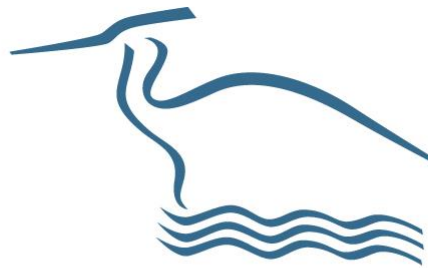


# *Galveston Bay Foundation's Oyster Shell Recycling Program*

GLO Contract No. 18-086-000-A596

**FINAL REPORT  
SEPTEMBER 2019**

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## **I. Project Summary**

In an effort to reverse the significant loss of oyster habitat in Galveston Bay, the Galveston Bay Foundation (GBF) works with local restaurants to recycle oyster shells and return them to the bay. Rather than being disposed of in landfills, the oyster shells are returned to the Bay to provide hard substrate and thus enhance the native oyster populations. While oyster larvae find many surfaces suitable for attachment/growth, oyster shells are the preferred substrate for spat recruitment as confirmed by Coen and Luckenbach (2000).

During Grant Cycle 22, specifically from February 2018 through March 2019, 152 tons of oyster shells were recycled through GBF's Oyster Shell Recycling Program. These shells are being stored at GBF's "Curing Sites" where they will be turned intermittently with a tractor to allow for proper sun curing before being returned to the Bay. The shells will be used as an aspect of GBF's Volunteer Oyster Gardening efforts and returned to Galveston Bay through (separately funded) oyster reef enhancement and restoration projects such as GBF's "oyster bar" breakwater construction.

## **II. Background Information**

Oyster reefs are a vital component of a healthy estuary. They filter contaminants from the water, protect shorelines, stabilize sediment, and provide habitat and food sources for other aquatic species. Unfortunately, oyster reefs are the most threatened marine habitat worldwide. Studies show that over 85% of oyster habitat has been lost on a global scale (Beck et al, 2011). In Galveston Bay, over 50% of the oyster reefs have been destroyed, primarily as a result of Hurricane Ike (Hons and Robinson, 2010). Prior to 2008, Galveston Bay provided nearly 80% of the oyster harvest in Texas (Haby et al, 2009). However, the severe sediment deposition resulting from Hurricane Ike smothered oyster reefs across the bay system and eliminated a large portion of the hard substrate required for oyster development.

To help replenish hard substrate in the bay and support local oyster restoration efforts, GBF partnered with local restaurant owner Tom Tollet of Tommy's Restaurant and Oyster Bar in 2011 and began recycling oyster shells. Before GBF's Oyster Shell Recycling Program began, oyster shells were discarded along with other restaurant waste and sent to a landfill. To avoid the disposal this vital resource, GBF now partners with multiple local restaurants to collect oyster shells and return them to the bay. The reclaimed shells will serve as new oyster habitat, thus enhancing the local oyster populations.

With the assistance of CMP funding, GBF has expanded the program from the pilot stage with one restaurant and one curing site to a total of eleven restaurant partners over seven years and four curing sites. Under Grant Cycle 21, GBF was able to establish a partnership with Texas A&M University at Galveston (TAMUG) which led to the expansion of recycling efforts onto Galveston Island; including the fourth curing site, on TAMUG property. Shell recycling efforts began through a partnership with BLVD Seafood under Cycle 22. GBF was also able to streamline recycling methods and curing site maintenance, develop new outreach materials and improve the education and awareness of both restaurant patrons and the public in general on the importance of oysters in Galveston Bay.

### **III. Project Implementation**

#### A) Task 1: Shell Collection & Maintenance

##### ***A.1 Shell Collection***

GBF staff collected oyster shells from participating restaurants on a weekly basis to relieve the restaurants of their shell waste. Throughout the week, restaurant staff deposited used oyster shells in recycling receptacles. GBF staff transported these containers of shells via truck and trailer to one of two “curing sites” where shells were stored temporarily. The shells were then left to sun cure or “bleach” for a minimum of 6 months. As identified by Bushek et al. (2004), sun curing oyster shells for a minimum of 1 month ensures that all bacteria and parasites are eliminated. Following the curing process, the shells were ready to be used in oyster gardening, as well as (separately funded) oyster reef restoration and enhancement projects throughout Galveston Bay.

GBF used Cycle 22 to manipulate the shell collection schedule based on restaurant shell output, participation, and seasonal changes. This adaptation has allowed GBF to maximize shell collection, while minimizing project costs.

Please refer to Appendix A for the shell collection numbers and associated graphs.

##### ***A.2 Curing Site Maintenance***

GBF and volunteers spent Cycle 22 managing and maintaining the two curing sites used for shell storage. The Texas City site is owned by GBF and requires shell turning, moving, and piling to ensure the proper shell curing and also provide ample room for continued shell storage. The Red Bluff curing site is a leased property that, under lease terms, GBF is responsible for all maintenance and management. As a much larger property, more time and effort is needed to ensure it is up to standards for proper and efficient shell curing. GBF staff and volunteers needed to perform regular mowing for access, and shell turning, moving, and piling for proper shell curing. Cycle 22 also allowed for 200 tons of road base to be delivered to allow for year-round access, even during the wettest months. In years past, this site was taken out of circulation during the rainy months, to prevent damage to the property by vehicular traffic, and to ensure the GBF truck and trailer used for shell collection does not get stuck or damaged on the wet, muddy road.

On both properties, shell at different stages of the curing process (cured, curing, and new) are kept in separate piles in order for GBF staff to keep track of what shell is available for use in restoration projects.

See Appendix B for a schedule of curing site maintenance.

## B) Task 2: Volunteer Oyster Gardening

### ***B.1 Volunteer Recruitment***

With the assistance of CMP Cycle 22 funds, GBF was able to expand its Gardening Program, by adding a 4<sup>th</sup> project site. GBF hosts four oyster gardening events in local, waterfront communities; San Leon, Kemah, Bayou Vista, and Tiki Island. GBF provided a presentation to volunteers on the entire Oyster Restoration Program, that included an overview of the shell recycling project and volunteer oyster gardening. Volunteers learned why gardening efforts are important as well as the methods for monitoring and maintaining their gardens for the entire oyster spawning season. These events also included the chance for all volunteers to build their gardens and provided a demonstration on how to properly secure the gardens to docks and piers, or bulkheads. Cycle 22 funds allowed GBF to provide gardeners with alternative methods for garden creation in an attempt to determine the most effective use of recycled oyster shell for oyster recruitment. Gardeners during Cycle 22 were able to make shell bags, shell cages, and shell stringers in an attempt to gauge differences in spat recruitment efficiency.

### ***B.2 Tracking Volunteer Oyster Gardening***

Volunteer activity was tracked throughout the entire the Oyster Gardening season, from the spring gardening events, throughout the summer months of monitoring, and finally to spat collection in the fall. A total of 108 volunteers attended the four separate oyster gardening events in the spring, resulting in the creation of 299 oyster gardens. Once spawning season concluded (per Texas Parks and Wildlife Department), all gardens were collected and spat recruitment was documented. 4,276 new spat were recruited in the volunteers' oyster gardens and successfully returned to the bay onto restoration reefs as a part of GBF's (separately funded) Oyster Restoration Program.

In reviewing each community's spat recruitment individually, GBF was able to get a better understanding of the productivity of these oyster gardens in an attempt to gauge if garden methodology affected oyster recruitment.

For detailed oyster gardening tracking documents please refer to Appendix C.

### C) Task 3: Outreach & Education

To improve the outreach and education component of the Oyster Shell Recycling Program, GBF used outreach materials developed and printed during Cycle 22 to better inform the public on both the Oyster Shell Recycling and Oyster Gardening Programs. Separate educational rack cards for both programs have been distributed by restaurant partners, as well as at boothing events throughout the Greater Houston area. Outreach materials have also been included in presentations by GBF staff at 13 conferences and events throughout the country to highlight the advances in oyster shell recycling in the Galveston Bay.

- 1) Recycling Rack Card – The Recycling Rack Card was updated under Cycle 22 to include new program logos. This handout has been a very effective means of communication at outreach events, from Oyster Team specific events to other boothing and presentation opportunities overseen by other GBF staff. Due to the simplified message on the rack card, it is easily used by other GBF staff to present information on the Oyster Shell Recycling Program and provide different avenues for interested parties to become involved.
- 2) Gardening Rack Card – Similar to the Recycling Rack Card, the Gardening Rack Card was updated with new program logos. This handout allows both the Oyster Team, as well as other GBF staff to promote oyster gardening and provide potential volunteers an avenue to become involved. Like the Recycling Rack Card, it has proven to be effective at large boothing events.
- 3) Social Media Campaign – GBF has approached partner restaurants to determine ways that the Recycling Program can better highlight its partners and their support of the program. A social media tabletop campaign was developed under Cycle 22 that will allow customers of restaurants to promote the restaurants they are visiting, while simultaneously learning more about GBF and the Oyster Shell Recycling Program. It will also incentive restaurant staff to promote the program as well.

Outreach materials can be found in Appendix D.

The Oyster Team attended and/or presented at 13 events in which the Oyster Shell Recycling Program was promoted through outreach and educational booths (refer to photographs in Appendix E). Local citizens were often presented with a display of two aquariums, one containing live oysters and one containing only bay water, demonstrating the filtration ability of oysters. Participants had the opportunity to help prepare oyster gardens and “send a message to an oyster” with a coloring activity, geared particularly towards the youth. Both the Recycling and the Gardening rack cards still prove to be a very effective means by which to present the different aspects of the project. Examples of the different shell recycling receptacles were also exhibited during these events. A visual of the entire shell recycling process using a mock oyster tray, toy recycling bin, and toy tractor were typically displayed to help the public grasp the concept of the entire shell recycling process. Through interactions with GBF staff and volunteers, attendees at outreach events were educated on the importance of oysters in Galveston Bay and the significance

of returning shells to the bay through the Oyster Shell Recycling Program. Oyster Team members also gave presentations on the Oyster Shell Recycling Program at all four gardening events.

#### D) Task 4: Participation

With the assistance of CMP Cycle 22 funds, GBF partnered with the seven local restaurants listed below during Cycle 22. CMP funds, and a partnership with Texas A&M University at Galveston (TAMUG), BLVD Seafood was added to the restaurant partnership as a trial run for Galveston Island Recycling. TAMUG provided staff and trucks to collect shells, while GBF managed and oversaw the operations and provided necessary supplies. While the local oyster industry continues to try to rebound from recent natural events, GBF spent Cycle 22 streamlining the collection process in order to maximize shell while minimizing costs. Potential future partnerships were discussed for Cycle 23 and beyond with Swamp Shack - Baybrook, No. 13, Sam's Boat, and Cajun Greek.

<b>Restaurant</b>	<b>Date Partner began Shell Recycling</b>
Tommy's Restaurant & Oyster Bar	March 2011
Topwater Grill	May 2013
Crazy Alan's Swamp Shack	November 2013
The Aquarium (Kemah)	August 2013
Captain Benny's Seafood (Gulf Fwy)	October 2015
Tookie's Seafood	June 2016
BLVD Seafood	January 2018

GBF has future plans to extend shell collections into downtown Houston with partner restaurants such as State of Grace, Loch Bar, and Liberty Kitchen and will use future CMP Cycles to develop and implement this process. In the meantime, GBF is focusing on the current route and where new restaurants partners can be added under current capacity.

#### **IV. Results**

A total of 152 tons of oyster shell was collected during CMP Cycle 22 and over 966 tons of oyster shells have been recycled since 2011, in large part, through support and funding from CMP. All oyster shells collected during Cycle 22 are being tracked to follow their state in the curing process and once a sufficient amount of shell is cured, it will be used in GBF's Volunteer Oyster Gardening Program and (separately funded) Oyster Restoration Program.

## **V. Lessons Learned**

Shell collection during Cycle 22 is still affected by the oyster industry, and any impacts to the bay's oyster populations can be seen in the amount of shell collected. Despite these challenges, GBF has worked to improve its collection process, enhance its partnerships, and continue to increase its focus on public outreach, awareness, and education.

GBF's Habitat Restoration Manager used Cycle 22 funds to develop a Strategic Development Plan (SDP). The purpose of the SDP is to provide guidance for the improvement and expansion of GBF's Oyster Shell Recycling Program. This Plan will help GBF address the feasibility of expanding shell recycling operations into the greater Houston area as well as along the existing routes. It appears that an expansion to Houston will be greatly beneficial to the Foundation's efforts. The largest concentration of restaurants, including those that sell oysters, are located in downtown Houston. An expansion will not only increase the amount of shell recycled, and subsequently reef habitat restored, it will also increase GBF's exposure in the community. The SDP may also serve as a framework for other organizations interested in starting a new oyster shell recycling program or in expanding an existing program.

Furthermore, GBF designed this document to facilitate the assessment of the Foundation's current oyster shell recycling operations as well as the operations of other programs (Step 1 and 2). Through this assessment, GBF will be able to analyze the costs and benefits associated with the current operations as well as alternative shell recycling methods (Step 3). GBF will also establish an action plan to implement the most appropriate shell recycling methodology within the next two to three years (Step 4). The final step in the process, evaluation (Step 5), will allow for reflection on actions taken to determine what is effective and what is not. GBF's strategic planning will serve as adaptive management through an ongoing pattern of analysis, planning, implementation, and evaluation. GBF plans to evaluate the state of the Oyster Shell Recycling Program on a quarterly basis and update the SDP on an annual basis to provide frequent opportunities for adjustment and improvement.

Please refer to Appendix F for the Strategic Development Plan



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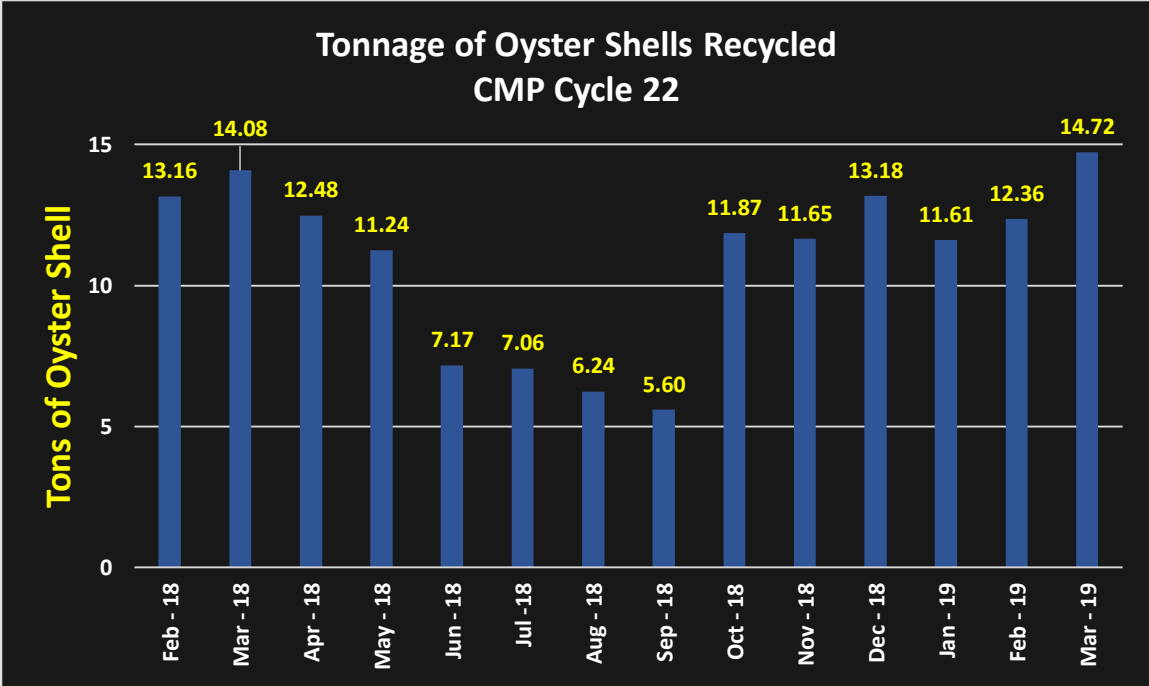
**VII. Appendix**

**APPENDIX A**  
**SHELL COLLECTION NUMBERS**

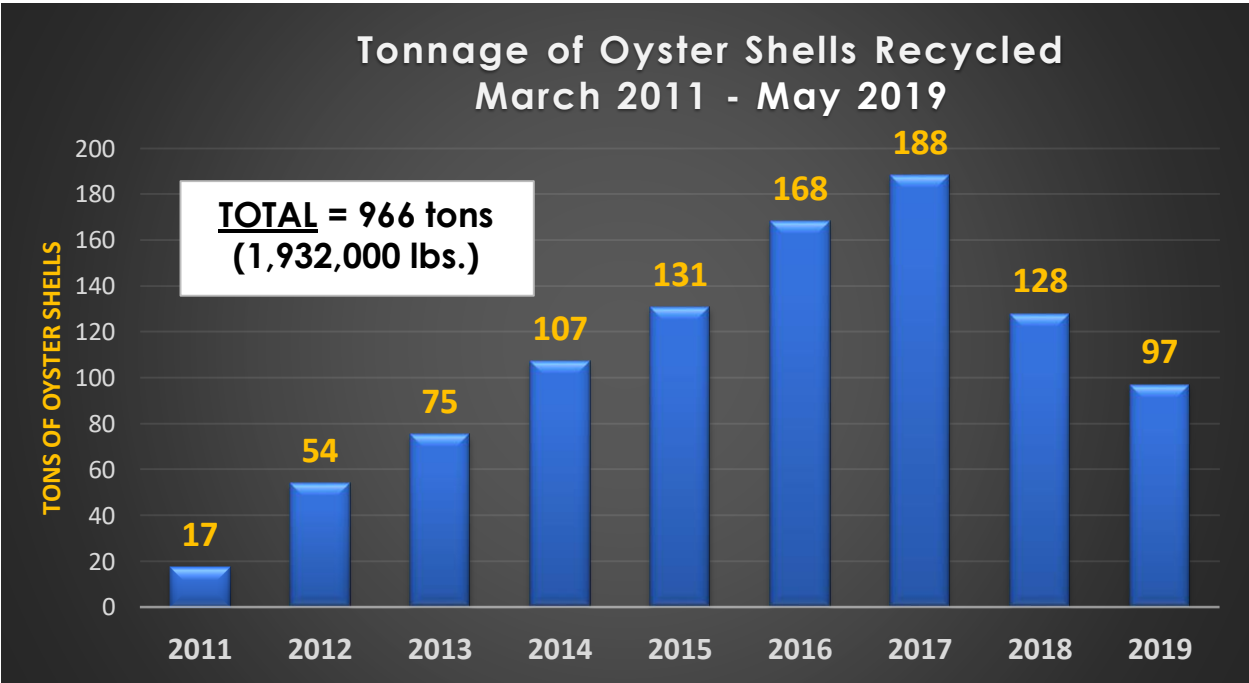
A.1 Tonnage of Oyster Shells Recycled During Cycle 22

Month	Oyster Shells Collected (tons)	Oyster Shells Collected (lbs)
Feb - 18	13.16	26,325
Mar - 18	14.08	28,160
Apr - 18	12.48	24,967
May - 18	11.24	22,485
Jun - 18	7.17	14,349
Jul -18	7.06	14,123
Aug - 18	6.24	12,485
Sep - 18	5.60	11,199
Oct - 18	11.87	23,739
Nov - 18	11.65	23,307
Dec - 18	13.18	26,361
Jan - 19	11.61	23,216
Feb - 19	12.36	24,725
Mar - 19	14.72	29,431
<b>Total</b>	<b>152.44</b>	<b>304,871</b>

*\*Oyster shell tonnage is based on an average weight of 192lbs of shell/32-gallon bin and 23lbs of shell/5-gallon bucket and is subject to a variance of ± 5%.*



A.2 Tonnage of Oyster Shells Recycled to Date



**APPENDIX B**  
**CURING SITE MAINTENANCE**

<b>Date</b>	<b>Curing Site</b>	<b>Maintenance Conducted</b>	<b>Volunteer/Contractor</b>
2018-02-20	Red Bluff Rd	Mowed	Scott Alford - NRCS partner
2018-03-15	Red Bluff Rd	Transported 6 truckloads (75CY) of shell to TBDC Consolidated newly dumped shell into new pile	Trucks, loader, operator - GCL
2018-05-15	Red Bluff Rd	Collected 40 buckets of shell (0.78 CY) for Oyster Gardening	GBF Staff
2018-08-20	Red Bluff Rd	Transported 15CY of shell to Sweetwater	GBF Staff
2018-09-28	Red Bluff Rd	Mowed	Scott Alford - NRCS partner
2018-10-10	Red Bluff Rd	Shannon & Haille piled shell with rented skid steer Transported 15CY of shell to Sweetwater	GBF Staff
2019-06-03	Red Bluff Rd	Collected 35 buckets of shell (.68CY) for oyster gardening	GBF Staff
2019-06-21	Red Bluff Rd	Collected 25 buckets of shell (.49CY) for oyster gardening	GBF Staff
2019-06-23	TX City	Property mowed Shell piled to begin curing process	GBF Staff
2019-06-25	TX City	Transported 151 shell bags (3.85CY) to TBDC	GBF Staff
2019-07-10	Red Bluff Rd	Property mowed and maintained	GBF Staff
2019-07-17	TX Ciy	Transported 126 shell bags (3.22CY) to TBDC	GBF Staff
2019-07-23	Red Bluff Rd	Transported 3 truckloads (~39 CY) of shell to Sweetwater Lake for oyster bar construction Piled new shell for 6-month curing	Trucks - GCL Loader, operator - GCL (pro bono)
2019-09-20	Red Bluff Rd	200 tons of material ordered for curing site maintenance	Trucks - GC

**APPENDIX C**  
**VOLUNTEER OYSTER GARDENING**

C.1 Number and Location of Oyster Gardens Created

Location of gardens	# of gardens created	Sub-bay system
Tiki Island	132	West Galveston Bay
San Leon	82	Central Galveston Bay
Bayou Vista	55	West Galveston Bay
Kemah (TCYC)	30	Central Galveston Bay
	<b>299</b>	

C.2 Oyster Gardening Volunteers

Community	# of Volunteers
Tiki Island	42
San Leon	11
Bayou Vista	24
Kemah (TCYC)	31
	<b>108</b>

C.2 Spat Recruitment

Community	# of Spat Recruited
Tiki Island	4035
San Leon	77
Bayou Vista	154
Kemah (TCYC)	10
	<b>4276</b>

## APPENDIX D OUTREACH MATERIALS

### D.1 Recycling Rack Card update



**OYSTER SHELL RECYCLING PROGRAM**  
A GALVESTON BAY FOUNDATION PROGRAM

Galveston Bay Foundation partners with local restaurants to collect shucked oyster shells after patrons enjoy a tasty meal. The empty oyster shells are sun-bleached for a minimum of six months to rid them of bacteria. The shells are then returned to Galveston Bay to provide new homes for baby oysters.

**Shell Collection**

**Sun Curing**

**Reef Restoration**

**New Life!**

Learn which restaurants recycle their oyster shells at [galvbay.org/oysters](http://galvbay.org/oysters) and eat your way to a healthier Bay!

### WHY ARE OYSTERS SO IMPORTANT?

- Oysters clean the water
- Oyster reefs create homes for fish, shrimp, crabs, and many other species
- Oyster reefs help protect the shoreline
- Oysters are food for people, birds, & crabs

### WHY RECYCLE OYSTER SHELLS?

Oyster larvae need a hard surface on which to attach so that they may begin to grow. While baby oysters can attach to just about anything, they prefer other oyster shells!



Galveston Bay lost more than 50 percent of its oyster reefs as a result of Hurricane Ike. To help restore the Bay's oyster population, keep our water clean, and provide habitat for aquatic life, Galveston Bay Foundation returns all recycled oyster shells to the Bay through Volunteer Oyster Gardening efforts and Oyster Restoration Workdays.



Interested in becoming an Oyster Program **Volunteer? Sponsor? Partner?**  
Call 281-332-3381 or email [info@galvbay.org](mailto:info@galvbay.org)

This project funded, in part, by a Texas Coastal Management Program grant approved by the Texas Land Commissioner pursuant to the National Oceanic and Atmospheric Administration Award No. NA18NO5490153

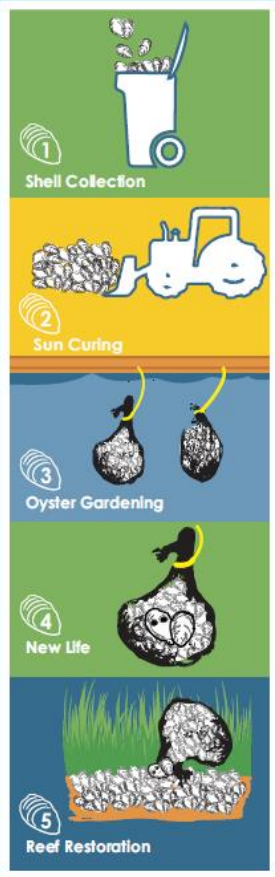
D.2 Gardening Rack Card



**OYSTER SHELL**  
RECYCLING PROGRAM

**GALVESTON BAY**  
FOUNDATION

**VOLUNTEER OYSTER GARDENING**  
*Galveston Bay Foundation partners with bayfront homeowners to give baby oysters a head-start.*



- 1 Shell Collection
- 2 Sun Curing
- 3 Oyster Gardening
- 4 New Life
- 5 Reef Restoration



**WHAT IS AN OYSTER GARDEN?**

An oyster garden is a mesh bag or cage filled with recycled oyster shells collected through GBF's Oyster Shell Recycling Program.



**WHY DO WE "GARDEN" FOR OYSTERS?**

The recycled shells in our oyster gardens make new homes for baby oysters!

Oyster larvae need a hard surface on which to attach so they may begin to grow. While oyster larvae can attach to just about anything, they prefer other oyster shells. The shells and baby oysters (aka spat) in our oyster gardens are transplanted onto restored oyster reefs to help repopulate native oysters in the Bay.

**INTERESTED IN BECOMING A VOLUNTEER OYSTER GARDENER?**



Complete the [Oyster Gardening Information Request Form](https://galvbay.org/oysters) online at [galvbay.org/oysters](https://galvbay.org/oysters)

*\*Please note: ALL oysters produced in GBF's oyster gardening program are strictly for restoration purposes and are NOT for consumption*



THIS PROJECT IS FUNDED IN PART BY A TEXAS COASTAL MANAGEMENT PROGRAM GRANT APPROVED BY THE TEXAS LAND COMMISSIONER PURSUANT TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION AWARD NO. NA16N054190174.



D.3 Social Media Campaign



**OYSTER SHELL  
RECYCLING PROGRAM**  
A GALVESTON BAY FOUNDATION PROGRAM

# EAT OYSTERS AND WIN!

-  **1.** *Take a picture of or with your oysters!*
-  **2.** *Check in at restaurant on Facebook*
-  **3.** *Like and tag Galveston Bay Foundation in the photo*

**At the end of the month, one winner will be randomly selected and earn a prize. Name your server and we'll give them credit too!**

 This project funded, in part, by a Texas Coastal Management Program grant approved by the Texas Land Commissioner pursuant to the National Oceanic and Atmospheric Administration Award No. NA18NOS4190153 





**APPENDIX E**  
**PROJECT PHOTOGRAPHS**

E.1 Oyster Shell Collection



E.2 Texas City Preserve Curing Site



Pre-road maintenance to curing pile



Shell pile maintenance

E.3 Port of Houston Authority Lease: “Red Bluff Curing Site”



Shell turning and piling

E.4 Oyster Gardening Events







E.5 Oyster Recycling Educational Booth







**APPENDIX F**  
**STRATEGIC DEVELOPMENT PLAN**

*See Attached*



# OYSTER SHELL RECYCLING PROGRAM

A GALVESTON BAY FOUNDATION PROGRAM



## Strategic Development Plan 2019-2021



A REPORT FUNDED BY A TEXAS COASTAL MANAGEMENT PROGRAM GRANT  
APPROVED BY THE TEXAS LAND COMMISSIONER PURSUANT TO NATIONAL  
OCEANIC AND ATMOSPHERIC ADMINISTRATION AWARD NO. NA17NOS4190139.





# **GALVESTON BAY** FOUNDATION

## **OUR MISSION**

The mission of the Galveston Bay Foundation is to preserve and enhance Galveston Bay as a healthy and productive place for generations to come.



# **OYSTER SHELL** RECYCLING PROGRAM

## **OUR GOAL**

The goal of the Galveston Bay Foundation's Oyster Shell Recycling Program is to reclaim oyster shells from local restaurants and return those shells to Galveston Bay to restore native oyster habitat.

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## STEP 1: INTERNAL ANALYSIS

### A) Need for Oyster Shell Recycling

Oyster reefs are a vital component of a healthy estuary and provide a unique suite of benefits as both a fishery and habitat for other aquatic species. They filter contaminants from the water, protect shorelines, stabilize sediment, and provide food and shelter for over 300 different species (Grabowski and Peterson, 2007). Unfortunately, oyster reefs are the most threatened marine habitat worldwide. Studies show that over 85 percent of oyster habitat has been lost on a global scale (Beck et al, 2011). In Galveston Bay, over 50 percent of the oyster reefs have been destroyed, primarily due to decades of heavy exploitation coupled with multiple storm events such as Hurricanes Ike (Hons and Robinson, 2010) and Harvey. Prior to 2008, Galveston Bay yielded nearly 90 percent of the oyster production in Texas (VanderKooy, 2012; Haby et al, 2009). Although the wild larvae supply in Galveston Bay is abundant, the removal of shells from the bay, due to storm-driven sedimentation and unsustainable harvesting, has led to a shortage of hard substrate, a key component for sustaining oyster populations. Furthermore, the last four years (2015-2019) of heavy rainfall events have led to extremely low salinity levels that have reduced oyster spawning success.

Hard substrate or “cultch” material, is required for successful oyster development. While oyster larvae can attach to many surfaces such as rock, wood, and porcelain, oyster shells are the preferred substrate for larval attachment and growth (Coen and Luckenbach, 2000; George et al, 2014). Over the last five to 10 years, it has become increasingly difficult and expensive to purchase oyster shells. In addition, the purchase of rock cultch, typically limestone, concrete, or river rock, is expensive and often a limiting factor in the size and scope of a reef restoration project. Therefore, sourcing oyster shells from local seafood restaurants or other end users, such as shucking houses, has become the common approach to securing cultch material for the restoration of oyster habitat. Without an oyster shell recycling program, restaurants will continue to discard oyster shells into their dumpsters and the shells will be lost to landfills, thus squandering a valuable resource.

### B) History of the Galveston Bay Foundation’s Oyster Shell Recycling Program

In response to the decline of Eastern oyster (*Crassostrea virginica*) habitat in Galveston Bay, the Galveston Bay Foundation (GBF) initiated an Oyster Shell Recycling Program (Program) in 2011. The Program was piloted through a partnership with local restaurant owner Mr. Tom Tollett of Tommy’s Restaurant and Oyster Bar. GBF began recycling the restaurant’s shucked oyster shells in 2011 to avoid the disposal of this important cultch material. Throughout the last eight years of shell recycling, GBF has expanded its operations through new restaurant partnerships and now collects an average of 100 tons (200,000 pounds) of shells a year. Since the inception of the Program and as of the date of this publication, GBF has collected over 970 tons (1,940,000 pounds) of oyster shell and returned approximately 500 tons of these recycled shells to Galveston Bay to help replenish hard substrate in the bay and sustain the local oyster population.

GBF initiated the Oyster Shell Recycling Program with one restaurant in the Clear Lake area of Houston, Texas, and one shell storage site located in Texas City, Texas. With grant funding from the Texas General Land Office Coastal Management Program (CMP) and US Fish and Wildlife Service (USFWS) Coastal Program, donations from private foundations and corporations, and technical assistance from the Texas Parks and Wildlife Department (TPWD), the Program has progressed through the Pilot and Expansion

Phases, resulting in 12 restaurant partnerships and four shell storage sites over the last eight years. Within the first two years of operations, the amount of shells recycled annually increased by 200 percent. Since that time, GBF has streamlined the shell recycling operations by establishing a regular shell collection schedule, purchasing new and larger equipment for hauling shells, and developing long-lasting relationships with restaurant partners.

In early 2018, GBF completed the first Expansion Phase of the program by expanding shell recycling operations to Galveston Island through a partnership with Texas A&M University at Galveston (TAMUG). The beginning of 2019 marked the start of the Evaluation Phase. During the Evaluation Phase, GBF will determine if an alternative approach to shell recycling should be pursued and if an expansion into downtown Houston is feasible. GBF hopes to provide shell recycling services to restaurants in downtown Houston by the end of 2020 and launch the inaugural Houston Oyster Festival in April of 2020.

**Table 1: Phases of the Galveston Bay Foundation’s Oyster Shell Recycling Program**

Program Phase	Timeframe	Shells Recycled	Restaurant Partners	Phase Description
Pilot Phase	2011	17 tons	1	<ul style="list-style-type: none"> <li>Secured first restaurant partner: Tommy’s Restaurant &amp; Oyster Bar</li> <li>Secured first curing site: GBF’s Texas City Preserve</li> </ul>
	2012	54 tons		<ul style="list-style-type: none"> <li>Increased tonnage of shells recycled annually by over 200%</li> </ul>
Expansion Phase	2013	75 tons	7	<ul style="list-style-type: none"> <li>Increased tonnage of shells recycled annually by 39%</li> <li>Secured 6 new restaurant partners</li> <li>Added new curing site: Port of Houston Authority Lease (aka Red Bluff) valued at \$33,534.00/year</li> <li>Purchased a shell recycling truck and trailer</li> </ul>
	2014	107 tons	7	<ul style="list-style-type: none"> <li>Increased tonnage of shells recycled annually by 43%</li> </ul>
	2015	131 tons	7	<ul style="list-style-type: none"> <li>Increased tonnage of shells recycled annually by 22%</li> </ul>
	2016	168 tons	8	<ul style="list-style-type: none"> <li>Increased tonnage of shells recycled annually by 29%</li> <li>Secured 2 new restaurant partners</li> <li>Purchased a new shell recycling trailer</li> </ul>
	2017	188 tons	6	<ul style="list-style-type: none"> <li>Increased tonnage of shells recycled annually by 12%</li> </ul>
	2018	128 tons	7	<ul style="list-style-type: none"> <li>Expanded to Galveston Island via partnership with TAMUG</li> <li>Decrease in shells recycled due to repercussions of Hurricane Harvey</li> </ul>
Evaluation Phase	2019	970 tons as of 9/30/2019	8	<p><b>Proposed Plans:</b></p> <ul style="list-style-type: none"> <li>Create a Strategic Development Plan (SDP)</li> <li>Develop a volunteer reef monitoring program</li> <li>Launch an outreach campaign</li> </ul>

## C) Current Program Status

### ***Main Recycling Route***

At this time, GBF provides oyster shell recycling services free of charge to participating restaurants. Each restaurant is provided with an appropriate number of recycling receptacles (32-gallon bins and/or 5-gallon buckets) depending on their weekly output of shucked shells. GBF staff follow a collection schedule of Monday, Wednesday, Friday, established in 2015, to maintain consistent and predictable collection times. Regular shell collection also prevents overflow of shells in the receptacles at restaurants. Restaurants producing greater than one ton of oyster shells per month are provided with two or more collections per week. Restaurant partners with less output, or those located further from the Foundation's office, receive collection services once a week. Please refer to Appendix A for a map of the current restaurant partners and Appendix C for maps of GBF staff's "main" recycling route.

The baseline cost for GBF's current shell collection operations along the main route averages \$1,300.00 per month. This includes basic travel (approximately 170 miles per week) and personnel (15 to 20 hours per week) expenses to conduct shell collections three times a week. This cost does not include program management, restaurant coordination, staff oversight, grant administration, outreach development, supplies, or equipment maintenance.

GBF's main recycling route is located in the Clear Lake area, the region southeast of Houston and northwest of Galveston. Along this route, one GBF staff member conducts the weekly shell collections, also called "shell runs." This individual holds the title of Shell Recycling Assistant and is currently part-time, working approximately five hours per shell run, thus 15 hours per week. This job is incredibly labor intensive and requires driving and trailering skills as well as the ability to manually pull up to 200 pounds up the trailer gate. In 2013, GBF purchased a half-ton Toyota Tundra and a 12-foot landscape trailer (upgraded in 2016) with federal funds and corporate donations to facilitate the collection of oyster shells in larger quantities. The Shell Recycling Assistant wheels the 32-gallon recycling bins onto the landscape trailer at each restaurant during a shell run. Full bins are swapped out with empty bins at each restaurant so the restaurant staff can continue recycling shells until the next collection day.

The Shell Recycling Assistant hauls each restaurant's shells via truck and trailer to one of two storage sites (aka "curing sites") where the shells are stored temporarily on land. GBF currently has access to two curing sites near the main route known as: Red Bluff and Texas City (see maps in Appendix B). As shells accumulate at the curing sites, GBF staff and volunteers strategically pile the shells using a front-end loader, often provided and operated by a volunteer. The turning of the shell occurs every three to four months. The shells are then left to sun-cure or sun "bleach" for a minimum of six months per TPWD requirements. As identified by Bushek et al. (2004), sun curing oyster shells for a minimum of one month ensures that all bacteria and parasites are eliminated. The majority of the shells recycled by GBF remain on land for a minimum of six months to one year due to the lag time between collection and transport to a restoration site. Therefore, all shells returned to Galveston Bay by GBF are thoroughly sun cured. Following the curing process, the shells are ready to be used in oyster reef restoration and enhancement projects throughout Galveston Bay.

## ***Galveston Recycling Route***

In January 2018, GBF began recycling oyster shells on Galveston Island through a partnership with TAMUG. Due to the distance from the GBF office in the Clear Lake area of Houston to Galveston (over 30 miles to simply reach the Island), recycling on the Island was not financially feasible if conducted solely by GBF staff. However, the partnership with TAMUG resulted in an in-kind donation of labor, travel, equipment and a new curing site. Students employed by Sea Camp at TAMUG are paid by the university to collect recycled oyster shells on the Island using a TAMUG-issued truck. Due to the lower volume of shells produced by the current restaurant partner on the Island, BLVD Seafood, a trailer is not required at this time. Instead, BLVD Seafood utilizes five-gallon buckets to collect their shucked shells in house. The buckets of shell are transferred by TAMUG staff into 14-gallon recycling tubs in the bed of the truck. These shells are transported to a curing site located adjacent to the TAMUG campus on Pelican Island within the “Wetland Center” property. Please refer to Appendix D for pictures of the recycling operations on Galveston Island and Appendix C for a map of the Galveston Island (TAMUG) recycling route.

## ***Documentation***

To track the amount of oyster shells recycled, GBF staff maintain Microsoft Excel spreadsheets in which the tonnage of oyster shells collected monthly and annually is recorded for each participating restaurant. To improve the accuracy of shell tonnage documentation, GBF staff conduct quality control measures every three to five years to confirm the average weight of recycled oyster shells in each 32-gallon recycling bin as well as the weight of shells in each five-gallon recycling bucket. In 2016, it was determined that each 32-gallon bin holds approximately 192 pounds of shells while each five-gallon bucket holds approximately 23 pounds of shell. The 14-gallon tubs used by TAMUG hold approximately 70 pounds of recycled shell. It is estimated that the average weight of shells per bin, bucket, and tub are subject to a variance of five percent due to potential human error in estimating the volume and weight of shells, the uneven settling of shells, added water from rain and/or ice, as well as other materials/waste often mixed in with the shells.

### **C.1) Program Goals**

The goal of GBF’s Oyster Shell Recycling Program is to increase the amount of hard substrate, or cultch material, in Galveston Bay to facilitate the successful recruitment of oyster larvae and thus promote a sustainable Eastern oyster population in the Galveston Bay estuary. Without hard substrate on which to attach, oyster larvae have a low survival rate. By encouraging restaurants to recycle their shells, GBF aims to reduce the amount of shells sent to landfills and increase the amount of shells returned to the bay.

In order to achieve these goals, the general public as well as state regulatory agencies and the commercial industry must understand the importance of oyster reefs in Galveston Bay. Through educational programs and outreach efforts, GBF aims to promote the need for shell recycling and reef restoration. Hands-on reef construction and oyster gardening activities directly engage community volunteers in reef restoration. Through these outreach efforts, GBF hopes to secure additional restaurant partnerships, dedicated volunteers, and new sponsorships to sustain the Program beyond current federal funding sources.



Throughout 2019 and early 2020, GBF plans to assess the current status and future potential of the Oyster Shell Recycling Program, as demonstrated by this Strategic Development Plan. After completing the Evaluation Phase, GBF hopes to achieve the following goals:

- 1) Secure one reef restoration project every two to three years
- 2) Continue annual oyster gardening efforts in at least four communities
- 3) Establish a volunteer-based reef monitoring program
- 4) Reinstate the Galveston Bay Oyster Workgroup

The ultimate success of the Program will be demonstrated by GBF's ability to provide recycling services for the majority, if not all, of the Houston-Galveston region. Likewise, by expanding shell recycling efforts to the entire region, GBF aims to have enough oyster shells "in stock" to allow for ongoing gardening efforts as well as reef creation for years to come.

### C.2) Current Values & Incentives

Due to current funding availability as well as the operational structure of GBF's Oyster Shell Recycling Program, the Foundation provides an entirely free service to restaurant partners. Restaurants are provided with recycling receptacles and weekly collection of their shells, all at no cost. Depending on the number of oyster menu items sold, and thus the amount of shells recycled, a single restaurant can reduce its annual waste production by at least 75 tons (150,000 pounds) per year, as demonstrated by Tommy's Restaurant and Oyster Bar as well as Tookie's Seafood in 2017.

Based on phone interviews with local waste hauling services, it is estimated that weekly collection by a waste vendor such as Republic Waste Services or Waste Management may cost a restaurant anywhere from \$150.00 up to \$800.00 per week depending upon the size of the restaurant's dumpster (typically six or eight yards), frequency of pickups per week (one to three times per week), and the location of the restaurant. Please refer to Appendix G for further details on waste hauling costs. By recycling oyster shells, restaurants can reduce the volume of waste placed in their dumpsters and therefore reduce the number of pickups required per week from waste vendors. It is estimated that a single restaurant would need to recycle a minimum of six bins, equivalent to 1,152 pounds of shells, per week to see a significant cost savings in their waste hauling expenses. Three of GBF's restaurant partners have exceeded this amount on a weekly basis: Tommy's Restaurant and Oyster Bar, Tookie's Seafood, and Topwater Grill. Unfortunately, most of GBF's restaurant partners have not observed a significant cost savings. However, they are making an impact by redirecting oyster shells from landfills to oyster reef restoration through participation in this Program.

Restaurant partners also benefit from the value of the oyster shells donated to GBF for reef restoration. Purchasing shell is nearly impossible since most commercial oyster companies return their shucked oyster shells to private and/or publicly harvestable reefs in Galveston Bay per TPWD requirements. After speaking with multiple commercial companies as well as TPWD, GBF only received one quote for oyster shell from Alby's Seafood, a wholesale seafood supplier and producer located in Rockport, Texas. Alby's sells shucked oyster shells for approximately \$35.00 per cubic yard; however, this price may increase or decrease depending upon availability and demand. According to a report prepared by Dr. Jennifer Pollack in 2011, one cubic yard of oyster shell was valued at \$25.00 (Pollack et al, 2011). Based on an average of these values, GBF can provide each restaurant partner with an in-kind donation form at the end of the year. The donation captures the volume of shell recycled at an average value of \$30.00 per cubic yard. This form allows restaurant partners to receive a return on their investment in the form of a tax deduction.

For instance, Tookie’s Seafood recycled 75 tons (150,000 pounds), equivalent to 128 cubic yards of shell in 2017. Therefore, the restaurant had the opportunity to deduct the value of this shell, estimated at \$3,840.00 from their 2017 taxes. Please refer to Appendix G for a copy of GBF’s in-kind donation form. Table 2 illustrates the variety of cost savings and benefits restaurants can receive by participating in GBF’s Oyster Shell Recycling Program.

**Table 2: Cost Saving Estimates for Restaurant Partners**

<b>Cost Saving Method</b>	<b>Annual Expense for GBF</b>	<b>Benefit for Restaurant</b>
<b>Collection Receptacles</b>		
32-gallon Recycling Bins	\$709.80/year \$70.98/bin 10 bins purchased per year	<b>FREE</b> Save \$709.80± per year depending upon the number of bins required.
14-gallon Recycling Tubs	\$54.90/year \$10.98/tub 5 tubs purchased per year	<b>FREE</b> Save \$54.90± per year depending upon the number of tubs required.
5-gallon Recycling Buckets	\$101.00/year \$5.05/bucket 20 buckets purchased per year	<b>FREE</b> Save \$101.00± per year depending upon the number of buckets required.
<b>Recycling Service</b>		
Truck	Mileage ~ \$5,200.00/year <ul style="list-style-type: none"> <li>• Average 8,900 miles/year</li> <li>• 2019 mileage rate = \$0.58/mi</li> </ul> Maintenance ~ \$800.00/year	<b>FREE</b> Save \$19,800±/year
Trailer	Maintenance ~ \$200.00/year	
Labor	Part-Time Staff ~ \$13,600.00/year <ul style="list-style-type: none"> <li>• 15-20 hours/week at \$15/hour</li> <li>• 3 collection days/week</li> </ul>	
<b>Waste Hauling</b>		
Vendor Expense	NA	Reduction of visits per week by waste hauling vendor  Annual savings of \$3,250.00± based on a minimum of 6 bins recycled/week
<b>Shell Donation (tax write-off)</b>		
Tax Deduction	NA	Annual savings of \$30.00 per cubic yard of shells recycled
<b>Outreach Materials</b>		
Labor & Marketing	Coasters: \$220/100 Rack Cards: \$175/100 Check Presenter Insert: \$60/100	<b>FREE</b> Provides “green image” for restaurants and enhances appeal to customers.

A less tangible benefit restaurant partners receive via oyster shell recycling is a “green” or “eco-friendly” image projected to their patrons. Not only will this draw in a new customer base, it also allows restaurants to explore new marketing tactics. GBF currently provides marketing opportunities for restaurants through free outreach materials and media exposure. In the past, GBF only provided restaurants with informational brochures, aka “rack cards,” and coasters. Due to a lack of interest in the brochures, GBF created a variety of infographic-style materials such as table tents, inserts for check presenters, window clings and other options which are presented to new and current partners in an outreach packet as shown in Appendix G. Restaurants are provided with the opportunity to review, select, and implement one or more of these outreach items. The goal of the new outreach packet is to help clarify the message of the Oyster Shell Recycling Program and involve restaurants in the decision-making process. Restaurants are also promoted on GBF’s website and highlighted in social media posts, thus bringing in new clientele for their businesses. GBF works with restaurants one-on-one to determine the best avenue for delivering the message to their patrons. While the media exposure and outreach items are currently free to partners, GBF is exploring the idea of requiring the purchase of at least two outreach items to prove commitment to the Program.

Furthermore, GBF is in the process of initiating a new social media campaign to raise awareness of shell recycling. To do this, table tents will be distributed to current restaurant partners. Each table tent will have information about the Oyster Shell Recycling Program, indicating that the restaurant is a participant. The table tents, and hopefully the servers, will also request patrons to post a picture of their oysters, tag GBF, and “check-in” at the restaurant on Facebook. As a result, both GBF and the restaurant will receive recognition in conjunction with the customers becoming directly engaged and informed.

## **D) Limiting Factors**

Every venture has its obstacles; to determine how to overcome these obstacles, it is crucial to understand the limiting factors. For GBF’s Oyster Shell Recycling Program, four limiting factors have been identified: 1) Funding, 2) Restaurants, 3) Program Capacity, and 4) Public Awareness. GBF staff have worked tirelessly to address each of these issues since the Program’s inception in 2011. However, it is clear the Program needs additional improvement and assessment, hence the initiation of the Evaluation Phase in 2019. By reviewing the reasons for each of these limiting factors, GBF hopes to gain a better understanding of how to move forward and continue to enhance the Program.

### **D.1) Funding**

As a non-profit operation, funding for the Oyster Shell Recycling Program is an ongoing challenge. GBF has received support from private companies such as Cheniere Energy, Aramco Services, ERM Group, and DOW Chemical to name a few. Federal and state grants have also provided financial stability for GBF’s shell recycling operations. These grants include seven cycles of CMP funding (National Oceanic and Atmospheric Administration (NOAA) funds administered by the Texas General Land Office), USFWS Coastal Program funding, as well as TPWD CO-OP funding. In-kind donations in the form of land, labor, and supplies have contributed to the continuation of GBF’s shell recycling efforts as well. A property donation from the Port of Houston Authority has provided GBF with an ideal location for stockpiling the recycled shells since 2013. GBF has full access to this land, referred to as the “Red Bluff Curing Site,” valued at \$33,534.00 per year, for a fee of only \$10.00 per year.

Although GBF has been fortunate to acquire substantial funds for the Program over the last eight years, there is always the possibility that major funding sources will extinguish at some point. Therefore, GBF is in the process of securing multiple sources of “perpetual income” to support at least the baseline operating costs of the Program. For example, GBF recently established a new partnership with Proud Pour, a company that “pairs wines with solutions to local environmental problems” ([www.proudpour.com](http://www.proudpour.com)). For each bottle of wine sold in Texas, GBF receives a percentage of the proceeds. These funds will be continually funneled into the Program as long as the specific wine is sold in Texas. Restaurant partners will also be encouraged to incorporate the wine on their menus (as it becomes available in the region) to further support shell recycling efforts. GBF has a similar partnership with Toadfish Outfitters whose mission is “regenerating the world’s oyster beds through thoughtfully designed eco-friendly products” ([toadfishoutfitters.com](http://toadfishoutfitters.com)). For every Toadfish product sold in Texas, GBF receives a portion of the proceeds. GBF staff are also researching options for restaurants to contribute financially to the Program through an annual or monthly participation or service fee, by providing customers with the option to donate, and/or by hosting an annual oyster charity at each restaurant.

Furthermore, GBF plans to host an annual Houston Oyster Festival starting with the inaugural event in April 2020. All proceeds from the festival will benefit the Oyster Shell Recycling Program and all shells produced by restaurants at the event will be recycled by GBF. It is proposed that this festival could provide the baseline funding required to sustain minimum shell recycling operations (approximately \$1,300.00 per month or \$15,600.00 a year). By securing ongoing/perpetual funding sources such as Proud Pour, Toadfish, restaurant buy-in, and the Houston Oyster Festival, GBF hopes to one day achieve financial stability for the Program and move away from annual funding requests from state and federal partners.

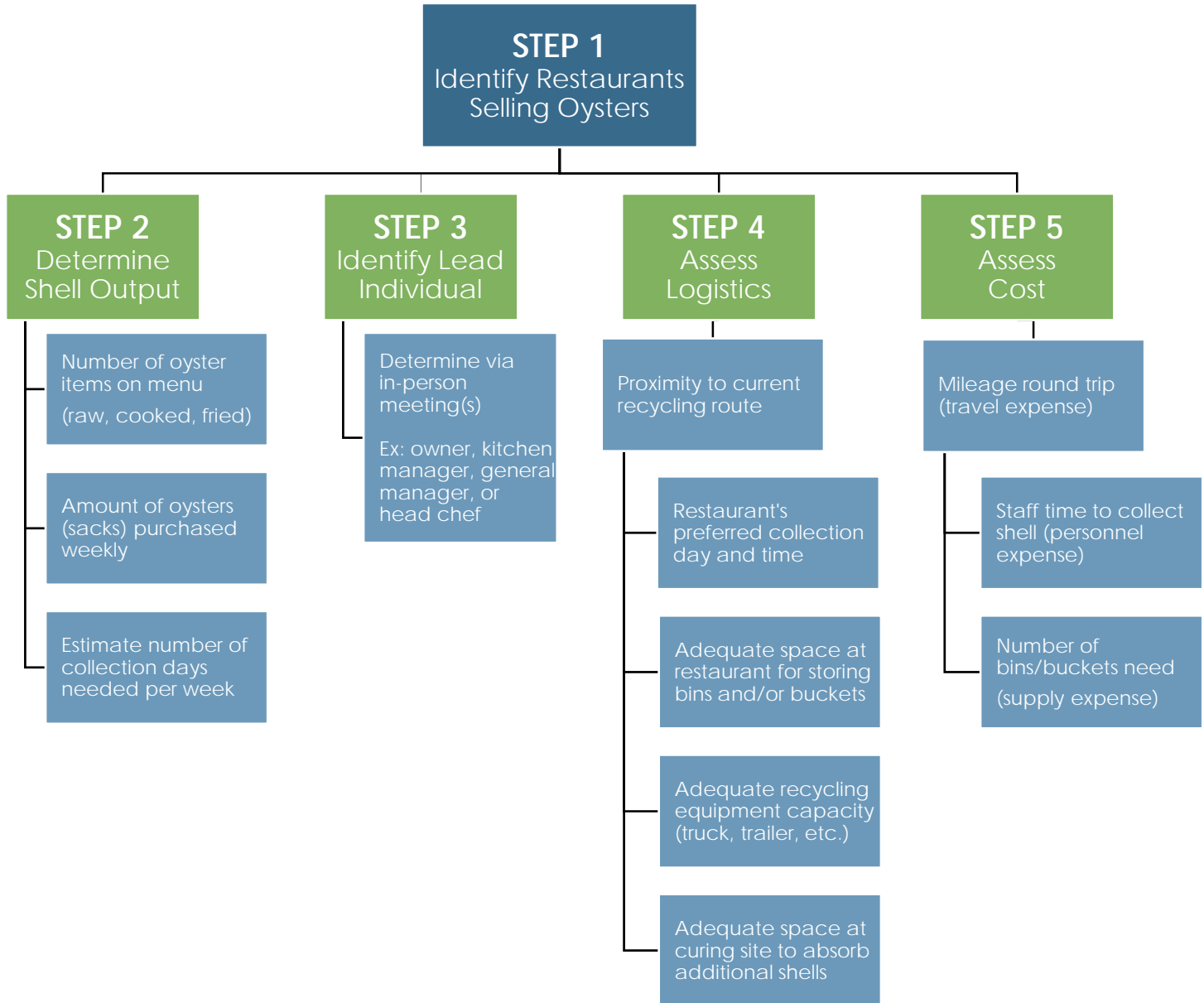
#### D.2) Restaurants

The GBF Oyster Shell Recycling Program was piloted by a single restaurant: Tommy’s Restaurant and Oyster Bar (Tommy’s). As the keystone partner, Tommy’s has consistently participated in GBF’s shell recycling efforts and set the example for new and future partners. After additional funding was secured in 2012 and beyond, GBF began investigating other potential partners. Throughout the past eight years of oyster shell recycling operations, GBF has partnered with 12 different restaurants. Due to changes in restaurant management, menu revisions, and/or lack of participation, four of these restaurants are no longer partners of the Program. Even Tommy’s has faced obstacles and has temporarily stopped selling oysters. For instance, after Hurricane Harvey in 2017, the oyster population in Galveston Bay remained small and undersized for harvest due to limited spawning. Thus, Tommy’s ceased all sales of oysters from mid-June 2018 through September 2018. This is a prime example of the unpredictability of the seafood business. Some restaurant partners have come and gone, but others have been consistent and dedicated partners of the Program, particularly Tookie’s Seafood. Working with such a variety of restaurants has made it clear that dedication to the Program must originate from the management or ownership level for a restaurant to be successful in oyster shell recycling.

As a grant funded program, GBF must be selective when it comes to restaurant partners. In response to challenges and lessons learned over the last eight years, GBF developed a tool, the “Restaurant Selection Criteria” flowchart (Figure 1), to help select new restaurant partners as funding allows. GBF plans to use the selection criteria to assess whether the output of shells from an individual restaurant will be beneficial to the Program. This will also help GBF determine whether the additional mileage, supplies, and personnel costs required to accommodate a new restaurant are justified.

By determining the minimum output of shells necessary for a restaurant to be considered for partnership, GBF can be more strategic in the expansion of the program and provide restaurants with standardized guidelines of what is expected as a partner of the Oyster Shell Recycling Program.

**Figure 1:** Restaurant Selection Criteria



While there are a multitude of seafood restaurants selling oysters in the Houston-Galveston region, only some are viable partners for shell recycling. To track the different restaurants serving oysters, GBF staff maintain a restaurant database (Appendix E). This document is updated annually to include any new restaurants in the region and remove any that have closed. Although the list is extensive, there is a finite number of restaurants serving oysters in the Houston-Galveston region.

As shown in the database, 135 restaurants are currently selling oysters in the Houston-Galveston region. In order to narrow-down potential partners, GBF staff also document how many oyster items, raw versus cooked, are on each restaurant's menu, if available online. This provides an initial idea of the type of oyster sales the restaurant may have on a weekly basis so GBF staff can make a more educated decision on which restaurants to pursue. GBF has observed that restaurants serving multiple oyster items on their menu, not just raw or fried, produce a larger output of shells, thus leading to a more practical shell recycling partnership. Based on the 2019 Restaurant Database, there are 88 restaurants in Houston (this includes the major suburbs of Houston to the west, north, and south), 36 restaurants in the Clear Lake region, and 11 restaurants in Galveston that serve oysters. Of those 135 restaurants, only 40 serve multiple, non-fried, oyster items on the menu. These 40 restaurants are on the top of GBF's list to pursue next as potential partners.

Once a restaurant is recognized as having potential, GBF staff then reach out by phone, email, and/or in person. This initial interaction with a restaurant allows GBF to determine the average number of sacks of oysters purchased weekly and gauge if there is interest as well as a dedicated individual (manager, head chef, owner) at the restaurant who will ensure the Program's success. The number of sacks purchased weekly also helps GBF and the restaurant decide how many collection days will be needed per week. Based on analysis of GBF's current restaurant partners, it was determined that a restaurant that purchases less than 40 sacks of oysters per week will only need shell collection services once a week. Restaurants that purchase 40 or more sacks of oysters per week will likely need at least three collection days. This information is integral to shell collection logistics and verifies whether GBF may incur additional personnel and travel expense by adding on a new partner.

Restaurant location as well as a willingness to cooperate and communicate are key to a successful shell recycling partnership. Many of the restaurants serving a sufficient number of oyster items on their menu are located a far distance from GBF's main recycling route. The current radius of GBF's main route only spans 10 to 15 miles (see Appendix C). Multiple restaurants located in downtown Houston have expressed interest in participating, but GBF simply does not have the funding to accommodate the travel and personnel time required to collect shells that far from the main route. In these situations, GBF may approach the restaurant about financial support and/or participation in the Houston Oyster Festival. Once it is determined a restaurant will be a reliable partner, then GBF addresses the final logistical requirements such as timing of shell collection, location of recycling bins, point of contact at the restaurant, and a start date.

Last but not least, it is vital that a restaurant has a lead individual with serious investment in the Program. This individual is typically the chef, kitchen manager, general manager, or owner. No matter the role of this lead individual, GBF has observed on multiple occasions that having someone at the managerial level who has the authority to make decisions and implement the new shell recycling steps, in addition to understanding the importance of shell recycling, is integral to a successful partnership.

It has also become evident that educating the service staff about the importance of oysters and the Oyster Shell Recycling Program is necessary. When restaurant staff can explain the Program, describe how the restaurant partners with GBF, and discuss the importance of oysters in Galveston Bay, it helps educate the public as well as entice them to purchase additional oyster items from the menu. These additional purchases and in-depth interactions also lead to larger tips for the servers, thus providing even more incentive for the staff to encourage and embrace oyster shell recycling.

Although GBF's oyster shell recycling service is currently free of charge, some restaurants are not fully dedicated to the effort. This is why it is critical to be selective in choosing a recycling partner while operating on a set budget. GBF has observed a lack of cooperation and decline in shell recycling when the owners, managers, or head chefs are not proponents of the Program and not hands-on in implementing shell recycling at their restaurants. Therefore, GBF is considering an annual "participation fee" or "buy-in fee" to ensure each restaurant partner's commitment to the Program, not to mention additional income for the Program.

### D.3) Program Capacity

Before GBF launches a second expansion phase of the Oyster Shell Recycling Program and reaches out to new restaurant partners, the capacity of the Program will need to be taken into consideration. Additional restaurants will require more recycling bins, more hours dedicated by staff, additional mileage resulting in more wear and tear on equipment, and of course more recycled oyster shells. By assessing the program's current capacity, GBF will be able to determine when and if it is feasible to expand and whether new methods, equipment, staff, and/or storage sites are needed.

#### ***Equipment***

Utilizing the half-ton Toyota Tundra and 12-foot landscape trailer currently owned by GBF, staff can haul up to 20 full recycling bins at one time. Each bin is estimated to weigh approximately 192 pounds when full of shell; therefore, 20 full bins is equivalent to approximately 3,840 pounds (1.92 tons) of recycled oyster shell. However, when the bins are collected from the restaurant, they typically contain water from rain and/or ice as well as food scraps in addition to the shells. Therefore, the weight of a single bin can increase to as much as 225 pounds, resulting in 4,500 pounds for a full, 20-bin load. The Tundra's towing capacity is 8,000 pounds and the landscape trailer is rated for a maximum weight of 7,000 pounds. The trailer alone weighs 1,500 pounds. While the Tundra has the ability to tow more than 20 bins on the 1,500-pound trailer, the trailer itself is not long enough to contain additional bins. Furthermore, excess empty bins are stored on the trailer to allow for replacement of full bins at restaurants. This allows GBF to save on mileage costs as staff do not have to make extra trips back to restaurants to return empty bins. However, this means only 12 to 16 full bins can be loaded on the trailer for each trip to a restaurant, resulting in a total of 2,300 to 3,100 pounds of oyster shells per trip. If additional restaurant partners join the Program, GBF will be close to max capacity of the trailer in terms of space rather than weight.

The shell recycling effort on Galveston Island is currently much smaller than GBF's main route in the Clear Lake region. With only one restaurant partner on the Island, TAMUG staff do not use a trailer, only a pick-up truck. All recycled shell collected on Galveston Island is emptied into 14-gallon recycling tubs in the bed of the TAMUG truck. While this method is effective with the single restaurant partner, BLVD Seafood, the capacity of this method is extremely limited. The truck bed can hold a max of 20, 14-gallon tubs and therefore only 0.70 tons (1,400 pounds) of recycled shell. When/if additional restaurant partners are secured in Galveston, new equipment will likely be needed. It is predicted that TAMUG will adopt the same method currently used along GBF's main recycling route: truck and landscape trailer with rolling 32-gallon recycling bins.

## ***Staff***

GBF currently employs one part-time staff member, the Shell Recycling Assistant, who collects the recycled shells from restaurants three times a week. GBF's Habitat Restoration Coordinator oversees shell recycling operations and occasionally conducts shell pick-ups when the part-time Shell Recycling Assistant is unavailable. Part-time staff are limited to a total of 30 hours per week. In the past, GBF employed two part-time Shell Recycling Assistants to accommodate varying schedules. This may be required again as new restaurant partners are added to the route and the time per collection day increases.

An alternative approach may be the promotion of GBF's current part-time staff member to full-time status, if funding allows. This internal promotion would involve less training and oversight by the Habitat Restoration Coordinator as well. Furthermore, as the Program expands into Houston, necessary staff time to perform shell collections may increase as new restaurants are added. As a result, additional part-time staff may be required.

At this time, GBF services seven restaurants along the main route in the Clear Lake region. It has been determined that adding more restaurants along the current, main route is feasible. However, the number of restaurants added will depend upon their output of shell and whether they require a significant number of bins to be emptied every week. Based on the restaurant database, it appears at least three to five restaurants along the main route are eligible to receive shell recycling services and would not drastically change the current recycling route.

TAMUG currently employs one student worker from the Sea Camp program to perform shell collections in Galveston. Sea Camp is a long-running program supported by TAMUG. Thus, the flow of available student workers via Sea Camp is consistent and dependable. As student workers graduate or have schedule changes, it is likely another Sea Camp employee will be able to fill their shell recycling role. Although the shell collection method utilized in Galveston is different than the one used along the main route, there is still only the need for one shell recycling assistant from TAMUG.

## ***Storage***

As of August 2019, GBF has access to two storage sites (aka curing sites) along the main route where the recycled oyster shells are temporarily stockpiled. Between these two sites, approximately 0.36-acre (15,690 square feet) is available for the storage of recycled shells. In addition, the TAMUG storage site provides 0.08-acre (3,655 square feet) of shell storage on Galveston Island. Table 3 shows the amount of space and equivalent shell storage available at each active curing site. Based on these measurements, it is estimated that GBF can currently store a total of 2,700 tons (4,600 cubic yards) of recycled oyster shells. As new restaurant partners are secured, additional shells will be recycled and stockpiled at the curing sites. If GBF recycles more than 2,700 tons over a period of two to three years, it is likely an additional curing site will be required. Furthermore, as GBF expands into Houston, it would be helpful to secure a new curing site in closer proximity to the new restaurants to reduce mileage and travel expenses.



Based on past curing site maintenance, GBF staff estimate that the newly recycled shells need to be piled by a tractor/front-end loader every three to four months. This allows the shells to be fully exposed to the sun and rain. Piling the shell frequently also creates more room onsite for additional shell storage. Each pile of shell can be stacked up to approximately 10 feet in height, depending upon the size of the tractor. It is recommended that the piles are placed a minimum of 10 feet apart to prevent contamination of cured shells and to allow for designation of each separate pile. Appendix B contains location maps of all active curing sites.

**Table 3: Current Curing Site Capacity**

Curing Site	Space Available	Average Pile Height	Estimated Shell Volume	Estimated Shell Tonnage
<b>Newly Recycled Shell</b>				
Red Bluff	6,200 ft <sup>2</sup>	~ 2 ft	459 CY	270 tons
TX City	1,200 ft <sup>2</sup>		89 CY	52 tons
TAMUG	1,180 ft <sup>2</sup>		87 CY	51 tons
<b>TOTALS</b>	<b>8,580 ft<sup>2</sup></b>		<b>636 CY</b>	<b>373 tons</b>
<b>Cured and/or Curing Shell</b>				
Red Bluff	4,570 ft <sup>2</sup>	~ 10 ft	1,693 CY	994 tons
TX City	3,720 ft <sup>2</sup>		1,378 CY	809 tons
TAMUG	2,475 ft <sup>2</sup>		917 CY	539 tons
<b>TOTALS</b>	<b>10,765 ft<sup>2</sup></b>		<b>3,987 CY</b>	<b>2,342 tons</b>
<b>ALL Shell</b>				
Red Bluff	10,770 ft <sup>2</sup>	NA	2,152 CY	1,264 tons
TX City	4,920 ft <sup>2</sup>		1,467 CY	862 tons
TAMUG	3,655 ft <sup>2</sup>		1,004 CY	590 tons
<b>TOTALS</b>	<b>19,345 ft<sup>2</sup></b>		<b>4,623 CY</b>	<b>2,716 tons</b>

*Texas City Storage Site:*

The original curing site, GBF’s privately owned Texas City Preserve, has been utilized for shell storage since the Program began in 2011. The Texas City site is approximately 0.11 acres and has the capacity to store a total of 860± tons of recycled shell. This property is also made accessible to the public, and the shell storage site doubles as a parking lot. However, the maintenance and promotion of the hiking trail at the Texas City Preserve has been non-existent over the last eight years, and the Oyster Shell Recycling Program has been allowed to utilize the entire parking area for shell storage.

To improve the storage of shell at the Texas City site, two separate scout groups have helped build a “cement pad” on the northernmost section of the site. The first scout group constructed the initial section of the cement pad in 2011, and a second scout group expanded the pad in 2016, resulting in a 20-foot by 40-foot cement pad. The cement base provides an ideal location for piling shell, not only to separate the curing shell from the uncured pile, but also to easily facilitate shoveling and other operations to prepare shell for future restoration projects. This site has provided an excellent location, away from residential areas, for storing newly recycled shell. However, GBF does not maintain ownership of the access road. This road is managed by another company that rarely maintains the gravel road which is now in disrepair due to multiple years of heavy rainfall. In addition, GBF leased the property to a cattle operation to help maintain the prairie habitat. As such, the cattle often wander into the shell storage site and leave their excrement on the shell; not an ideal situation for curing the shell. Thus, GBF and the cattle rancher are in the process of fencing off the entire shell storage area to resolve this issue.

#### *Red Bluff Storage Site:*

Thanks to a donation by the Port of Houston Authority (PHA), an additional curing site, Red Bluff, was secured in 2013. The PHA leases 1.5-acres to GBF for a fee of \$10.00 per year, although the property is valued at \$33,534.00 per year. Therefore, GBF has been able to utilize the value of this property as match for federal CMP grants. The Red Bluff Curing Site has been essential to GBF’s success, not only due to the match value, but also due to the central location of the property in relation to the main recycling route. This curing site allows for the storage of approximately 1,260± tons of recycled shell. While this site has been invaluable to the Program, it also has its share of disadvantages. As an undeveloped property, the dirt/gravel road and shell storage area experience flooding and drainage issues during times of inclement weather. GBF often delays use of the property during heavy rains to prevent significant road damage by the truck and trailer. This also delays transporting shell offsite to the Foundation’s restoration project sites. GBF has received donations to help with road repairs, but additional upgrades are still needed to ensure everyday access.

#### *Inland Marine Storage Site:*

GBF temporarily stored shell at partner’s construction yard, Inland Marine Services, LLC, from June 2016 through September 2018. Approximately 210 tons of recycled oyster shells were sun cured at this site and later placed in Dickinson Bay to create 0.25 acres of new oyster habitat. The Inland Marine Curing Site is no longer available due to lack of space on the property resulting from new regulations enforced by the City of Texas City on the landowner. GBF now only has access to two curing sites along the main route.

#### *TAMUG Storage Site:*

TAMUG allows the Foundation to store all shell recycled on Galveston Island at the Wetland Center, a facility located directly across from the TAMUG campus on Pelican Island. The shell is currently stored in a small parking area near the single building on the Wetlands Center property. While this storage site is small, approximately 3,700± square feet, it is more than sufficient for the amount of shell being collected at this time. There is a possibility of expanding the shell storage site further into the Wetlands Center property if/when the Galveston recycling operations expand.

#### D.4) Public Awareness

A key component of GBF's mission is to enhance the knowledge of local citizens so they may become stewards of Galveston Bay with an understanding of the benefits a healthy bay system provides to the entire Houston-Galveston region. Ongoing outreach efforts through the Oyster Shell Recycling Program specifically aim to educate the public on the importance of oysters in Galveston Bay. GBF staff have employed a variety of outreach efforts such as: boothing at public events, education of volunteer oyster gardeners and volunteers participating in reef construction, distribution of informational handouts, distribution of coasters to restaurant partners, and a webpage hosted on the GBF website ([www.galvbay.org/oysters](http://www.galvbay.org/oysters)). Unfortunately, there is still a huge gap in public knowledge when it comes to the importance of oyster reefs as well as the actions GBF is taking to restore this essential habitat.

Oyster shell recycling is a relatively new concept, particularly in the Gulf Coast states. The East Coast benefits from a widespread knowledge of oysters as the consumption of oysters is more engrained in East Coast culture. Texas on the other hand, is well-known for barbeque and crawfish but not oysters. Yet, Texas maintains a productive oyster industry, and Galveston Bay alone was once responsible for nearly 90 percent of the oyster harvest in the State (Haby et al, 2009). With such strenuous fishing pressure placed on the local oyster population, there is even more reason to return oyster habitat back to the Bay, not only to support the commercial industry but also to sustain the native reefs as they are the backbone of the Bay.

Knowledge of oyster shell recycling in Texas has slowly grown as both GBF's Program and "Sink your Shucks," a shell recycling program based in Corpus Christi, Texas, have proven their success over the last eight to 10 years. For GBF, the first challenge is to increase the public's awareness of Galveston Bay alone. Many of the citizens in the Houston-Galveston region are not aware that such an important estuary exists adjacent to the Houston metroplex; instead, their focus is on the Gulf of Mexico. GBF's advocacy efforts diligently work to enhance the public's knowledge of the Bay; one way is through the newly created Galveston Bay Report Card ([www.galvbaygrade.org](http://www.galvbaygrade.org)). A component of the Bay's grade, found in the Report Card, is based on oyster reefs and other shellfish habitat. Unfortunately, there is insufficient data to come to any solid conclusions about the health of Galveston Bay oysters. This reflects the issue of funding, particularly in regard to funds for monitoring reef restoration projects conducted by both GBF and the state (TPWD), as well as lack of ongoing research and assessments.

Without widespread knowledge of Galveston Bay oyster reefs or the Oyster Shell Recycling Program, GBF will continue to face challenges in securing new partners and support for the Program. Restaurant partners play a prominent role in the public's education on the matter and still have much potential to grow in this role. GBF is beginning to more actively encourage outreach and education at participating restaurants where shells are recycled. Not only will this spread the word about shell recycling, it will also encourage patrons to return to participating restaurants, therefore benefiting both GBF and their restaurant partners.

The knowledge of the importance of oyster reefs and shell recycling efforts in the Galveston Bay region will continue to be minimal until GBF can expand its operations into downtown Houston where the majority of the population and key decision-makers are located. Additional expansion on Galveston Island will also help the Program gain exposure. In 2019 and 2020, GBF will begin a new outreach campaign, both in person through community presentations and via social media, to inform local communities and natural resource partners of the Foundation's ongoing oyster restoration efforts.

Lastly, GBF plans to re-instate the regional Oyster Workgroup for Galveston Bay by the end of 2019. This Workgroup will bring together professionals around Galveston Bay to help site future reef restoration projects, develop best management practices in terms of construction and monitoring, and provide a forum for connecting partners and leveraging funds to support more effective reef restoration in Galveston Bay.

## STEP 2: EXTERNAL ANALYSIS

### A) Shell Recycling Programs in the U.S.

Although oyster shell recycling is rather new to the Texas coast, many states on the East coast have been shell recycling for some time. It appears the Gulf Coast states are also becoming more inundated with shell recycling and reef restoration efforts, but only within the last five to 10 years. As shown in Appendix H, there are approximately 29 active oyster shell recycling programs in the United States at this time. These programs range from small-scale volunteer, student, or staff-driven like both Texas programs, to large-scale operations in which a recycling vendor is sub-contracted to collect the shells. Large-scale operations can be found in Louisiana and New York as shown in Table 4. By assessing the Foundation's current and potential capacity as well as a variety of different shell recycling techniques, discussed in the four case studies below, GBF hopes to determine the best approach to shell recycling in the Houston-Galveston region.

Table 4: Program Case Studies

State	Start Date	Organization Program Name	Equipment	Labor	Average Cost/Month	Restaurant Partners	Collection Days/Week
LA	2014	Coalition to Restore Coastal Louisiana (CRCL) Oyster Shell Recycling Program	Dump Truck (vendor)	Contract	\$20,000.00	19	5
NY	2014	New York Harbor School Billion Oyster Project	Box Truck (no vendor)	Staff	\$12,000.00	70	5
FL	2010	Choctawhatchee Basin Alliance Oyster Shell Recycling Program	Truck & Trailer	Staff (3)	\$1,5000.00	8	3
TX	2009	TX A&M University Corpus Christi Sink Your Shucks	Truck & Trailer	Students	\$5,000.00	3	5
TX	2011	Galveston Bay Foundation Oyster Shell Recycling Program	Truck & Trailer	Staff (1)	\$1,300.00 <i>Main Route</i>	7	3
	2018		Truck	Students (1)	\$300.00 <i>TAMUG Route</i>	1	2

#### A.1) Case Study 1: Coalition to Restore Coastal Louisiana – “Oyster Shell Recycling Program”

The Coalition to Restore Coastal Louisiana (CRCL) is a fellow member organization of Restore American’s Estuaries (RAE). In 2014, CRCL staff approached GBF about initiating an oyster shell recycling program. Due to a one-time, \$1,000,000.00 donation, CRCL was able to subcontract a recycling vendor, Phoenix Recycling, to collect shell from the organization’s restaurant partners. Initially, the shell recycling service was free of charge to the 25 plus restaurant partners. However, when those funds ran out, CRCL was forced to charge each restaurant for the recycling vendor’s services. As a result, CRCL now works with 19 restaurants who pay \$100.00 per month for each 32-gallon recycling bin they use for shell recycling. In addition to the restaurant fees, CRCL’s Oyster Shell Recycling Program is funded via governmental grants and private donations. In return for their participation in the program, restaurants receive regular promotion from CRCL through their website and social media, as well as invitations to participate in CRCL events to increase advertising and publicity.

Phoenix Recycling collects shell five days a week from CRCL’s restaurant partners. The vendor also provides a temporary storage site for the recycled shell. Each month, CRCL must transport the shell to a curing site located in Buras, Louisiana, 60 miles from downtown New Orleans, where it remains for at least six months before being utilized in reef restoration projects. CRCL commented that the use of a private recycling vendor makes for a hassle-free program, however it is very costly, averaging approximately \$20,000.00 per month, thus necessitating the need for monthly restaurant fees. In addition, the mileage and time required to transport the shell to Buras is another high cost element of the program.

#### A.2) Case Study 2: New York Harbor School – “Billion Oyster Project”

New York Harbor School’s Billion Oyster Project is one of the largest oyster shell recycling programs in the nation, now partnering with over 70 restaurants. These restaurants are located throughout Manhattan and Brooklyn, making logistics rather challenging. In order to avoid traffic and congestion at the restaurants, staff and volunteers drive a box truck to restaurants first thing in the morning to collect 64-gallon bins and 5-gallon buckets full of shucked oyster shells. The shell collection operations are conducted five days a week. Staff and volunteers utilize two box trucks at the same time to facilitate collection from multiple restaurants in one stop. The recycled shell is transported daily to the ExxonMobil Greenspoint Campus located in Brooklyn. Each month, the shell is transported from the Brooklyn site to a property owned by the New York Harbor School on Governor’s Island for longer-term storage and sun curing. New York Harbor School’s recycling services are currently free of charge to restaurants. However, their operational costs are somewhat high, averaging over \$12,000.00 per month. Their program is funded by both governmental grants and private donations. Restaurants receive free advertising and promotions through the program’s website and social media, as well as invitations to participate in organizational events throughout the year.

### A.3) Case Study 3: Choctawhatchee Basin Alliance – “Oyster Shell Recycling Program”

Choctawhatchee Basin Alliance (CBA) operates its Oyster Shell Recycling Program with a combination of full-time and part-time staff as well as their AmeriCorps partners. Three staff collect shell three times a week from 12 restaurant partners using a Ford F350 truck and 14-foot dump trailer donated by Northwest Florida State College. Restaurant partners are provided with 30-gallon recycling bins to fill with shell. CBA staff lift those bins onto the trailer by hand. The recycled shells are then transported back to the CBA Headquarters where shell is stored and cured for minimum of six months. The curing site is located away from the main building, adjacent to a storage building. CBA staff frequently utilize a skid steer to turn the shells for proper sun curing.

Restaurants receive CBA’s recycling service free of charge and are provided recognition through CBA’s website and social media. Operational costs, which average about \$1,500.00 per month, are supported primarily by governmental grants and other private funding sources. The truck and trailer donation made their initial overhead costs low. However, the need for three staff members to manually load bins onto the trailer increases personnel expenses.

CBA is in the process of streamlining their program to improve efficiency, reduce costs, and increase the amount of shell collected. Their staff reached out to GBF in 2019 for advice and consultation on shell recycling methodologies. As a result, GBF had the pleasure of visiting CBA staff and observing their shell recycling operations in person.

### A.4) Case Study 4: TX A&M Corpus Christi – “Sink Your Shucks”

In 2009, the first oyster shell recycling program in Texas was created through a partnership between the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University-Corpus Christi (TAMUCC), the Port of Corpus Christi Authority, and Water Street Seafood Company in Corpus Christi, Texas. Founded by Dr. Jennifer Pollack with TAMUCC, the “Sink Your Shucks” program continues to recycle shells with three restaurant partners and at oyster festivals. Prior to Hurricane Harvey, TAMUCC also collected shell from a local wholesaler, Groomers, who is no longer participating in the program. Since the program is operated entirely by the university, students (some paid and some unpaid) and other university staff are employed to conduct the shell collection activities. Students and staff collect shells from restaurants five days a week using two different methods. The first method is utilized for smaller volumes of shell produced by restaurant partners. In this scenario, students load 30-gallon recycling bins into a dump trailer with the assistance of a tilt lift. The second method is utilized for larger volumes of shell produced. In this scenario the recycled shell is loaded directly into a dump trailer. A three-quarter-ton pickup truck is used to haul both trailers. All recycled shell collected by TAMUCC is transported to a site owned by the Port of Corpus Christi where it is stored for at least six months for proper sun curing.

By employing students and utilizing university-owned equipment (truck and trailer), TAMUCC is able to keep their operating costs down. On average, the program requires approximately \$5,000.00 per month to operate. Like GBF’s Oyster Shell Recycling Program, TAMUCC receives the majority of their funds for Sink You Shucks from CMP grants, indicating the state of Texas is in support of these shell recycling efforts. Furthermore, since the program is operated through Dr. Pollack’s lab, the recycled shell is used not only for reef restoration, but also for valuable research on cultch material and oyster habitat in the Coastal Bend region of Texas.

## B) Key Players and Target Audience

In addition to on-the-ground operations of shell recycling, the key players involved must also be addressed. This audience is typically composed of restaurants, government agencies, individual donors, and the community. By incorporating the interest of these parties and addressing their potential giving ability, a more successful and sustainable oyster shell recycling program can be developed.

### B.1) Restaurants

Restaurants are the key component of any oyster shell recycling program. When initiating a new program or expanding an existing program, GBF has determined it is important to focus on three fundamental elements associated with restaurant partnerships: selection, retention, and incentives.

The focal restaurants targeted for a shell recycling partnership typically include local seafood venues with a variety of oyster items on their menus. Multiple oyster items on the menu indicate a better chance for shell recycling. For instance, only fried oyster items on a menu typically means the restaurant purchases their oysters pre-shucked and will therefore have no shell to contribute.

While most shell recycling services are free, as indicated by the case studies discussed above, recycling shells still requires effort from the restaurant and their staff. This includes additional training to ensure the staff know how and where to recycle shells, space to store the recycling bins and/or buckets, as well as a time commitment from the owner and/or manager(s). If a lead individual from a restaurant is not invested in the process, it is unlikely the partnership will be successful. Therefore, it is imperative to provide incentives for restaurants to participate in shell recycling. The reduction of waste hauling costs is limited and often unnoticed by most restaurants who recycle shell. The tax deduction associated with shell recycling also has a low impact on a restaurant's finances. Thus, it appears the key to engaging restaurants is through new marketing opportunities and more exposure that will recruit new patrons and in return, increase profits.

Over the last eight years, 12 restaurants have participated in GBF's Oyster Shell Recycling Program. Although GBF's Program is free to restaurants, some partners find the additional efforts unmanageable, particularly those without an invested owner or manager. CRCL has also fluctuated in the number of restaurant partners due to new fee requirements. While some restaurants dropped out of CRCL's program when the fee was introduced, the most committed ones remained. As discussed in Step 1 of this document, GBF is beginning to utilize the Restaurant Selection Criteria and Restaurant Database to narrow-down the search for additional partners. This information will help determine which restaurants are the most practical and sustainable partners, in contrast to GBF's past opportunistic approach. By streamlining partner selection methodologies, GBF hopes to stabilize the Program through more consistent participation. Furthermore, by finding new ways to incentivize restaurants, such as participation in the new Houston Oyster Festival and ongoing social media campaigns, GBF hopes to retain more restaurant partners as the Program expands.



## B.2) Texas Parks and Wildlife Department (TPWD)

In the state of Texas, TPWD is responsible for managing the natural, public resources including the oyster fishery. TPWD manages both oyster harvest and trade in coordination with the Texas Department of State Health Services. While economic measures associated with harvest are the one of the primary concerns of the TPWD Commission, the conservation and sustainability of wild oyster populations are also addressed by TPWD. An overview of the Texas oyster regulations implemented by TPWD are included in Appendix I.

Tasked with managing this public resource, TPWD aims to restore and sustain oyster reefs along the entire Texas coast. To support these restoration efforts, the Oyster Shell Recovery and Replacement Program was established. TPWD collects a fee from oyster harvesters for every sack of oysters harvested. Oyster dealers are also required to return 30 percent of their shucked shell back to designated waters or pay a fee to TPWD. These fees allow TPWD to purchase cultch material to be planted on publicly harvestable reefs. TPWD typically uses river rock, limestone, or concrete rather than oyster shell. However, this clutch is sometimes capped with a layer of recycled shell sourced from commercial oyster companies. Oyster shell is rarely, if ever, sold in the state of Texas, except for use in chicken feed, and is therefore difficult to source for restoration efforts. Based on personal communications with TPWD staff, the Oyster Shell Recovery and Replacement Program can support up to 20 to 30 acres of reef restoration a year for the entire Texas coast (Emma Clarkson, TPWD, 2019).

In addition to sustaining publicly harvestable reefs, TPWD also oversees the permitting and management of private leases. Galveston Bay is the only location in the state where private oyster leases, also known as “Certificates of Location,” are permitted. Currently, over 2,000 acres of bay bottom is leased by private companies in Galveston Bay. These private leases are off-limits to other fishermen and the public. Private lease owners pay an initial fee and an annual fee to TPWD and are required to supplement their oyster habitat with cultch material. These individuals can place cultch themselves or they can pay a fee and TPWD will design the project and oversee construction. Most private lease holders invest a significant amount of time and money into their leases to help maintain a sustainable practice.

While the Oyster Shell Recovery and Replacement Program was initiated to help with the “recovery of oyster shell” in an effort “to maintain or enhance public oyster reefs,” the shell utilized for these efforts is primarily sourced from wholesalers and distributors but does not address the shells discarded by restaurants or individuals. Thus, all of the oyster shell leaving Galveston Bay via harvest is not returned through TPWD’s efforts. GBF’s Oyster Shell Recycling Program supplements these efforts but is focused on returning recycled shell to areas off-limits to harvest. With differing goals, collaboration on reef restoration between TPWD and GBF is challenging and often unfeasible.

As demonstrated in this document, GBF is in the process of securing more substantial and long-lasting support to sustain shell recycling operations. Additional support from the state level would benefit not only the Foundation’s efforts but also TPWD’s oyster fishery management goals. Such collaboration would result in a more harmonious approach to sustaining the Galveston Bay oyster population both as a fishery and as a vital ecological component of the estuary.

### B.3) Commercial Industry

Seafood dealers as well as oyster harvesters are some of the largest sources of oyster shell. Many of the commercial operations in Galveston Bay, such as Jeri's Seafood, Misho's Oyster Company, and Prestige Oysters, Inc., conduct harvesting operations, process the wild caught oysters, sell to wholesalers and even handle the distribution of some of their product to local restaurant groups or grocery stores such as HEB and Kroger. Throughout this process, the shell from shucked oysters is typically stockpiled by the harvesters or shucking houses to return to their private leases or to return to public reefs as required by TPWD's 30 percent rule.

Not only are commercial oyster companies the primary source of shell, they're also a potential avenue for reaching new restaurant partners. A partnership with these companies would be advantageous in large-scale reef restoration efforts which utilize the majority, if not all, of GBF's shell stock for one project. Therefore, GBF is in the process of discussing partnership opportunities with these companies in terms of shell recycling as well as general Program support.

Similar to GBF's partnership with TPWD, there is little incentive for commercial oyster companies to assist GBF in reef restoration efforts. GBF's efforts are focused on restoring oyster habitat for preservation purposes, not for harvest. Thus, GBF's oyster reef projects are located in areas off-limits to harvest. It is difficult to promote restoring areas off-limit to harvest when the success of the commercial oyster companies and the livelihood of their employees depends upon a successful oyster fishery. That being said, research has shown that during the first two to three weeks of their life, oyster larvae can be transported via tides and currents to set on a reef habitat different than their origin (Luckenbach et al, 1999). Therefore, it stands to reason that oyster habitat restored by GBF in areas off-limit to harvest may provide larvae to harvestable reefs, thus helping to sustain the Galveston Bay oyster population as a whole and improving future harvests on private leases and public reefs.

GBF is currently serving as a partner on the Galveston Bay Sustainable Oyster Reef Restoration Project with The Nature Conservancy (TNC) and TPWD. Upon completion, this project will provide data on larval transport from a sanctuary reef to harvestable reef(s) in upper Galveston Bay. Having this information documented in Galveston Bay will hopefully encourage the commercial oyster industry to consider a partnership with the Foundation.

### B.4) Local Communities

As discussed in Step 1, community engagement is essential to the success of any oyster shell recycling program. The community includes not only individual citizens but also local restaurants and municipalities. Their support and investment in an oyster shell recycling program can have immense beneficial impacts, particularly as they transform into advocates for the program. Engaging this audience requires a variety of approaches including outreach efforts through public events, as well as at participating restaurants.

Oyster roasts and festivals are not engrained as part of the culture in Texas, especially in the Houston-Galveston region where crawfish boils dominate springtime. Although oyster festivals are slowly becoming more prevalent in Texas, most citizens consume oysters in restaurants. Therefore, the first step in improving public engagement must begin with active restaurant partners. Restaurants can promote the shell recycling program through visual aids in the restaurant itself, such as table tents, information on the menu, or even an insert accompanying the final check. Servers can also be trained to promote shell recycling to patrons, thus promoting oyster sales for the restaurant as well as conservation.

Obtaining exposure in the community can be accomplished via community presentations for local businesses, restoration and funding partners, master naturalist chapters, and a variety of other groups. A wide range of audiences will extend the reach of a shell recycling program and thus educate a larger component of the community. Outreach booths at local events can also accomplish this goal. Visual aids, showing the recycling process and/or an oyster's filtration ability provide a clear message to the audience. In addition, hands-on activities, particularly for children, are an effective method to inciting involvement/interest.

Education is the first step to positive action. By helping the local community understand the importance of oysters, they will be able to make educated decisions on where to eat and how to help. Providing action items for interested citizens is essential in their engagement. Precise recommendations on where to eat oysters, how to volunteer and provide hands-on help, or even how to contribute financially to support shell recycling efforts will provide a clear path forward for truly interested individuals. By tying in the ways oysters affect the lives of local communities, such as helping to clean the water and providing habitat for important recreational fisheries, individuals will be more incentivized to take action.

#### B.5 Restoration Partners

In addition to restaurant partners and the local community, restoration partners must be included in the ongoing activities of any oyster shell recycling program. By informing local resource managers of ongoing shell recycling and reef restoration efforts, opportunities and ideas will arise for collaboration, funding, and future reef restoration projects. For GBF, many of these partners, such as TPWD, Texas Commission on Environmental Quality (TCEQ), Coastal Conservation Association (CCA), and the USFWS Coastal Program, are aware of the existence of the Oyster Shell Recycling Program but have not been engaged in the Foundation's ongoing efforts. Within the next year, GBF plans to initiate a regional Galveston Bay Oyster Workgroup to bring these partners together and brainstorm ways to improve the shell recycling process and reef restoration methodology.

Further collaboration can be accomplished via university partners. GBF is working directly with Texas A&M University at Galveston (TAMUG) and the University of Houston (UH) to conduct monitoring and research on the Foundation's projects that incorporate recycled shell. Not only do these partnerships help guide future restoration efforts, they also provide a new avenue for community engagement. For instance, partners at TAMUG are pursuing a study of the public perception of oyster reefs in Galveston Bay. This study will involve surveying the general public in the Houston-Galveston region to gauge their knowledge of oyster reefs, the status of the Galveston Bay oyster population, as well as GBF's Oyster Shell Recycling Program. The results of this study will help GBF improve outreach strategies and will provide a better understanding of the specific communities lacking awareness.

## STEP 3: PLANNING

### A) Objectives

The purpose of this document is to provide guidance for the improvement and expansion of GBF's Oyster Shell Recycling Program. The Strategic Development Plan may also serve as a framework for other organizations interested in starting a new oyster shell recycling program or in expanding an existing program.

While GBF's ultimate goal is to provide oyster shell recycling services for the majority of the Houston-Galveston region, it is likely not achievable without significant and consistent financial support as well as additional physical assets such as new equipment and a new property for shell curing. It is feasible in the short-term however, to adapt GBF's current shell recycling methods and restaurant partnerships to help ensure a more efficient and effective shell recycling operation.

In planning for expansion, GBF must focus on the feasibility of servicing more restaurants. The feasibility of expansion depends on the program's capacity and associated limiting factors as discussed in Step 1. Approximately 135 restaurant locations serve oysters in the Houston-Galveston region. GBF's analysis of the restaurant database (Appendix E) indicates that 40 of these restaurants stand out as potential partners based on their location and the number and type of oyster items sold. At this time, GBF has the capacity in terms of equipment, staff, and curing site space to accommodate at up to five additional restaurants along the main route in the Clear Lake region. Another three restaurants could be added to the Galveston route, pending their actual shell output. Yet any additions in Houston would not be feasible as of September 2019 due to a lack of staff time, equipment capacity, and associated funding.

In order to reach the goal of stockpiling enough oyster shells to allow for ongoing gardening efforts as well as reef restoration for years to come, an expansion into Houston is required. To achieve this goal, GBF has established the following objectives:

- 1) Streamline data collection via Access Database by December 2019;
- 2) Secure a new curing site in close proximity to downtown Houston by June 2020;
- 3) Host the Inaugural Houston Oyster Festival to recycle additional shell, recruit new partners and patrons, and raise money and awareness by April 2020;
- 4) Secure additional funding to purchase new equipment and pay for additional staff time and travel by November 2020;
- 5) Add at least two new restaurant partners along the main route by December 2020;
- 6) Add at least one new restaurant partner in Galveston by December 2020;
- 7) Begin recycling in Houston with at least three restaurant partners by December 2020;
- 8) Increase annual tonnage of shell recycled annually by ten percent.

## B) Proposed Options

Sufficient funding is the primary deciding factor in terms of program expansion. Therefore, GBF must assess all potential avenues to facilitate the expansion and the costs associated with each option. An assessment of these options will help determine the minimum and maximum financial support required to expand to Houston.

As indicated in Step 1, GBF's current truck and trailer can haul additional shell but space is limited on the trailer. The Red Bluff and Texas City curing sites have sufficient space but are located a long distance from downtown Houston. GBF's current part-time Shell Recycling Assistant is tasked with an incredibly laborious job and any additional manual shell hauling may be a health and safety risk. Thus, GBF must take the following steps to allow for expansion into Houston:

- 1) Secure new equipment that can haul more shell at one time,
- 2) Secure a new curing site located closer to downtown Houston, and
- 3) Advance the part-time Shell Recycling Assistant to full time or hire a second part-time assistant to accommodate additional shell collections in Houston.

These steps would not only reduce travel and personnel expenses associated with the expansion, they would also decrease the physical labor component of the shell collections.

### B.1) Alternative Recycling Methods

The case studies discussed in Step 2 reveal a variety of shell recycling methods. These range from small, grass-roots operations like GBF, to large-scale, vendor-based operations like CRCL. As shown in Table 4, there is an increase in operational costs as the number of restaurant partners increases and consequently the number of collection days increase.

To understand the range of expenses associated with each level of program growth, GBF created Tables 5, 6, and 7 shown below. The baseline shell recycling expenses displayed in Table 5 only include the basic travel and personnel costs associated with weekly shell collection services. These expenses do not include program or staff management, nor do they include ongoing restaurant coordination and outreach efforts. Furthermore, the costs associated with each option outlined in Tables 6 and 7 are estimates based on 2019 quotes and/or online research conducted in 2019. These values are solely for the purpose of initial planning activities and are subject to change.

**Table 5: Baseline Shell Recycling Expenses for Galveston Bay Foundation**

Route	Average Mileage per Week	Monthly Travel Expenses	# of Staff Needed	Hours/Week	Monthly Personnel Expenses	TOTAL Monthly Expenses	TOTAL Annual Expenses
Current Route (Clear Lake Region)	170	\$400.00	1 part-time	15 hrs @ \$15/hr	\$900.00	\$1,300.00	\$15,600.00
Expansion Option A (Clear Lake Region)	200	\$500.00	1 part-time	20 hrs @ \$15/hr	\$1,200.00	\$1,700.00	\$20,400.00
	250	\$600.00	2 part-time	15 hrs @ \$15/hr	\$1,800.00	\$2,400.00	\$28,800.00
Expansion Option B (Downtown Houston)	320+	\$750.00	1 full-time	30+ hrs @ \$18/hr	\$2,160.00	\$2,910.00	\$34,920.00
			2 part-time	20 hrs @ \$15/hr	\$2,400.00	\$3,150.00	\$37,800.00
			1 full-time 1 part-time	20 hrs @ \$18/hr 20 hrs @ \$15/hr	\$2,640.00	\$3,390.00	\$40,680.00

*\*Please note, the hours per week listed above are an estimate based on the current 15 hours per week required to service seven restaurants along the main route. It is proposed that an additional 15 to 20 hours per week will be required to facilitate recycling in downtown Houston.*

**Table 6: Shell Recycling Methodology Options**

Option	Shell Recycling Method	Item	Cost/Item	Total Cost	Capacity
1	Truck & Trailer (current method)	1/2-ton Truck	Already purchased ~\$29,000.00	\$0.00	20 recycling bins 2 tons of shell
		12-ft Landscape Trailer + Modifications	Already purchased ~\$5,500.00		
2	2nd Truck and 2nd Landscape Trailer	1/2-ton Truck	\$30,000.00	\$36,000.00	40 recycling bins 4 tons of shell
		12-ft Landscape Trailer + Modifications	\$6,000.00		
3	1-ton Truck and Dump Trailer	1-ton Truck	\$30,000.00	\$37,500.00	4 tons of shell/load
		Dump Trailer	\$6,500.00		
		Bin Lift	\$1,000.00		
4	1-ton Truck with Dump Insert	1-ton Truck with modifications	\$40,000.00	\$48,000.00	3 tons of shell/load
		Dump Insert	\$7,000.00		
		Bin Lift	\$1,000.00		
5	Box Truck	Box Truck (includes lift gate)	\$40,000.00	\$40,000.00	20 recycling bins 2 tons of shell
6	Dump Truck	Dump Truck (includes bin lift)	\$100,000.00	\$100,000.00	8 tons of shell/load
7	Recycling Vendor	NA (most likely a dump truck will be used)	NA	\$15k to \$20k per month \$180k to \$240k per year	8 tons of shell/load

Table 7: Pros and Cons of Shell Recycling Methodology Options

Option	Shell Recycling Method	Additional Cost for GBF	Pros	Cons
1	Truck & Trailer <i>(current method)</i>	\$0.00	<ol style="list-style-type: none"> <li>1) Operated by GBF Staff</li> <li>2) Minimal maintenance</li> </ol>	<ol style="list-style-type: none"> <li>1) Labor intensive</li> <li>2) Limited to 20 bins on trailer</li> </ol>
2	2nd Truck and 2nd Landscape Trailer	\$26,000.00	<ol style="list-style-type: none"> <li>1) Operated by GBF Staff</li> <li>2) Minimal maintenance</li> <li>3) Increase hauling capacity (facilitate addition of new restaurants)</li> </ol>	<ol style="list-style-type: none"> <li>1) Labor intensive</li> <li>2) Some additional maintenance</li> <li>3) Additional storage required</li> <li>4) Additional registration fees, insurance, etc.</li> </ol>
3	1-ton Truck and Dump Trailer	\$37,500.00	<ol style="list-style-type: none"> <li>1) Operated by GBF Staff</li> <li>2) Less physical labor required</li> <li>3) Increase hauling capacity (facilitate addition of new restaurants)</li> <li>4) Can use equipment to transport shell to restoration sites</li> <li>5) 1-ton truck can be used to haul tractor or other equipment needed for curing site maintenance</li> </ol>	<ol style="list-style-type: none"> <li>1) Additional maintenance</li> <li>2) Additional storage required</li> <li>3) Additional registration fees, insurance, etc.</li> </ol>
4	1-ton Truck with Dump Insert	\$48,000.00	<ol style="list-style-type: none"> <li>1) Operated by GBF Staff</li> <li>2) Less physical labor required</li> <li>3) Increase hauling capacity (facilitate addition of new restaurants)</li> <li>4) Can use equipment to transport shell to restoration sites</li> <li>5) No trailer required (easier access to restaurants)</li> <li>6) 1-ton truck can be used to haul tractor or other equipment needed for curing site maintenance</li> </ol>	<ol style="list-style-type: none"> <li>1) Additional maintenance</li> <li>2) Additional storage may be required</li> <li>3) Additional registration fees, insurance, etc.</li> <li>4) Dump insert may limit use of truck for other activities</li> </ol>
5	Box Truck	\$40,000.00	<ol style="list-style-type: none"> <li>1) Operated by GBF Staff</li> <li>2) Less physical labor required</li> <li>3) Increase hauling capacity (facilitate addition of new restaurants)</li> <li>4) No trailer required (easier access to restaurants)</li> <li>5) Can be used for other GBF Events</li> </ol>	<ol style="list-style-type: none"> <li>1) Additional maintenance</li> <li>2) Additional storage required</li> <li>3) Additional registration fees, insurance, etc.</li> <li>4) Need skilled/trained driver (increased personnel cost)</li> <li>5) Box Truck cannot be used to transport shell to restoration sites</li> </ol>
6	Dump Truck	\$100,000.00	<ol style="list-style-type: none"> <li>1) Most likely operated by GBF Staff</li> <li>2) Less physical labor required</li> <li>3) Increase hauling capacity (facilitate addition of new restaurants)</li> <li>4) No trailer required (easier access to restaurants)</li> <li>5) Can transport shell to restoration sites</li> </ol>	<ol style="list-style-type: none"> <li>1) Additional maintenance</li> <li>2) Additional storage required</li> <li>3) Additional registration fees, insurance, etc.</li> <li>4) CDL required</li> <li>5) Need skilled/trained driver (increased personnel cost)</li> <li>6) <b>EXPENSIVE</b> initial purchase</li> </ol>
7	Recycling Vendor	<p>\$15k to \$20k per month</p> <p>\$180k to \$240k per year</p>	<ol style="list-style-type: none"> <li>1) No physical labor</li> <li>2) Increase hauling capacity (facilitate addition of new restaurants)</li> <li>3) No storage required</li> <li>4) No maintenance costs</li> <li>5) Reduced personnel costs</li> </ol>	<ol style="list-style-type: none"> <li>1) Hands-off Approach</li> <li>2) Vendor will likely not transport shell to restoration sites</li> <li>3) Tonnage of shell recycled will be tracked via 3rd Party</li> <li>4) <b>EXPENSIVE</b></li> </ol>



## B.2) Cost-benefit Analysis

Based on Table 4, GBF's Oyster Shell Recycling Program is one of the least expensive in the nation. While GBF's low operational costs may be indicative of an efficient program, GBF only collects shell from seven restaurant partners along the main route and one partner in Galveston. If GBF wishes to add up to five restaurants along the main route, additional staff and/or equipment will likely be required. Upon expansion to Houston, these needs will increase exponentially.

A thorough analysis of Tables 5 through 7 has led to the conclusion that GBF can move forward with one of four options. These include Option 2, 3, 4, or 5 as described in Tables 6 and 7.

**Option 1** is the current shell recycling method used by GBF. Since the goal is to expand the Program and collect more shell, the Foundation would clearly prefer to expand on this current methodology. However, if the additional funds required to expand to Houston are not secured, GBF may focus on only expanding locally first. Option 1 is sufficient for shell recycling with approximately 10 to 15 restaurants within a 15 to 20 mile radius. This can be accomplished with one part-time staff, dedicating 20 to 30 hours per week strictly to shell collection duties. A second part-time staff could also be hired to accommodate additional shell collections, perhaps on Tuesdays and Thursdays, to offset the current part-time staff's schedule of Monday, Wednesday, Friday. However, many restaurants prefer shell collection on Monday and Friday or have specific time restrictions associated with other deliveries that may make the addition of Tuesday and Thursday collections challenging. Option 1 also serves as a baseline operational structure. In the worst-case scenario, if GBF were to expand operations and funding became scarce or fell through, GBF could downsize to the basic truck, trailer, and recycling bin approach once again.

**Option 2** may be applicable if GBF wishes to increase shell hauling capacity with minimal change to the current operating structure. However, this option would only make sense with an increase in staff. It is proposed that one additional part-time staff could operate the second truck and trailer. With two staff and two trucks and trailers, restaurants along two separate routes (main and Houston) could receive shell collections on the same day. As noted in Step 1, GBF has found that most restaurants prefer shell collections on Mondays and Fridays to accommodate the larger volumes of shell recycled during the weekend.

While this option would allow for expansion into Houston, the personnel and travel expenses would double, and the physical labor component of the process would not decrease (staff would still haul bins onto trailer and physically dump them at the curing site). The initial purchase of the second truck and trailer would be more feasible in comparison to Options 6 and 7. GBF was successful at securing funds to purchase the current half-ton truck and landscape trailer, thus it seems reasonable to assume the Foundation has the ability to acquire that amount of money once again.

**Option 3** would allow GBF to easily haul and dump loose shell at restoration sites, thus eliminating the cost of hiring dump trucks and drivers to transport the shell. The dump trailer could also be used to collect shell from restaurants, although a bin lift would be required. The dump trailer could haul up to four tons of shell at one time, doubling GBF's current equipment capacity. Similar to Option 2, if another truck was purchased, two staff could conduct shell collections along different routes at the same, and therefore facilitate the expansion into Houston. It is proposed that a 1-ton truck be purchased to provide a larger towing capacity. For instance, the 1-ton truck would be able to tow the tractor needed to pile shell at curing sites. The dump trailer could also haul equipment such as a skid steer (if rented or purchased in the future) which is ideal for piling and loading shell at the curing sites.

While a dump trailer would be more expensive than a landscape trailer, it would reduce the physical labor associated with shell collection and reduce costs associated with shell transports to restoration sites. However, it is likely the maintenance costs associated with the dump trailer would be higher than a landscape trailer due to the hydraulics and other mechanisms required for the dump feature and the bin lift. The maintenance costs associated with the 1-ton truck would likely be higher as well as, due to the need for a diesel engine and tandem axle.

**Option 4** appears to be one of the most feasible approaches for GBF at this time. The modified 1-ton truck with a dump insert would reduce the physical labor associated with shell collections and allow for larger volumes of shell to be collected at one time (up to approximately three tons per load). Expanding to Houston will require shell collections in crowded neighborhoods and commercial districts. While it could be accomplished via truck and trailer, the lack of a trailer would make accessing restaurants in downtown much easier.

A single staff member could handle all of the shell collections with this equipment, but time may be the limiting factor upon expanding to Houston. Thus, a second staff member would allow for simultaneous collections in Houston (using the dump insert) and in the Clear Lake region (using the current truck and trailer). Similar to Option 3, the truck with a dump insert would also allow GBF to transport shell to restoration sites, thus saving money on dump truck contracts. The main drawback of the dump insert would be the annual maintenance costs. Due to the fact that this equipment would be modified post manufacturing it may be challenging to find a mechanic who can tend to the typical maintenance requirements for a reasonable fee.

**Option 5** is comparable to Option 4 in that a single vehicle, the box truck, could be used to access restaurants in congested downtown Houston. A box truck would also reduce the physical labor associated with shell collection via the use of a lift gate to load bins full of shell. Depending on the size of box truck purchased, it may or may not increase shell hauling capacity.

The box truck may also come in handy for other GBF events, such as Bike Around the Bay and Trash Bash, during which box trucks are rented for hauling supplies or trash. Unfortunately, the box truck would not be able to facilitate transporting shell to restoration sites. It would also likely require additional maintenance costs, similar to Options 3 and 4.

**Option 6** was ruled out due to the high initial costs of purchasing a dump truck. In addition, a Commercial Driver's License (CDL) would be required and thus the staff hired to operate the truck would likely require a higher wage. These expenses, coupled with the need for additional storage space and maintenance, make it clear that this option is not the best fit for GBF.

**Option 7** was eliminated due to the high operating costs associated with subcontracting a recycling vendor. While GBF's efforts would be greatly reduced, there is concern that the lack of involvement in daily operations would hamper restaurant relationships and prevent GBF from observing/anticipating potential issues as they arise. The financial requirements for this option are not feasible at this time and likely unsustainable if GBF wishes to continue a free, or even lost-cost, service for Houston-Galveston area restaurants.

It is clear that GBF will require an additional vehicle and/or equipment and most likely one additional staff member to facilitate the Houston expansion of the Oyster Shell Recycling Program. It seems logical to split two staff and two sets of equipment between the two routes: downtown Houston and Clear Lake region. In this scenario, staff can collect shell from all restaurant partners during the most desirable days and times. As a result, staff would avoid congestion at restaurants during peak delivery hours as well as traffic in downtown Houston. All restaurants would be given the option of collections on Mondays and Fridays to address the increase in shell output over the weekend. Most importantly, this approach would provide the best option for the restaurants, thus keeping the key players in the process happy and participating.

The initial purchase costs for Options 2, 3, 4, and 5 are somewhat comparable. The addition of any new vehicles or equipment will come with added maintenance, registration, and insurance costs. A new landscape or dump trailer will require an additional storage unit. Even the box truck and 1-ton truck with a dump insert may require a storage unit depending on what is allowed at GBF's current office as well as the future headquarters building. While all of these options address the ability to conduct shell collection along the two routes simultaneously, only Option 3 and 4 would allow for the transport of loose shell to restoration sites. This would reduce expenses for GBF's reef restoration projects immensely. A single reef restoration project may require dozens of loads to be transported, depending on the amount of shell needed, resulting in expenses ranging from \$500.00 to \$5,000.00 or more. Therefore, GBF has narrowed down the options to Option 3, a new one-ton truck and a dump trailer or Option 4, a new one-ton truck with a dump insert, to facilitate the Houston expansion.

While annual expenses will increase with an expansion of the Oyster Shell Recycling Program, the benefits of oyster reef restoration far outweigh the costs. As documented by GBF staff and volunteer observations, a single recycled oyster shell can house at least 10 to 15 oyster larvae. Each one of these oysters will grow into an adult that will not only filter up to 50 gallons of water per day but will also spawn and supplement other reefs within the Galveston Bay ecosystem.

## STEP 4: IMPLEMENTATION

### A) Action Plan

The Analysis and Planning sections of this document address the feasibility of GBF expanding shell recycling operations into the greater Houston area as well as along the existing routes. Based on the case studies and cost-benefit analysis, it appears that an expansion to Houston will be greatly beneficial to the Foundation's efforts. The largest concentration of restaurants, including those that sell oysters, are located in downtown Houston. The expansion will not only increase the amount of shell recycled, it will also increase GBF's exposure in the community.

It is proposed that the Houston expansion can be accomplished via the addition of one part-time staff and the purchase of another vehicle (1-ton truck with a dump insert) and/or trailer (1-ton truck with a dump trailer). The initial purchase costs would range from \$37,500.00 to \$48,000.00 and the annual baseline expenses for the expansion would be approximately \$38,000.00. This includes two part-time staff working 20 hours a week for \$15.00 per hour and an average mileage of 320+ miles a week. GBF believes it is feasible to secure these funds by the fall of 2020 to enable the start of the Houston shell recycling route in December 2020. As of September 2019, GBF has secured \$25,000.00 via CMP for new equipment purchases in 2020 and plans to receive additional funds via the Inaugural Houston Oyster Festival in April 2020 to support the increase in baseline expenses and/or equipment needs.

In order to reach these funding goals and recruit new restaurant partners, GBF plans to increase the interest in and knowledge of the Oyster Shell Recycling Program. New outreach initiatives including community presentations and coordination with restaurant partners (as discussed in Step 1) will help reach a wider audience. The Houston Oyster Festival will also engage more restaurants and citizens in the Program. Lastly, GBF is working with the Galveston Bay Estuary Program to reinstate the Galveston Bay Oyster Workgroup. This Workgroup will be comprised of agency, university, and other NGO partners as well as contractors and engineers. These partners will work together to help guide the development of the Oyster Shell Recycling Program, site reef restoration projects, and determine best management practices and restoration methodologies for Galveston Bay oyster reefs.

In addition to increasing the Program's exposure, GBF will also work towards streamlining the current shell recycling operations. GBF plans to create a more consistent maintenance schedule for all vehicles, equipment, recycling bins, and curing sites. This will ensure a smoother transition as the Program grows. By December of 2019, GBF plans to migrate all existing Program data to an Access Database to improve the efficiency of tracking tonnage of shell recycled, stockpiled, and transported to restoration sites. The Access software will allow for easier access to all data which is currently spread across more than 20 Excel spreadsheets. It will also simplify calculations to determine GBF's "shell balance" (the amount of shell currently available for use in restoration).

The expansion to Houston will also require a new curing site. While both Red Bluff and Texas City have adequate space, they are a long distance from downtown Houston. Utilizing either of these sites would drastically increase the daily mileage during Houston shell runs. Therefore, it is proposed that a third curing site will be secured by June 2020 to store all shell collected in Houston. GBF will site potential locations on the east side of Houston, preferably south of Highway 225, east of Interstate 610, and north of Interstate 45.

Once the funds and new curing site are secured, GBF will confirm the participation of at least three to five new restaurants in Houston. GBF is currently in communication with four restaurants who are interested in shell recycling and will likely be participants in the 2020 Inaugural Houston Oyster Festival. Once these restaurants are officially onboard, GBF will establish a new shell recycling schedule to incorporate the Houston Route. If funding allows, a new part-time staff member will be hired by September 2020 to allow for at least two to three months of training prior to the start of initiating Houston shell recycling services in December 2020.

## **B) Timeline**

In order to achieve the goal of expanding the Oyster Shell Recycling Program to Houston, GBF has created a timeline, shown in Table 8, to implement each action item described above. This timeline will be updated with each new version of this document to aid in the strategic planning process in three-year increments. It is expected that unknown challenges and circumstances may arise, thus rendering this timeline inaccurate. In order to continue moving the Program forward, adaptive management will be required. To address these concerns, Step 5 lays out an adaptive management plan for the Oyster Shell Recycling Program.

**Table 8: Proposed Timeline to Achieve Program Expansion**

<b>YEAR</b>	<b>MONTH</b>	<b>OBJECTIVE</b>
<b>2019</b>	September	Complete Version 1 of the Strategic Development Plan
	November	Secure restaurant partners for Houston Oyster Festival Add at least 1 new restaurant partner along the main route Host 1 <sup>st</sup> Galveston Bay Oyster Workgroup Meeting
	December	Migrate data into Access Database
<b>2020</b>	March	Complete Version 2 of the Strategic Development Plan
	April	Host the Inaugural Houston Oyster Festival
	May	Host Bi-Annual Galveston Bay Oyster Workgroup Meeting
	June	Secure new curing site in close proximity to downtown Houston
	September	Hire second part-time staff member
	October	Secure at least 3 restaurant partners in Houston
	November	Host Bi-Annual Galveston Bay Oyster Workgroup Meeting Secure additional funding to purchase new equipment
	December	Add at least 2 new restaurant partners along the main route Add at least 1 new restaurant partner in Galveston Begin recycling in Houston
<b>2021</b>	March	Complete Version 3 of the Strategic Development Plan
	April	Host the 2 <sup>nd</sup> Annual Houston Oyster Festival
	May	Host Bi-Annual Galveston Bay Oyster Workgroup Meeting
	November	Host Bi-Annual Galveston Bay Oyster Workgroup Meeting
	December	Secure at least 2 new restaurant partners in Houston Increase annual tonnage of shell recycled annually by 10%

## STEP 5: EVALUATION

Upon implementation of the action plan described in Step 4, GBF will begin documenting the successes and obstacles associated with the proposed approach to expansion. By following an adaptive management framework, GBF will be able to continuously address challenges and uncertainties throughout this process.

### A) Adaptive Management

Although natural resource management is the origin of adaptive management, this strategy can be applied across many disciplines and is thus applied here, to oyster shell recycling operations. Unlike the trial and error method, adaptive management provides a more structured approach with the goal of reducing uncertainty over time. As demonstrated by this document, adaptive management provides alternatives as well as avenues for learning and cooperation between partners, thus leading to a pattern of ongoing implementation, evaluation, and reassessment. Most importantly, this process helps narrow down which approaches are most effective.

This document was designed to facilitate the assessment of GBF's current operations and the operations of other programs (Step 1 and 2), analyze the costs and benefits associated with alternative shell recycling methods (Step 3), and outline an action plan to implement the most appropriate methodology (Step 4). The final step in the process, evaluation (Step 5), allows for reflection on actions taken to determine what is effective and what is not. Moving forward, GBF plans to evaluate the state of the Oyster Shell Recycling Program on a quarterly basis to provide frequent opportunities for adjustment and improvement. The Strategic Development Plan will also be updated on annual basis to document these findings.

### B) Success Criteria

The goal of GBF's Oyster Shell Recycling Program is to reclaim oyster shells from local restaurants and return those shells to Galveston Bay to restore native oyster habitat. Based on this goal, GBF has developed the following success criteria to help document the accomplishments and potential challenges of the Oyster Shell Recycling Program on an annual basis:

- 1) Continue to recruit new restaurant partners along all recycling routes
- 2) Retain at least ninety percent of restaurant partners
- 3) Maintain or increase tonnage of shell recycled
- 4) Return at least five percent of shells recycled to Galveston Bay
- 5) Site at least one new reef restoration project in Galveston Bay

### **C) Updates to the Strategic Development Plan**

Thanks to CMP, the next two installments of the Strategic Development Plan have been fully funded. Following the timeline of CMP's final reporting, the next version of the Strategic Development Plan will be finalized by March 2020 or June 2020 at the latest. GBF will compare the status of the program to the timeline (Table 8) and success criteria established here as well as evaluate the need for any changes. Version 2.0 of the Strategic Development Plan will delve further into possible partnerships with commercial oyster companies as well as state agencies. The Restaurant Database will also be updated to eliminate any restaurants that have closed or no longer serve oysters and any new restaurants that have opened in the Houston-Galveston region. Last but not least, GBF will discuss the process of establishing a new city-wide Oyster Festival and the associated outcomes.



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## APPENDIX

### A) Restaurant Partner Locations

1. Active Restaurant Partners
2. Shell Recycling Radius

### B) Curing Site Locations

1. TX City Curing Site
2. Red Bluff Curing Site
3. TAMUG Curing Site

### C) Oyster Shell Recycling Routes

1. Main Recycling Route Maps
2. Galveston Recycling Route Map

### D) Oyster Shell Recycling Photographs

1. Main Recycling Route
2. Galveston Recycling Route

### E) Restaurant Database

1. Clear Lake Region
2. Galveston Island
3. Houston Region

### F) Curing Site Capacity

1. Texas City
2. Red Bluff
3. TAMUG

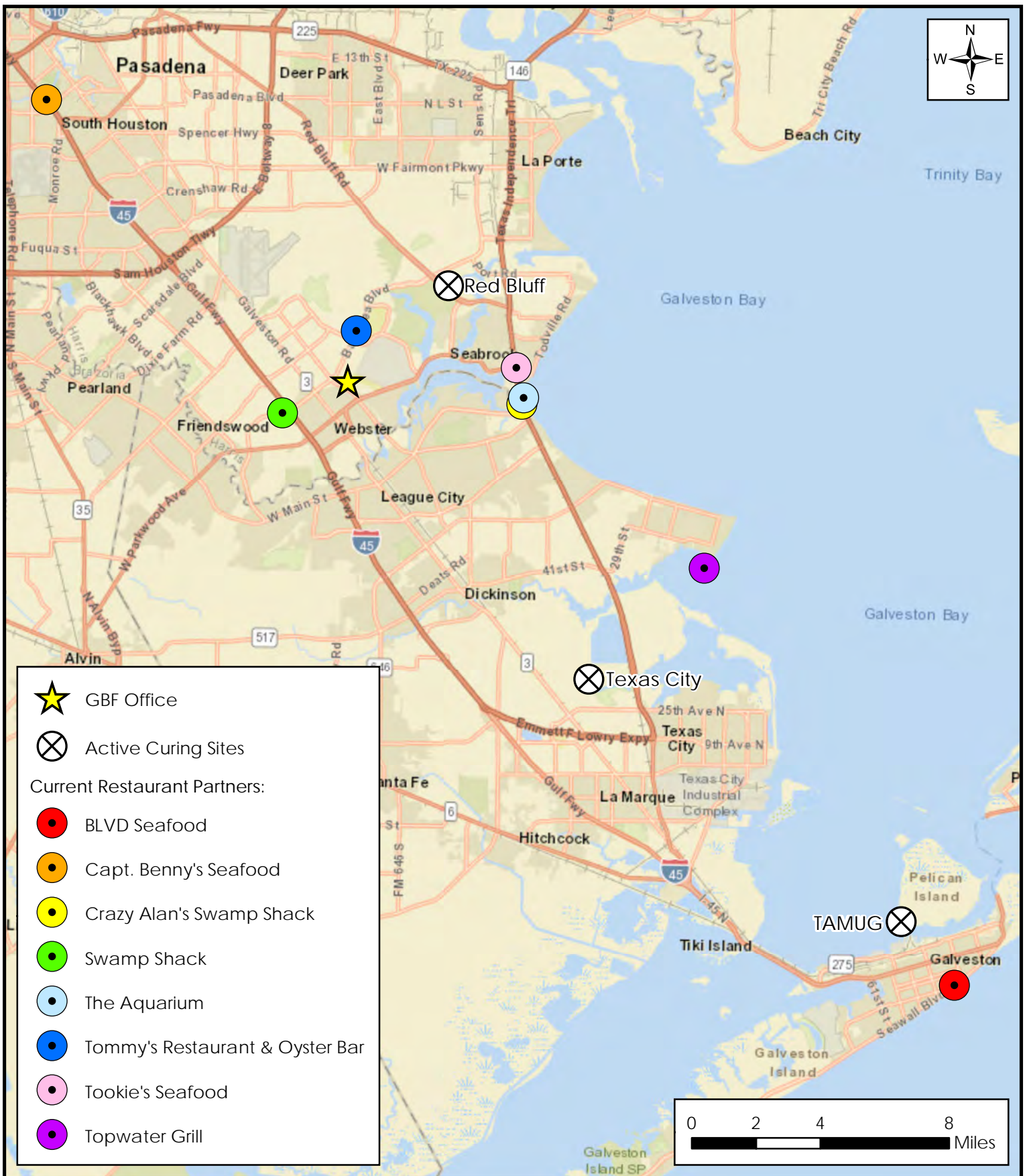
### G) Restaurant Materials










1. Waste Hauling Costs
2. In-Kind Donation Form
3. Outreach Material Options

### H) Database of Oyster Shell Recycling Programs in the United States

### I) Texas Oyster Regulations

**APPENDIX A**  
Restaurant Partner Locations



-  GBF Office
-  Active Curing Sites
- Current Restaurant Partners:
-  BLVD Seafood
-  Capt. Benny's Seafood
-  Crazy Alan's Swamp Shack
-  Swamp Shack
-  The Aquarium
-  Tommy's Restaurant & Oyster Bar
-  Tookie's Seafood
-  Topwater Grill

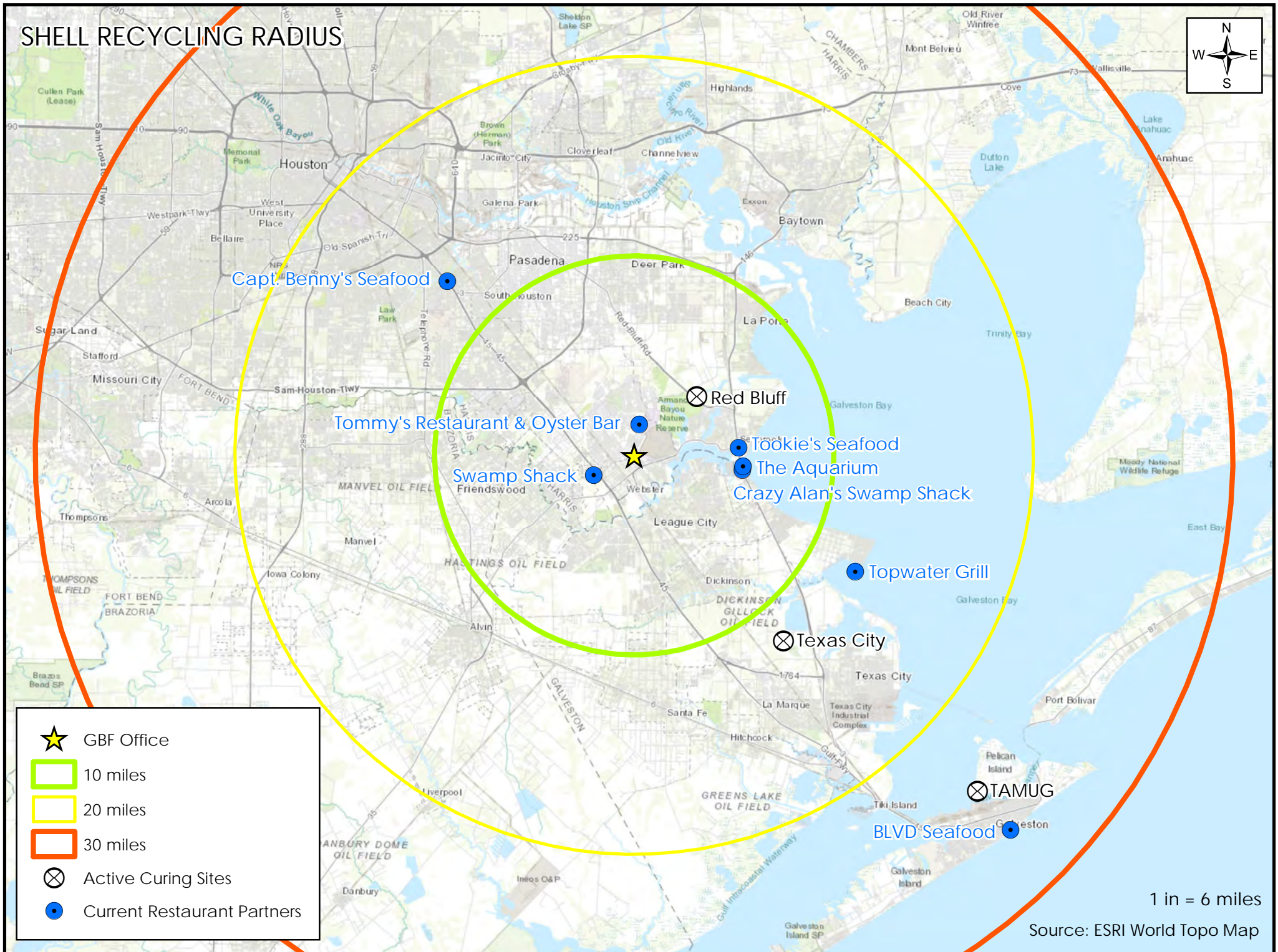
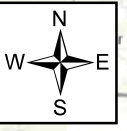
**ACTIVE RESTAURANT PARTNERS**

Project Name: Oyster Shell Recycling Program	
Project Location: Harris & Galveston County, TX	
Image Source: ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/30/2019	Drawn by: H.Leija



1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381

# SHELL RECYCLING RADIUS

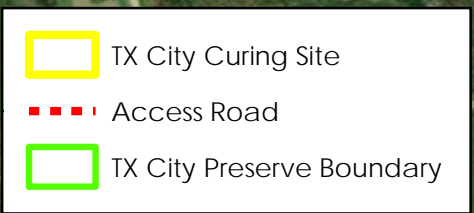
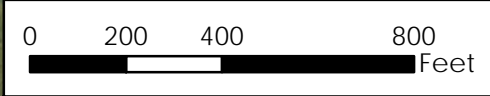


- ★ GBF Office
- 10 miles
- 20 miles
- 30 miles
- ⊗ Active Curing Sites
- Current Restaurant Partners

1 in = 6 miles

Source: ESRI World Topo Map

**APPENDIX B**  
Curing Site Locations

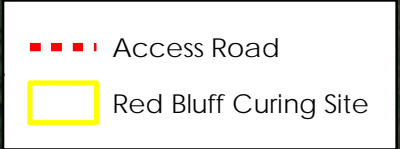


TX CITY CURING SITE - LOCATION MAP	
Project Name: TX City Curing Site: Oyster Shell Recycling Program	
Project Location: TX City, Galveston County, TX	
Image Source: ESRI World Imagery; ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/30/2019	Drawn by: H.Leija



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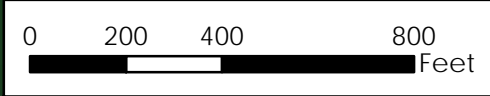



RED BLUFF CURING SITE - LOCATION MAP	
Project Name: Red Bluff Curing Site; Oyster Shell Recycling Program	
Project Location: Pasadena, Harris County, TX	
Image Source: ESRI World Imagery; ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/30/2019	Drawn by: H.Leija



**GALVESTON BAY**  
FOUNDATION

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381



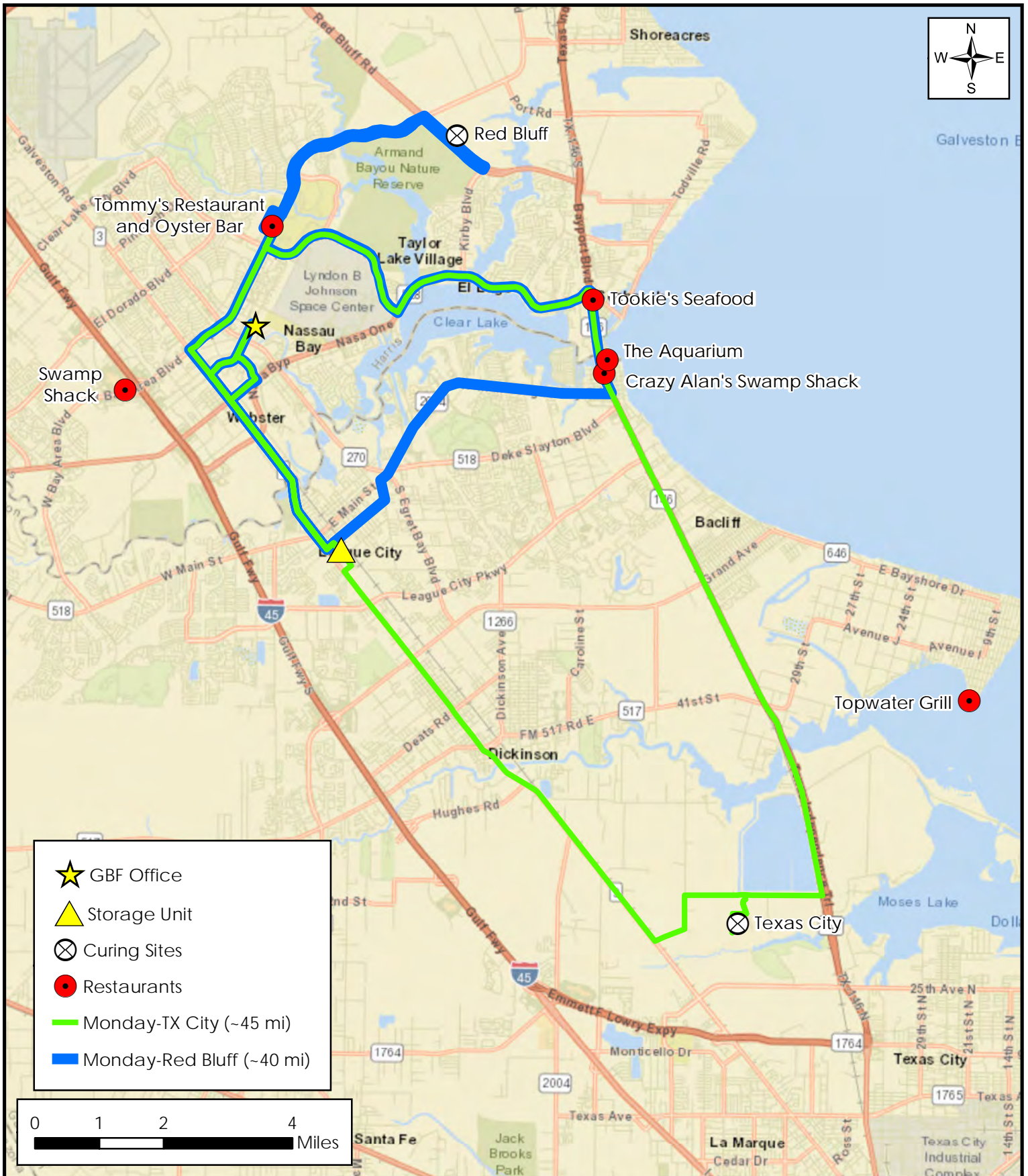
 TAMUG Curing Site  
 Access Road

TAMUG CURING SITE - LOCATION MAP	
Project Name: TAMUG Curing Site; Oyster Shell Recycling Program	
Project Location: Pelican Island, Galveston County, TX	
Image Source: ESRI World Imagery; ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/30/2019	Drawn by: H.Leija



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**APPENDIX C**  
Oyster Shell Recycling Routes



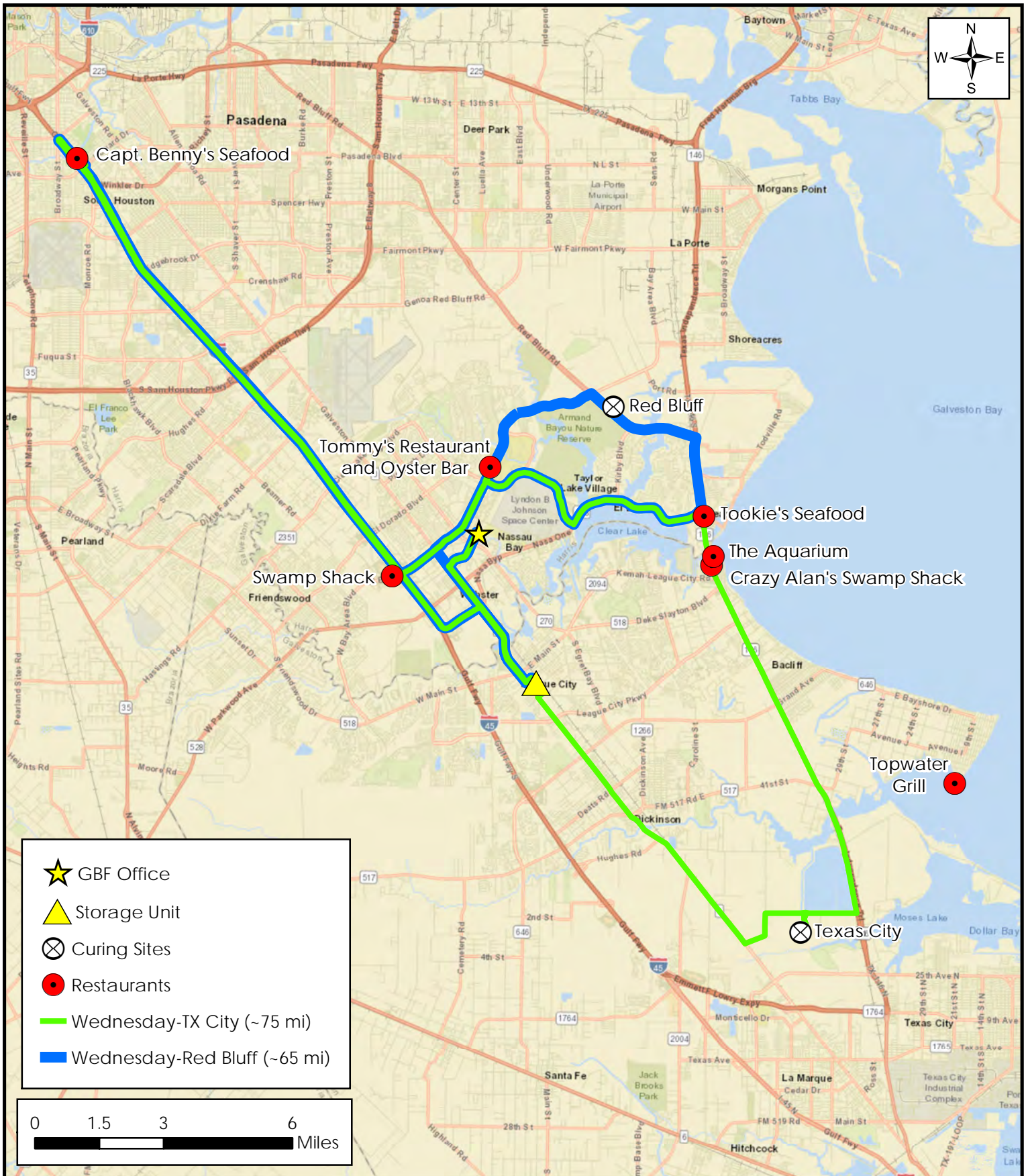
### MAIN ROUTE - MONDAY

Project Name: Oyster Shell Recycling Program - Main Route	
Project Location: Clear Lake Region - Harris & Galveston County	
Image Source: ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/16/2019	Drawn by: S.Batte



**GALVESTON BAY**  
FOUNDATION

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381



**MAIN ROUTE - WEDNESDAY**







Project Name: Oyster Shell Recycling Program - Main Route	
Project Location: Clear Lake Region - Harris & Galveston County	
Image Source: ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/16/2019	Drawn by: S.Batte

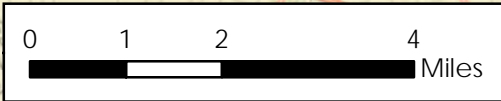


**GALVESTON BAY  
FOUNDATION**

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381



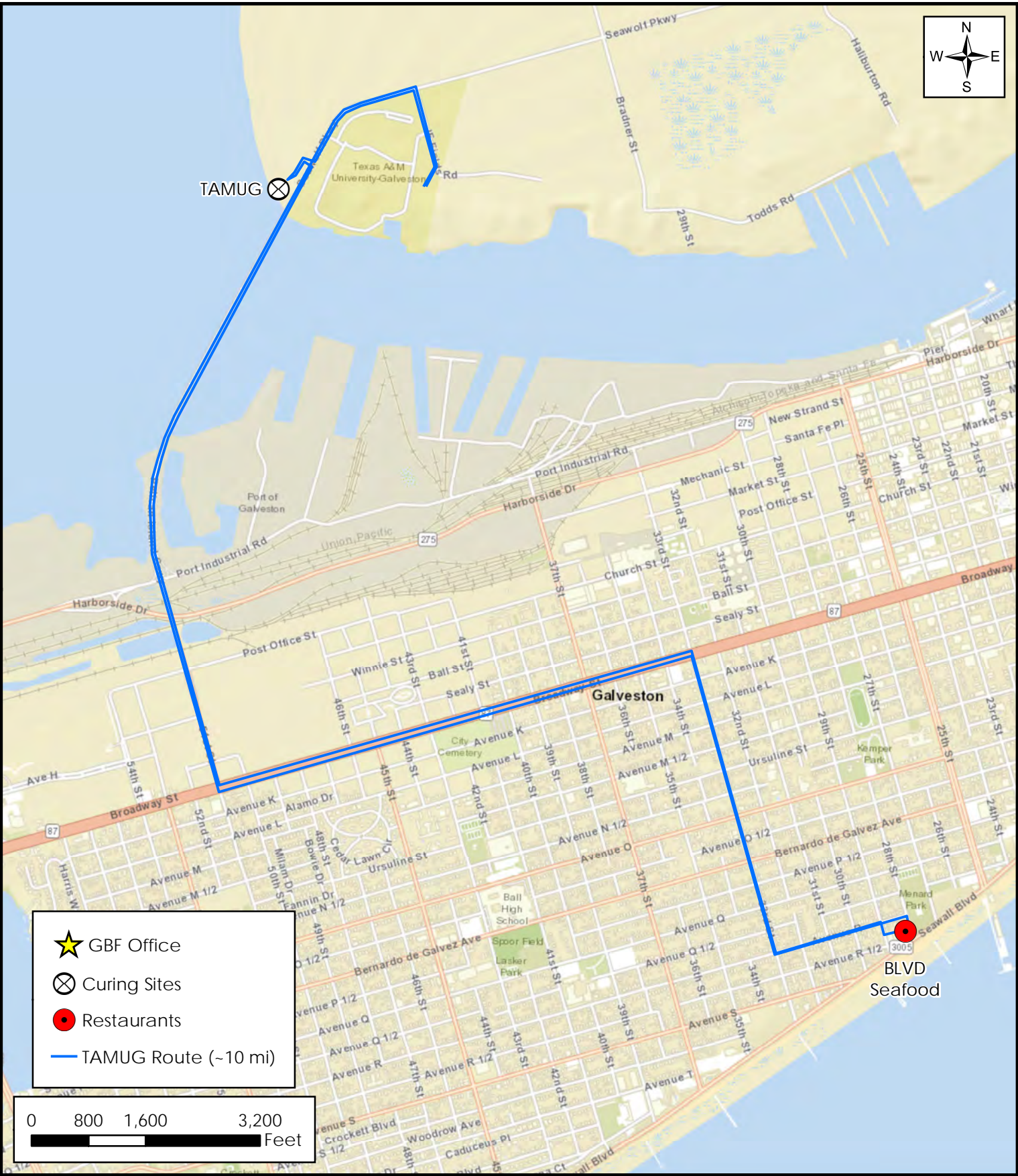
-  GBF Office
-  Storage Unit
-  Curing Sites
-  Restaurants
-  Friday-TX City (~50 mi)
-  Friday-Red Bluff (~40 mi)







<b>MAIN ROUTE - FRIDAY</b>	
Project Name: Oyster Shell Recycling Program - Main Route	
Project Location: Clear Lake Region - Harris & Galveston County	
Image Source: ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/16/2019	Drawn by: S.Batte



1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381



-  GBF Office
-  Curing Sites
-  Restaurants
-  TAMUG Route (~10 mi)



<b>GALVESTON ROUTE</b>	
Project Name: Oyster Shell Recycling Program - Main Route	
Project Location: Galveston Island, Galveston County	
Image Source: ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/16/2019	Drawn by: S.Batte



**GALVESTON BAY**  
FOUNDATION

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381

**APPENDIX D**  
Oyster Shell Recycling Photographs



## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 1. Loading recycled oyster shells onto landscape trailer.



Figure 2. Loading recycled oyster shells onto landscape trailer.

## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 3. Loading recycled oyster shells onto landscape trailer.



Figure 4. Oyster Shell Recycling Program trailer signage.

SHELL RECYCLING PHOTOGRAPHS  
Main Recycling Route



Figure 5. Recycled oyster shells collected at a restaurant.

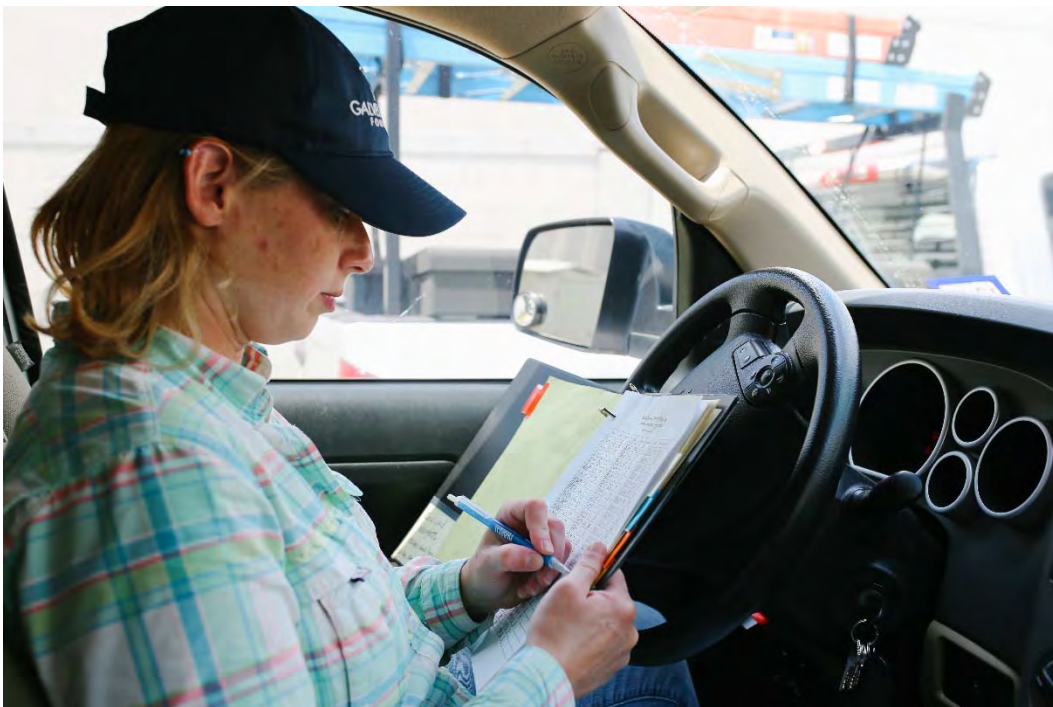


Figure 6. Documenting recycled oyster shells collected from restaurant partners.

## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 7. Oyster shell recycling truck and trailer at Red Bluff Curing Site.



Figure 8. Dumping newly recycled oyster shell at Red Bluff Curing Site.

SHELL RECYCLING PHOTOGRAPHS  
Main Recycling Route



Figure 9. Newly recycled oyster shell at Red Bluff Curing Site.



Figure 10. Recycled oyster shell piled for sun curing at Red Bluff Curing Site.

## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 11. Piling recycled shell at Red Bluff Curing Site.



Figure 12. Newly piled shell at Red Bluff Curing Site.

## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 13. Dumping newly recycled oyster shell at TX City Curing Site.



Figure 14. Recycled oyster shell piled for sun curing at TX City Curing Site.

## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 15. Cement pad at TX City Curing Site.



Figure 16. Newly piled shell and bagged shell at TX City Curing Site.



**SHELL RECYCLING PHOTOGRAPHS**  
**Main Recycling Route**



Figure 17. Recycled oyster shell piled for sun curing at TX City Curing Site.



Figure 18. Recycled oyster shell piled for sun curing at TX City Curing Site.

## SHELL RECYCLING PHOTOGRAPHS Main Recycling Route



Figure 19. Piling recycled shell at TX City Curing Site.



Figure 20. Piling recycled shell at TX City Curing Site.

SHELL RECYCLING PHOTOGRAPHS  
Galveston (TAMUG) Recycling Route



Figure 21-22. 5-gallon buckets with recycled shell stored outside BLVD Seafood on Galveston Island.



Figure 23. Shell collection by TAMUG via 14-gallon tubs.

SHELL RECYCLING PHOTOGRAPHS  
Galveston (TAMUG) Recycling Route



Figure 24. Dumping newly recycled oyster shell at TAMUG Curing Site



Figure 25. Dumping newly recycled oyster shell at TAMUG Curing Site

**APPENDIX E**  
Restaurant Database

## RESTAURANT DATABASE Clear Lake Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
1	The Aquarium Restaurant	Kemah	Y	0	#11 Kemah Boardwalk	(281) 334-9010	www.aquariumrestaurants.com/aquariumkemah
2	Captain Benny's Seafood	Houston	Y	4	8253 Gulf Fwy	(713) 643-0589	captbennys.com
3	Captain Benny's Seafood	Deer Park	Y	4	1200 East Blvd	(281) 476-1513	captbennys.com
4	Chasin' Tail Sports Bar	Clear Lake	Y	1	2402 Bay Area Blvd, Ste. M	(281) 480-3000	www.chasintailscajunfood.com
5	Crazy Alans Swamp Shack	Kemah	Y	4	310 Texas Ave	(281) 334-5000	crazyalanswampshack.com
6	Crazy Alans Swamp Shack	Friendswood	Y	4	1330 Bay Area Blvd	(832) 284-4895	crazyalanswampshack.com
7	East Star Chinese Buffet	Webster	Y	0	1025 W Nasa Pkwy	(281) 280-8822	No website
8	Flippers Coastal Seafood	Dickinson	Y	2	628 FM 517 W	(832) 340-7340	No website
9	Floyd's Cajun Seafood & Steakhouse	Webster	Y	6	20760 Gulf Fwy	(281) 332-7474	floydsseafood.com
10	Flying Dutchman	Kemah	Y	4	9 11th Ave Kemah Waterfront	(281) 334-7575	www.flyingdutchmankemah.com
11	Gilhooley's Restaurant	San Leon	Y	4	222 9th St	(281) 339-3813	No website
12	Hibachi Grill & Supreme Buffet	Webster	Y	0	155 W Bay Area Blvd	(832) 932-5795	No website
13	Jackie's Brickhouse	Kemah	Y	1	1053 Marina Bay Dr	(832) 864-2459	www.jackiesbrickhouse.com
14	LA Crawfish	Webster	Y	3	939 W Bay Area Blvd	(832) 905-5154	www.lacrawfish.com
15	LA Crawfish	Baytown	Y	3	4609 Garth Rd A	(832) 479-8081	www.lacrawfish.com
16	LA Crawfish	Pasadena	Y	3	4300 Fairmont Parkway	(832) 288-4494	www.lacrawfish.com
17	Landry's Seafood House	Kemah	Y	1	1 Kemah Boardwalk	(281) 334-2513	www.landryseafood.com/location-kemah.asp
18	Little Daddy's Gumbo Bar	League City	Y	2	1615 West FM 646	(281) 524-8626	www.littledaddysgumbobar.com

**LEGEND:**

Current Partner

Potential Partner

## RESTAURANT DATABASE Clear Lake Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
19	Lone Star Grill	Bacliff	Y	3	3435 Hwy 146	(832) 864-3788	lonestargrilltexas.com
20	Mambo Seafood	Baytown	Y	0	4300 East Fwy	(832) 926-7551	www.mamboseafood.com
21	Marais	Dickinson	Y	4	2015 FM 517 Rd East	(281) 534-1986	marais.tx.com
22	Monument Inn	La Porte	Y	0	4406 Independence Pkwy S	(281) 479-1521	monumentinn.com
23	Noah's Ark Bar & Grill	Bacliff	Y	4	4438 Boulevard St	(281) 339-2895	noahsarkbarandgrill.com
24	O2 Bistro	Clear Like Shores	Y	1	1002 Aspen Road	(281) 532-6860	www.o2bistro.com
25	Opus Ocean Grill	Clear Lake Shores	Y	4	1510 Marina Bay Dr #124	(281) 334-0006	www.opusoceangrille.com
26	Outriggers	Seabrook	<i>Closed Temporarily for relocation</i>			(281) 474-3474	No website
27	Pappas Seafood House	Webster	Y	1	19991 Gulf Fwy	(281) 332-7546	www.pappasseafood.com
28	Perry's Steakhouse & Grille	Friendswood	Y	0	700 Baybrook Mall Dr	(281) 286-8800	perryssteakhouse.com
29	The Reef Seafood House	Texas City	Y	0	1301 31st 1/2 St N	(409) 945-6151	thereefseafoodhouse.com
31	The Rouxpour	Friendswood	Y	4	700 Baybrook Mall, Ste H100	(281) 480-4052	www.therouxpour.com
32	Sam's Boat	Seabrook	Y	0	3101 Nasa Rd 1	(281) 326-7267	www.samsboat.com
33	Tommy's Restaurant & Oyster Bar	Houston	Y	5	2555 Bay Area Blvd	(281) 480-2221	tommys.com
34	Tookie's Seafood	Seabrook	Y	6	1106 Bayport Blvd	(281) 942-9445	www.tookiesseafood.com
35	Topwater Grill	San Leon	Y	5	815 Ave O	(281) 339-1232	www.topwatergrill.com
36	Valdo's Seafood House	Seabrook	Y	4	4106 Nasa Rd 1	(281) 326-3866	www.valdos.com

**LEGEND:**

Current Partner

Potential Partner

## RESTAURANT DATABASE Galveston Island

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
1	Black Pearl Oyster Bar	Galveston	Y	0	327 23rd St	(409) 762-7299	www.galveston.com/blackpearl
2	BLVD Seafood	Galveston	Y	3	2804 R 1/2	(409) 762-2583	www.blvdseafood.com
3	Cajun Greek	Galveston	Y	0	2226 61st St	(409) 744-7041	www.cajun-greek-seafood.com
4	Fish Tales	Galveston	Y	0	2502 Seawall Blvd	(409) 762-8545	www.fishtalesgalveston.com
5	Fisherman's Wharf	Galveston	Y	0	2200 Harborside Dr	(409) 765-5708	www.fishermanswharfgalveston.com
6	Gaido's Seafood Restaurant	Galveston	Y	0	3828 Seawall Blvd	(409) 761-5500	www.gaidos.com
7	Landry's Seafood House	Galveston	Y	1	5310 Seawall Blvd	(409) 744-1010	www.landrysseafood.com/location-galveston.asp
8	Little Daddy's Gumbo Bar	Galveston	Y	2	2107 Postoffice St	(281) 524-8626	www.littledaddysgumbobar.com
9	Number 13	Galveston	Y	0	7809 Broadway St	(409) 572-2650	www.number13steak.com
10	The Spot	Galveston	Y	0	3204 Seawall Blvd	(409) 621-5237	www.islandfamous.com
11	Willie G's	Galveston	Y	1	2100 Harborside Dr	(409) 762-3030	www.williegs.com/galveston

<b>LEGEND:</b>	Current Partner	Potential Partner
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## RESTAURANT DATABASE Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
1	1751 Sea and Bar	Houston	Y	2	191 Heights Blvd	(832) 831-9820	1751houston.com
2	a'Bouzy	Houston	Y	1	2300 Westheimer	(713) 722-6899	www.abouzy.com
3	Brennan's of Houston	Houston	Y	2	3300 Smith St	(713) 522-9711	www.brennanshouston.com
4	Café Annie	Houston	Y	0	1800 Post Oak Blvd	(713) 840-1111	www.cafeanniehouston.com
5	Cajun Kitchen	Houston	Y	4	6938 Wilcrest Dr	(281) 495-8881	cajunkitchenhouston.com
6	Captain Benny's Seafood	Houston	Y	4	8506 S Main St	(713) 666-5469	captbennys.com
7	Captain Benny's Seafood	Stafford	Y	4	12135 Murphy Rd	(281) 498-3909	captbennys.com
8	Captain Benny's Seafood	Houston	Y	4	10896 Northwest Fwy	(713) 680-1828	captbennys.com
9	Captain Tom's Seafood & Oyster	Houston	Y	0	13955 East Fwy	(713) 451-3700	No website
10	Caracol	Houston	Y	1	2200 Post Oak Blvd	(713) 622-9996	www.caracol.net
11	Chilos Seafood & Oyster Bar	Houston	Y	No menu online	1150 Edgebrook Dr	(713) 947-8700	No website
12	Christie's Seafood & Steaks	Houston	Y	2	6029 Westheimer	(713) 978-6563	www.christies-restaurant.com
13	The Crawfish Pot & Oyster Bar	Houston	Y	2	9820 Gulf Fwy #7	(713) 360-6547	thecrawfishpot-oysterbar.netwaiter.com
14	Eugene's Gulf Coast Cuisine	Houston	Y	5	1985 Welch St	(713) 807-8889	www.eugeneshouston.com
15	Drunken Oyster	Spring	Y	0	7110 Louetta Rd, Ste B	(832) 843-6196	drunkenoyster.eat24hour.com
16	Eddie V's Prime Seafood	Houston- West Ave	Y	4	2800 Kirby Dr	(713) 874-1800	www.eddiev.com

**LEGEND:**

Current Partner

Potential Partner

## RESTAURANT DATABASE Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
17	Eddie V's Prime Seafood	Houston- City Centre	Y	4	12848 Queensbury Ln	(832) 200-2380	www.eddiev.com
18	Eunice	Houston	Y	2	3737 Buffalo Speedway	(832) 491-1717	www.eunicerestaurant.com
19	Field & Tides	Houston	Y	1	705 E 11th St	(713) 861-6143	fieldandtides.com
20	Floyd's Cajun Seafood & Steakhouse	Sugar Land	Y	6	16549 SW Fwy	(281) 240-3474	floydsseafood.com
21	Floyd's Cajun Seafood & Steakhouse	Pearland	Y	6	1300 E. Broadway	(281) 993-8385	floydsseafood.com
22	Georgia James	Houston	Y	1	1100 Westheimer	(832) 241-5088	www.georgiamessteak.com
23	Goode Company- Seafood	Houston	Y	4	2621 Westpark Dr	(713) 523-7154	www.goodecompany.com
24	Hugos	Houston	N	0	1600 Westheimer Rd	(713) 524-7744	www.hugosrestaurant.net
25	Jimmy G's Cajun Seafood	Houston	Y	1	307 N Sam Houston Pkwy	(281) 931-7654	www.jimmyg.com
26	LA Crawfish	Houston- Greenway	Y	3	3957 Richmond Ave	(832) 767-1533	www.lacrawfish.com
27	LA Crawfish	Houston- Memorial	Y	3	1005 Blalock Rd	(713) 461-8808	www.lacrawfish.com
28	LA Crawfish	Houston- Willowbrook	Y	3	17375 Tomball Pkwy, Ste 2H	(281) 809-5722	www.lacrawfish.com
29	LA Crawfish	Houston- Langwood	Y	3	6439 W 43rd St	(832) 491-1121	www.lacrawfish.com
30	LA Crawfish	Houston- Wallisville Rd	Y	3	5810 E Sam Houston PkwY N	(281) 416-5352	www.lacrawfish.com
31	LA Crawfish	Katy	Y	3	569 S Mason Rd	(346) 251-5902	www.lacrawfish.com
32	LA Crawfish	Pearland	Y	3	1910 Country Place, Ste 150	(832) 781-4946	www.lacrawfish.com

**LEGEND:**

Current Partner

Potential Partner

## RESTAURANT DATABASE Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
33	LA Crawfish	Houston- Gulfgate	Y	3	3331 Telephone Rd, Ste C	(832) 804-6901	www.lacrawfish.com
34	LA Crawfish	Missouri City	Y	3	3823 FM 1092 Rd	(281) 208-7759	www.lacrawfish.com
35	La Lucha	Houston	Y	3	1801 N. Shepherd Dr	(713) 955-4765	laluchatx.com
36	Liberty Kitchen & Oysterette	Houston- River Oaks	Y	2	4224 San Felipe St.	(713) 622-1010	libertykitcheneats.com
37	Liberty Kitchen at the Tree House	Houston- Memorial	Y	2	963 Bunker Hill Rd.	(713) 468-3745	libertykitcheneats.com
38	Liberty Kitchen & Oyster Bar	Houston- Heights	Y	2	1050 Studewood St	(713) 802-0533	libertykitcheneats.com
39	Loch Bar	Houston	Y	5	4444 Westheimer Rd, Ste G110	(832) 430-6601	lochbar.com/houston
40	Mambo Seafood	Houston- 45S & Edgebrook	Y	0	10402 Gulf Fwy	(713) 946-0000	www.mamboseafood.com
41	Mambo Seafood	Houston- 290 & Tidwell	Y	0	13485 Northwest Fwy	(713) 462-0777	www.mamboseafood.com
42	Mambo Seafood	Houston- 45N & West Rd	Y	0	10810 North Fwy	(281) 820-3300	www.mamboseafood.com
43	Mambo Seafood	Houston- Airline & Tidwell	Y	0	6101 Airline Dr	(713) 691-9700	www.mamboseafood.com
44	Mambo Seafood	Houston- Gessner & Long Point	Y	0	10002 Long Point Dr	(713) 465-5009	www.mamboseafood.com
45	Mambo Seafood	Houston- Hillcroft & Bellaire	Y	0	6697 Hillcroft	(713) 541-3666	www.mamboseafood.com
46	Mambo Seafood	Houston- I-10 & Federal	Y	0	12333 East Fwy	(713) 637-0553	www.mamboseafood.com
47	Mambo Seafood	Katy	Y	0	20210 Katy Fwy	(832) 391-6644	www.mamboseafood.com
48	Mannie's Seafood	Houston	Y	2	8520 Gulf Fwy	(713) 641-5003	No website

**LEGEND:**

Current Partner

Potential Partner

## RESTAURANT DATABASE Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
49	Marcos Seafood & Oyster Bar	Houston	Y	0	917 Edgebrook Dr	(713) 946-1168	No website
50	Mastro's Steakhouse	Houston	Y	1	1650 W Loop S	(713) 993-2500	www.mastrosrestaurants.com
51	Nick's Fish Dive & Oyster Bar	Woodlands	Y	1	20 Waterway Ave #105	(281) 419-8885	www.nicksfishdive.com
52	Orleans Seafood Kitchen	Katy	Y	1	20940 Katy Fwy, Ste G	(281) 646-0700	orleansseafoodkitchen.com
53	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #11	Y	1	5819 Gulf Fwy #900	(713) 921-1800	www.ostioneriamichoacan.net
54	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #1	Y	1	11402 North Fwy	(281) 999-3995	www.ostioneriamichoacan.net
55	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #3	Y	1	1006 Federal Rd A	(713) 330-4419	www.ostioneriamichoacan.net
56	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #4	Y	1	13433 Tomball Pkwy #16	(281) 447-5061	www.ostioneriamichoacan.net
57	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #5	Y	1	5895 South Gessner	(713) 974-6828	www.ostioneriamichoacan.net
58	Ostioneria Michoacan Seafood & Oyster Bar	Woodlands- #6	Y	1	25919 I-45 North, Ste A	(281) 292-6811	www.ostioneriamichoacan.net
59	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #7	Y	1	1817 Wirt Rd.	(713) 463-5410	www.ostioneriamichoacan.net
60	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #8	Y	1	15125 N. Fwy	(281) 877-8855	www.ostioneriamichoacan.net
61	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #15	Y	1	10865 Jones Rd.	(281) 477-7697	www.ostioneriamichoacan.net
62	Ostioneria Michoacan Seafood & Oyster Bar	Houston- #16	Y	1	12810-B Gulf Fwy	(832) 672-4139	www.ostioneriamichoacan.net
63	Pappadeaux Seafood Kitchen	Houston- Hobby Airport	Y	1	7800 Airport Blvd	(713) 847-7622	pappadeaux.com
64	Pappadeaux Seafood Kitchen	Houston- Upper Kirby	Y	1	2410 Richmond Ave	(713) 527-9137	pappadeaux.com

**LEGEND:**

Current Partner

Potential Partner

## RESTAURANT DATABASE Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
65	Pappadeaux Seafood Kitchen	Houston- Avenida	Y	1	1001 Avenida de las Americas	(713) 654-5077	pappadeaux.com
66	Pappadeaux Seafood Kitchen	Houston- Galleria	Y	1	6015 Westheimer Rd	(713) 782-6310	pappadeaux.com
67	Pappas Seafood House	Houston- Shepherd	Y	1	3001 S. Shepherd	(713) 522-4595	pappadeaux.com
68	Pappas Seafood House	Houston- Woodridge	Y	1	6945 I-45 S. at Woodridge	(713) 641-0318	pappadeaux.com
69	Perry's Steakhouse & Grille	Houston- Champions	Y	0	9730 Cypresswood Dr	(281) 970-5999	perryssteakhouse.com
70	Perry's Steakhouse & Grille	Katy	Y	0	23501 Cinco Ranch Blvd, q100	(281) 347-3600	perryssteakhouse.com
71	Perry's Steakhouse & Grille	Houston- Memorial City	Y	0	9827 Katy Fwy	(832) 358-9000	perryssteakhouse.com
72	Perry's Steakhouse & Grille	Houston- River Oaks	Y	0	1997 West Gray St.	(346) 293-8400	perryssteakhouse.com
73	Perry's Steakhouse & Grille	Sugar Land	Y	0	2115 Town Square Place	(281) 565-2727	perryssteakhouse.com
74	Perry's Steakhouse & Grille	Woodlands	Y	0	6700 Woodlands Parkway	(281) 362-0569	perryssteakhouse.com
75	The Oyster Bar at Prohibition	Houston	Y	6	1010 Prairie St	(832) 301-8833	theoysterbarprohibition.com
76	Ragin' Cajun	Houston- The Original	Y	1	4302 Richmond Ave	(713) 621-3474	ragin-cajun.com
77	Ragin' Cajun	Houston- Westchase	Y	1	9600 Westheimer #80	(832) 251-7171	ragin-cajun.com
78	Riel	Houston	Y	1	1927 Fairview St	(832) 831-9109	www.rielhtx.com
79	The Rouxpour	Sugarland	Y	4	2298 Texas Dr	(281) 240-7689	www.therouxpour.com
80	The Rouxpour	Katy	Y	4	2643 Commercial Center Blvd A300	(281) 394-5013	www.therouxpour.com

**LEGEND:**

Current Partner

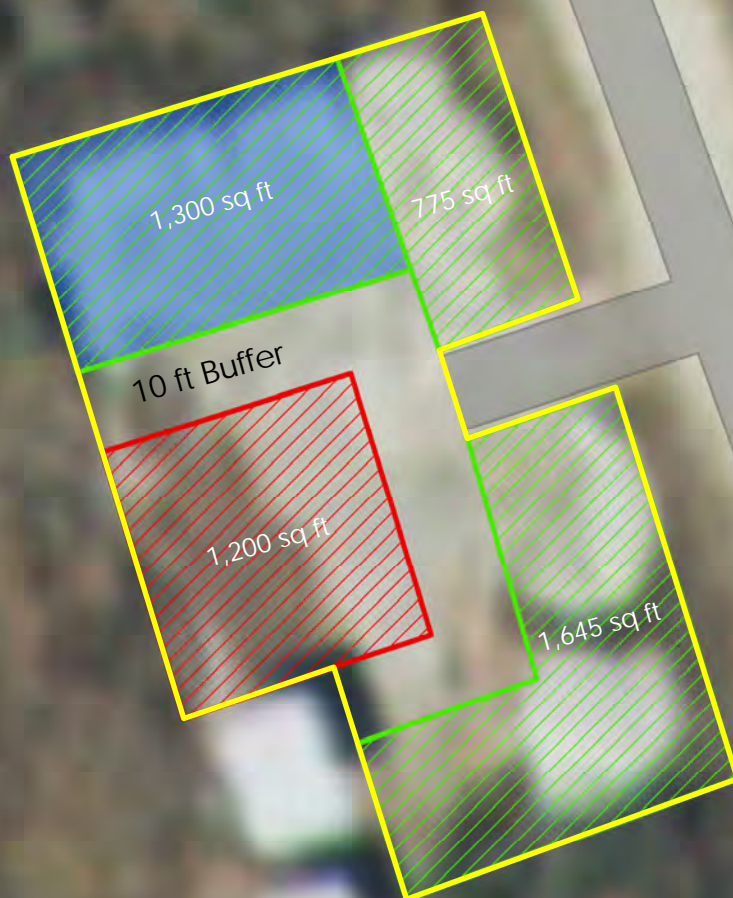
Potential Partner






## RESTAURANT DATABASE Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Restaurant Address	Restaurant Phone #	Restaurant Website
			Raw	Cooked			
81	Sam's Boat	Pearland	Y	0	3239 Silverlake Village Dr	(713) 436-0201	www.samsboat.com
82	Sam's Boat	Houston	Y	0	5720 Richmond Ave	(713) 781-2628	www.samsboat.com
83	State of Grace	Houston	Y	1	3258 Westheimer Rd	(832) 942-5080	stateofgracetx.com
84	The Pearl Restaurant & Bar at The Sam Houston Hotel	Houston	Y	3	1117 Prairie St	(832) 200-8817	www.pearlrestauranthouston.com
85	Tony Mandola's Gulf Coast Kitchen	Houston	Y	2	1212 Waugh Dr	(713) 528-3474	www.tonymandolas.com
86	Truluck's Seafood Steak & Crab House	Houston	Y	1	5350 Westheimer Rd	(713) 783-7270	trulucks.com
87	Truluck's Seafood Steak & Crab House	Woodlands	Y	1	1900 Hughes Landing Blvd, Ste 600	(281) 465-7000	trulucks.com
88	Willie G's	Houston	Y	8	1640 West Loop South	(713) 840-7190	www.williegs.com/postoak

<b>LEGEND:</b>	Current Partner	Potential Partner
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**APPENDIX F**  
Curing Site Capacity



-  Overall Capacity ~6,100 sq ft
-  Access Road (10' wide)
-  Cement Pad
-  Curing/Cured Piles ~ 3,720 sq ft
-  Newly Dumped Shell ~ 1,200 sq ft

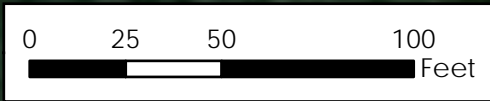
TX CITY CURING SITE - CAPACITY	
Project Name: Oyster Shell Recycling Program	
Project Location: TX City, Galveston County, TX	
Image Source: ESRI World Imagery	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 7/9/2019	Drawn by: H.Lejja



**GALVESTON BAY**  
FOUNDATION

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381





- Overall Capacity ~ 14,300 sq ft
- Access Road (10' wide)
- Curing/Cured Piles ~ 4,570 sq ft
- Newly Dumped Shell ~ 6,200 sq ft
- Potential Curing Area ~ 15,700 sq ft

RED BLUFF CURING SITE - CAPACITY	
Project Name: Oyster Shell Recycling Program	
Project Location: POHA Lease, Harris County, TX	
Image Source: ESRI World Imagery	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 7/9/2019	Drawn by: H.Lejja

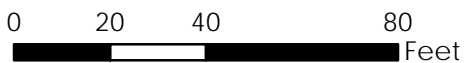






**GALVESTON BAY**  
FOUNDATION

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381



TAMUG  
Wetlands  
Center



-  Overall Capacity ~ 5,000 sq ft
-  Access Road
-  Curing/Cured Piles ~ 2,475 sq ft
-  Newly Dumped Shell ~ 1,180 sq ft

### TAMUG CURING SITE - CAPACITY

Project Name: Oyster Shell Recycling Program	
Project Location: TAMUG Wetland Center, Galveston County, TX	
Image Source: ESRI World Imagery	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 8/16/2019	Drawn by: H.Lejja



**GALVESTON BAY**  
FOUNDATION

1100 Hercules Ave. Ste. 200, Houston, TX; (281) 332-3381

**APPENDIX G**  
Restaurant Materials

### Waste Hauling Cost Estimates

Company	Dumpster Size	City	Frequency of Pickup	Cost/Month	Landfill	Additional Fees
<b>Waste Management</b> 713-686-6666	6 yard (6'Lx6'Wx5'H) Max weight: 1200 pounds	Houston (77058)	Does not service this area			
	6 yard (6'Lx6'Wx5'H) Max weight: 1200 pounds	Seabrook (77586)	Once a week	\$131.33	Baytown Landfill 4791 Tri City Beach Rd Baytown, TX 77520	One time installation fee of \$35.90 Locks are free
			Twice a week	\$200.35		
			Three times a week	\$269.48		
	6 yard (6'Lx6'Wx5'H) Max weight: 1200 pounds	Galveston (77550)	Once a week	\$270.00 plus tax	Coastal Plains Landfill 21000 E Highway 6 Alvin, TX 77511	One time installation fee of \$35.90 \$20/month for lock Cost varies due to fuel cost
			Twice a week	\$486.00 plus tax		
			Three times a week	\$703.00 plus tax		
	8 yard (6'Lx6'Wx6'8"H) Max weight: 1600 pounds	Houston (77058)	Does not service this area			
	8 yard (6'Lx6'Wx6'8"H) Max weight: 1600 pounds	Seabrook (77586)	Once a week	\$156.95	Baytown Landfill 4791 Tri City Beach Rd Baytown, TX 77520	One time installation fee of \$35.90 Locks are free
			Twice a week	\$251.39		
			Three times a week	\$346.04		
	8 yard (6'Lx6'Wx6'8"H) Max weight: 1600 pounds	Galveston (77550)	Once a week	\$305.00 plus tax	Coastal Plains Landfill 21000 E Highway 6 Alvin, TX 77511	One time installation fee of \$35.90 \$20/month for lock Cost varies due to fuel cost
Twice a week			\$563.00 plus tax			
Three times a week			\$814.00 plus tax			
<b>Republic Services</b> 713-849-0400	6 yard (6'Lx6'Wx5'H) Max weight: 1200 pounds	Houston (77058)	Once a week	\$127.00	Galveston County Landfill 3935 Avenue A Santa Fe, TX 77510	One time installation fee of \$133.88 \$7.50/month for gravity bar/lock
			Twice a week	\$223.00		
			Three times a week	\$320.00		
	6 yard (6'Lx6'Wx5'H) Max weight: 1200 pounds	Seabrook (77586)	Does not service this area			
	6 yard (6'Lx6'Wx5'H) Max weight: 1200 pounds	Galveston (77550)	Once a week	\$127.00	Galveston County Landfill 3935 Avenue A Santa Fe, TX 77510	One time installation fee of \$133.88 \$7.50/month for gravity bar/lock
			Twice a week	\$223.00		
			Three times a week	\$320.00		
	8 yard (6'Lx6'Wx6'8"H) Max weight: 1600 pounds	Houston (77058)	Once a week	\$140.00	Galveston County Landfill 3935 Avenue A Santa Fe, TX 77510	One time installation fee of \$133.88 \$7.50/month for gravity bar/lock
			Twice a week	\$245.00		
			Three times a week	\$350.83		
	8 yard (6'Lx6'Wx6'8"H) Max weight: 1600 pounds	Seabrook (77586)	Does not service this area			
	8 yard (6'Lx6'Wx6'8"H) Max weight: 1600 pounds	Galveston (77550)	Once a week	\$140.00	Galveston County Landfill 3935 Avenue A Santa Fe, TX 77510	One time installation fee of \$133.88 \$7.50/month for gravity bar/lock
Twice a week			\$245.00			
Three times a week			\$350.83			



## In-Kind Donation Reply Form

*Donor information:*

\_\_\_\_\_  
First Name M.I. Last Name

\_\_\_\_\_  
Donor Title

\_\_\_\_\_  
Organization or Company Name Phone Fax

\_\_\_\_\_  
Address, Street City St Zip

*Donation information:*

**Recycled Oyster Shells** \_\_\_\_\_ tons/\_\_\_\_\_ CY

Items/Services Donated Quantity (if applicable)

**CLAIMED VALUE OF DONATION:**

\$ \_\_\_\_\_ (\$30/CY)

The Galveston Bay Foundation is a 501(c)(3) organization, tax ID # 76-0279876. The information above is needed for our internal recording keeping.

\_\_\_\_\_  
Donor Signature Date

Please return this form to the Galveston Bay Foundation at the address below.



**OYSTER SHELL**  
**RECYCLING PROGRAM**  
A GALVESTON BAY FOUNDATION PROGRAM

**Outreach & Marketing  
Options for Active  
Restaurant Partners**



# OYSTER SHELL RECYCLING PROGRAM

The Galveston Bay Foundation has designed seven options for public outreach and marketing of the Oyster Shell Recycling Program in participating restaurants. These materials will recognize the efforts of the restaurants contributing to the Oyster Shell Recycling Program in addition to providing educational information about oyster reef restoration to restaurant patrons.

<b>Outreach Options</b>	<b>Estimated Cost</b>	<b>Dimensions</b>
Coasters	\$155/2000	4" diameter round
Insert for Check Presenter	\$175/500	3.75" x 8.75"
Menu Recognition	\$0 (GBF will provide logo; restaurant may incur printing costs)	Menu Specific
Menu Callouts		
Table Tent	\$170/250	3" x 5"
Table Tent	\$185/250	4" x 4"
Window Cling	\$70/10	3" x 6"
Rack Card	\$175/500	4" x 9"

*\*\*prices are quoted estimates, and actual costs may vary\*\**



# COASTER

We recycle our oyster shells.

Eat your way to a healthier Galveston Bay!

[www.galvbay.org/oysters](http://www.galvbay.org/oysters)

**OYSTER SHELL RECYCLING PROGRAM**  
GALVESTON BAY FOUNDATION

**OYSTER SHELL RECYCLING PROGRAM**  
GALVESTON BAY FOUNDATION

Shell Collection

Sun Curing

Reef Restoration

New Life!

This project is funded in part by a Texas Coastal Management Program Grant approved by the Texas Land Commissioner pursuant to National Oceanic and Atmospheric Administration Award No. NA15NO54196162.



INSERT FOR CHECK PRESENTER - *FRONT*

# We Recycle Our Oyster Shells!

**Each shell from  
oysters you eat  
makes its way  
back to the Bay.**

Follow **Galveston  
Bay Foundation** on  
Facebook to get  
involved today!

Visit [www.galvbay.org/oysters](http://www.galvbay.org/oysters)  
for more information.



**OYSTER SHELL**  
RECYCLING PROGRAM

**GALVESTON BAY**  
FOUNDATION

INSERT FOR CHECK PRESENTER – *BACK*



## MENU RECOGNITION

We recycle our oyster shells through  
Galveston Bay Foundation!








**OYSTER SHELL**  
RECYCLING PROGRAM

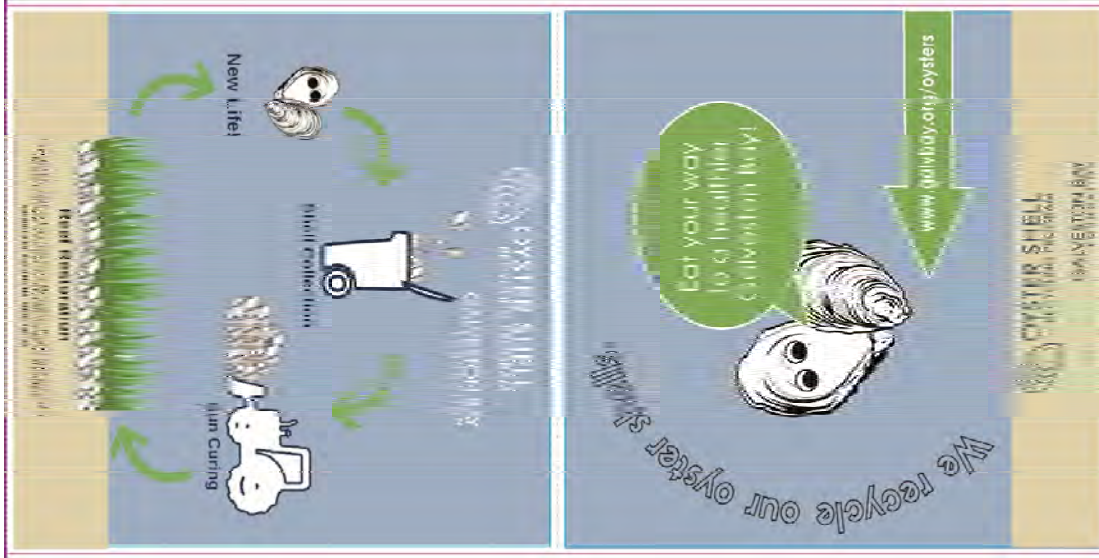
**GALVESTON BAY**  
FOUNDATION

[www.galvbay.org/oysters](http://www.galvbay.org/oysters)

## MENU CALLOUTS

<b>Oysters on the Half Shell</b>	<b>Baked Oysters</b>
 ½ Dozen \$X.XX	 ½ Dozen \$X.XX
1 Dozen \$X.XX	1 Dozen \$X.XX
<b>Fried Oysters</b>	<b>Oysters Rockefeller</b>
 ½ Dozen \$X.XX	 ½ Dozen \$X.XX
1 Dozen \$X.XX	1 Dozen \$X.XX
 All shells from the oysters consumed in this restaurant are recycled through Galveston Bay Foundation's Oyster Shell Recycling Program. For more information visit <a href="http://www.galvbay.org/oysters">www.galvbay.org/oysters</a> .	

## TABLE TENT



## WINDOW CLING



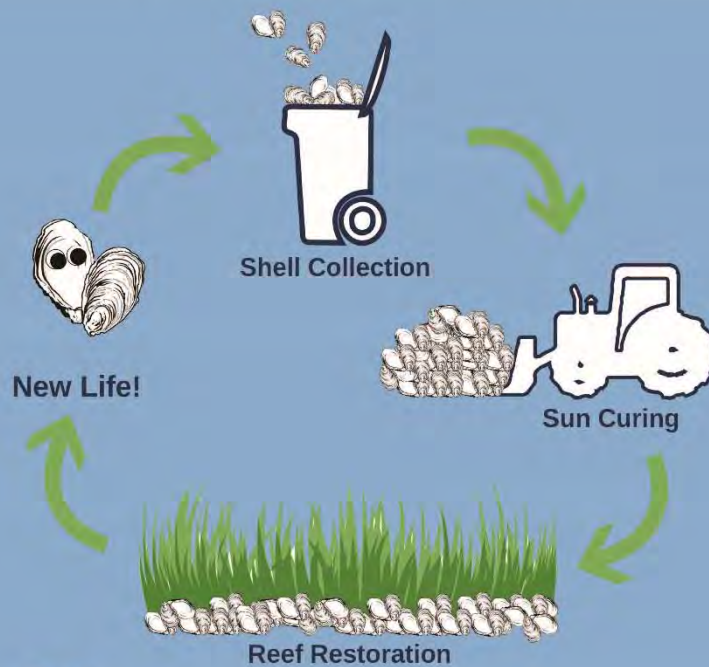
# RACK CARD - FRONT



## OYSTER SHELL RECYCLING PROGRAM

GALVESTON BAY  
FOUNDATION

*Galveston Bay Foundation partners with local restaurants to collect shucked oyster shells after patrons enjoy a tasty meal. The empty oyster shells are sun bleached for a minimum of 6 months to rid them of bacteria. The shells are then returned to Galveston Bay to provide new homes for baby oysters.*



Find out which restaurants recycle their shells at [www.galvbay.org/oysters](http://www.galvbay.org/oysters) and eat your way to a healthier Bay!



# RACK CARD - *BACK*

## WHY ARE OYSTERS SO IMPORTANT?

- ♥ Oysters clean the water
- ♥ Oyster reefs create homes for fish, shrimp, crabs, and many other species
- ♥ Oyster reefs help protect the shoreline
- ♥ Oysters are food for people, birds, & crabs

## WHY RECYCLE OYSTER SHELLS?

Oyster larvae need a hard surface on which to attach so that they may begin to grow. While baby oysters can attach to just about anything, they prefer other oyster shells!



Galveston Bay lost more than 50 percent of its oyster reefs as a result of Hurricane Ike. To help restore the Bay's oyster population, keep our water clean, and provide habitat for aquatic life, Galveston Bay Foundation returns all recycled oyster shells to the Bay through Volunteer Oyster Gardening efforts and Oyster Restoration Workdays.



Interested in becoming an Oyster Program  
**Volunteer? Sponsor? Partner?**  
Contact Haille Carter at [hcarter@galvbay.org](mailto:hcarter@galvbay.org)



A PUBLICATION FUNDED BY A TEXAS COASTAL MANAGEMENT  
PROGRAM GRANT APPROVED BY THE TEXAS LAND COMMISSIONER  
PURSUANT TO NATIONAL OCEANIC AND ATMOSPHERIC  
ADMINISTRATION AWARD NO. NA16NOS4190174.



**APPENDIX H**  
Database of Oyster Shell Recycling  
Programs in the United States

## Database of Oyster Shell Recycling Programs in the United States

State	Organization	Name of Program	Start Date	Equipment	Labor	Public Drop-Off Site	Website
Alabama	Alabama Coastal Foundation	Oyster Shell Recycling Program	2016	Dump Truck (vender)	Contract	No	<a href="http://joinacf.org/oyster-shell-recycling-program">joinacf.org/oyster-shell-recycling-program</a>
Delaware	Delaware Center for the Inland Bays	Don't Chuck Your Shucks	2014	Truck with Lift Gate	Staff	No	<a href="http://inlandbays.org/projects-and-issues/all/dont-chuck-your-shucks">inlandbays.org/projects-and-issues/all/dont-chuck-your-shucks</a>
Delaware	Partnership for the Delaware Estuary	Delaware Estuary Shell Recycling Program	2016	Truck with Lift Gate	Staff	No	<a href="http://delawareestuary.org/science-and-research/oysters">delawareestuary.org/science-and-research/oysters</a>
Florida	Brevard Zoo	Shuck & Share	2014	Unknown	Unknown	No	<a href="http://restoreourshores.org/shuck-and-share">restoreourshores.org/shuck-and-share</a>
Florida	Choctawhatchee Basin Alliance	Offer Your Shell to Enhance Restoration (OYSTER)	2010	Truck & Trailer	Staff	No	<a href="http://basinalliance.org/what-we-do/in-our-communities/oyster-shell-recycling">basinalliance.org/what-we-do/in-our-communities/oyster-shell-recycling</a>
Florida	Coastal Connections, Inc.	Shuck & Share	2019	Personal Vehicle	Volunteers	No	<a href="http://www.coastal-connections.org">www.coastal-connections.org</a>
Florida	Florida Oceanographic Society	Florida Oceanographic Oyster Restoration (FLOOR) *part of Shuck & Share	2014	Unknown	Unknown	No	<a href="http://www.floridaocean.org/floor">www.floridaocean.org/floor</a>
Florida	Friends of Gamble Rogers State Park	Shuck & Share	Unknown	Unknown	Volunteers	No	<a href="http://frogrs.wixsite.com/mysite/shuck-and-share">frogrs.wixsite.com/mysite/shuck-and-share</a>
Florida	Guana Tolomato Matanzas National Estuarine Research Reserve	Oyster Shell Recycling Program	2012	Truck & Trailer	Staff & Volunteers	No	<a href="http://gtmnerr.org/stewardship/aquatic-resource-management">gtmnerr.org/stewardship/aquatic-resource-management</a>
Florida	Halls River Alliance	Shuck & Share	Unknown	Truck & Trailer	Unknown	No	<a href="http://hallsriveralliance.org/shuck-share">hallsriveralliance.org/shuck-share</a>



## Database of Oyster Shell Recycling Programs in the United States

State	Organization	Name of Program	Start Date	Equipment	Labor	Public Drop-Off Site	Website
Florida	Keep Pensacola Beautiful	OYSTER Project (Offer Your Shell to Enhance Restoration)	2011	Truck & Trailer	Staff & Volunteers	No	<a href="http://keeppensacolabeautiful.org/what-we-do/recycling/oyster_1/shell-recycling">keeppensacolabeautiful.org/what-we-do/recycling/oyster_1/shell-recycling</a>
Florida	Marine Discovery Center	Shuck & Share (organized the program)	2014	Truck (vol.) & Box Truck (vendor)	Volunteers & Vendor	No	<a href="http://shuckandshare.org">shuckandshare.org</a>
Florida	Martin County's Coastal and Water Quality Groups	Oyster Reef Restoration Project *receive shell from FLOOR	2014	Truck & Trailer	Staff	No	<a href="http://oysterrestoration.com">oysterrestoration.com</a>
Florida	University of Central Florida	Shuck & Share	2017	Unknown	Restaurants	No	<a href="http://www.cs.ucf.edu/ux/shuck-and-share">www.cs.ucf.edu/ux/shuck-and-share</a>
Louisiana	Coalition to Restore Coastal Louisiana (CRCL)	Oyster Shell Recycling Program	2014	Dump Truck (vendor)	Contract	No	<a href="http://crcl.org/oyster-shell-recycling">crcl.org/oyster-shell-recycling</a>
Maryland	Oyster Recovery Partnership	Shell Recycling Alliance (Oyster Shell Recycling Program)	2010	Box Truck (no vendor)	Staff & Volunteers	No	<a href="http://oysterrecovery.org/sra">oysterrecovery.org/sra</a>
Mass.	Wellfleet SPAT (Shellfish Promotion and Tasting, Inc.)	Shell Recycling Program	2009	Dump Truck (vendor)	Volunteers	No	<a href="http://wellfleetspat.org">wellfleetspat.org</a>
Mass.	Natural Resources Department	Natural Resources Department Shell Recycling Program	2014	Truck with Lift Gate	Staff	No	<a href="http://nantucket-ma.gov/594/Shell-Recycling-Program">nantucket-ma.gov/594/Shell-Recycling-Program</a>
New Hampshire	Coastal Conservation Association of New Hampshire	Great Bay Oyster Shell Recycling Program	2009	Truck & Trailer	Volunteers	No	<a href="http://ccanh.org/oyster-shell-recycling-program">ccanh.org/oyster-shell-recycling-program</a>
New Jersey	American Littoral Society	Shuck It, Don't Chuck It	2016	Truck	Staff	No	<a href="http://littoralsociety.org/operation-oyster">littoralsociety.org/operation-oyster</a>

## Database of Oyster Shell Recycling Programs in the United States

State	Organization	Name of Program	Start Date	Equipment	Labor	Public Drop-Off Site	Website
New York	New York Harbor School	Billion Oyster Project	2014	Box Truck (no vendor)	Staff	No	<a href="http://billionoysterproject.org">billionoysterproject.org</a>
North Carolina	North Carolina Division of Marine Fisheries	Oyster Shell Recycling Program	2003	Public Recycling Station	Volunteers	✓	<a href="http://nccoast.org/uploads/documents/factsheets/FS_oysterrecycle">nccoast.org/uploads/documents/factsheets/FS_oysterrecycle</a>
South Carolina	South Carolina Department of Natural Resources	South Carolina Oyster Restoration and Enhancement (SCORE) Program	2001	Truck & Dump Trailer	Staff & Volunteers	✓	<a href="http://saltwaterfishing.sc.gov/oyster">saltwaterfishing.sc.gov/oyster</a>
Texas	TAMU Corpus Christi Harte Research Institute	Sink Your Shucks	2009	Truck & Trailer & Dump Trailer	Students & University Staff	No	<a href="http://oysterecycling.org">oysterecycling.org</a>
Texas	Galveston Bay Foundation	Oyster Shell Recycling Program	2011	Truck & Trailer	Staff	No	<a href="http://galvbay.org/oysters">galvbay.org/oysters</a>
Virginia	Lynnhaven River NOW	Save Oyster Shell (SOS) *partners of City of Virginia Beach	2006	Truck & Trailer	Staff	✓	<a href="http://lynnhavenrivernow.org/lynnhaven-oysters">lynnhavenrivernow.org/lynnhaven-oysters</a>
Virginia	Virginia Commonwealth University Rice Rivers Center	Virginia Oyster Shell Recycling Program (VOSRP)	2013	Personal Vehicle	Volunteers	✓	<a href="http://ricerivers.vcu.edu/community-engagement/oyster-shell-recycling">ricerivers.vcu.edu/community-engagement/oyster-shell-recycling</a>
Virginia	Chesapeake Bay Foundation	Save Oyster Shell	2005	Personal Vehicle	Volunteers	✓	<a href="http://www.cbf.org/how-we-save-the-bay/programs-initiatives/virginia/oyster-restoration/save-oyster-shell">www.cbf.org/how-we-save-the-bay/programs-initiatives/virginia/oyster-restoration/save-oyster-shell</a>
Virginia	Friends of the Rappahannock	Oyster Program *part of VOSRP	Unknown	Unknown	Unknown	✓	<a href="http://riverfriends.org/oysters">riverfriends.org/oysters</a>

**APPENDIX I**  
Texas Oyster Regulations

## Texas Oyster Regulations as of September 2019

REGULATION	RECREATIONAL	COMMERCIAL	PRIVATE LEASE
<b>General</b>	Oysters may be taken for personal use (food) with a recreational license but may not be sold  Valid fishing license and a saltwater endorsement is required	A vessel used while engaged in fishing with tongs or a dredge requires the purchase of an additional Sport Oyster Boat commercial fishing license	Oysters may not be taken from marked private leases except by permission of the lessee  <i>*TPWD permit required</i>
	Oysters may be taken only from waters approved by the Texas Department of State Health Services Seafood and Aquatic Life Group. For more information call (800) 685-0361 or check the TDSHS website.  <u>CLOSED to HARVEST</u> : Areas along all shorelines with state health department approved or conditionally approved areas for shellfish harvest extending 300 feet from the water's edge or exposed oysters inside of the 300-foot area.		
<b>Season</b>	Monday through Friday; Sunrise to 3:30pm		
	November 1 <sup>st</sup> through April 30 <sup>th</sup>		NO closed season
<b>Approved Devices &amp; Harvest Methods</b>	Harvest by Hand  Tongs  Oyster dredge ≤ 14" width	Harvest by Hand  Tongs  Oyster dredge ≤ 48" width ≤ 2-barrel capacity Only 1 dredge allowed onboard	
<b>Bag Limits</b>	≤ 2 sacks per person	≤ 30 sacks per day	
	A sack is defined as 110 pounds of oysters including dead oyster shell and the sack. No more than 110 lbs. per sack, INCLUDING dead oyster shell and the sack.		
<b>Size Limits</b>	<p><u>LEGAL SIZE</u>: 3 inches or larger as measured by the greatest length of the shell</p> <p>Oysters 3/4 inch to 3 inches and dead oyster shell &gt; 3/4 inch (measured along any axis) must be culled and returned to the reef from which taken</p> <p>Oysters 3/4 inch to 3 inches and dead oyster shell &gt; 3/4 inch may not make up more than 5% by number of oysters in possession</p> <p>No more than the equivalent of 6 sacks of un-culled oysters are permitted on board while on a reef and must remain un-sacked and separate from the culled cargo (Commercial/Private Lease operations)</p>		
<b>Oyster Shell Recovery Program</b>	NA	Harvesters – required to pay \$0.20/sack Dealers – required to return 30% of shell to public reefs or pay fee	

\*Please note, these regulations are based on TPWD's 2019-2020 commercial and recreation guides and are subject to change.