OLD FORT BAYOU FEASIBILITY STUDY
Connection Bridge to Twelve Oaks Trail

MDEQ AGREEMENT #20-00053

LAND TRUST FOR THE MISSISSIPPI COASTAL PLAIN

Prepared for the Land Trust for the Mississippi Coastal Plain

by

Mississippi State University
Gulf Coast Community Design Studio

MISSISSIPPI STATE UNIVERSITY™
GULF COAST COMMUNITY
DESIGN STUDIO

BACKGROUND

This project references the following three properties owned and/or managed by the Land Trust for the Mississippi Coastal Plain:

- Thrash Property acquired by the Land Trust in 2014 (27.62 acres).
- Hussey Property acquired by the Land Trust in 2009 (11.17 acres).
- Twelve Oaks Property acquired by the Land Trust in 2005 adjoined to property owned by the State of Mississippi (30 acres).

The Land Trust for the Mississippi Coastal Plain has worked since 2010 toward connecting the above-referenced properties as part of a blueway-greenway plan for Old Fort Bayou. The greatest obstacle for the connection has been an unnamed canal off Old Fort Bayou east of the LTMCP (Hussey) Property. This prompted further site study, and eventually a preliminary design drawing by **Compton Engineering** in 2011 for a proposed bridge that would traverse the canal. This drawing was used in a preliminary permitting process which affirmed the viability of the bridge connection, receiving approval from both the United State Army Corps of Engineers and the U.S. Coast Guard, Department of Homeland Security. At that time, the Department of Homeland Security determined the channel to be navigable by small watercraft only and that the project would not require a special bridge permit.

With the potential challenges and expense of a canal crossing, the LTMCP then sought the assistance of **unabridged Architecture, PLLC** in 2012 to assess alternative options for the connection. This 2012 study explored three options: a fair-weather ferry crossing that would be a bit cumbersome; a land crossing along Hwy 90 that would all but eliminate a nature-based experience; and finally, the bridge crossing at the existing canal. The bridge crossing was determined the most desirable option, and plans continued to move forward until stalled due to the political climate at that time and availability of funds.

In 2018 the Land Trust was awarded a 319 Non-Point Source Pollution Grant by the Mississippi Department of Environmental Quality. This allowed for an update to the Old Fort Bayou Action Plan resulting in the Old Fort Bayou Watershed Implementation Plan published in December 2018. During development of the Watershed Implementation Plan, Best Management Practices (BMP's) as well as specific projects were selected for implementation to improve water quality.

In 2019 the Land Trust then applied for funds which would provide funding to implement the identified projects, one of which is the completion of a trail to connect via land and water all three parcels referenced above. The portion of that trail addressed in this document is the portion to create a connection over the canal, and is known as the Connection Bridge to Twelve Oaks Trail, for which the **Mississippi State University's Gulf Coast Community Design Studio** was then hired as outlined below.

MSU / GCCDS SCOPE OF WORK

Connection Bridge to Twelve Oaks Trail

1. Assessment of previous permitting applications and findings to determination what needs to be done and/or re-done regarding permitting and due diligence.

2. Assessment of any change in conditions of channel and bank that might impact design and/or permitting.

3. Determination of current barriers to project implementation (i.e. permitting, environmental, political, etc.).

4. Assessment of previous design alternatives and construction specifications/estimates.

5. Develop concept design and cost estimates for preferred alternative.

PROJECT PREMISE

The original Twelve Oaks Trail has been successful since its implementation in 2016 with over 300 visitors to the trail annually. The Connection Bridge to Twelve Oaks Trail is seen as an opportunity to build on that success, attracting even more visitors to the unique ecosystems along Old Fort Bayou. The connection is even more important today than ever before because of new development on adjacent properties such as the Inlet Condos with 95 condominium units and over 12,000 square feet of retail space, providing a contiguous trail from the Condos and the Kayak Landing to the Twelve Oaks Historic Home Site totaling 4,890 feet or .93 miles. This will be a tremendous asset in the way of recreational access to Old Fort Bayou as well as improved public health and economic impact through access to nature for neighboring communities including residents and visitors alike.

In addition to recreational use, the location is ideal for bird watching and wildlife viewing, and for environmental education for people of all ages to learn more about nature and ecology, the intrinsic benefits of wetlands, and the importance of protecting conservation lands. Specifically, the trail and landing areas will serve as an outdoor classroom to area K-12 students and the University of Southern Mississippi Gulf Coast Research Lab to experience and study the wetland marsh and the wooded uplands. There is opportunity to expand upon the Mississippi State University's research on the Marsh Hen (*Rallus spp.*), with the partnership of two public universities creating even greater capacity for environmental education, potential funding, and academic research.

Because of its tremendous potential for recreation, education, health, and economic impact, we anticipate being successful in obtaining funding for the Connection Bridge to Twelve Oaks Trail.

PART 1 Assessment of Previous Research & Documentation

A. Documents from previous assessment reviewed include the following:

APPENDIX	DATE	DOCUMENT NAME
A	8/31/2012	Unabridged Architecture Report: Twelve Oaks Extension of Conservation-Education Area
B	7/15/2011	USACE Letter, in response to Joint Application outlining additional requirements.
C	5/30/2011	USACE Joint Application and Notification
D	3/30/2011	US Coast Guard, Department of Homeland Security letter affirming the canal is navigable only by small vessels such as "canoes, rowboats, rafts and small motorboats" and thus "a specific coast Guard bridge permit will not be required for this project. The letter further outlines other requirements and is valid for one year only and must be renewed at that time.
E	3/21/2011	U.S. Coast Guard, Department of Homeland Security Bridge Project Questionnaire
F	3/00/2011	Compton Engineering preliminary drawings and cost estimate.
G	2/06/2011	LTMCP Land Management Site Visit Assessment
H	6/15/2010	Plan drawing of proposed 8' x 275' connection and 840' on-grade trails.

B. Data compiled spatial and analyzed include the following:

DATE	DATA SOURCE
2014	Mississippi (MARIS
3/18/29	Google Earth Imagery
	FEMA Flood Plain Data
	Property Bounds, Jackson County Tax Assessor

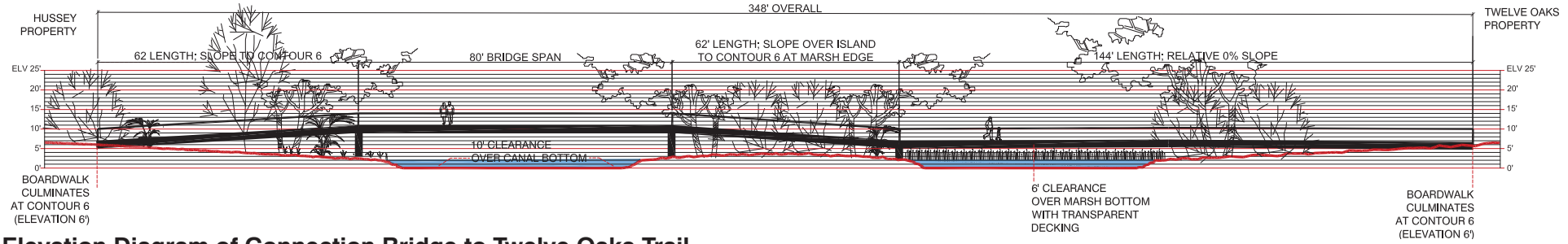
PART 2 Site and Data Analysis / Assessment of Existing Conditions

A. Site Visits and Data Study. A site visit with LTMCP staff and GCCDS was made in April 2020, and it was confirmed that site conditions of the channel and bank have not significantly changed since the 2011 review in a way that would influence or impact the design.

The location and width of the canal, the location and width/height of the island, the width and location of the marsh, and the identification/location of salt pannes (aka/mud flats) south of the island as referenced in the 2011 LTMCP Land Management Site Visit Assessment. The salt pannes offer a unique habit for foraging birds at low tides. For this reason, and at the recommendation of the LTMCP assessment, the current drawings cross over the island to avoid these sensitive ecosystems. This crossing will allow users a view of the salt pannes at low tide without causing environmental impact.

It was determined by site and topographic analysis the connection should culminate at Elevation (ELV) 6’ on the land both east and west of the canal to allow for sufficient clearance over the canal and marsh, and to provide a ramped walking experience without stairs that would culminate at the ground at a comfortable slope. The earlier studies mentioned only the eastern extension. This finding results in a total connection length of 348’ as compared with 250’ – 275’ noted in previous studies. The most feasible (lowest cost with least environmental impact) way to connect to existing and proposed on-grade trails is a straight connection, and it has been determined that a 6’ width is sufficient for the connection. These findings are reflected in the drawings herein.

NOTE: If the adjacent connecting on-grade trails are ADA accessible, the bridge should be ADA compliant as well, which would put the culmination of the ramp closer to Elevation 10 to provide landings at appropriate intervals.



Elevation Diagram of Connection Bridge to Twelve Oaks Trail

Further, the height of the bridge should consider tidal storm levels. According to FEMA data shown in the following table, the lower-most portion of the bridge should be at an elevation to avoid frequent tidal inundation.

FEMA Flood Level Data for Old Fort Bayou		
PROBABILITY OF OCCURANCE	STORM EVENT	RECOMMENDED BRIDGE ELEVATION
.20%	500-Year	15’
1%	100-Year	11.5’
2%	50-Year	10’
10%	10-Year	6’

B. Current Use. Current use is estimated at 300 pedestrians per month; it is anticipated this will increase with full occupancy of the Inlet Condos and associated retail shops, restaurants, and other amenities.

C. Visibility. This bridge will be seen from afar by boaters, fishers, and explorers of Old Fort Bayou. Many canals and inlets jut from the bayou and attract small watercraft for wildlife viewing and fishing. The bridge will no doubt provide added interest, attracting small craft into the canal to explore further. Other visibility will occur from the trail itself, as used by Twelve Oaks Trail users and residents or visitors to the Inlet Condos, as well as patrons of the associated businesses. With increased visibility comes increased opportunity for access to nature-based experiences and environmental education both from the land and from the waterway.

PART 3 Permitting Requirements

A. The US Homeland Security Questionnaire has expired and must be resubmitted for approval once the final concept is selected and preliminary construction drawings are prepared.

B. According to the 2011 Coast Guard Letter, it was determined a special permit would not be required for this project. However, a request for verification based on updated drawings should be resubmitted along with the original letter to verify the status has not changed.

C. USACE Joint Application must be updated and resubmitted, along with DMR approval as required when crossing a saltwater marsh / wetland.

PART 4 Design Recommendations

A. The biggest structural threat to the bridge is the lateral and uplift force of a tidal storm. There will be tidal movement as flood water moves in and out of the bayou, and if the bridge floods significant uplift force will occur. The structural design will need sufficient lateral support to off-set this challenge. Design should ensure parts and pieces of the bridge are not lost in the event of a severe storm. The most vulnerable section of the connection will be at the canal crossing. The marsh will be slightly less vulnerable, with the upland areas being the least vulnerable.

B. To provide the most interesting viewing experience with the least environmental impact, the connection is shown in the drawings to cross the canal, island, and marsh at 90°. This design avoids salt pannes to the south and allows trail users a view of the unique ecosystem at low tide. The placement also allows users a view back to Old Fort Bayou and the opportunity to orient themselves in the larger natural landscape.

C. A six-foot (6') width is adequate for the connection bridge.

D. A finished viewing deck elevation of at least 10' is recommended to provide a high-viewing experience for the pedestrian who can then orient themselves within the larger landscape. The design should cross the marsh at a minimum Elevation (ELV) 6' with transparent decking that allows natural light and waterflow to support the marsh ecosystem immediately below and in the nearby vicinity.

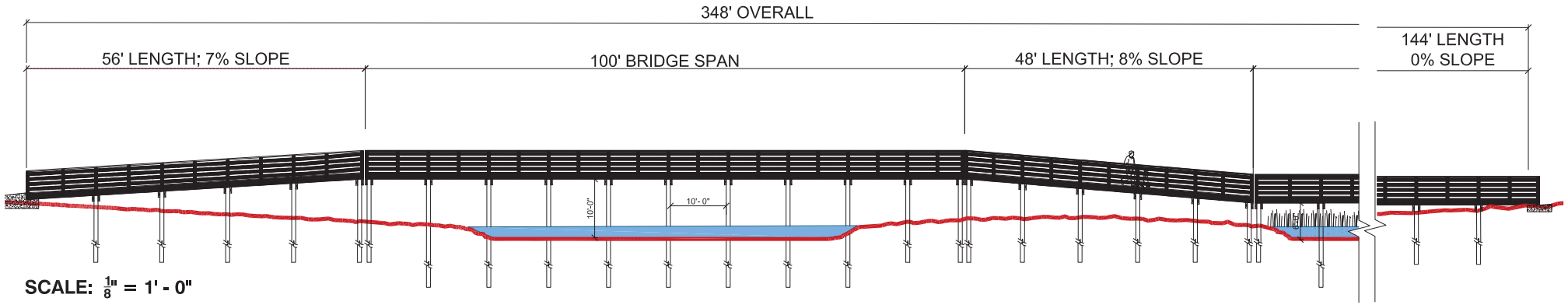
PART 5 Design Alternatives & Cost Comparisons

Costs associated with bridge construction include concrete, steel, timber, equipment, surveying, geotechnical surveying, soil/site investigation, research, design, construction administration, and permitting by local, state, and federal agencies. Itemizing projected costs for the Connection Bridge to Twelve Oaks Trail would take place once a final design solution is selected. For the current scope, an estimated range of bridge and decking costs for various bridge types based on comparable projects is provided. The drawings provided on the following pages are preliminary concepts, not intended to serve as construction drawings.

A large format drawing set is provided separately.

FOCUS AREA: Connection Bridge to Twelve Oaks Trail

TYPE A Timber Bridge & Rails



SCALE: $\frac{1}{8}$" = 1' - 0"

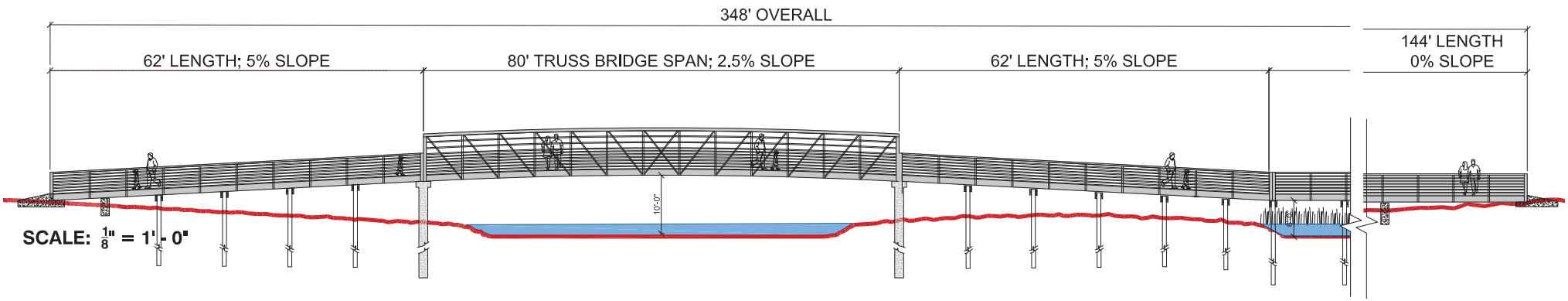
TYPE A: TIMBER BRIDGE & RAILS WITH TIMBER PILINGS
Bridge Structure Ht: 4.5'
Viewing Deck at Elevation 11'

PROS: Cost effective, natural materials blend with wooded backdrop, low profile.

CONS: Timber is the material least able to withstand severe storms. The buoyancy of timber would result in damaged boards becoming lost debris in a storm event. Spacing requirements of timber pilings (estimated at 10' - 16' O.C.) presents the highest impact on the sensitive landscape. The frequency of pilings compromises aesthetics and can block fast-flowing debris in sever storm events.

ESTIMATED COST & PROJECT COMPARISONS:
+/- $100,000 1000' linear-foot Shepherd's State Park Boardwalk (currently under construction)
+/- $230,000 500' linear-foot Old Fort Bayou Boardwalk (proposed design bid by Borries Construction)

TYPE B Painted Steel Fabricated Truss Bridge & Rails



TYPE B: PAINTED STEEL FABRICATED TRUSS BRIDGE & RAILS WITH CONCRETE PEIRS
Bridge Structure Ht: 8'-0"
Viewing Deck at Elevation 11.5'

PROS: Moderate cost, ability to withstand high waters with minimal points of potential obstruction in high storm events.

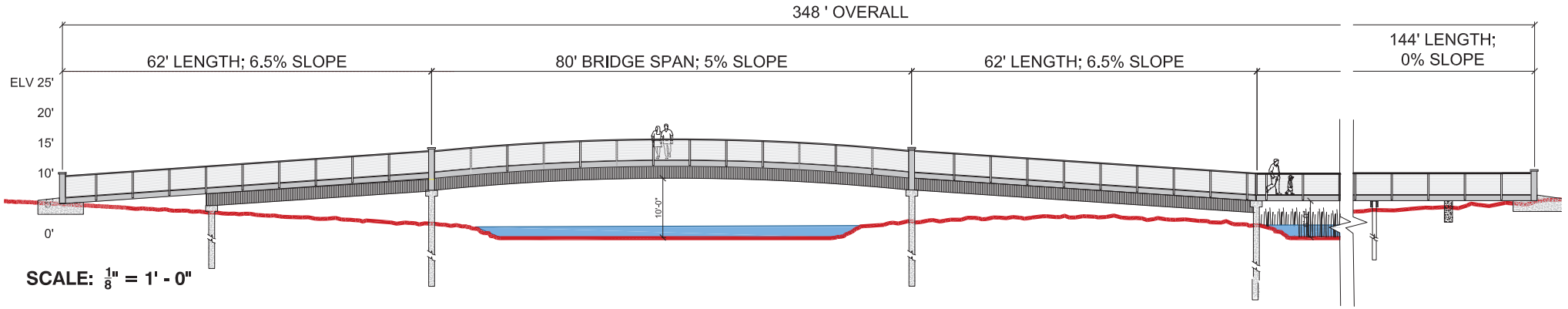
CONS: The pedestrian walks through a truss system which extends above their head, creating a heavy and enclosed experience. Particularly in a marine environment, the bridge would require maintenance painting. Conversely, unpainted weathering steel is not suitable for a marine environment. Installation would require a barge and crane. In order to eliminate the need to extend the truss system the length of the boardwalk (in addition to the bridge over the canal), concrete or timber pilings are use at frequent intervals to support the boardwalk.

ESTIMATED COST & PROJECT COMPARISONS:

$375,000 - $550,000 + 10% design fees.

Based on research and costing information in consultation with Contech Engineered Solutions.
A local example of a truss bridge is the pedestrian bridge crossing Hwy 90 at the Beau Rivage Bridge, Downtown Biloxi.

TYPE C Painted Steel Fabricated Beam Bridge & Rails



SCALE: $\frac{1}{8}$" = 1' - 0"

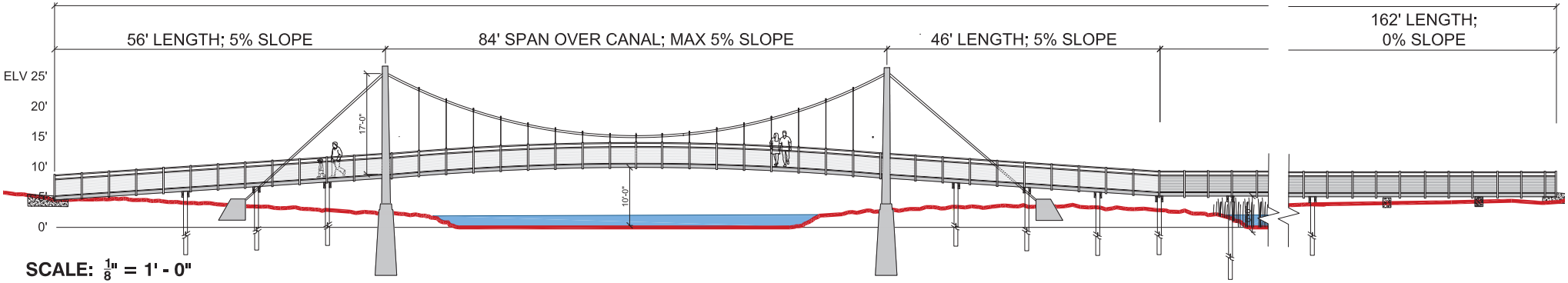
TYPE C: STEEL BEAM BRIDGE & CABLE RAILS WITH CONCRETE PIERS
Bridge Structure Ht: +/- 7'-0"
Viewing Deck at Elevation 11'

PROS: The custom design with much of the structure below the viewing deck creates a more open and light experience for the user. Ability to withstand high waters with minimal points of potential obstruction in high storm events is high. The lower-profile and stainless steel cable rails, as well as the minimal number of piers, provide a light-on-the-land aesthetic and reality.

CONS: Higher cost than timber or truss options. The frame would require maintenance painting. Conversely, unpainted weathering steel is not suitable for a marine environment. Installation would require a barge and crane.

ESTIMATED COST & PROJECT COMPARISONS:
$450,000 - $650,000 + 10% design fees. Based on research and costing information in consultation with Contech Engineered Solutions.

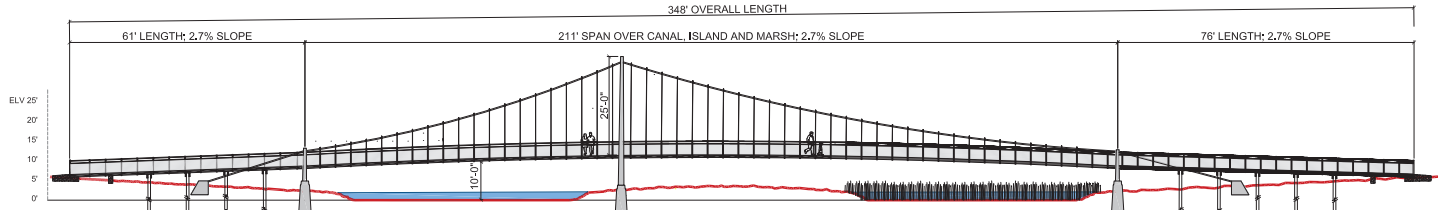
TYPE D Suspension Bridge and Cable Rails



SCALE: $\frac{1}{8}$" = 1' - 0"

TYPE D: SUSPENSION BRIDGE & STAINLESS CABLE RAILS W/ PIER-SUPPORTED EXTENSIONS

Concrete Piers; Stainless Steel Towers
Bridge Structure Ht: 4' - 4"
Viewing Deck at Elevation 10.5'



PROS: There are a variety of options for the design of a suspension bridge. Shown are example diagrams for two-tower or a single-tower options. The design is low-impact environmentally, particularly the single-tower design. The aesthetic value is high and the design can easily allow for a gentle (2.7%) slope across the entire span. The stainless steel towers and cable rails will not require maintenance painting and are ideal for marine environment. Stainless Steel will provide the longest service life and corrosion resistance. There are minimal points of potential obstruction in high storm events.

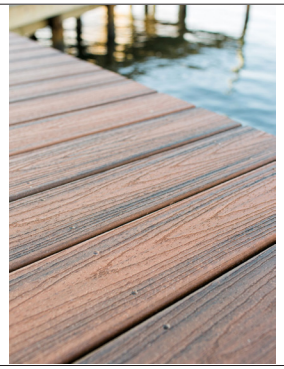
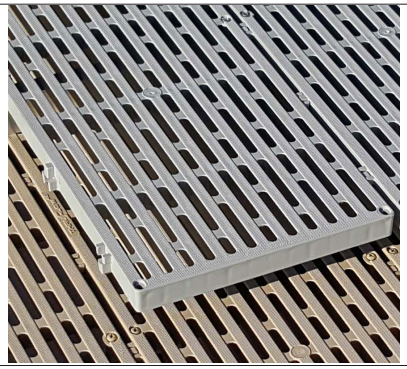
CONS: High Cost

ESTIMATED COST & PROJECT COMPARISONS:

USM Marine Research Education Center Suspension Bridge (Cost $750,000)
Constructed by Seattle Bridge Company. The 220’ bridge is 4’ wide and is positioned at 20’ above grade with its single tower rising approximately 25’ above the viewing deck.

By comparison, the Connection Bridge to Twelve Oaks Trail would require a longer span. In the drawings above this is accomplished with boardwalk exensions. With this information as a guide, the cost can be estimated between $850,000 and $1,200,000.

PART 6 Decking Alternatives

1	2	3	4
Moisture Shield® Plank 2” x 6” x 12’ Boards	Thru-Flow® 12” x 36” Panels Model: Surge 50	Aluminum I-Bar Grating	Protruded Fiberglass Decking
			
$7.40 per sf	$6.00 per sf	$12.85 per sf	$ 20.00 per sf
Example: Davis Bayou Fishing Pier 225 LF	Example: Specified for the Old Fort Bayou Boardwalk Behind the Inlet Condos. 500 LF	Example: Weeks Bayou Water Quality Testing Platform The I-Bar design provides a comfortable walking surface as compared to steel grating without the I-Bar.	Example: USM Marine Education Center Suspension Bridge
The premium decking choice of the Gulf Islands National Seashore	Designed in Florida for its capacity to withstand severe storms due to the flow-through design. Approved for habitats requiring non-light-inhibiting decking.	Approved for habitat requiring translucent decking.	Designed for walkability, movement, and longevity for suspension bridges. Corrosion and slip resistant.

PART 6 Next Steps

A. Present concept design alternatives Mississippi Department of Environmental Quality

B. Make a final determination regarding the design alternative with which to move forward.

C. Search for funding resources for:
- Preliminary Construction Drawings for Permitting and Itemized Cost Estimation
- Permitting
  - Updated USACE Joint Application
  - Updated letter from the U.S. Homeland Security
- Surveying - A geo-technical survey should be conducted, as well as a professional survey to locate a benchmark on-site, and document contour and spot elevations from which the design can then be worked out and implemented with precision.
- Final Construction Drawings
- Bid Documents and Contractor Selection
- Construction Administration and Implementation of the 350' Connection