GALVESTON BAY PARK

A VISION FOR HOUSTON AND GALVESTON BAY

SSPEED CENTER

The Severe Storm Prediction, Education and Evacuation from Disaster (SSPEED) Center is based out of Rice University and serves as a resource for research and education related to protection strategies for severe storm flooding and hurricane-related surge. The SSPEED Center's goal is to educate the Gulf Coast region by increasing governmental and public awareness of the risks associated with severe storms and hurricanes. It addresses both structural and non-structural mitigation strategies at all scales for the region.

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6100 Main St, MS-317
Houston, TX 77005
+1 713.348.4951

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ROGERS PARTNERS Architects+Urban Designers unites multiple disciplines and designs environments where architecture, landscapes and urban spaces converge. We are a studio of 40 architects, urban designers and landscape architects with a breadth of experience in projects of varying types and sizes including projects for a range of civic and public clients. We approach these projects with a focus on making places and spaces that encourage social connections and activity in many forms, with a commitment to the continued viability of the communities in which we work.

NEW YORK

100 Reade Street
New York, NY 10013
+1 212.309.7570

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718 Richmond Avenue
Houston, TX 77006
+1 646.442.8778

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1301 McKinney Suite 1100
Houston, TX 77010
+1 713.630.7300

GALVESTON BAY PARK

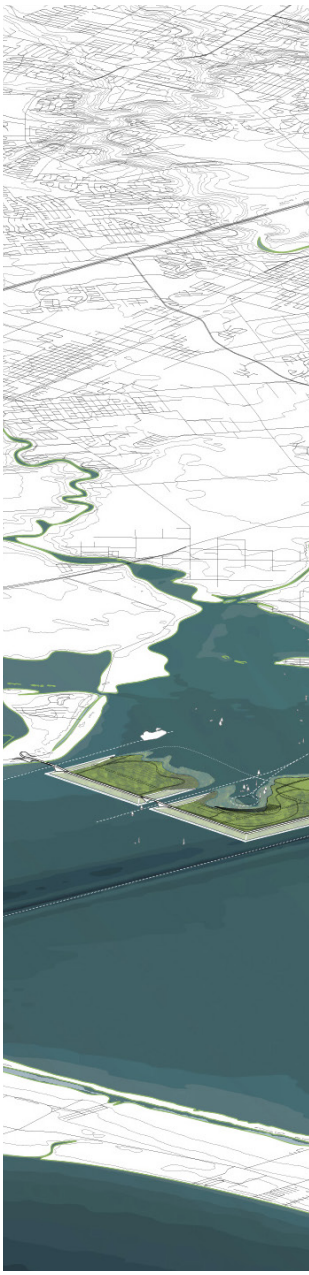
A VISION FOR HOUSTON AND GALVESTON BAY

A VISION

LET'S DO SOMETHING AMAZING, AGAIN

On November 10, 1914, the Houston Ship Channel opened to great fanfare. Rightly so, as the occasion was to be a pivotal one for the future of the region, shifting the Gulf's commercial power to Houston and creating a port that would transform a small town into a global energy leader. This catalytic moment was about a decade in the making and resulted from strong civic leadership. Funding was assembled from a mix of federal and local dollars via private sector leadership from the likes of Jesse Jones to clear the path to implementation.

In the face of a highly probable direct hit to this critical economic infrastructure, and the bayfront communities that surround it, by a deadly storm, the region once again has the opportunity and cause to initiate and demonstrate what transformational public and private investment can do. Without action, the Houston and Galveston Bay region remains on the precipice of immanent devastation. With the support of public and private local leadership, we can protect and bolster the vitality, economy, and health of this vibrant and important community. **It's time to act, again.**



Price Two Cents

THE HOUSTON CHRONICLE

HOME EDITION

VOL. 14. NO. 28 HOUSTON, TEXAS, TUESDAY, NOVEMBER 10 1914 EIGHTEEN PAGES

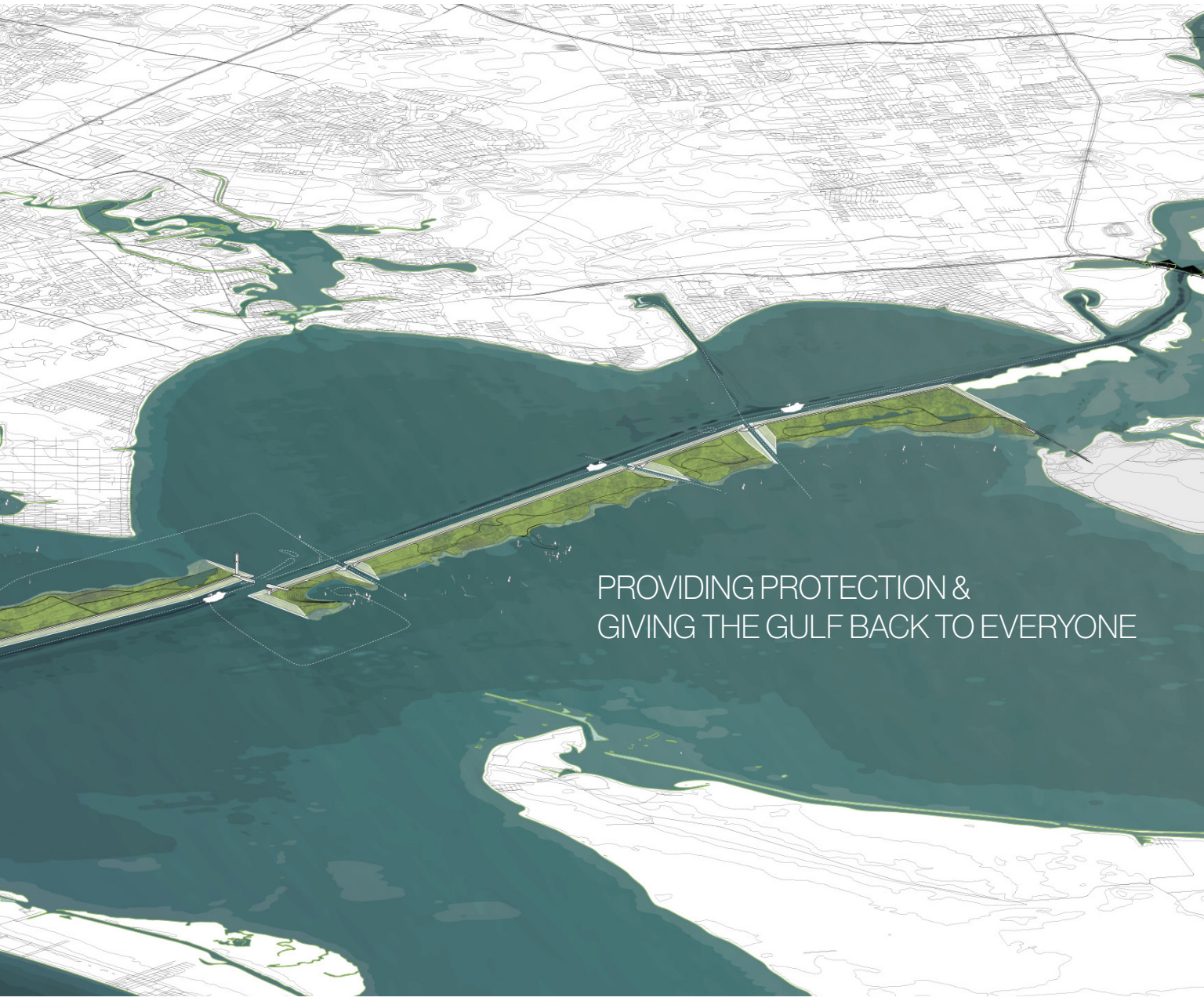
WILSON TOUCHES A BUTTON AND THE SHIP CHANNEL IS OPENED

WITH BOOM OF CANNON PORT OF HOUSTON OPENS TO WORLD'S COMMERCE

Many Notables Present to Witness Formal Opening of Houston's Waterway—Score or More Gaily Decorated Vessels in Fleet—Perfect Weather Prevails and Thousands Line Banks of the Channel as the Port Is Christened.

Interrupts Cabinet Meeting

Newspaper Clipping from November 10th 1914 celebrating the opening of the Houston Ship Chanel


PROVIDING PROTECTION &
GIVING THE GULF BACK TO EVERYONE

RISK

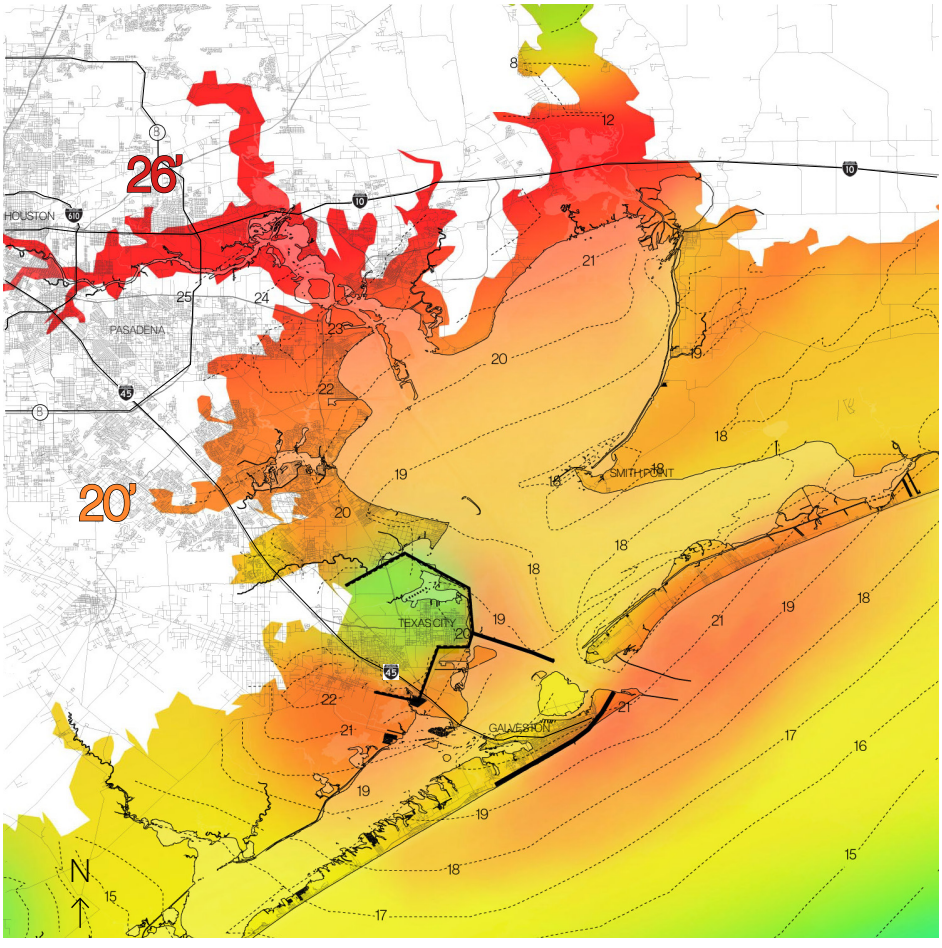
WE ARE WITHOUT PROTECTION

According to NOAA, the Houston-Galveston area is due to be hit by a hurricane roughly every seven years. While 2017's Hurricane Harvey changed the landscape of the area - due to its torrential rains rather than its surge - the last hurricane force winds and storm surge to deeply impact the region came with 2008's Hurricane Ike, a Category 2 that tracked up the Houston Ship Channel. Ike produced storm surges up to 13 feet in the west and northwest portions of the bay, flooding thousands of acres of residential and commercial properties.

Scientific models show that the convergence of high category storms, sea level rise, and coastal development patterns will lead to significant risks for the region. We are now overdue for a major hurricane, and yet ten years on from the cataclysmic effects of Hurricane Ike, **bay-front communities, the city of Galveston, and the Houston Ship Channel remain virtually unprotected.**

Models by the SSPEED Center (right) demonstrate what inaction means in the face of the next major hurricane (i.e. a small Category 4 with 250-yr storm surge levels at Pier 21). This hypothetical hurricane with a trajectory westward of Galveston Bay would cause the worst case surge scenario for the region. Rapid and severe coastal flooding is anticipated with water levels as high as 26 feet above mean sea level (MSL) causing major impacts on the heavily populated communities that surround the bay. With rising sea levels, storm surge for this hurricane can increase up to 30 feet by 2085.

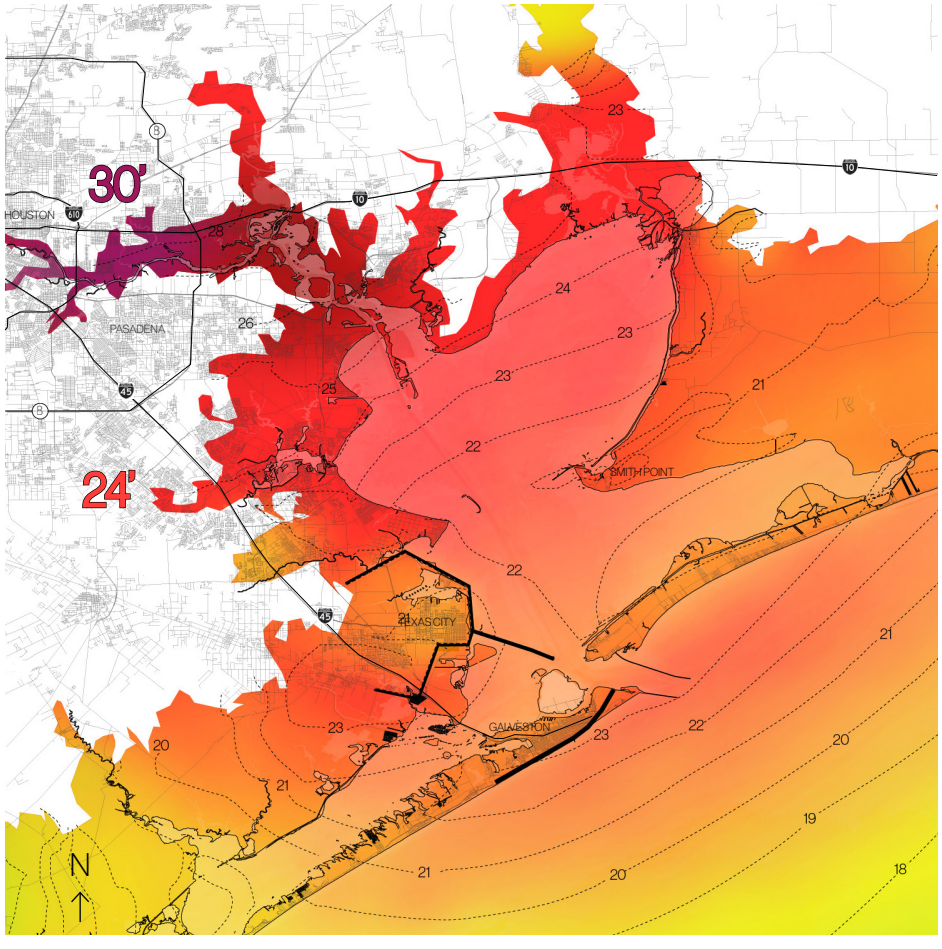
Hurricane Ike 2008



Small Cat. 4 Storm
(132 mph max winds)

EXISTING PROTECTION

SSPEED Center maximum water elevation (feet above MSL) in existing conditions as of 2015.



Small Cat. 4 Storm + Sea Level Rise (~2.4 ft)

EXISTING PROTECTION

SSPEED Center maximum water elevation (feet above MSL) in existing conditions as of 2015.

BAYFRONT COMMUNITY & WORKFORCE HOUSING

EXAMPLE ASSESSMENT OF TANK FLOTATION FAILURE PROBABILITY:

- 0.00 - 0.01
- 0.02 - 0.05
- 0.06 - 0.10
- 0.11 - 0.20
- 0.21 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- urban areas

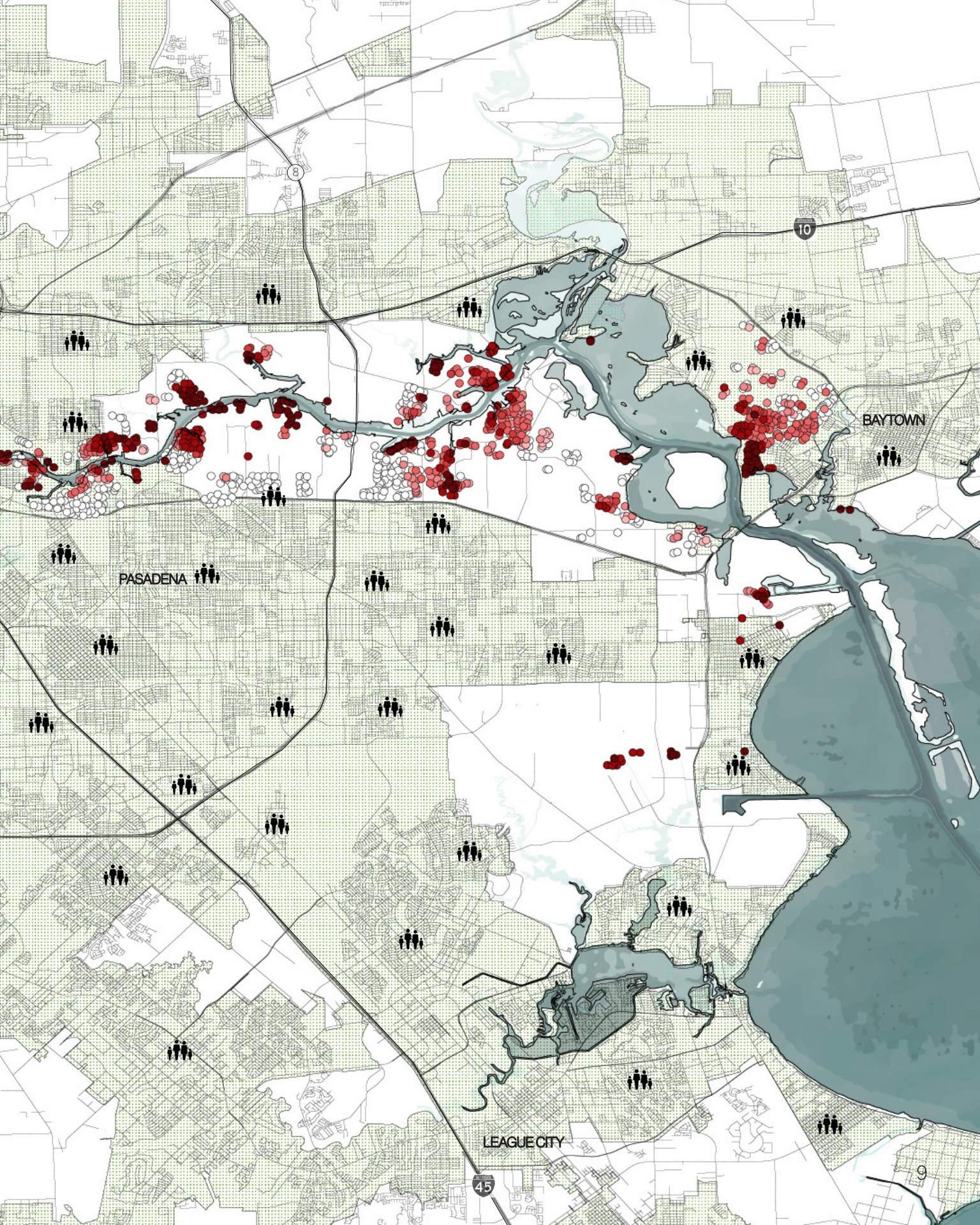
WHO AND WHAT IS AT RISK?

The nation's fourth largest port and the extensive energy infrastructure that line the Houston Ship Channel face significant damage in the next storm surge event. If the chemical storage tanks (right) and facilities here are compromised, the result could be a new record-setting environmental disaster. Given the importance of Houston's petrochemical facilities, the entire nation could be crippled by such a direct hit to the ship channel. In addition to this major impact to the chemical and refining industry, the residential community on the west side of Galveston Bay would be devastated by the hypothetical Category 4 storm. It is certainly feasible that over 25,000 homes could be destroyed by such a surge and tens of thousands more simply flooded.

Furthermore, many of the smaller communities in southeast Harris County are at significant risk, including southeastern Houston and the communities of northern Galveston County. Collectively, over 300,000 people live in these areas, not counting the population in the Clear Lake City area. The area behind the Texas City levee would also be flooded by this storm event. If people in these areas do not heed evacuation warnings, several thousand people could be killed by this surge event. **This is a matter of national security.**

Bayfront Industry

Bayfront Residents


8
10
BAYTOWN
PASADENA
LEAGUE CITY
45

GALVESTON BAY PARK

A VISION FOR THE FUTURE

In order to serve the region in the most effective way, the new surge protection system will begin with achievable goals, while at the same time be proactive and forward looking to care for the needs of future generations. Understanding that the ship channel will continue to be dredged, the plan anticipates and provides locations for the deposition of dredge material towards a productive use. For the next 100 years, the port will know where the dredge product goes, and the community will see it used to create and sustain bay habitat and recreational facilities. Silt build-up in the channel is a natural process that is exacerbated by runoff from the region's high rainfall flood events. Galveston Bay Park envisions a symbiotic relationship between the economic drivers of the region and its' natural environment.

Galveston Bay Park provides long-term, multi-functional surge protection that will serve future generation to come. The plan includes a vital in-bay barrier system with additional protection along Galveston Island and Bolivar Peninsula. The in-bay feature promises enhanced storm surge protection for the industrial complexes and densely populated areas in the west and northwest areas of the bay. A backside levee on Galveston Island creates targeted protection for the city of Galveston. In addition to providing storm surge protection, the Park boasts year-round multifunctionality, which brings new levels of access to the bay and creates space for a variety of recreational activities. **Galveston Bay Park provides protection and gives the Gulf back to everyone.**

MULTIPLE LINES OF DEFENSE

- (E) Galveston Seawall (Existing)

BUILDING GATES AND LEVEES

- (G) Mid Bay Gate (approx. 1,000 ft wide)
- (1) Texas City Levee (Update)
- (2) Backside Levee

RAISING ROADWAYS

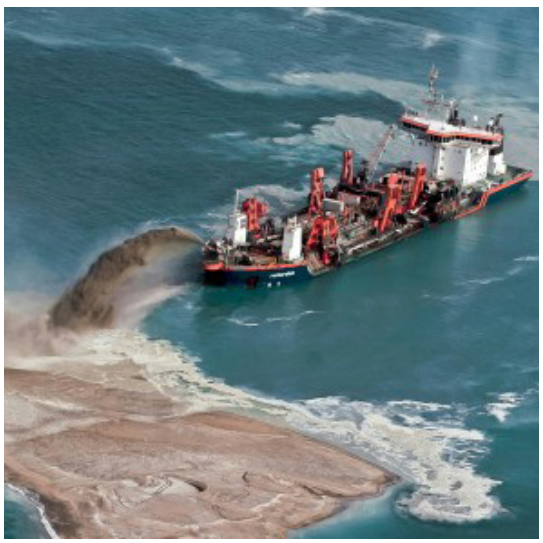
- (3) Raised Highway 87
- (4) Raised FM 3005

CONSTRUCTING BERMS

- (5) In-Bay Berms
- (3) Small Dunes
- (4) Small Dunes

RESTORING OYSTER REEFS

- Oyster Reefs



Dredger depositing sediments


miles
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4

ACCESS

THE BAY BELONGS TO EVERYONE

Today, the shores of the bay are mostly privately owned and controlled. Anyone not owning bay-front property only has access to the bay through a few select points. The bay-fronting public lands total about 500 acres which is miniscule considering the bay's shores extend for over 200 miles. As the development of the region continues, lands reserved for public recreation and immersive experiences in the natural environment have become scarce. Galveston Bay Park is an opportunity to simultaneously provide a new shoreline with **miles of continuous access and nearly 10,000 acres of public lands** for recreation and appreciation of the bay's ecosystem.

For the operation and maintenance of the gates, an access road will be built. From this base infrastructure, a whole network of activities can be planned. From horse trails, to fish camps, to bicycle trails, the protection system's islands will become destinations for outdoor enthusiasts. In the middle of the bay, at the ship channel gate, an event center will include amphitheater seating and a floating stage where musical performances can take place against the backdrop of the expansive bay waters and high Texas skies. Marinas for recreational vessels will create a whole new set of places to go while out for a day on the bay. Boaters who miss the recently lost Redfish Island will find various new locations to drop anchor and explore.


ROAD


TOWER


TRIATHLON


RIDING TRAILS


EVENT SPACES


CAMPING


BIRD WATCHING

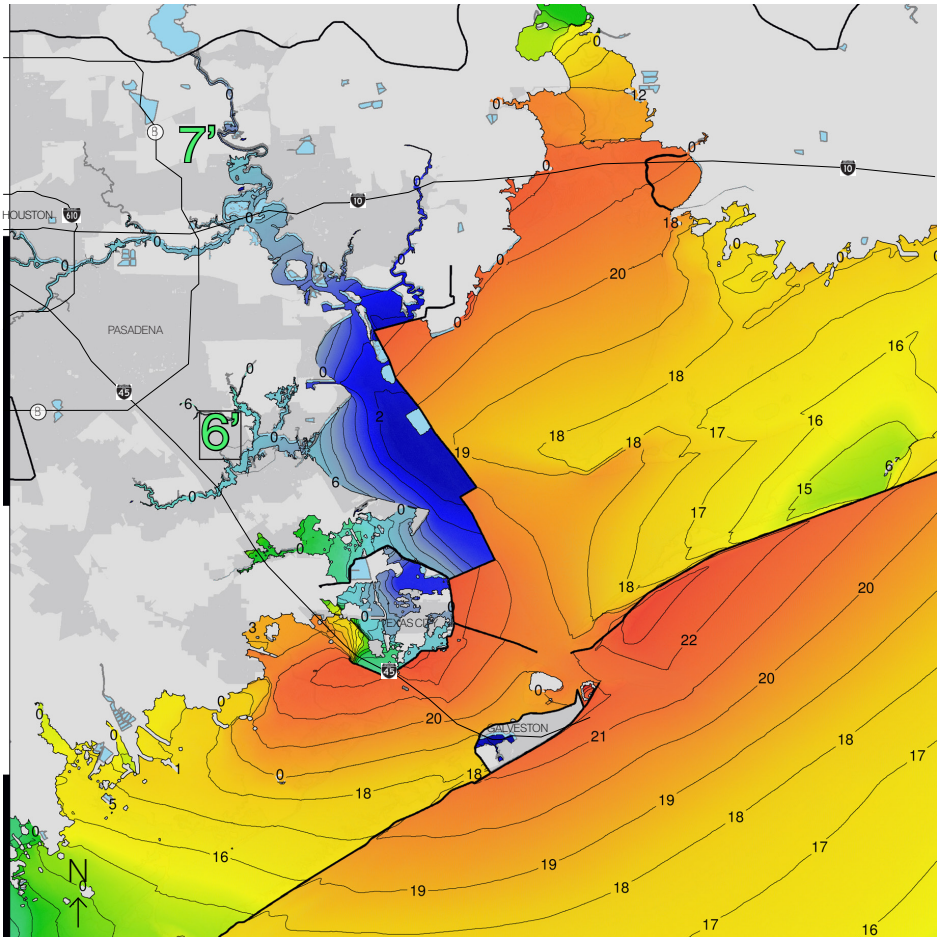
Visualization of the type of park space that will exist on Galveston Bay Park


1 mile
10
BAYTOWN
SMITH POINT
TEXAS CITY
45
N

STORM SURGE MITIGATION

Scientific models show that the Galveston Bay Park plan reduces residual flooding behind the in-bay barrier, preventing damage to the industrial and residential areas west of the bay in a storm surge event. Surge levels in the hypothetical small Cat. 4 storm (right) are expected to decrease up to 75% around the ship channel. Even with future sea level rise, the most vulnerable regions still see ample protection. Furthermore, Galveston Bay Park provides additional lines of defense including the backside levee on Galveston Island, which connects to the existing Galveston Sea Wall and provides a ring of protection for the City of Galveston. Even with sea level rise, the city remains protected against storm surge in this small Cat. 4 storm. Additionally, the raised highways provide a layer of protection against island overtopping. Galveston Bay Park promises storm surge protection for vulnerable residents, infrastructure, and wildlife for decades to come.

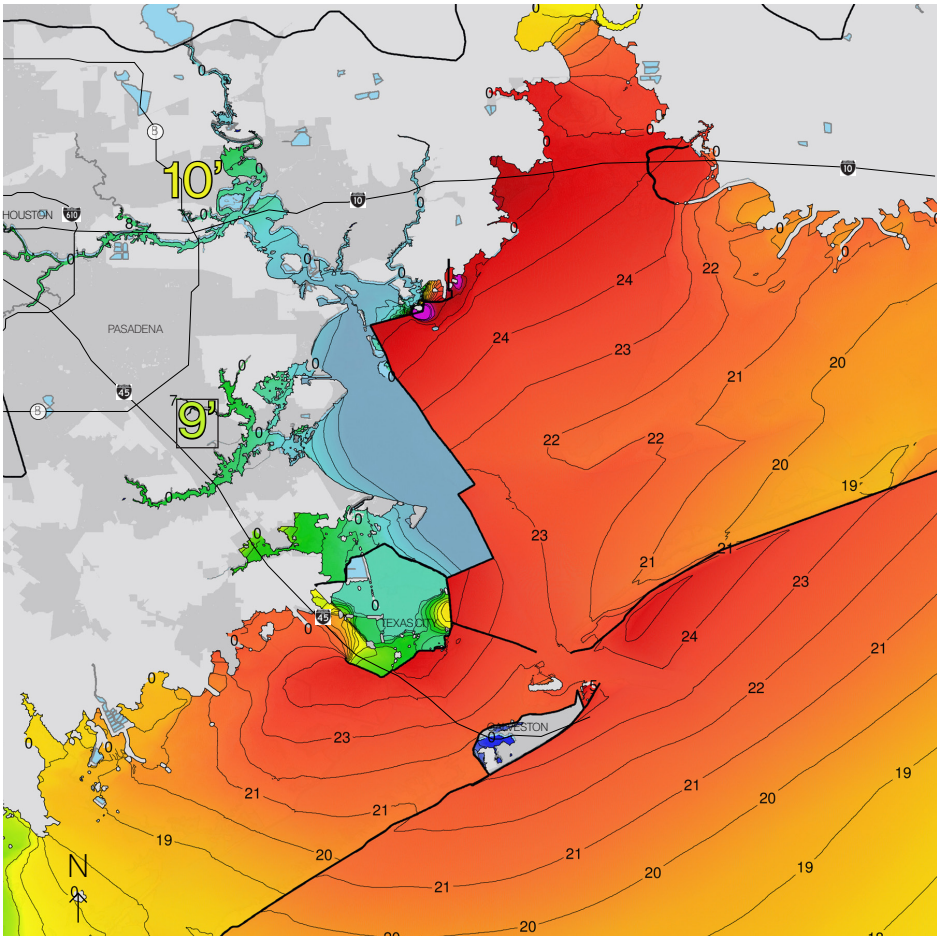
Delta Works series of storm surge barriers in the Netherlands protecting against a heavy storm



Small Cat. 4 Storm with the Galveston Bay Park

EXISTING PROTECTION
+ GALVESTON BAY PARK

SSPEED Center maximum water elevation (feet above MSL)



Small Cat. 4 Storm + Sea Level Rise with the Galveston Bay Park

EXISTING PROTECTION
+ GALVESTON BAY PARK

SSPEED Center maximum water elevation (feet above MSL)

PHASING

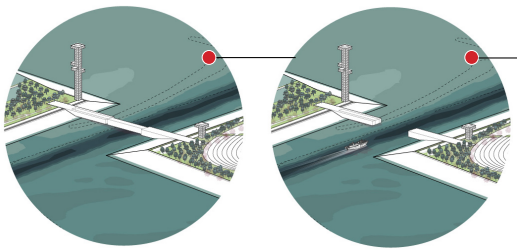
FAST & EFFECTIVE EARLY PHASES

While federal funding is being pursued for a coastal barrier, the in-bay component needs to be pushed forward. Presently, inland construction in the bay is active. Dredging activity in the port is already permitted by the Army Corps of Engineers, and existing dredge banks or islands in the bay could rapidly be converted into a portion of the efficient and high-performing surge protection system. With the environmental review being completed for the coastal barrier portion of the protection system, the permitting process is now relatively straightforward and can begin immediately for the in-bay component of the H-GAPS plan.

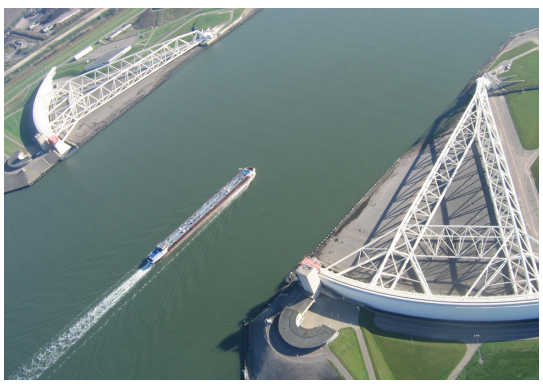
TECHNOLOGY

LEVERAGE EXISTING TECHNOLOGIES

The Maeslant, Ijssel and Hartel Barriers are storm surge gates that protect key navigational points within the Dutch Delta Works system. These are proven technologies that have been in place for decades, providing reliable storm surge protection to the Dutch western coast. In the interest of efficiency and reliability, **the storm surge protection system in Galveston Bay has been designed around these known and implementable technologies**. Openings in the barrier system are minimized to preclude closure distances that exceed current technologies. The mid-barrier navigational openings and gates allow for easy passage of recreational and commercial vessels across the line of protection. At the intersection of the ship channel navigational lanes, the opening is larger--indeed large enough for future expansion of the ship channel capacity should that happen--but still within the distances where proven technologies can be deployed.



CLOSED MIDBAY GATE OPEN MIDBAY GATE



Storm surge barrier in Delft, Netherlands


1 mile
10
BAYTOWN
SMITH POINT
TEXAS CITY
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ENVIRONMENT

ENABLE RECOVERY

Over time the western shore of Galveston Bay has been built as a hard edge. Unlike the agricultural eastern shore, with its soft tidal wetland edge, the western shore is made up of walls, piers and riprap embankments. Industry and development infrastructure reach to the coast, restricting freshwater runoff and displacing habitat. The balance of life in the bay is also at risk and this is an opportunity to not only protect the communities and industry of the region, but also to begin to restore the ecological vibrancy of Galveston Bay.

The introduction of soft edges along the outward edges of the barrier will create a different kind of bay-front experience from what exists today. New nesting sites for migratory birds, created oyster beds, and tidal wetlands supporting the diverse and unique wildlife of the bay are all part of the reimagined Galveston Bay. **The islands are planned to support varied habitat types, from tidal wetlands to coastal prairies.**

BROWN PELICAN

GREEN SEA TURTLE

KING MACKEREL

PIPING PLOVER

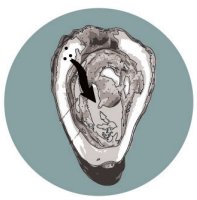
ECOLOGY

OYSTERS ARE THE LIFE OF THE BAY

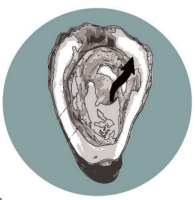
A single oyster can filter tens of gallons of bay water every day. Although devastated by over-harvesting and the direct and indirect destruction of their habitat, Galveston Bay's oysters are critical to the ongoing survival of the bay's ecosystem. Without the oysters, the unfiltered waters of the bay will struggle to support life.

The creation of new oyster beds is integral to the planning of Galveston Bay Park and the mid-bay storm surge protection system. These new oyster habitats will be established in the locations where they are the most ecologically viable and they will be built as part of the project's first phase. Starting with the oysters, a range of flora and fauna will be supported through new habitats within the bay promoting healthy and vibrant ecosystems.

(1)
oxygen and suspended particles are absorbed into the oyster with water.

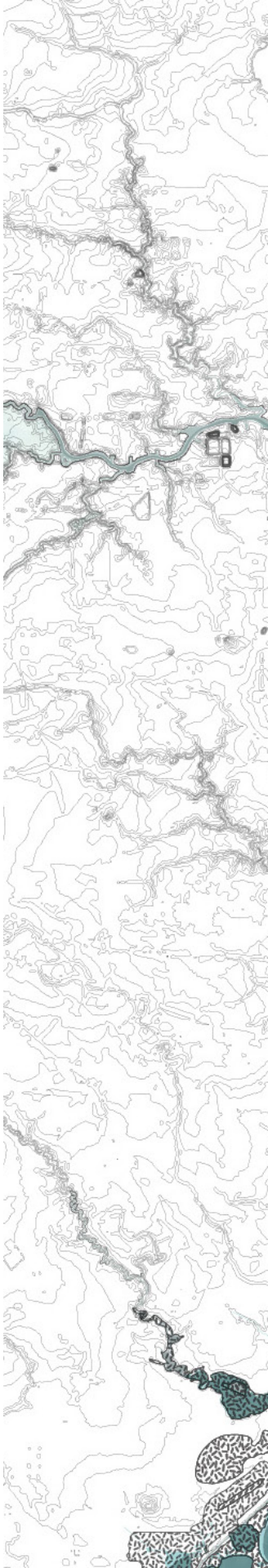


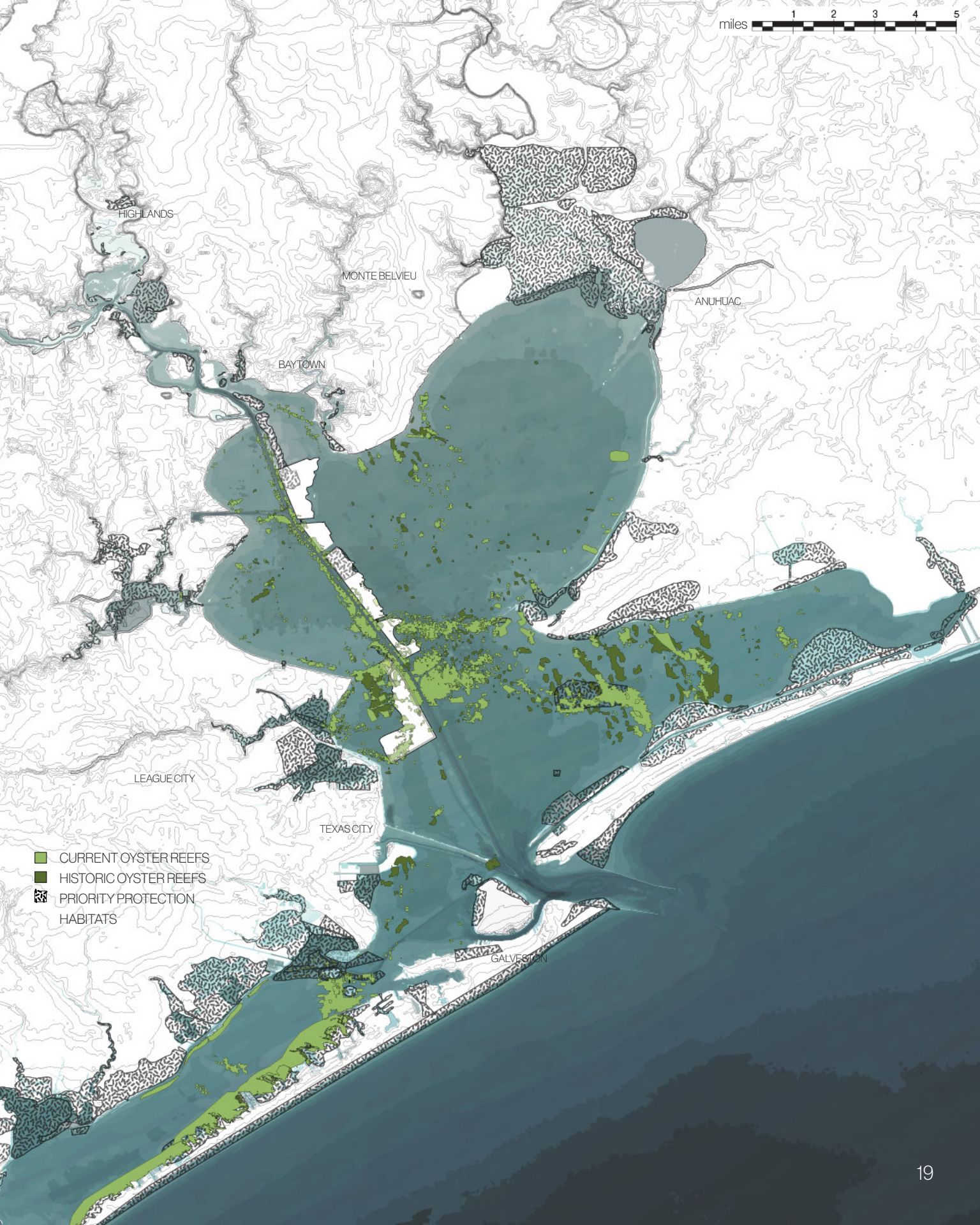
(2)
these particles are absorbed through the gills.



(3)
the water passes through the mantle and the particles are processed into the protective shell.

(4)
The filtered water returns as clean water. Oysters can filter up to 50 gallons of water every day.

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HIGHLANDS
MONTE BELVIEU
ANUHUAC
BAYTOWN
LEAGUE CITY
TEXAS CITY
GALVESTON
CURRENT OYSTER REEFS
HISTORIC OYSTER REEFS
PRIORITY PROTECTION HABITATS

FUNDING

FAST, AFFORDABLE, DOABLE

A storm surge protection system for the region can't wait any longer. With the start of each annual hurricane season, disaster is on the doorstep. The Galveston Bay Park project is designed to be built quickly and efficiently. Strategically located along the line of dredge banks currently permitted by the Army Corps of Engineers, the project is ready to start today. The project's cost is estimated at less than a third of the cost of other proposals for the region. Rather than rely on a single source for backing, the project funding strategy is envisioned to enable a range of participants to contribute. Public funding will be a mix of federal, state, and local dollars while private philanthropy will also play a role. Just as the ship channel was built with a mix of federal and local funding, this project will be a joint effort and an honest Texan public-private partnership. Scaled and calibrated to create the most benefit, on the quickest schedule, for the least cost, this project is ready to go.

H-GAPS PLAN SCENARIO :	COST ESTIMATE :	.....WITH 20% CONTINGENCY :
MID-BAY GATE	$ 0.5 B	$ 0.6 B
IN-BAY BERMS	$ 1.4 B	$ 1.7 B
GALVESTON FM-3005	$ 0.075 B	$ 0.09 B
BOLIVAR SH-87	$ 0.06 B	$ 0.07 B
SMALL SAND DUNES	-	-
GALVESTON LEVEE	$ 0.25 B	$ 0.3 B
PHASE 1 SUBTOTAL	$ 2.3 B*	$ 2.8 B**

* This cost estimate does not include the cost of raising Texas Levee and the construction of small sand dunes at F' and G'

** One Tenth of the cost of IKE at 28 B

BREAKDOWN

Financial support and leadership often evolve over the project life cycle enabling different partners to facilitate project realization.

PROJECT PHASE

CONCEPTUALIZATION	DESIGN	IMPLEMENTATION
PHILANTHROPIC →	PUBLIC →	PRIVATE

FUNDING AND SUPPORT MECHANISMS

GRANTS	FEDERAL GRANTS	PRIVATE EQUITY
TECHNICAL ASSISTANT	TAX CREDITS	BONDS
PROJECT CHAMPION	STREAMLINED APPROVALS	LOANS

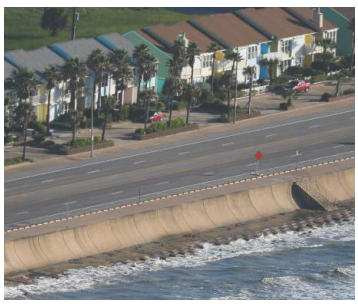
BENEFITS

Galveston Bay Park will enable a range of benefits to public. private, and civic stakeholders:

JOB CREATION & RETENTION

LOCAL, STATE & GOVERNMENT SAVINGS

ACCESS TO OPEN SPACE AND AMENITIES



REDUCED RESIDENTIAL FLOODING

KEY INDUSTRIAL PROTECTION

DECREASED INSURANCE COSTS


A'AL