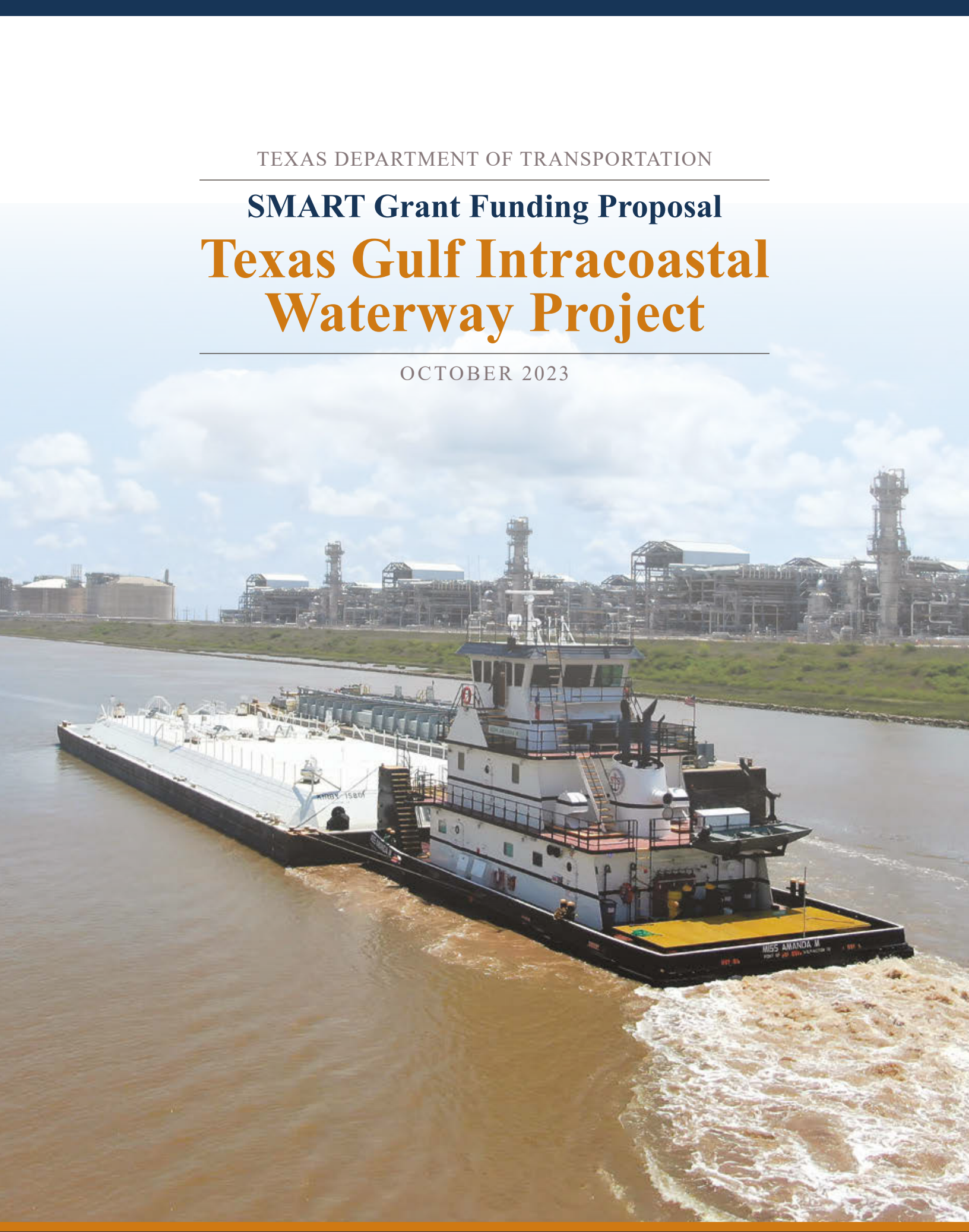
TEXAS DEPARTMENT OF TRANSPORTATION

SMART Grant Funding Proposal

Texas Gulf Intracoastal Waterway Project

OCTOBER 2023



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1. PROJECT REQUIREMENTS

A. Overview/Project Description

Project Description

The proposed project will develop a digital twin (a virtual representation) of a portion of the Texas Gulf Intracoastal Waterway (TX GIWW). TX GIWW is a portion of the Gulf Intracoastal Waterway which runs from Brownsville, TX to Saint Marks, FL. The TX GIWW is a critical piece of infrastructure with 75 million tons of goods moved on the Texas portion of the GIWW in 2020.[1]

Implementation of the digital twin involves the development of a digital platform that will rely on cloud-based infrastructure and technologies. The solution will integrate internet of things (IoT) services, a near real-time solution with support for spatial/temporal vector data, cloud object storage for raster data products, model simulation, a static content delivery service, and cloud hosted APIs for serving forecast model products. Technology focused on harvesting real-time data collection from vessels and forecasting shoaling in waterways is being developed and implemented by The Water Institute (WI) under an active project focusing on major Louisiana ports along the Mississippi River.

The project will use structured decision making (SDM) — a transparent and systematic approach to decision-making that can incorporate data and numerical models with stakeholder engagement to define/refine project objectives, identify relevant features/capabilities of the digital twin, generate desired scenario modeling and key performance metrics, and perform consequence and trade off analysis to optimize waterway management strategy. The proposed project will be rooted in stakeholder engagement with ports, tug companies, federal/state entities, and local communities, to guide the digital twin's development, features, and associated performance metrics.

Addressing Real-world Issues and Challenges

The TX GIWW grapples with an array of challenges, such as channel shoaling, vessel congestion/delays, limited areas for dredge placement, heightened safety concerns for vessels due to increased currents, underutilized vessel capacity, and disruptions related to extreme storm events and sea level rise. To combat unknown hazards, vessel operators will commonly increase buoyancy by loading less-than full capacity. Recent estimates found that the loss of one foot of draft reduces dry cargo capacity by 200 tons and liquid capacity by approximately 17,000 gallons[2]. Another challenge is dated infrastructure such as flood gates and river locks which cause vessel delays and congestion, with average delays of 12 hours per tow at some locations. Given the projected 45% growth in both the Texas population and national freight by 2045, devising a management strategy for the TX GIWW is of utmost significance.[3] Compounding these challenges is the proximity of the TX GIWW to multiple communities which experience high levels of poverty. Any enhancement to the waterway that boosts commerce has the potential to create jobs in surrounding communities and ease the burden on the nation's aging land-based infrastructure.

1 2022 GULF INTRACOASTAL WATERWAY LEGISLATIVE REPORT—88TH TEXAS LEGISLATURE
2 IBID
3 IBID

Proposed Technology

The digital twin will be designed to support three main functions: **near real-time monitoring, predictive modeling**, and **optimization of vessel operations**. The overall goal of implementing a digital twin is to increase commerce along the TX GIWW and associated ports and develop a sustainable waterway plan that considers environmental, safety, and economic issues.

Real-time monitoring will leverage existing sensor networks, remote sensing data (e.g., NASA satellite data), and bathymetric surveys to develop the digital twin. In addition to existing data, this project will explore the use of crowd sourcing through private partnerships with vessel operators. Forecasts of key environmental factors such as shoaling (the buildup of sand and sediment that can lead to dangerously shallow water), will enable **predictive modeling** of the channels. Predictive modeling will allow those performing maintenance activities on the GIWW to preemptively address dredging needs before shoaling impacts vessel traffic. Longer term predictive modeling can be used for risk mitigation by identifying and modeling the seasonal statistics of the inputs to the shoaling forecasts. Scenarios can include, but not limited to, changes in sea level, precipitation, and temperature.

The **optimization of vessel operations** will implement advanced algorithms to evaluate vessel transit and routes for efficiency, safety, and emission reduction. Additionally, testing of different vessel scheduling strategies will be explored to optimize traffic and overall waterway efficiency.

Desired Outcomes for Stage 2 Grant

Implementation of the Stage 2 grant would include expansion of the stakeholder network and full development of the digital twin across the entire footprint of the TX GIWW, including the major ports it serves. Additional data gathering efforts will include harvesting real-time data (e.g., gage networks, vessel data, etc.) and historical data sources (e.g., bathymetric surveys, gage networks, etc.) that are present outside of the digital twin's prototyping area. Stage 2 will follow the same SDM process of stakeholder engagement to identify primary concerns among stakeholders and how associated issues could be addressed by the digital twin's monitoring and modeling capabilities.

Meeting the Goals of the SMART Grants Program

Developing a digital twin prototype touches on both USDOT strategic goals (Safety, Economic Strength and Global Competitiveness, Climate and Sustainability, Equity, and Transformation) and the SMART Program Priorities (Safety and Reliability, Resiliency, Climate, Integration, and Partnerships). The overarching project objective is to increase commerce along the TX GIWW, which is a designated Marine Highway within the official Marine Highway System. The various USDOT goals and SMART Program Priorities are addressed through real-time monitoring, scenario modeling, and optimization.

Improving Status Quo of the Transportation System

The overall goal of this project is to increase commerce along the TX GIWW and associated ports and develop a sustainable waterway plan that considers natural resource, safety, and economic issues. Development and use of the digital twin will serve as a platform for collaboration among the TX GIWW's multiple stakeholders. A digital twin and its associated monitoring/modeling results will enhance maritime safety, identify navigational hazards with increased lead time, improve vessel traffic thereby reducing emissions, increase vessel cargo

capacity, and provide data for properly allocating dredging resources. The process of developing the digital twin using SDM will strengthen collaboration among stakeholders and lead to more effective decision-making and overall waterway management in the short and long-term. Improvement of the waterway's functionality can both secure and promote maritime jobs to surrounding communities.

B. Project Location

The prototype stage of this project would exist as a digital representation of a portion of the TX GIWW, with a western boundary of approximately Freeport, TX/Brazos River and an eastern boundary of Port Arthur, TX. Stage 1 would serve a large community size mostly designated as rural except for one urban area: Lake Jackson[4]. The project includes 16 census tracts identified by the Climate and Economic Justice Screening (CEJST) Tool, shown in **Exhibit 1**.

Exhibit 1: Project Area Census Tracts

Count	Tract	Disadvantaged
1	48039664400	Yes
2	48039664200	Yes
3	48167723900	Yes
4	48167724101	Yes
5	48167724000	Yes
6	48167725800	Yes
7	48071710500	Yes
8	48245005100	Yes
9	48245006100	Yes
10	48245011800	Yes
11	48245005400	Yes
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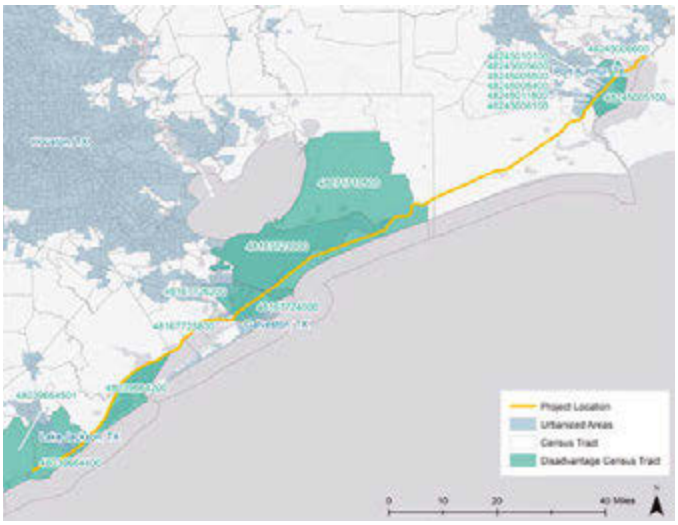
13	48245005600	Yes
14	48245010100	Yes
15	48245006600	Yes
16	48361020300	Yes



C. Community Impact

This project would provide a measurable benefit to communities surrounding the TX GIWW. Enhancing safety and improving transportation efficiency will positively impact disadvantaged communities. The digital twin would help industries along the TX GIWW utilize the waterway as an economically competitive asset by improving travel time reliability and vessel capacity. This portion of the TX GIWW is a major maritime thoroughfare and benefits from the improved safety and reliability of the waterway would extend to port communities beyond project location. A potential negative externality of the proposed project is increased maritime traffic.

4 Source: US Census Bureau, Geography Division (https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2022&layer-group=Urban+Areas)

D. Technical Merit Overview

Problem to be Solved

The TX GIWW faces several challenges affecting safe and efficient maritime commerce. The continual need for dredging to maintain adequate channel depths substantially impacts operations. Coastal dynamics (erosion, sea level rise, and subsidence) exacerbate this issue, necessitating ongoing maintenance efforts. Disruptions in channel availability directly impact the amount of cargo that can be transported on the waterway. Additionally, the increasing volume of vessel traffic along the waterway, combined with outdated infrastructure (e.g., Brazos and Colorado River locks), has raised concerns about congestion, navigation safety, and the potential impacts of increased ship traffic. Finally, the TX GIWW must adapt to the effects of rising sea levels and more frequent extreme weather events, which threaten to disrupt operations and infrastructure resilience along its route. Addressing these multifaceted challenges demands careful planning, investment, and collaboration among various stakeholders to secure the waterway's future as a key driver of Texas' maritime commerce and economic vitality.

Brazos River Floodgates
Vessel traffic around the Brazos River Floodgates results in an average of 36 accidents per year, which results in damages of approximately $800,000 per year to the facility and vessels, as well as an estimated $100,000 per year in train delays from collision repairs.

Source: GIWW Brazos River Crossing Project (March 2023 Briefing)

Proposed Solution

This project proposes the development of a prototype digital twin, which can serve as a dynamic, real-time monitoring and management system, providing continuous data feeds, predictive modeling, and optimization capabilities. The proposed digital twin would incorporate cutting-edge technology and data analytics to monitor channel depths, sedimentation rates, vessel traffic, and environmental conditions in real-time. By doing so, it would enable predictive maintenance, allowing authorities to proactively schedule dredging operations and alert the maritime community of navigational hazards.

Additionally, an important component of this proposal will be focused on crowd-sourcing data (depth, positioning, and vessel traffic) from vessels working in the TX GIWW. Crowd-sourcing data will significantly increase data volume and frequency and can be used as a direct input for real-time monitoring. Moreover, this digital twin would offer scenario modeling capabilities, allowing stakeholders to consider the effects of potential future scenarios such as sea level rise. It would facilitate optimization of vessel traffic management, improving efficiency and safety. The cloud-based infrastructure that will host the digital twin can be dynamically scaled to accommodate growing data volumes, complex simulations, and additional connected devices or assets, allowing organizations to adapt and evolve as their needs and demands change over time. By leveraging this digital twin as a management tool, the TX GIWW can enhance its resilience, adaptability, and overall performance, ensuring its continued role as a vital economic conduit for the region. A critical component of the project's success is the development and implementation of an appropriate data management plan for data inputs and corresponding outputs generated during the duration of the grant.

Expected Benefits

The proposed project will be rooted in stakeholder engagement with ports, tug companies, federal/state entities, and local communities, to guide the digital twin's development, features, and associated performance metrics. Implementing SDM framework, in combination with the digital twin allows for a transparent, data-driven tradeoff analysis. This analysis will be performed across various metrics that capture value-based, potentially conflicting stakeholder objectives while accounting for uncertain future events. The digital twin can serve as a platform to identify and forecast waterway issues and serve as a communication tool among stakeholders. The real-time monitoring and predictive maintenance component of the digital twin can identify and forecast safety issues, including draft and increased currents at varying timescales (from days to months). Additionally, forecasting areas of restricted draft will provide valuable information to decision-makers regarding dredging resource management. Scenario modeling can provide long-term outlooks of the waterway as a system under various weather events that can lead to increased resiliency of the waterway. Lastly, optimization focused on vessel movements can directly address deficiencies in current operations and offer alternative solutions (including faster deliveries and emission reduction). A digital twin with real-time monitoring, scenario modeling, and vessel optimization capabilities would enhance the safety and efficiency of the TX GIWW. This data driven approach is expected to contribute to economic growth, resiliency, and improved overall performance of the waterway, making GIWW a continued asset for the region.

E. Project Readiness Overview

Feasibility of Work Plan

Work Plan and Timeline

The prototyping stage of this project will be executed over the course of 18 months with five major tasks to be completed by the project team. Overseen by TxDOT, most of the work will be conducted by WI and Lamar University (LU). This team has developed a Phase 1 timeline that ensures completion in 18 months. See **Exhibit 2** for the proposed timeline.

Exhibit 2: Stage 1 Timeline

Task	Month																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Metric Identification																		
2. Digital Twin Design Iteration																		
3. Data Collection																		
4. Exploratory Data Analysis																		
5. Real-time Monitoring																		
6. Predictive Modeling																		
7. Digital Twin Platform/Infrastructure																		
8. Final Stakeholder Input																		
9. Optimization of Vessel Operations																		
10. Project Management																		

Task 1, Metric Identification, will actively involve stakeholders to identify issues along the TX GIWW and provide feedback on specific metrics of interest to be tracked by the digital twin. The project team will prepare workshops and synthesize information received from stakeholders. A literature review will be conducted to identify quantitative metrics tracked in similar studies. As part of Task 1, a data management plan will also be developed.

Task 2, Digital Twin Design, will use decision science (SDM) to engage stakeholders in the high-level design of the digital twin. WI and LU will develop a dashboard that allows stakeholders to visualize and interact with the digital twin.

Task 3, Data Collection, will focus on different aspects of the data collection. WI will gather historical and real-time data related to climate and the environment. WI will work to recruit vessel operators and deploy software to crowdsource depth, position, and AIS data.

Task 4, Exploratory Data Analysis, will visually and statistically characterize the data to understand what has been collected and what preparation will be required (likely cleaning, imputation, and formatting) to understand the results of the data. This task will be a joint initiative between WI and LU.

Task 5, Real-time Monitoring, led by WI, will incorporate sensor and monitoring data streams (tides, currents, wind patterns, weather conditions, and vessel transducer data) and earth observation products (remote sensing, bathymetric surveys). WI and LU will develop an automated internet of things (IoT) solution for the vessel associated data stream.

Task 6, Predictive Modeling, led by WI, this task will include development of statistical and machine learning forecasts to simulate the effects of various environmental scenarios on hydrodynamics, shoaling, as well as vessel operations.

Task 7, Digital Twin Platform, will be a joint initiative to define the technologies, services, and the integration layers necessary to enable the twin. This will include the selection of the cloud service infrastructure and associated platforms required for cloud computing. A key component of Task 7 is to develop the dashboard and monitoring solution for end-users to interact with the twin.

Task 8, Final Stakeholder Input, will include engagement workshops with stakeholders to review metrics and gather input on the scenario analysis and draft dashboard for the twin. This task will be a joint initiative, led by WI structured decision-making experts.

Task 9, Optimization of Vessel Operations, led by LU, will utilize traffic simulations of the TX GIWW to develop an optimal vessel schedule, optimal maintenance schedule, and predictive travel time estimates.

TASK 10, Project Management, will be overseen by TxDOT and will include overall project and quality management. For the first six months, TxDOT, WI, and LU will meet monthly with bimonthly meetings for the remaining grant period.

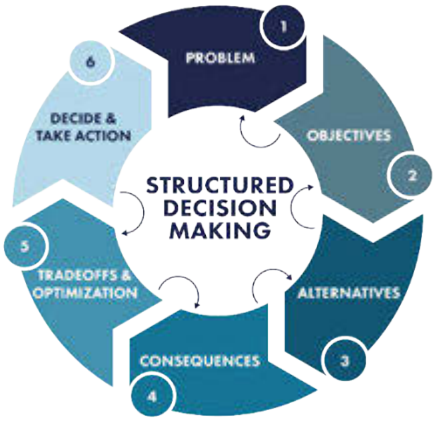
Legal, Policy, and Regulatory Requirements
The installation and deployment of this technology does not require any special permitting or regulatory processes.

Performance Measurement
To measure the success of the project, performance metrics selected through stakeholder engagement will be analyzed. Relevant measures include: reducing emergency dredging contracts, reducing draft restrictions, and reducing groundings in the project area.

Workforce Development
A portion of this work will be fulfilled by graduate students who will be involved throughout the project, providing them real-world experience in a growing field of transportation. To educate the public about and promote the TX GIWW, publications and conference presentations will be pursued to share the results of this project.

Community Engagement and Partnerships

The multifaceted challenges confronting the TX GIWW involve a wide array of stakeholders and have significant impacts on the neighboring communities. Creating a solution that caters to various requirements necessitates transparency and public support, both of which are facilitated by an approach grounded in SDM. The SDM framework is centered in transparency and engages multiple stakeholders to jointly develop objectives and associated metrics, while allowing data to be directly incorporated with stakeholder values. This leads to the importance of having a data-driven approach that has the flexibility to address questions/concerns in real-time with a solution decision-makers can have confidence in.



Leadership and Qualifications

TxDOT will serve as the primary grant applicant for the project and will coordinate the partnership team of LU and WI. Serving as the non-federal sponsor, TxDOT will coordinate with stakeholders, including the U.S. Army Corps of Engineers (USACE), USCG, and the maritime industry, among others, to identify and solve problems that arise with the TX GIWW. WI has previous experience with implementation of these technologies, installing software to send real-time observations to the cloud along the Mississippi River. WI has proven experience applying its expertise in the SDM methodology to establish consensus on objectives, goals, and ultimate outcomes with groups comprising over 140 experts across state government, academia, civic organizations, and private sector stakeholders. In anticipation of Stage 2, TxDOT staff will identify the staffing levels, information technology needs, and additional funding opportunities to ensure the agency's commitment to see the project through full implementation. Both WI and LU are committed to Stage 2. Resumes of critical staff members for the project can be found in **Appendix 1**.

APPENDIX I: RESUMES

Texas Department of Transportation

Ray Newby, P.G., *Administrative Project Manager*

Ray Newby is a Waterways Coordinator for the Texas Department of Transportation Maritime Division. He is a geoscientist with over 23 years of experience in coastal restoration and resilience planning. Prior to TxDOT, he worked in private consulting and at the Texas General Land Office (GLO) leading coastal restoration and shoreline protection projects. While at GLO, Ray coordinated with the U.S. Army Corps of Engineers (USACE) Galveston District to implement beneficial use of dredged material projects for habitat restoration. Ray was involved with GLO planning efforts in the early development of the Texas Coastal Resiliency Master Plan and was a GLO project manager for the USACE-partnered Coastal Texas Protection and Restoration Study and the Sabine to Galveston Bay Coastal Storm Risk Management Study.

Travis Milner, MBA, *Director of Strategic Planning*

Travis Milner brings nearly two decades of experience with the Texas Department of Transportation. His time with the Department began with the Houston District where he was responsible for developing financial plans for highway projects and project portfolio initiatives. From there, Travis took a position involving transportation planning, oversight of Metropolitan Planning Organizations, and contract administration. His time with the Maritime Division began seven years ago, where he was responsible for managing the Division's budget and contract activities. For the last four years, Travis has functioned as the Planning & Strategy Section Director for the Division where he is responsible for addressing the needs of TX ports and promoting waterborne commerce. Travis holds a bachelor's degree in economics from Texas A&M University and an MBA with an emphasis on finance from the University of Houston.

Lamar University

Maryam Hamidi, PhD, *Principal Investigator*

Maryam Hamidi is an associate professor at Lamar University, department of Industrial Engineering and Center for Port Management. Her research interests are maritime transportation and waterway operational efficiency. She is the corresponding author of more than 20 journal and conference publications on quantifying wide-body vessel delay in narrow waterways, vessel scheduling, and terminal performance index. She is the PI on GIWW AIS analysis package awarded by TxDOT and also mitigating impacts of waterway closure for bridge construction awarded by Harris County toll road. She has led several doctoral dissertations in contact with waterway stakeholders including Port Author and Galveston VTS, and Lone Star brown water operation committee. She teaches courses on terminal operations, decision making and risk analysis, and is the handling editor of Transportation Research Record, maritime section.

The Water Institute

Andrew Courtois, *Principal Investigator*

Andrew Courtois, Geoscientist, joined The Water Institute in 2019. His background is in sediment dynamics, hydrographic and geophysical surveys, and fluvial and coastal geomorphology. For the SmartPort project, he is managing the harvesting of crowd-sourced depth data from vessels working on the Mississippi River to create a near-real time shoaling forecasting tool to help inform operations at several port locations on the Mississippi River. To date, The Water Institute has partnered with more than a dozen vessel operation companies and nearly a billion depth observation readings have been gathered.

Nick Howes, *Co-Principal Investigator*

Nick Howes, Analytics, Computing, and Technology (ACT) Manager, brings years of experience in applied science and machine learning to The Water Institute. During his eight years as an applied scientist at Shell, he worked on a cross-disciplinary team focused on prototyping novel methods for subsurface stratigraphic characterization. Prior to joining The Water Institute, Nick was a Senior Technical Consultant with MathWorks, where he helped organizations scope, develop, and deploy science and engineering solutions, leading projects in areas of artificial intelligence, experiment management, big data, software engineering, and supporting projects in enterprise integration and application development. Nick has served as the lead expert in machine learning models developed under SmartPort.

Mike Miner, PhD, P.G., *Subject Matter Expert*

Mike Miner, Ph.D., Director of Applied Geosciences, joined The Water Institute in 2018 and leads a team of physical scientists focused on applied research to improve sediment management practices, coastal restoration strategies, and assess multitemporal-scale landscape evolution in response to climate change and potential future management scenarios. He is the Principal Investigator for Lower Mississippi River SmartPort & Resilience Center (SmartPort), a decision support tool which aims to improve port operations and benefit a variety of stakeholders who need to understand how sediment impacts navigation in the Mississippi River.

P. Soupy Dalyander, PhD, *Structured Decision Making Subject Matter Expert, Facilitator*

Patricia “Soupy” Dalyander, Ph.D., structured decision-making (SDM) facilitator and coastal oceanographer, has over 20 years of experience in research and decision-support. Dalyander specializes in SDM application and has been certified through the USFWS National Conservation Training Center (NCTC). She also studies sediment transport and morphodynamic change, beach and barrier island evolution, and developing ways to predict coastal restoration project success.

Mark Bartlett, PhD, PE, *Machine Learning, Subject Matter Expert*
Mark Bartlett, PhD, PE is the Data Science and Machine Learning Practice Lead at The Water Institute. He brings more than 18 years of experience in flood hydrology and hydraulics, statistics, ecohydrology, water quality, stormwater management, and data science and machine learning. Mark's work spans from developing a rapid flood forecasting tool that can be replicated across landscape types and locations to creating data models for agricultural purposes. Mark serves as Technical Lead for the SmartPort project where he developed the initial prototyping approaches for analyzing the project data and using machine learning for predicting river water depth and channel bed elevations. Currently he is guiding different techniques for taking real time vessel data and projecting it to a full spatial representation of the river channel bedforms.

Travis Swanson, PhD, *Geoscientist*
Travis Swanson, a geoscientist, has experience in the development and application of numerical models using modern high-level computer languages and application of pre-existing models to simulate geomorphic, hydrodynamic, and geologic phenomenon. His recent collaborations include the application of an existing shoreline model (ShorelineS, a reduced complexity shoreline model) to investigate a significant engineering challenge: Why delta lobe orientation to wave climate along the Yellow River Deltas is unable to explain why land loss is greater for engineered deltaic avulsions when compared to natural abandoned delta lobe avulsion. At Sargent Beach in Texas, a combination of remotely sensed and in-situ erosion measurements were combined to inform a data-driven model that connects rapid post-storm rates of mud cliff erosion to storm-generated changes in cliff shape and sediment cover.

Christian Ariza-Porras, *Data Architect*
Christian Ariza-Porras is a Data Architect at The Water Institute, where he focuses on data management and analysis. As Data Architect for the SmartPort project, Christian led the design and implementation of the platform for collecting near-continuous vessel geospatial data (IOT) and high-resolution repeat multibeam bathymetry to develop spatiotemporal machine learning for shoaling forecasts at the Port of New Orleans and other ports along the Mississippi River. He is a certified Apache Spark 2.4 developer with Python 3 and skilled in Python, Java, and shell scripting, among other programming languages.

APPENDIX II: BUDGET NARRATIVE

Texas Department of Transportation's total budget request for this project is $1,908,938 which is a pass-through to LU, as TxDOT will fund administration and oversight of the project with existing resources. As per the SF424A instructions, LU as a sub-recipient to the Texas Department of Transportation includes a subcontract to the WI which is budgeted in the "Contractual" category. This budget breakdown and accompanying narrative is for informational purposes only.

WI and LU Combined Budget

Category	Budget
Personnel	$745,886.28
Fringe Benefits	$214,736.71
Travel	$61,573.00
Equipment	-
Supplies	$67,000.00
Contractual	-
Construction	-
Other	-
Indirect Charges	819,742.65
Total	**$ 1,908,938.92**

Personnel

The project team includes key personnel (as identified in Appendix I) as well as other full-time technical staff, deliverable support staff, graduate student support, and administrative support staff. Andrew Courtois will serve as Principal Investigator with support from up to 10 additional WI staff members.

Funds Requested for Personnel: $745,886.28 (LU-$257,985) (WI-$487,901.28)

Fringe Benefits

The fringe benefits include Medicare, Social Security, unemployment, and vacation and are calculated at 37.37% of the personnel costs and computed as detailed in the Negotiated Indirect Cost Rate Agreement.

Funds Requested for Fringe Benefits: $214,736.71 (LU-$32,408) (WI-$182,328.71)

Travel

The travel costs include transportation, meals, and lodging for WI and LU key personnel to attend project meetings in Washington, DC with USDOT. Travel costs also include travel to multiple stakeholder meetings, including SDM meetings with stakeholders in Southeast Texas and Austin. WI staff will make 11 trips to Texas to install equipment on vessels. It is assumed two people will make these trips and each trip will be two days.

Funds Requested for Travel: $61,573 (LU-$11,573) (WI-$50,000)

Equipment
n/a

Funds Requested for Equipment: $0

Supplies
Funds requested will be used for cloud computing and platform services to enable the digital twin prototype.

Funds Requested for Supplies: $67,000 (WI-$67,000)

Other Direct Costs
n/a

Funds Requested for Other Direct Costs: $0

Indirect Charges
The federally approved indirect rate for the WI is 90.59 percent of their Modified Total Direct Cost (MTDC = $787,230) and the approved indirect rate for LU is 32.6 percent of their MTDC (MTDC = $1,802,348 minus $1,500,382(WI sub) +$25,000(1st $25K)=$326,966). The Overall Indirect charges were computed using WI MTDC ($787,230 x 90.59%=$713,152) and LU MTDC ($326,966 x 32.6% = $106,591)

Funds Requested for Indirect Charges: $819,742.65 (LU-$106,591) (WI-$713,152)

APPENDIX III: LETTERS OF COMMITMENT

Letters of Commitment from the following project partners are provided:

- Lamar University
- The Water Institute

RESEARCH & SPONSORED PROGRAMS ADMINISTRATION
LAMAR UNIVERSITY

September 28, 2023

The Honorable Pete Buttigieg, Secretary
United States Department of Transportation
1200 New Jersey Avenue SE
Washington, DC 20590

Dear Secretary Buttigieg,

This letter of commitment is provided on behalf of Lamar University investigator, Dr. Maryam Hamidi. In the event that the SMART proposal, submitted by Texas Department of Transportation (TxDOT) and other partners, titled "Digital Twin of the Texas Gulf Intracoastal Waterway (GIWW)" is funded, Lamar University will support the project in the two tasks below.

- Researchers at LU will perform the work for GIWW Operation Simulation, Optimization, and Prediction.
- Lamar University will participate in knowledge transfer and implementation of the project, along with engaging with stakeholders.

The proposed project is anticipated to increase fluidity and decrease congestion of the GIWW during frequently scheduled closures due to maintenance, deepening, dredging, construction projects, and to take the traffic back to steady state after unscheduled disruptions such as fog or hurricanes. In addition, the proposed research is needed for analytical decision-making tools to support fluidity at the waterway.

If awarded, Lamar University is committed to collaborating on stage 2 of the project. Please contact me if you have questions or need additional information regarding this proposal. In the event of an award, Lamar University reserves the right to negotiate terms and conditions applicable to Texas public institutions of higher education. Awards may be emailed to the Office of Research and Sponsored Program at rspa@lamar.edu.

Sincerely,

C. Jerry Lin
Associate Provost of Research and Sponsored Programs
Lamar University
409-880-8021 | rspa@lamar.edu

THE WATER INSTITUTE

October 10, 2023

Secretary Pete Buttigieg
U.S. Department of Transportation
1200 New Jersey Ave, SE
Washington, DC 20590

Re: FY2023 Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program

Dear Secretary Buttigieg:

The Water Institute is committed to work with the Texas Department of Transportation on the Development of Digital Twin of the Texas Gulf Intracoastal Waterway (GIWW) project.

The Water Institute is an independent, non-profit applied research organization that works across disciplines to advance science and develop integrated methods used to solve complex environmental and societal challenges. The Water Institute's research teams—including coastal ecology, applied geosciences, planning and policy research, coastal and deltaic systems modeling, artificial intelligence (AI), computing, and technology deployment—are integrated using a transdisciplinary approach to develop actionable research to provide the technical rigor and framing necessary to support robust decision making.

To support the Digital Twin of the Texas GIWW project, The Water Institute commits to provide the following:

- Expertise in planning and development of a decision support tool that forecasts and monitors shoaling, channel depths, sedimentation rates, vessel traffic and environmental conditions, which enables ports to improve efficiency and become more resilient. To support planning and development of the tool, The Water Institute will lead data collection and analysis; vessel fleet identification, recruitment, and deployment; real-time monitoring; predictive modeling; and technical design and solution architecture.
- Proven success in structured decision making (SDM), an objectives-oriented, transparent process that can support decision makers by providing a framework for engaging stakeholders and incorporating defensible, science-based tools for evaluating tradeoffs between choices. For this project, The Water Institute will lead engagement of stakeholders through vision/objective setting webinars, rapid prototyping workshops, and tradeoffs analysis for scenarios.

This commitment is new, specific, and measurable in the following ways:

- A digital twin of the GIWW will enable decision makers to proactively address issues of draft, increased currents, and other navigational hazards. Built with real-time monitoring, scenario modeling, and vessel optimization capabilities, GIWW's digital twin can enhance operations efficiency, safety, and resilience – ensuring the GIWW's continued role as a vital economic conduit for the region.
- With the application of SDM, the tool will be developed based on a common vision defined by key stakeholders and capable of predicting metrics that meaningfully quantify their desired outcomes for success. The SDM framework, in combination with the digital twin, will thereby enable data-driven tradeoff analysis to support transparent decision-making for managing the GIWW to the mutual benefit of the people whose lives and livelihoods are tied to the waterway.

As demonstrated above and in the details of the grant application, the benefits of GIWW's digital twin meet the goals of US DOT strategic goals (Safety, Economic Strength and Global Competitiveness, Climate and Sustainability, Equity, and Transformation) and the SMART Program Priorities (Safety and Reliability, Resiliency, Climate, Integration, and Partnerships). The Water Institute is excited to commit our expertise and resources with TX DOT on this important project and look forward to continuing our collaboration in Phase 2 Implementation of this grant.

Sincerely,

Beaux Jones
Acting President and CEO