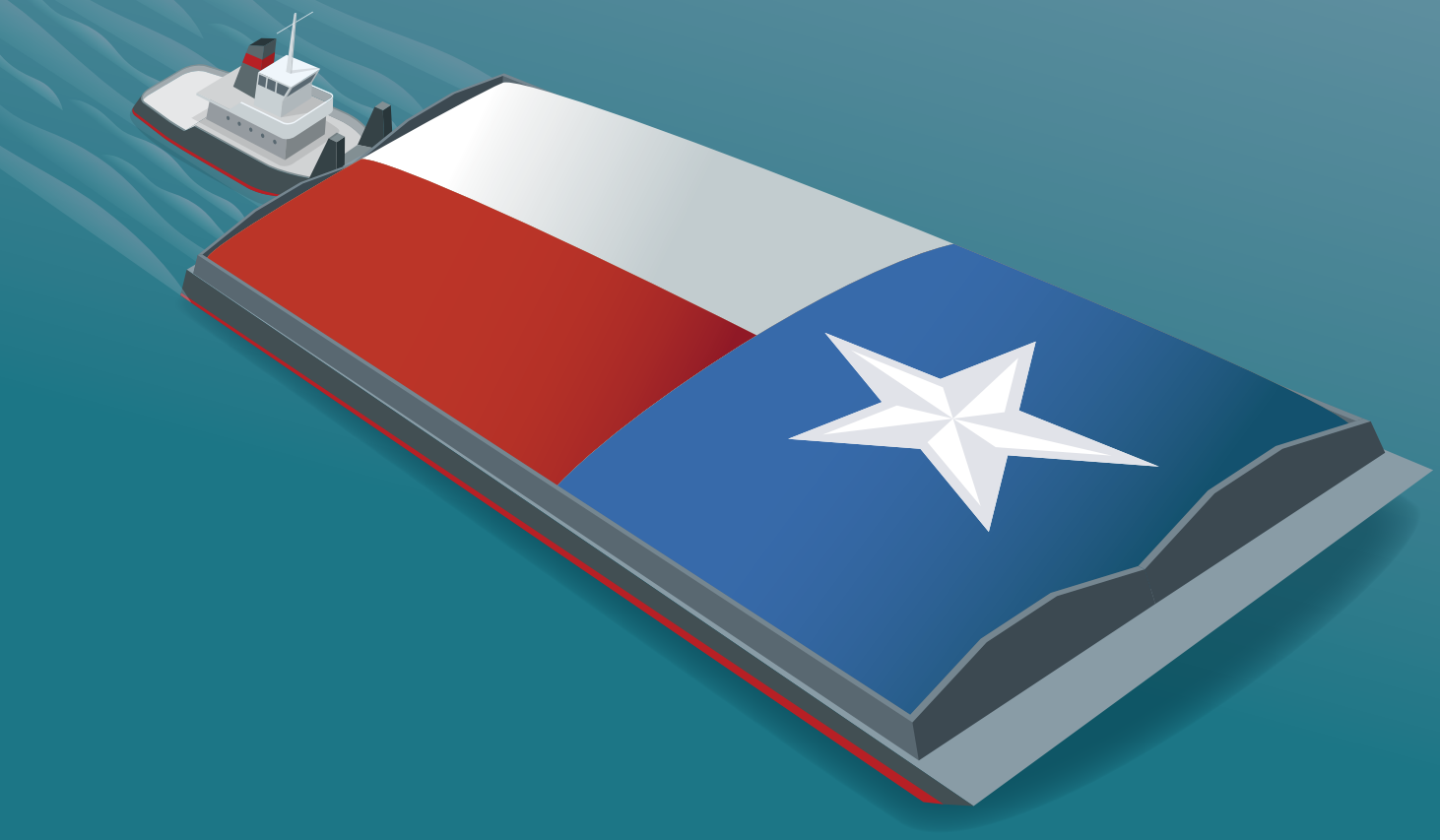
Texas Department of Transportation

# GULF INTRACOASTAL WATERWAY
# LEGISLATIVE REPORT

89TH LEGISLATIVE SESSION



Texas Department of Transportation

# GULF INTRACOASTAL WATERWAY LEGISLATIVE REPORT

89TH LEGISLATIVE SESSION

## CONTENTS

# Letter from the Director

Texas's vast natural resources are invaluable assets to our great state. The Gulf Intracoastal Waterway (GIWW) is a prime example. As the Director of the Texas Department of Transportation's (TxDOT) Maritime Division, I am pleased to present the GIWW Legislative Report to the 89th Legislative Session on behalf of the Texas Transportation Commission.

The State of Texas, through the TxDOT Maritime Division, is the non-federal sponsor of the Texas portion of the GIWW (GIWW-T), which extends 379 miles along our state's Gulf coast. It connects 23 Texas seaports to one another, private terminals and the world at large. In partnership with the U.S. Army Corps of Engineers (USACE), TxDOT works to ensure the sustainability of the waterway by supporting projects that strengthen its navigability and vitality. For example, in line with the USACE's goal to utilize 70% of dredged material extracted from the waterway by 2030 for beneficial use, we are partnering with stakeholders to develop a Beneficial Use Master Plan to identify sites where we can create or restore marshes, build bird islands and more. Rather than something to be disposed of, dredged material is a valuable repurposed resource available for use along our coast.

*Geir Eilif Kalhagen*

*Director, Maritime Division*
*Texas Department of Transportation*

As a key part of our larger transportation network, the waterway provides an alternative transportation mode that mitigates the deterioration of our roadways, produces three times less nitrogen oxide emissions per ton-mile than rail and truck, and is statistically safer. Impressively, the GIWW-T supports $77 billion in economic activity in Texas annually. In 2022, 80 million tons of cargo traversed the waterway, of which 74 million tons was outbound tonnage. Petroleum products constitute 90%, by volume, of all tonnage moving along the GIWW-T. Based on this data and the anticipated continued growth in alternative fuels along the Texas coast, such as liquified natural gas, hydrogen, and ammonia, it is critical that we maintain the health of this asset to provide a safe and economical transport of such commodities.

To this end, TxDOT Maritime is pursuing solutions to address some of the most critical threats to the health of the waterway. The Brazos River Floodgates (BRFG), initially constructed in 1943, is an obsolete structure, resulting in dangerous navigation conditions, substantial delays and costly repairs. To demonstrate the magnitude of this issue, on average, one accident occurs every five days, costing nearly $30 million per year to address collisions, complete repairs, and break down cargo.

Additionally, TxDOT Maritime is collaborating with partners to implement technologies to aid in maintaining the GIWW-T. For example, we are exploring digital twin technology to model the waterway to help facilitate the USACE's maintenance efforts. Having this information results in a safer and more reliable waterway, allowing its maximum value and impacts to be realized.

As Texas continues to experience significant population growth, increased demands will be placed on the supply chain and, in turn, the GIWW-T. Additional challenges such as erosion, aging infrastructure, and shoaling persist and will continue to affect this transportation route. Reliable transit along the GIWW-T is critical for recreational users and private industry alike, and the recommendations included in this document will allow TxDOT and the USACE to collaboratively safeguard and maximize the benefits of the GIWW-T.

It is my sincere hope that this report serves as a valuable guide to understanding the GIWW-T's significance within our transportation system and clearly outlines improvements we can make to strengthen the waterway and ensure this resource provides the greatest benefit to our state.

Texas Department of Transportation

GULF INTRACOASTAL WATERWAY LEGISLATIVE REPORT

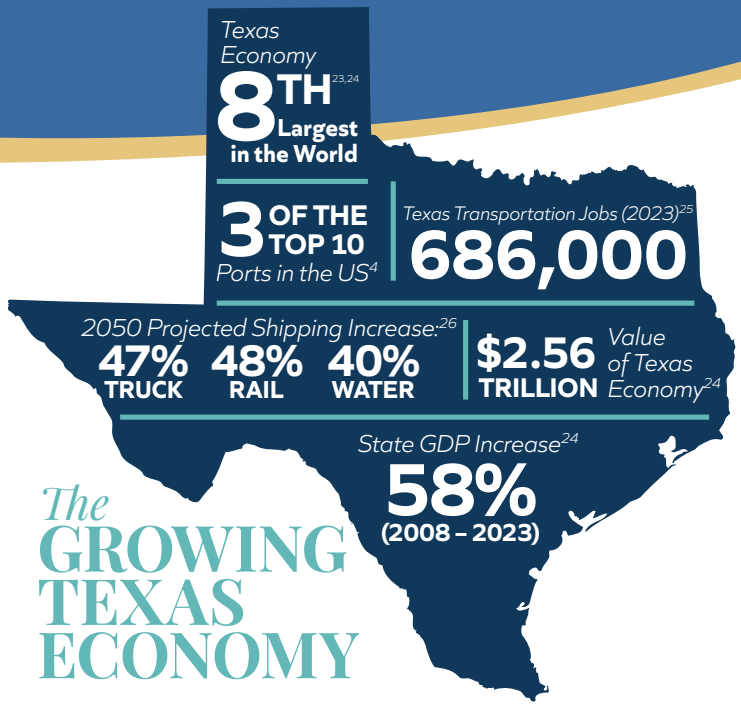
# EXECUTIVE SUMMARY

89TH LEGISLATIVE SESSION

The Gulf Intracoastal Waterway (GIWW) is a navigable channel along the Gulf Coast that runs from St. Marks, Florida to Brownsville, Texas. The portion of the GIWW in Texas (GIWW-T) spans 379 miles long, connecting ports and private terminals while allowing for efficient and safe transport of cargo along the Texas coast and beyond. Transport along the GIWW-T reduces congestion on Texas' highways and rail networks and serves as a primary passage for the import and export of commodities. From the Economic Impact Analysis, the GIWW-T supports yearly $77 billion in economic output to the state and provides 261,000 total jobs[2].

The Texas Department of Transportation (TxDOT) serves as the non-federal sponsor and the U.S. Army Corps of Engineers (USACE) Galveston District serves as the federal sponsor for the GIWW-T. USACE responsibilities include channel and infrastructure maintenance, overseeing new construction and reviewing and denying or approving permits for construction under their authority. TxDOT's main responsibility includes the acquisition of placement areas for USACE, used for dredge material disposal. TxDOT also has the ability, but not responsibility, to fund the incremental cost for the beneficial use of dredge material (BUDM) on dredging projects. Other stakeholders in the GIWW-T include the United States Coast Guard (USCG), non-government organizations (NGOs), private industries, Texas ports, waterway associations, and recreational users. Upon interviewing and engaging with stakeholders of the GIWW-T, it is apparent that the GIWW-T faces several significant challenges and issues. According to stakeholders, the four main challenges facing the GIWW-T include:

- Sediment shoaling
- Aging and degrading infrastructure
- Erosion to shorelines and barrier islands
- Damage to aids to navigation (ATONs)




## What *Moves on the* GIWW?

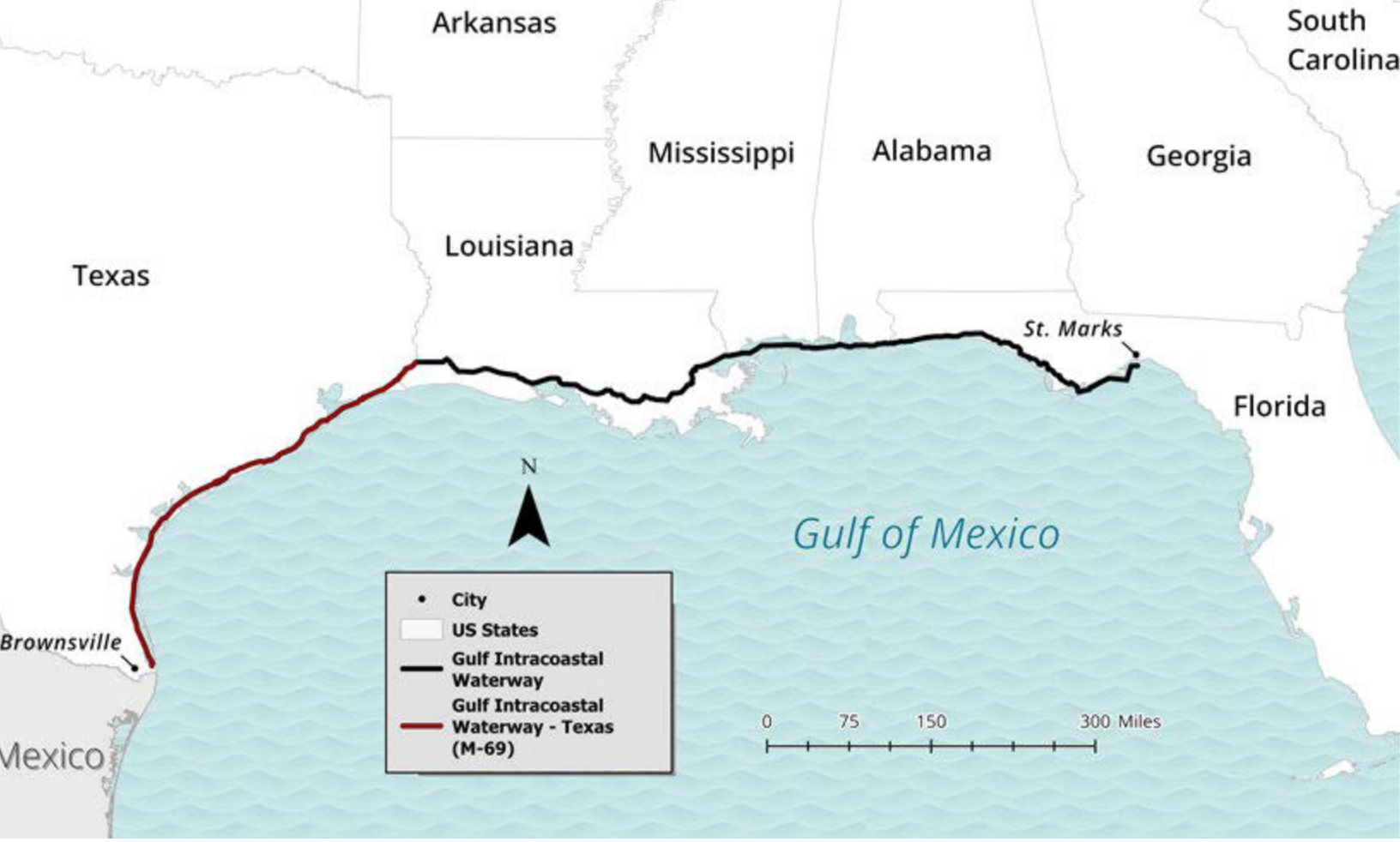
Enough ***wheat*** to bake a loaf of bread for every person in Dallas each month

Enough ***gasoline*** to fuel every person's car in Houston each week

Enough ***asphalt*** to pave a 5-lane road from Brownsville to Amarillo each year

**LEARN MORE ABOUT THE GIWW-T:**

The GIWW Viewer, developed by TxDOT and accessible via this QR code, provides data, details of infrastructure, shipping lanes and other notable locations found along the GIWW-T.




*GIWW and GIWW-T Extent*

Accelerated economic growth is expected along the Texas coast alongside changing weather and environmental conditions. Because of this, it is paramount to address the challenges to the GIWW-T and improve long-term navigability of the channel.

Shoaling occurs when sediment accumulates in the channel due to shoreline erosion or from tidal and riverine influences. As the channel fills with sediment, the channel depth is reduced which can impede navigation. Millions of dollars are spent annually to remove sediment out of the GIWW-T. Finding a placement area for dredged material is becoming increasingly difficult, as many placement areas are full or unavailable due to environmental restrictions.

Aging infrastructure poses a critical risk to the serviceability of the GIWW-T. Much of the infrastructure along the channel was built in the 1940s and 1950s and is currently past the end of their effective service life. Moreover, the existing infrastructure is not designed to accommodate modern vessels which can lead to concerns with time delays and safety. A prime example of the impacts aging infrastructure can be seen at the Brazos River Flood Gates (BRFG), where an average of one allision occurs every 5 days. Approximately $30 million is spent annually to address repairs and breakdowns due to these issues, according to USACE records.

Barrier islands provide essential protection to the GIWW-T through blocking waves, currents and sediment coming from the Texas Gulf and Texas bays. These barrier islands also serve as crucial habitats for wildlife, promote marshlands and provide inland protection. Currently, the barrier islands to the GIWW-T are being eroded from major storm events, vessel wakes and waves, all of which are compounded with relative sea level rise. As barrier islands deteriorate, more sediment is deposited into the channel, and barges become more susceptible to harsh, gulf-like conditions. Increased shoaling also leads to navigability issues, increased costs of consumer goods and negatively affects Texas's economic growth. Restoring the function of these barrier islands is critical to reducing the anticipated cost burden that would result from their continued deterioration.

ATONs, which include items such as lighthouses, buoys, daybeacons, range lights, and audible signals, serve an important role in providing safe and organized travel to navigators of the GIWW-T. The number of damaged ATONs is increasing yearly and is often unreported by mariners. Without effective ATONs, vessels run the risk of grounding which can lead to damages and delays. Modernization of this system to a virtual network of ATONs could provide a solution to reduce the reliance on physical ATONs that may be damaged, displaced or unreliable.

Despite the many challenges that the GIWW-T faces, there have been several recent accomplishments in constructing improvements to alleviate these issues. For example, in 2021, TxDOT constructed the Sargent Corkscrew Bridge, replacing the existing swing bridge and allowing for unimpeded roadway and channel navigation. Another example was the closure of Rollover Pass in 2019. Constructed in 1955, Rollover Pass connected East Galveston Bay to the Gulf of Mexico to address water quality, salinity and fish migration concerns. However, Rollover Pass was expensive to maintain and led to shoaling of the GIWW-T and beach erosion. Closure of the Pass has significantly reduced the ongoing maintenance costs of the GIWW-T.

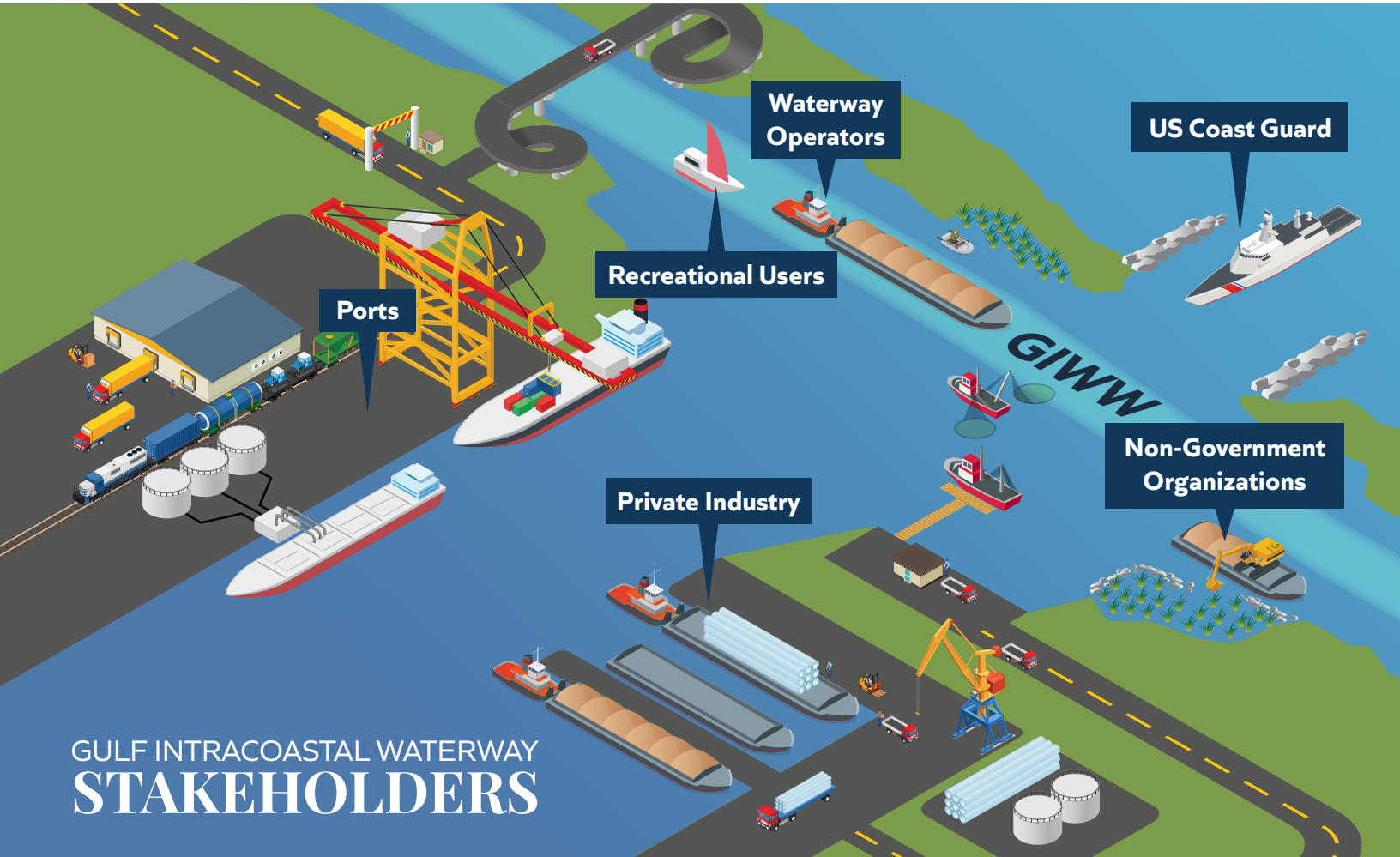
The future success of the GIWW-T hinges upon the involvement of stakeholders to bridge knowledge gaps, increase coordination between planning and permitting stages and help provide access to alternative funding sources such as state and federal grants. Several recommended projects and studies are included in this report ranging from new construction and increased maintenance dredging to pilot projects that can help address the main challenges that the GIWW-T faces.

The GIWW-T is essential to Texas' economy and connectivity, but its potential is currently limited by the challenges outlined in this report. Only with proper maintenance and full funding can it truly fulfill its role. Therefore, investing in the GIWW-T is not just necessary but a strategic investment in the economic future of Texas.

*The Sargent Corkscrew Bridge (Photo credit: TxDOT)*

**"The GIWW is a vital component of the Texas economy and coastal environment. The waterway has many advantages over the other modes of freight transportation, but these advantages can only be realized if the GIWW is fully maintained. The legislative proposals in this report will enable TxDOT and USACE to work together to realize the maximum possible benefit of the GIWW."**

*Geir Eilif Kalhagen*
*Director, Maritime Division*
*Texas Department of Transportation*



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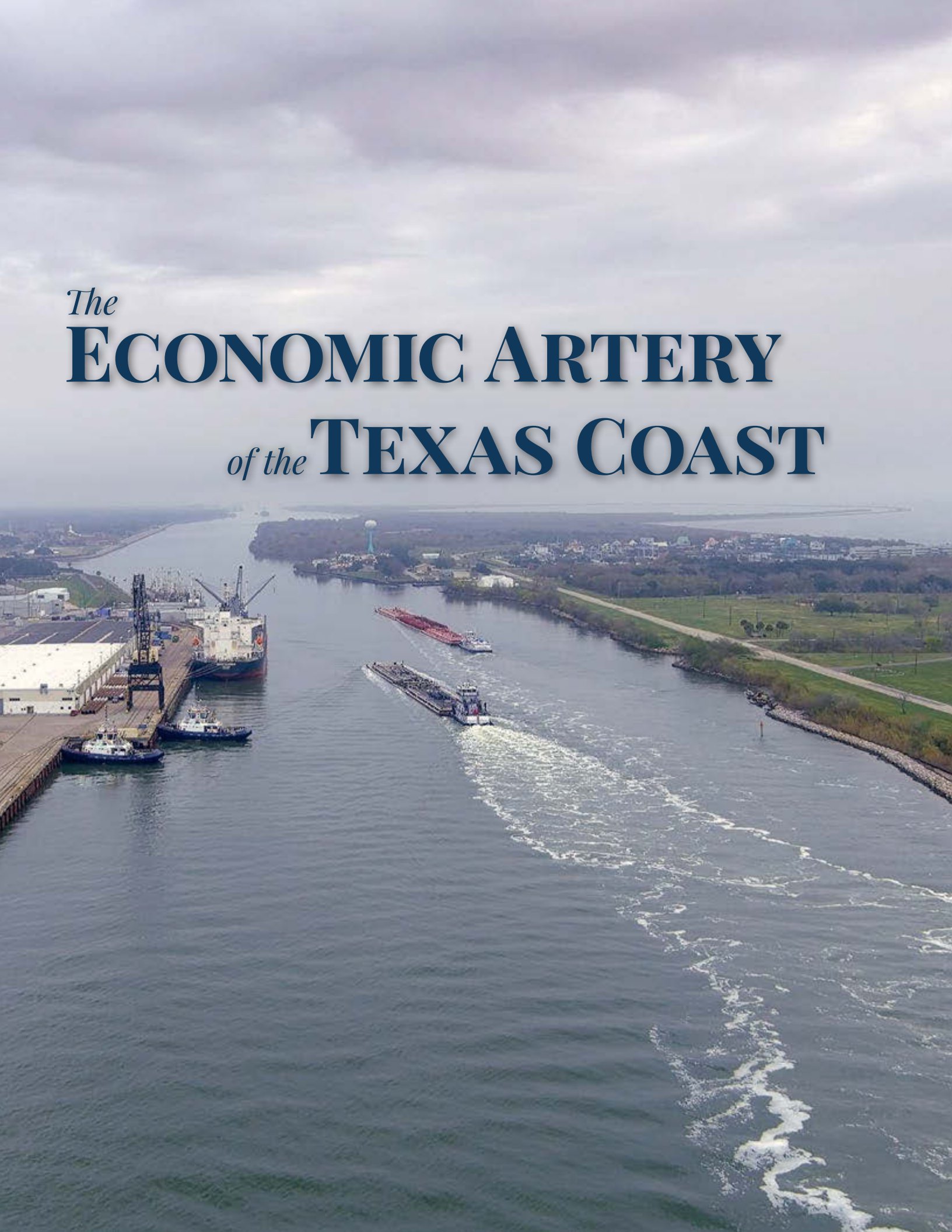


# *The* ECONOMIC ARTERY *of the* TEXAS COAST


*GIWW and GIWW-T Extent*

# 1. The GIWW-T

## 1.1. Introduction

Across the Gulf Coast states, the Gulf Intracoastal Waterway (GIWW) forms an expansive "economic artery" linking numerous ports, terminals, harbors, channels and infrastructure. Its role in facilitating economically efficient bulk trade remains unparalleled by other land-based modes. The GIWW is an integral part of the state's transportation system, providing a waterborne alternative to transporting cargo between ports and private terminals on the Texas coast and beyond. The GIWW connects Texas industries to the U.S. Midwest via the Mississippi River and the Inland Waterway, ensuring a seamless and efficient transportation network that supports the nation's economy. This allows cargo owners, particularly those in the petrochemical industry, to move their goods along the Gulf Coast in a manner that is safer for the public, better for the environment, more efficient and less damaging to the state's roadways and bridges than moving the same goods via road or rail.

The GIWW in Texas (GIWW-T) is a critical section of the GIWW spanning 379 miles from the Sabine River to Brownsville. This 12-foot authorized depth channel interconnects Texas's 12 deep-draft and 11 shallow-draft ports, serving as a lifeline for commercial industries along rural and urban coastlines. Beyond Texas's border with Louisiana, the GIWW extends approximately 721 miles through the Gulf Coast region, ultimately terminating in St. Marks, Florida.

*A barge on the GIWW-T (Photo credit: TxDOT)*

### Did You Know?

The GIWW-T supports an impressive ***$77 billion*** in economic activity for the state of Texas each year.

**LEARN MORE ABOUT THE GIWW-T:**
The GIWW Viewer, developed by TxDOT and accessible via this QR code, provides data, details of infrastructure, shipping lanes and other notable locations found along the GIWW-T.

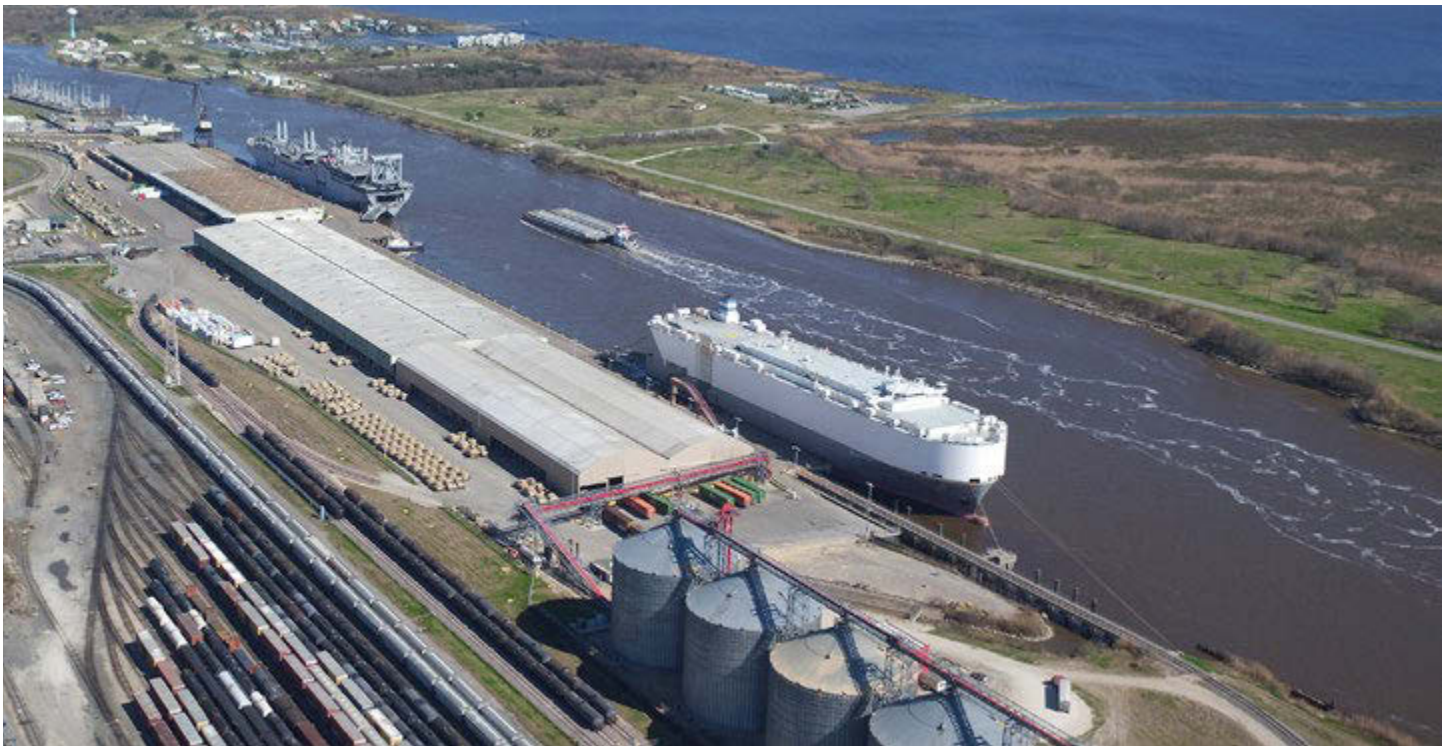
## Users

The GIWW-T is frequently used by a wide variety of people and private industries. Commercial goods movement, specifically chemicals and petroleum products, makes up the bulk of GIWW-T usage. However, shrimp, oyster and other commercial fishing vessels heavily depend on the waterway to access fishing grounds and bring their catches to port. Private charter fishing vessels, recreational fowl hunters and fishermen, bird watchers, pleasure boaters and many other recreational users all rely on the GIWW-T to access the network of bays and wetlands across Texas. Commonly, these various users have come to rely on the GIWW-T as a means of safe and reliable navigation across the entire coastline of the state.

## Marine Highway System

The U.S. Marine Highway System comprises 31 channels, canals or other waterway routes that run approximately parallel to inland highways, as designated by the U.S. Maritime Administration (MARAD). These waterways are essential for facilitating trade and the transportation of commodities. Originally, the GIWW-T was part of the M-10 marine highway. However, stakeholders demonstrated the importance of reducing road traffic and minimizing emission footprints, recognizing that the GIWW-T handles a significant majority of the tonnage transported on the M-10. As a result, in 2016, the GIWW-T secured its own spot in the Marine Highway System as Marine Highway 69 (M-69), symbolizing the waterway's importance to the Texas economy and, importantly, allowing it to qualify for federal grant funding through the United States Marine Highway Program (USMHP) within the state of Texas[1].


*United States Marine Highway Network*



*An auto carrier, a deep draft vessel, at Port Arthur (Photo credit: Port of Port Arthur)*

## 1.2. GIWW-T Seaport Network and Connectivity

All seaports across Texas rely to some extent on the GIWW-T for overall traffic. Smaller seaports, in particular, depend heavily on their connection to the GIWW-T for importing and exporting commodities. Smaller, shallow-draft ports that are not connected to Gulf-facing ship channels rely solely on the GIWW-T to provide connectivity across Texas's shallow bays. The GIWW-T also serves as a link between larger deep-draft ports with Gulf access and inland waterways, providing a more direct and safer passage for inland barge traffic to reach its destination.

Across its 379 miles, the GIWW-T connects the state's 23 seaports to one another and the Gulf of Mexico. Without this connection, the steady supply chains along the coast would be severely disrupted, leading to extreme congestion on highways and rail networks as they try to compensate for the loss of barge movement. Such a significant impact would greatly diminish the Texas Coast's economic power and growth trajectory. It is essential to understand how the GIWW-T should be maintained, but more importantly, how Texas can plan for economic growth, increased usage and navigational hazards along the waterway while promoting efficient, safe and consistent transportation between ports.


*Texas Seaports*

# 1.3. GIWW-T Value and Strategic Economic Importance

Texas dramatically exceeds all other GIWW states combined in usage, tonnage and traffic on its section of the waterway[2]. In 2022, the GIWW-T boasted approximately 80 million tons in total tonnage. Of this, 74 million tons were Texas-originating, while the remaining 6 million tons consisted of interstate (inbound) tonnage from the rest of the GIWW. An impressive estimated 92.5% of all goods moved on the GIWW-T originated from Texas. Many chemical, petrochemical, gas processing facilities and terminals are strategically located with direct access to the GIWW-T or through a connecting deep or shallow-draft port, incentivized by the efficiency of bringing in raw materials, inter-facility trade and final product transport. By volume, 90% of total commodities moved on the GIWW-T are petroleum products, and non-petroleum derived chemicals account for 4% of total commodities. The remaining 6% consists of agricultural, construction material and others as depicted in the following graphics.

There has been some volatility in the volumes shipped on the GIWW-T in the past few years, primarily due to supply chain and demand-side disruptions caused by the COVID-19 pandemic. The top commodities transported on the GIWW-T include distillate fuel oil, crude petroleum, and naphtha with other petroleum derived solvents. These commodities, which are discussed in more detail later, experienced a quick recovery in volumes from 2020 to 2022.

## LNG, Ammonia, and Hydrogen

Several Texas ports and navigation districts have been adjusting their infrastructure to trade and store alternatives to traditional fuels over the past decade, specifically, liquified natural gas (LNG), hydrogen and ammonia.

Hydrogen and ammonia production is growing rapidly in Texas, as evidenced by the recent selection of the U.S. Department of Energy's (DOE) Regional Clean Hydrogen Hub program in the Houston area. Texas was awarded this hub as part of the DOE's $7 billion program to introduce regional clean hydrogen hubs across the U.S. to contribute to de-carbonizing heavy-duty transportation industries funded through the 2022 Bipartisan Infrastructure Law[3].

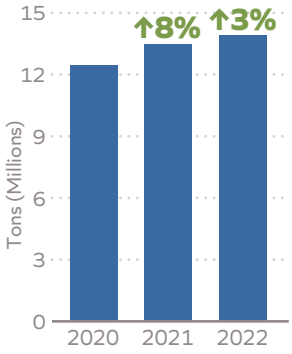
While ammonia and hydrogen are still emerging in Texas, LNG is much more widespread, with many large ships in Texas already primarily LNG-fueled. LNG has the advantage of being relatively compatible with existing machinery and infrastructure and can be created directly from natural gas. This allows substantial emissions reductions for vessels while keeping operating costs reasonable. One should note that a large part of American LNG and alternative vessel fuel is destined for export or bunkering (vessel refueling) and, therefore, would not appear on GIWW statistics, as it is directly transferred from LNG or other production facilities to large ocean-going vessels.

As the alternative energy sector expands, fuels such as hydrogen and ammonia will become more widespread and continue growing in tonnage. This growth is earmarked for Texas, placing more importance on the health of the GIWW-T.

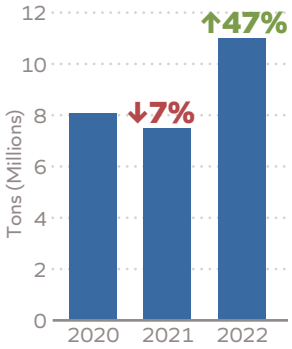
# GIWW Trade Statistics[4]

## TOP 3 Commodities

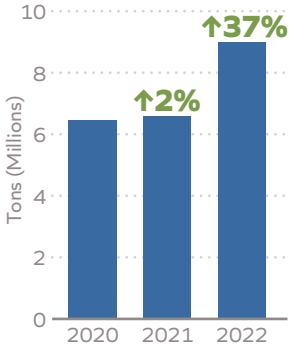
### Distillate Fuel Oil




### Crude Petroleum




### Naphtha & Other Petroleum Derived Solvents




## Other Commodities *on the* GIWW

**Residual Fuel Oil**
↑13% GROWTH
6.6 Million Tons (2020) → 7.5 Million Tons (2022)

**Gasoline**
↑10% GROWTH
6.1 Million Tons (2020) → 6.6 Million Tons (2022)

**Natural Gas & LNG**
↓36% DECLINE
1.35 Million Tons (2020) → 0.86 Million Tons (2022)

**Manganese Ore**
↑113% GROWTH
32,100 Tons (2020) → 68,500 Tons (2022)

**Liquid Sulfur**
↑73% GROWTH
39,200 Tons (2020) → 67,900 Tons (2022)

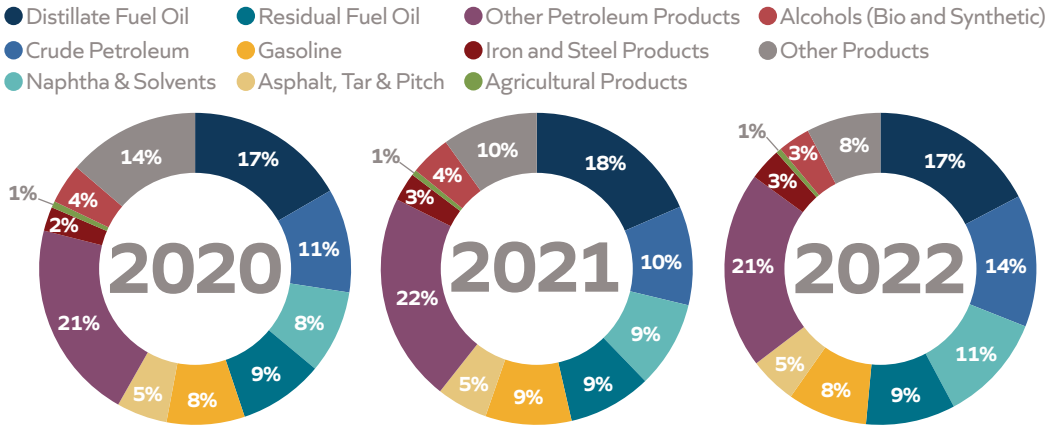
**Sulfuric Acid**
↓36% DECLINE
872,000 Tons (2020) → 556,000 Tons (2022)

**Rice**
↑75% GROWTH
75,000 Tons (2020) → 131,000 Tons (2022)

**Iron & Steel**
↑10% GROWTH
953,000 Tons (2020) → 1,049,000 Tons (2022)

**Sand & Gravel**
↓23% DECLINE
933,000 Tons (2020) → 713,000 Tons (2022)

## Top Commodities – Percent *of* Tonnage




## What *Moves* *on the* GIWW?

Enough ***wheat*** to bake a loaf of bread for every person in Dallas each month

Enough ***gasoline*** to fuel every person's car in Houston each week

Enough ***asphalt*** to pave a 5-lane road from Brownsville to Amarillo each year

*Liquid cargo barge at Port Freeport (Photo credit: TxDOT)*

*Tug and barges at a fleeting location near the Texas City Dike (Photo credit: AECOM)*

## 1.4. Economic Impact Analysis

An economic impact analysis (EIA) was performed to determine the full annual value of the GIWW-T. The analysis broadly aligns with the approach from a similar EIA completed in 2018 by the Texas A&M Transportation Institute (TTI)[5]. This EIA estimates the direct outputs and economic impacts supported by the GIWW-T. A further explanation of this process and additional findings are included in the Economic Impact Analysis Appendix. The EIA estimates that the GIWW-T supported significant total economic impacts:

- $77.0 billion in economic output in annual terms on average over 2020-22 (expressed in 2021 dollars).
- $19.5 billion in earnings in annual terms on average over 2020-22 (expressed in 2021 dollars).
- 261,000 jobs in annual terms on average over 2020-22.
- $40.2 billion in value added in annual terms on average over 2020-22 (expressed in 2021 dollars).

Table 1.1 summarizes the economic impacts supported by the GIWW-T.

**FURTHER READING:** More details on the economic impact analysis can be found in the Appendix.

### 1.1. GIWW Average Economic Impacts (2020-2022)

| | Output (2021 $M) | Earnings (2021 $M) | Employment (Jobs) | Value Added (2021 $M) |
|---|---|---|---|---|
| Direct and Indirect Impacts | $56,843 | $13,446 | 126,715 | $28,519 |
| Induced Impacts | $20,170 | $6,047 | 134,671 | $11,668 |
| **Total Impacts (Direct, Indirect, and Induced)** | **$77,013** | **$19,493** | **261,387** | **$40,187** |

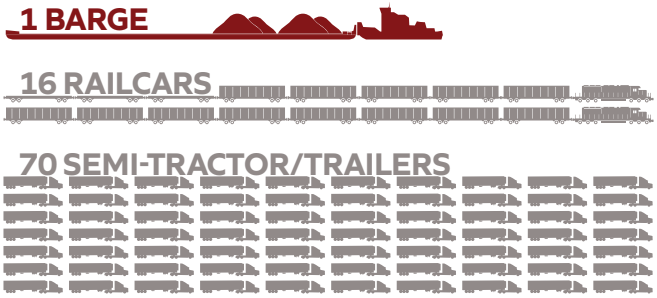
*Source: US Army Corps of Engineers, Bureau of Transportation Statistics, Bureau of Economic Analysis, AECOM. Notes: Figures may not sum due to rounding.*

*Liquid barge loading at Port Freeport (Photo credit: USACE)*

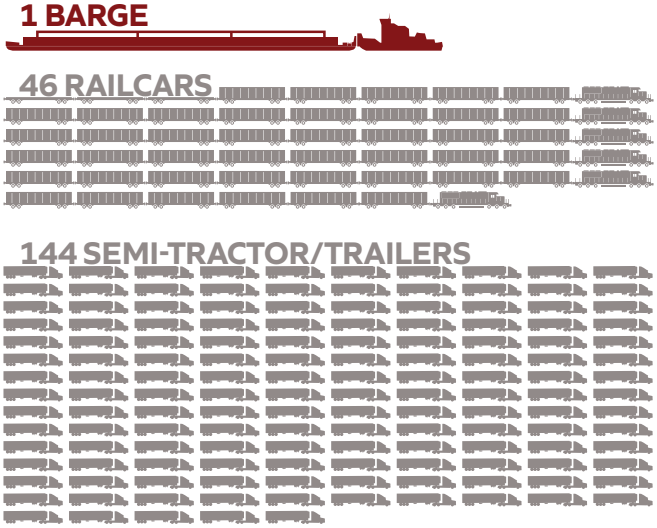
## 1.5. Barge is Better

Barge is the most efficient mode of transportation when compared to truck and rail modes. For liquid cargoes, a single barge can transport the same as 46 rail cars or 144 tractor trailers[6]. On a ton-mile basis compared to rail and truck, barge transportation is more cost effective, provides cleaner emissions (NOx and carbon emissions) and is statistically safer regarding accidents, injuries and fatalities. Increased utilization of barges across the transportation network will improve the efficiency of freight movement, leading to transportation cost savings, emissions reduction and accident cost savings while improving the overall resiliency of the transportation network.

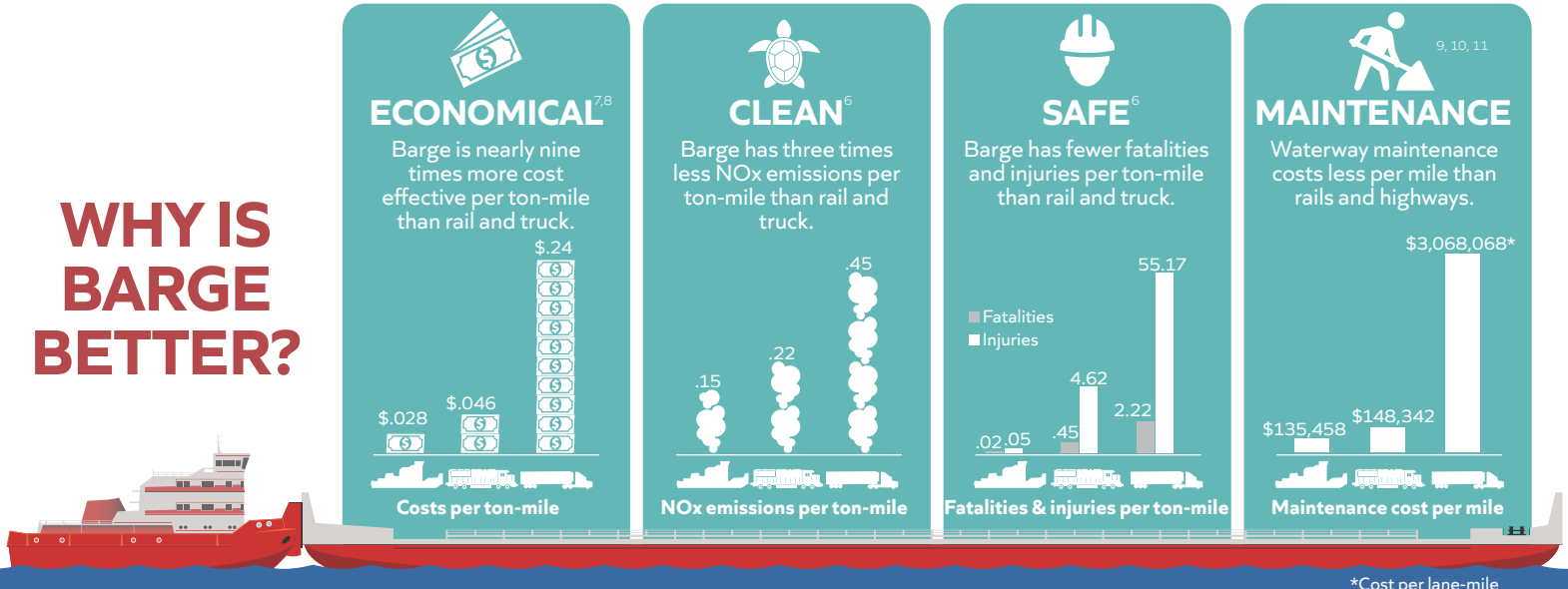
HOW WOULD YOU MOVE
**1,750 SHORT TONS**
OF DRY CARGO?



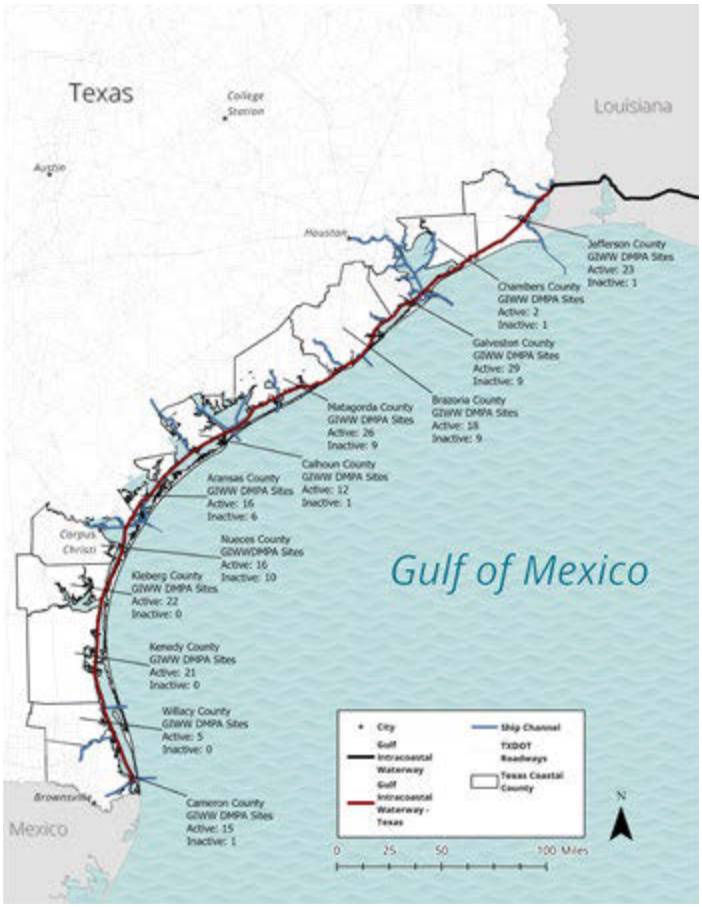

HOW WOULD YOU MOVE
**27,500 BARRELS**
OF LIQUID CARGO?




# WHY IS BARGE BETTER?




*Cost per lane-mile




*GIWW-T DMPA Inventory*

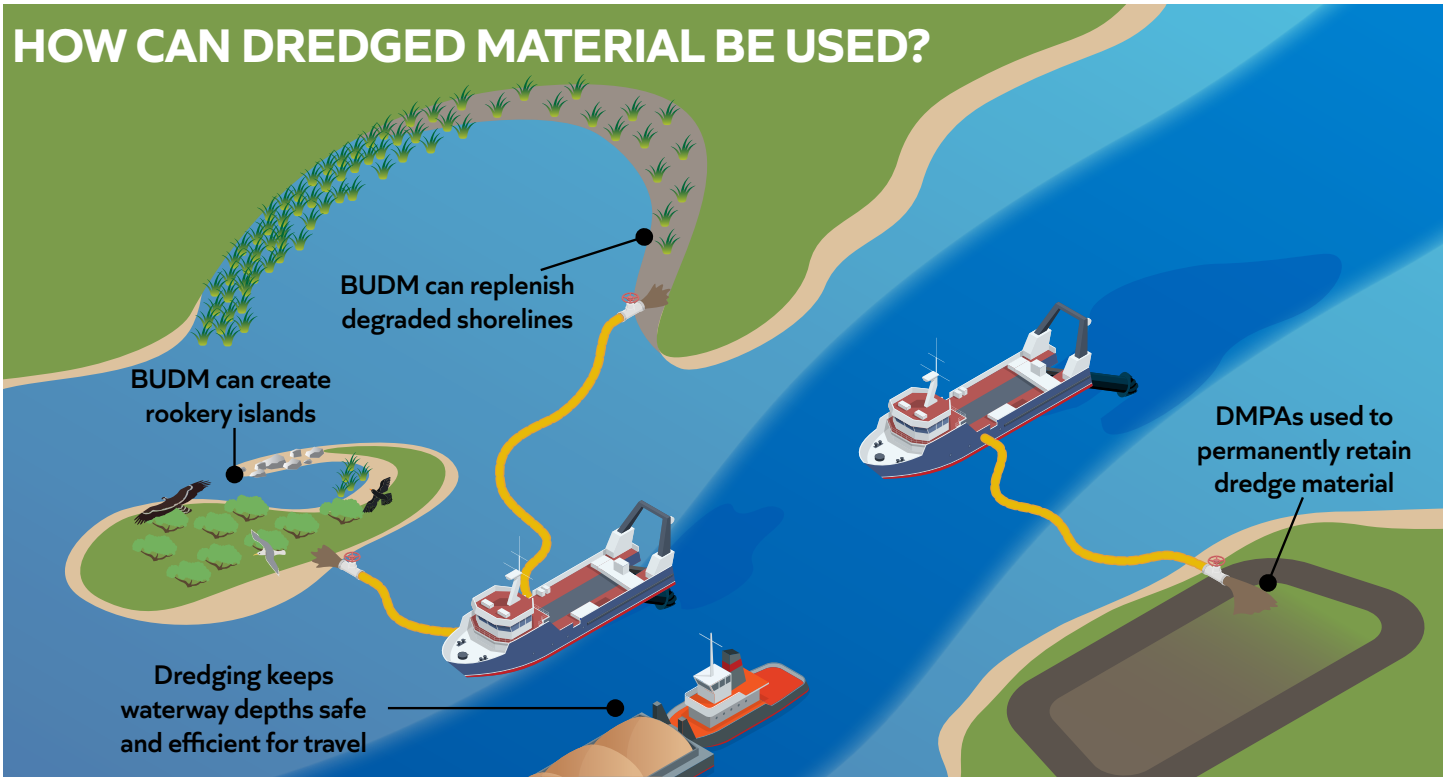
*Pierce Marsh covers 2,346 acres and has multiple restoration efforts dating back to 1999 that include beneficial use of GIWW-T dredge material to create marsh cells, cordgrass seeding, and cordgrass transplanting. (Image source: Landsat)*

# 1.6. Federal & Non-Federal Sponsors

The GIWW-T is governed by a Memorandum of Agreement (MOA) between the federal government and the State of Texas. This agreement outlines the shared responsibilities and cost-sharing obligations necessary to execute the project.

- **Federal Sponsor:** The U.S. Army Corps of Engineers (USACE) serves as the federal sponsor for the GIWW. For the GIWW-T segment, this responsibility falls more specifically to the USACE Galveston District. The Galveston District is responsible for maintaining the waterway's authorized dimensions and overall integrity to ensure safe navigation. The Galveston District's responsibilities include channel maintenance that mainly consists of dredging to maintain the authorized depth, new construction, infrastructure repairs and channel surveying. The USACE is also responsible for reviewing and approving or denying permit applications that fall under Section 404 of the Clean Water Act[12] or Sections 10 and 408 of the Rivers and Harbors Act of 1899[13] that pertain to the GIWW-T.
- **Non-Federal Sponsor:** As designated in the Texas Coastal Waterways Act passed in 1975, TxDOT is responsible for acquiring land to provide the USACE with a network of dredge material placement areas (DMPAs). As USACE executes GIWW-T maintenance, construction or improvements that involve dredging, the dredged material is placed in DMPAs. Maintaining a geographically comprehensive network of DMPAs is essential to ensure that the placement of dredged material from channel maintenance and new construction is feasible and economically viable.
- **Shared Responsibilities:** : TxDOT also has the ability, although not the responsibility, to financially support the beneficial use of dredged material (BUDM) practices into GIWW-T maintenance and new work dredging projects. The intent of BUDM as a practice is to reuse dredged material from dredging projects to serve an environmentally beneficial purpose. Applications of BUDM from GIWW-T dredging range from rookery island creation/restoration to marsh creation/restoration, beach and dune nourishment, living shoreline creation and more. These projects can cost more upfront but typically provide additional benefits beyond traditional DMPA disposal. BUDM projects can be engineered to provide multiple benefits to the environment while also addressing navigability and shoreline stabilization challenges. The Texas Beneficial Use Master Plan, developed by Ducks Unlimited, TxDOT and Anchor QEA,

**FURTHER READING:** The Beneficial Use Master Plan developed by Ducks Unlimited and TxDOT

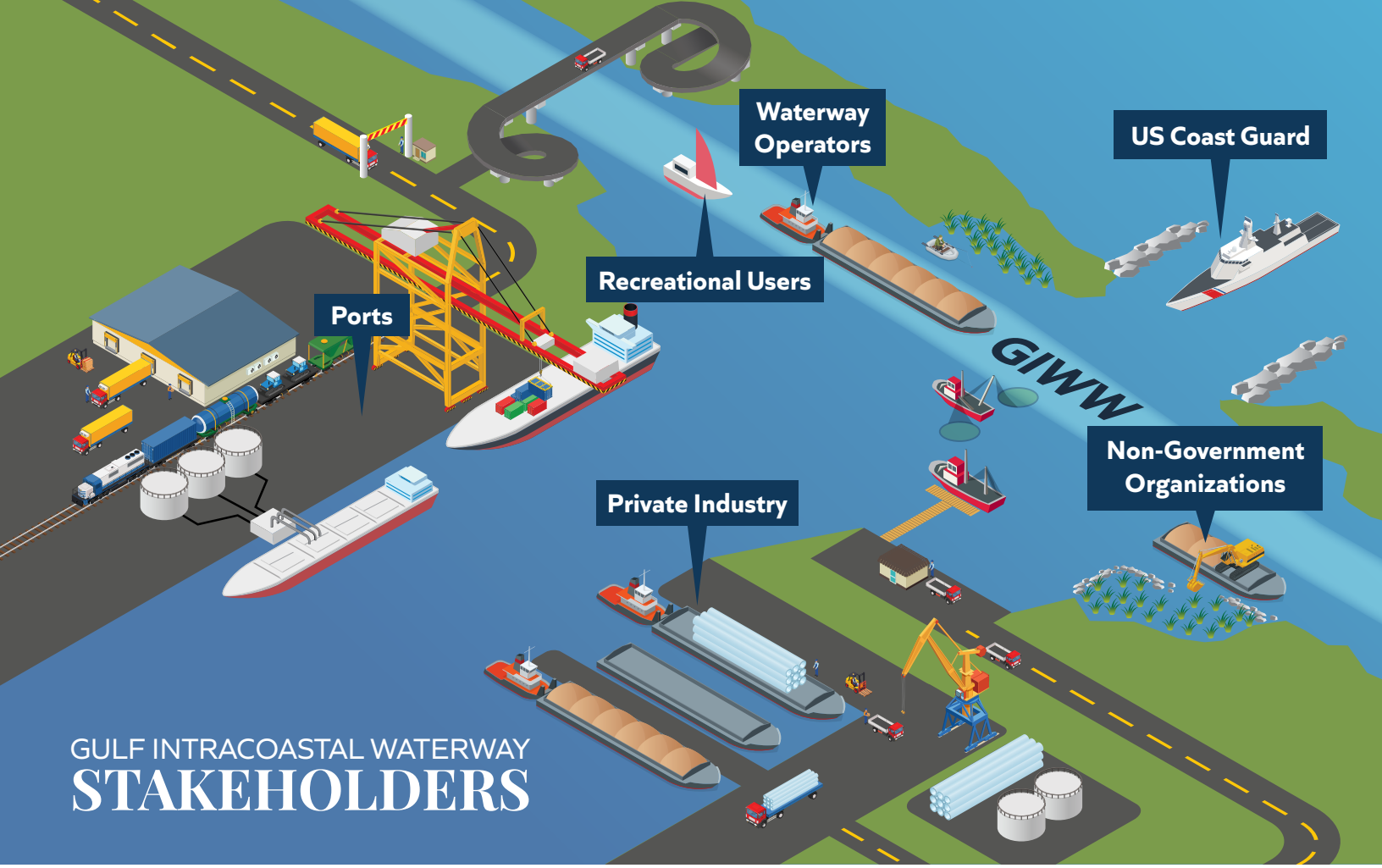



was created to improve the coordination and implementation of coastal restoration projects involving the beneficial use of dredged material[14]. Historically, coastal restoration BUDM projects have faced coordination and permitting challenges that limit the success of their implementation, and this effort aims to reduce those challenges by providing preliminary planning, engineering, design and cost estimates for stakeholders and their potential beneficial use projects.

BUDM applications greatly depend on local sediment composition, environmental regulations, geographic proximity to a project site and permitting restrictions but are growing in popularity. The USACE has set a target to use 70% of the material it dredges nationwide beneficially by 2030[15]. Where the USACE will pay the cost of traditional disposal, TxDOT as well as other entities such as NGOs can cover the incremental cost difference to include BUDM applications on suitable projects where these beneficial aspects would be realized.

Additionally, as a part of the USACE's permit review process, TxDOT is tasked with providing partner agency review for all permits pertaining to the GIWW-T. This allows TxDOT to be involved in all proposed development along the GIWW-T and provides TxDOT's position and feedback on proposed projects to be considered in the USACE's final permit decision, including any special conditions the applicant may be required to address.

*Beneficial Use Sites Across The Texas Coast*




A diversified set of stakeholders provides a well-rounded perspective and support when approaching challenges and planning for the GIWW-T's future.

## 1.7. Stakeholders

An expansive network of industries, government agencies, organizations and associations are dependent upon or have responsibilities pertaining to the GIWW-T. As a group, this diverse pool of involved stakeholders makes up the network surrounding and supporting the GIWW-T. Across the stakeholder network, many partnerships are formed with one another to share information, collaborate, pursue funding, address issues and improve the safety and functionality of the waterway.

A diversified set of stakeholders provides a well-rounded perspective and support when approaching challenges and planning for the GIWW-T's future. Below are some of the other major stakeholders aside from the federal sponsor (USACE) and the non-federal sponsor (the State of Texas through TxDOT's Maritime Division) related to the GIWW-T, as well as their associated roles and responsibilities.

**The United States Coast Guard (USCG)** is responsible for navigation safety of U.S. waters, which include the GIWW-T. Some of the main USCG duties pertaining to the overall GIWW are maintaining the federal aids to navigation (ATONs), regulating traffic, providing and enforcing safety and operational requirements for vessels, investigating vessel accidents and providing emergency services on the water.

**Non-Government Organizations (NGOs)** take part in protecting and restoring environments alongside or near the GIWW-T. Vessel traffic can affect erosion rates along shorelines and wetland areas. NGOs, such as Ducks Unlimited and Audubon Texas, look to implement projects in those areas to protect and restore habitat for fish, birds and other wildlife. The GIWW-T also provides an economically feasible access network for construction mobilization, demobilization and delivery of project materials for coastal restoration projects outside of developed port areas that is critical to their success.

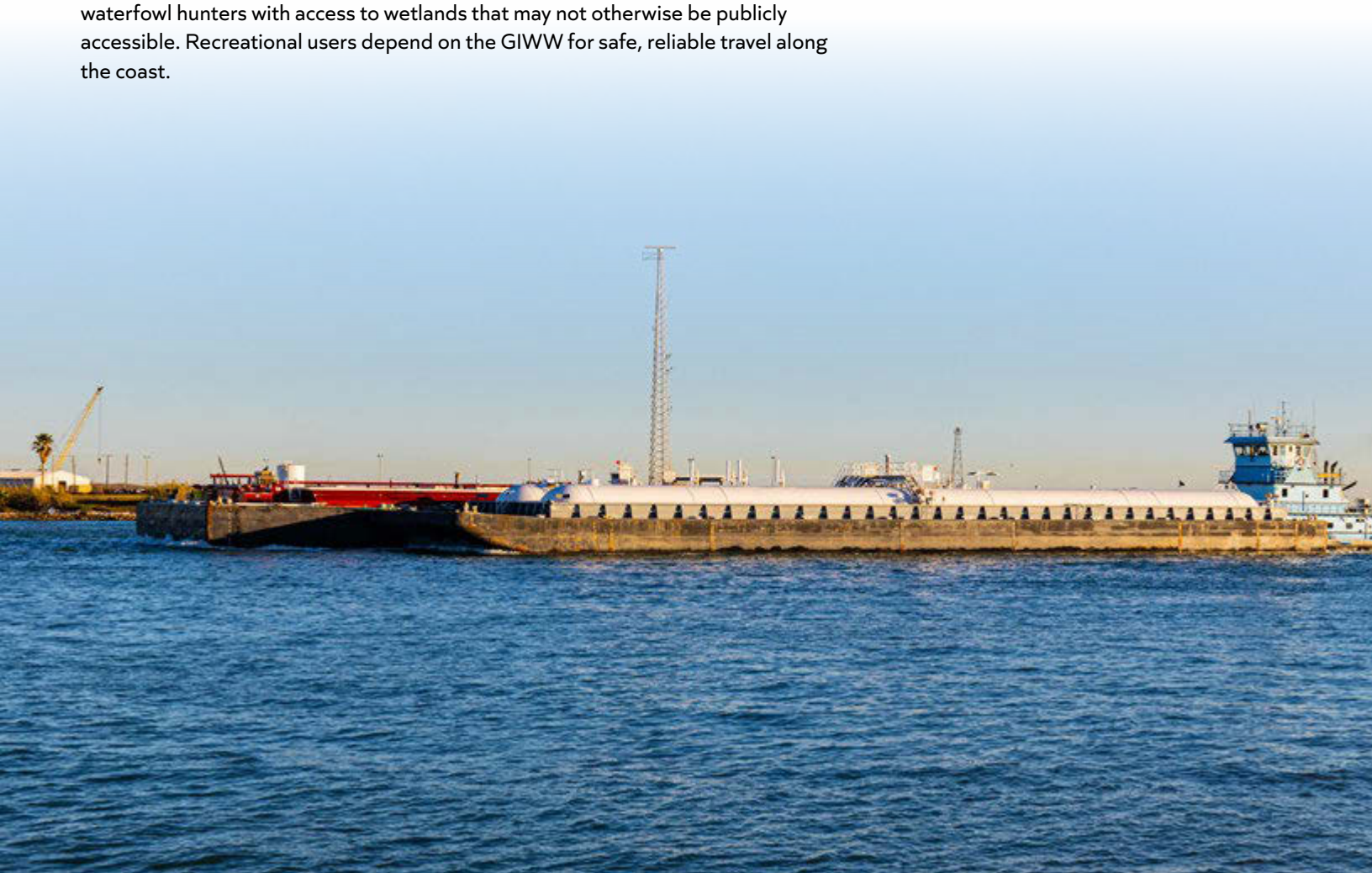
**Private industries** depend on the GIWW-T for the transportation of goods and materials related to their manufacturing, refining or logistical goals. Access to low-cost bulk transportation routes is extremely important for these entities and benefits the entire supply chain. Marine construction is also frequently mobilized through the GIWW-T for private industry projects such as wharf or terminal expansion and maintenance. Commercial fisherman and shellfish harvesters often use the GIWW-T to access bays and offshore fishing grounds.

**Texas ports** partially or entirely depend upon the GIWW for vessel access. Barge traffic from the GIWW-T is essential for the flow of commodities between private industry terminals and ports, but also for the supply of fuels, goods and maintenance services to support larger ship traffic within the ports.

**Waterway associations** represent individual workers and organizations supplying support and transportation along the GIWW-T. These associations are proactive in advocating for their members and also contribute by supporting projects and promoting legislation to expand, improve and maintain the GIWW-T.

**Recreational users** such as fisherman frequently use the GIWW-T to access various bays and fishing spots along the coast from their point of entry. The GIWW provides waterfowl hunters with access to wetlands that may not otherwise be publicly accessible. Recreational users depend on the GIWW for safe, reliable travel along the coast.

*The GIWW-T supports the $6.8 billion/ year recreational fishing and ecotourism industry along the Texas Coast. (Photo credit: Adobe Stock)*



# 2. Stakeholder Identified GIWW-T Challenges

The TxDOT Maritime Division interviewed a range of stakeholders knowledgeable about the GIWW-T to understand the current state of the waterway and identify issues and safety concerns. This group was comprised of individuals from private industry, barge and tug operators, representative labor associations, non-governmental organizations and non-profits and federal, state and local governments. Stakeholders provided detailed information about today's challenges, some of which are consistent with historically documented issues along the GIWW-T. The major challenges identified from stakeholders are discussed further in this section.

## Challenges

1. Shoaling
2. Aged and Degraded Infrastructure
3. Erosion
4. Navigation – ATONs

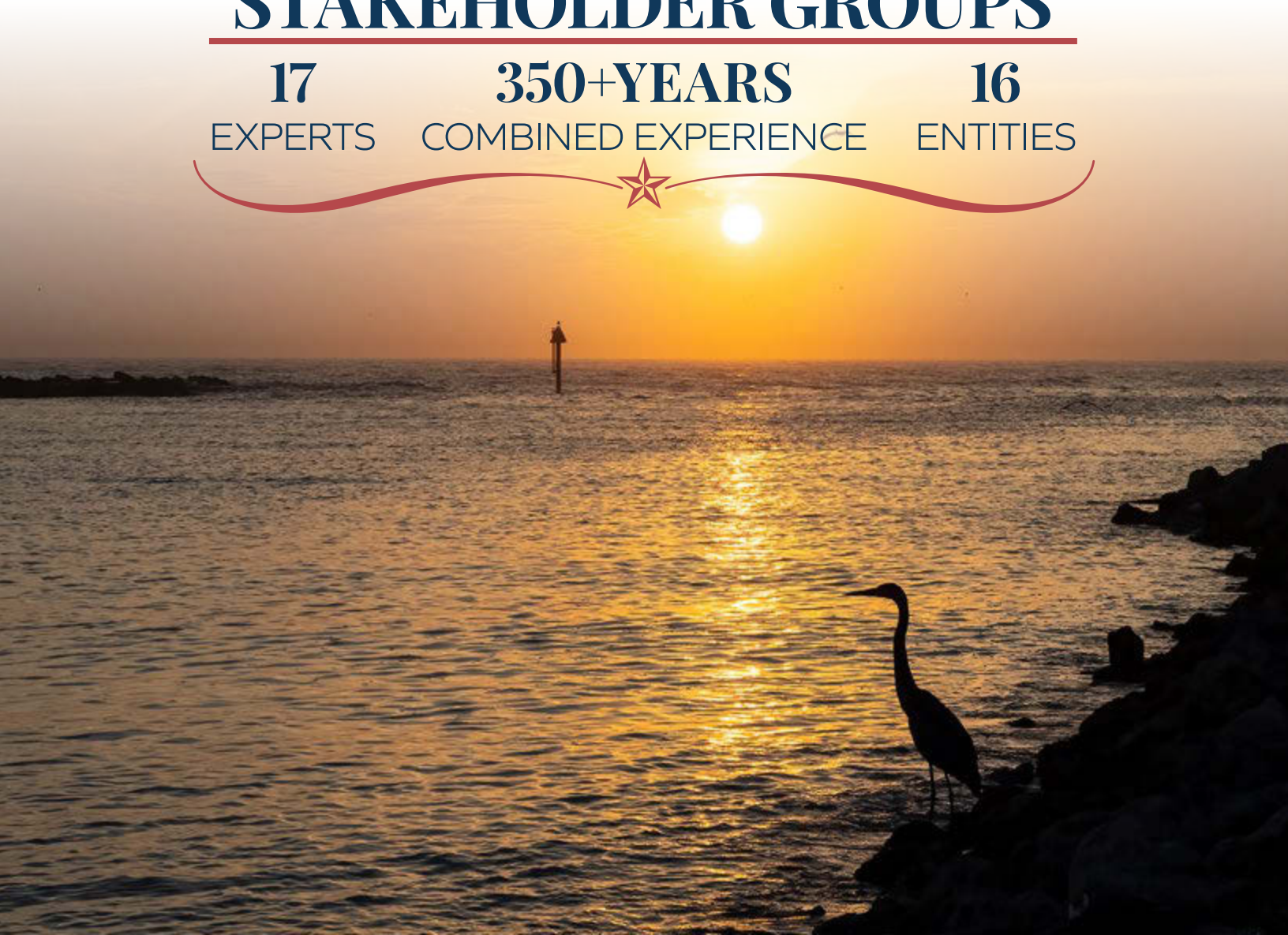
GULF INTRACOASTAL WATERWAY

## STAKEHOLDER GROUPS

**17** EXPERTS

**350+YEARS** COMBINED EXPERIENCE

**16** ENTITIES



*A wave carrying sediment along the Texas shoreline. (Photo credit: Adobe Stock)*

# 2.1. Challenge 1: Shoaling

## Background

Sediment influx into the GIWW-T system results in shoaling, which reduces system reliability and increases system maintenance costs, both of which drive negative economic consequences. This sediment influx is due to multiple mechanisms, including coastal storm events, river confluence with the GIWW-T and shoreline erosion from waves generated from wind and vessel movement.

**What is shoaling?**

**Shoaling** is the accumulation of sediment in a waterway, such as the GIWW-T, which reduces channel depth and impedes navigation, requiring frequent maintenance dredging to restore navigability and prevent economic disruptions.


*Bolivar Flare and Rollover Pass near Galveston Bay (Image source: Landsat)*

## Known Areas of Greatest Concern

Two areas along the GIWW-T known for their problematic high rates of shoaling are Caney Creek/Mitchell's Cut and the Bolivar Flare.

The GIWW Coastal Resilience Study from January 2022, completed by the USACE and TxDOT, analyzed the amount of shoaling and erosion on the GIWW-T along the Brazoria and Matagorda counties coastlines including the intersection of Caney Creek at the GIWW-T[16]. This area has been identified as a major area of concern by the Gulf Intracoastal Canal Association (GICA) due to shoaling and dangerous cross currents from Mitchell's Cut's tidal influence from the Gulf of Mexico. The adjacent Sargent Beach is ranked as one of the highest eroding shorelines in Texas, and much of the eroded material enters the GIWW-T through Mitchell's Cut. Caney Creek transects the GIWW-T in this area, depositing sediment directly into the waterway.

The Bolivar Flare is also identified as a shoaling hot spot that requires annual maintenance dredging. This area has multiple waterways that intersect in a high energy area. As these waterways intersect, the sediments carried from the waterways fall out of suspension and settle into the GIWW. For FY 2019-2023, the Bolivar Flare has experienced a combined 65 allisions, collisions and groundings, as reported by the USCG[17].

Approximately 20 miles northeast of this area is Rollover Pass. This pass was constructed through the Bolivar Peninsula adjacent to the GIWW-T in 1955. After the installation of this pass, the USACE noticed a significant uptick in siltation in the GIWW-T in and around the pass. This heavily trafficked GIWW-T section historically had required twice as much dredging as other portions of the GIWW-T. Following Hurricane Ike in 2019, the Texas General Land Office (GLO) and Galveston County agreed to close Rollover Pass. In September of 2019, the GLO began construction to close the Pass. The closure, as predicted, reduced the amount of dredging in this vicinity by half[18].

## Effects of the GIWW-T on Waterway Operators

Barges navigating shoaled portions of the GIWW-T must light load or they will be unable to transit shoaled areas. In these locations, barge operators will contact the USCG to report the hazard to navigation. Depending on the severity of the obstruction, the USACE may perform emergency dredging to relieve the shoaled area. Emergency dredging can also be required after a storm event that has caused significant shoaling.

GIWW-T navigation restrictions are dangerous and very costly. Emergency dredging occurred at the Caney Creek location in fiscal years 2018, 2020 and 2021, costing the state and federal government millions of dollars[16]. The light loading of barges in areas where shoaling has reduced the channel depth or obstructed passage entirely causes inefficiencies that are costly to the barge operators, commodity traders and eventually to the State of Texas. Additionally, shoaled areas present potential navigation safety hazards to industry and users of the waterway.

Once shoaled material is dredged from the GIWW-T, identifying permitted and available DMPAs to place the material can be challenging, particularly if placement areas are full or unavailable due to environmental restrictions such as habitat for endangered species.

## Addressing the Problem

A GLO-backed project at Sargent Beach is anticipated to begin construction in late 2024 and includes the addition of multiple breakwaters, a groin and beach nourishment. The project aims to reduce shoaling from the beach and thus shoaling into the GIWW-T. It addresses one of the critical shoaling mechanisms at this location. In the Caney Creek/ Mitchell's Cut area, sediment traps were not shown by models to be effective due to the cross current. Models indicated that breakwaters placed adjacent to the southern edge of the GIWW in this location, however, reduced the cross currents and were effective in reducing wave energy to the barrier island.

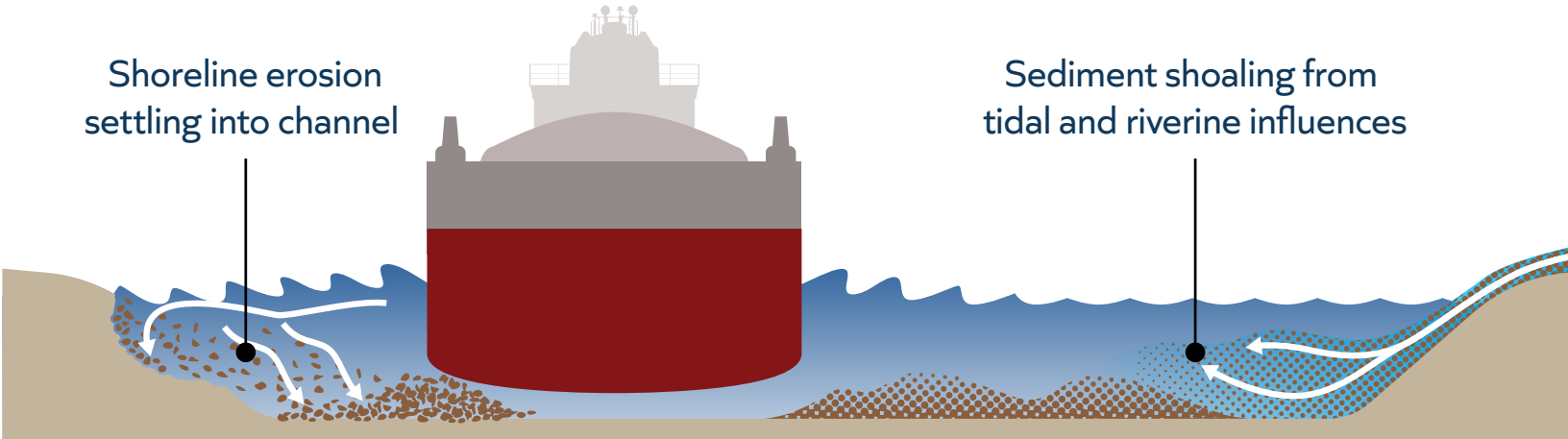
The high shoaling rates at the Bolivar Flare are difficult to mitigate given the high regional sediment flux in the area. This segment of the GIWW-T experiences especially large rates of sediment movement due to the proximity to the tidal inlet and the multiple other adjacent channels. For this area, annual maintenance dredging is typically required to keep the sediments from negatively impacting the navigability of the waterway. The USACE, with TxDOT, is developing a plan to widen the GIWW in the vicinity of the Bolivar Flare to reduce groundings and ease dredging frequency.

"Erosion of the banks adds sediment to the channel which then must be removed. This widens the width of the channel which results in the loss of adjacent private and public lands. The placement of these sediments has become a challenge as designated areas are nearing their capacity."

*-Jarrett "Woody" Woodrow, USFWS*

Emergency dredging occurs at least annually on the GIWW-T and costs the state and federal government millions of dollars every year.

# SEDIMENT SHOALING



*A 72-feet-wide barge navigates through the USACE Galveston District's 75-feet-wide Colorado River Locks in Matagorda, Texas. (Photo credit: USACE)*

**What is an allision?**
**Allisions** occur when a moving vessel strikes a stationary object such as a dock. A **collision** occurs when a moving vessel strikes another vessel.

"Brazos Floodgates remains one of the most heavily hit structures in the inland waterway system."
*-Nathan Hough, Campbell Transportation Company*

**TxDOT's Informational Video of the Brazos River Floodgates (BRFG)**

# 2.2. Challenge 2: Aging & Degraded Infrastructure

## Background

Outdated channel infrastructure prevails as one of the most recognized and impactful issues affecting the GIWW-T. The locks and floodgates on the GIWW-T are reaching the end of their service life as effective infrastructure.

Additionally, existing fleeting and mooring locations, where tows shelter from storms or stage and interchange barges, are currently inadequate for the traffic levels on the GIWW-T and are undermaintained. Developments in naval architecture, navigation systems, communication technology and the increasing demand for commodities have significantly outpaced the current GIWW-T infrastructure. These effects have generated substantial economic impacts for operators, industries and consumers, heightened safety risks and have led to extensive operations and maintenance obligations for stakeholders.

## Areas of Concern

Two of the most significant infrastructure issues are located at the Brazos River Flood Gates (BRFG) and Colorado River Flood Gates, which were initially constructed in 1943. In 1954, USACE added another set of gates to each side of the Colorado Flood Gate facility converting the structure to the Colorado River Locks (CRL) that remain in service today. These structures' effectiveness have significantly decreased over the years as developments in marine transportation reduced the BRFG and CRL's ability to handle modern tow sizes and traffic demands.

The BRFG and CRL are difficult to navigate due to narrow widths and close proximity to the rivers they serve. Vessels transiting the BRFG frequently sustain damage from barge allisions. Across the maritime industry, it is a well-accepted view that these structures are critically out-of-date, inefficient in relation to current navigation practices and equipment and pose an elevated safety risk that stakeholders are adamant to address.

Fleeting and mooring areas are essential to support barge logistics and provide safe harbor for operators and their crews. However, the available fleeting and mooring

locations on the GIWW-T are not sufficient for current traffic levels. Fleeting and mooring areas are typically located near and around ports, locks, floodgates and other high traffic zones but may not be within proximity for vessels transiting on remote reaches of the GIWW-T. The fleeting and mooring network is in constant need of maintenance due to continual, rigorous use by operators which results in damaged, degraded and unusable infrastructure.

## Effects of the GIWW-T on Waterway Operators

The BRFG and CRL along the GIWW-T inhibit the efficient and safe flow of traffic, costing operators and industries. Most critically, at the BRFG, the breaking down of barges from the tugboat, individual transport of single barges across Brazos River and reassembly of the load, known as tripping, imposes long delays for operators and has implications on trip efficiency, safety and client commodity needs. Cost burdens also fall to the USACE, which has the responsibility of maintaining the antiquated BRFG and CRL. Repairs for damages and aging components, especially for structures that sustain frequent barge strikes, such as the BRFG, can be a costly burden. On average, an allision occurs once every 5 days at the BRFG – more than any other USACE structure in the nation. Annually, it costs approximately $30 million to address allisions, associated repairs and barge breakdown and reassembly during the tripping process. The CRL also result in substantial cost delays to operators and industries and requires operation and maintenance funding from the USACE to staff, maintain and repair damages to the locks.

A widespread network of mooring locations is critical for operators when adverse weather is present because it allows for safe mooring until conditions are navigable. If no mooring areas are available when conditions begin to cause navigational hazards, this may leave operators and their crews vulnerable. Many operators choose to push their barge directly into the shoreline to remain in place when under these circumstances which can lead to physical degradation of the shoreline and channel, contributing to shoaling and depth restriction issues. Over time, this practice can increase maintenance costs, erode protective barrier islands and affect sensitive shoreline habitats.

Too few available fleeting locations can also increase transit time and delay costs, as barge operators use mooring locations for fleeting activities to interchange and stage barge shipments. Limited availability of fleeting areas compromises the effective logistics planned by operators and their organizations.

## Addressing the Problem

The USACE determined in 2000 through a reconnaissance study that the BRFG and CRL were in need of modification to address safety and transportation efficiency concerns. In 2019, the USACE released a feasibility study for reconstructing both the BRFG and CRL[19]. This feasibility report details various aspects of the improvement projects, including impacts, initial designs, cost estimates and strong cost-benefit ratios that demonstrate the importance and necessity of the two projects. Over 20 years after the BRFG and CRL were identified as needing modification, stakeholders are still trying to obtain construction funding for both projects for enhanced safety and efficiency on the channel.

Recently, the USACE has respaced mooring buoys and replaced or fixed damaged mooring infrastructure along the GIWW-T. A new 150-foot spacing will allow for three mooring points on a 300-foot barge to reduce the overall tension in the mooring lines and equipment. Between 2016 and 2020, 114 buoys at Port Arthur, Bolivar Peninsula, Pelican Island and both east and west of the BRFG and CRL were respaced, inspected for repair and replaced as needed. Progress is ongoing as of 2020 for 57 similar buoys in Victoria, Aransas National Wildlife Refuge, Oyster Lake and the Arroyo Colorado. While improvements are taking place, there are concerns the growth of vessel traffic will continue to exceed the capacity of existing fleeting and mooring systems.

*Top and Bottom: Brazos River Flood Gates (Photo credits: TxDOT)*

*Shamrock Island (Photo credit: GLO)*

**What is a GIWW-T barrier island?**

Barrier islands along the GIWW-T are man-made landforms created from dredged materials excavated during the construction and maintenance of the waterway. These islands serve as barriers that protect the mainland from storm surges and provides habitat for wildlife.


*GIWW-T barrier islands at Bolivar Flare on Galveston Bay (Image source: Landsat)*

# 2.3. Challenge 3: Erosion – Shoreline & Barrier Island

## Background

GIWW-T barrier islands serve multiple, useful functions for a variety of stakeholders. Barrier islands are critical to barge operators because they protect commercial vessels against waves and currents from the open waters of Texas bays. These islands also block eroded sands from Gulf shorelines and in-bay suspended sediments from entering the GIWW-T, significantly reducing the need for costly and time-intensive maintenance dredging. Barrier islands allow for increased resilience of the GIWW-T after significant storm events because an island's width and elevation can absorb harsher conditions, making barrier islands less susceptible to failure or breaching than breakwaters.

From an environmental perspective, GIWW-T barrier islands serve as nesting and foraging habitat for a wide variety of coastal wildlife by protecting critical marsh and shoreline habitat along the mainland, reducing turbid waters, improving water quality and providing island shrub/scrub habitat.

Texas GIWW-T barrier islands are deteriorating due to major storm events, vessel wakes, wind and waves. These issues are compounded by relative sea level rise, which intensifies waves that are already eroding island shorelines.

## Effects of the GIWW-T on Waterway Operators

The effects of GIWW-T barrier island erosion are far-reaching. Barge operators are currently losing the protection of the barrier islands from wave impacts, subjecting vessels to harsher, open water conditions. This decreases the efficiency of travel, increases costs to navigate the GIWW-T, and drastically reduces safety

Less protection from wave action from Texas bays is also bringing larger amounts of sediment into the GIWW-T, causing draft restrictions that require barges to light load to maintain safe operations and necessitate additional maintenance dredging—which leads to more expensive operations for shipping companies and increased maintenance costs.

Priceless shoreline habitats, especially coastal marshes and prairies that are normally protected by GIWW-T barrier islands, are at significant risk of erosion, as they cannot sustain the coastal forces of open waters. The loss of these ecosystems is being felt not just by wildlife, but also by the stakeholders and outdoorsmen who enjoy recreation in these areas.

## Addressing the Problem

Work is being done to protect and restore GIWW-T barrier islands along the Gulf of Mexico coastline. Islands are being both restored and built by beneficially using dredged material. These dredged materials add height and width to the existing islands, increasing their durability.

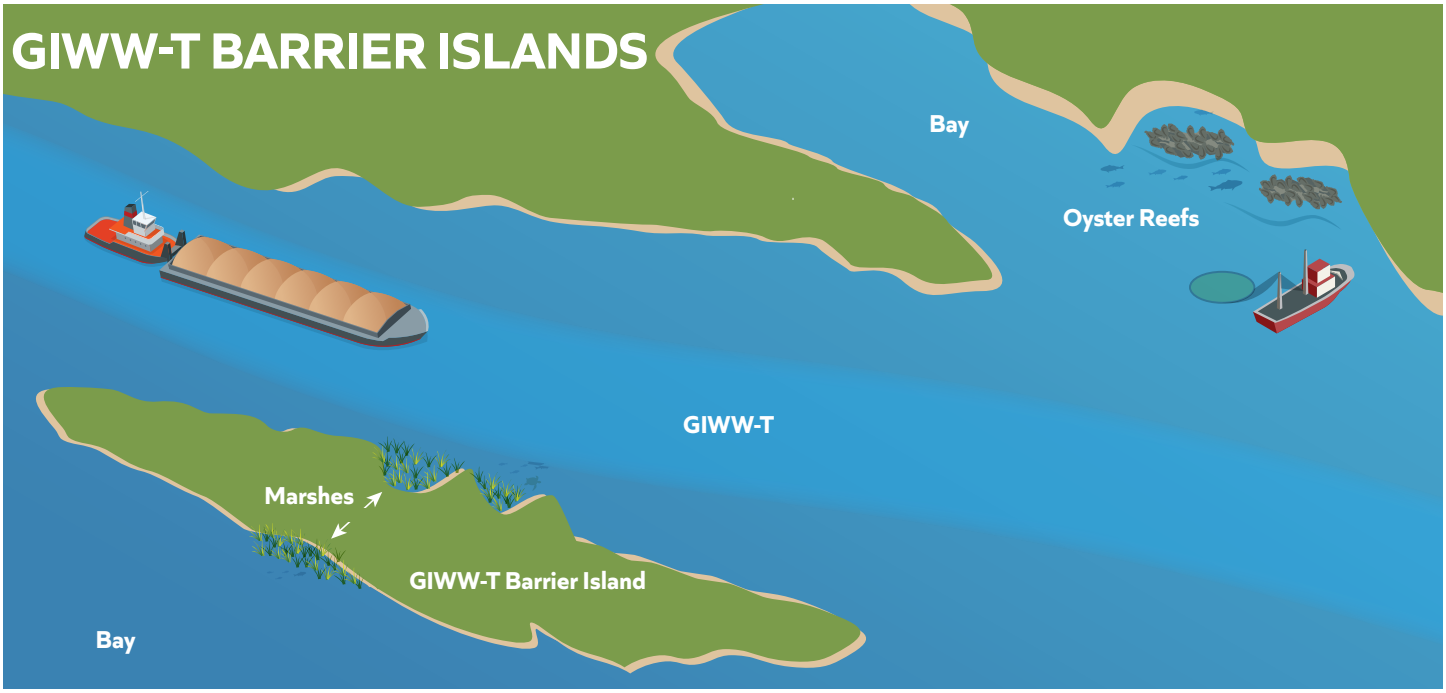
Studies and action plans have recently been developed by USACE to address GIWW-T barrier island erosion, specifically the:

- GIWW-T West Galveston Bay Barrier Island Reconstruction Project
- Gulf Intracoastal Waterway Coastal Resilience Study, Texas for Brazoria and Matagorda Counties
- Coastal Texas Protection and Restoration Feasibility Study

Once GIWW-T barrier islands are eroded, mainland shorelines lose the protection the island once provided, and wind-driven waves will accelerate erosion of the shoreline on the mainland side of the GIWW-T. Unfortunately, loss of barrier islands could become irreversible if threatened and endangered species migrate into the gradually eroded areas and create new critical habitats that prevent the islands from being recreated. Instead, restoring the function of barrier islands by armoring, adding new materials or creating living shorelines would allow the islands to continue to protect navigation within the channel and existing habitats from major storm events, as well as the day-to-day erosion impacts from winds and waves. Creating living shorelines is a nature-based solution that has been effective in protecting barrier islands from erosion, as highlighted in the GIWW Coastal Resilience Study[16]. Living shorelines typically use vegetation behind a hard structure, such as a breakwater, to provide protection to the shoreline to withstand wave energy.

The continued function of GIWW-T barrier islands as placement areas provides flexibility to place dredged material from channel maintenance. This process is ultimately more adaptable to changing future conditions along the channel impacted by winds and waves.

> "Wind and wave fetch continue to cause erosion of the shoreline, causing further widening and loss of wetlands and coastal prairie that provide habitat for fish and wildlife and that also provide for coastal resiliency"
>
> *-Dr. Todd Merendino, Ducks Unlimited*




*A group of pelicans sit on a marker post in the waters of Galveston Bay, Texas*

# 2.4. Challenge 4: Navigation - ATONs

## Background

The USCG maintains 44,582 aids to navigation (ATONs) across the U.S. Marine Transportation system[20]. ATONs include lighthouses, daybeacons, range lights, audible signals and lighted and unlighted buoys that provide recreational and commercial vessel traffic with directional, marine hazard and navigation information pertinent to safe and organized travel. ATONs are intended to be interpreted visually and used in conjunction with charts for trip planning and navigation.

**What are ATONs?**

**Aids to navigation, or ATONs, include lighthouses, minor lights, daybeacons, range lights, audible signals, and lighted and unlighted buoys that provide recreational and commercial vessel traffic with directional, marine hazard and navigation information pertinent to safe and organized travel.**

ATONs define the navigable boundaries along the GIWW, including the GIWW-T. The majority of ATONs along the GIWW-T are lighted and unlighted buoys that direct traffic flow with specific visual annotations through open water segments, channel intersections and around bends.

The number of damaged ATONs along the GIWW-T is increasing and is often unreported by mariners. ATONs can physically be damaged or moved when struck by a vessel, which affects their ability to be visually interpreted by operators as geographical reference. Misalignment of ATONs, or "off-station" ATONs, can become a navigation hazard when vessel captains rely on ATON positioning to align themselves within the channel. Off-station ATONs make it difficult to visually discern where the channel is in open water or where channel bends or alignment changes occur, leading to more frequent groundings or traffic hazards with other vessels.

In FY 2023, the USCG responded to 366 damaged ATONs along the GIWW-T resulting in approximately $4,575,000 in taxpayer obligations, 95% of which were unreported by mariners.

## Areas of Concern

ATON damage can occur throughout the entire GIWW-T and fluctuates with traffic levels, channel intersections, weather conditions, poor visibility and currents. Areas with low visibility, high traffic or strong currents may be more susceptible to damaged or off-station ATONs. ATONs in high traffic areas, such as major ship channel intersections with frequent traffic, may be damaged or off-station more frequently due to barge or ship impacts.

## Effects of the GIWW-T on Waterway Operators

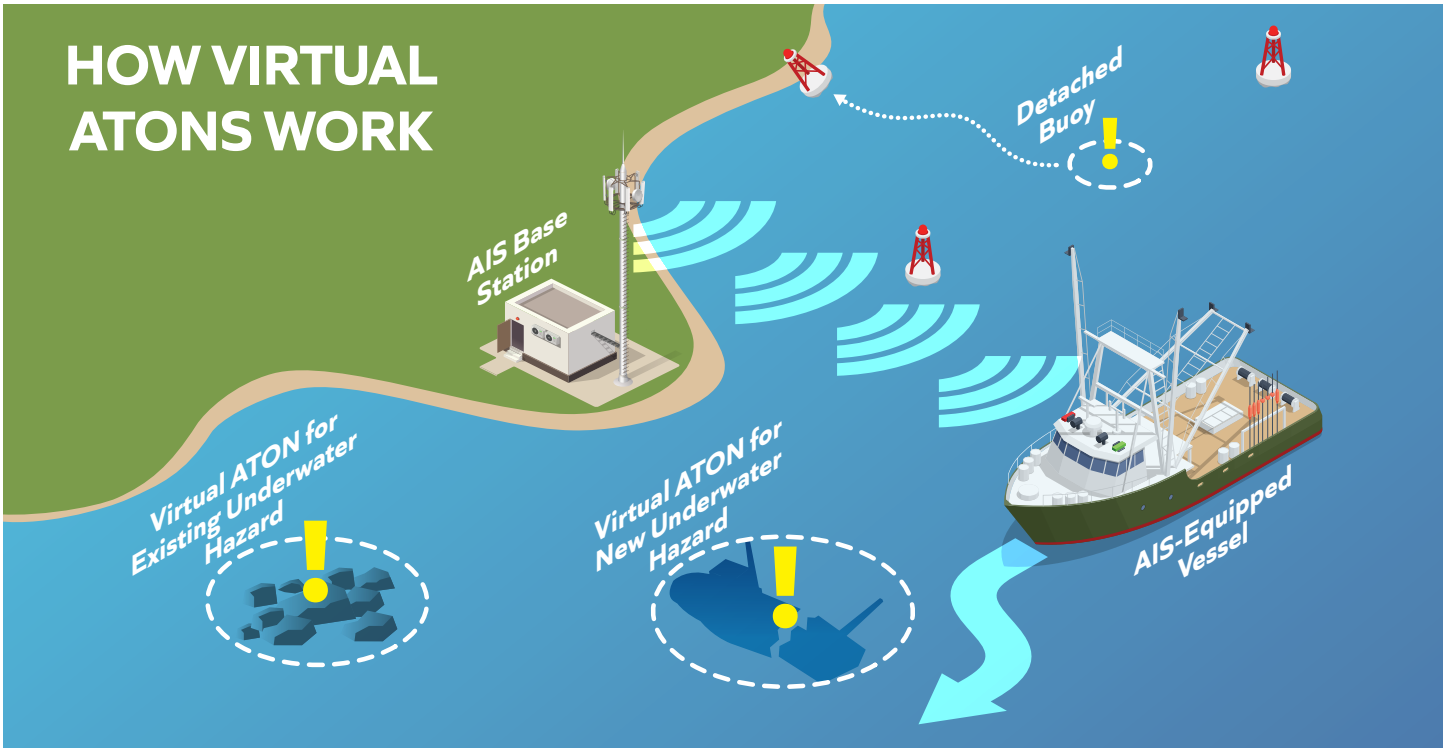
Running aground on the shallow banks on either side of the GIWW-T, known as grounding, can lead to costly delays in transportation, physical degradation of the channel banks and slopes or increased dredging maintenance costs and can result in vessel damage or oil spills. A grounded vessel can easily become a navigation hazard. When ATONs are off-station or damaged, otherwise safe reliance on visual navigation aids can instead lead to more frequent groundings of barges on the GIWW-T. Maintaining an accurate constellation of ATONs is imperative for safe and efficient traffic flow within the GIWW-T.

## Addressing the Problem

Virtual ATONs allow a way for mariners to receive ATON positioning information on their digital navigational chart. Unlike a permanent symbol on a navigation chart, virtual ATONs use the automatic identification system (AIS) to interpret the very high frequency (VHF) radio transmitted location of the virtual ATON. This is directly overlayed on the operator's electronic navigation chart. The ability to virtually transmit ATON locations allows for instant updates regarding missing, broken, un-interpretable or off-station ATONs where physical adjustment, maintenance or replacement may take extended periods of time and demand large quantities of taxpayer dollars.

Virtual ATONs are not physically present on the channel, so smaller recreational vessels that may not be equipped with AIS receivers are not able to access the network and receive information. In the commercial vessel industry, however, AIS transmitters and receivers are standard equipment for marine navigation. A transition to modernizing marine navigation with virtual ATONs could reduce the operational costs of maintaining a larger constellation of physical ATONs and allow the USCG to focus its resources on better maintaining fewer physical ATONs. Cultural shifts in navigation practices to a heavier reliance on electronic navigation and communication will aid in a smoother transition and wider adaptation of implementing virtual solutions for marine navigation.

> "The use of virtual buoys should continue to be evaluated to supplement the ATON system in areas where buoys are routinely missing or off station"
>
> *-Nathan Hough, Campbell Transportation Company*



*The Sargent Corkscrew Bridge (Photo credit: TxDOT)*

## 2.5. Recent Success in Addressing Challenges

There are many accomplishments and improvements that have been implemented to address issues previously affecting GIWW-T stakeholders. Many successful dredging and other improvement projects have taken place to date to maintain the waterway and improve navigability up and down the coast of Texas.

Particularly of note, TxDOT recently constructed the Sargent Corkscrew Bridge spanning the GIWW-T in 2021. Previously, the Sargent Swing Bridge had been identified by stakeholders as a navigability concern due to its obstruction of the channel, and so TxDOT constructed the Sargent Corkscrew Bridge to replace the Sargent Swing Bridge. The new bridge's corkscrew design, which was based on the limited adjacent upland area for conventional approach ramps, features a suspended roadway seven stories above the GIWW-T channel and clears the channel of infrastructure where the swing bridge was formerly located. The corkscrew bridge design allows operators to freely navigate the channel 24 hours a day, which reduces the cost of commodity transportation and improves navigational safety.

The closure of Rollover Pass in 2019 was also a significant advancement in improving the GIWW-T[18]. Originally, the Pass was constructed through Bolivar Peninsula in 1955 by the Texas Parks and Wildlife Department to address water quality, salinity and fish migration concerns. However, construction of the Pass led to shoaling, beach erosion and extensive cost burdens. Dredging maintenance to mitigate shoaling directly due to the Pass resulted in a $600,000 to $1 million annual obligation to the USACE. TxDOT also provided over $675,000 for Rollover Pass bridge repair costs after Hurricane Ike, and the GLO provided more than $827,000 in State matching funds for beach nourishment in the immediate Pass area between 2001 and 2008. The closure protects the GIWW-T from an influx of beach sediment entering through the Pass that previously resulted in chronic shoaling, strong cross currents affecting navigation and beach erosion. Closing of the Pass significantly reduced O&M dredging expenses and the need for beach renourishment projects.

"A clear span bridge has replaced the swing bridge, that's a good thing."

*-Captain Daniel Martinez, Golden Barge Line*

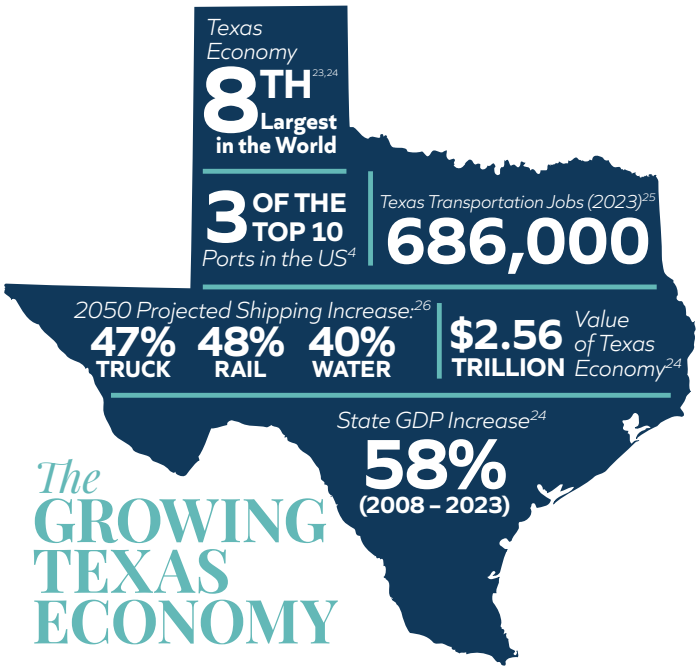
*Top: Rollover Pass prior to closure,2019*
*Bottom: Rollover post-closure, 2020*
*(Photo credit: GLO)*

# 3. Stressors and Dynamic Influences on the GIWW-T

Existing issues along the GIWW-T identified in the previous section have been exacerbated by changing stressors over time. Texas's population increase, growing economy and increased exposure to severe weather have contributed to the shoaling, infrastructure and navigation challenges. Understanding these stressors and dynamic influences when planning and developing protection and resiliency projects for the GIWW-T will aid in identifying effective, longer-term solutions.

## 3.1. Growing Economy and Population

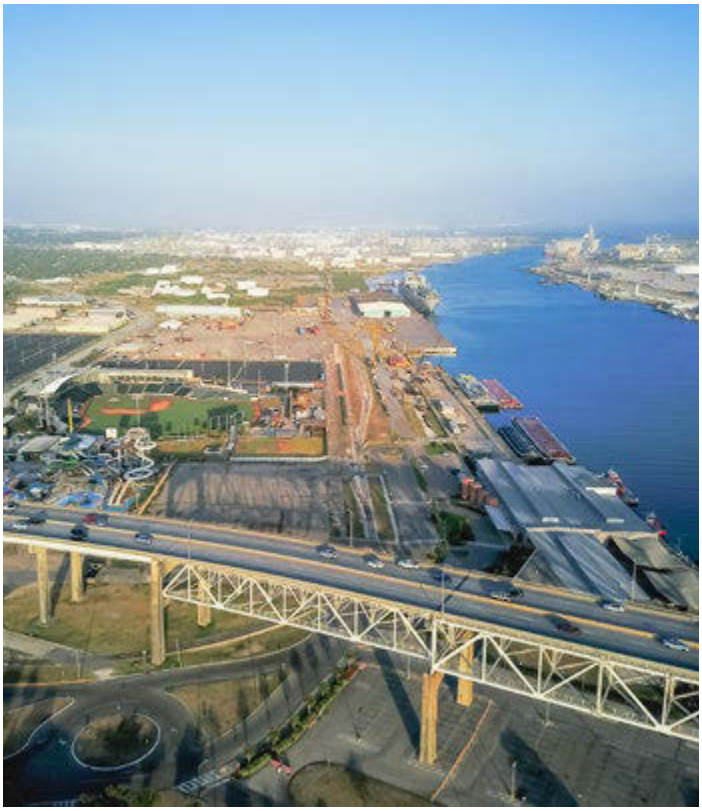
Texas's economy and population are simultaneously growing at faster rates than most states in the nation. A booming population[21] and economy leads to an increase in usage of the GIWW-T. New and growing industries, driven by the thriving economy along Texas's Gulf Coast, will increase the already-high commercial traffic demand seen on the GIWW-T. Additionally, a growing population will yield increased numbers of recreational fishing, hunting and pleasure boaters who depend on the GIWW-T for safe and reliable navigation to access Texas's wetlands and bays.




Future large-scale coastal construction projects, like the Coastal Texas Program, will also utilize the GIWW-T and further increase its usage. The largest civil engineering project in USACE history, the Coastal Texas Program aims to protect infrastructure, coastal communities and industry from hurricane and storm damage while also implementing projects to restore ecosystems and produce benefits from their natural functions[22].

However, with large-scale coastal construction projects, growing industry and an increasing population, the GIWW-T will face additional stress on top of today's challenges. Additional commercial and recreational vessels on the waterway will extend delay times at locations like the Brazos River Floodgates and Colorado River Locks. Due to these factors, the loss of GIWW-T barrier islands and wetlands from vessel wake-induced erosion will be a concern. The USCG will also need to address damages to ATONs more frequently.

Properly considering the robust Texas economy and the growing number of individuals who contribute to it and understanding how these factors further stress the identified challenges on the GIWW-T is essential for planning and executing effective long-term solutions.



*Port of Corpus Christi (Photo credit: Adobe Stock)*

"There will be an increase in the movement of anhydrous ammonia by approximately 3 million tons (2,000 barges inbound/out bound) and gasoline by 300,000 tons (200 barges inbound/out bound) in the Victoria Barge Canal (VBC) and GIWW in the next 2 years. Also, an existing terminal will increase their production by an additional 800,000 tons."

*-Randolph Insley, Port of Victoria*

"The ports and waterways of Texas continue to see significant growth in maritime activity with increasing container terminal imports and exports, cruise ship passenger operations, crude oil and liquified gas exports, and the start of alternative fuel bunkering projects... To protect our critical infrastructure and the waterways... we must continually assess risks and work closely with all port and maritime partners to implement the absolute best technical tools, monitoring equipment, communications systems and other safeguards."

*-Captain Keith Donohue, USCG*

## 3.2. Changing Commodity Trends

As previously discussed, the GIWW-T features strong growth patterns, with total cargo volumes increasing from 75 million tons in 2020 to 80 million tons in 2022. Much of this trade is driven by the American petrochemical industry, as domestic oil production has increased considerably in the past decade. Political considerations such as the oil and gas embargo on Europe by Russia have further strengthened the position of the American petrochemical industry, which is now needed to supply a significant portion of Europe's energy demands.

The rise of new commodities' source and shipment destinations may change traffic patterns over time. As technologies improve and the renewable energy sector gains importance, this trend may shift; however, as seen by the recent ongoing expansion in the foundry industry, the states positioned along the GIWW have other sectors and industries that are likely to expand and make use of the waterway. The expansion of LNG, a cleaner energy source and an alternative maritime shipping fuel, is another developing industry. Annual LNG demand is expected to grow by 100 billion cubic meters in 2024[27].

The overall drive for American-made products, as well as the recent, rapid demographic growth patterns of southern states revealed by the US Census Bureau to drive 87% of the Nation's growth in 2023, solidifies the importance of the GIWW-T into the future as a vital and efficient artery for shipping along the Texas Gulf Coast. The traffic demand to support growing and shifting trends will simultaneously increase pressure on the waterway and alter typical traffic patterns as industries expand and develop new infrastructure along the Gulf Coast. These stressors are important to evaluate when planning for the development of the GIWW-T to address and improve long-term navigability.

*(Photo credit: TxDOT)*

# 3.3. Weather and Environmental Changes

The GIWW-T faces significant impacts from increasing weather event intensity, continual erosion, sea level rise and the conversion of wetlands to open water. These environmental stressors play a crucial role in shaping the resilience and functionality of the waterway.

- **Storm Frequency and Intensity:** Increasing weather event intensity, particularly the mounting frequency and strength of hurricanes and tropical storms, poses significant challenges to the GIWW-T. Historical data suggests that parts of Texas have seen increased precipitation by up to 15% over the past century and extreme rainfall events like hurricanes and tropical storms have intensified, largely influenced by climate change[28]. When these storms strike, they bring with them storm surges and heavy rainfall that elevate water levels and can lead to extensive flooding along the GIWW-T corridor. This flooding can erode the waterway's banks and barrier islands and damage its infrastructure like locks and levees.
- **Blockages and Debris:** The combination of storm surge and rainfall can also lead to waterway blockages from accumulated debris and sediment, making sections of the GIWW-T impassable. Such blockages not only disrupt commercial activities and the transport of goods but also complicate emergency response efforts during storms. As a result, the GIWW-T often faces emergency closures during severe weather events to manage channel conditions that require immediate and intensive recovery efforts post-storm to restore full functionality.
- **Erosion:** Continual erosion along the GIWW-T, both natural and human-made, further exacerbates these challenges. Erosion is primarily driven by coastal storms, seasonal winds and currents that wear away GIWW-T barrier islands and shorelines. This natural process is intensified by human activities, such as boat traffic, which generate waves that contribute to shoreline degradation[16]. The erosion not only alters the landscape but also leads to an influx of sediment into the waterway, resulting in channel shoaling.
- **Sea Level Rise:** The impacts of sea level rise on the GIWW-T are also a significant concern, with global projections forecasting substantial increases in sea levels by 2100. According to NOAA's projections[29] used in the GLO's Texas Coastal Resiliency Master Plan (TCRMP)[30], global mean sea level is expected to rise between 1 and 8.2 feet by 2100. However, relative sea level rise—which considers local factors such as land subsidence and global mean sea level rise—means that the Texas coast could see rises approximately 2 feet higher than the global average in some areas. Relative sea level rise in Texas is particularly pronounced due to significant subsidence driven by groundwater extraction, making the rate of relative sea level rise faster in Texas than in many other coastal areas. This local increase in sea levels, coupled with intensified storm surges, threatens the GIWW-T, as higher sea levels will likely lead to more frequent and severe flooding, accelerating erosion. These factors compromise the structural integrity and operational efficiency of the waterway, increasing maintenance burdens and operational disruptions.
- **Habitat Conversion**: Sea level rise also drives significant habitat conversions, particularly the transformation of wetlands to open water. This process occurs as rising sea levels and increased saltwater intrusion inundate marshes, leading to their gradual submersion. For these wetlands to survive, they must accrete sediment at a rate that keeps pace with rising sea levels. If they fail to do so, these areas will no longer provide habitat for flora and/or fauna and will simply be barren open water. This transition may not only diminish the extent of these wetlands but also change their ecological character, reducing biodiversity and ecosystem services and eroding natural buffers against storms and erosion. These changes make the GIWW-T more vulnerable to shoreline loss overall.

*Heavy traffic at the Colorado River Locks in 2015 (Photo credit: USACE)*

Collectively, these environmental challenges are leading to higher-than-ever operational and maintenance costs for the GIWW-T. These factors pose significant challenges to its long-term sustainability and effectiveness as a critical transportation route, impacting economic activities and ecological health along the GIWW-T corridor.

# 4. Ensuring Success – The Future of the GIWW-T

## 4.1. Leveraging Stakeholder Partnerships and Accessing Funding

Stakeholders often have better success when involving other entities in planning and executing coastal construction and improvement projects. Partnerships between GIWW-T stakeholders are valuable relationships that improve coordination in the planning and permitting stages of projects, provide well-rounded perspectives to improve projects' benefits and functionality and can unlock multiple funding mechanisms to support the projects. As projects become larger in scale and stressors intensify the challenges already present, collaboration between stakeholders will be critical to ensuring the success of improving the GIWW-T.

Alternative funding via state and federal grants is frequently geared toward coastal restoration, shoreline stabilization and wetland restoration projects. Although possible, these funding mechanisms do not typically apply to dredging projects for channel maintenance, deepening or widening. However, BUDM projects pertaining to the GIWW-T, such as barrier island and wetland restoration and protection, are ideal candidates to take advantage of these alternative funding mechanisms. Restoring and protecting these ecosystems have widespread ecological benefits to marine life and birds, but they can also provide benefits to navigation on the waterway. Protected, more resilient barrier islands and wetlands will reduce erosion from vessel wakes and aid in providing long-term reliable navigation.

A wide variety of funding opportunities exist for the types of projects previously discussed. The TCRMP[30] developed by the GLO analyzes coastal challenges and impacts and showcases Tier 1 projects to address challenges deemed most important by its technical advisory committee stakeholder group. In conjunction with the TCRMP, the GLO has also developed the "Funding Programs Resiliency Design Guide" [31] which details over 35 funding mechanisms, applicable project types, funding amounts and other specifics.

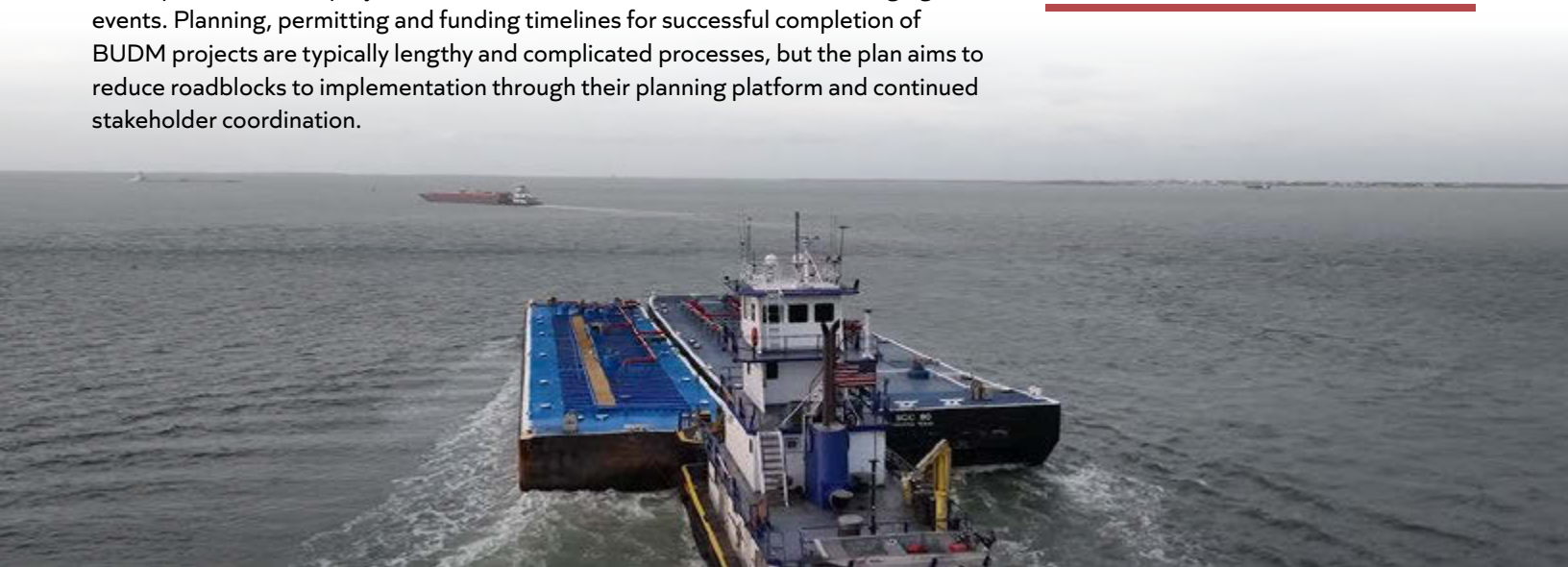
As previously mentioned, the Texas Beneficial Use Master Plan aims to leverage stakeholders to provide potential projects involving beneficially used dredge material. Stakeholders can submit potential projects to be considered for selection in the planning process, and the plan provides an open format to improve coordination and exposure for their projects in an effort to connect them with future dredging events. Planning, permitting and funding timelines for successful completion of BUDM projects are typically lengthy and complicated processes, but the plan aims to reduce roadblocks to implementation through their planning platform and continued stakeholder coordination.

**LEARN MORE ABOUT THE GIWW-T:**

The GIWW Viewer, developed by TxDOT and accessible via this QR code, provides data, details of infrastructure, shipping lanes and other notable locations found along the GIWW-T.

**FURTHER READING:**

- The 2023 Texas Coastal Resiliency Master Plan aims to protect and promote a vibrant and resilient Texas coast that supports and sustains a strong economy and healthy environment.
- Part of the TCRMP, the Funding Programs Resiliency Design Guide details a list of state and federal grant opportunities that may be considered by project proponents to fund coastal resiliency projects.



## IMPROVEMENT CATEGORIES


Safety


Navigation


O & M Cost Savings


Transportation Cost Savings


Coastal Resiliency


Knowledge and Planning

# 4.2. Adapting for Success – Assessment, Solutions and Recommendations to the Texas Legislature and Congress

To address challenges and increasing stressors covered in this report, the following improvements are recommended regarding the GIWW-T to ensure its status as an efficient, resilient and safe waterway.

### Replacement of CRL and BRFG

**Action:** Request the appropriation of State or Federal funds for the replacement of the BRFG and CRL to begin construction of improvements to both systems, addressing high O&M costs, safety concerns, transportation inefficiencies and poor navigability.

The Texas Transportation Commission is currently considering a Legislative Appropriations Request (LAR) for State funding in the 2026-2027 fiscal biennium of $140 Million to begin the removal and reconstruction of the BRFG due to its urgent need.

**BRFG Cost:** $279.635 Million
**CRL Cost:** $319.4 Million
**Assumption:** USACE FY25 cost estimates

### Increased Maintenance Dredging Budget

**Action:** Support an increase of Federal USACE O&M budget funding to promote additional routine dredging maintenance projects to achieve authorized depth over a larger portion of the GIWW-T, reducing shoaling and light loading. Historical allocations typically only support approximately 50% of GIWW-T maintenance dredging needs.

**Cost:** $176 Million
**Assumptions:** Based on USACE survey data in comparison to a -16 ft NAVD88 advanced maintenance template and estimated dredging quantity of 32 million cubic yards utilizing hydraulic cutter suction dredges

### BUDM and Resilient Shoreline Stabilization Projects

**Action:** Promote the implementation of BUDM in maintenance projects and execute resilient shoreline stabilization projects to address barrier island erosion and wetland habitat conversion along the GIWW-T.

**Cost:** $5 / Cubic Yard * Pipeline Mile[32]
**Assumptions:** Incremental cost to a new work or maintenance dredging project for the placement of dredge material at a beneficial use project site, dependent on the volume of sediment in cubic yards and length of hydraulic cutter suction dredge pipeline to reach the site.

### Developing Solutions to Address Shoaling

**Action:** Conduct research and hydrological modeling of alternatives to address shoaling with gray, hybrid or nature-based solutions that can be implemented in regions that experience chronic riverine and tidal shoaling, reducing light loading impacts and furthering the reach of maintenance funding.

**Cost:** $2 Million
**Assumptions:** High level of detail in-situ data collection and hydrodynamic modeling study comparing multiple shoaling mitigation alternatives to determine sediment transport characteristics for each alternative at a single site.

### Virtual ATON Pilot Projects

**Action:** Carry out pilot projects involving the implementation of virtual aids to navigation in regions with frequently damaged, knocked down or off-station physical ATONs, analyze the projects' effectiveness and develop plans to expand usage of virtual ATONs.

**Cost:** $1-$2 Million
**Assumptions:** Port region-size study implementing and evaluating the use of virtual ATONs that covers a single major port area.

### Additional Maintenance and Expansion of Fleeting and Mooring Locations

**Action:** Provide more frequent routine maintenance to fleeting and mooring locations and develop expansion plan for new facilities in consideration of industrial growth, changing vessel traffic patterns and changing commodity trends.

**Cost:** $30,000 per mooring
**Assumptions:** Previous USACE mooring procurement and installation costs adjusted to present values, accounting for inflation.

**"The GIWW is a vital component of the Texas economy and coastal environment. The waterway has many advantages over the other modes of freight transportation, but these advantages can only be realized if the GIWW is fully maintained. The legislative proposals in this report will enable TxDOT and USACE to work together to realize the maximum possible benefit of the GIWW."**

*Geir Eilif Kalhagen*
*Director, Maritime Division*
*Texas Department of Transportation*

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