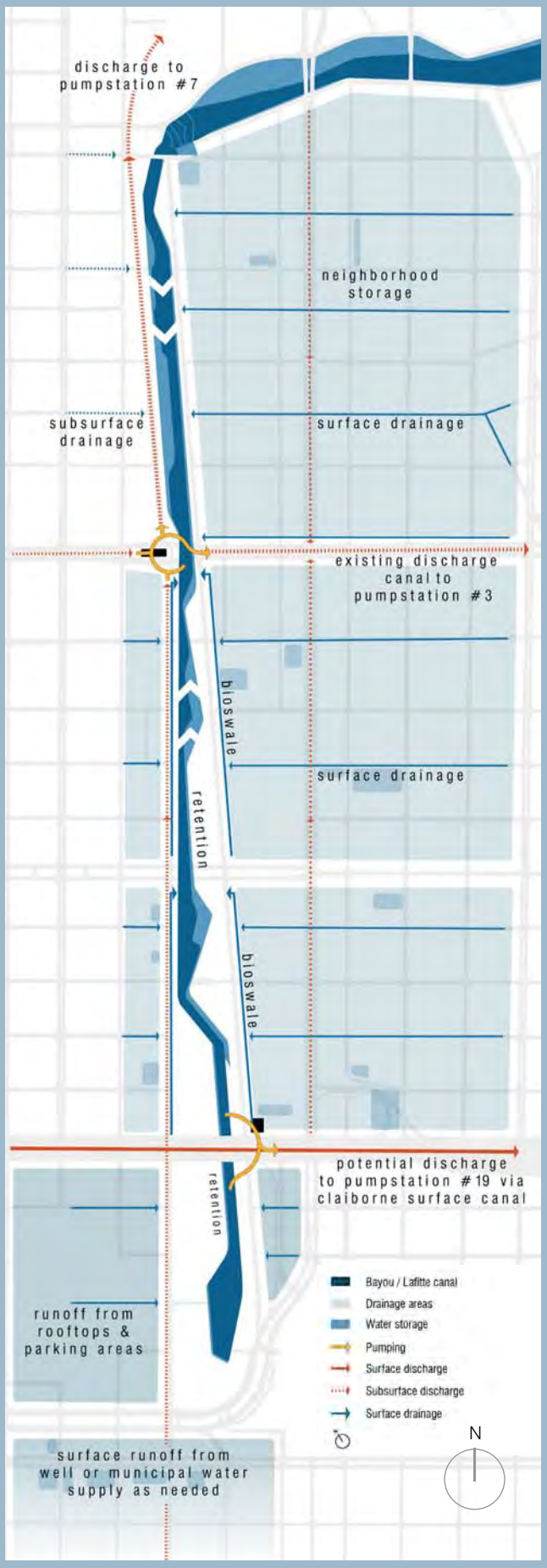
# Lafitte Blueway

The Lafitte Corridor occupies a unique place in Greater New Orleans. The city was founded where Bayou St. John extends from Lake Pontchartrain toward the Mississippi River. This conjunction of waterways facilitated trade, allowing for shipping between the Gulf and the Mississippi that was easier than sailing against the current through the river's birdfoot delta.

Originating from Bayou St. John, the Carondelet Canal was created for commerce and drainage, but it also served as a promenade for people strolling from the French Quarter. The canal connected the back of the French settlement in a straight line to the bayou and from there allowed passage into the lake. Maritime commerce eventually declined along the corridor due to competition from railroads. Between 1927 and 1938, the canal and its turning basin were covered over. As the Carondelet Corridor became less important, the area around it slowly deteriorated.

Basin Street, Lafitte Street, N. Jefferson Davis Parkway, and St. Louis Street currently bound the strip of land known as the Lafitte Corridor. Adjacent to the city-owned corridor, there are a number of underutilized and vacant commercial buildings and blighted residential properties. Large parcels remain fenced off and inaccessible. Today, the area between the Bayou St. John terminus and the French Quarter is an abandoned strip of urban tissue, but it is an area with important opportunities for development.

The Lafitte Blueway can play an important role within the Urban Water Plan. The existing drainage system is insufficient to convey all of the stormwater from the surrounding area to pumping stations during intense rain events. This inadequacy results in substantial localized flooding along the corridor's edges, as evidenced by repetitive insurance loss claims. In addition to these drainage issues, the absence of a water supply for recharging groundwater during periods of dry weather contributes to unbalanced groundwater levels that




Water Systems

Carondelet Canal and Canal Walk c 1890s
Image courtesy of New York Digital Library

Turning Basin c 1900
Image courtesy of New Orleans: Then & Now


Restoring the historic city arrival

result in soil subsidence and related damages to infrastructure.

By excavating soil out of the artificial ridge of the Lafitte Corridor, a new surface waterway can be created with Bayou St. John as the source. A stepped control structure will allow higher water from the bayou to cascade into the Lafitte Blueway, providing a constant source of water. This open waterway will recharge groundwater, provide habitat for wildlife within the city, offer recreational opportunities, and restore the historic connection between Bayou St. John and the French Quarter.

The Lafitte Blueway can become one of the major green-blue parkways of New Orleans, providing  significant public spaces with recreational and educational opportunities for both residents and visitors. Programming includes baseball fields, tennis and basketball courts, playgrounds, a track, community gardens, farmer's market, possibly even a museum, and small-scale housing development. Pathways can be developed for pedestrians, cyclists, in-line skaters, and runners. Furthermore, the Lafitte Blueway can be accessible from the bayou for canoeists and kayakers; and like Bayou St. John, it can be a place where people experience and interact with water.

Plan Design Alternative 1


Plan Design Alternative 2

Lafitte Blueway Turning Basin

Lafitte Blueway Section at Bayou St. John cascade

**Connect Bayou to Downtown**

Bayou St. John joins the Lafitte Blueway by means of a cascading water plaza, making the flow of water both visible and audible. Naturalized edges filter the flow of water and provide valuable hatching places for fish and amphibians. A series of pedestrian and cyclist pathways and bridges lead to the Blueway's culmination, the former Carondelet Canal's turning basin, at the edge of the French Quarter and adjacent to Louis Armstrong Park. Canal edges near the turning basin feature harder edges more suitable to the dense urban context, and are built up with new mixed-use development.

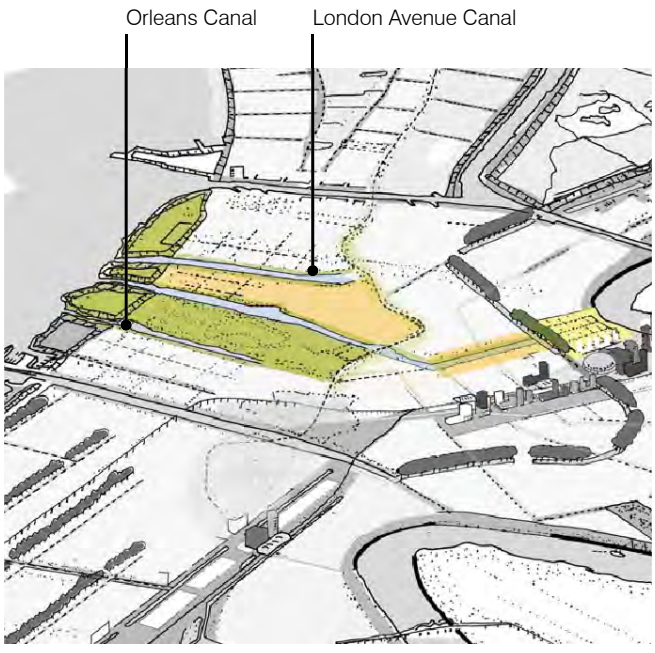
# Lafitte Blueway

View from downtown towards Lake Pontchartrain. The Lafitte Blueway connects the French Quarter to Bayou St. John.

# Orleans and London Avenue Outfall Canals

These canals present opportunities for improving safety and public access to existing waterways, supporting the continued recovery of surrounding neighorhoods.

- Lower the water level in outfall canals
- Create inhabitable canal banks with trails and walkways
- Widen canals where possible, utilizing vacant and blighted lots adjacent to the canal right-of-way
- Create spaces for waterfront retail, restaurant, recreational, and residential opportunities




The Gentilly Ridge proved a hindrance to removing stormwater from the backslope and bowl as the city drained its swamplands. Bayou St. John, the only remaining bayou, did not have the capacity to drain all of the city's stormwater. The solution was to construct large drainage canals to move water from the bowl to the lake. A pump station at the base of each canal moved stormwater up and over the ridge into the canals. These canals, however, compromised the future of the city. Vast swamps were transformed into hard ground, with drainage ditches and pumps lowering the groundwater table and causing subsidence. Because they were directly connected to the lake, the outfall canals allowed storm surge to enter into the heart of the city in 2005, leading to floodwall failures and catastrophic flooding across the city's lowlands and bowls.

The outfall canals were subsequently bolstered as part of the improved Hurricane Storm Damage and Risk Reduction System (HSDRRS), with temporary closure structures that protect against storm surge at the lakefront, and construction of permanent closure structures and lakefront pump stations scheduled for the coming years.

The Orleans Canal separates Lakeview from City Park and extends 2.1 miles from Pump Station #7 to the lake.

The London Avenue Canal, the largest of the set, runs 4.0 miles from Pump Station #3 to Lake Pontchartrain. Pump Station #4 is located at the intersection of Prentiss Avenue and the canal.

The canals have resulted in disconnected districts. The drainage system for these neighborhoods directs water via subsurface flows to the base of each canal, where internal pump stations redirect the water back towards the lake. Water levels inside the canals, while lower than the concrete floodwalls and the crown of the earthen levee, are higher than the elevation of surrounding neighborhoods. With the new pump stations and closure structures that will be constructed at the lakefront, it can be possible to lower water level in these canals, as they will be hydrologically disconnected from the lake. This will increase canal capacity and allow for the safe removal of concrete floodwalls, thereby reconnecting lowland districts long made inaccessible by the outfall canals.

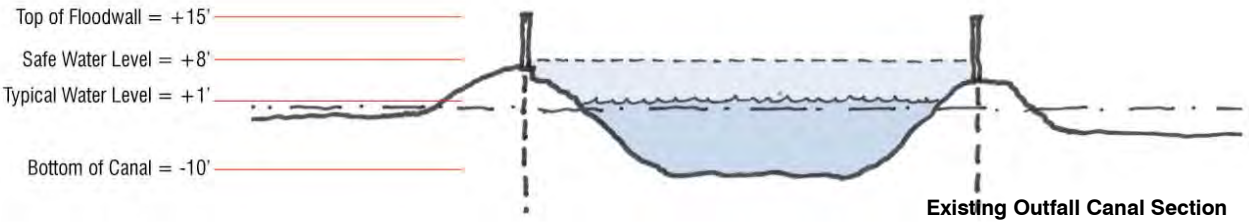
**Existing Landscape**

Outfall canals currently block visual access and physical connections between neighborhoods in the lakeside lowlands. They are also hidden assets that can transform the landscape as vital public spaces integrated into the urban fabric.


**A Lowland Canal Network**

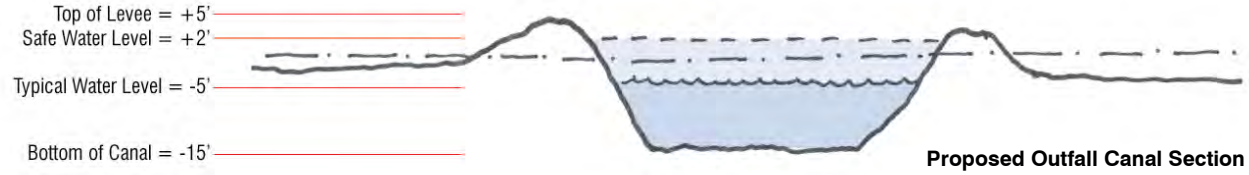
Above: A circulating canal network connects Bayou St. John to the Orleans and London Avenue outfall canals through the Lafitte Blueway, providing improved drainage during wet weather and circulating water during dry periods.

Right: Bayou St. John cascades into the Lafitte Blueway, taking advantage of the change in surface elevation, carrying water into the heart of the city as the Carondelet Canal once did.




**Existing Outfall Canal Section**

Keep levees and floodwalls




**Proposed Outfall Canal Section**

Lower water levels and remove floodwalls


**Proposed Outfall Canal Section**

Lower water levels, widen canal, and remove floodwalls

### Proposed Outfall Canal Sections

Permanent closure structures at the lakefront eliminate the role of outfall canal floodwalls in protecting the city from hurricane storm surge. Lowering the remnant concrete floodwalls to reveal each waterway as a vital public space is now possible.

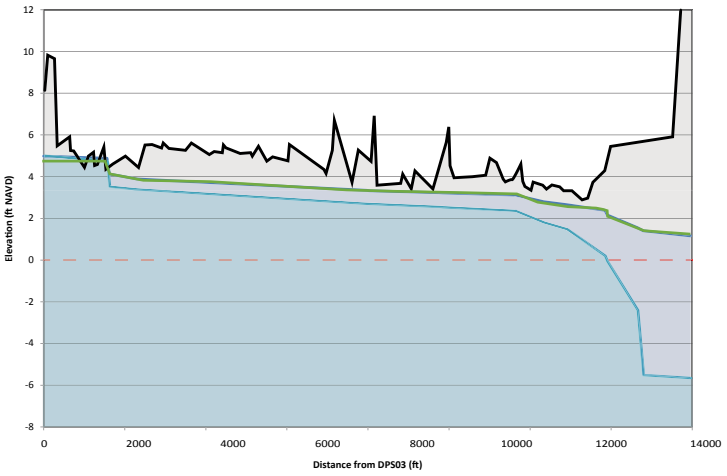
### System Modeling Results

The systems modeling shows three key factors, all exaggerated along the vertical axis for clarity. The black line indicates the top of the earthen levee. The green line indicates existing maximum water level as modeled, while the blue line shows the proposed maximum water level as modeled. The graphs, read from left to right, indicate distances from the internal pump station at the base of the canal to the lakefront pump station.

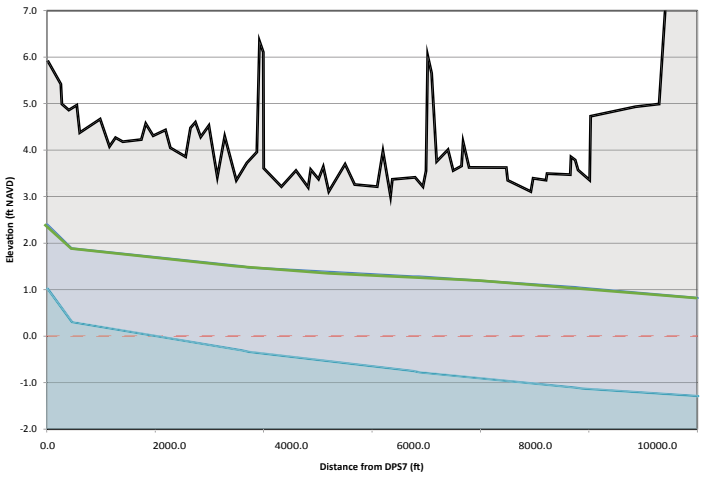
Top right: The top graph shows the challenge of lowering the **London Avenue Canal** walls with the existing capacity. With the Urban Water Plan, less water would flow through the canal during wet weather, making it possible to lower the floodwalls.

Bottom right: Lowering floodwalls along the **Orleans Canal**, shown in the bottom graph, proves much easier because of the additional freeboard between the wall and the elevation of the water.

**London Avenue Canal**




**Orleans Canal**



Orleans Canal Plan

Orleans Canal and City Park


Orleans Canal Proposal

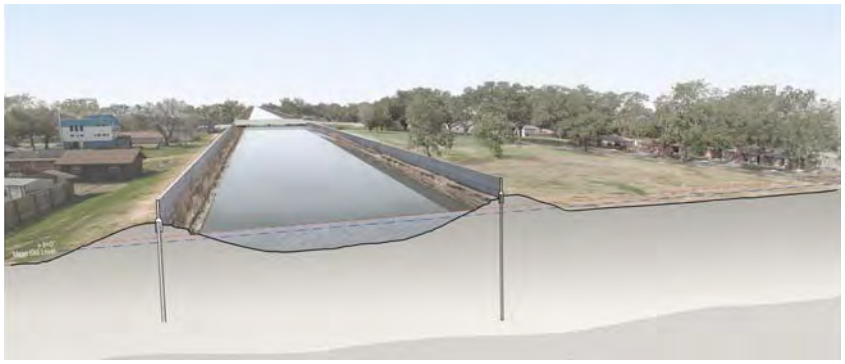
**Orleans Canal**

The Orleans Canal and its concrete floodwalls form a high barrier between the Lakeview neighborhood and City Park that limits visual and physical access. The Orleans Canal's walls did not fail during Hurricane Katrina, in contrast to the 17th Street and London Avenue Canals, although floodwaters did overtop levees and enter City Park at the southern terminus where the eastern floodwall ends. The Urban Water Plan recommends widening the canal on the City Park side, allowing water levels to be lowered and providing additional capacity. Along the canal banks, pedestrian pathways and bridges allow one to traverse the top of the levees and provide direct access from Lakeview to City Park.

This canal redesign can be implemented in phases. The first phase lowers the floodwalls on the City Park side, and introduces a pathway connecting to the lake along the canal's length. The second phase includes lowering the floodwall on the Lakeview neighborhood side and allows for an additional pathway on that canal bank. Additional water storage features can be added beyond canal edges on both sides of the canal.

London Avenue Canal Plan, Proposed

London Avenue Canal, Proposed

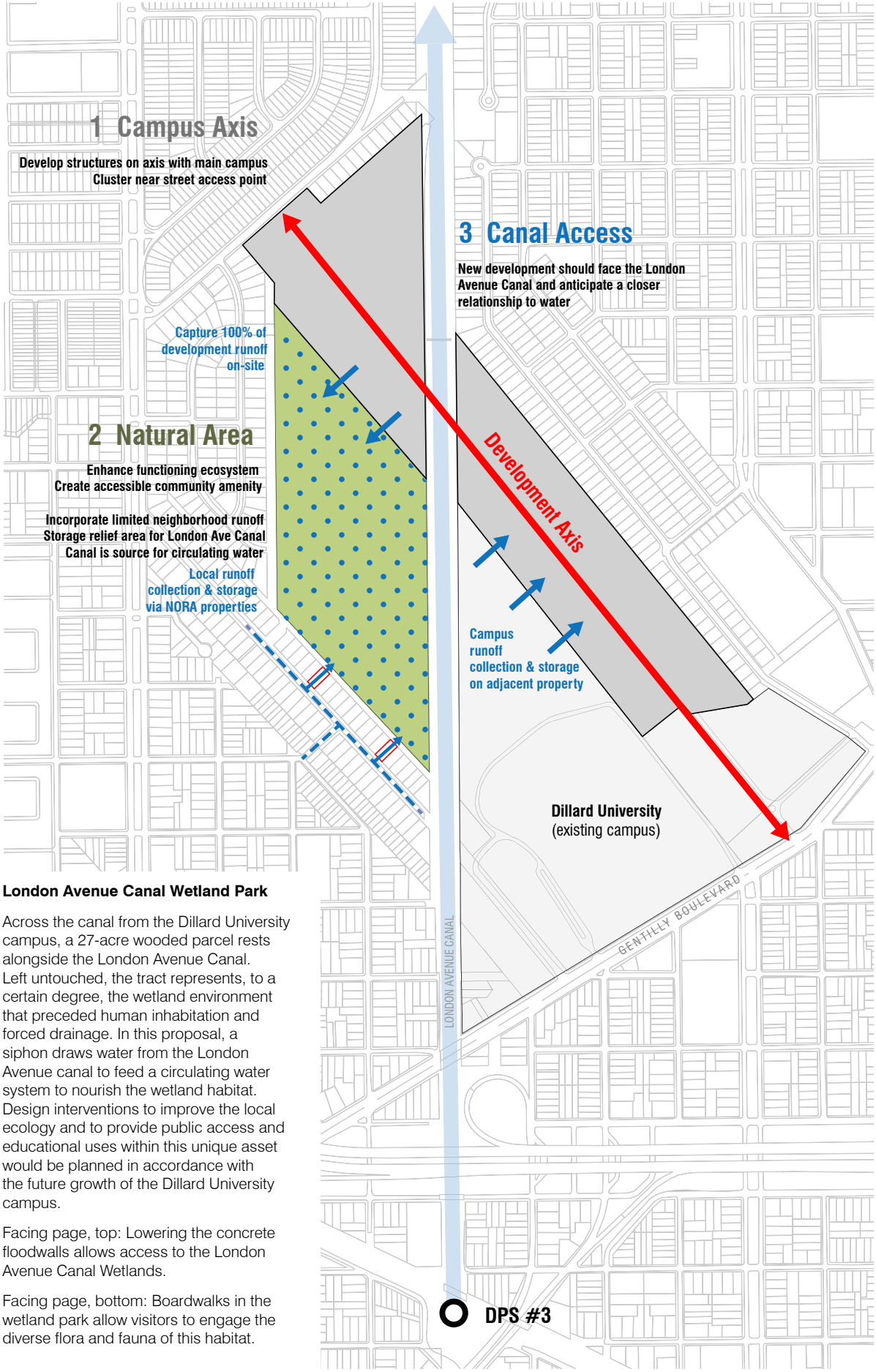



London Avenue Canal, Existing

London Avenue Canal Existing

**London Avenue Canal**

Vacant lots on either side of the London Avenue Canal present the opportunity for the canal width to expand and contract. Experientially, one can walk within the earthen levees and experience the water. The canal also can provide a commodious new connection with walkways, bike paths, and pedestrian bridges, between Dillard University at the Gentilly Ridge, the proposed London Avenue Wetland Park to the west of Dillard, and the University of New Orleans at the lakefront.




**London Avenue Canal Wetland Park**

Across the canal from the Dillard University campus, a 27-acre wooded parcel rests alongside the London Avenue Canal. Left untouched, the tract represents, to a certain degree, the wetland environment that preceded human inhabitation and forced drainage. In this proposal, a siphon draws water from the London Avenue canal to feed a circulating water system to nourish the wetland habitat. Design interventions to improve the local ecology and to provide public access and educational uses within this unique asset would be planned in accordance with the future growth of the Dillard University campus.

Facing page, top: Lowering the concrete floodwalls allows access to the London Avenue Canal Wetlands.

Facing page, bottom: Boardwalks in the wetland park allow visitors to engage the diverse flora and fauna of this habitat.

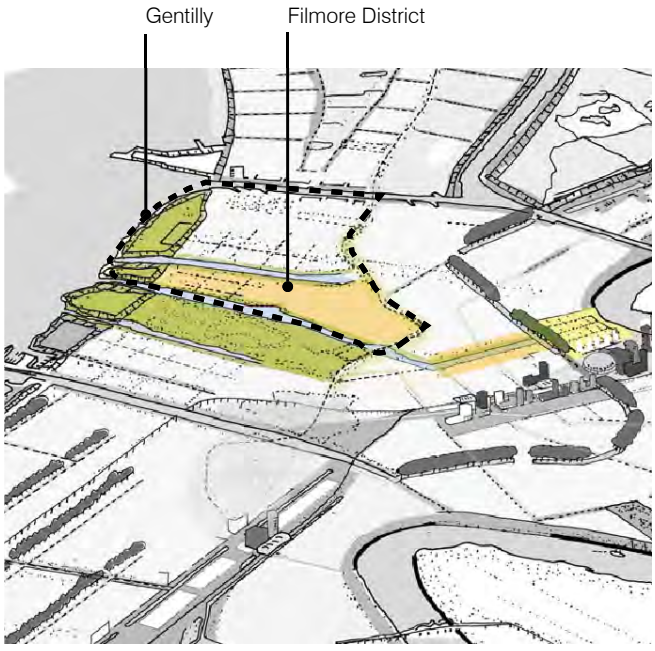
London Avenue Canal adjacent to Wetland Park

Boardwalk in London Avenue Canal Wetland Park

# Filmore District (Gentilly)

Vacant lots and underutilized neutral grounds can be used to form a blue-green network, catching and holding runoff, and infiltrating water into soils that need to remain saturated to slow subsidence in an area that is already largely below sea level.

- Provide urban water framework to connect and transform vacant lots into a network of pocket parks and corridors
- Utilize neutral grounds to lessen street flooding by adding water storage
- Reduce area subsidence by stabilizing groundwater
- Make water a visible element in local streetscapes and parks




Once a thriving residential district, Filmore was flooded after Hurricane Katrina. As a result many empty lots and vacant structures remain throughout the district. The ground beneath Filmore continues to sink; the effects of subsidence can be seen in cracked roadways and driveways, homes, and foundations. Empty roadway medians, referred to throughout Greater New Orleans as"neutral grounds," shed stormwater into streets and contribute to localized flooding. Introducing a circulating water network to this lowland area can help create a more sustainable landscape, and serve as a prototype for other lowland areas.

Vacant lots can form intra-block corridors that function as pocket parks during dry conditions and provide safe water storage during rain events. These lots can be designed with pedestrian walkways that allow residents many more means of access through the district.

Bioswales and circulating canals can be constructed in existing neutral grounds. The major east/west streets, such as Robert E. Lee Boulevard, Prentiss Avenue, Filmore Avenue, and Mirabeau Avenue, can be designed to form a system of terraces, slowing and holding water as it flows via gravity from the ridge through the lowlands. Perpendicular to these waterways, north/south neutral grounds can link the system together to create a circulating network. The terraced system holds water at a higher level, allowing for improved groundwater management and properly saturated soils. Terraces also allow water to be stored at the higher elevations along the ridge, reducing the amount of stormwater that tend to flood the lower areas between Prentiss Avenue and Robert E. Lee Boulevard. Bayou St. John and the London Avenue Canal can provide inlets and outlets to the circulating system.

Circulating canals are ideal elements to recharge groundwater in the lowlands. Curb cuts will allow stormwater from streets to be collected by these new features. Planted edges can filter and infiltrate water as water flows through these canals. New trees provide shade and and improved environmental quality for the district. Pedestrian pathways adjoin the canals and link the district to the London Avenue Canal.

**Existing Landscape**

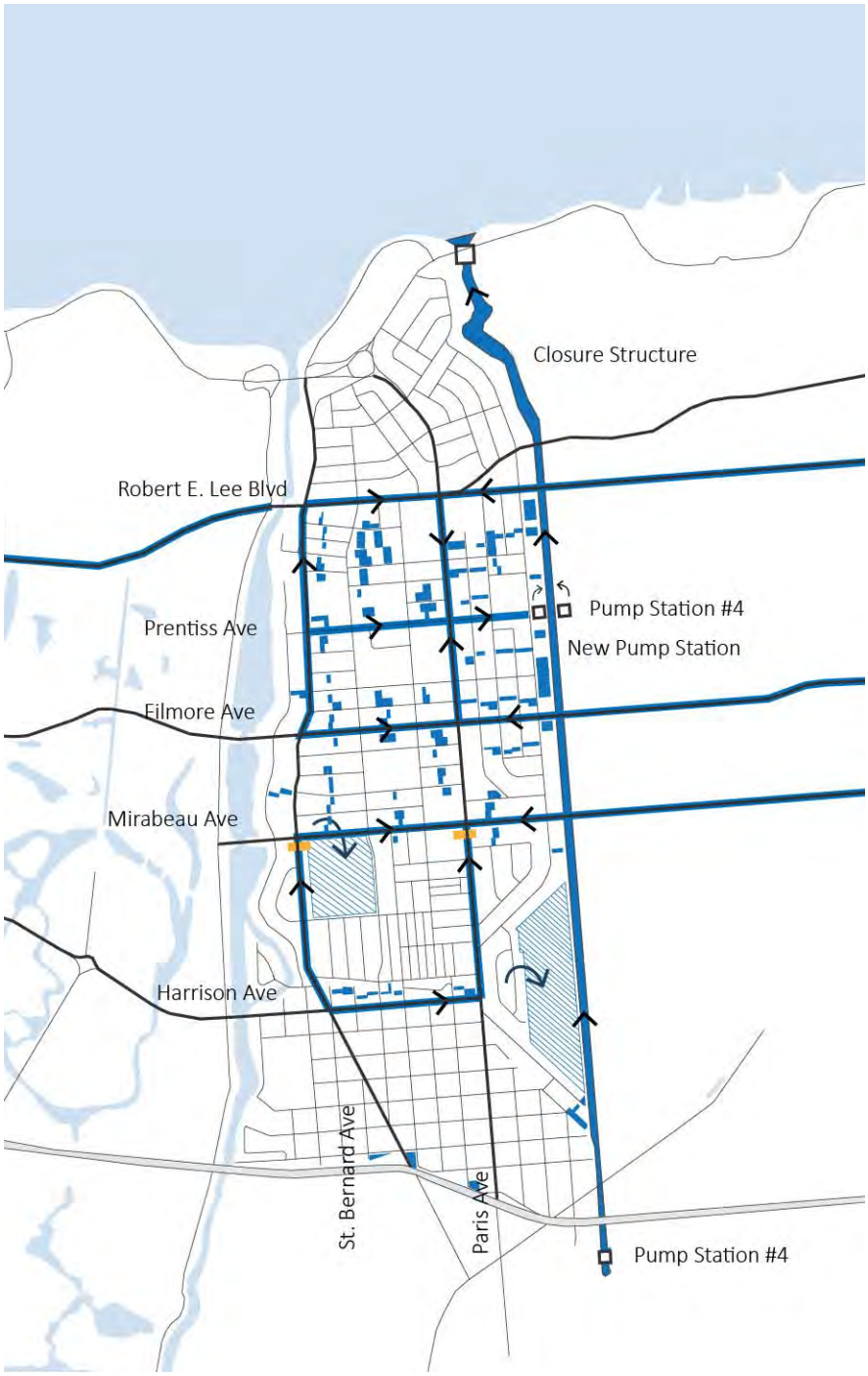
The Filmore District suffers from broken streets due to subsidence and localized flooding. Though the district is adjacent to the London Avenue Canal, visual and physical connection to the water is blocked. Re-imagining lowland streetscapes and waterways can address both problems, and improve quality of life across the district.


**Existing Condition**

Currently, all stormwater enters the drainage system and is pumped to the lake through the London Avenue Canal.


**Dry Condition**

Neutral grounds and vacant lots can become a network of circulating canals and pocket parks.




**Wet Condition**

In addition to neutral grounds and vacant lots, large vacant lots can also become place for safely storing stormwater.

**Filmore District Plan**

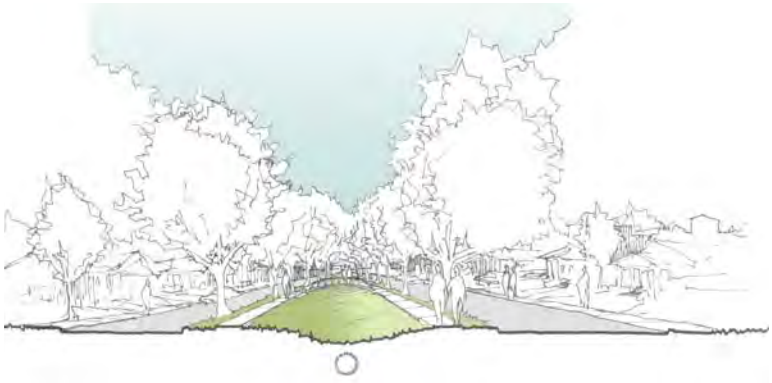
Filmore's design emphasizes the use of existing neutral grounds. These spaces can be used to form a circulating water network through the district, functioning on two tiers to manage water levels. This system will raise groundwater levels and address local subsidence.

These circulating networks can use Bayou St. John and the London Avenue Canal as water inlet and outlets. Vacant lots in the area can become pocket parks storing water during heavy rainfall. Additionally, these lots can connect to form pedestrian alleys throughout the neighborhood.

**Filmore Canal Networks**

Neutral ground canals can circulate water through the district at all times to help maintain high groundwater levels and limit further subsidence. The design employs a two-tier system to balance groundwater levels and infiltrate stormwater into the ground.

Right: Options for neutral grounds include bioswales, which would fill with water only immediately following a rain event, or circulating canals, constantly carrying water and filling to capacity during storm events.



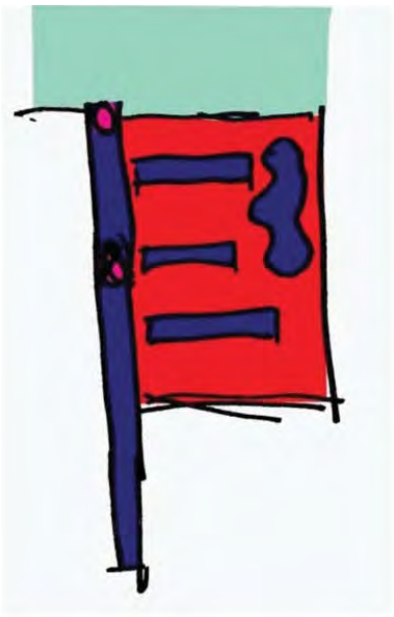
Neutral Ground Bioswale

Neutral Ground Circulating Canal


Filmore and Pontilly neighborhoods are part of the larger area known as Gentilly.

**Gentilly Canal Networks**

Right: The proposed neutral ground circulating canals in Filmore can become prototypes for other lowland neighborhoods in Gentilly. The image shows opportunities for neutral ground canals at the intersection of Robert E. Lee Boulevard and Paris Avenue. New development can feature on-site storage.

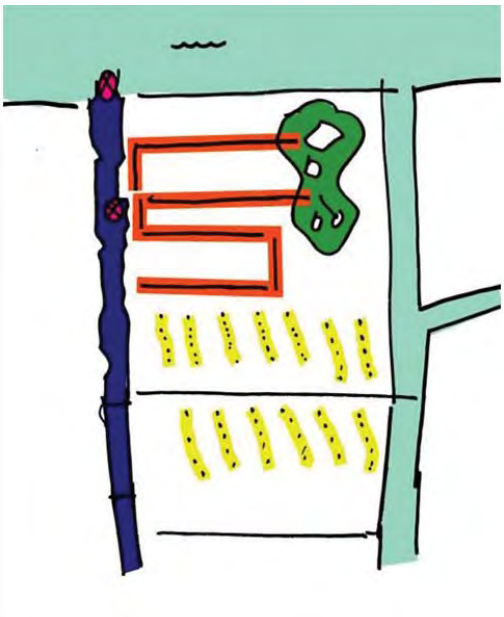


**Option A**

More internal water is needed to prevent further subsidence and maintain the water table closer to the surface.

**Option B**

Circulating canal networks in neutral grounds can use the London Avenue Canal as an inlet and outlet.



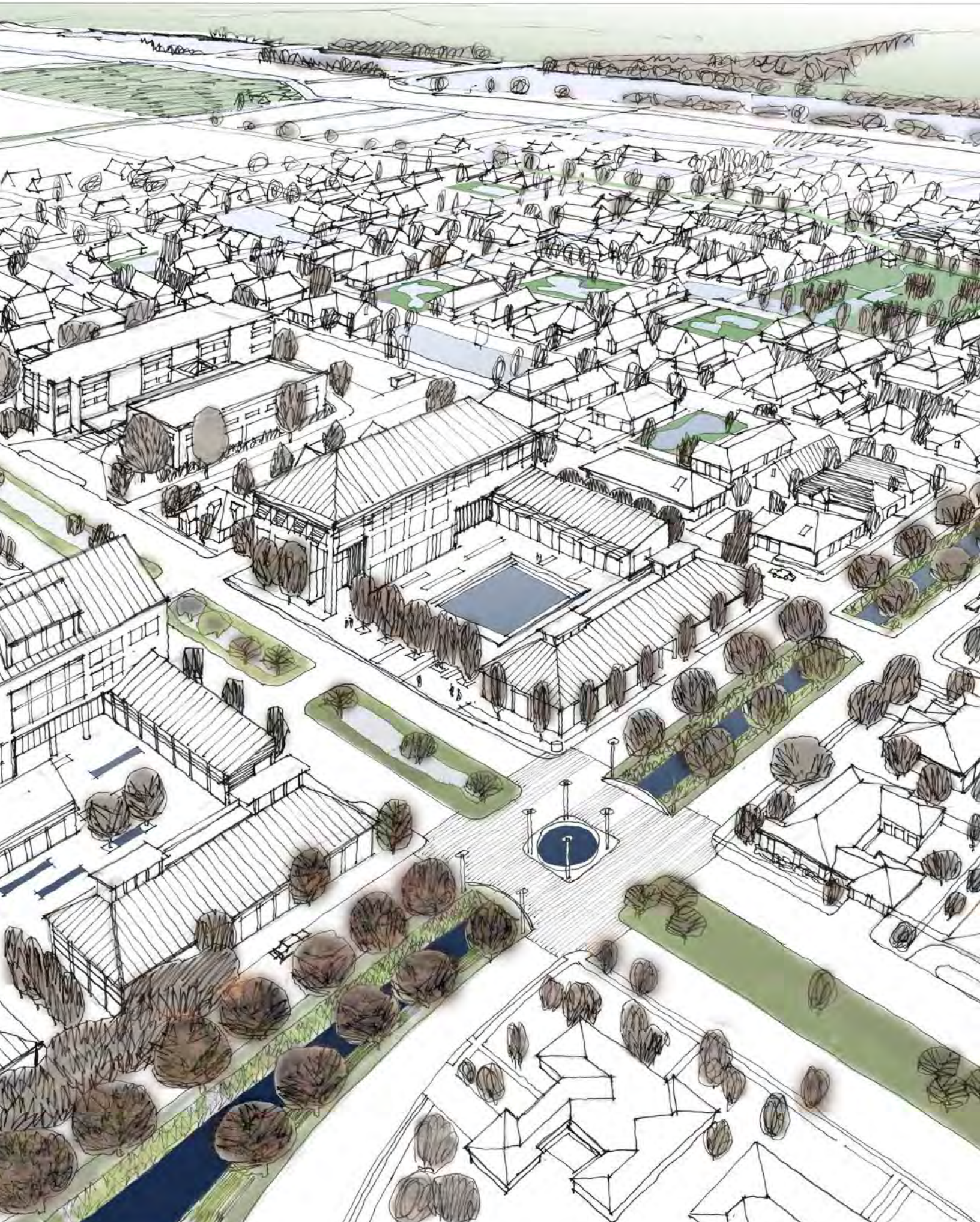
**Option C**

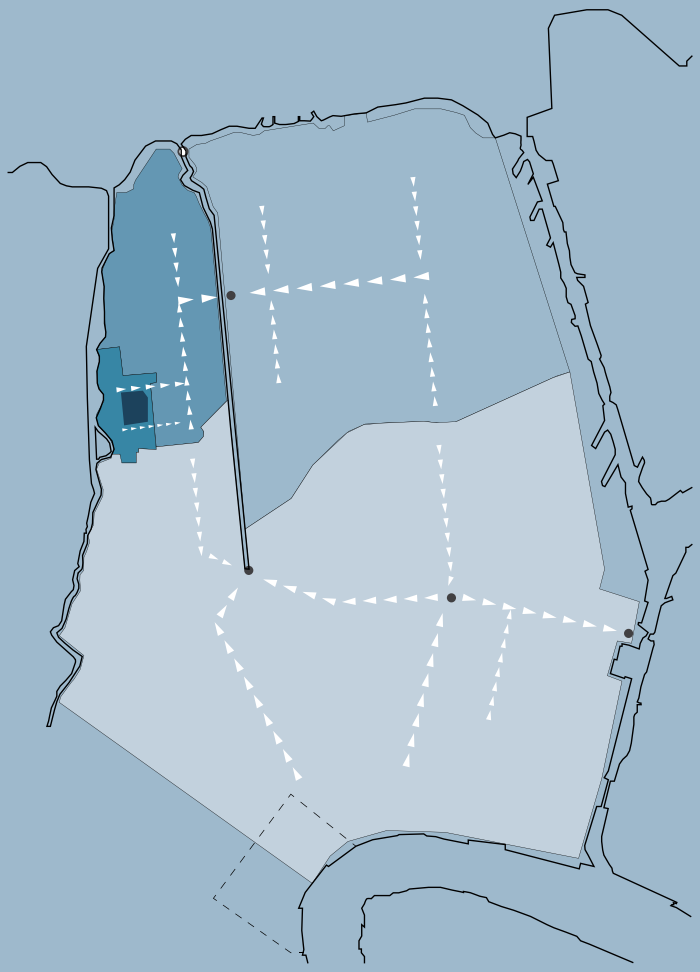
Backslope water retention elements and lowland water storage can create a new water-based identity in Gentilly.

**Pontilly District Plan**

Gentilly Woods and Pontchartrain Park neighborhood associations advocated for funds around a shared flooding problems. The Federal Emergency Management Agency granted New Orleans Redevelopment Authority (NORA) $15 million in hazard mitigation funding for the design and construction of a series of linked pocket parks used to slow and store the flow of stormwater, in order to alleviate flooding. Formerly vacant or blighted lots will become places for recreation during dry weather and alleviate neighborhood flooding during wet weather. Water storage is prioritized where it matters most: upslope, before water overwhelms the drainage system downstream.

The project is a collaboration between NORA, CDM Smith, Dana Brown & Associates, Waggonner & Ball Architects, and Chester Engineers.





# Mirabeau Water Garden

Twenty-five acres of land rest unused on Mirabeau Avenue in the heart of the Filmore neighborhood between Bayou St. John and the London Avenue Canal. Oak trees lining the northern edge of the site lead to a grove of expansive live oaks in the northeastern corner of the site. Looking to the south, one can glimpse the skyline of downtown New Orleans through the trees.

The proposal aims to slow and store stormwater from the Mirabeau Avenue S&WB drainage trunk line. In this proposal, water from the trunk line, located beneath the neutral ground, enters a forebay, an open concrete-lined box only several inches deep, five feet beneath the ground. Passersby will both hear and see this flow of water onto the site. As one enters the site, water cascades into a deeper forebay where it collects before pumps lift the water into a sequential filtration "train" that absorbs pollutants common to the stormwater runoff and dry weather flow of the Mirabeau trunk line. Water winds through a series of vegetated wetland terraces, the first of which is planted with lily pads to filter nutrients, petroleum and toxins from the water. From the lily pond, water flows into a constructed bed filled with tall reeds and grasses. The third and final bed features cypress trees. Channels connected to the filtration beds cut laterally across the site and fill when the beds overflow, creating a gridded network across the property.

The filtration sequence culminates in a freshwater swimming pool. In this final step of the cleansing cycle, one can directly engage water that has been stored and made usable again, rather than drained into Lake Pontchartrain. Leaving the freshwater swimming pool, one faces a tree-lined pedestrian boulevard leading toward the memorial to the Congregation of St. Joseph (CSJ), longtime owners of the tract.

As the pool fills, water will fall into a willow and cypress grove. Inspired by

**Catchment Area**

The 25 acre parcel lessens runoff volume from the Filmore District, served by Orleans Pump Station #4 at the intersection of the London Avenue Canal and Prentiss Avenue. Mirabeau Water Garden can provide benefits to the hydrology and hydraulics of the entire Lafitte to Lakefront transect.

**Water Assignment**

As designed, the 25 acre site would be able to hold 28 acre feet of water, meaning the site could store its own runoff and neighborhood runoff diverted from the Mirabeau trunk line, equivalent to approximately eight percent of the T-10 water assignment for Orleans Pump Station #4.

**Cost Estimates**

The cost estimate calculated for the Mirabeau Water Garden includes all water features on-site, including the pumping facility, filtration sequence, woodland wash, concrete-lined channels, bioswales, and athletic fields. Total cost also includes supplemental features, such as photovoltaic panels to power the pumping facility, as well as greywater and blackwater purification systems for buildings on site.

| Design Component | Cost |
|---|---|
| Mirabeau Water Garden | $ 19,041,818 |

**Sisters of St. Joseph at Mirabeau**

The twenty-five acre parcel remains as one of the only large parcels in the city of New Orleans under single ownership, the Sisters of St. Joseph. This site can become both a replicable example of water management for the lowland landscape, as well as an educational destination for residents to learn of water filtration and management.

Historic photographs courtesy of the Sisters of St. Joseph

2013

1950

1950

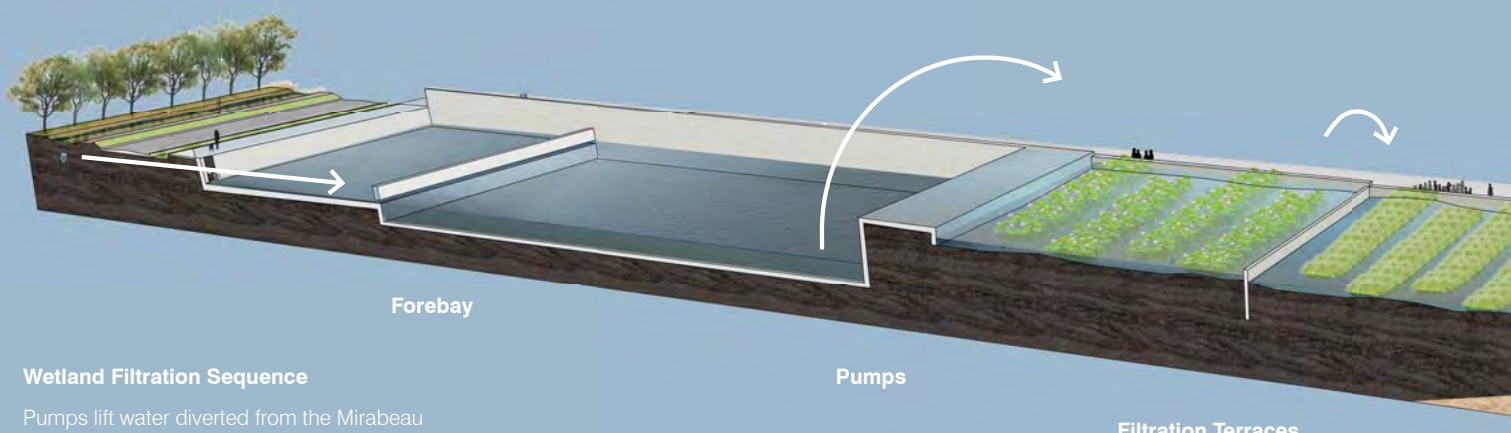
the chinampas of Mexico, beds of willow trees alternate with navigable waterways, providing space for water recreation such as kayaking or paddle boarding. The willow grove collects water from the southern edge of the site before overflowing to the woodland wash.

The southern half of the site and its athletic fields are designed to function as detention basins in case of extreme rainfall. Because the Pine Island Beach Trend, a sand layer, underlies this half of the site, large volumes of stormwater will be able to infiltrate into the ground.

Buildings are arranged along a series of channels that catch runoff and convey the water to the woodland wash, which winds around the high ground that marks where the convent's main building once stood, the woodland wash is excavated lower than the rest of the site, so that it can collect excess stormwater and reveal the groundwater that exists close to the surface of the site. Shaded by existing and newly planted trees, one can walk along the woodland wash and catch glimpses of buildings at the northern end of the site and athletic fields to the south. As water nears the end of the woodland wash, it winds around the CSJ memorial. Any excess water that the site cannot safely manage passes over a weir at the northern end of the woodland wash, through the existing oak grove, and re-enters the subsurface drainage system at the northeastern corner of the site.

**Plan Key**

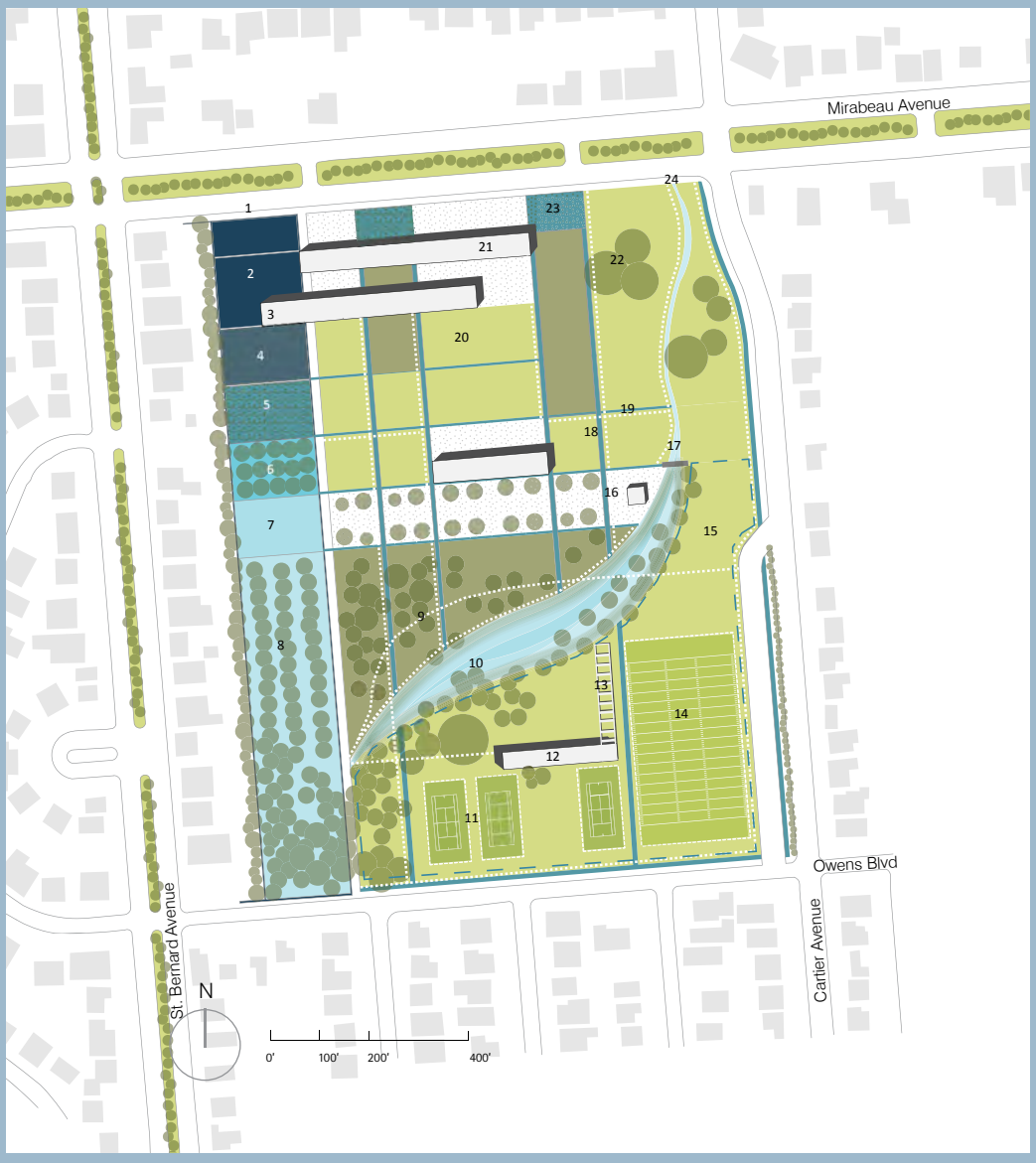
1 Inlet from Mirabeau Avenue Trunk Line
2 Forebay
3 Pumps
4 Lily Filtration Pond
5 Reeds & Tall Grass Filtration Pond
6 Cypress Filtration Pond
7 Swimming Pool
8 Cypress & Willow Grove
9 Pathways
10 Woodland Wash
11 Athletic Fields and Courts
12 Field House & Seating
13 Shaded Terrace & Seating
14 Football Field
15 Excavated Zone for T10+ Storage
16 Memorial
17 Weir
18 Vegetated Bioswales
19 Concrete-Lined Channels
20 Grass Lawn
21 Classrooms and Additional Programming
22 Existing Oak Grove
23 Rain Garden
23 Outlet to Mirabeau Avenue Trunk Line



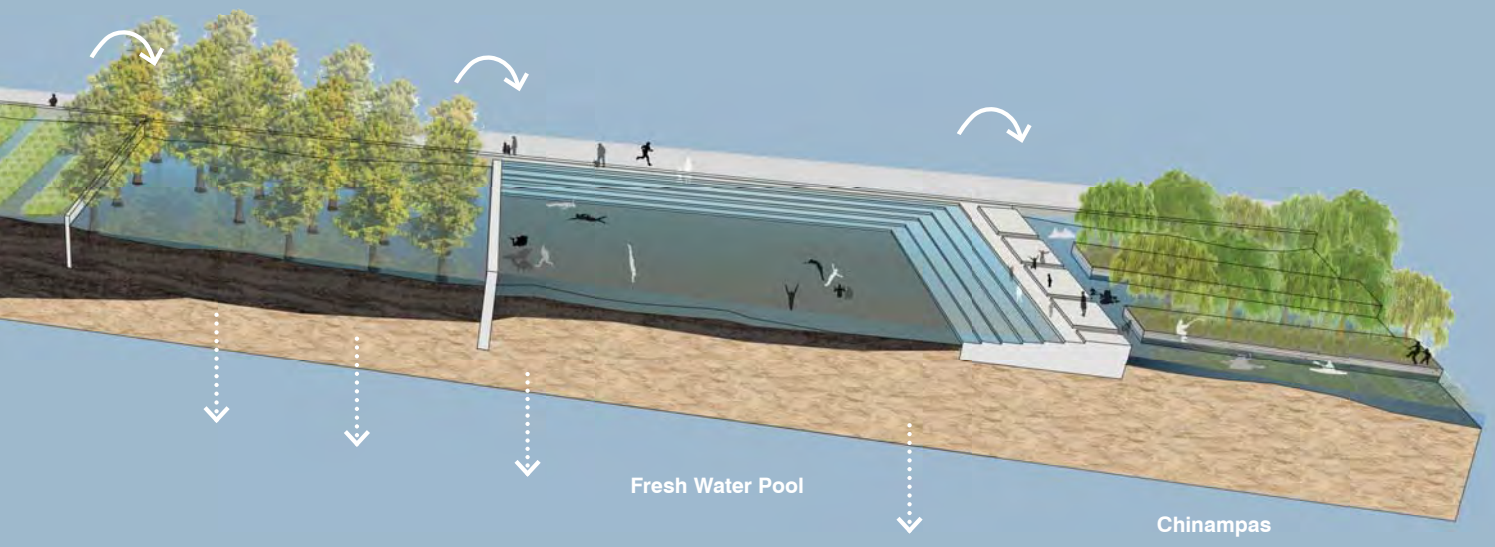

**Wetland Filtration Sequence**

Pumps lift water diverted from the Mirabeau Trunk Line into a constructed wetland filtration sequence. The terraces infiltrate water into the soils below, and provide habitats for wetland species plants and organisms that play an important role in filterinng stormwater before it flows into a freshwater swimming pool.

Water Levels

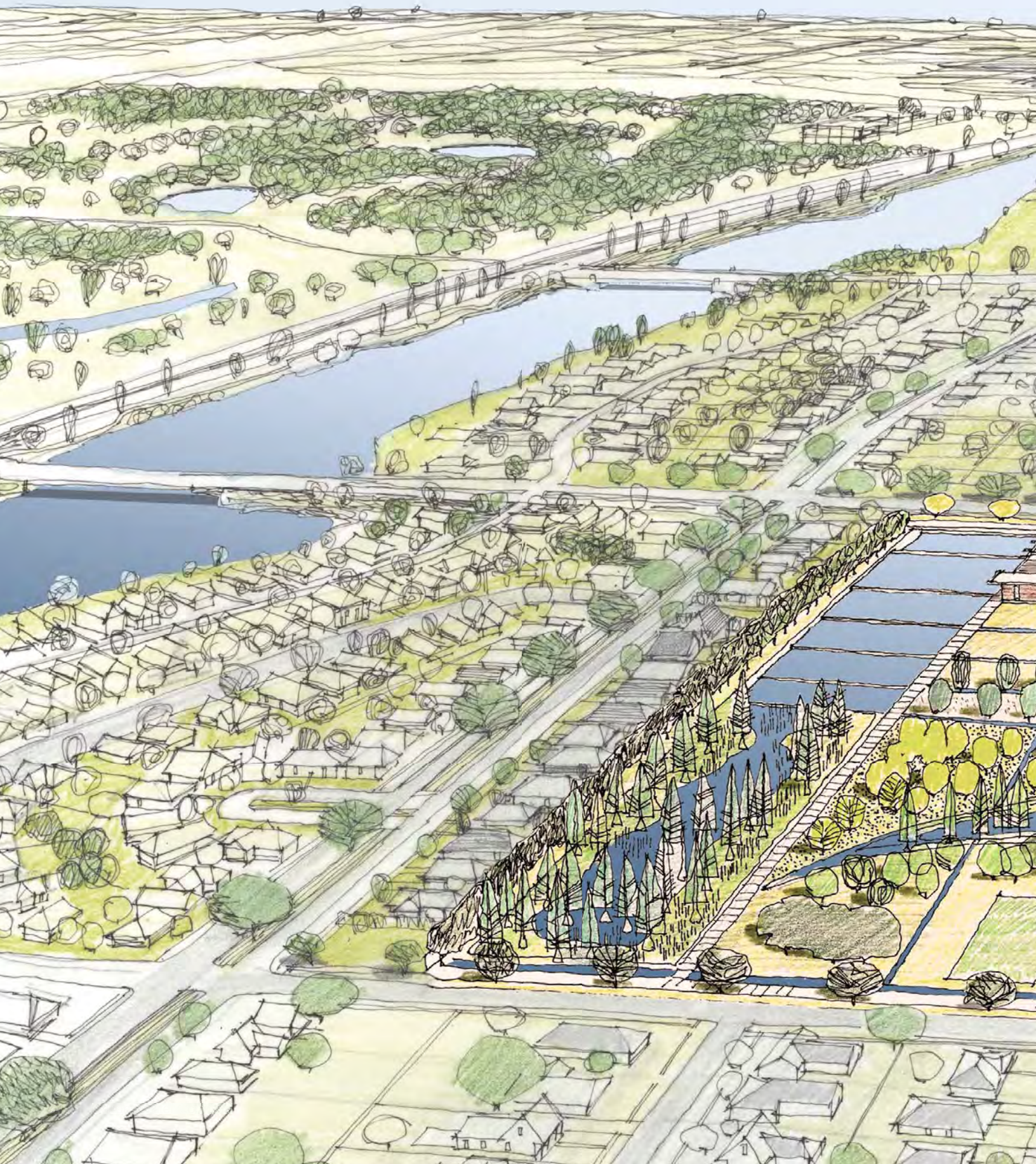


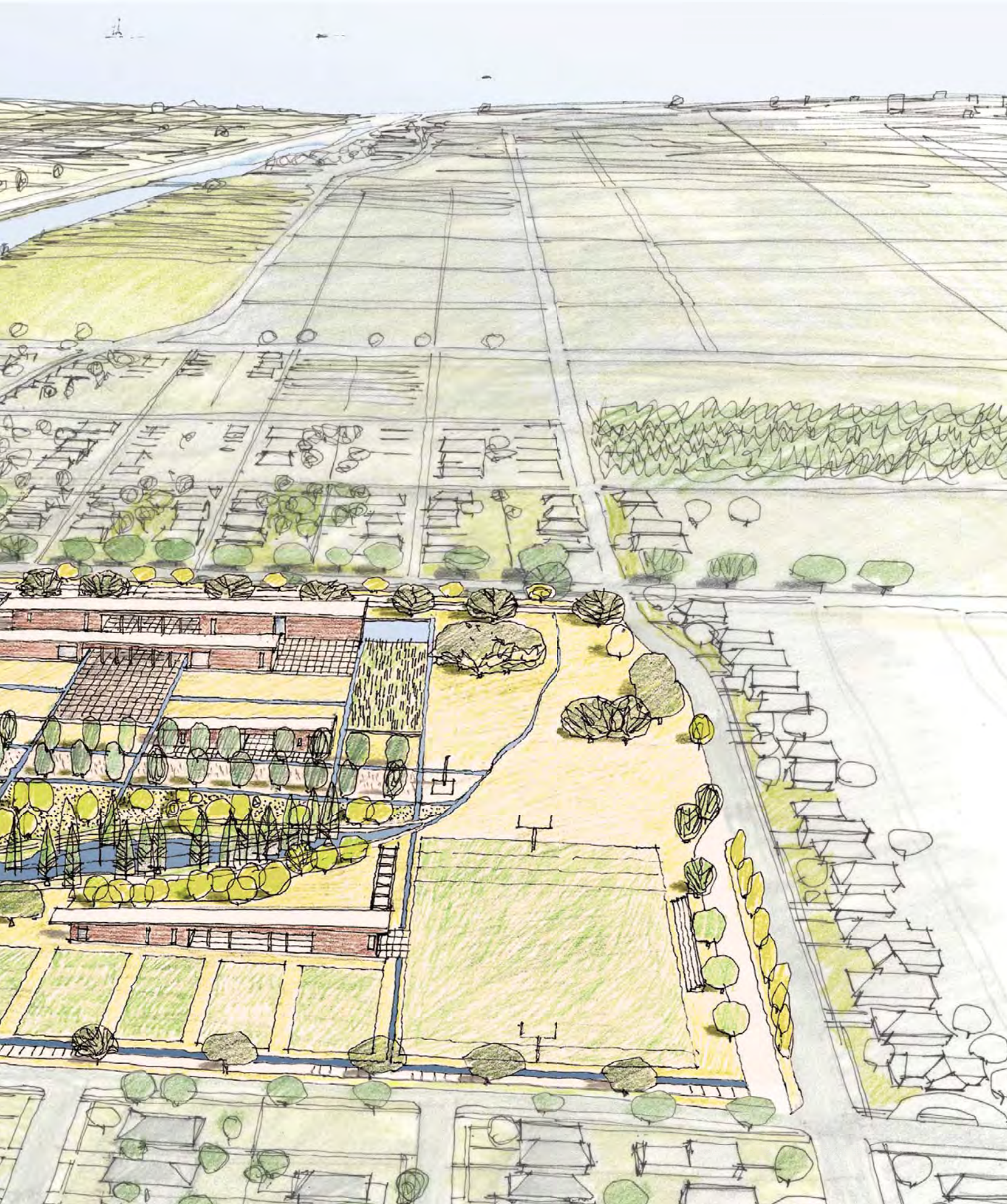

Mirabeau Water Garden Plan



# Mirabeau Water Garden

The Mirabeau Water Garden, in the Filmore neighborhood next to Bayou St. John, will serve as a model for water management in the lowlands.





# Claiborne to Inner Harbor

Splitting drainage at the Gentilly Ridge means that runoff from the French Quarter, Treme, Seventh Ward, and Upper Ninth Ward will be diverted along the Claiborne Corridor into the Industrial Canal, rather than flowing toward the lake as it does now. This new flow pattern brings water into the Desire Parkland, a broad open area with the capacity to store and filter thousands of acre feet of runoff and also to drive reinvestment in surrounding neighborhoods.

Expanded pumps at the eastern edge of the Desire Parkland lift stormwater into the Industrial Canal and Gulf Intracoastal Waterway, a new center for industry, innovation, and waterfront development.


**Pumping to Bayou Bienvenue**

The 1895 Drainage Master Plan proposed pumping stormwater along a primary outfall canal at the northern edge of the city out towards Bayou Bienvenue and Lake Borgne to the east, rather than towards Lake Pontchartrain.

Image courtesy of the Historic New Orleans Collection


1 Claiborne Avenue Canal forms the backbone to the Pump to the River concept, draining water to the west through the Monticello Canal and to the east through the Florida Canal and Industrial Canal.

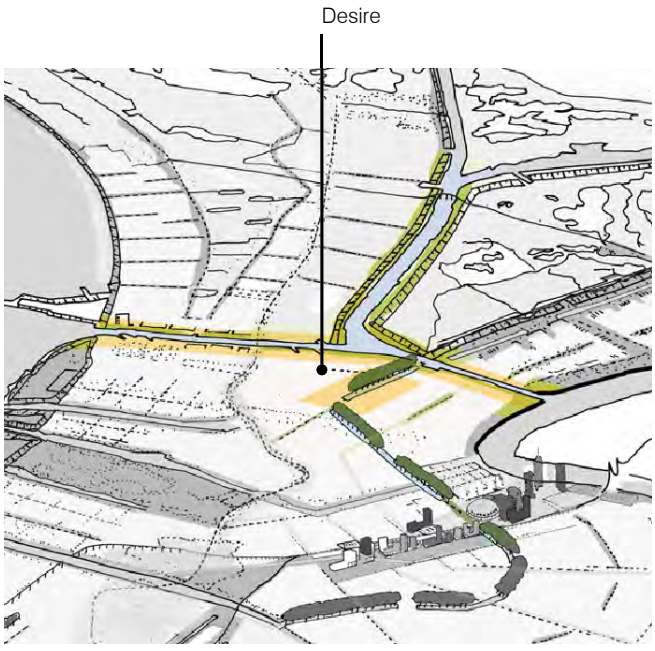
2 Expansion of the Florida Avenue Canal and the development of the **Desire Parklands** can expand the drainage system's capacity and provide the surrounding neighborhoods with new recreational and ecological amenities.

3 The **Inner Harbor** can be a site for waterfront residential, commercial, and industrial development, with ready access to downtown, the riverfront, lakefront, and local wetlands.

# Desire Parklands

## Isolated by the highway and railroad from vital services, the Desire District and the Florida Avenue Canal have the potential to store water and create a new center for reinvestment, connection, and neighborhood activity.

- Reconnect the Desire District to the rest of the city through streetscape improvements and new crossings over utlities and drainage canals.
- Widen the Florida Avenue Canal for greater capacity, and provide public access and programming along canal banks.
- Revitalize neighborhoods on either side of the Florida Avenue Canal through investments in infrastructure, open space, and drainage improvements.

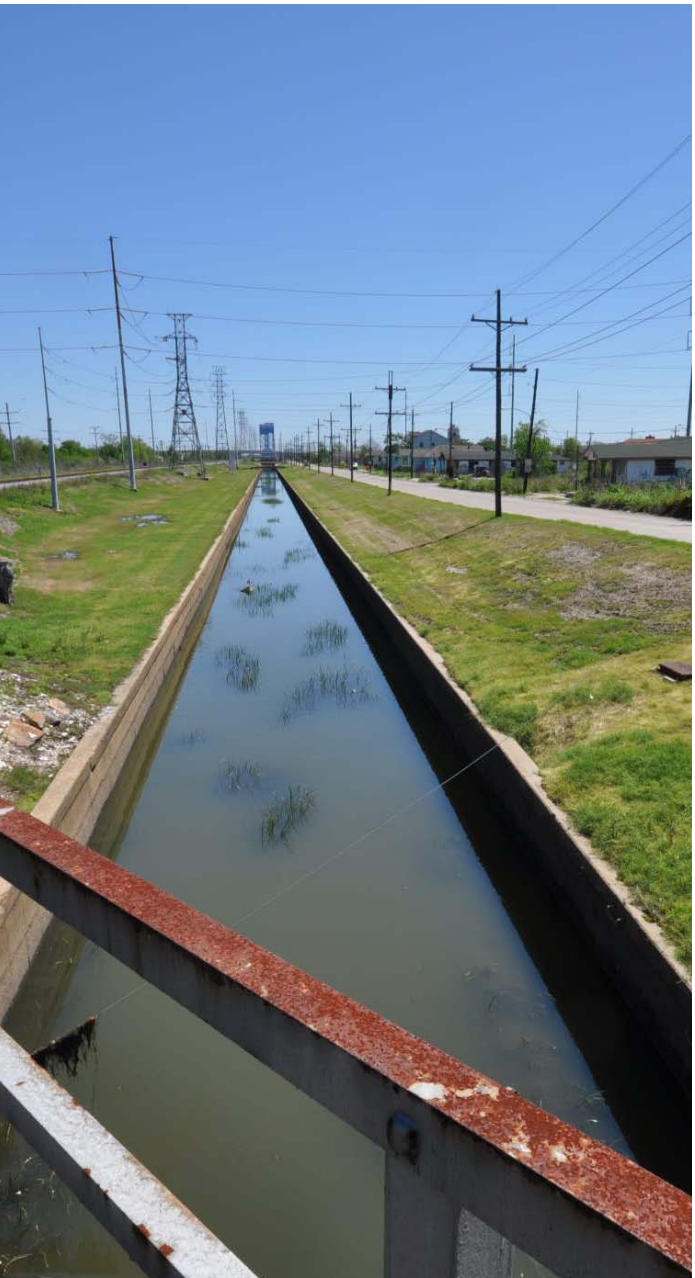



Interstate 10, railroad tracks, the Inner Harbor Navigation Canal, and the Florida Avenue Canal effectively isolate the Desire District from the rest of New Orleans. The Agricultural Landfill occupied the western edge of Desire; the landfill has caused significant health issues for residents and was eventually declared a Superfund site. The former landfill has been remediated, but vacancy and blight still plague the area.

The Florida Avenue Canal is a vital component of the Urban Water Plan. With the proposal to split drainage at the ridge, using the Claiborne Corridor to divert runoff from the backslope of New Orleans to the Industrial Canal and away from the lake, the Florida Canal becomes a critical conduit for stormwater from west to east. The existing canal is 25 feet wide but can expand to 100 feet in width for increased capacity in anticipation of the larger volumes of water that will flow through the canal.

In addition, the canal can be transformed from a single concrete-lined canal into a braided network of channels that pass through a broad wetland habitat. Vegetated edges filter water as it travels downstream and arrives at a lake. Bridges span the braided network, and pathways allow access onto islands within the corridor. Day-to-day, the canal offers recreational amenities in the form of open parklands and within the braided channels and constructed wetlands. Additionally, two large lots along the northern edge of the corridor offer additional relief for the Desire District; they become large storage basins during intense rainfall.

The expansion of the Florida Canal and the creation of this new strategic parkland around this canal can transform the area. The former landfill will receive an additional topping layer from excavated soils, and additional tree plantings can transform the area into a wooded park with pathways for recreation and pedestrians. New water features along the edges and integrated into the Desire Parklands will anchor sites for commercial and residential redevelopment.

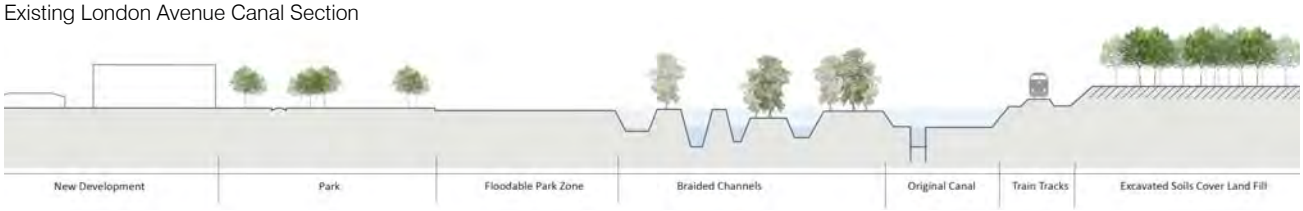


**Existing Landscape**

The highway, railroad, and Florida Avenue Canal isolate Desire District from the rest of the city, exacerbating long-term disinvestment. The Florida Avenue Canal is an important drainage corridor, but neglected as a potential public asset where investments in infrastructure can help improve connections to other neighborhoods and spur reinvestment.

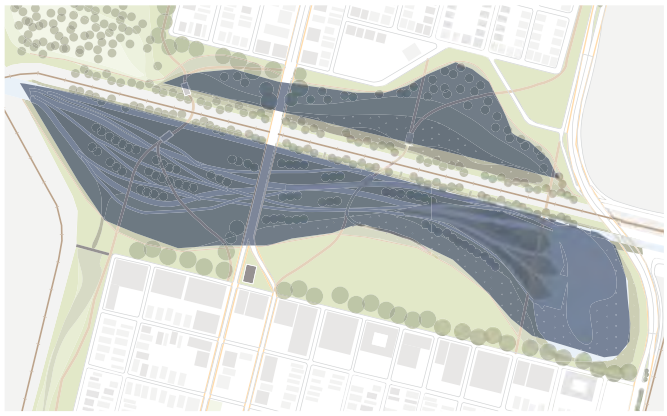

Desire Parklands Plan

Existing London Avenue Canal Section




Proposed London Avenue Canal Section

Sections are exaggerated vertically by a factor of 10.



T10 Storm Floodable Zone

**Desire Parklands**

The Florida Avenue Canal can become a wetland habitat. Braided channels weave between vegetated islands, forming a natural filtration train. The braided channels empty into a lake, which serves as a forebay from which stormwater is pumped into the Inner Harbor. Pathways and bridges connect the Florida and Desire neighborhoods to the waterfront park and to each other. Crossing the canal, one passes through zones of new tree plantings and open lawns, with space for recreation and accessible waterfronts. On the river side of the canal, three blocks of housing are relocated to accommodate the widened canal.

Investments in the canal can spur redevelopment on either side of the canal. Louisa Street, a major thoroughfare, connects the two neighborhoods on either side of the canal and can become a key commercial corridor for the area.

Existing Vacant and Blighted Properties

abandoned/blighted
from AnneMarieJohnMonnat Survey

vacant
from GIS exports, AnneMarieJohnMonnat Survey

NORA available
from GIS exports

# Inner Harbor

Once a popular place for people to view passing ships, the Industrial Canal can once again become an important place for public life and the growth of the region. Protected by new flood protection closure structures, the Inner Harbor's existing port facilities, infrastructure, industrial installations, and nearby wetland restoration efforts can be the basis for new forms of eco-industry and development.

The idea of connecting the lake to the river harkens back to the original siting of New Orleans. The vision finally materialized in the 1930s with the construction of the Inner Harbor Navigation Channel, more commonly known as the Industrial Canal. A lock at the river allows watercraft to safely change in surface elevation between the river and the lake. Slips and docks support regional industry and commerce. Currently, concrete floodwalls line the edges of the canal, blocking visual and physical access from surrounding neighborhoods.

Now protected by the Seabrook Floodgate Structure, the Inner Harbor presents opportunities for new kinds of waterfront development. At the lakefront, the western edge can support mixed-use development with residences, marinas, and shops. On the eastern edge, industrial development can be connected to the urban fabric beyond.

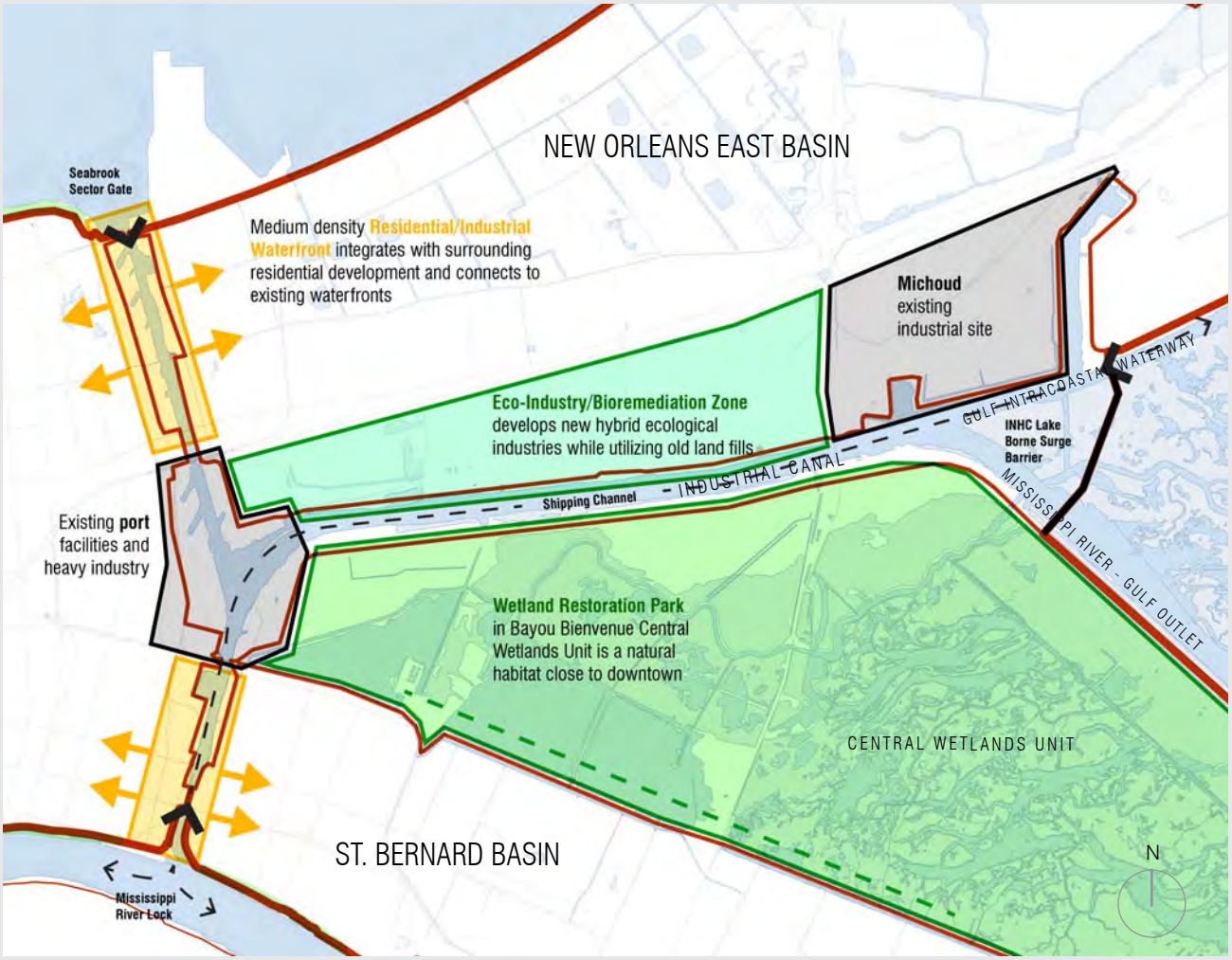
Running between New Orleans East and the Central Wetlands Unit, the Gulf Intracoastal Waterway can support new eco-industry development zones, formed out of remediated landfill sites. To the south, the Central Wetlands Unit can become a wetland restoration park and vital habitat that provides unique recreational and ecological amenities to the whole region.

At the riverfront, improved public access to the Inner Harbor can strengthen the identities of and the connections between the Upper Ninth Ward and the Lower Ninth Ward.

**Carving a Pathway**

Constructed in the 1930s, the Inner Harbor Navigation Canal completed the vision of creating a navigable channel between the river and the lake.

Image courtesy of the U.S. Army Corps of Engineers




Inner Harbor Development Zones

**Industrial Canal**

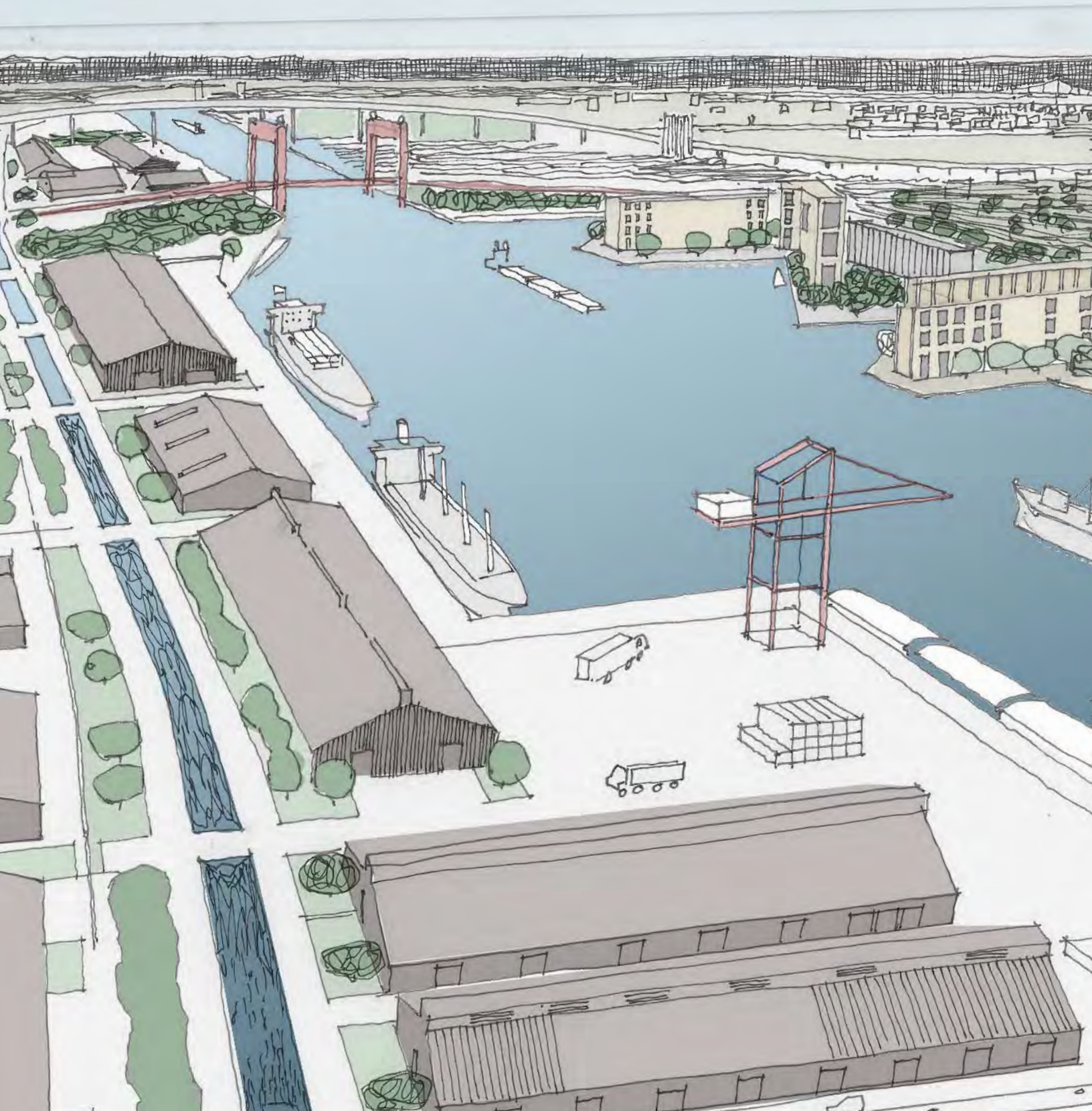
A view of the canal today in Gentilly reveals an industrial waterfront inaccessible to neighborhoods beyond.

**Waterfront Property**

The Inner Harbor presents an opportunity for waterfront living within the confines of the federal levees and floodwalls.

# Inner Harbor

The juncture of the Industrial Canal and the Gulf Intracoastal Waterway is important to the regional hydrology and economy. Its existing industrial facilities and proximity to both business centers and wetland restoration zones provide opportunities for redevelopment and innovation in industry and ecology.



# Uptown to Bucktown

The Garden District, Central City, Hollygrove, and Lakeview may seem to have little in common, but are bound together by shared lines of water infrastructure. The rain that falls on Uptown Streets in backslope neighborhoods flows toward the main bowl of New Orleans, which is drained by the Palmetto Canal. This essential channel fills to the brim with every heavy rain and brings stormwater into the 17th Street Canal, where it joins with water that drains from Hollygrove and Hoey's Basin into the Monticello Canal, which follows the parish line into the 17th Street Canal. In the lowlands, stormwater from Lakeview also joins this torrent of water on its way to the lake.

While the Pump to the River proposal would redirect the flow of backslope runoff towards the river, small retrofits and storage features that are feasible today can reduce flooding and improve groundwater balance. The Claiborne Corridor forms the backbone for Pump to the River, linking to the Florida Avenue and Monticello Canals.

**New Basin Canal**

The New Basin Canal c. 1948; filled in for the construction of West End Boulevard

Image courtesy of U.S. Army Corps of Engineers


1 Streets along the backslope in the **Uptown District** can slow and hold water with features like rain gardens and pervious paving.

2 The **Hollygrove District** proposal combines retention strategies for a safe and attractive district. A proposed expansion of the Monticello Canal reduces flood risk for the neighborhood.

3, 4 In the **Lakeview District,** streets are reconstructed as **Lakeview Floating Streets** that store stormwater in the roadway subbase and in curbside bioswales, while conveying excess water towards large storage areas.

5 The **17th Street Canal** can offer waterfront real estate and create a positive identity and shared amenity for adjoining neighborhoods.

# Uptown Streets

## Slow stormwater runoff from the high ground to prevent localized street flooding and flooding further downslope.

- Slow flow of water down the backslope to prevent flooding in the bowl
- Prevent localized flooding
- Provide additional storage capacity to detain and retain stormwater before it enters the drainage system
- Create attractive streetscapes, lessen paving, and increase street vegetation

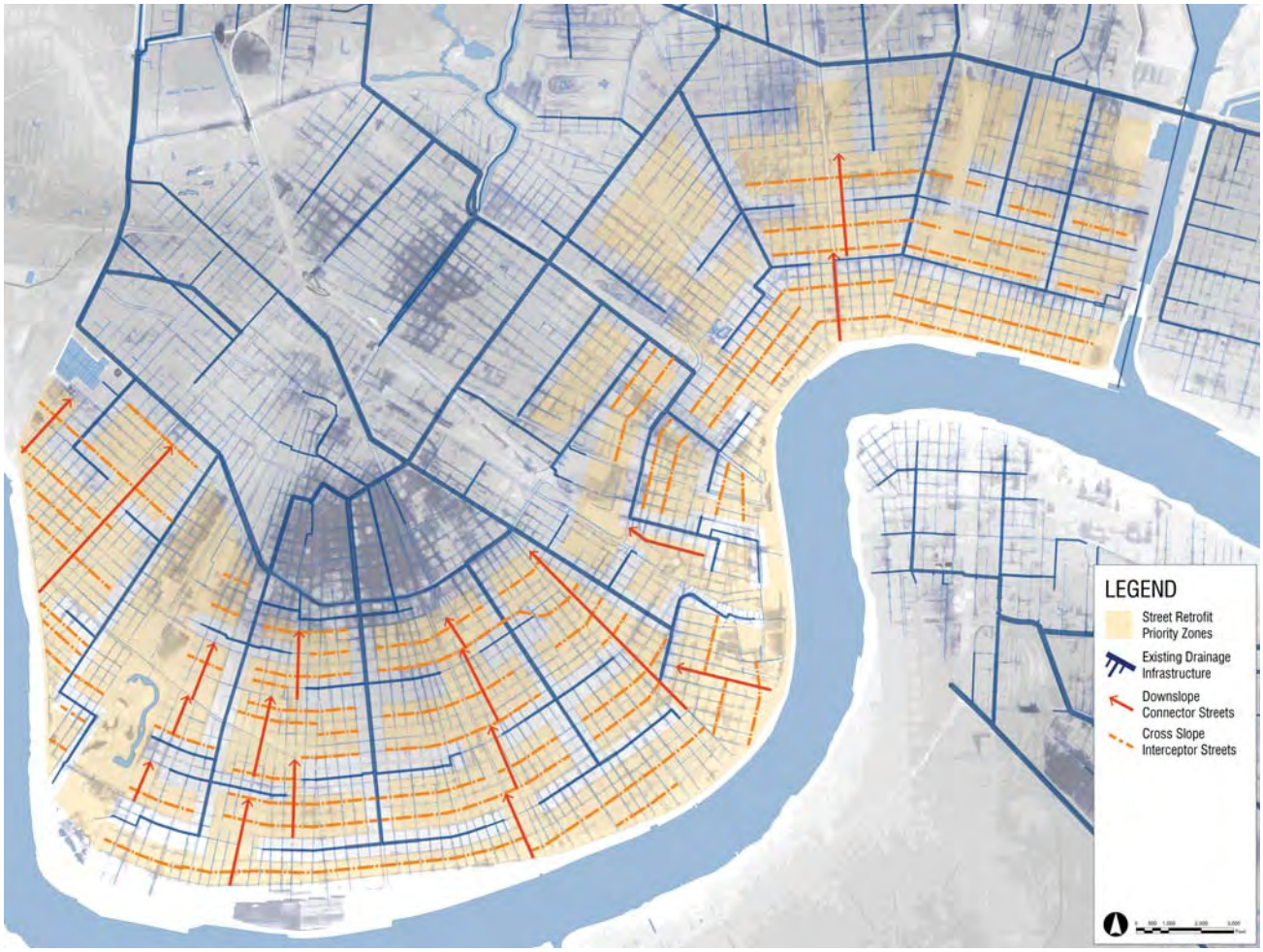

The Uptown Streets Design District is a section of Uptown New Orleans that extends from the river to the bowl, from Louisiana to Jackson Avenues. It is representative of the region's historical high ground and is a highly urbanized area, so that solutions for this district are applicable for similar areas adjacent to the Mississippi River. As rain falls onto rooftops and flows into nearby streets, it enters directly into streetside catch basins. With high runoff volumes, the drainage system is often overwhelmed, both on the backslope and further downslope, resulting in flooding that disrupts everday activities.

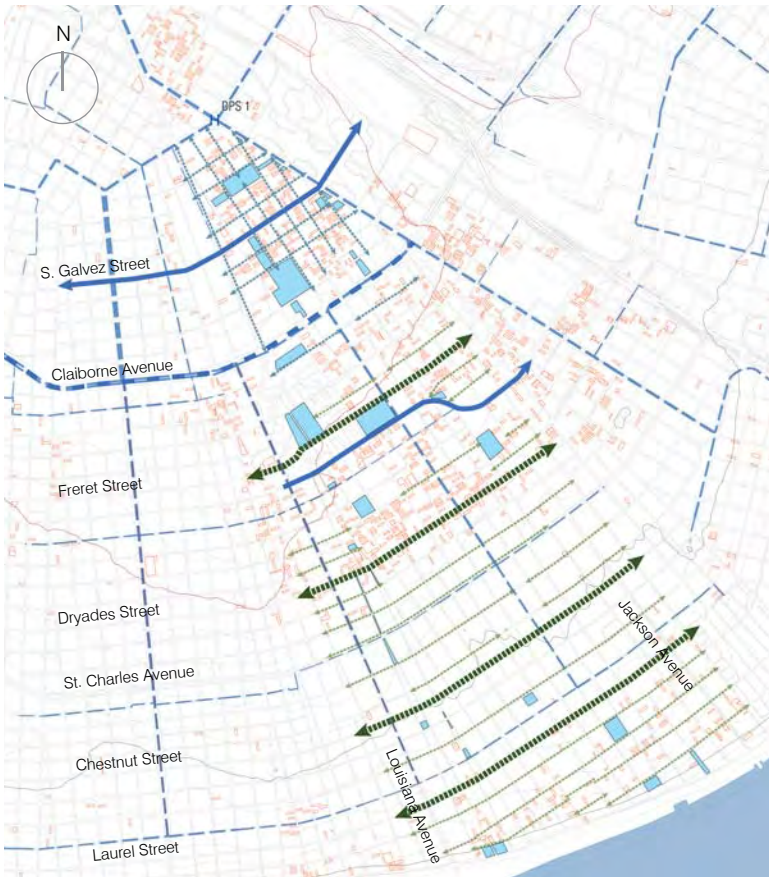
Streets following the river's curve can form a series of terraces perpendicular to the slope of the land away from the river. Each of these "interceptor streets" delays and stores stormwater, preventing some flow of water downslope and into the bowl. Features such as curbside rain gardens integrated into these streets expand their storage capacity. Water infiltrates into the ground through the porous bottoms of rain gardens or reenters the atmosphere through evapotranspiration, which aids in lowering ambient air temperatures. Rain gardens are designed to benefit the live oaks that are characteristic of Uptown streets, giving tree roots more space to grow, and a source of water each time it rains. Additionally, streets can be reconstructed with pervious pavement or pavers, allowing water to seep through to soils below. Measures taken upslope to reduce runoff helps to prevent system overflows downsope. This improves drainage bowl neighborhoods as well.

Within the bowl, the design measures discussed above can also offer relief from localized flooding. Rain gardens flanking both sides of the street make space for water and are aesthetic improvements to streetscapes. Subsurface storage chambers hold even more water and allow water to seep into surrounding soils. These improved streetscapes ease the load on drainage systems downstream, specifically the Palmetto and 17th Street Canals.

**Existing Landscape**

Overwhelmed systems lead to localized street flooding on backslope streets and in the bowl, but small scale retrofits on the backlsope can alleviate both street flooding and pressure on the drainage system downstream.




Target Areas for Interceptor Streets

**Uptown District**

A range of retrofits becomes adaptable geographically. On the backslope, new water retention features can be strategically placed near the top and edges of catchment areas to slow and store as much stormwater as possible. These interceptor streets, shown in green at left, are chosen because they do not have any subsurface drainage, sewerage, or water mains. Whenever possible, utilize vacant and blighted properties, neutral grounds, and open spaces for additional storage. In the bowl, large open spaces can be utlized to store water and allow infiltration. Because the bowl is prone to flooding, additional mitigation measures such as the raising of homes are necessary to minimize repetetive losses.

Interceptor Street

New Surface Canal

Existing Subsurface Canal

Potential Water Storage Area

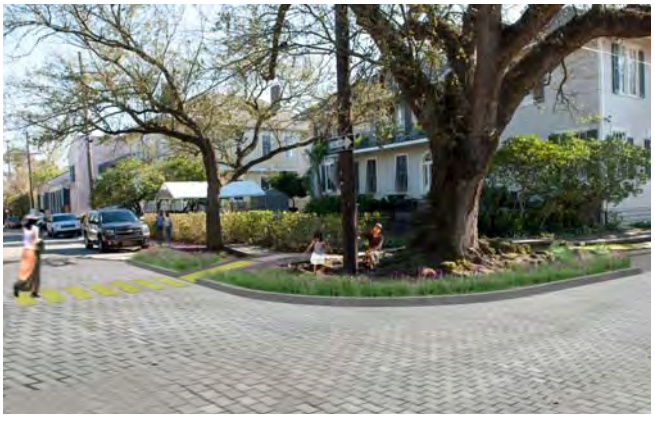
Blighted Property

**Typical Uptown Streets**

Above: Uptown streets on the backslope can be redesigned to slow and store stormwater to help reduce local flooding. Rain gardens flank both sides of the street and connect to subsurface storage chambers. Additionally, pervious pavers allow water to infiltrate soils. Where there are unnecessary parking spaces, rain gardens can be inserted.

Right: Pervious paving increases infiltration on the backslope, easing flooding further down slope. An alternative to pervious concrete is a system of precast, articulated concrete paver mats, which are easier to install and repair than permeable concrete and have been tested by the Department of Transportation in northeastern United States.

Below: Precast Permeable Paver Mats



Existing Canal, Dry Weather

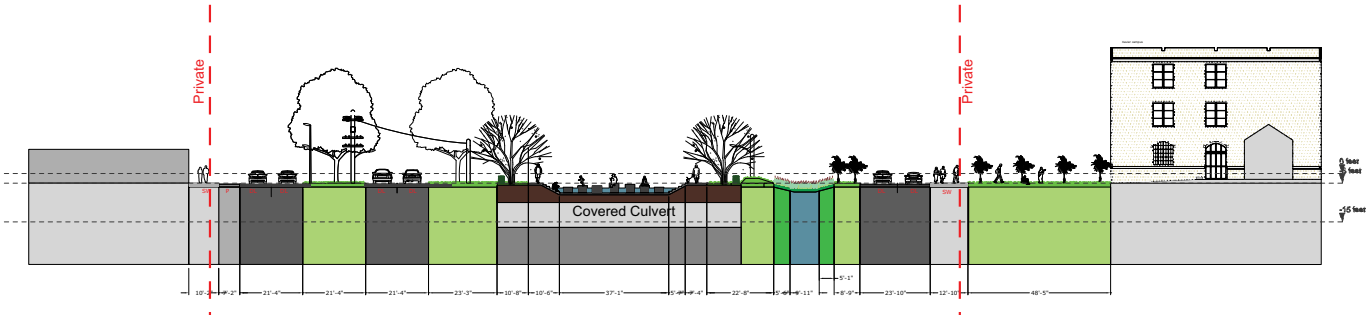
Existing Canal, Wet Weather

**Palmetto Canal at Washington Avenue**

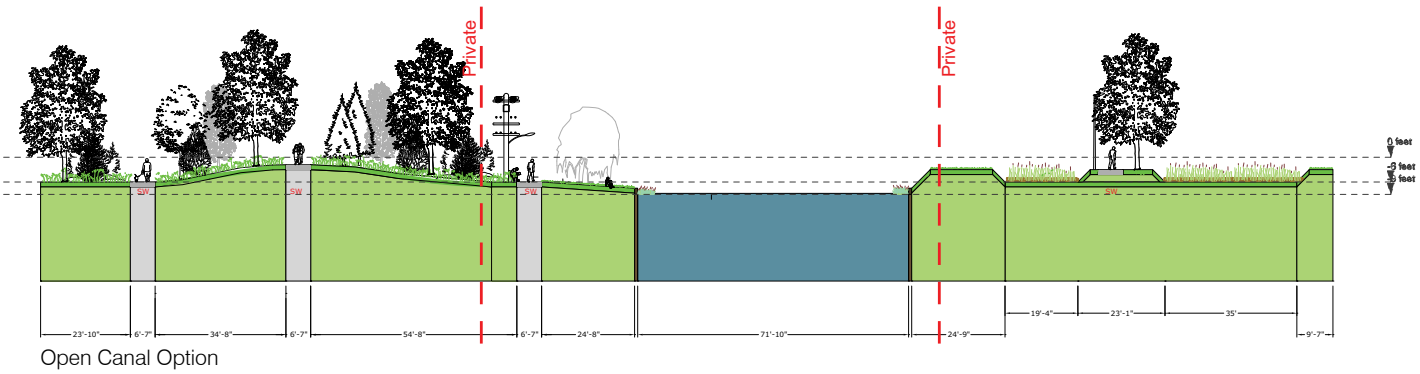
The Palmetto Canal is one of the most visible elements of water infrastructure in Greater New Orleans but serves as a barrier rather than a place for public life. What is now a wide barren cut through the city can become a public asset like Bayou St. John, and an amenity for Broadmoor, Gert Town, Hollygrove, and Xavier University.

This opportunity reflects the interconnected nature of watersheds and water systems. Slowing runoff from the backslope in Uptown New Orleans, with water management elements on interceptor streets, is one of the necessary improvements that makes the transformation of the Palmetto Canal from a concrete ditch into a beautiful waterway possible.

One design solution is to create a new landscaped surface that covers a box culvert in place of the existing Palmetto Canal. This solution provides a recreational space for Xavier University students and nearby residents. A related proposal would utilize the proposed Claiborne Canal as the major discharge canal for Uptown New Orleans, thereby lessening the load on the Palmetto Canal. The Palmetto Canal can then become a beautiful open waterway and public amenity in the heart of the city.




Covered Canal Option




Open Canal Option

Existing: Palmetto Canal at Xavier University

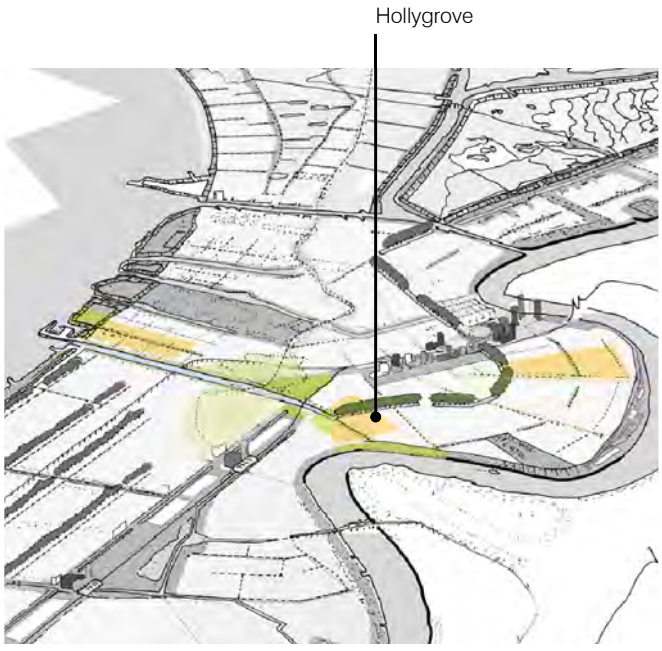

Covered Canal Option

Open Canal Option

# Hollygrove District

Hollygrove and the Monticello Canal present the opportunity to strengthen this corner of Greater New Orleans with neighborhood water features and a new strategic parkland.

- Improve the function and appearance of the Monticello Canal
- Revitalize nearby neighborhoods with new developments along the Monticello Canal and Airline Highway
- Reconstruct streets to slow and store stormwater
- Design the Monticello Canal Park as a regional amenity that makes use of vacant land alongside the canal




Bounded by Airline Highway to the north and Claiborne Avenue to the south, the Hollygrove District is composed of single-family residential blocks and commercial properties on major streets. Hollygrove is situated in the bowl, between the Monticello and Palmetto Canals. Uneven levee heights on the two sides of the Monticello Canal is a potential source of flood risk for Hollygrove, while subsidence has damaged streets and subsurface drainage infrastructure. Additionally, the area lacks an extensive tree canopy.

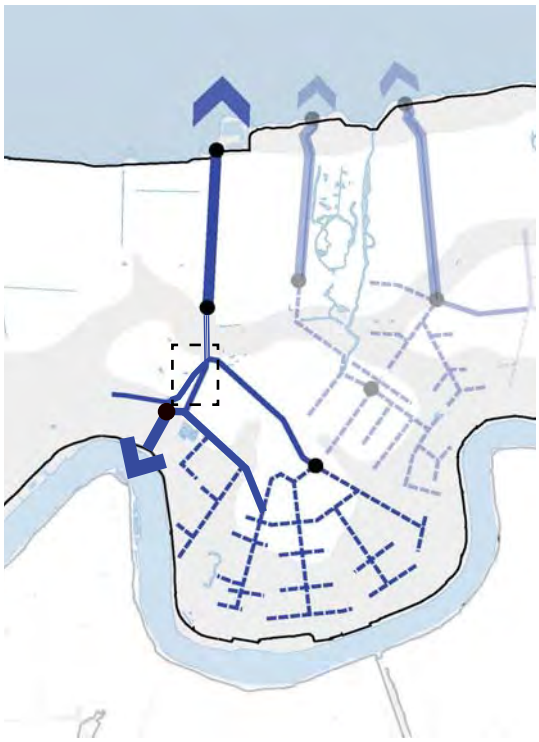
The Hollygrove District proposal promotes access to water, improved street design, increased vegetation, an improved tree canopy, pedestrian amenities, and revitalization of commercial and public spaces. The design provides the district with additional water storage both internally and in the Monticello Canal zone, in order to reduce localized flooding. The proposal also includes spaces for urban agriculture, which is already and important part of Hollygrove's identity in the form of the Hollygrove Farm and Market.

Hollygrove's vacant and blighted properties can be aggregated to form blue and green corridors for slowing, storing, and infiltrating water. The addition of streetside bioswales, filled with water-loving vegetation and trees, adds shade and water retention features to neighborhood streets.

The larger district plan combines these vacant lots in four larger catchment zones. When necessary, these catchment zones drain to the Monticello Canal. A widening of the canal and new levees of equal height and strength on either side of the canal can allow for the development of floodable agricultural and recreational parkland between the levees. This strategic parkland at the parish line can benefit neighborhoods and businesses on both sides. Widening the Monticello Canal where space is available is crucial because of the need to relieve pressure on hydrologic bottlenecks where the canal intersects the railroad and Airline Highway, and also because the Pump to the River proposal splits drainage at the Metairie Ridge. This means that stormwater from the backslope is redirected towards the river via the Monticello Canal instead of towards the lake via 17th Street Canal.

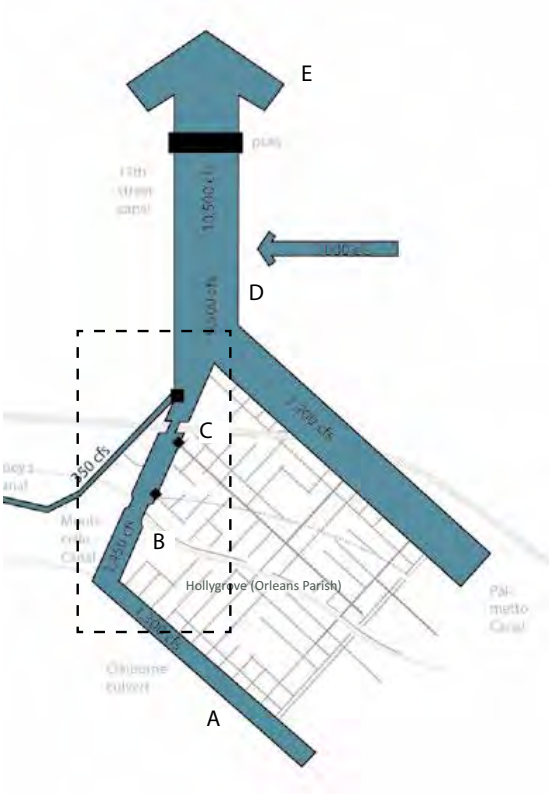
**Existing Landscape**

Hollygrove suffers when a overburdened Monticello Canal prevents the neighborhood from draining properly. Additionally, subsidence damages streets and subsurface infrastructure. Improving streetscapes, utilizing vacant lots, and enhancing the Monticello Canal can address both problems.



**Split at the Ridge**

The Uptown to Bucktown drainage system splits at the ridge along the Monticello and 17th Street Canal connection.




**Existing Monticello Canal Diagram**

Palmetto and Monticello Canals converge at the 17th Street Canal, which conveys stormwater towards Lake Pontchartrain. Two bottlenecks in the Monticello Canal can overburden sections of the canal.

**Monticello Canal Park**

The proposed Monticello Canal design transforms the area into a floodable landscape between the levees with the capacity to store and convey stormwater that is redirected into the canal from the backslope of both Jefferson and Orleans. The new canal park features multiple water storage compartments which fill sequentially during rain events. The park becomes:

- a park connecting from Airline Highway to the river, with overlooks at the intersection of the Monticello Canal with the Palmeeto and 17th Street Canals and key roadways
- a light rail stop along the potential Airline Corridor into downtown
- a new bridge into Hollygrove and safe passageway under Airline Highway
- an area for urban agriculture
- a water filtration zone with educational features


Monticello Canal Park Plan

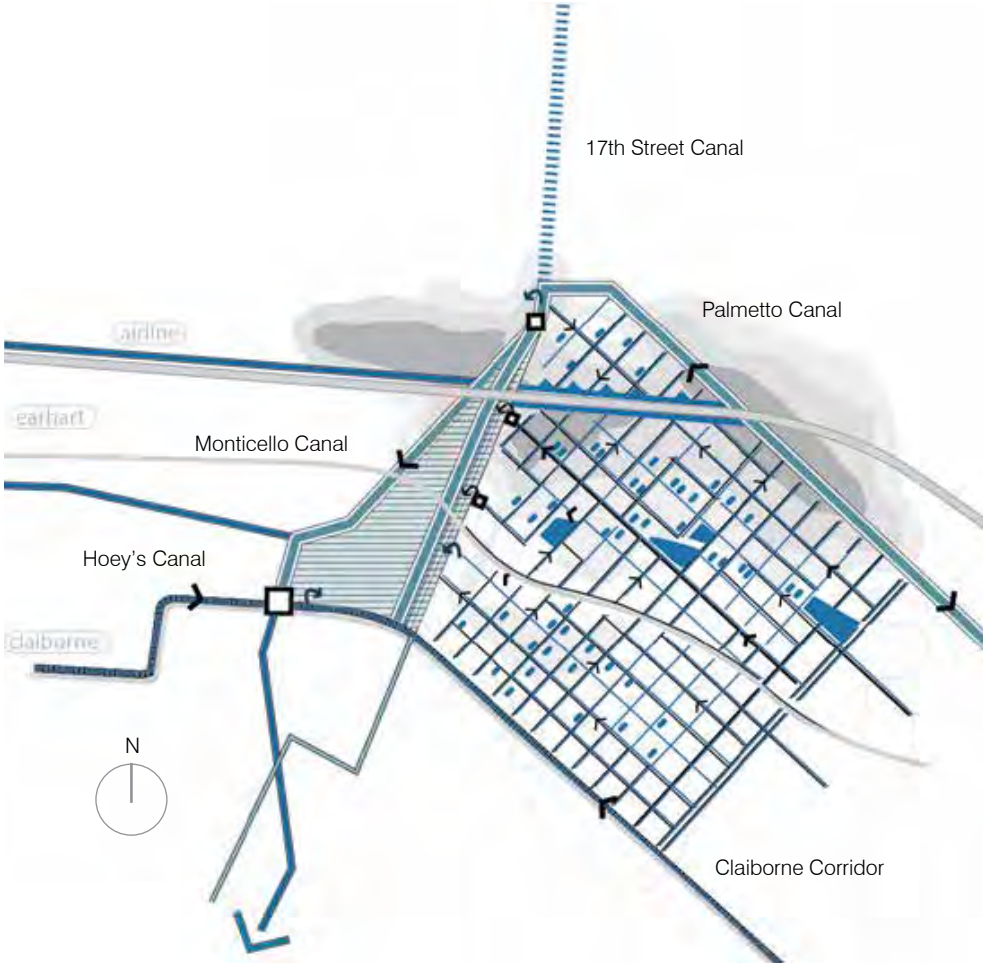
Dry Condition


Light Rainfall

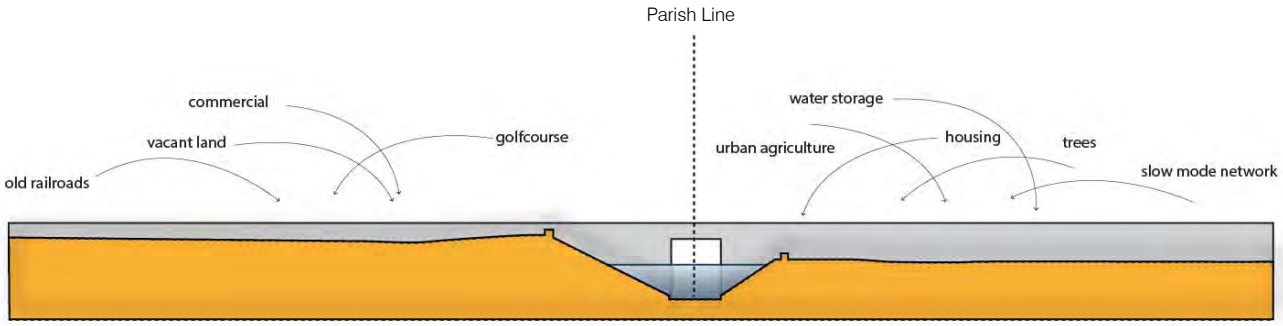

Heavy Rainfall

**Hollygrove District Plan**

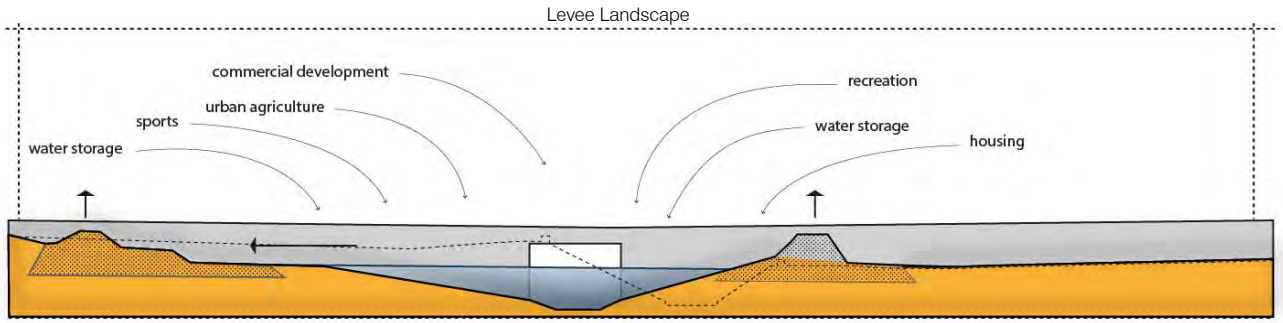
Water collects in roadside bioswales and vacant lots for retention and infiltration. Excess water flows to the Monticello Canal Park.




Hollygrove District Plan




Existing Monticello Canal bottleneck

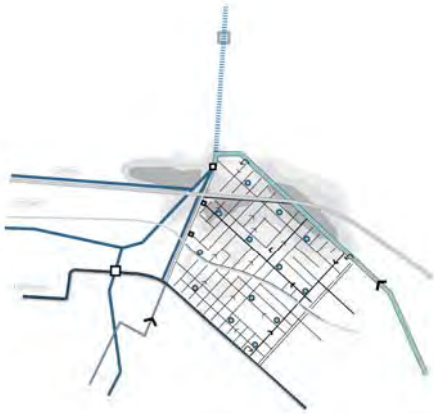



Proposed Monticello Canal expansion


**Existing Condition**

### District Goals

Goals for the Hollygrove District include improving the drainage system as well as neighborhood spatial quality, using vacant lots and open spaces to provide water storage, and enhancing the tree canopy. Improving the Monticello Canal will benefit residents, both in terms of drainage and in terms of public amenities.



**Dry Condition**

Groundwater recharge wells infiltrate stormwater to maintain groundwater balance.


**Light Rainfall**

Vacant lot corridors and bioswales retain stormwater.

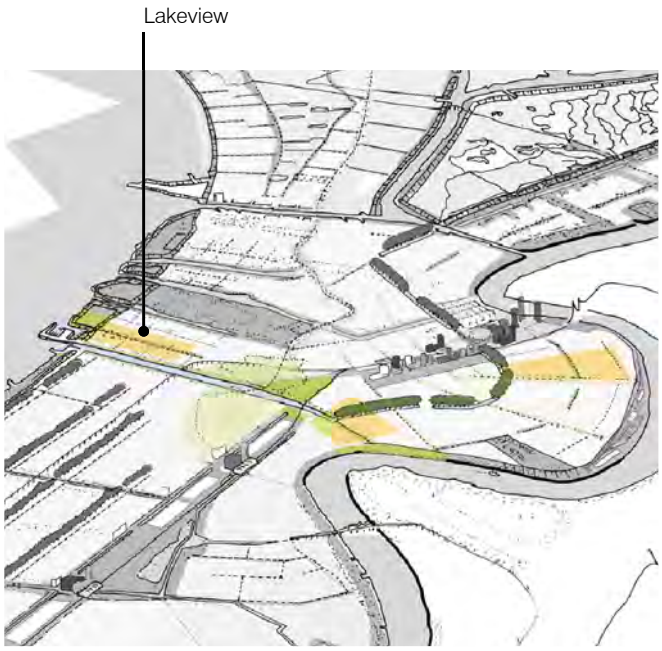

**Heavy Rainfall**

Excess overflow is accommodated within the Monticello Canal Park.

# Lakeview District

## A mostly residential lowland neighborhood offers the opportunity to design a new type of street for Greater New Orleans.

- Reconstruct streets to implement the concept of "floating streets" to safely store and infiltrate stormwater
- Plant trees throughout the district for shade and improved air quality
- Develop the West End Boulevard neutral ground as a critical component of a circulating water system
- Make water visible and attractive, creating favorable microclimates within the district
- Use 17th Street Canal retrofits such as lowering water levels and outfall canal walls to improve the western edge of the district




The Lakeview District is one of the lowest areas in New Orleans. Until the 20th century, the area had been left to nature; and it existed as largely uninhabited marshland lakeside of Greater New Orleans. The invention of the Wood Screw Pump allowed for the draining of the marshes, and the Lakeview District became the site of suburban residential development, located between City Park and the 17th Street Canal. In the last century, organic peat soils beneath the surface oxidized as they dried out. As a result, the land continuously and gradually sinks, causing damage to buildings and streets. The area's low elevation and continued subsidence have made it more vulnerable to flooding.

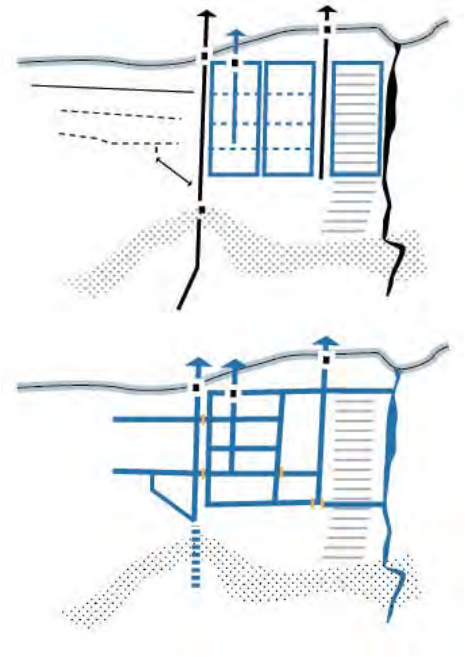
With streets in poor condition, the need for repairs provides an opportunity to conceive a new type of street for the region. For example, roadways can be redesigned as "floating streets" that slope in only one direction rather than crowned in the middle, so that water collects along one side, and traffic can flow on the high side even if the lower half of the street is flooded. In addition, roadside bioswales, pervious paving, a water-storing subbase, and perforated infiltration pipes allow the streets to safely store, filter, and infiltrate large volumes of stormwater.

Some of the floating streets serve as "outlet streets," which slope towards storage or outlet area, such as a vacant lot or to West End Boulevard's vast neutral ground.

West End, where a flourishing canal once connected to the downtown New Orleans, can become a waterway once again. Designed to hold and distribute water in many ways, the area provides for controlled flooding as well as new recreational possibilities for adjacent neighborhoods. Collected stormwater infiltrates into the ground, or flows slowly outwards toward Lake Pontchartrain. During dry weather, West End Canal Park will take water from the lake or the river, and serve as a source of water for the district's circulating water network. These measures serve to enhance the overall quality of the district by reducing flooding and slowing subsidence, and by providing new public amenities and waterfront development sites.

**Existing Landscape**

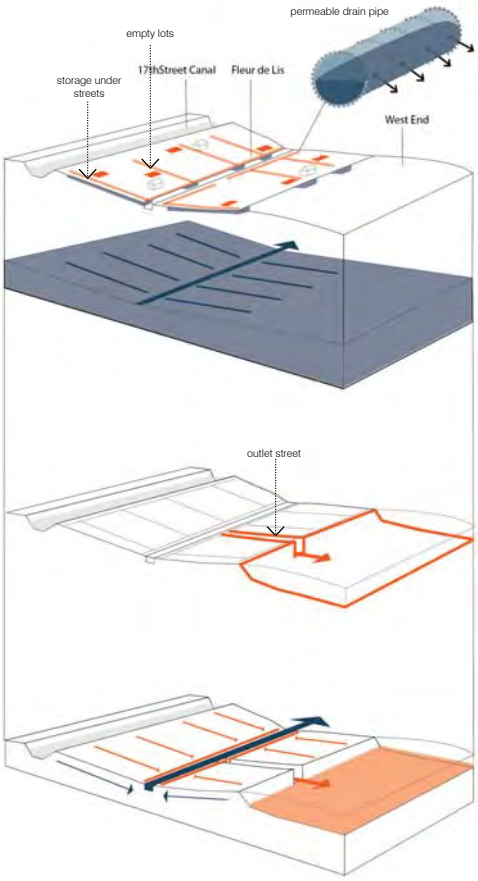
Lakeview's buckling streets and vacant lots still require substantial investments and innovative strategies. Cypress trees in low-lying neutral grounds, as seen above along Canal Boulevard, serve as positive examples of more sustainable water management strategies in lowland areas with organic soils.



**Phases for Implementing a Circulating Water Network**

Above: The proposed water system begins as separate networks. In a later phase, these can be combined into a larger network of circulating canals.

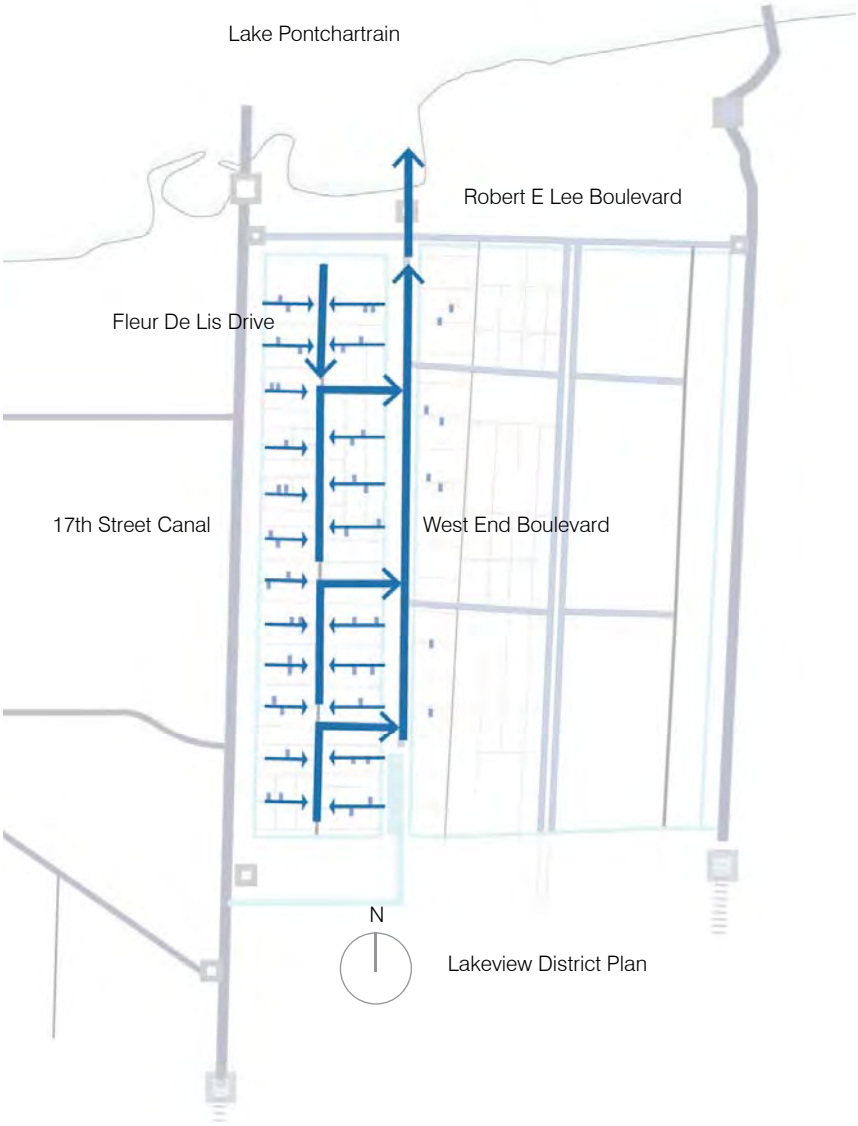
Below: The goal is to connect all streets into one circulating system that uses both Fleur De Lis and West End for additional storage.




Combine surface and subsurface systems

Outlet streets convey water to West End

Surface drainage




**Lakeview District Plan**

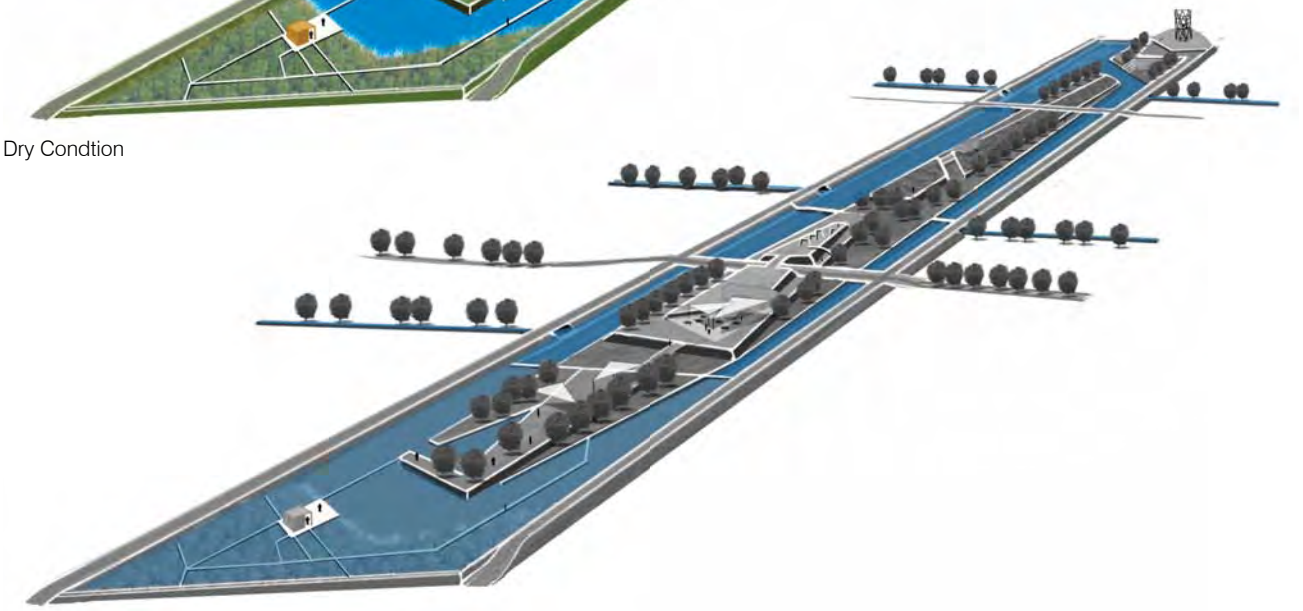
The first step towards improved water and soil management is to reconstruct streets to combine subsurface and surface drainage, and to link this water infrastructure to vacant lots that provide additional storage. When the system fills to capacity, stormwater overflows into the West End Canal Park.

Currently, the outfall canals add a source of risk of lakefront lowland districts like Lakeview. (See the section on the Orleans and London Avenue Outfall Canals for a full explanation and recommendations.)

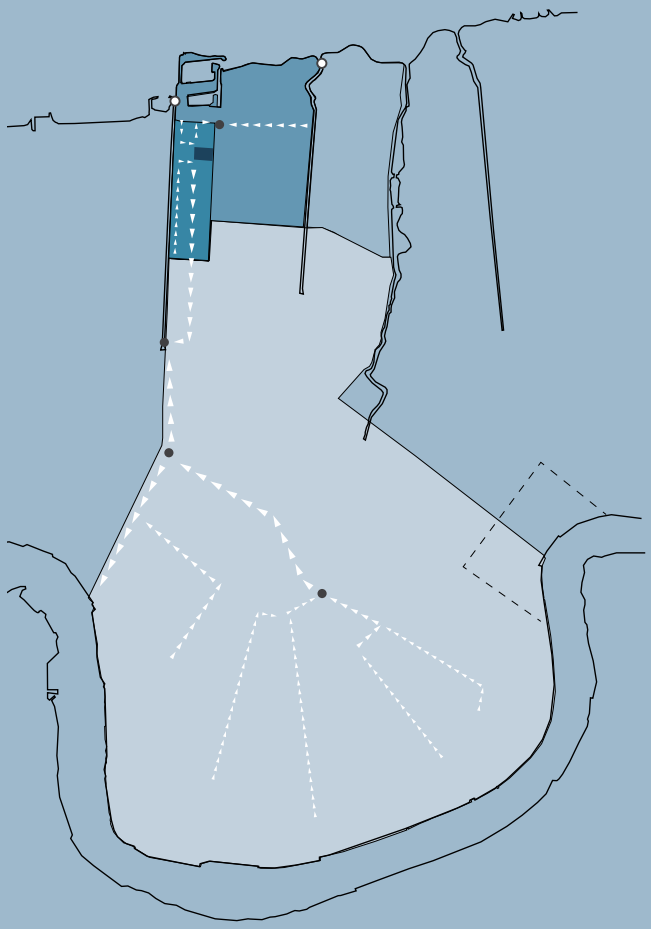
**West End Canal Park**

Constructed in the 1830s, the New Basin Canal provided a second connection from the lakefront to downtown New Orleans. Construction of the Industrial Canal and the rise of the railroads reduced the importance of the New Basin Canal, and it was filled in by 1950. The Lakeview proposal turns the canal's right-of-way once again into a public amenity. West End becomes a blueway linked hydrologically through the 17th Street Canal to the lake and providing additional storage for heavy rainfall events. It serves, too, as a source of water for the district's proposed circulating canal system during dry weather.

Dry Condtion



Heavy Rainfall



# Lakeview Floating Streets

In order to create an attractive, safe, and sustainable environment, a "floating street" proposal can provide a three-part concept for this basic element of infrastructure as: a water management system, organized subsurface utility system, and zones for safe travel for multiple transportation modes.

The proposal slopes the roadway surface in one direction, so that traffic can flow unimpeded on the high side even if the low side of the street fills with stormwater.

The proposal also suggests replacing old asphalt with pervious pavement. A layer of sand and pervious granulate subbase — with 40% void space that can hold approximately 35 gallons in 100 square feet — stores stormwater and allows stormwater to infiltrate into the ground so that soils are saturated and buoyant, and thus more stable. These new streets also provide space for utilities to be arranged safely underground, as well as a safe travel lane for cyclists and sidewalks for pedestrians.

In the proposal, excess parking on one side of the street will be replaced by a vegetated bioswale. Bioswales gradually fill during heavy rainfall and overflow into vacant lots and a subsurface drainage system. After a rain event, small permeable pipes drain bioswales to prevent standing water and mosquito breeding. Excess stormwater flows via outlet streets towards the West End Canal Park, where large volumes of stormwater can be safely stored.

During dry weather, water flowing through the permeable drainage pipes will recharge and balance groundwater levels. Trees absorb stormwater and prevent soil erosion while creating shade and improving the microclimate of the district. Floating streets serve as a prototypical retrofits for subsidence-prone lowlands throughout the region.

**Catchment Area**

Lakeview's Floating Streets can store and infiltrate water, reducing localized flooding across the district.

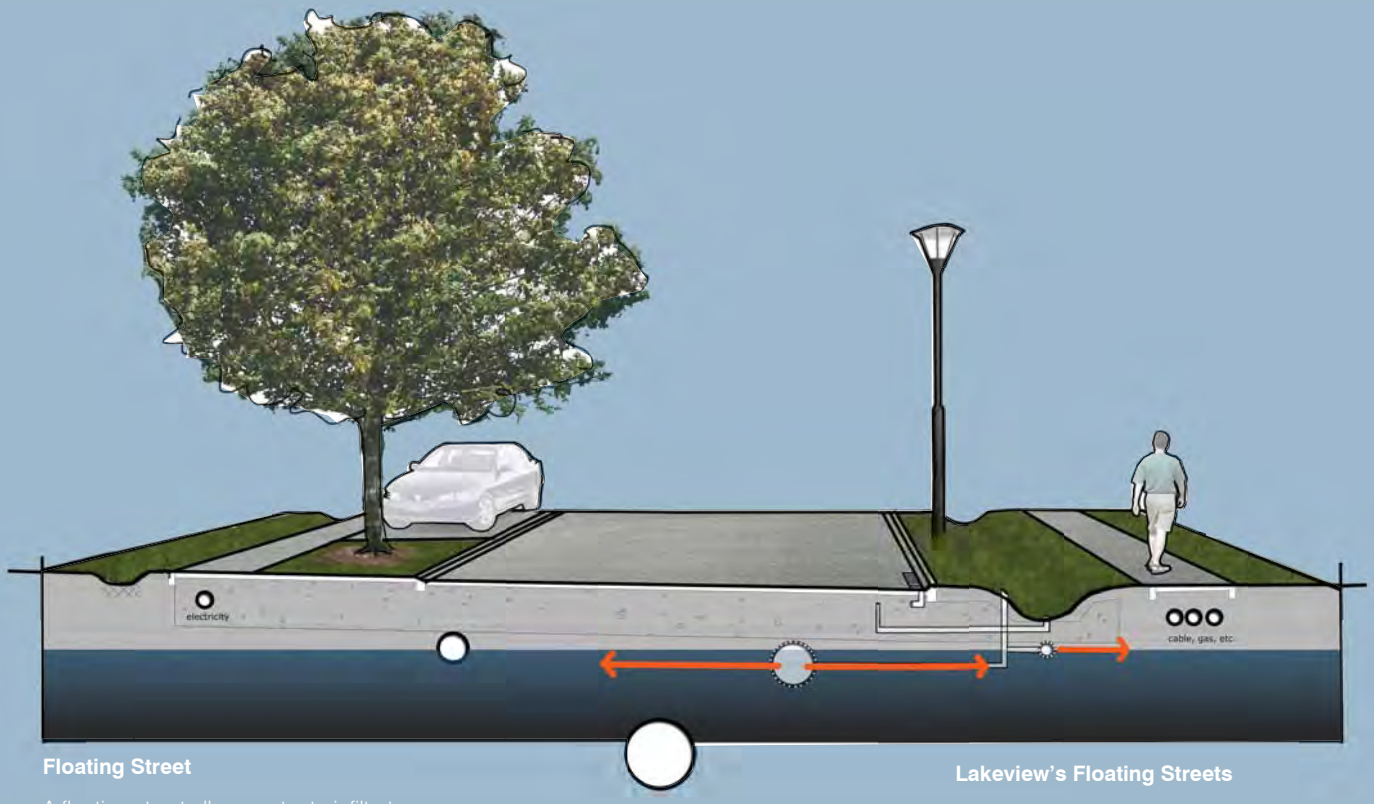
**Water Assignment**

The research area is approximately 27.5 acres and the required storage to meet the local T-10 water assignment is approximately 3.6 acre feet (155 thousand cubic feet). The reconstructed streets, cost estimated below, combined with stormwater retention features on two vacant lots per block, provide 100% of the storage necessary to meet the water assignment This reduces the drainage load on Pump Station #12, and provides a model for managing stormwater for all of Lakeview.

**Cost Estimates**

Cost estimates are based on a typical street cross section cut through a range of proposed street types. The cost breakdown shows the cost for each street type and the total cost if all types are implemented.

| Design Component | Costs |
|---|---|
| 40th Street Section | $ 2,508,542 |
| Fleur de Lis Drive Section | $ 2,938,818 |
| Avenue A Section | $ 2,212,087 |
| 38th Street Section A | $ 1,040,534 |
| 38th Street Section B | $ 1,715,691 |
| TOTAL | $ 10,415,671 |

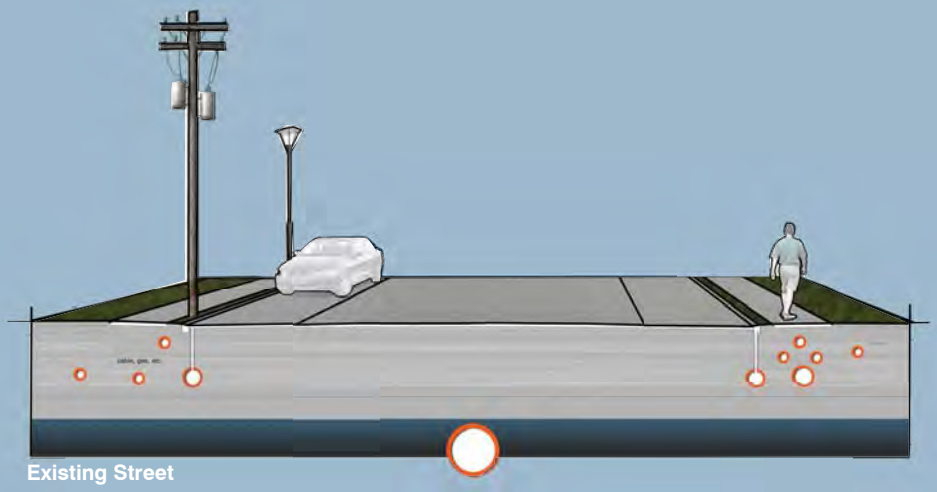



**Floating Street**

A floating street allows water to infiltrate into soils beneath its surface, allowing for a more stable and sustainable street.

**Lakeview's Floating Streets**

Typically streets sections are crowned, with a peak in the center and low points at the curbs. This means that street flooding typically occurs in parking lanes and on sidewalks. The floating streets proposal slopes the surface of the road in one direction, and down into a bioswale. During wet weather, the roadside bioswales collect and infiltrate stormwater, and they connect to surface and subsurface drainage infrastructure that directs excess stormwater into vacant lots and the West End Canal Park.



**Existing Street**

The impervious surfaces of existing streets allow little infiltration. This results in a low groundwater table, which contributes to local subsidence.

**Floating Streets Toolbox**


From crowned to single-sloped profile

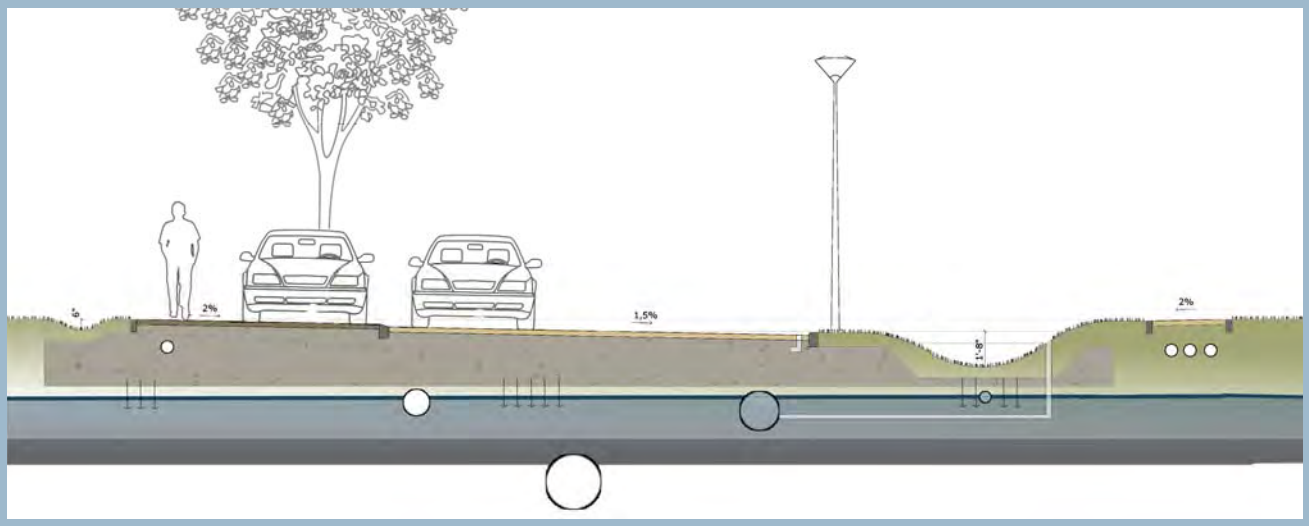
Subsurface storage combined with pervious pavement

Water storage in bioswales

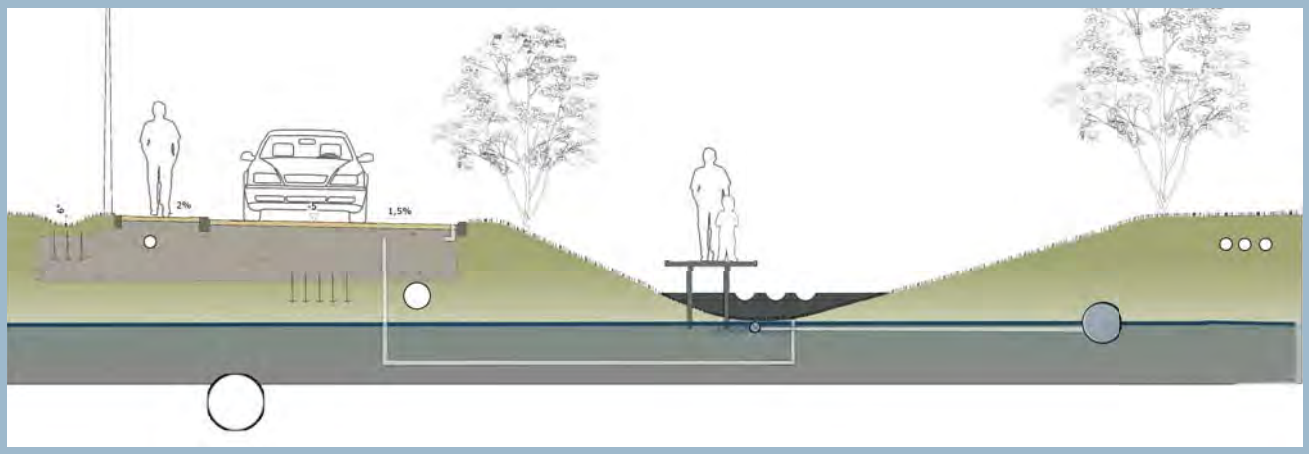
Subsurface utility system

Design for all modes of transport

Tree plantings




40th Street Section A




38th Street Section B

**Street Sections**

Sections show two scenarios alongside Lakeview's Fleur de Lis Park

Floating Streets Plan


**Floating Streets Plan**

The plan at left shows the location of four different street types adjacent to Fleur de Lis Park.

Dry Condtion

Wet Condtion

# 17th Street Canal

Once a vibrant waterway, the 17th Street Canal presents an opportunity for waterfront development and a beautiful connection from Lake Pontchartrain to the Mississippi River along the Orleans and Jefferson Parish line.

The 17th Street Canal was dug in the mid-1800s to drain Carrollton and Uptown New Orleans. Between the 17th and New Basin Canals, the resort village of West End developed on the Orleans side of the parish line. Fishermen used the canal as a port, and a village developed on the Jefferson side of the lakefront, formerly called East End and now known as Bucktown. Houseboats and working vessels docked along the canal until the late 20th century, when concrete floodwalls were added. Today, the canal drains stormwater from Orleans Parish, west of the Pontchartrain Expressway, and from Hoey's Basin in Jefferson Parish. The Monticello and Palmetto Canals feed stormwater into the 17th Street Canal below Pump Station #6, which pumps large volumes of water into Lake Pontchartrain during rain events.

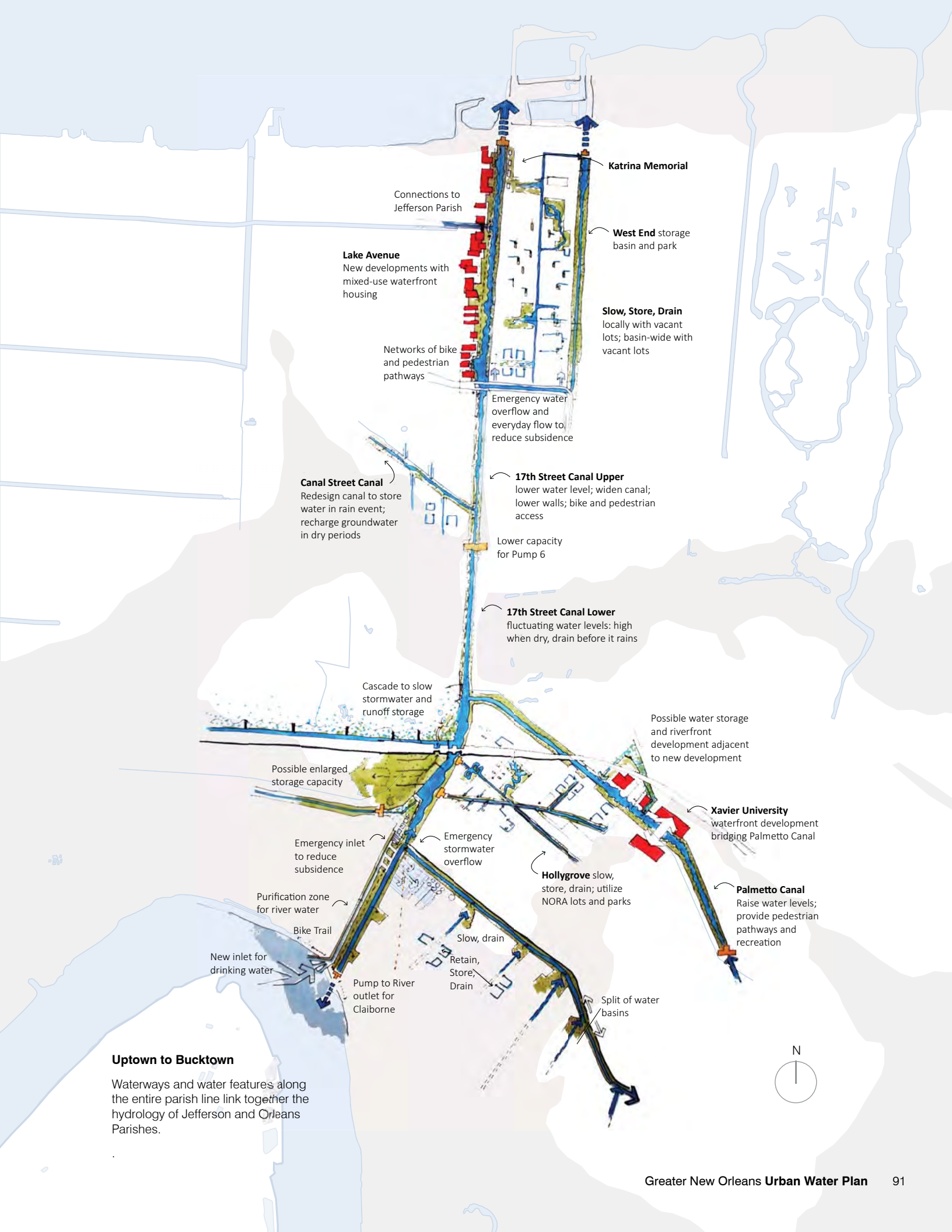
A new closure structure at the lakefront will reduce the risk of storm surge entering the canal. By redirecting runoff from Uptown New Orleans towards the river, the volume of discharge in the 17th Street Canal would be significantly reduced. A widened canal zone will increase storage capacity between the levees. With these safety measures in place, the canal's floodwalls can be removed, revealing this waterway once again as a public asset.

The new waterfront provides an opportunity for mixed-use and residential development in Bucktown and West End. A park where storm surge breached the floodwall can memorialize the impact of Hurricane Katrina and the district's recovery. Trails and pathways alongside the canal can connect Lake Pontchartrain to the Mississippi River.

17th Street Canal boat houses c. 1983

Image courtesy of the Louisiana Division/City Archives, New Orleans Public Library

Railroad Crossing over 17th Street Canal




**Uptown to Bucktown**

Waterways and water features along the entire parish line link together the hydrology of Jefferson and Orleans Parishes.

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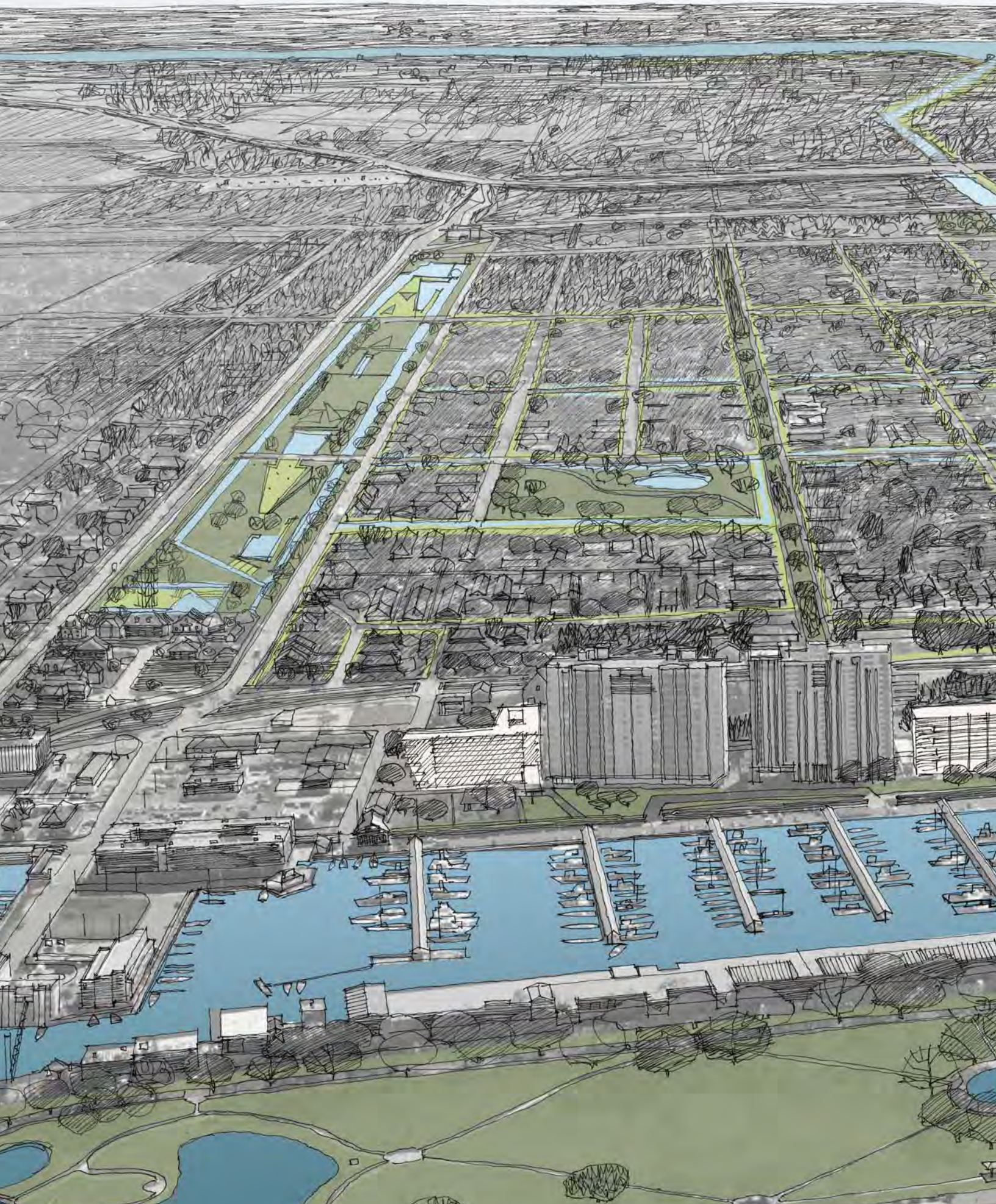
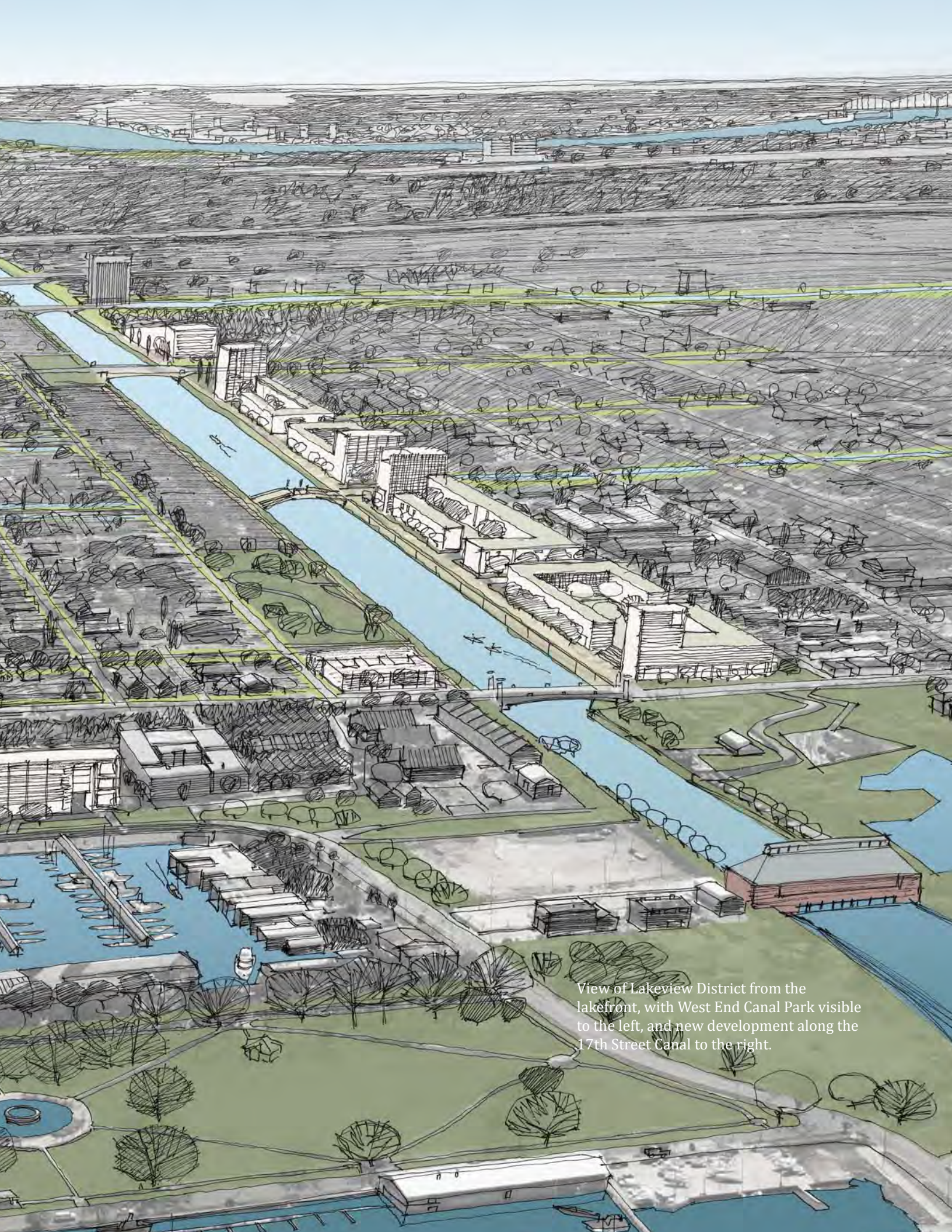
# West End and 17th Street Canal





View of Lakeview District from the lakefront, with West End Canal Park visible to the left, and new development along the 17th Street Canal to the right.

Lafreniere Park, Jefferson Parish

# 3 Jefferson's Blue Networks

JEFFERSON PARISH

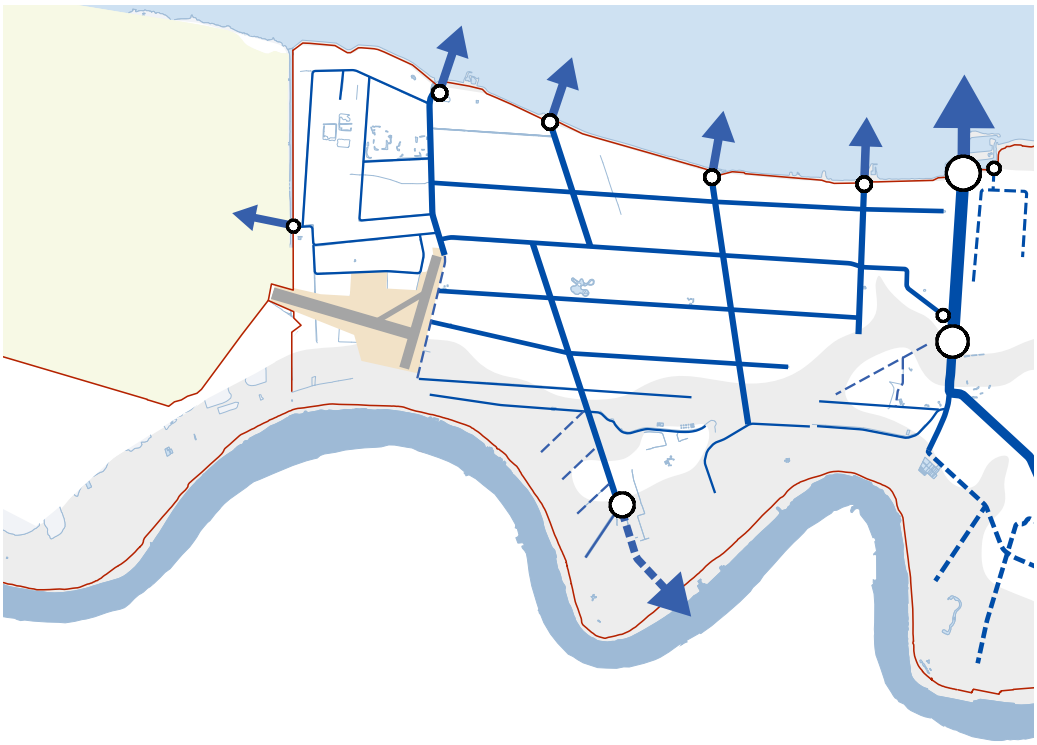
"It is in fact reimagining our relationship to water. We did this a long time ago with levees. This is a step. It's a matter of embracing it."

--Pat Forbes, *Executive Director*
*Louisiana Office of Community Development*



**Existing Landscape**

Clockwise from above: Lafreniere Park, Elmwood parking lot, Elmwood Parking lot Mississippi River levee in Kenner, Fat City



**Existing Drainage System**

All stormwater currently flows by gravity through a canal network to the lakefront, where it is pumped into the lake or the LaBranche Wetlands. The USACE Pump to the River project in Harahan is currently under construction.

# Jefferson Parish

Bordered by the Mississippi River, the LaBranche Wetlands, Lake Pontchartrain, and the Orleans Parish line, Jefferson Parish grew when developers looked upriver from the historic city for new land. Streets radiating from the river recall the geometry of agricultural plots and plantation boundaries. Away from the river and past the Metairie Ridge, drainage channels were dug to drain cypress swamps and to enable the development of Metairie's characteristic suburban neighborhoods.

## The Backslope

Beginning with a loose grid shaped by the curves of the river, open drainage ditches characterize the drainage system of the backslope. An exception to the area's residential developments is the largely paved Elmwood Business Park, which lies in the shadow of the Huey P. Long Bridge. Here, runoff from the area's rooftops, parking lots, and streets collects so quickly that roadways frequently become impassable. Furthermore, runoff from Elmwood flows downstream into the lowland canal network, exacerbating drainage problems there. Further west, in the city of Kenner, is the old settlement of Rivertown, as well as the parking lots, warehouses, and industrial areas that characterize the landscape around Louis Armstrong International Airport.

## Bowl Landscape

The low-lying bowl is located between Airline Highway and the Earhart Expressway. While the roadways are on relatively high ground, neighboring homes and businesses experience flooding. New water storage areas can hold significant volumes of stormwater are needed to reduce flood risk in this area.

## Lowland Landscape

Once an uninhabited area of cypress swamp, the land was developed into swaths of suburban neighborhoods divided by broad boulevards and canals that extend north-south and east-west across the broad low-lying areas of Metairie and Kenner.

Commercial enterprises and associated parking lots are concentrated along these boulevards, and are responsible for the massive quantities of runoff that make drainage in the lowlands so difficult . The canals that run through the neutral grounds of these boulevards are unsightly ditches with stagnant water during dry periods, and fill to the brim with runoff during rain events. The low static water levels in the canals, and the lack of infiltration due to the prevalence of impervious surfaces, lower the water table and contributes to the soil subsidence that has dropped many of these lowland areas five feet or more below sea level over the course of the last century.


The insertion of water retention features and tree plantings along Metairie's grid of boulevards and in commercial districts, improvements to canal banks, and the construction of parklands that store and filter stormwater bolster soil stability and the basin's capacity for safely handling intense rainfall. Additionally, the Urban Water Plan proposes investing in the Airline Corridor as an important hydrological boundary, and also as a critical connection joining the Airport to downtown New Orleans and the rest of the region. Improved canals and walking trails connect residential neighborhoods to the lakefront.

**Proposed Living Water System**

The new drainage system splits the basin into two distinct subbasins. Water from the backslope, south of the Metairie ridge, is pumped to the river instead of the lake. Strategic parklands in Kenner and along the Airline corridor provide storage and filtration.

# Jefferson's Blue Networks

Jefferson Parish is part of the Jefferson-Orleans Basin, so that Urban Water Plan strategies that are appropriate for Orleans Parish are appropriate in Jefferson Parish as well. As in Orleans, there is a proposal to divide this area into two subbasins along the Metairie Ridge, diverting backlsope runoff back towards the river in order to relieve the lowland canal network and pump stations.

## Split at the Ridge

Airline Highway demarcates the northern edge of the river side subbasin. All drainage south of the ridge can be pumped to the river, either through the Monticello Canal along the Jefferson-Orleans Parish line or the Soniat Canal via the Pump to the River project that is currently under construction.

New detention and retention features on the backslope, such as rain gardens, water lanes (bioswales), parking lots that infiltrate and store stormwater, and pervious paving, can all be used to slow the flow of stormwater across the backslope.

The construction of strategic parklands along the Airline Corridor can anchor the redevelopment of this swath of land as a key hydrological boundary and as a restored entryway to the region that connects from Louis Armstrong International Airport all the way to downtown New Orleans. Integrated into this landscape are existing assets such as Zephyr Field and the New Orleans Saints practice facility.

## Lowland Canal Networks

New vegetation and trees can be planted on both sides of the lowland canals, offering shade and heightening evapotranspiration. Reducing runoff from both backslope and lowland neighborhoods will make it possible for system managers to maintain higher water levels in the canals without increasing flood risk. Higher water levels and canal bank retrofits will improve the aesthetics of each of these boulevard/canal corridors, while balancing groundwater and slowing subsidence.

In dry weather, water drawn from Lake Pontchartrain will feed the circulating canal network, which will ensure improved water quality and canal ecology year-round. Strategic parklands located in Kenner will feature filtration wetlands that will clean the water that flows through the canal network, and store and filter stormwater during wet weather.

# Airline to City Center

For residents and visitors alike, a major entry point to the southeast Louisiana and the Mississippi River Delta is the Louis Armstrong Airport. From there, Interstate 10 and the historic Airline Corridor bring travelers from Kenner to and from Downtown New Orleans. With new water features and improved urban design, each provides opportunities for strengthening the impression that the region makes on those travelers.

Adjacent to Airline Corridor is the Elmwood District, an important contributer to the region's commercial base, where smart retrofits and district-scale water management will reduce flood risk and provide favorable conditions for the long-term prospects of the district's businesses and institutions.

**Airline Corridor**

Left: The Metairie Ridge coincides with the Airline Corridor, which defines the zone between Jefferson's backslope and lowlands.


1 The **City Arrival** corridor links Louis Armstrong International Airport to Downtown New Orleans.

2 As a largely paved commercial and light industrial area, **Elmwood District** presents an opportunity to use water features to reduce runoff and enhance the area as a place to live, work, and shop.

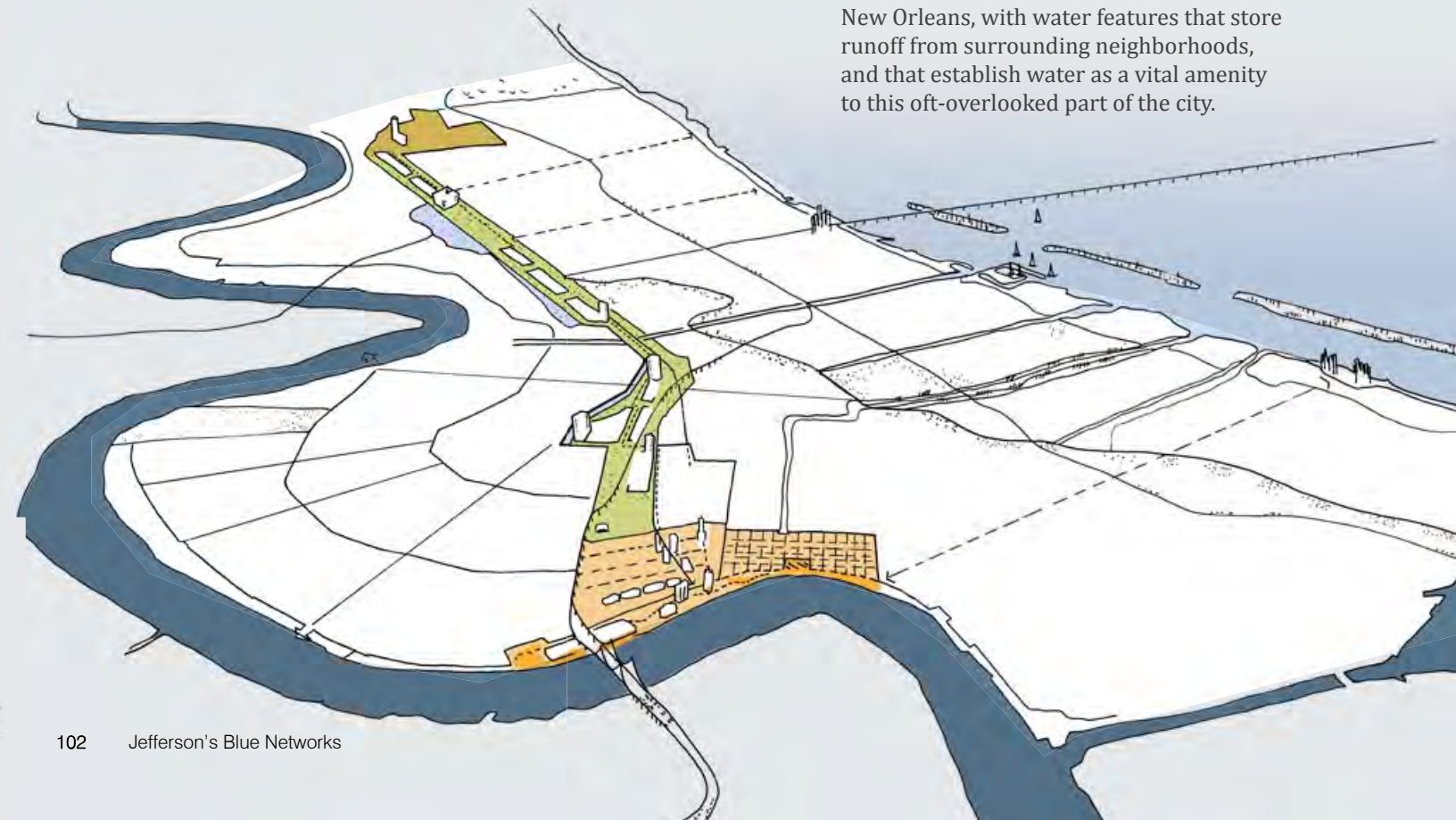
3 Space for water can be found along roadways and in parking lots, in **Elmwood's Fields and Water Lanes**.

# City Arrival

The City Arrival corridor links the airport to the Central Business District of New Orleans. With new water features and improved urban design, this corridor can become a place where the importance of water to the region and the urban landscape is made visible from the moment a person sets foot in the region.

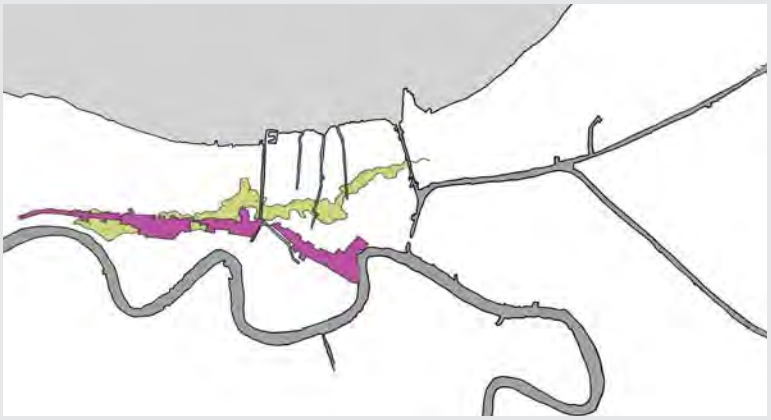
The City Arrival corridor is found between the backslope and the lowlands of the Jefferson-Orleans Basin. In Jefferson Parish, the corridor is bounded by Airline Highway to the north and Earhart Expressway to the south, and its boundaries are roughly coterminous with the Metairie Ridge. As one approaches the parish line, the Metairie Ridge swings to the north, whereas the City Arrival corridor turns south towards downtown, passing through the main bowl of the city. Today, the corridor is primarily an infrastructural zone with large areas of vacant and underutilized land. The corridor can be transformed into a connecting element for the region that combines urban water management, redevelopment opportunities, 21st century transportation possibilities, and recreational programs.

Along Airline Highway, a light-rail line can provide rapid public transit access between the airport and downtown. Each stop along the way is a site for mixed-use development, linking to Elmwood District to the south, and to Metairie's residential neighborhoods to the north. Because of its location at the base of the backslope, the construction of strategic parklands along this corridor serve an important stormwater storage function to alleviate flooding both upstream and downstream. In Orleans Parish, the corridor links together Xavier University, the BioDistrict that is under construction, and downtown New Orleans, with water features that store runoff from surrounding neighborhoods, and that establish water as a vital amenity to this oft-overlooked part of the city.



**Non-residential Area**

An underutilized infrastructural corridor separates the backslope from the lowlands; Metairie/Gentilly Ridge in green, City Arrival Corridor in Purple

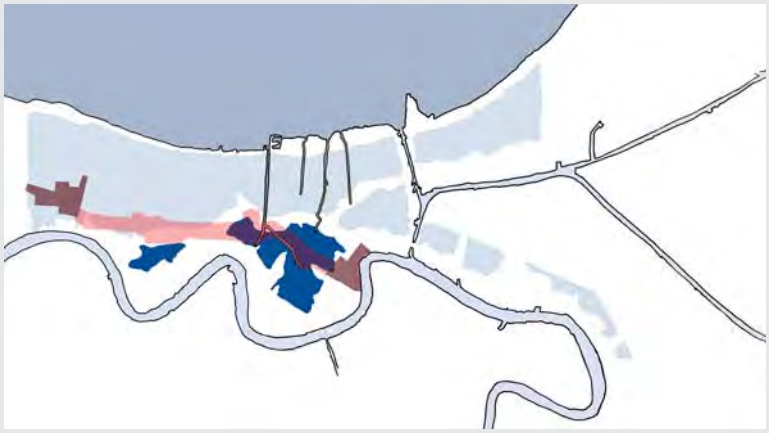


**Infrastructural Area**

Key roadways and a rail corridor connect between the airport and downtown New Orleans. The City Arrival Corridor is also a transition zone from Causeway Boulevard to the Huey P. Long Bridge that crosses the Mississippi River at Elmwood.

**Topographical Shift**

Blue indicates areas with higher rates of vacant and underutilized property. The City Arrival Corridor passes through this zone in New Orleans, which is situated in the main bowl of the city.



**Shift in Urban Patterns**

The City Arrival Corridor divides the Jefferson-Orleans Basin at an important transition from backslope to lowlands, which coincides with a shift in urban patterns from the historic arpent-based street grid of the backslope to the suburban street grid of the lowlands.

Existing highway infrastructure at the Superdome

Area for potential water storage, reconfigured highways, and a relocated railway station make redevelopment of this zone viable.

**City Arrival**

A new light-rail corridor can bring visitors from the airport into the historic heart of the New Orleans and its Central Business District, more efficiently and comfortably than is possible today.

Strategic parklands can be incorporated into the area adjacent to the Elmwood District, in order to retain runoff flowing from Elmwood's rooftops and parking lots, with space alongside the parklands and at light rail stops redeveloped for residential, commercial, and recreational uses.

In Orleans, the corridor links to the new development of the BioDistrict. Unused land beneath the interstate and along the Palmetto Canal can become retention basins in this low-lying bowl landscape. store additional water, while providing a pedestrian network connecting to the Superdome.

## 1 Airline Corridor

One enters the city from the airport along an attractive route filled with public amenities, recreational pathways, and new homes and businesses.

## 2 BioDistrict

This new institutional zone provides green public amenities dedicated to pedestrian connectivity, recreation, and additional development.

## 3 Downtown Gateway

The Superdome marks the downtown end of the corridor. Relocation of the train station and reconfiguring the highway infrastructure (see facing diagrams on facing page) would enhance this area a site for public gatherings and celebrations, with easy access to the French Quarter and Central Business District.

# Elmwood District

Characterized today by wide expanses of asphalt, concrete, and commercial and industrial buildings, Elmwood can become instead a vibrant commercial district distinguished by verdant "fields" and "water lanes" integrated into its streetscapes.

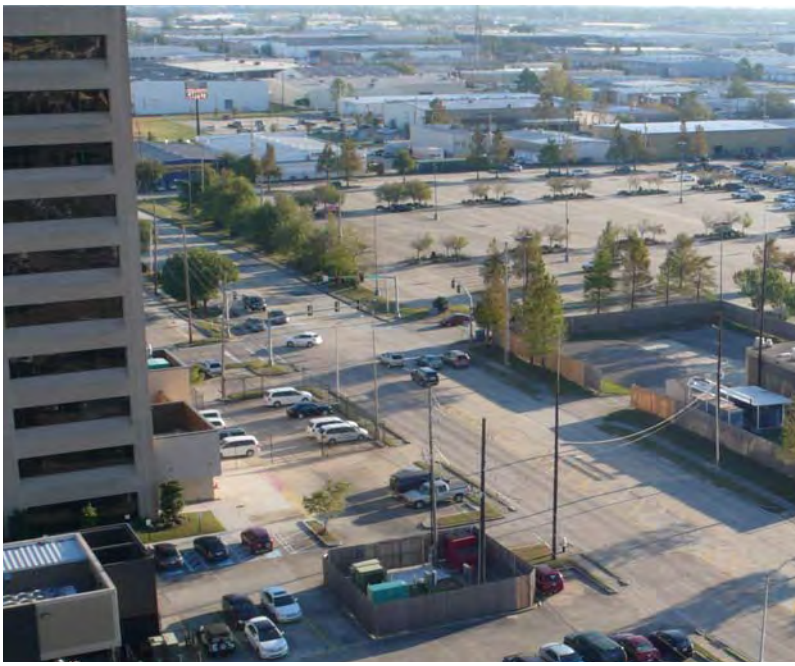
- Install a network of retention and water conveyance structures to collect runoff from Elmwood's impervious areas
- Filter and reduce the volume of runoff entering the Soniat Canal from Elmwood, in order to reduce the load on the drainage system downstream
- Design Elmwood's drainage system to overflow into larger system-level retention areas in the bowl landscape along Airline Highway
- Through a planting program, improve the aesthetic quality and the microclimate of the district to attract a wider range of tenants and customers while reducing the urban heat island effect generated by large parking lots and rooftops

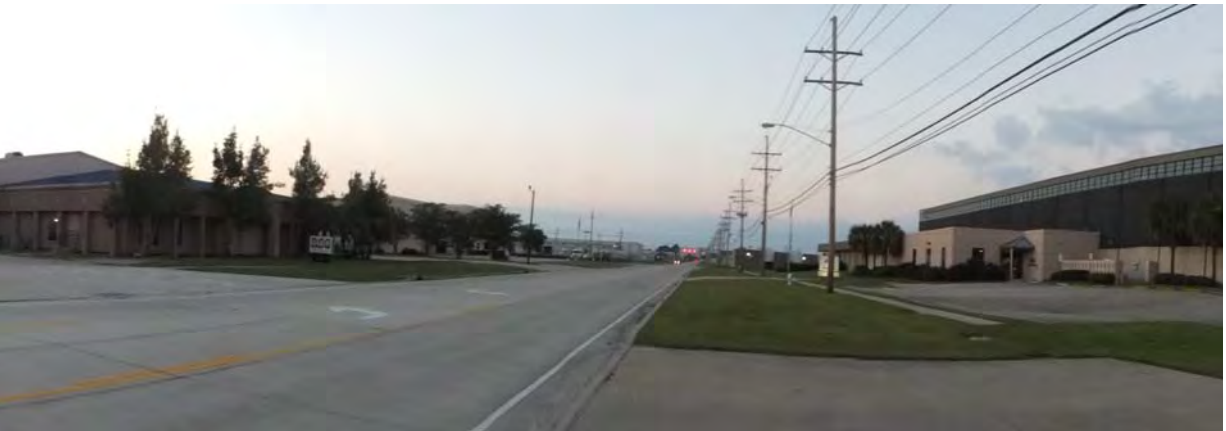

As railroad-borne shipping grew in importance, the Elmwood area was developed to support railroad infrastructure, concrete and asphalt replaced woodlands, creating a vast paved landscape on the backslope of Jefferson Parish. Today, Elmwood is bordered by Airline Highway to the north and the Mississippi River to the south. With twelve hundred paved acres, runoff volumes and intensity are high, and there is periodic street flooding. After a thunderstorm, workers and visitors to the area can expect to find standing water in parking lots and/or impassable streets, which results in considerable lost business and inconvenience. On sunny days, the area's paved surfaces and dearth of trees and other vegetation provide little relief from the hot summer sun.

The Urban Water Plan proposes augmenting the current district's existing canals and culverts in several ways. The current street system is often excessive in terms of paved area and provides more than adequate capacity for automobiles even during the busiest times. In the proposal, the typical street section is adapted to incorporate "water lanes," or bioswales into the existing right-of-way, where there is space permitting in turning lanes or alongside the edges of the streets. These linear water features form a network of channels that can infiltrate stormwater and convey runoff to "fields." These are retention areas formed out of both vacant parcels and existing parking lots.

Parking lots are especially important. Instead of shedding runoff into the drainage system, each parking lot can be redesigned to infiltrate stormwater using pervious paving materials, rain gardens and bioswales, and subsurface storage chambers that allow the parking lots to store tremendous quantities of stormwater.

These proposed improvements serve to reduce local flooding and simultaneously create a higher quality environment for work, and with which to attract customers. Importantly, implementing these retention features in Elmwood reduces the volume of runoff that flows from Elmwood into lowlands of Jefferson Parish. These measures are also prototypical for highly impervious commercial areas throughout Greater New Orleans, such as Metairie's Fat City.



**Existing Landscape**

A primarily commercial and industrial district, Elmwood experiences regular street flooding due to excess runoff from rooftops, parking lots, and streets. Simple measures can transform this landscape, reduce flooding, and improve infiltration.


Elmwood District Plan

Water lane

Infiltration in parking lots

Infiltration lots

Water storage lots

**Design Objectives**

The addition of water lanes (bioswales) and linear tree plantings can improve the district's street network. Parking areas feature both above-ground and below-ground retention features. South of the Metairie Ridge and along Earhart Expressway and Airline Highway, strategic parklands in the low-lying bowl area are used to collect excess runoff from Elmwood.

**Alternative Design**

Adding pumps to the network can make it possible to circulate water through the district's water lane network, even during dry weather. This will allow for additional infiltration and improve groundwater management on the backslope.

**Dry Condition**

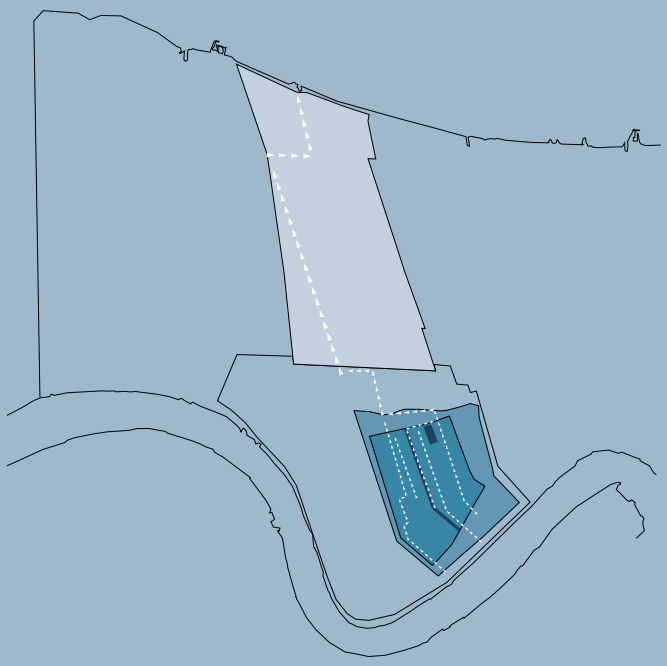
Water lanes and large storage areas are dry, providing visual relief throughout the district with their grasses, wildflowers, and other plantings.

**Light Rainfall**

Rain gardens on vacant lots and in parking lots fill. A series of weirs allows water lanes to fill before collected runoff cascades over each weir's edge and into a lower level. The water lanes convey water to rain gardens and subsurface storage chambers.

**Heavy Rainfall**

Fields and water lanes fill to maximum capacity. All excess water from a T10 storm can be stored within the district and in strategic parklands at the northern end of the district. The Harahan Pump to the River project provides additional relief, and overflow to the lowland drainage network remains as a fail safe.



# Elmwood Fields and Water Lanes

The Elmwood District is an almost completely paved commercial and light industrial district. With so many impervious surfaces, all of the storm runoff drains directly into the subsurface pipes, with no opportunity for slowing, storing, or using stormwater. Heavy rainstorms produce water beyond the drainage system's capacity, often resulting in localized street and standing water in parking lots.

Fields and water lanes can improve roadway safety during major rain events. Water features in parking lots, or the green fields, use excess parking spaces to provide linked vegetated storage ponds and lagoons. During dry times, pathways alongside bioswales and lines of new street trees connect these new retention areas. During wet conditions, these same features store, infiltrate, and filter stormwater. Once barren, streets are improved with a lush tree canopy and water lanes softening the district's hard edges and inhospitable paved landscape. The water lanes and fields can also be designed to serve as traffic calming measures and buffers, providing a safer environment for motorists, cyclists, and pedestrians alike.

Elmwood's Fields and Water Lanes serve as demonstration projects for all of Greater New Orleans's heavily paved commercial and industrial areas, including Metairie's Fat City, and shopping plazas along Veterans Boulevard in Metairie, Judge Perez Drive in St. Bernard, or Lake Forest Boulevard in New Orleans East. Each of these areas has the opportunity to store stormwater so that net runoff volumes from each of their respective districts are lower than they are today. Large parking areas and the broad rooftops of commercial and industrial establishments have a disproportionate impact on the drainage system. The implementation of simple and proven technologies can change this all-to-common condition, making the urban landscape of Greater New Orleans more sustainable as a whole.

**Catchment Area**

Two demonstration projects in the Elmwood District — the water fields in the Yenni Building and Upper Slope parking lots and the water lane on Edwards Avenue — are representative of the solutions that are necessary to address localized flooding and to solve the water assignment for the district as a whole.

**Water Assignment**

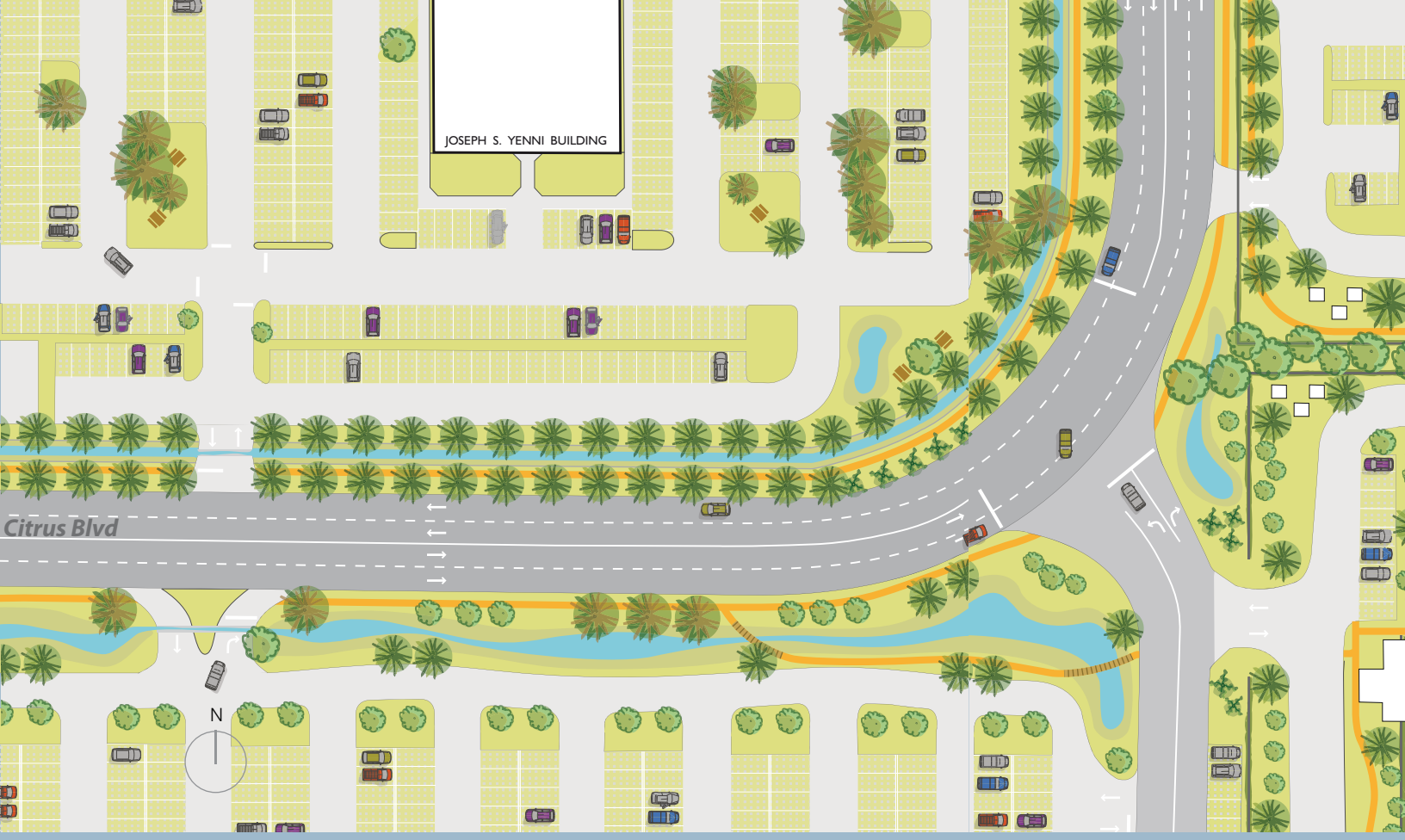
Implementation of water lanes, stormwater retention on vacant lots, parking lot retrofits, and system-scale storage along Airline and Earhart would allow Elmwood District to meet over 80% its T-10 water assignment.

Water lanes are primarily for conveying and infiltrating stormwater, but can provide over 15 acre feet of storage if implemented across the entire district. The proposed Yenni Building Park Lot retrofit provides 4 acre feet of storage, and the Upper Slope parking lot retrofits provide an additional 15 acre feet of storage. Both are ambitious but viable models for approaching the 2.5 inches of storage per acre that are necessary to meet Elmwood's T-10 water assignment.

**Cost Estimates**

Cost estimates are developed for street retrofits based on a "wide" and a "narrow" profile. The Yenni Building parking lot and Upper Slope parking lots demonstration projects are estimated separately.

| Design Component | Costs |
|---|---|
| Upper Slope, Min. Design | $ 1,084,402 |
| Upper Slope, Max. Design | $ 2,172,129 |
| Wide Street Retrofits | $ 26,127,964 |
| Narrow Street Retrofits | $ 1,029,964 |
| Yenni Building Parking Lot | $ 9,369,423 |
| TOTAL | $ 39,783,463 |

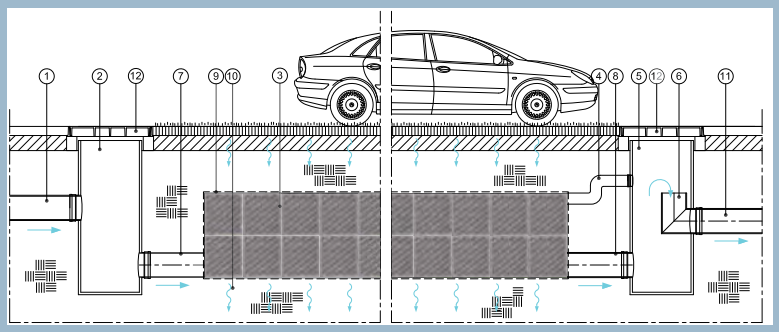



Yenni Building Parking Lot Plan

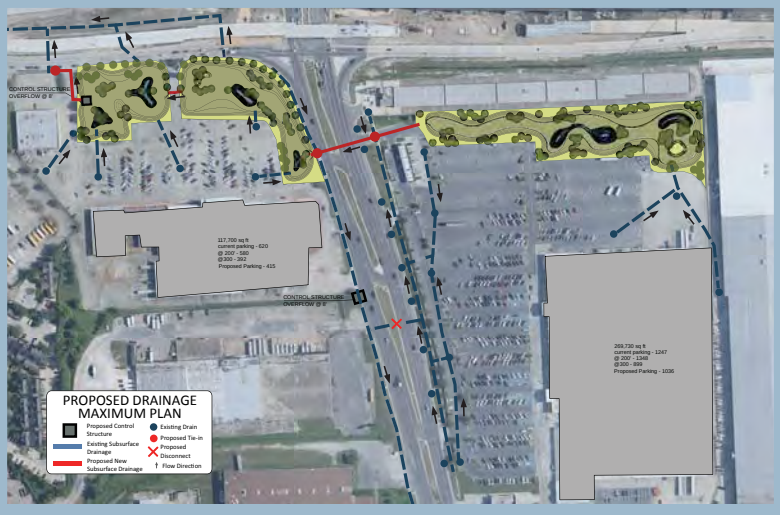
**Elmwood Fields**

Stormwater largely flows unimpeded across Elmwood's paved landscape and into the drainage system. Perimeter bioswales, rain gardens, pervious paving, and subsurface storage in the Yenni Building parking lot are some of the replicable solutions that are possible for every parking lot in Elmwood in order to improve the district's basic runoff and infiltration characteristics. These water features have the capacity to handle both site runoff and also some of the runoff from sites further upstream. These fields — retrofitted parking lots — are hydrologically connected via gutters and water lanes.

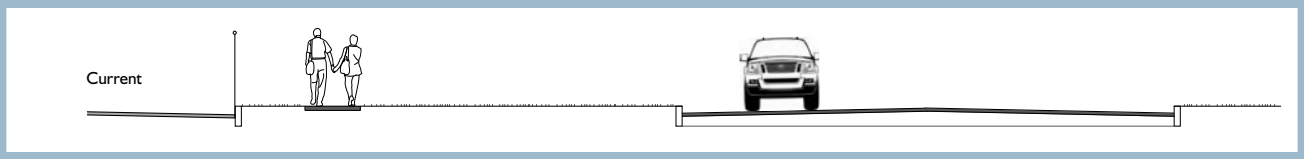
Further upslope, stormwater retention takes the form of larger retention basins constructed in oversized parking lots. These water zones serve as buffers between parking areas and street traffic, and as new amenities that both employees and visitors can enjoy. Most importantly, having such retention features increases infiltration rates where the soils are most suitable, and reduces runoff volumes that flow into the drainage system and downstream. Every parking lot can make a difference.



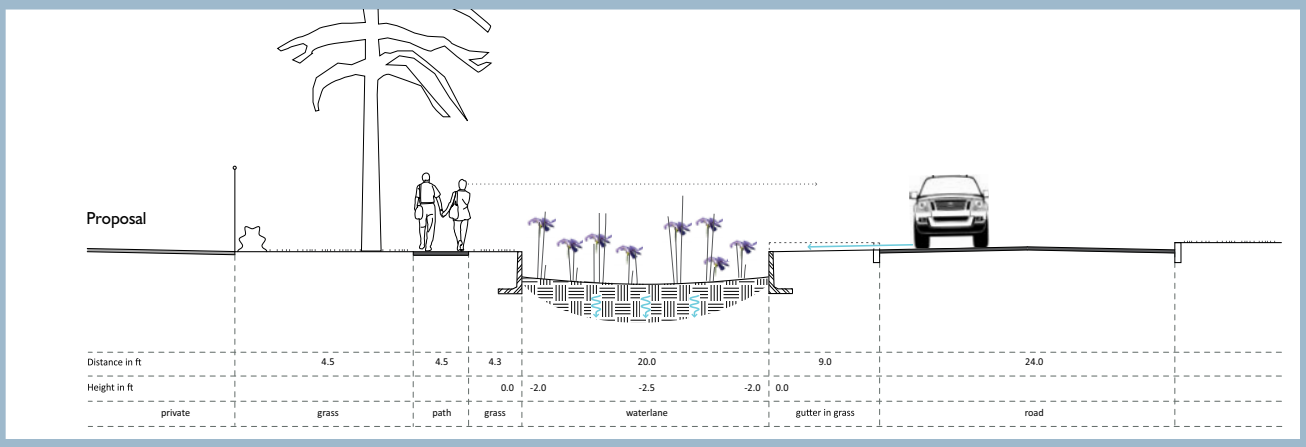
Cross Section of Subsurface Storage Chamber




Upper Slope Maximum Storage Plan




Existing Street Section




Proposed Street Section

**Elmwood Water Lanes and Trees**

Different water lane solutions are available for variations in street types, whether they are wider or narrower.

Planting trees provides a means for orientation in a landscape that is currently gray and undifferentiated. Primary streets become shaded corridors with enhanced quality of life and aesthetics for the entire district.

Right-of-way Water Lane Section Perspective

Former Railroad Spur Water Lane Section Perspective

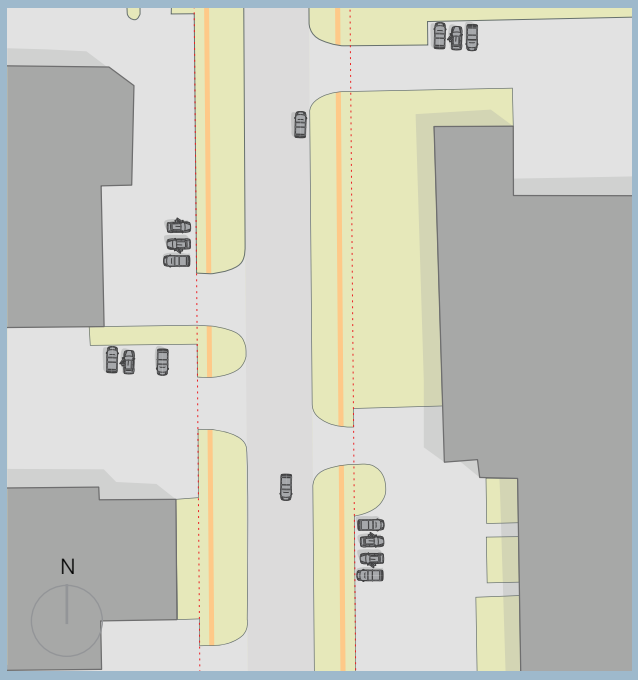
Turning Lane Water Lane Section Perspective

Edwards Avenue as a tree-lined corridor

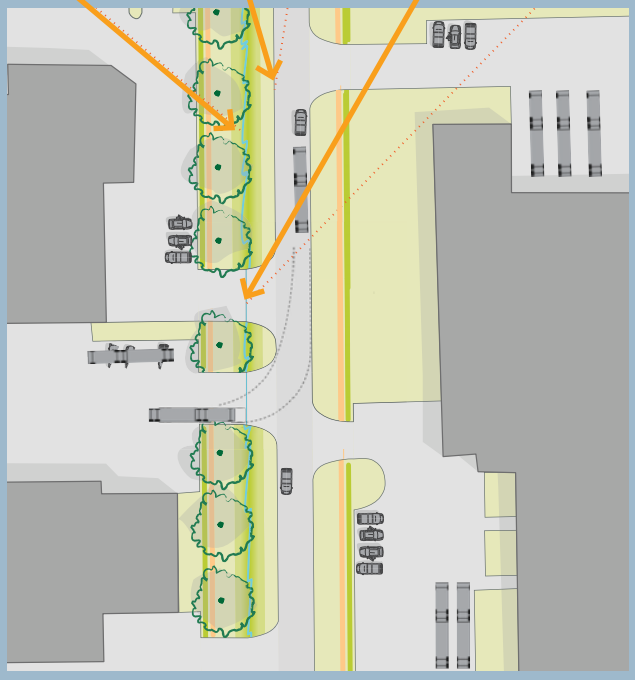
### Transforming Streets

Elmwood's barren streets, such as Edwards Avenue, can be transformed into tree-lined corridors with shaded water lanes and pedestrian pathways.

Inspriations




Existing Edwards Avenue Plan



Proposed Edwards Avenue Plan

# Elmwood Fields and Water Lanes

Located at the base of the Huey P. Long Bridge, Elmwood is a highly visible and important center of commerce. It has the opportunity to become a leader in sustainable stormwater management as well, with retrofits to its streets, parking lots, and rooftops to address localized flooding and to reduce stormwater runoff from the district.

# Parish Line to Kenner Wetlands

Water drawn from the 17th Street Canal can enter Jefferson's lowland canal network through the Canal Street Canal. This is an ideal site, at the line between Jefferson and Orleans Parishes, for demonstrating improved canal bank design and water level management. During dry periods, water flows from here into the Veterans Canal, which flows from east to west towards the Kenner Wetlands.

In the Kenner Wetlands, constructed wetlands filter the outflow of the basin's lowland canal network before it empties out into the LaBranche Wetlands on the western side of the federal levees and floodwall that protect the boundary of the Jefferson-Orleans Basin.

**Rethinking the Lowlands**

Paving over swampland to make way for Veterans Boulevard c. 1955

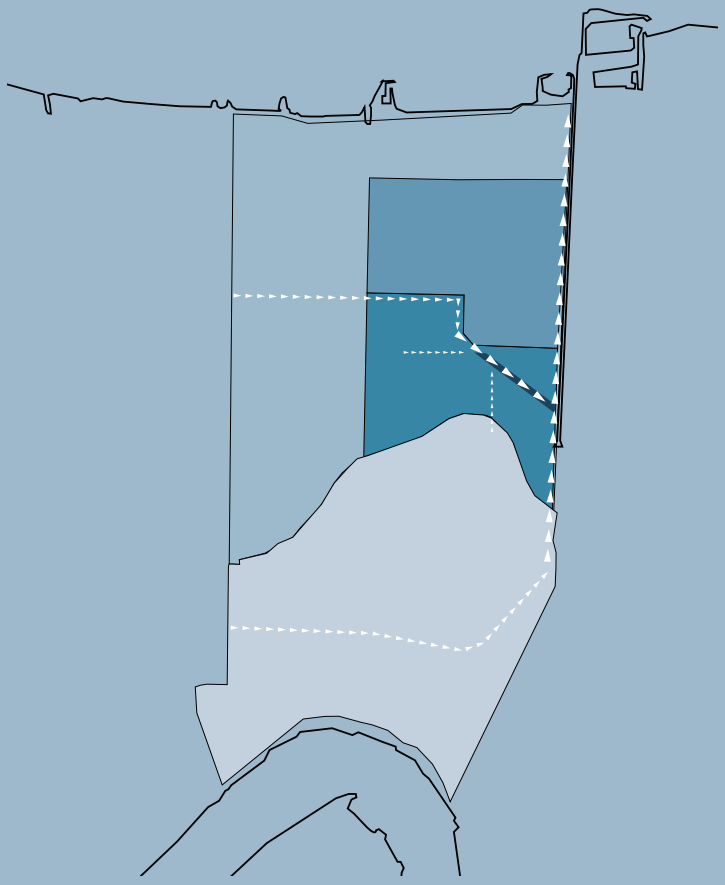
Image courtesy of the Jefferson Parish Yearly Review


1 The design for the **Canal Street Canal** employs exfiltration catch basins to allow some of the water that drains into the canal back into soils.

2 Jefferson's **Lowland Canals** can be an asset for the lowlands that reduce subsidence and enhance urban quality.

3 The **Kenner Wetlands** can store and filter both stormwater and dry weather flow from Jefferson's Lowland Canal network, and can serve, too, as an anchor for new commercial and residential development.

# Canal Street Canal



A small neighborhood canal in Metairie, the Canal Street Canal flows southeastward toward the 17th Street Canal, draining part of Jefferson Parish into one of New Orleans' primary outfall canals. North of Interstate 10, the canal transitions from an open canal to a subsurface pipe that runs north-south between Sena Drive and West William David Parkway to Veterans Boulevard. A manually operated canal gate at Focis Street is used to manage water levels. During heavy rainfall, the gate is closed so that the canal drains only runoff from the immediately adjoining neighborhood. Because of this gate, the canal and its hydrology can be isolated from the rest of the parish, which means that it can be used as a testing ground for improved water management and infiltration techniques.

The streets flanking the canal have fallen into disrepair, and no curbs or gutters exist. Grass-covered canal banks are steep, and sloughing of the banks is a common problem. Outfall pipes are visible along the length of the canal, adding to the unattractive nature of the corridor.

Along portions of the corridor with a wide right-of-way, the canal can be widened. Located just south of Interstate 10, the proposed canal gate can be operated to stabilize canal levels on a seasonal schedule. Gabions filled with recycled concrete can line both sides of the canal, filtering sediment and stabilizing canal banks. A widened median creates more ample, usable pedestrian space. Replacing conventional catch basins with exfiltration catch basins in the surrounding neighborhood can recharge groundwater. Devices for monitoring groundwater levels, soil moisture, infiltration rates, and water quality can yield useful data with which to develop groundwater and surface water management techniques for other canals in the region.

This canal redesign will result in reduced street flooding, soil subsidence, and improve the aesthetic and experiential quality of the canal.

**Catchment Area**

The Canal Street Canal discharges to the 17th Street Canal, which discharges runoff from both Orleans Parish and Jefferson Parish into Lake Pontchartrain. The Canal Street Canal redesign will allow it to alleviate pressure on the 17th Street Canal and reduce flood risk for the Canal Street Canal Pump Station catchment area.

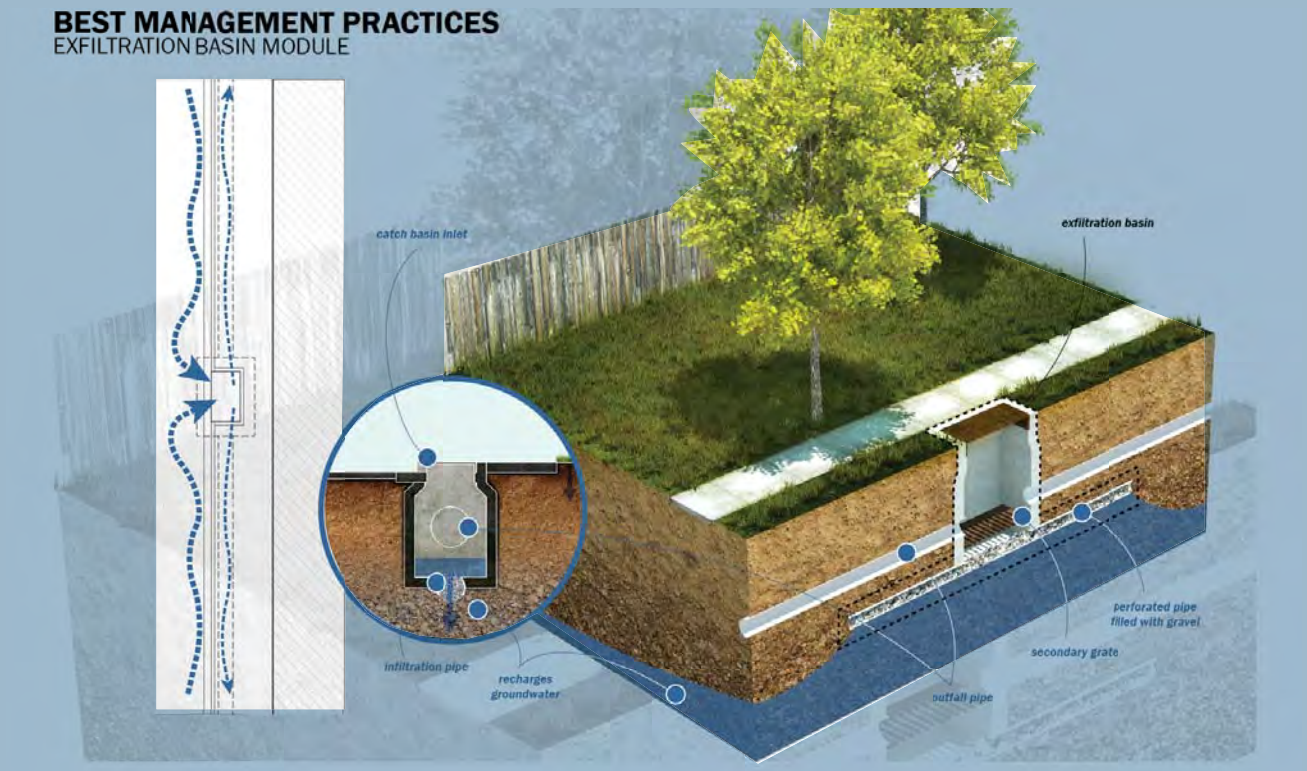
**Water Assignment**

The design for the Canal Street Canal reconstruction widens part of the canal, which will provide an additional 20 acre feet of volume over the length of the canal. This is equal to over 25 percent of the T-10 water assignment for the Canal Street Canal Pump Station. The 33 exfiltration catch basins that are proposed will further reduce flood risk, because they are designed to infiltrate stormwater into surrounding soils, though a quantification of their impact would require further study of local soil types and groundwater levels.

**Cost Estimates**

The demonstration project has two phases: replacing standard catch basins with exfiltration catch basins and installing groundwater monitoring wells along one avenue in the first phase, and then widening parts of the canal for greater storage capacity and installing additional exfiltration catcbh basins in the second phase.

| Design Component | Costs |
|---|---|
| Replace Catch Basins on Papworth Ave. | $ 230,114 |
| Widen Canal Street Canal | $ 11,236,549 |
| TOTAL | $ 11,466,573 |




**Exfiltration Catch Basin**

Design for an innovative catch basin that directs stormwater into the ground with an open bottom and perforated pipe.

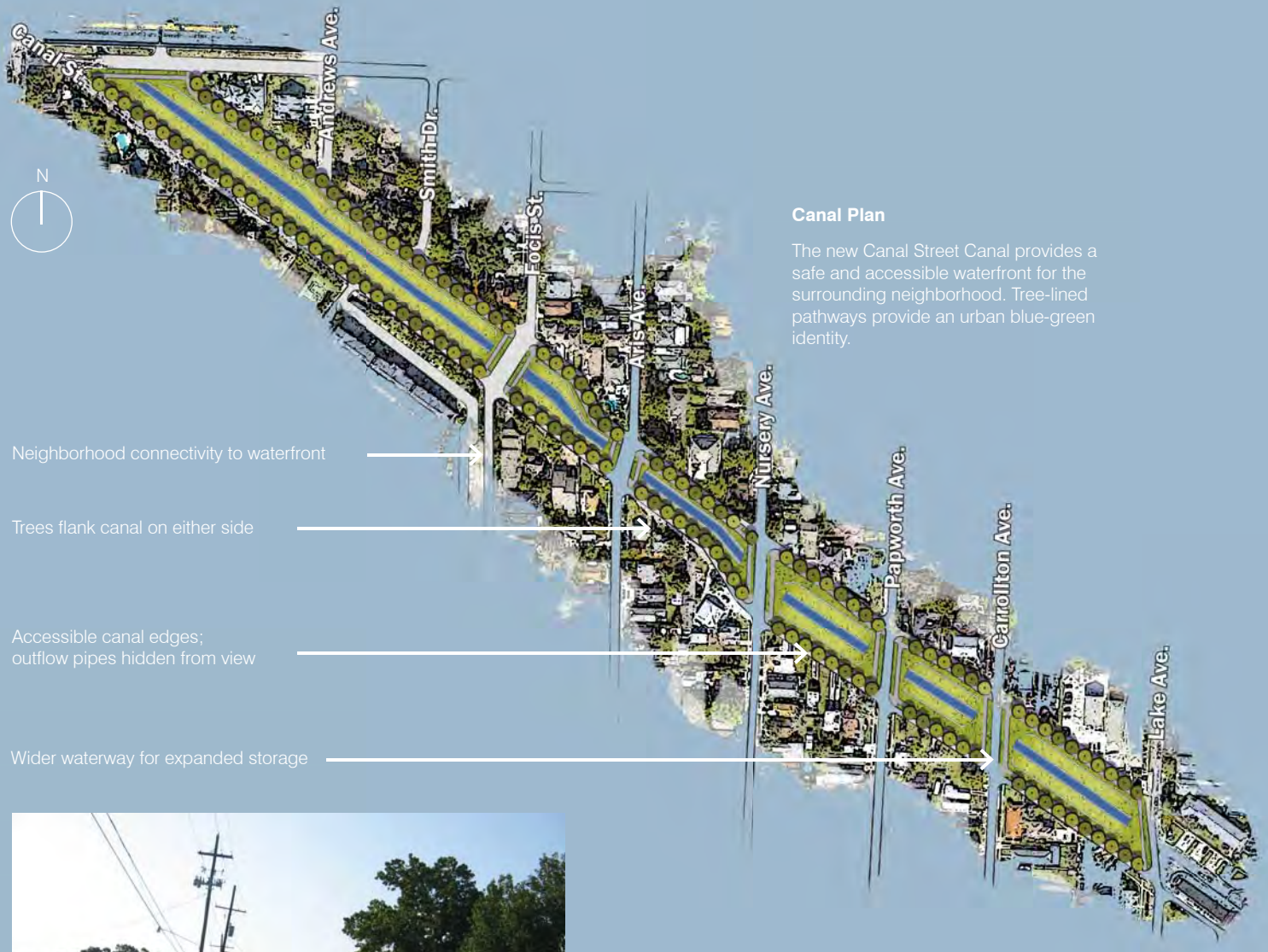
**Canal Sections**

Canal banks are steep and lined with grass. Unsightly pipes project from canal banks and water levels are low, with stagnant water during dry weather. In the redesign, outfall pipes are concealed with plantings, gabions, and higher water levels. Pedestrian pathways and trees line the canal.


Existing Canal Street Section

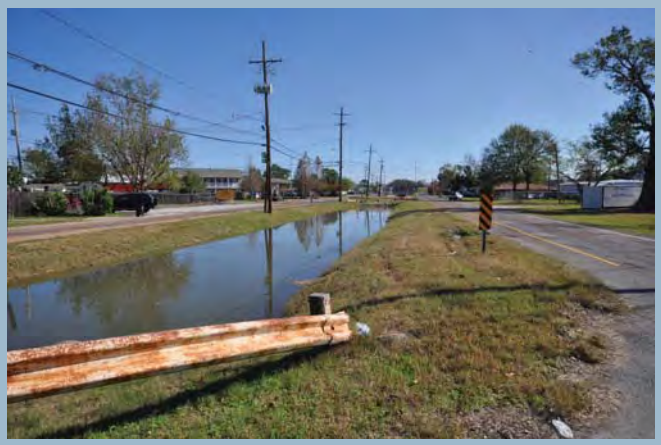

Proposed Canal Street Section Option A


Proposed Canal Street Section Option B




**Canal Plan**

The new Canal Street Canal provides a safe and accessible waterfront for the surrounding neighborhood. Tree-lined pathways provide an urban blue-green identity.



**December 2012 Test**

In an experiment to test the effects of raising water levels in a canal, the Jefferson Parish Drainage Department closed the gate at Focis Street and siphoned water from the 17th St. Canal into the Canal St. Canal to raise water levels from 13' C.D. to 17' C.D. Surface water levels then dropped two feet in just 24 hours, either due to infiltration through the bottom of the canal or leaky pipes, or leakage at the gate.

Monitoring wells were installed to track groundwater levels, and backflow into the drainage pipes that feed into the canal was observed in catch basins as far as the I-10 service road. Higher water levels hide outfall pipes and canal banks, greatly improving the aesthetics of the canal.

Right: With the proposed canal redesign, stormwater rises to fill the second tier during rain events. Both tiers are lined with gabions to improve canal bank stability and to filter large sediments and floatables. Pedestrian and bicycle pathways alongside the canal and in the

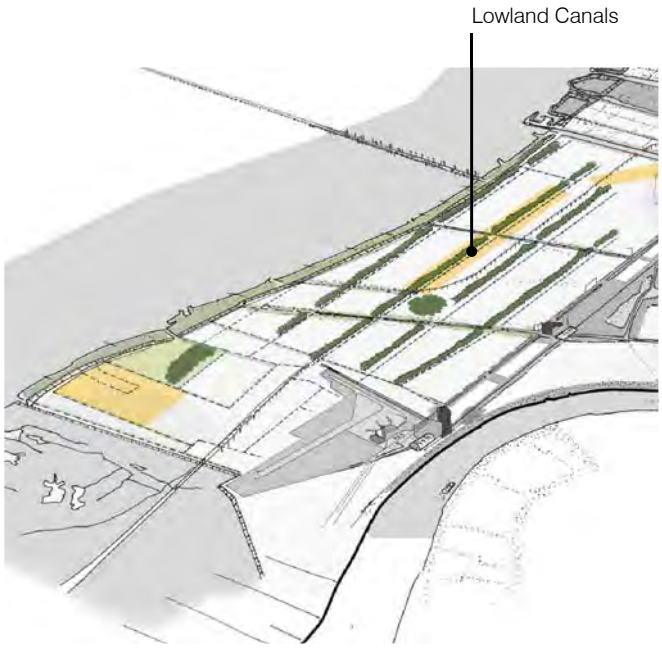

Existing Canal Street Canal

Proposed Canal Street Canal

# Jefferson Lowland Canals

Jefferson's extensive network of boulevards and canals can become blue-green amenities with which to strengthen the identity of the entire parish.

- Provide additional storage for runoff
- Improve canal edges with landscaping and vegetation to enhance biodiversity and filter water
- Make canals attractive urban features with improved water quality and flow
- Expand pedestrian networks to provide safe means of travel between residential neighborhoods and commercial corridors




Once uninhabitable marshland, the Jefferson lakeside subbasin is now a hardened landscape subdivided by a grid of drainage canals and roadways. Commercial development quickly followed residential development, providing residents and visitors with a suburban way of life distinct from that of New Orleans.

Open drainage canals with grass-covered or concrete banks are common throughout the subbasin. Canals that run north-south are often situated at the rear of residential properties, making it difficult for system managers to access and maintain canal banks. Canals that run east-west are typically situated in the neutral grounds of major boulevards, such as West Esplanade, Veterans, and West Napoleon boulevards. These canals are also difficult to access, because they are flanked on both sides by multiple lanes of high-speed and high-volume traffic. In short, drainage canals as they are configured now provide little value to the urban landscape.

Improving water level and water quality management in these canals will also improve the canals' aesthetic qualities. Static water levels in the canals can be raised to an average of -3 feet to -5 feet seasonally, and lowered to -8 feet in anticipation of heavy rainfall, when storage capacity within the canals is critical. Raising water levels will reduce rates of subsidence, and hide unsightly pipes along that jut out from the canal banks. Additionally, canal banks can be designed for pedestrians, improving access to and along these corridors for pedestrians and cyclists. Tree plantings offer much needed shade, and they absorb and transpire large quantities of stormwater.

Currently, these drainage canals have steeply sloped banks, which is both unsightly and unsafe. Canal banks can be adjusted to feature more gradual slopes, making them safer and more inviting, especially in conjunction with higher water levels.

These solutions can be prototypical for Jefferson's canal network. Converting these rather bleak corridors into green-blue boulevards heralds a new vision for public space, and the possibility of more sustainable commercial and residential corridors.


**Existing Landscape**

With low water levels, sloughing canal banks, unsightly outfall pipes, canals contribute little to Metairie's urban landscape. Each is an opportunity, though, to revitalize the urban landscape through improved water management and canal design and roadway design.

Top: Proposed West Esplanade Canal

Above: Existing West Esplanade Canal

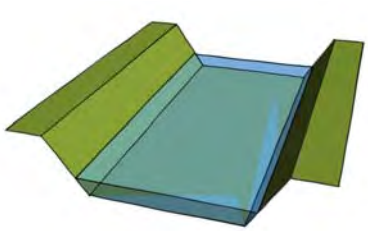
Below: Existing and Proposed Canal Bank Designs

**Canal Bank Design**

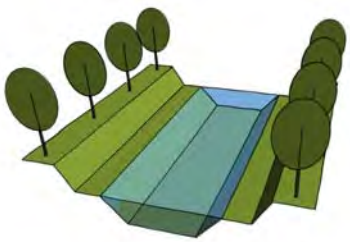
Steep canal banks can become tree-lined terraces. In some cases, there is enough space to insert a pedestrian pathway and other features that allow parish residents to enjoy the canals as beautiful amenities and public spaces.

Design goals include:

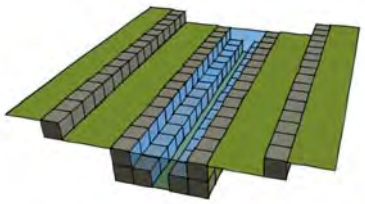
- Raising water levels
- Showcasing water
- Increasing biodiversity
- Vegetating canal edges and tree plantings
- Making canal banks inhabitable



Existing Canal



Vegetated Edge Condition



Urbanized Edge Condition

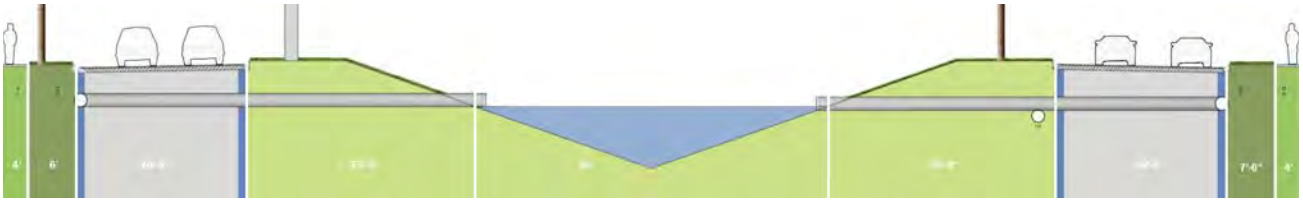
**Veterans Canal and Boulevard**

An improved Veterans Canal will ameliorate the vast expanse of six paved traffic lanes that currently dominate this main commercial corridor. Water will be a visible amenity to the motorist and offer a more varied landscape and visual relief from parking lots and signage on either side of the boulevard, and building upon recent efforts to improve plantings and large-scale public art along Veterans.

The Veterans corridor is representative of other east-west boulevards and canals. Improvements made here can be replicated throughout the Jefferson lowlands.

Top: Proposed Veterans Canal

Above: Veterans Canal from a motorist's perspective



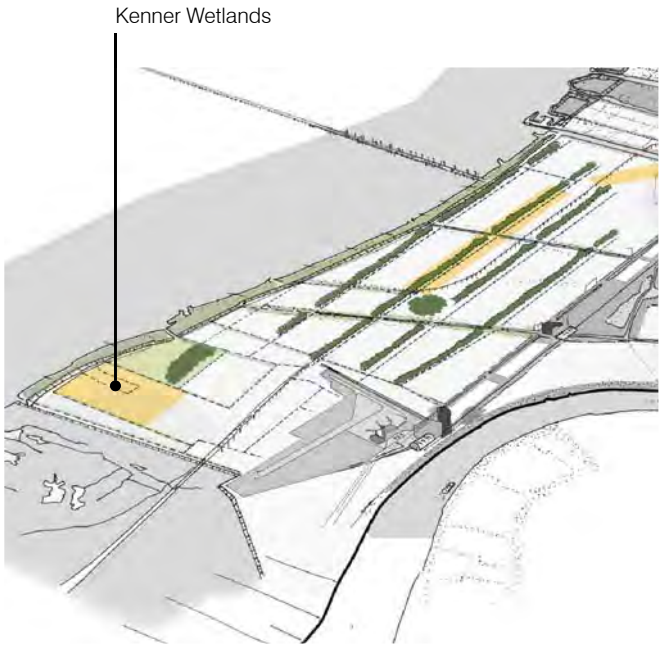
Existing Veterans Canal

Proposed Veterans Canal

# Kenner Parklands

Large open lots in Kenner are suitable for providing system-scale stormwater storage in the form of retention wetlands. Investing in this infrastructure benefits Jefferson Parish as a whole, and serves as a starting point for commercial and residential redevelopment in the parts of Kenner that are stricken by blight.

- Filter dry weather flow from Jefferson's Lowland Canal Network
- Improve groundwater balance through infiltration and higher water levels
- Provide thousands of acre feet of stormwater storage for all of Jefferson Parish during rain events, in order to reduce flooding
- Create internal urban wetlands with mixed residential and commercial development
- Spur economic development in Kenner with new waterways and integrated wetlands




Though much of Greater New Orleans faces the threat of subsidence, Kenner is particularly susceptible because of the high levels of organic materials in local soils. Because the ground is so low in certain locations, the water table is close to the surface, making it difficult to store stormwater in the ground or to construct deep retention features. Because of this, larger areas of land need to be designated for handling stormwater. Kenner is unique in that it is one of the only areas on the east bank of Jefferson Parish where there are large numbers of open parcels with which to create system-scale storage. Without larger storage features in Kenner, Jefferson Parish would be hard pressed to find the storage necessary to allow system managers to raise static water levels in the parish's canal network.

The design of this system must be sensitive to Kenner's street patterns and neighborhoods. Interstate 10 divides North Kenner from South Kenner, while Williams Boulevard, Chateau Boulevard, Loyola Drive, Vintage Drive, and West Esplanade Avenue define superblocks. Commercial and institutional areas are concentrated along major boulevards, and residential subdivisions are contained within the superblocks. A survey of vacant land in the heart of Kenner suggests possibilities for creating significant stormwater storage and filtration features, in the form of integrated wetlands and retention basins. An analysis of land use in the vicinity of the vacant properties informs the distribution of these new water features, as well as possibilities for commercial and residential development alongside the wetlands that can revitalize the heart of the district.

At the same time, the wetlands will serve as a new public amenity, not only for Kenner, but all of Jefferson Parish. Waterways and pathways will connect between North and South Kenner. Vital urban habitats can take the place of barren and underutilized properties that mar the district today. Furthermore, integrated wetlands and other water features can reshape the identity of Kenner, as they will exemplify the new regional approach to water management, in which canal networks support the ecology of urban wetland habitats, and stormwater is managed to reduce both flooding and subsidence.


**Existing Landscape**

Above: The concrete floodwall that marks the boundary between Kenner and the LaBranche Wetlands to the west

Left: Large vacant parcels and unsightly canals present the opportunity to improve both water management in Jefferson's Lowland Canals and to develop constructed wetlands for filtering and storing water flowing through those canals.

North Kenner Plan

**Kenner Parklands**

Constructed wetlands will be the primary elements in this proposal for Kenner. Jefferson's Lowland Canals will drain into these wetlands during dry weather, so that dry weather flow can be filtered and infiltrated into the ground during dry weather. During wet weather, the wetlands and associated retention basins will provide ample system-scale storage for Jefferson's drainage system. Introducing water into Kenner's fragile landscape is crucial for limiting further subsidence in this lowland area.

Above: Kenner's new wetlands as a place for recreation, public gatherings, and also commercial and residential development

Left: The proposed wetlands are located in the heart of Kenner. Potential new development is indicated in red.

Schiphol Airport

**Arriving in Greater New Orleans**

Above: With a multi-million dollar redevelopment planned, Louis Armstrong International Airport provides an opportunity to remake the first impression that Greater New Orleans makes on visitors as they alight in the region. Storage basins and constructed wetlands change with seasons, filling with stormwater each time it rains, filtering runoff, and reducing the volume of runoff that leaves the airport.

**Schiphol Airport**

Left: As an example, visitors to the Schiphol Airport in Amsterdam are greeted with blue and green features that allow airport managers to tightly control surface and groundwater levels. Schiphol Airport is located in a polder situated roughly 15 feet below sea level, with soils and water issues similar to those at Louis Armstrong International Airport.

**Maxent Canal**

Pedestrian amenitites along the canal transform canal into a front yard

# 4 Heart of New Orleans East

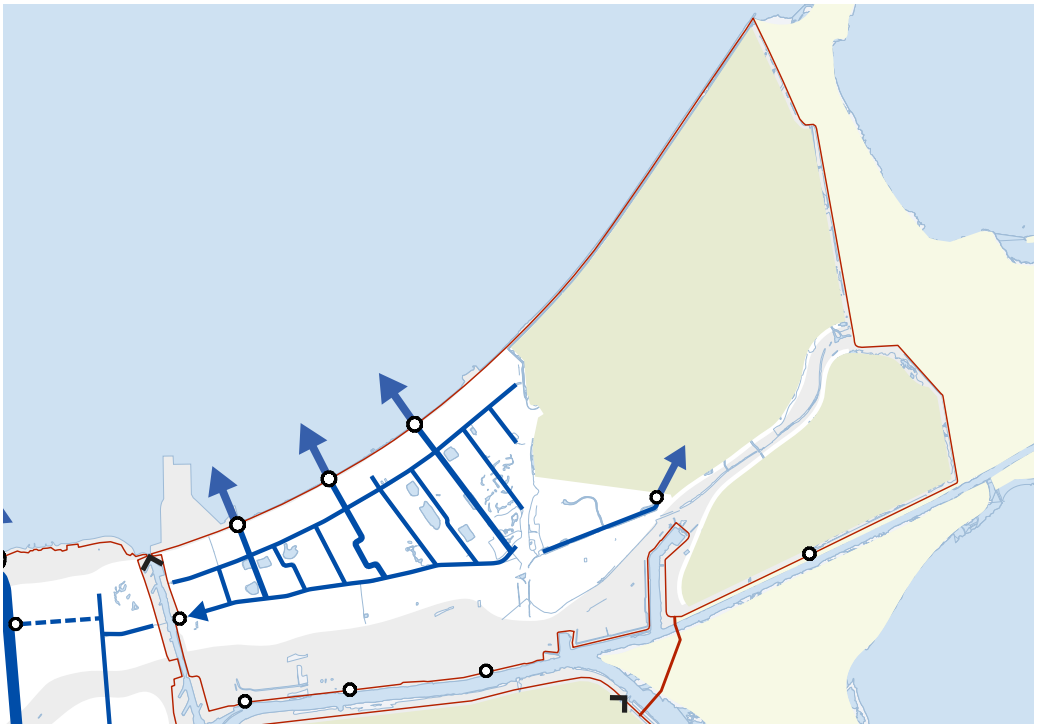
NEW ORLEANS EAST

"Now is the opportunity not to hide that water. We don't want to do that. We want to celebrate that canal, we want to incorporate it into economic activity. It's up to us. Yes, we can do this."

—Marcia St. Martin, *Director*
*Sewerage and Water Board of New Orleans*

**Existing Landscape**

Clockwise from right: subsidence in Village de l'Est, former subdivision on Dwyer Road, lake in New Orleans East, lower Citrus Canal, upper Citrus Canal



**Existing Drainage System**

Stormwater currently drains to Lake Pontchartrain.

# New Orleans East

After New Orleans expanded to the lakefront, the wetlands of New Orleans East became attractive as the next zone of development. New subdivisions constructed in the second half of the 20th century provided homes to thousands of families in suburban subdivisions on the drained marshland of New Orleans East. New Orleans East is bordered by the Gulf Intracoastal Waterway, the Industrial Canal, Lake Pontchartrain, and the Bayou Sauvage National Wildlife Refuge.

## Former Marshlands

The Gentilly Ridge runs through New Orleans East as the stretch of high ground upon which Chef Menteur Highway is situated. From the highway, the basin slopes down into lowlands that stretch all the way to the lakefront levee. Because the lowlands are drained marshlands, subsidence is a basin-wide issue. Most of these areas are already 10 to 11 feet below sea level, and some of the highest rates of subsidence in the region are found in this basin.

Once a prime commercial destination for the region just miles from downtown, the heart of New Orleans East was devastated by flooding after Hurricane Katrina, and large vacant and blighted parcels continue to mar the landscape.

## Canals and Lakes

New Orleans East has a network of open drainage canals. The major canals that run north-south alternate with the major boulevards and highway exits that divide up the basin. East-west canals alongside Dwyer Road and in the neutral ground of Morrison Road connect between the north-south canals so that water can flow between the catchment areas for each of the lakefront pump stations.

Unique to New Orleans are the lakes around which many of the basin's subdivisions are constructed. For the residents off these subdivisions, these lakes provide waterfront living. In some instances, the lakes are directly connected to the canal network, so that the lakes provide some additional storage capacity for stormwater. These bodies of water distinguish the New Orleans East landscape, and are suggestive of the patterns of water infrastructure and development that will serve the basin well in the future.

## Eastern Wetlands

The Bayou Sauvage National Wildlife Refuge bounds the eastern end of developed areas of New Orleans East, and is protected by the federal hurricane protection system. The many wetland habitats that comprise the refuge are a regional asset for birders, hikers, hunters, and fishers.


New dry-weather water sources, flowing water, and parklands built around storage and wetland features augment the storage capacity and function of the basin's existing lakes, canals, and pump stations. Together with a new waterfront commercial and recreational district in the heart of the basin, and stronger connections to the Bayou Sauvage National Wildlife Refuge, the Urban Water Plan's proposed retrofits lift the profile of New Orleans East as a distinctive place to establish a home and business.

**Proposed Living Water System**

Canals and lakes are linked to form a circulating network that recharges groundwater. Excess stormwater drains to the lake and to Bayou Sauvage, while dry-weather flow in the canal network is directed into Bayou Sauvage National Wildlife Refuge.

# Heart of New Orleans East

There is opportunity to create a memorable core for New Orleans East. Abandoned commercial blocks and subdivisions can be made into new developments built around the basin's lowland canal network, lakes, and asssociated green and blue amenities. These features, both existing and proposed, can be designed to serve the residential communities that surround the heart of the basin.

## Core of the Basin

To the south, west, and north of this core are suburban neighborhoods. To the east are privately owned wetland areas and Bayou Sauvage National Wildlife Refuge. This core is a prime area for redevelopment as a place that's central to the commerce and culture of the entire basin, with ongoing redevelopment efforts along key corridors such as Lake Forest Boulevard and Read Boulevard. This core provides a means of connecting between neighborhoods via blueways and greenways, and between the urbanized landscape in the western half of the basin to the wetlands in the eastern half of the basin through improved flows of nutrients and water across the basin.

## A Model for Water Management

At the same time, New Orleans East has opportunities for improving soil and water managment, because of its system of broad and interconnected canals, and because of the large parcels of vacant land that eixst throughout the core. Unlike any other basin, New Orleans East could reconfigure this area, the Heart of New Orleans East, to safely accept excess stormwater from the entire basin, enough to meet the water assignment for the entire basin for a T-10 storm without expanding pumping capacity. This will require incentivizing higher levels of stormwater retention on individual properties, strengthening streetscapes with plantings and stormwater features, creating lateral canals that densify the network of waterways that drain the basin, linking canals to existing lakes, and creating large detention basins and stormwater wetlands in fallow areas and along transportation corridors such as 510/Paris Road and Dwyer Road.

The result would be a landscape rich in water, a more stable landscape with improved groundwater balance in an area with highly organic soils, and a network of green and blue infrastructure that supports economic development, recreation, and local ecology.

# Heart of the East to Bayou Sauvage

New Orleans East's residential neighborhoods extend from the Chef Menteur Ridge to the lakefront. In between is the Heart of the East, an area rich with civic assets and commercial real estate.

The Citrus Redevelopment Zone and Eastern Water Walk anchor commercial redevelopment in the Heart of the East. Integrated Lakes and Wetlands strengthen the basin's canal network, which provides connections from the Heart out to wetland habitats of Bayou Sauvage.

**Water as Asset**

Left: Fishing camps all along the lakefront of New Orleans East preceded suburban development of the basin. Lincoln Beach served the area's African American population from 1939 to 1965.

Image courtesy of the New Orleans Public Library

Left: The construction of drainage canals and pump stations allowed for the drainage of marshlands, c. 1961

Image courtesy of J.R. St. Julien


1 A revitalized canal and district-scale water management can be paired with new commercial development to establish the **Citrus District** as a regional destination in the heart of New Orleans East.

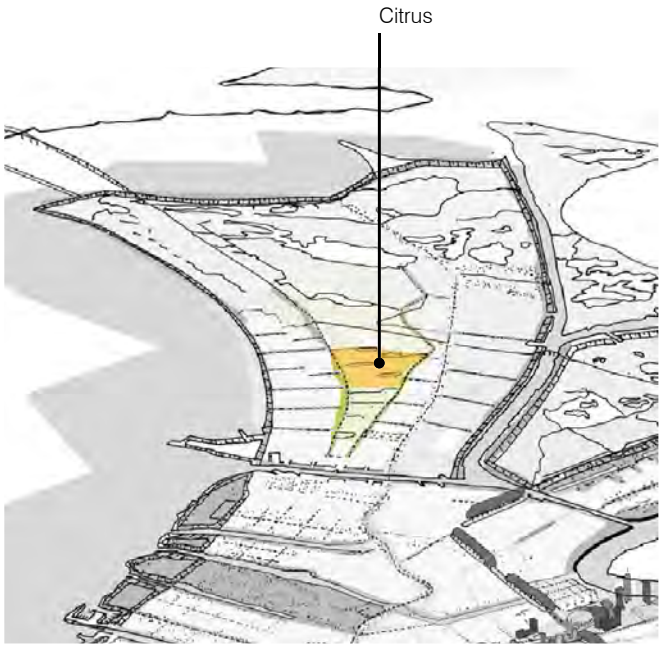
2 Strategies to slow, store, and use water on public and private properties along Lake Forest Boulevard make for an amenity-rich environment, the **Eastern Water Walk**.

3 The **Eastern Wetlands** form a corridor along Paris Road, extending from the lakefront and Bayou Sauvage National Wildlife Refuge, across the Gulf Intracoastal Waterway, and to the Central Wetlands Unit of the St. Bernard Basin.

# Citrus District

Linking existing lakes to drainage canals, new waterways and stormwater retention features, and streetscape improvements are the basis for sustainable soil and water management in New Orleans East.

- Create water storage along roadways
- Revitalize commercial corridors
- Propose site-level water management strategies suitable for privately owned properties
- Utilize new and existing waterways as shared amenities, and sites for redevelopment
- Link neighborhoods, commercial areas, and institutions with blue-green networks




North-south boulevards and major drainage canals alternate as one moves from west to east across New Orleans East. Together with the ridge of Chef Menteur Highway, and the east-west corridors of Dwyer Road, Interstate 10, and Morrison, these main lines of infrastructure subdivide the basin into large rectangular superblocks.

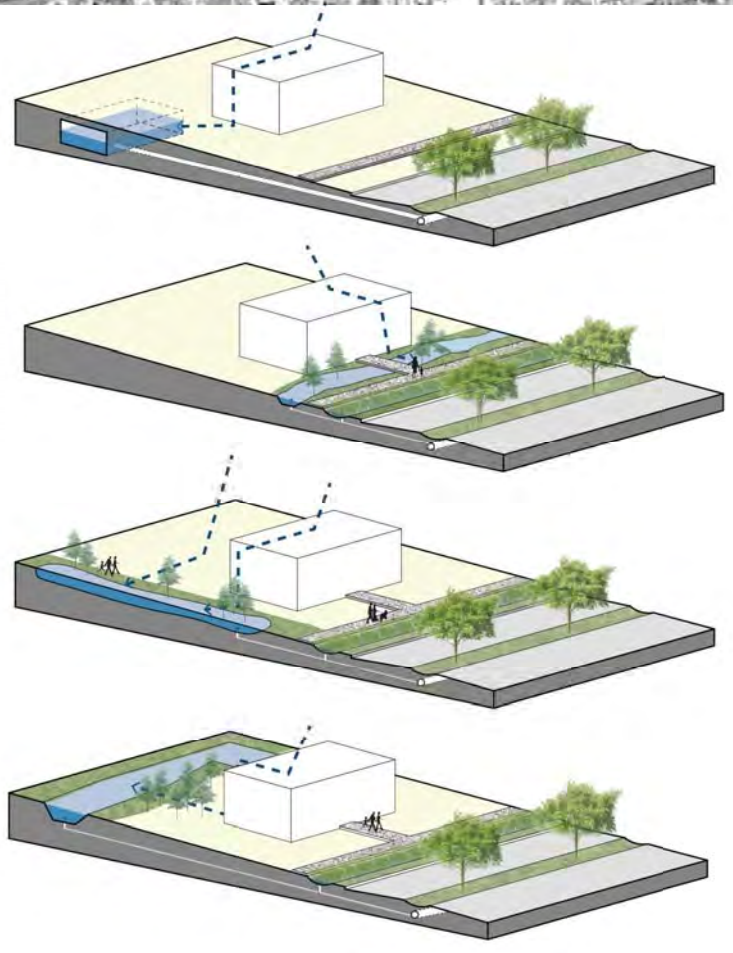
One such area is the Citrus District, named for the drainage canal that bounds this area to the west. Read Boulevard and Lake Forest Boulevard are important commercial corridors that intersect in the middle of the district. R2ead Boulevard is the site of some of the strongest redevelopment that has taken place in New Orleans East since 2005. In addition, a refurbished Joe Brown Park, a new public library, church, school, a range of businesses, and the ongoing redevelopment of the New Orleans East Hospital make Read Boulevard one of the most vibrant and important corridors in the entire basin.

The Urban Water Plan focuses on the Citrus District as one of the most promising locations for establishing a new paradigm for both water management and urban development in New Orleans East. Despite all of the activity along Read Boulevard, Citrus District faces many of the same challenges that other parts of the basin are also struggling. Large commercial and office buildings sit vacant, deep inside vast swaths of broken asphalt parking lots. Many of these are situated along Lake Forest Boulevard, a tree-lined corridor that winds its way through the district, and has the potential to attract developers, businesses, shoppers, and residents again.

By focusing attention on the Citrus District, the Urban Water Plan's proposals for New Orleans East allows for public and private investors to tackle the vacant properties and broader challenge of redevelopment one block, one corridor at a time. The strategies outlined for New Orleans East depend first and foremost on a new approach to water management and infrastructure, one that will yield long-term resiliency, immediate gains in the urban environment, and environmental conditions that will support redevelopment efforts by capitalizing on the water resources and infrastructure that are unique to the basin.

**Existing Landscape**

New Orleans East and the Citrus District still bear the marks of Hurricane Katrina, with many blighted properties and abandoned buildings throughout the basin. These areas, however, hold the promise of new forms of sustainable development.

**Design Guidelines for Citrus District**

Each property in the district can be designed to detain or retain at least the first 2.5 inches of runoff from a rain event. This is a higher standard than what is required for the rest of the region, but district-level incentives allow this ambitious goal to be achieved. Public spaces and new development are organized around parks, green and blue corridors, and new lateral canals that subdivide the landscape into distinctive subcatchments and development zones.

**Water Up Front**

Throughout the district, developers are encouraged to develop stormwater retention features at the front of the site, in contrast to conventional stormwater management features that are hidden at the back of a site or below ground. This emphasis on making water visible underscores the importance of integrating water and green infrastructure into the landscape and the sustainable development represented by the Citrus District.

Where space is at a premium, fostering collaborative efforts between property owners to construct and maintain shared stormwater features at the property line allows for more efficient designs, and shared benefits due to economies of scale.

### A Commercial Destination

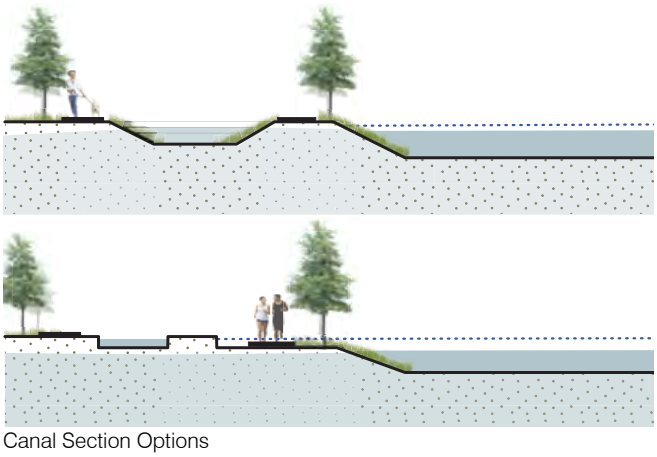
Above: Lake Forest Boulevard can become an attractive commercial corridor. Bioswales and tree plantings in the public right-of-way are an alternative to conventional subsurface infrastructure, making for a lush, planted ambiance that enhances the district's aesthetics and quality of life.

A district water management plan incentivizes the development of stormwater retention features on private properties between buildings and along Lake Forest Boulevard, further enhancing the boulevard as a blue-green corridor.

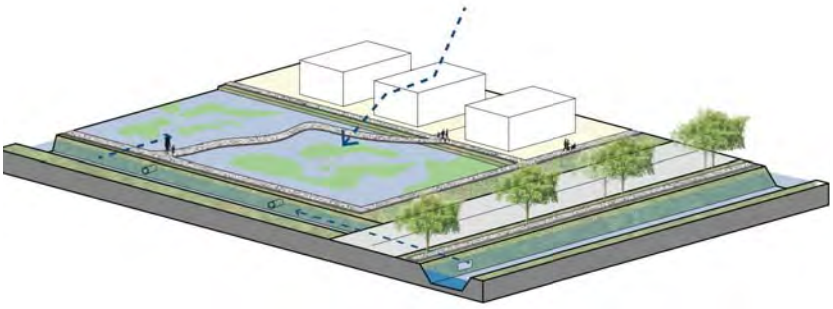
### Canal-front Real Estate

Right: Wide drainage canals order much of the lowland landscape of New Orleans East, but are largely underutilized as amenities. Low water levels, outfall pipes, poorly maintained banks, trash, and invasive species make for unappealing environments. Maintaining higher water levels and dry-weather flow, improving canal banks for public access and ecology, and developing retention features and public amenities alonside the canals that run through the Citrus District can reduce soil subsidence, improve water quality, and transform these existing features into important public assets for residents and visitors to the district.

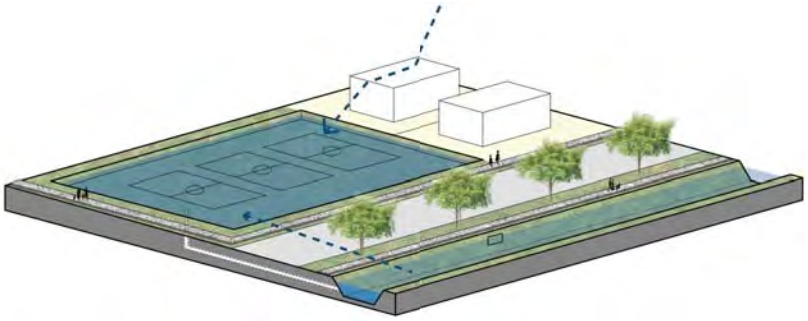
Waterfront Retail and Recreation



Canal Section Options



Wetland Storage



Floodable Program

**Dwyer Road Ecological Corridor**

Dwyer Road is an important thoroughfare that forms the southern edge of the Heart of New Orleans East. A canal that runs alongside the roadway redirects some of the runoff from the basin into the Industrial Canal via the Dwyer Road Pumping Station, located at the western terminus of the road.

The Urban Water Plan envisions this corridor as an even more important line of infrastructure. With a new connection to the Maxent Canal in Village de l'Est and Bayou Sauvage Wildlife Refuge beyond, the Dwyer Canal can be used to divert runoff from the ridge (Chef Menteur Highway) and the residential neighborhoods south of the canal, to the east and to the west, thereby reducing the load on the lakefront pump stations.

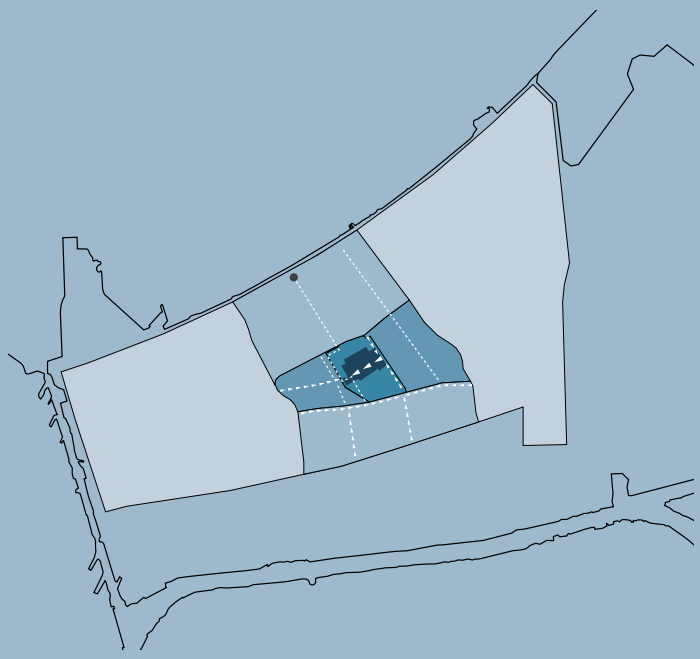
There are a large number of vacant and blighted properties along the Dwyer Road corridor, along with Joe Brown Park and the Louisiana Nature Center. Developing stormwater retention and filtration wetlands and basins along this corridor will allow Dwyer Road to become an ecological and hydrological backbone for the basin that stretches from the Industrial Canal to Bayou Sauvage.

**Eastern Lakes**

The lakes of New Orleans East hold water and provide waterfront real estate. The disparate water levels between the canal in the foreground and the lake in the background in the image above, however, show that water does not flow freely between the lakes and the canals in many cases. That is, these bodies of water hold runoff from the immediate surrounding area and overflow into the drainage canal network, but many do not provide as much storage capacity for the basin's drainage network as they would if they were directly connected to the canals.

Linking the lakes to the canals will allow for a more resilient network with expanded storage capacity, and healthier ecology as a network with improved water flow and a more diverse range of habitats. The added capacity provided by the lakes will allow system managers to maintain higher water levels in the canals without increasing flood risk, which will help stabilize groundwater levels and reduce rates of subsidence.

Approaching the basin's lakes and canals as an integrated network rather than as discrete features will strengthen the basin as a whole.



# Eastern Water Walk

Located in the middle of the Citrus District, in the Heart of New Orleans East, the Eastern Water Walk is a reimagining of the Lake Forest Boulevard corridor from the Citrus Canal to the west to Read Boulevard to the east. The project examines the ramifications of the Citrus District Plan at the site scale.

The commercial site design model of recent years is largely economics driven. Retail frontage, adequate and often excessive parking, and maximizing square footage of units have become the prevailing design criteria, often at the expense of landscape aesthetics, urban form, and importantly, processes for handling stormwater. Typically, impervious surfaces direct stormwater to a series of underground storm sewers as quickly as possible or, at best, direct stormwater to an unused area with the singular purpose of detaining water during storm events. The rationale is that real estate is too valuable to devote square footage to addressing stormwater quantity and quality issues.

The net results are large quantities of stormwater that collect contaminants and are directed to public drainage corridors and ultimately the Gulf. Water is not filtered in this process and moves at a rapid rate, resulting in erosion and flooding downstream. Additionally, water does not infiltrate into the ground, resulting in groundwater imbalances and subsidence.

The Eastern Water Walk seeks to resolve the tension between economically viable development and sustainable stormwater management. The premise is to achieve every economic goal of commercial development, while introducing efficient site design principles and promoting versatile construction materials and methods in managing site runoff. Thus, it is a valuable prototype for development in Greater New Orleans. While the existing model compartmentalizes site uses, designating areas strictly as parking, buffer, retention, and building, this demonstration project endeavors to thread program together in order to provide multiple functions on the same square footage.

### Catchment Area

The Eastern Water Walk is an area along Lake Forest Boulevard within the Citrus District, which is designed as model for storing 2.5 inches of stormwater on every site.

### Water Assignment

The Urban Water Plan's goal for individual lots is to slow and store the first 1.25 inches of rainfall on every lot. The strategies proposed for the Eastern Water Walk -- representative of strategies that are appropriate for the entire Heart of New Orleans East -- provides 2.5 inches of storage on each site, with additional capacity provided by new lateral canals, stormwater retention features alongside roadways and in public spaces, and within widened canals. With these measures in place, the Heart of the East would have the capacity to safely store more than 100% of the water assignment for the entire basin, even with raised water levels in the drainage canals.

### Cost Estimates

The following costs are broken down for different measures for stormwater management and canal infrastructure. Each of these measures is integral to the Eastern Water Walk proposal, and will need to be adjusted to match the specifics of each location.

| Design Component | Costs |
|---|---|
| New Lateral Canal | $ 2,402,382 |
| Floodplain Edge | $ 110,739 |
| Water Plaza Edge | $ 2,836,026 |
| Basic Access Edge | $ 209,524 |
| Outdoor Market Place | $ 1,983,647 |
| Lake Forest Boulevard | $ 20,919,463 |
| TOTAL | $ 28,461,781 |


**Redevelopment along Lake Forest Boulevard**

The site design intends to store the first 2.5 inches of a storm event through a district-scale vascular stormwater system, and stormwater detention and retention features on every property. Water in excess of the first 2.5 inches storm event will then be drained by conventional subsurface infrastructure. The conceptual design begins with adjustments within the right-of-way to Lake Forest Boulevard, the major east-west corridor through the area of study. Drive lanes will be adjusted to more appropriate widths and designated areas for bicycles and pedestrians will promote a more complete street. Additionally, this circulation corridor will operate as the major stormwater corridor. Bioswales on either side of the road will serve as the required green buffer and allow for substantial stormwater storage.

1 Hospital

2 Lowe's

3 Vacant Theatre

4 Executive Plaza

5 Forebay

6 Continuous Swale Stormwater Collection

7 "Back of House" Stormwater Storage

8 "Front of House" Stormwater Storage

9 Edge Stormwater Condition

10 Focal Point Stormwater Collection

11 External Shared Stormwater Storage

12 Shared Stormwater Storage

13 Urban Strip Stormwater Collection

14 Parking Stormwater Collection

15 Green Roof

16 Outdoor Market Space

Existing Buildings

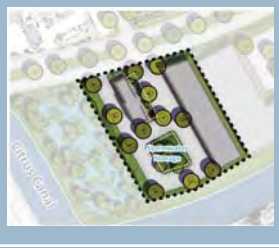
Proposed Buildings

**Toolbox for On-site Stormwater Management**

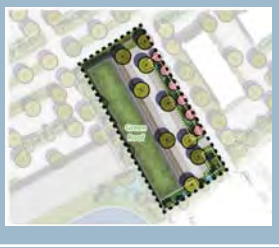
Neighbor Mitigation


Infrastructure Demolition


Shared Resources

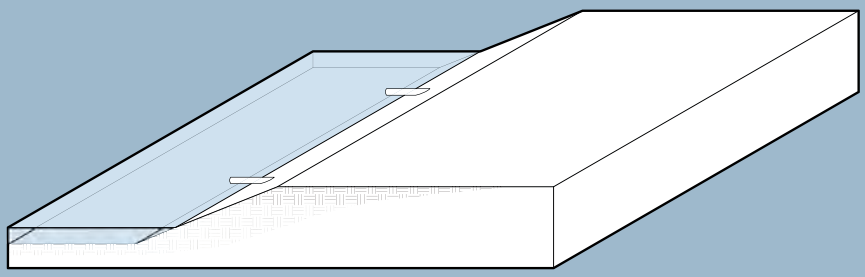



Low Impact Infrastructure



### Making Use of Citrus Canal

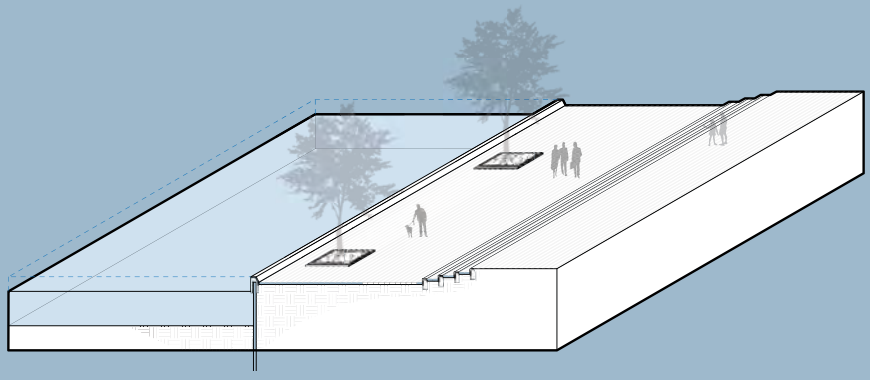
The Citrus Canal anchors the Eastern Water Walk as a major existing water feature. The existing canal edges can be transformed from an unkept backyard condition to a front yard condition, inviting access to the waterfront.



Existing North/South Canal Axonometric

### Water Plaza Edge

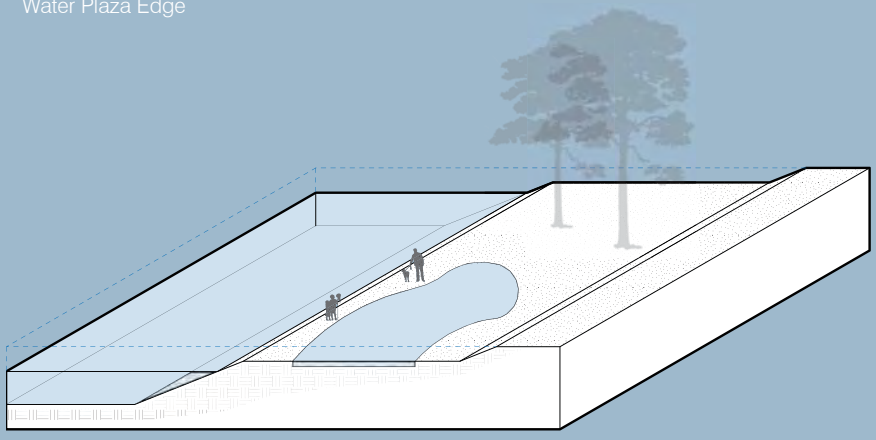
New profiles for canal edges can help revitalize adjacent businesses and residential neighborhoods. The water plaza edge provides a more formal urban landscape constructed with pervious pavers that allow for infiltration and heavy use. During heavy rainfall, the plaza can be flooded, providing additional storage capacity alongside the canal.



Water Plaza Edge

### Floodplain Edge

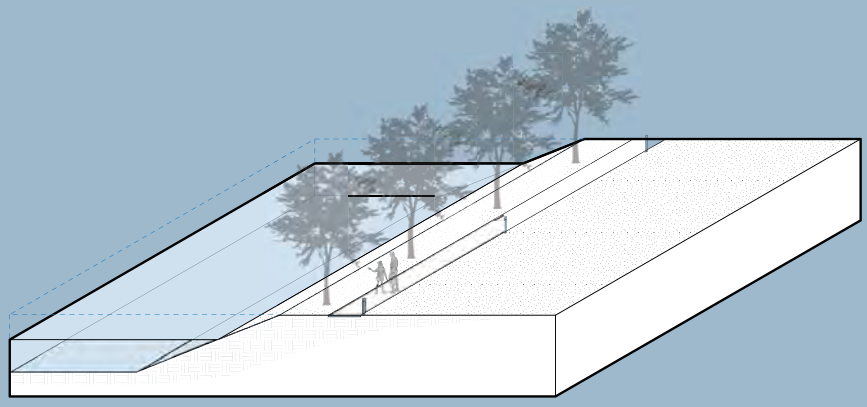
A floodplain edge allows the canal to safely overflow its banks during heavy rainfall. During dry weather, the floodplain is a vegetated shelf planted with cypress, tupelo, reeds, and marsh grasses.



Floodplain Edge

### Basic Edge

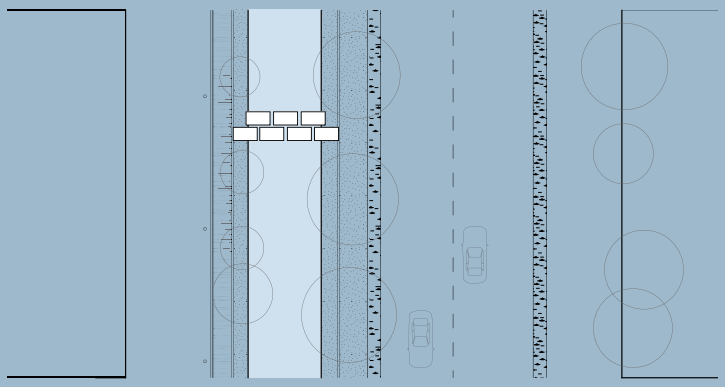
The basic edge requires no excavation and provides public access along the canal. Walkers, joggers, and cyclists can make use of a six foot wide porous asphalt pathway, with trees and solar-powered lighting bollards providing shade and safety.



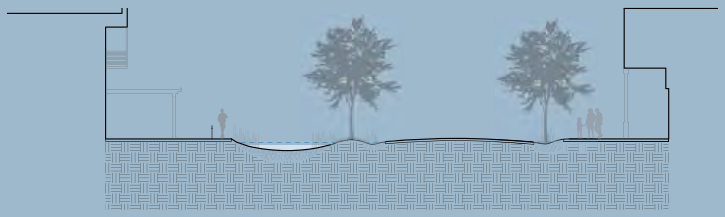
Basic Edge Access

### Lateral Canals

Right: A denser network of surface waterways improves stormwater retention, infiltration, and conveyance, and water quality and groundwater balance during dry weather. New lateral canals are smaller waterways that form new connections between the basin's primary north-south canals.



Lateral Canal Plan



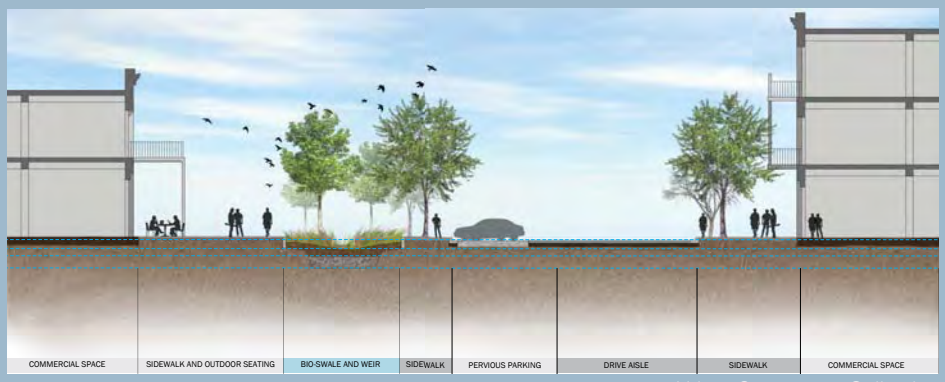
Lateral Canal Section

### Urban Stormwater Collection Strategy

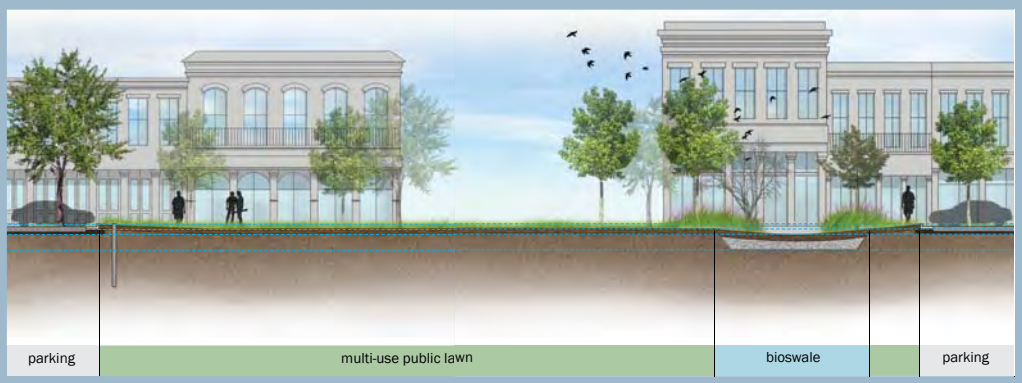
Right: Smaller bioswale applications within the Eastern Water Walk will collect and store stormwater.

Below right: Designated stormwater storage areas will hold the first fliush in rain gardens. Additional rainfall will fill surface storage in and around the bioswale. Rainfall beyond 1.5 inches, and up to 2.5 inches, will fill common spaces such as buffer zones and market grounds.

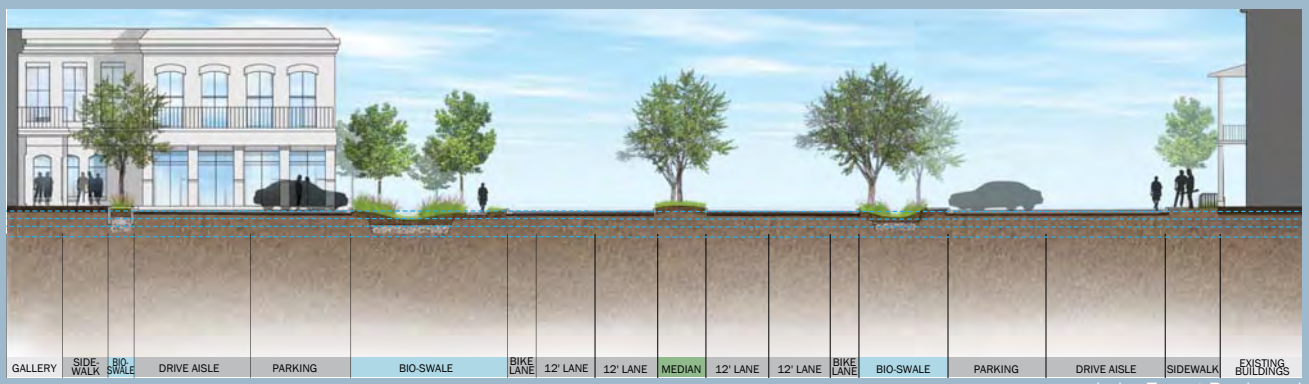
Bottom: Lake Forest Foulevard, as it exists today, is excessively wide for the four lanes of traffic it now holds. The roadway can be narrowed to provide stormwater storage within the right-of way in the form of bioswales on either side of the road.




Urban Stormwater Collection




Storage Zones



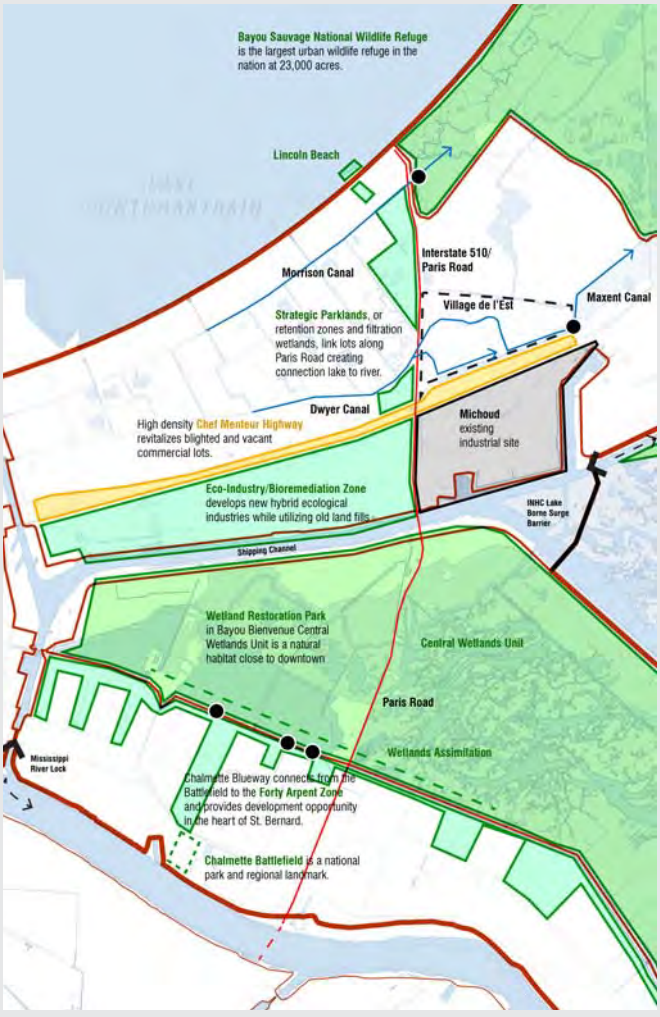

Lake Forest Boulevard

# Eastern Water Walk

The Citrus Canal, adjacent to the New Orleans East Hospital and  at the western end of the Eastern Water Walk. can be a beautiful public asset that draws people at all hours of the day, a site for commercial redevelopment, and a model for sustainable water management in the lowlands of New Orleans East.

# Eastern Wetlands

Bayou Sauvage National Wildlife Refuge anchors a corridor of wetlands, fallow properties, industry, and communities that stretches from Lake Pontchartrain to the Mississippi River. This corridor holds opportunities for ecological restoration, system-scale stormwater management features, industrial development, and recreation.




Established in 1990, Bayou Sauvage National Wildlife Refuge is the largest urban wildlife refuge in the nation, with 24,000 acres of fresh and brackish marshes, bayous, coastal hardwood forests, ponds, borrow pits, and cheniers. The refuge supports over 340 bird species, including tens of thousands of migratory waterfowl as well as year-round residents like the brown pelican. Other wildlife include small mammals and alligators.

The U.S. Fish & Wildlife Services operates floodgates and pumps to regulate water levels and salinity levels in the refuge to increase diverse bird populations, protect and conserve threatened native species, protect archaeological resources, and provide urban wildlife and fish recreation and education.

The Urban Water Plan proposes directing some of the stormwater and all of the dry-weather flow of the New Orleans East canal network into Bayou Sauvage, as an additional source of freshwater with which to enhance hydrological conditions within the refuge and in nearby wetlands. This requires the construction of a pump at the eastern end of Morrison Canal, and a new connection between the Dwyer Canal and the Maxent Canal, which will allow water to flow from Dwyer Canal through Village de l'Est and to an existing pump station at the at the southeastern end of Village de l'Est.

Establishing these flows of water eastward towards Bayou Sauvage is important because doing so provides an outlet for dry weather flow through the canal network, and restores to a degree the flow of water across the delta. The flow of water between urbanized areas and wetlands also establishes a direct connection between the the wetlands and water features of the Heart of New Orleans East to the wetland habitats of Bayou Sauvage, making for a richer and stronger regional ecology.

Located at the northern end of the 510/ Paris Road corridor, Bayou Sauvage belongs to a broad corridor of publicly and privately owned wetland assets, fallow lands, industry, and infrastructure that extends from Lincoln Beach at the lakefront, down through the industrial facilities of Michoud, across the Gulf Intracoastal Waterway, through the Central Wetlands Unit and Forty Arpent Zone of St. Bernard Basin, and all the way to the Chalmette riverfront.

**Bayou Sauvage**

Located entirely inside the federal levee system, the Bayou Sauvage National Wildlife Refuge is an important ecological asset for New Orleans East and Greater New Orleans as a whole.

**Shrimping Boats in St. Bernard**

For centuries, the residents of St. Bernard have made their fortunes in the wetlands, open seas of delta, and the Gulf of Mexico.

# 5 St. Bernard's Watercourses

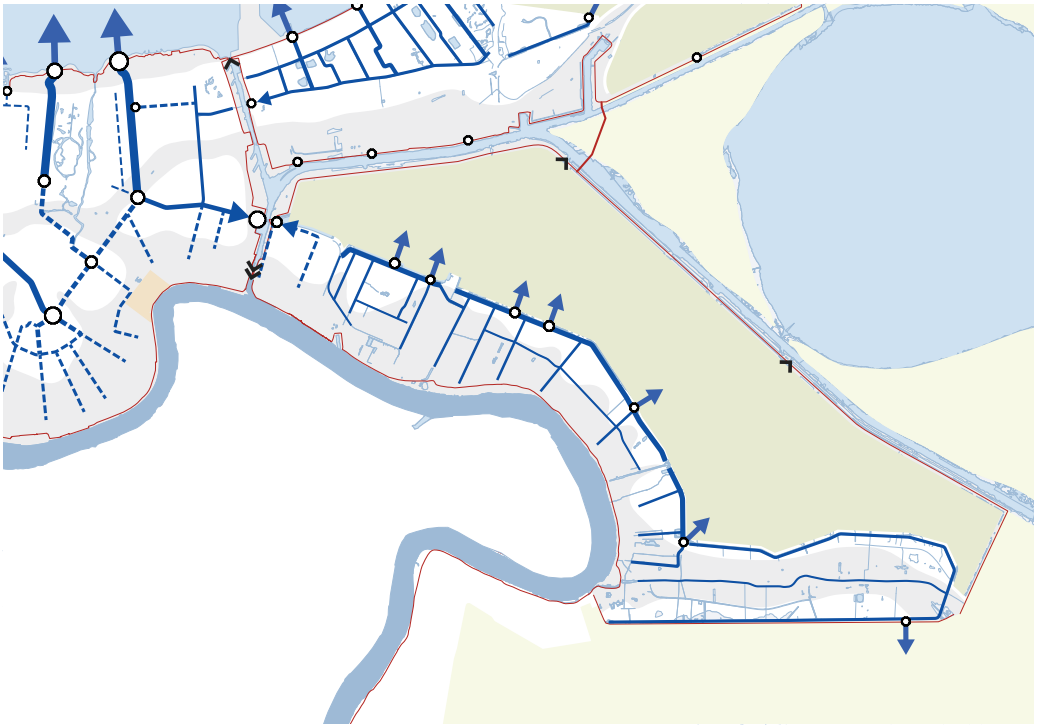
## LOWER NINTH WARD AND ST. BERNARD PARISH

"The engineered solutions are a critical component, but truthfully, that's only one piece of the puzzle. People have to understand that there are long term changes that need to happen and everyone plays a part."

—Nick Cali, *Director of the Lake Borgne Basin Levee District*

**Existing Landscape**

Clockwise from top: drainage canal with stagnant water, vacant lots, Forty Arpent Canal, industrial facilities along the riverfront in the Lower Ninth Ward



**Existing Drainage System**

The Forty Arpent Canal collects all drainage from St. Bernard's drainage canal network. Pump stations drain stormwater runoff from the Lower Ninth Ward into the Industrial Canal and from St. Bernard into the Central Wetlands Unit.

# Lower Ninth Ward and St. Bernard Basin

Bounded by the Mississippi River, the Industrial Canal, and the Gulf Intracoastal Waterway, the Lower Ninth Ward and St. Bernard belong to the same hydrological basin, and share geo-hydrological characteristics and ecological assets, even if they are governed separately by two different parish governments.

## Backslope to Forty Arpent

As in the Jefferson-Orleans Basin, the highest ground in the basin is the backslope of the Mississippi River levee. This high ground is the site of the basin's historic settlements, from the Holy Cross neighborhood in the Lower Ninth Ward to Old Arabi, Chalmette, Meraux, and Violet in St. Bernard Parish. Industrial installations such as ports, oil and gas refineries, and the Domino Sugar Refinery are also located along the riverfront, so that much of the this land is not publicly accessible.

Two main thoroughfares, St. Bernard Highway (St. Claude) and Judge Perez Highway (Claiborne), are the main commercial and institutional corridors that run east-west through the basin. In Chalmette, Paris Road extends from the riverfront in St. Bernard to New Orleans East across the Central Wetlands Unit, and across the Mississippi River to Algiers via ferry. Residential neighborhoods are located on the backslope, between the river and the Forty Arpent Canal. The land slopes down gradually from the river towards the Forty Arpent Canal, and stormwater flows via gravity flow through drainage canals into the Forty Arpent Canal. Pump stations arrayed along the canal lift stormwater over the internal levee and into the Central Wetlands Unit, which is connected to the Intracoastal Waterway and Lake Borgne via operable gates at Bayou Bienvenue and Bayou Dupre.

Though it belongs to the same hydrological basin, the Lower Ninth Ward is drained separately by a subsurface pipe network that conveys water to Pump Station #5, which lifts stormwater into the Industrial Canal.

## Lower St. Bernard

The Violet Canal divides the basin in two. Lower St. Bernard is the area further downstream that is oriented along the ridge formed by the Bayou Terre aux Boeufs. No longer connected to the river, the bayou is a stagnant ditch that runs alongside Lower Bayou Road.

Historic rural communities are situated off of Bayou Road, and stormwater drains off of this high ground towards canals located at the perimeter of the basin.


Restored wetland habitats, linear parklands, and a combination of urban blueways and neighborhood-scale water features build upon the basin's existing canal network and ecological assets. The Urban Water Plan's proposals enhance soil stability and environmental quality across the basin, while enhancing the identity of St. Bernard and the Central Wetlands Unit as a primary gateway to local wetlands and the Gulf of Mexico.

**Proposed Living Water System**

The proposed system will reconnect the drainage networks of the Lower Ninth Ward and St. Bernard Parish. Freshwater sources will enhance water flow and water quality through the basin's canals, and strategic parklands will increase system storage and access to the Central Wetlands Unit.

# St. Bernard's Watercourses

The basin can be organized into three zones. The first is an area of historic settlements and industrial activity on the high ground along the Mississippi River where small scale interventions and interceptor streets will reduce runoff from the backslope. The second is a more suburban and largely residential zone with two major east-west thoroughfares that are the primary commercial corridors for both the Lower Ninth Ward and St. Bernard Parish, where stormwater corridors and improved canals will anchor redevelopment. The third is a lower-lying area with large numbers of vacant parcels and more subsidence-prone organic soils where the construction of strategic parklands will provide stormwater storage, new habitats, and access to the Central Wetlands Unit.

## Combined Systems

Even though the Lower Ninth Ward and St. Bernard Parish belong to the same hydrological basin, as they are bounded by the same federal levees and floodwalls, they have two separate drainage systems that were once hydrologically connected, so that water could flow back and forth between the two parishes. Reconnecting these systems at the northern edge of the basin, at the parish line, would strengthen stormwater management in the basin as a whole, because the pump stations and canals on both sides of the parish line would be able to support each other during intense rain events and hurricanes. Building this would require the construction of a surface canal alongside Florida Avenue in the Lower Ninth Ward as a continuation of the Forty Arpent Canal of St. Bernard.

## Strategic Parklands

The Forty Arpent Canal and its extension into the Lower Ninth Ward are the basis for establishing strategic parklands between the urbanized areas of the basin and the Central Wetlands Unit to the north. The canals demarcate an important line that marks not only the lowest areas in the basin, but also the line to which all stormwater runoff flows. All of the basin's pump stations are located along this line. Stormwater detention and retention basins located in these parklands will improve water and soil management in the entire basin, by providing storage and infiltrating stormwater into the ground.

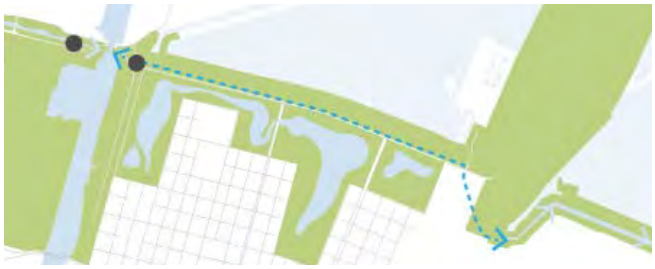
## Waterfronts

With the riverfront forming its southern edge, an open canal network, and the Central Wetlands Unit as a shared asset to the north, St. Bernard Basin has the opportunity to reestablish its identity around its waterfronts and watercourses.

# River to Forty Arpent

The Lower Ninth Ward and Chalmette belong to the same hydrological basin. Both districts slope from the river down to the Forty Arpent Canal Zone, where a backbone canal and wetland basins provide storage during heavy rainfall.

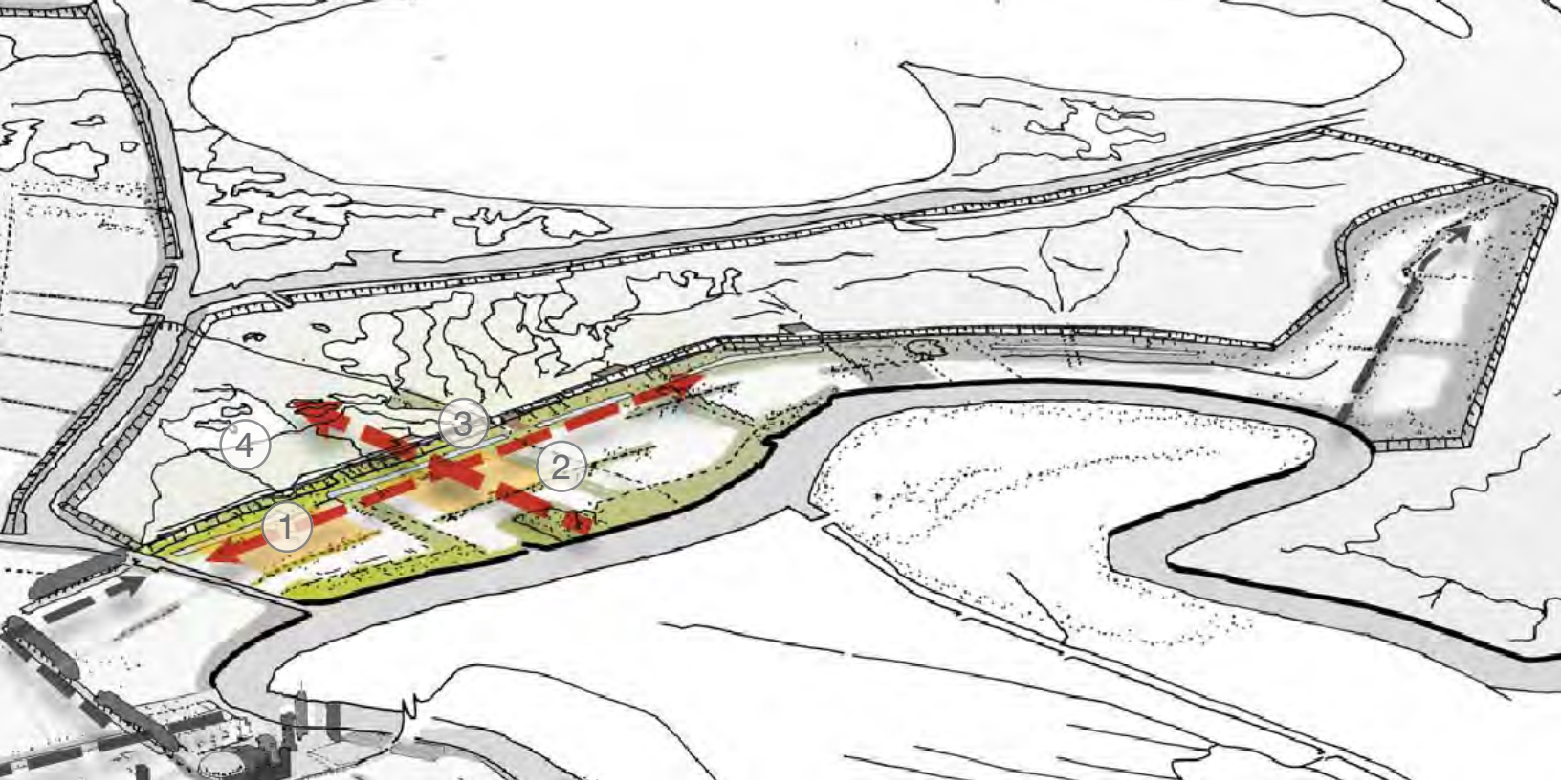
The Forty Arpent Canal Zone is also the region's entry point to the Central Wetlands Unit, a levee-protected urban wetland that is only a few minutes drive from the French Quarter.



**Reconnect the Forty Arpent Canal**

Left: Reconnecting the drainage systems of the Ninth Ward and Upper St. Bernard by extending the Forty Arpent Canal back across the parish line can create a more adaptable and stronger drainage system for residents on both sides of the parish line.

Left: The Forty Arpent Canal is underutilized as a beautiful waterway unique to the St. Bernard Basin.




1 Creating wetland zones along the northern edge of the **Lower Ninth Ward** and sustainable development around these new features supports existing recovery efforts, and strengthens the district as a whole.

2 The **Chalmette Blueway** draws flowing water, public parks, and new development through St. Bernard, from the Chalmette Battlefield to the Forty Arpent Canal.

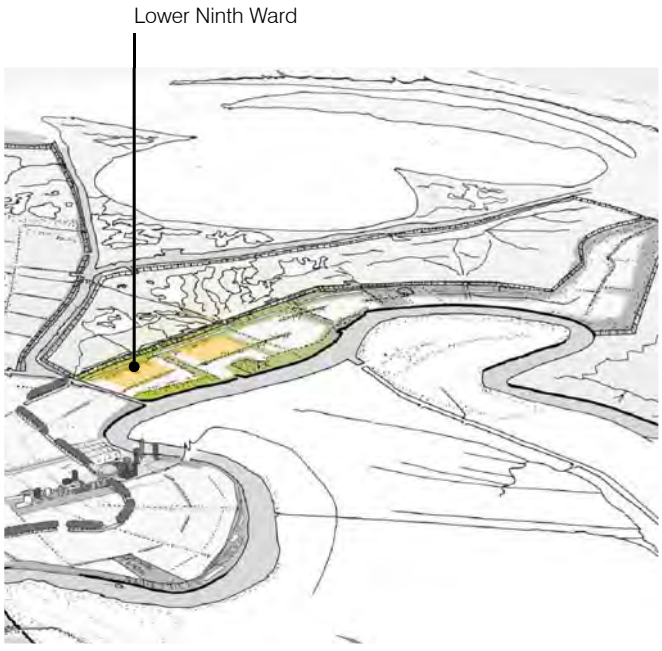
3 The **Forty Arpent Canal Zone** can provide expanded storage capacity, while providing wetland habitats, recreational options, and access to the adjacent Central Wetlands Unit.

4 The **Central Wetlands Unit** Assimilation Project will restore part of this wetland ecosystem with freshwater and nutrients.

# Lower Ninth Ward

## Three zones and two primary corridors define appropriate water management strategies, as well as patterns of development.

- Slow and store water on high ground
- Encourage residential development alongside stormwater corridors
- Create strategic parklands for system-scale stormwater storage and to provide new habitats
- Restore connection between the drainage systems of the Lower Ninth Ward and Upper St. Bernard
- Reduce the rate of subsidence in low-lying areas
- Improve access to Bayou Bienvenue and the Central Wetlands Unit
- Establish commercial nodes to spur economic development




Construction of the Inner Harbor Navigation Canal in the early twentieth century and the Gulf Intracoastal Waterway a few years later divided the Ninth Ward into three and surrounded the Lower Ninth Ward on three sides with water. The fourth edge is whared with St. Bernard Parish. The Central Wetlands Unit, the Lower Ninth Ward and St. Bernard comprise the St. Bernard Basin. All three are protected by the same perimeter levees, though an internal levee separates the Central Wetlands Unit from the urbanized areas.

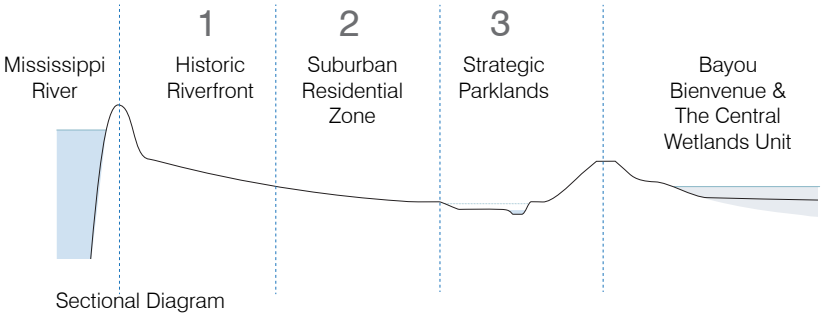
The Lower Ninth Ward and Upper St. Bernard share topographical, geological, and hydrological characteristics, as well as opportunities that are unique to the basin. Clear patterns of development and stormwater features can be established as the ground slopes away from the river. The earliest settlements and industry took place along the high ground of the riverfront, and this area has also seen the highest rate of return since 2005. The riverfront is already widely used as a promenade, a place to enjoy the river, and a vantage point to look back at the skyline of the city. On the backslope, rain gardens and improved stormwater detention reduce runoff.

Two major corridors, St. Claude and Claiborne, extend from west to east, connecting the Lower Ninth Ward to downtown New Orleans and to St. Bernard. Streetscape improvements can improve stormwater retention and draw new commerce and activity to these corrridors. Farther away from the river, stormwater corridors made out of vacant lots intercept runoff moving downslope, infiltrate stormwater, and provide recreational amenities to serve nearby residents. Grouping new residential development around these corridors can support a more sustainable pattern of development in lower-lying areas.

A new canal, overflow basins, and wetlands at the northern edge of the district can connect the Ninth Ward ecologically to Bayou Bienvenue and the Central Wetlands Unit, St. Bernard downriver, and the Industrial Canal and Desire parklands upriver. The new canal restores the hydrological connection between the Lower Ninth Ward and Upper St. Bernard that once existed, and which is important to improving basin-wide water management as a whole.

**Existing Landscape**

With water on three sides, an advantageous location minutes from downtown, and large numbers of vacant and blighted properties, innovative and sustainable infrastructure and development are possible in the Lower Ninth Ward that will strengthen the landscape and draw both new residents and visitors.


Sectional Diagram
Exaggerated vertically

**Lower Ninth Ward**

Stormwater features that are specific to the topography and soils of each area within the district organize more resilient patterns of development, while strengthening the identity of the Ninth Ward as a place with distinct cultural and natural assets.


Three Zones of Development

Commercial Nodes

Relink the Drainage Networks

**Wetlands Interface**

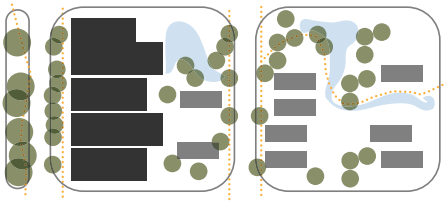
Above: Strategic parklands located along the northern edge of the Lower Ninth Ward, the mid-ground in this view facing upriver towards downtown, provide stormwater storage, double as a buffer along a vulnerable edge, and bridge between the urbanized landscape and the Central Wetlands Unit.

**Water Management on the Backslope**

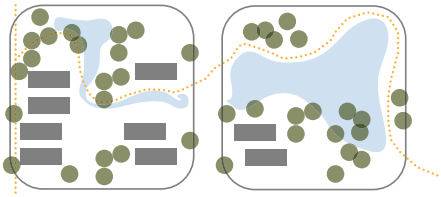
Right, top: Streets are lined with trees and bioswales, with building and site runoff stored on site.

Right, middle: The suburban residential zone provides more stormwater storage and infiltration in the form of linear stormwater corridors.

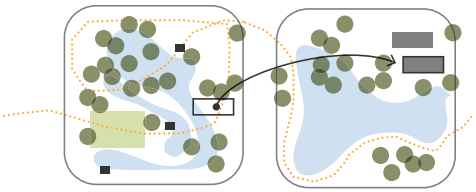
Right, bottom: The strategic parklands border the Central Wetlands Unit. Development of this zone includes detention basins as well as surface water bodies for maintaining groundwater levels and wetland habitats, as well as athletic fields, nature walks, and pedestrian pathways.



Suburban Residential Zone



Suburban Residential Zone to Strategic Parklands

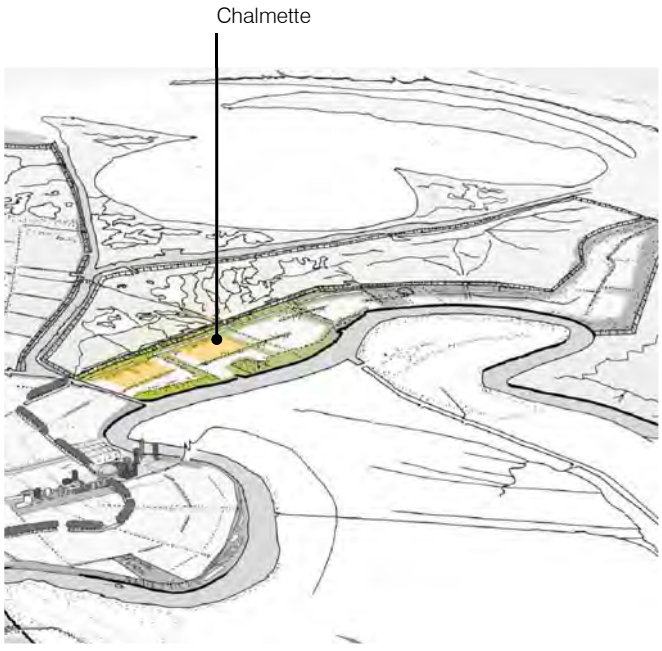


Strategic Parklands

# Chalmette Blueway

## Chalmette presents an opportunity to connect the Chalmette Battlefield at the riverfront to the Forty Arpent Canal and Central Wetlands Unit.

- Establish a new hydrological connection from the riverfront to the Central Wetlands Unit
- Improve water quality and flow through the drainage canal network by providing a freshwater source
- Create development zones through the heart of Upper St. Bernard that build upon existing commercial and institutional facilities




The Chalmette Battlefield is part of Jean Lafitte National Historical Park and a site of historical significance to the country, It is, however, currently disconnected from the basin's other landmarks, civic assets, and institutions. The Urban Water Plan proposes a new urban amenity for the very core of Upper St. Bernard. The Chalmette Blueway will flow from the river to the wetlands, linking the Chalmette Battlefield to the new parish hospital, commercial centers along St. Bernard Highway and Judge Perez Drive, the parish's government center and the water features and habitats of the Forty Arpent Canal Zone and the Central Wetlands Unit. Because over half of the basin's entire population lives within three miles of the new Blueway, it brings direct benefits to the everyday lives of those who live close by.

A new siphon introduces freshwater from the Mississippi River onto the backslope of the St. Bernard Basin, which allows for a continual flow of water through St. Bernard's canal network into the Forty Arpent Canal. As the ground slopes down and away from the riverbank, a series of weirs set into the canals at regular intervals maintains higher water levels during dry periods. This reduces the rate of subsidence in areas with highly organic soils, while the flow of water through the canals combats the spread of invasive plants as well as the breeding of mosquitoes.

Located between the historic communities of Arabi and Chalmette, the Chalmette Blueway strengthens the canal network as the basin's primary distribution system for freshwater, while park spaces, wetlands and floodable detention zones on either side enlarge the water storage capacity of the network. These features are also the basis for new commercial and residential development opportunities. Shopping plazas, housing units, and civic spaces look out onto urban waterfronts and park spaces. Residents and visitors can make use of the blueway's paths and trails to travel north and south across the basin, where major thoroughfares run east-west and are difficult to cross. The Blueway is possible only in the St. Bernard Basin, because no other basin has a similar stretch of open land, or the opportunity to improve access and connections between the basin's most important assets.

**Existing Landscape**

Upper St. Bernard has wonderful assets in the form of waterways and historic oak corridors, but many of its neighborhoods struggle with expanses of vacant land and stagnant drainage canals.


A weir for maintaining higher water levels, with new development along the waterfront

**Chalmette District Plan**

The Chalmette Battlefield at the riverfront connects to the Forty Arpent Zone and the Central Wetlands Unit. At the very core of St. Bernard, a new waterway flowing from the river to the wetlands links the Chalmette Battlefield to the new parish hospital, key commercial centers along St. Bernard Highway and Judge Perez Drive (a continuation of Claiborne Avenue), the parish's government center, and the water features and habitats of the Forty Arpent Zone and the Central Wetlands Unit.

This flow of fresh water across the basin provides the basis for new commercial and residential development opportunities, stormwater storage features, and improved groundwater management in the low-lying areas of the basin where the soils are most susceptible to subsidence.

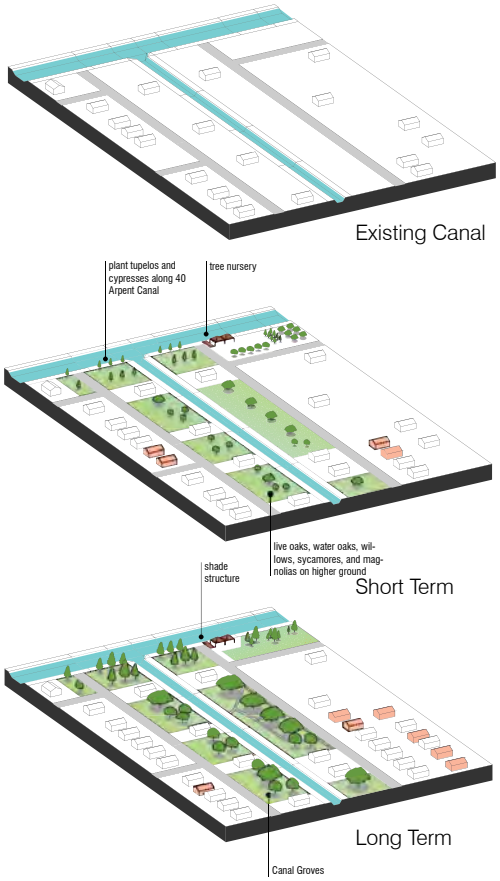
**Making Use of Waterways**

Above: The new Chalmette Blueway provides sites for waterfront development, and serves as a model for integrating the basin's many underutilized waterways into the urban landscape. With weirs and a freshwater source to control water levels and flow, rows of trees along canal banks, and investment in public spaces alongside, each waterway can become a connective element and public asset.

Right, top: Vacant lots along Chalmette's north-south drainage canals can be used to reduce the sloughing of canal banks, and to provide open spaces for passive recreation.

Right, middle: A short-term development plan uses these vacant lots to enhance the parish's tree canopy while providing better definition to the parish's communities by emphasizing existing waterways as green and blue corridors.

Right, bottom: Canal Groves are designed to be low in cost and maintenance and include amenities such as pathways, signage, and open groves of trees. In addition to providing public amenity, these groves slow, store, and use stormwater.



# Forty Arpent Canal Zone

**Catchment Area**

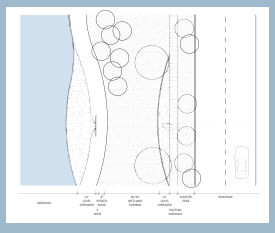
The Forty Arpent Canal Zone provides more storage at the lowest elevation in Chalmette along the sparsely populated area next to the Forty Arpent Canal.

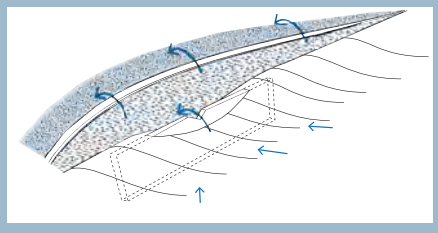
**Water Assignment**

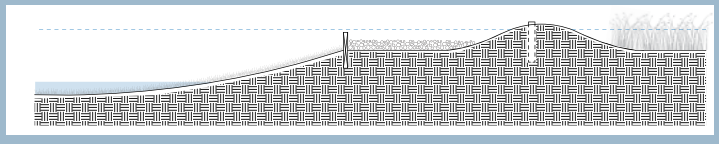
The demonstration project provides 60 acre feet of additional storage. Because there is no T-10 water assignment for this particular catchment area, the proposed retrofits will allow system managers to raise water levels in the drainage canal network in order to reduce subsidence, and also detain up to the first three inches of runoff from the surrounding neighborhood.

**Cost Estimates**

The design proposal is two-fold: a redesign of the Chalmette Vista lateral canal leading to the Forty Arpent Canal and the Forty Arpent Canal itself. Design details are provided for the Chalmette Vista Canal below.







| Design Component | Costs |
|---|---|
| Chalmette Vista Canal | $ 888,877 |
| Forty Arpent Canal | $ 4,593,604 |
| Marina Facility | $ 3,450,861 |
| TOTAL | $ 8,933,342 |

At the proposed Jean Lafitte Parkway Visitor Center, pavilions and outdoor interpretive educational displays can serve as the arrival point for residents and visitors. Extending from the center is a series of rectangular wetland terraces stretching from the center along the length of the Forty Arpent Canal to the Chalmette Vista Canal. Closest to the Forty Arpent is a native grasses floodplain area, over which visitors can view the Central Wetlands. A bottomland hardwood forested wetland is located to the south, creating another type of wetland habitat. South of the forest and near the Visitor Center will be wetland swamp areas, sited at a lower elevation than the forest. These zones are demarcated by crushed stone paths, and are connected by pipes that convey water from level to level. The environmental outdoor education center would require the relocation of a few houses that exist along the Forty Arpent Canal to more valuable homesites across from the new open space and education center.

The outflow from the culvert beneath Jean Lafitte Parkway will be diverted from the Forty Arpent Canal, and rerouted to the bottomland hardwood/wetland system. This will provide a space to slow, filter, and stormwater before it enters the canal. The bottomland hardwood/wetland area has the capacity to handle up to a three inch storm event. A large overflow is provided for storm events that exceed three inches.

Along the Chalmette Vista Canal, open green space will connect the Forty Arpent Canal and the Central Wetlands Unit back into Chalmette. At outfall pipes, neighborhood runoff will flow into water quality treatment forebays. Forebay weirs will control outfall into the Chalmette Vista Canal, where water levels will be raised to improve groundwater balance. Crushed stone paths will follow along the treatment forebay edges and a new sidewalk and street trees will line Kings Drive. The redesign of the Chalmette Vista Canal corridor is intended to serve as a model that can be replicated along other lateral canals in St. Bernard Parish.

**Forty Arpent Canal Zone Plan**

Strategic parklands are established around the basin's most important canal. Situated in the lowest lying area of the basin, where the soils are weakest, the Forty Arpent Zone is the line to which the basin drains, and the interface between urbanized areas and the Central Wetlands Unit.

Increasing the stormwater storage capacity of the Forty Arpent Zone, in the form of floodable areas and wetlands basins reduces the pumping that is necessary with each rainstorm and improves both stormwater and groundwater management for St. Bernard Parish and Lower Ninth Ward residents.


40 Arpent Canal Zone Section A


Chalmette Vista Canal Section B


View on Lawn adjacent to Forty Arpent

# Forty Arpent Parklands

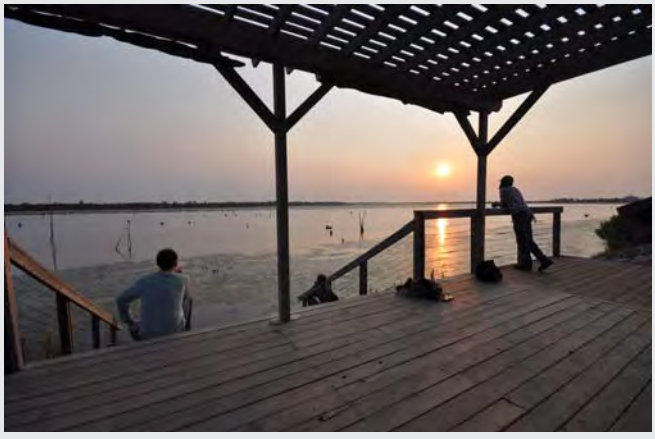
The Forty Arpent Parklands forms the backbone of the Chalmette District and larger St. Bernard Basin, connecting between neighborhoods and serving as a transitional zone between urban/suburban areas and the Central Wetlands Unit.

# Central Wetlands Unit

Forty seven square miles of wetland can be restored as a regional asset. Bounded to the south by St. Bernard and the Lower Ninth Ward and to the north by the Gulf Intracoastal Waterway, the Central Wetlands Unit is critical to the safety of the entire region as a wetland buffer, as the outfall area for St. Bernard's drainage networks, and as a potential relief area for the Industrial Canal during the heaviest rain events.

Facing Page: Louisiana swampland (Jean Lafitte National Historical Park and Preserve)

Below: Bayou Bienvenue outlook in the Lower Ninth Ward



The Central Wetlands Unit, on the other side of an internal levee, bounds both the Lower Ninth Ward and St. Bernard Parish to the north. This area was once a tupelo-cypress swamp, but the construction of the Mississippi River Gulf Outlet (MR-GO) directed salt water directly from the Gulf into the wetlands, destroying swamp vegetation and wildlife. What remains today is a broad expanse of shallow open water. The stumps of cypress trees dot the landscape as reminders of a once thriving habitat that supported not only innumerable species, but was also a source of food and recreation for nearby residents.

This landscape, though devastated by the loss of the swamp and by the storm surge of Katrina, is poised for renewal. The closure of MR-GO has reduced the flow of saltwater into the wetlands, and the construction of the Inner Harbor Navigation Canal Surge Barrier also alters the hydrology and chemistry of local waters, including the Central Wetlands Unit.

The Sewerage and Water Board of New Orleans and the Lake Borgne Basin Levee District are collaborating on a wetlands assimilation project in which treated sewage is rerouted into these degraded wetlands as a source of freshwater and nutrients with which to nourish wetland plantings. Though the project will only cover a portion of the Central Wetlands Unit, it will create valuable new habitat along the southern edge of wetlands, and serve as a model for restoring the entire ecosystem. As a cypress swamp once again, the Central Wetlands Unit will be a one-of-a-kind urban habitat and a stopping point for locals, tourists, and winged travelers alike.

Both the Lower Ninth Ward and St. Bernard Parish are advantageously located in relation to the Central Wetlands Unit. Already connected hydraulically by the pumping of stormwater into the wetlands, establishing public access points such as the Bayou Bienvenue outlook that exists already in the Lower Ninth Ward, will enable the residents of the basin to make use, once again, of the wetland habitats that are vital to the health, economy, and ecology of the delta. At the same time, a restored Central Wetlands Unit will function as an important storm surge buffer within the federal levee system.

# Poydras to the Gulf

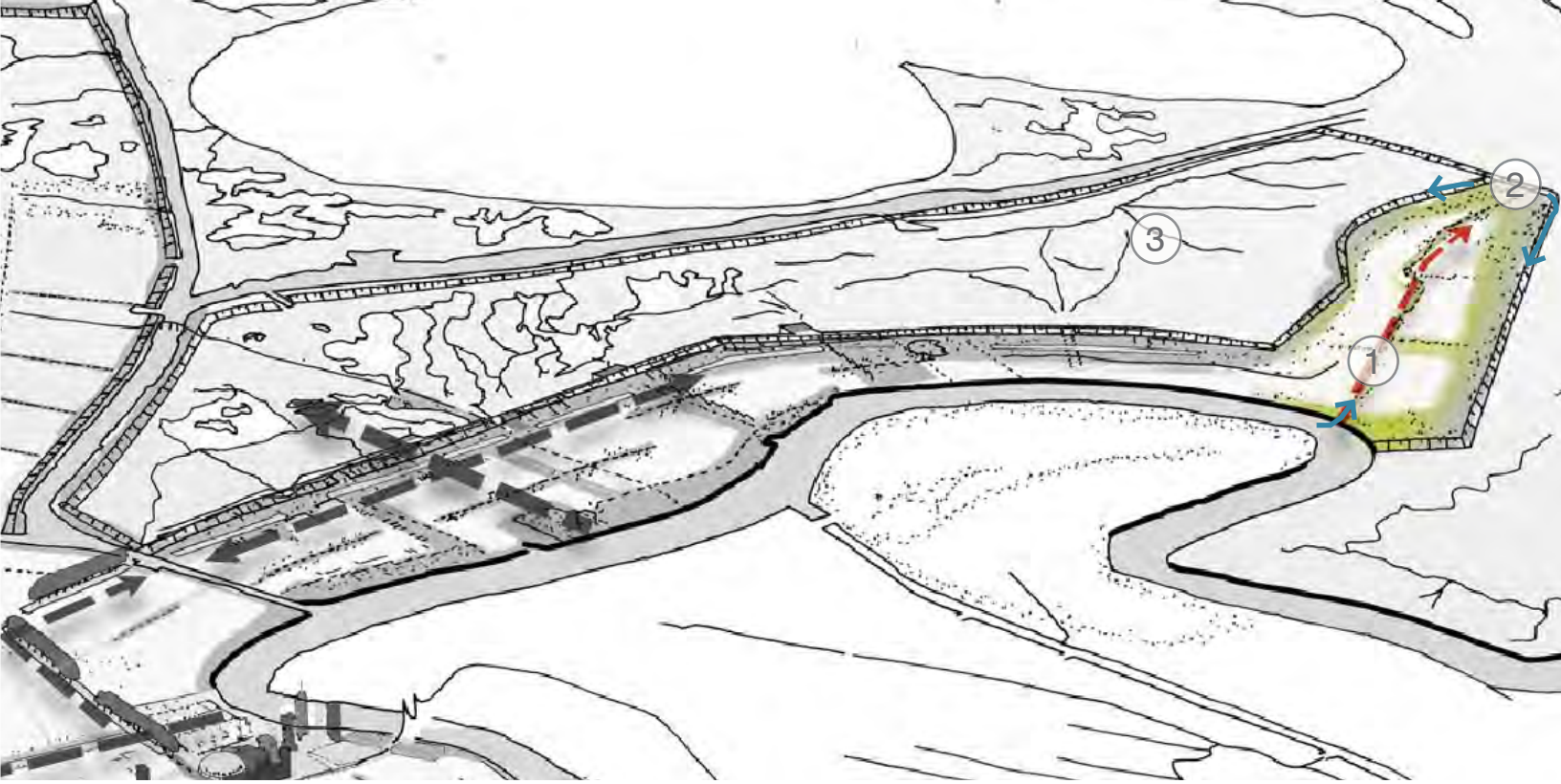
The restored Bayou Terre aux Boeufs brings beauty, ecological vitality, and a healthy flow of water back to the historic communities of Lower St. Bernard, where unique traditions and a rural way of life can continue to thrive within the protection afforded by the farthest reaches of the region's federal levees and floodwalls.

The villages of lower St. Bernard are situated along the Bayou Terre aux Boeufs. In the 18th century, Isleños first settled the banks of this bayou, formerly a channel of the Mississippi and from there supplied New Orleans with produce and poultry through the 18th and 19th centuries.

**Restoring the Bayou Terre aux Boeufs**

The bayou is currently a stagnant ditch that runs alongside Bayou Road, the length of Lower St. Bernard.

Floodgates and floodwalls at the eastern end of Lower St. Bernard




1 Water from the Mississippi River can be siphoned into the Bayou Terre aux Boeufs to reestablish the flow of water through the bayou.

2 Some of the flow of the bayou can be diverted into the drainage canals at the northern and southern perimeters of Lower St. Bernard.

3 The Central Wetlands Unit lies to the north of Lower St. Bernard, and is an important regional asset, habitat, and storm surge buffer.

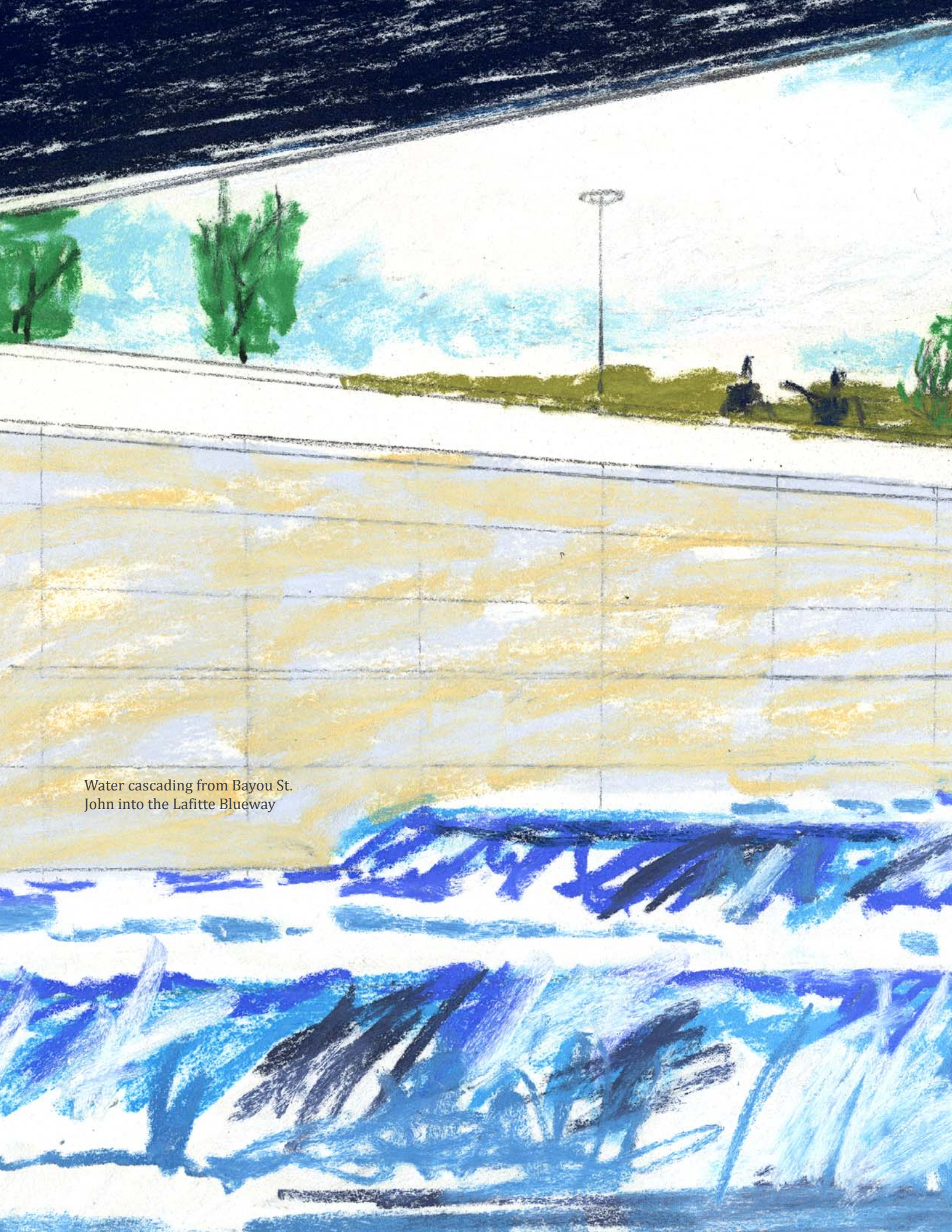
As a primary ridge, the high ground of the bayou and Bayou Road still serve as an important connector between the urbanized communities of St. Bernard further upriver to fishing villages such as Delacroix and Yscloskey, located beyond the federal levee and floodwall system.

However, the bayou no longer has a steady source of water and exists largely as a stagnant weed-filled ditch that parallels Bayou Road as it runs from Poydras out to the far eastern floodwalls of the HSDRRS. In Poydras, the one place where the bayou exists as an amenity to the surrounding area, the bayou is a place of astounding beauty.

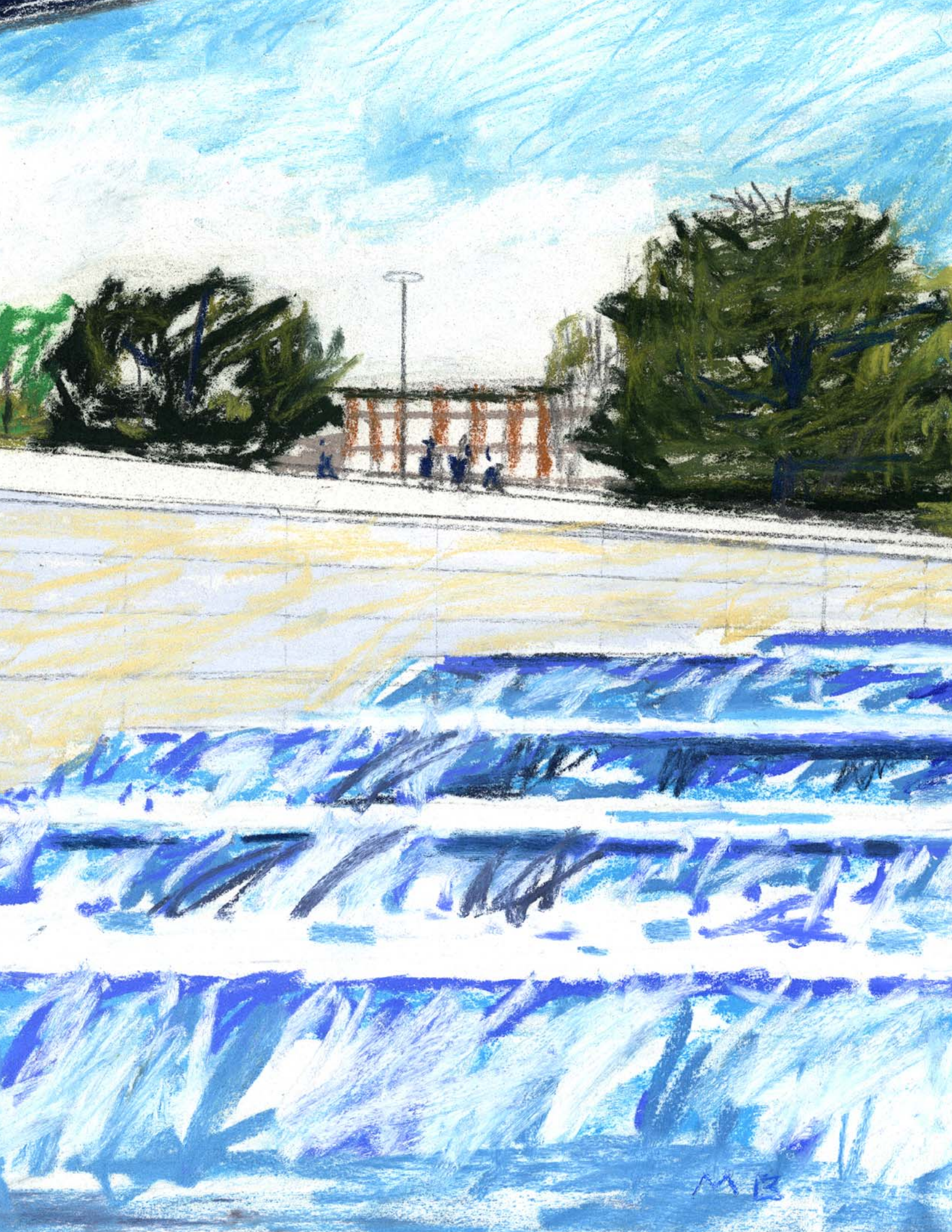
Restoring the flow of water in the bayou with water from the Mississippi River improves the ecology of Lower St. Bernard. Flowing water flushes the channel of debris, improves groundwater levels, and provides the freshwater that is necessary to maintain healthy swamps and oak hammocks alongside the bayou. Such an investment would restore the bayou as a defining feature and critical asset for all of Lower St. Bernard's communities.

Clockwise from below: water tower, view from Bayou Road, Parish Courthouse, Toca Gas Plant, Plantation on Bayou Road
Facing Page: Bayou Terre aux Boeufs, Poydras





Water cascading from Bayou St. John into the Lafitte Blueway



By plane, one descends over an immense estuary, vast expanses of wetland and the sinuous Mississippi River, and lands on a lily pad-like clearing. By car, one enters on bridges and causeways over open water and swamp, downtown skyline in the distance. Upon entry, that connection to the water—the element that sustains the delta— disappears. Reestablishing water as a defining feature of Greater New Orleans, reintegrating water back into the urban fabric and the daily lives of residents and visitors, are keys to ensuring the longevity of this region.

This is a city and region on the river and an island in the delta. It is, and always has been, a place on the edge, with one foot on land, and one foot in the sea. It is an imperfect place, but can there be a city that speaks more to this time and to our collective future?

**Measuring Groundwater Levels**

Measuring groundwater levels is a simple and necessary process for a delta landscape. A monitoring network for the region would ensure that water management strategies could be targeted precisely when and where needed.

# Glossary

## TALKING ABOUT WATER

Discussions about water and the landscape require a new vocabulary. Some terms, like runoff, describe well-known problems. Others, like subsidence, are terms that all citizens should learn in order to better understand issues facing the region and advocate for effective solutions.

The following glossary includes technical terms for water-related problems and water-based solutions, including the names of important natural and man-made features that affect the flow of water.

# Talking About Water

## A WATER GLOSSARY

**10-year storm**
an event that has a 10% chance of occurring or being exceeded any given year. In New Orleans, a 10-year storm has an average total rainfall of 8.5 inches, with a peak hour total of 3.43 inches. Also known as a **T10 storm**, where the "T10" refers to the return period.

**100-year storm**
an event that has a 1% chance of occurring or being exceeded any given year. The US Army Corps of Engineers levees and floodwalls are meant to protect against this level of storm. Hurricane Katrina was a 75-year storm, meaning it was less intense than a 100-year storm. Also known as a **T100 storm**, where the "T100" refers to the return period.

**acre foot**
the volume of water needed to cover one acre to a depth of one foot, equal to 325,851 gallons or 43,560 cubic feet of water.

**adaptation**
adjustments to a changing climatic characteristics such as rising sea levels. These may include structural changes such as the lifting of levees or the raising of homes, as well as changes in policy and management practices that reduce vulnerability and risk to communities. See also **climate change**.

**aquifer**
an underground layer of permeable rock or soil layer that holds water that can be extracted for human use. The Gonzales-New Orleans Aquifer is a 100-300 feet thick sand layer underlying southeastern Louisiana that serves as the primary source of fresh groundwater for Jefferson Parish and Orleans Parish.

**bald cypress (taxodium distichum)**
the dominant tree species in Louisiana's native swamps as well as Louisiana's official state tree. Cypress swamps play an important as natural buffers to storm surges. Logging, development, subsidence, and saltwater intrusion have damaged cypress swamps throughout Greater New Orleans.

**base flood**
a flood with a 1% chance of being equaled or exceeded in any given year. This regulatory standard is used by the National Flood Insurance Program (NFIP) and other federal agencies for determining flood insurance rates and regulating new development.

**base flood elevation (BFE)**
an elevation set by the Federal Emergency Management Agency (FEMA) that measures the elevation to which floodwater is anticipated to rise during a base flood. To receive FEMA funds in the case of storm damage, FEMA requires the lowest floor of the building to be at or above BFE.

**bayou**
a slow-moving creek or swampy body of water, which may be brackish (mixed fresh- and saltwater) and home to a rich diversity of wildlife. Bayous are often associated with the southeastern part of the United States and can be found throughout coastal Louisiana and Greater New Orleans.

**berm**
a raised barrier dividing space, which may be used to prevent flooding or erosion. Berms can be incorporated into landscape designs to create detention and retention basins.

**best management practice (BMP)**
a method or technique that consistently yields outcomes superior to those achieved by other means and generally agreed upon by a community of experts to be the most effective means of delivering a particular outcome.

**bioswale**
A linear depression in the landscape constructed to slow and filter stormwater with vegetation and soil media. Bioswales can remove silts, pollutants, and pathogens, and reduce the quantity of runoff from a site.

**blight**
the impact of a slowed or depressed economy on the built environment, where the abandonment of properties, lack of maintenance, and other destructive forces lead to dilapidated buildings and overgrown lots, along with other health and safety challenges.

**blueway**
a waterway, typically with landscaped banks, and used as a recreational and aesthetic amenity that can benefit the communities and stakeholders that use and access it.

**bottomland hardwood forest**
a wetland ecosystem found throughout the Gulf Coast states, typically in floodplains alongside rivers and streams that periodically flood. Gum, oak, and bald cypresses are common tree species, along with other plants that can survive periodic flooding or standing water for much of the year.

**brackish water**
a mix of freshwater and seawater found in places like estuaries and deltas. Sources of brackish water in Greater New Orleans include Lake Pontchartrain and Bayou St. John.

**canal**
a man-made channel for water, often built as connections to larger bodies of water. Throughout Greater New Orleans, canals both convey and store stormwater.

**catch basin**
also known as a **storm drain** or **curb inlet**, is a receptacle that captures solids and large sediment, typically at the point where water passes from a gutter into a piped drainage system.

**catchment area**
an area where all runoff is conveyed to the same outlet, with boundaries typically defined by ridges or other topography. In Greater New Orleans, catchment area refers to an area drained by a pump station. See also **watershed**.

**circulating canals**
a system that maintains the flow of water through drainage canals even during dry weather, in order to improve water quality, recharge groundwater, and allow canals to serve as recreational and aesthetic assets.

**climate change**
changes in temperatures, precipitation patterns, and the frequency of extreme weather events commonly linked to human activity. In New Orleans, climate change has resulted in some of the highest rates of sea level rise in the world, and is likely to increase the intensity of storms as well as instances of drought.

**culvert**
a closed drain, pipe or channel used to carry water, for example, from beneath a roadway from one side to another. In New Orleans, concrete box culverts store and convey massive quantities of stormwater to drainage pump stations.

**detention**
the holding of stormwater temporarily in a swale, **detention basin**, or other features. Detention reduces peak discharge by allowing the slower and more controlled release of runoff, and does not allow for the permanent pooling of water.

**1895 Drainage Master Plan (New Orleans)**
In response drainage crises that escalated in the 1880s, the newly created Drainage Advisory Board of 1895 recommended a modern drainage system featuring improved collection, conveyance, and discharge, using street gutters, storm drains, underground pipes, canals, and large new pump stations. This plan led to the creation of the New Orleans Sewerage and Water Board, the invention of the Wood screw pump, and enabled the draining and settling of wetland areas.

**evapotranspiration**
the transfer of water from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. Solar radiation, atmospheric vapor pressure, temperature, wind, and soil moisture are some of the factors that affect the rate of evapotranspiration.

**delta**
the flat low-lying plain that sometimes forms at the mouth of a river emptying water and sediment into another body of water, such as an ocean or lake. Greater New Orleans is situated on the Mississippi River Delta.

**drainage canal**
an artificial channel built to drain an area with no natural outlet for runoff. In Greater New Orleans, aboveground and underground drainage canals move runoff to and from drainage pump stations.

**drought**
below-average precipitation over an extended period of time that results in a water shortage, most commonly measured by a season or longer.

**Dutch Dialogues**
a series of workshops between 2006 and 2009 that focused on sustainable water management and regional planning in Greater New Orleans. The workshops were initiated by Waggonner & Ball Architects with the American Planning Association and the Royal Netherlands Embassy in Washington D.C., and brought together US and Dutch experts trained in engineering, urban design, architecture, landscape architecture, city planning, and geohydrology. The workshop results were the basis for the Greater New Orleans Urban Water Plan.

**ecological services, ecosystem services**
the beneficial products and processes provided to humanity by the natural systems of the biosphere. These services include, but are not limited to the production of clean water, crop pollination, waste decomposition, climate regulation, and recreational benefits. In stormwater management, for example, wetlands and urban forests provide these services in the form of pollutant bioremediation, evapotranspiration, and groundwater recharge.

**elevation**
the altitude of a place above or below sea level.

**estuary**
a partially-enclosed body of water where freshwater from rivers and streams flows into the ocean, mixing with seawater and forming brackish water. Estuaries such as Lake Pontchartrain are rich habitats influenced by tides but protected from the direct impact of ocean waves and winds by surrounding land, wetlands, and barriers islands.

**first flush**
initial runoff from a rain event. This typically has higher concentrations of pollutants such as organic debris, sediments, oil, and other surface pollutants that accumulate on rooftops and roadways in the period before the storm.

**flood**
the temporary condition of inundation of what is usually dry land. It can be caused by an overflow of inland or tidal waters, or the rapid accumulation of runoff in drainage ditches or inland waterways. **Flash floods** are floods that subside in fewer than six hours.

**floodplain**
an area of typically flat land that is susceptible to inundation by water from any source. Floodplains are typically fertile agricultural areas as a result of nutrient-rich sediments deposited by floodwaters.

**floodwall**
A vertical barrier, usually made of concrete, constructed to contain floodwaters from a river, lake, or sea to prevent flooding in urbanized areas. They are used in densely developed areas where building levees is not feasible, or atop levees in order to increase the level of safety provided by the levee.

**floodgate**
a structure that can be opened or closed in order to adjust the flow of water through a sluice or canal, or to prevent the flow of water as part of a levee and floodwall system. **Sector gates**, **lift gates**, and **barge gates** are forms of floodgates integrated into Greater New Orleans' perimeter levees and floodwalls that allow waterborne navigation through those hurricane defenses when the region is not under threat from a tropical depression or hurricane.

**fluvial**
of or relating to rivers and streams, and the flooding, erosion, and soil deposition associated with these waterways.

**freeboard**
the distance between operating and maximum water levels, such as in a drainage canal or a retention basin. The freeboard is used to calculate the capacity of a given water feature.

**geohydrology, hydrogeology**
the study of groundwater, including its flow and its physical and chemical interactions with soils and surface water.

**gray infrastructure**
traditional mechanisms for storm water management and wastewater treatment, such as pipes and sewers.

**graywater**
wastewater generated from domestic activities such as dishwashing, laundry, and bathing. Properly treated, it can be recycled for other uses like irrigation.

**green infrastructure**
an approach to stormwater management that utilizes natural processes, soils, and vegetation to filter and reduce runoff. In contrast to gray infrastructure, green infrastructure can provide additional benefits such as improved air quality and streetscapes.

**green roof**
a roof system of soil media and vegetation that helps to absorb and store stormwater that falls on the roof. Green roofs lessen roof runoff, improve water quality, and reduce heat gain through evapotranspiration.

**groundwater**
water held in underground permeable rock or soil layers. When these layers hold enough water to be usefully extracted for human use, it is called an aquifer.

**groundwater monitoring network**
a system of wells, gauges, and data collection for tracking groundwater levels and quality. Such a network allows for a more comprehensive understanding existing groundwater issues such as subsidence and saltwater intrusion, and the management of soils and groundwater.

**harden**
to make structures and utilities resistant to storms and natural hazards.

**hazard mitigation**
sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects, such as the building of levees, elevating of structures, or the relocation of assets. Improving urban water management is a form of hazard mitigation.

**hydraulics**
an applied science that studies the properties of water and other fluids, especially in relation to the application of mechanical forces. Hydraulics are fundamental to the operation of forced drainage systems in Greater New Orleans. The term **hydraulic** indicates a system or activity involving fluid under pressure.

**hydrograph**
a chart that graphically describes the rate of flow—of water, for example—relative to a specific point over a period of time. A hydrograph can help in describing the contours of a rain event, and in the planning and design of waterways and water control structures.

**hydrology**
the study of the distribution, flow, and quality of water. This includes the water cycle, water resources, and watershed sustainability. The term **hydrologic** refers to the movement of water between land areas, waterways, water bodies, and the atmosphere.

**impervious surface**
a material or area that cannot be penetrated by water. This includes most rooftops and structures like roads, sidewalks, and parking lots that are paved with concrete, asphalt, or stone. Impervious surfaces prevent rainfall from infiltrating into the ground and recharging groundwater, and accelerate runoff.

**infiltration**
the passage of water into below-ground soil layers. The velocity at which this occurs is called the infiltration rate, which is dependent on the composition of surface soil layers. Infiltration replenishes groundwater and raises the water table.

**infrastructure**
foundational systems and installations necessary to maintain and enhance basic social, economic, governmental, economic, and military functions. These include drinking water systems, drainage systems, sewers, hurricane defenses, schools, transportation networks, electrical grids, and telecommunications networks.

**inundation**
flooding, the overwhelming of an area by floodwaters.

**levee**
a linear earthen ridge that divides areas hydrologically, and can be used to protect inhabited areas from flooding. Greater New Orleans has both naturally occurring levees and manmade levees. Many natural levees have been reinforced with additional soil, rock, concrete, and/or grass. Levees are also known as **dikes**.

**LIDAR**
stands for Light Detection and Ranging and is a remote sensing method that uses a pulsed laser to measure variable distances to the Earth. LIDAR systems help scientists and mapping professionals examine both natural and manmade environments with greater accuracy. In Louisiana, LIDAR is one of many tools used to create more accurate shoreline maps and digital elevation models.

**Louisiana Coastal Master Plan**
a framework created by the state's Coastal Protection and Restoration Authority (CPRA) focused on protecting and restoring the state's deteriorating coastline. Threats to many of Louisiana's coastal assets led to the passing of Louisiana Legislature Act 8 in 2006, which created the CPRA and required it to develop a coastal master plan every five years. The latest edition was adopted by the state legislature in 2012.

**marshes**
wetlands that are frequently inundated with water and characterized by soft-stemmed vegetation adapted to saturated soil conditions. Nutrients are typically abundant, allowing plant and animal life to thrive in these areas. Marshes help reduce flood damage by slowing and storing flood water. As water moves slowly through a marsh, sediments and other pollutants settle to the marsh floor. Municipalities are now building urban wetlands to harness these natural processes in cleaning stormwater and wastewater.

**Mississippi River Gulf Outlet (MRGO)**
built by the Army Corps of Engineers in the 1960s, this route provided a shorter shipping passage from the Gulf of Mexico to the Inner Harbor Navigation Canal and also an emergency outlet from the Mississippi River. Its construction allowed saltwater intrusion that damaged to local wetlands, and channeled Hurricane Katrina's storm surge into New Orleans. The channel was closed by a rock barrier in 2009.

**Multiple Lines of Defense**
a core concept of both the Louisiana Coastal Master Plan and the Best Practices Manual for Development in Coastal Louisiana, developed by the Lake Pontchartrain Basin Foundation. MLOD describes the importance of naturally-occurring and manmade features in protecting inhabited areas from the direct impact of hurricanes in southeast Louisiana. Manmade features include levees, flood gates, pump stations, elevated structures, highways that serve as ridges, and hurricane evacuation routes. Natural features external to perimeter levees include offshore shelves, barrier islands, sounds, marsh land bridges, and natural ridges. The Greater New Orleans Urban Water Plan introduces urban water management to the MLOD concept as a means of addressing risks associated with rainfall in order a achieve a higher factor of safety overall.

**network**
a group of interrelated elements connected by lines, conduits, or channels, and where the function of one network component is dependent on the function of other components. Networks are common within infrastructural systems, such as road networks, telecommunications networks, sewer networks, or canal networks.

**outfall**
the pipe, channel or opening through which water is emptied into another body of water, or the location where such discharge occurs.

**oxidation**
the decomposition and compaction of organic matter that occurs in the presence of oxygen. Oxidation is a primary cause of subsidence in Greater New Orleans, in areas where highly organic soils with lowered water tables are exposed to oxygen.

**peak rainfall**
the duration or point in a rain event when rain is falling at its highest intensity.

**peak stage**
the highest level reached by water flowing through a channel, relative to a datum such as mean sea level. Improved stormwater management can lower a canal's peak stage.

**pervious paving**
a material for walkways, roadways, and parking lots that allows stormwater to be absorbed by the ground where it falls, reducing runoff into the drainage system.

**pluvial**
of or relating to rainfall.

**polder**
a Dutch term for land that is surrounded by embankments that is dependent on mechanical drainage systems for inhabitation. Polders are created when low-lying areas are enclosed by levees, groundwater is drained and removed from within the polder, and the enclosed land subsides, eventually sinking below the surrounding level of water. They are commonly found in river deltas. The hydrological basins of New Orleans are examples of polders.

**pump, pumping**
the mechanical removal of water from an area. This is how stormwater has been traditionally managed in Greater New Orleans, but is also the primary cause of subsidence in the region.

**pumping capacity**
the volume of water that a pump station can move over a given period of time, typically measured in cubic feet per second (cfs). Some of the pump stations in Greater New Orleans have a capacity of over 10,000 cubic feet per second.

**rain garden**
a shallow excavated basin that collects and cleans storm water runoff on a small scale. Soil layers and plantings are designed for infiltration and the removal of pollutants.

**resilience**
the capacity to anticipate potential threats, reduce a community's vulnerability to hazard events, respond to and recover from specific hazard events when they occur, and adapt to changing risks and hazards. In Greater New Orleans, resilience refers to the region's ability to withstand and recover from major flooding and hurricanes. With the loss of coastal wetlands and climate change, the long-term future of Greater New Orleans depends on the region's ability to enhance its resiliency.

**retention**
the holding of stormwater permanently in basins, ponds, and cisterns. **Retention basins** allow stormwater to infiltrate the ground, and for the collected stormwater to be repurposed for other uses such as irrigation.

**retrofit**
a measure taken to adapt existing infrastructure to operate more efficiently and effectively, without having to completely rebuild existing systems.

**risk**
a predictive measure of harm or loss due to the likelihood of a hazard occurring, and the consequences of such an event.

**runoff (surface runoff)**
Stormwater flowing from rooftops, streets, and other surfaces that neither infiltrates into the ground nor evaporates, but collects instead and must be drained away in order to prevent flooding.

**sea level rise**
most simply defined as an increase in the mean sea level, caused by changes in air temperatures that are linked to global climate change. Sea level rise poses a growing risk to low-lying coastal communities. With land subsiding at high rates as well, coastal Louisiana is experiencing some of the highest rates of sea level rise in the world.

**sinkhole**
a cavity in the ground which is caused by the weight and movement of water. In Greater New Orleans, sinkholes can be caused by broken pipes and/or subsidence.

**siphon**
a conduit for drawing water from a water source at a higher level into a water body or waterway at a lower level. Siphons can be used to pull water into circulating canal systems from outlying sources, such as the Mississippi River or Lake Pontchartrain.

**slow, store, drain**
a new approach to stormwater management fundamental to the Greater New Orleans Urban Water Plan: slow water as it hits the ground, create spaces in the city to store water and use it as a resource, and drain using pumps only as a last resort to prevent flooding.

**sluice**
a water-conveyance channel where the flow of water is controlled by a gate or other device at the head.

**soil organic content, soil organic matter**
component of a soil layer comprised of plant and animal residues at different stages of decomposition, cells and tissues of microorganisms, and living organisms along with the organic residues that they produce. Soil organic content is a critical measure of a soil's ecological function, quality, and stability.

**stormwater management**
techniques, methods, or policies that control planning, maintenance, and regulation of stormwater (rainfall). Stormwater management is critical in precipitation-rich Greater New Orleans in order to prevent flooding and reduce subsidence.

**subsidence**
the sinking of land relative to sea level. In Greater New Orleans, the primary cause of subsidence is the excessive pumping of groundwater. As groundwater is removed, the soil from which it is drawn compresses and highly organic soil layers are able to oxidize. Subsidence damages buildings, streets, and other infrastructure, and its effects are irreversible.

**swamp**
a shallow body of water and wetland habitat, typically dominated by woody vegetation such as cypresses. Swamps have highly organic soils that provide a nutrient-rich environment for the growth of a rich variety of water-tolerant species of flora and fauna.

**topography**
the position and elevation of natural and artificial features in an area, and also the study of the surface shape and features of an area. Topographic maps and models provide graphic representations of features that appear on the Earth's surface, including infrastructure and development, waterways and water bodies, relief (mountains, valleys, slopes, depressions) and vegetation.

**water assignment**
the volume of stormwater for a given rain event that exceeds the total storage and pumping capacity of a catchment area. The water assignment provides a rough measure of flooding that may occur if such an event were to occur, without taking into account finer variations in rainfall intensity and distribution that determine the actual impact of each rain event.

**water balance**
the calculation of the various inputs and outputs of water in an area, including rainfall, groundwater withdrawals, drinking water withdrawals, and both stormwater and sewage discharges.

**water literacy**
an understanding of how water impacts and functions in a given landscape—where water is coming from, how it is used, how it is stored, and risks and opportunities associated with water. Water literacy is an important aspect of a sustainable water future for New Orleans.

**water quality**
a measure of how suitable water is for a particular type of use (such as drinking and bathing) based on physical, chemical, and biological characteristics such as temperature, turbidity, mineral content, and the presence of bacteria.

**water table**
the boundary between water-saturated soils and unsaturated soils. Typically, deeper soil layers are saturated with water while those closer to the surface are drier. In wet areas like Greater New Orleans, the water table is high and often reaches the surface of the ground.

**watershed**
a land area, and distinct hydrological entity, where all water drains to the same point. See also **catchment area**.

**weir**
barriers that alter the flow of waterways to prevent flooding, to store water, or for navigation purposes, while allowing the steady flow of water over the top of the structure.

**wetlands**
ecosystems that are saturated with water, including bottomland hardwood forests, swamps, marshes, and bayous. The presence of water drives the nature of soil development, as well as characteristic plant and animal communities living in and above the soil. Wetlands are natural storm buffers that store and filter runoff. They are also habitats that support hundreds of thousands of species of plants and animals, as well as myriad fishing, hunting, agriculture, and recreational uses. Much of Greater New Orleans' natural ecosystems are comprised of wetlands.

# References & Project Team

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"There is on the globe one single spot... It is New Orleans, through which the produce of three-eighths of our territory must pass to market."

—Thomas Jefferson, from an 1802 letter to the US Minister to France

# Project Team

## WAGGONNER & BALL TEAM

| | |
|---|---|
| **David Waggonner** | *Director* |
| Mac Ball | *Consulting Principal* |
| Maria Papacharalambous | *Project Manager/Implementation* |
| Andy Sternad | *Design Coordination/Planning* |
| Aron Chang | *Design Coordination/Planning* |
| Ramiro Diaz | *Design/Planning/GIS* |
| Derek Hoeferlin | *Design/Planning/Review* |
| William Marshall | *Graphics/Marketing* |
| John P. Klingman | *Design/Editing* |
| Kathleen Peaden | *Design/Planning* |
| Megan Harris | *Design/Planning* |
| Francis Aguillard | *Design/Planning* |

## SENIOR ADVISORS

**Dale Morris**
*Senior Economist, Royal Netherlands Embassy*

**Paul Farmer**
*Executive Director & CEO, American Planning Association*

**Piet Dircke**
*Worldwide Global Knowledge Network Leader, Arcadis NL*

## DESIGN TEAM

**Arcadis US**
Joseph Sensebe, David Fulks
*Engineering, System Cost Estimating*

**CDM Smith**
Louis Jackson, Jessica Watts
*Hydraulic Modeling, Outreach*

**Dana Brown & Associates**
Dana Nunez Brown, Austin Evans
*Landscape Architecture, Outreach*

**FutureProof**
Joe Evans, Prisca Weems, Jenna Anger
*Sustainability, Implementation*

**Manning Architects**
Ray Manning, Andrew Baqué, Aaron Ryan
*Urban Design, Outreach*

**Tulane University**
Mark Davis
*Jurisdictional Context, Implementation*

**Waggonner & Ball Architects**
See above for team members
*Project Lead, Coordination*

**Bosch Slabbers Landscape + Urban Design**
Stijn Koole, Anne Sietske Verburg
*District Landscape Architecture and Project Design*

**City of Rotterdam**
Daniel Goedbloed
*Water System Operations*

**Deltares**
Roelof Stuurman, Frans van de Ven
*Geohydrology, Implementation*

**H+N+S Landscape Architects**
Pieter Schengenga, Jaap van der Salm
*System Landscape Architecture and Urban Design*

**Palmbout Urban Landscapes**
Jaap van den Bout, Sabien Thomaes
*Landscape Urbanism*

**Robbert de Koning Landscape Architect**
Robbert de Koning, Emilka Zemlak
*District Landscape Architecture and Project Design*

**Royal Haskoning**
Nanco Dolman
*Hydrology, Water System Analysis*

ADVISORS

**Kristina Hill**
*University of California, Berkeley*

**Bry Sarté**
*Sherwood Design Engineers*

**Jane Wolff**
*University of Toronto*

**Han Meyer**
*TU Delft*

**Ton Schaap**
*City of Amsterdam*

**Steven Slabbers**
*Bosch Slabbers Landscape + Urban Design*

**Lodewijk van Nieuwenhuijze**
*H+N+S Landscape Architects*

RESOURCES

**Bright Moments**
Bill Rouselle, Caryn Rodgers
*Outreach Consultant*

**Dewberry**
Michael Buckley, Jerri Daniels
*NFIP Consulting, Risk Assessment*

**Eustis Engineering**
Bill Gwyn
*Geotechnical and Hydrogeological Data*

**GCR**
Rafe Rabalais, Rebecca Rothenberg, Tyler Antrup
*Economic Benefit Analysis*

**LSU Coastal Sustainability Studio**
Jeff Carney, Brett Davis, Justine Holzman,
Matthew Siebert
*Visualization Tools*

**Waldemar S. Nelson and Company, Inc.**
Charles Nelson, Michelle Bales, Timothy Kay,
Kim Nguyen, Stephen Champagne
*Project Cost Estimating*

# Credits

ADVISORY COUNCIL

| | |
|---|---|
| Ryan Albright | *Greater New Orleans Foundation* |
| Kazem Alikhani | *Jefferson Parish Dept of Public Works, Director* |
| Charles Allen, III | *City of New Orleans, Director of Coastal & Environmental Affairs* |
| Blair Beter | *The Water Institute of the Gulf, Executive Assistant* |
| Steven Bingler | *Concordia Architects, CEO* |
| Jerry Bologna | *JEDCO, Deputy Director* |
| Andrea Bourgeois-Calvin | *Lake Pontchartrain Basin Foundation* |
| Nicholas Cali | *Lake Borgne Basin Levee District, Director* |
| Marco Cocito-Monoc | *GNOF, Director of Regional Initiatives* |
| Sidney Coffee | *America's Wetland Foundation, Senior Advisor* |
| Keith Crawford | *The Loftin Group* |
| Timothy Doody | *Southeast Louisiana Flood Protection Authority - East, President* |
| Mark R. Drewes | *Jefferson Parish Engineering Department, Director* |
| Lynn Dupont | *Regional Planning Commission, Principal Planner* |
| Ed Elam | *American Planning Association LA Chapter, President* |
| John Ettinger | *EPA, Region 6* |
| Pat Forbes | *State of LA, OCD-DRU, Executive Director* |
| Sandra Fury | *Chevron Corporation* |
| Jeanne-Marie Ganucheau | *Office of U.S. Senator Mary Landrieu, Smart Growth Coordinator* |
| Bill Gilchrist | *City of New Orleans, Director of Place-Based Planning* |
| Jerry Graves | *St. Bernard Parish, CAO* |
| Charles "Chip" Groat | *The Water Institute of the Gulf, President and CEO* |
| Paul Harrison | *Environmental Defense Fund, Sr Director for Rivers and Deltas* |
| Jeffrey Hebert | *New Orleans Redevelopment Authority, Executive Director* |
| Michael Hecht | *GNO, Inc., President and CEO* |
| Rachel Heiligman | *Horizon Initiative Water Committee* |
| Tara Hernandez | *JCH Development, President* |
| Clinton Hotard | *Jefferson Parish Drainage Department, Professional Engineer* |
| Brian Jackson | *Environmental Defense Fund, Associate Director* |
| T. Bradley Keith | *Office of U.S. Senator Mary Landrieu, State Director* |
| Merritt Lane | *Canal Barge Company, President* |
| Angela Lawson | *Louisiana OCD-DRU, Program Manager* |
| John Lopez | *Lake Pontchartrain Basin Foundation* |
| Sarah Mack | *Tierra Resources, CEO* |
| Jacky Madden | *Jefferson Parish Community Foundation, Board Member* |
| Camille Manning-Broome | *Center for Planning Excellence* |
| Kirsten Melberg | *New Orleans Redevelopment Authority, Project Manager* |
| Ricky (Tony) Melerine | *St. Bernard Parish, Director of Fisheries and Water Management* |
| Robert Miller | *S&WB, Deputy Director* |
| Dale Morris | *Royal Netherlands Embassy, Senior Economist* |
| Spencer Murphy | *Canal Barge Company* |
| Alexandra Norton | *City of New Orleans, Service and Innovation Manager* |
| Stacye Palmer-McBride | *National Park Service - Rivers, Trails & Conserv. Assist. Program* |
| Paul Rainwater | *Louisiana Recovery Authority, Executive Director* |
| Kara Renne | *NORPC, Former Director of Economic Development* |
| Stephen Reuther | *St. Bernard Chamber of Commerce, CEO* |
| Emilie Riser | *Louisiana Division of Administration, Assistant to P. Rainwater* |
| Paul Sawyer | *State of LA, Economic Development* |
| Amber Seely | *NORPC, Interim Director of Economic Development* |
| Stevan Spencer | *Southeast Louisiana Flood Protection Authority - East* |
| Nick Speyrer | *The Water Institute of the Gulf* |
| Elizabeth "Boo" Thomas | *Center for Planning Excellence, Executive Director* |
| Keith Twitchell | *Committee for a Better New Orleans, President* |
| Candace Watkins | *St. Bernard Parish, Director of Community Development* |
| Reda Youssef | *Jefferson Parish Capital Projects, Director* |

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## AGENCIES PROVIDING DATA

Jefferson Parish Department of Public Works
Jefferson Parish Department of Environmental Affairs
Lake Borgne Basin Levee District
New Orleans City Planning Commission
New Orleans Department of Public Works
New Orleans Redevelopment Authority
New Orleans Regional Planning Commission
Sewerage and Water Board of New Orleans
Southeast Louisiana Flood Protection Authority - East
U.S. Army Corps of Engineers

## ADDITIONAL PROJECT PARTICIPANTS

| | |
|---|---|
| Robin Barnes | *Greater New Orleans, Inc., Executive Vice President & COO* |
| Blake Bertuccelli | *Decubing Web Services* |
| Richard Campanella | *Tulane School of Architecture, Geographer* |
| Jennifer Graeff | *American Planning Association, International Program Manager* |
| Annemarie Gray | *Intern* |
| Zoe Grueskin | *Intern (Williams College)* |
| Pableaux Johnson | *Blue Crab Labs, Electronic Publications* |
| Grasshopper Mendoza | *Horizon Initiative Water Committee, Chair* |
| John Monnat | *Intern* |
| Steve Picou | *Horizon Initiative Water Committee* |
| Meredith Sattler | *Professor at LSU Architecture, Sustainable Design* |
| Tiffin Thompson | *Intern* |