Upper Texas Coast TMDLs: Bacteria in Oyster Waters

- Six TMDLs Adopted August 2008, Approved by EPA February 2009
- **Two TMDLs Added by Addendum January 2012**, Approved by EPA April 2012 (scroll to view or print this publication)

Prepared by the:
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Addendum Two to Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast

Two TMDLs for Bacteria in Drum Bay

For Segment 2435OW
Assessment Units 2435OW_01 and 2435OW_02

Introduction

The Texas Commission on Environmental Quality (TCEQ) adopted the total maximum daily loads (TMDLs) Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast: Segments 2421, 2422, 2423, 2424, 2432, and 2439 (TCEQ 2008) on 8/20/2008. The TMDLs were approved by the United States Environmental Protection Agency (EPA) on 2/4/2009. This is an addendum to that original TMDL document.

Drum Bay (Segment 2435OW) was inadvertently not included in the Draft 2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) (TCEQ 2010a; the Integrated Report), and the TCEQ and EPA reached an agreement to allow it to be addressed through an update to the Water Quality Management Plan (WQMP).

This addendum includes information specific to Drum Bay that has been added to the adopted TMDL. Figure 1 shows Drum Bay's location in relation to the original TMDL segments.

Background Information

This TMDL addresses an impairment to the oyster waters use identified as a "Restricted Harvest Zone" (RHZ) by the Texas Department of State Health Services (DSHS). The RHZ pertinent to this TMDL is described and illustrated by a map in the DSHS publication *Classification of Shellfish Harvesting Areas of West Galveston Bay* (DSHS 2010; Figure 2). The DSHS publication describes the RHZ for Drum Bay as: "All of Drum Bay following a line from Rattlesnake Point 162 degrees southeast to the marsh, then south and west to the Intracoastal Waterway."

This TMDL addresses elevated fecal coliform concentrations in the restricted area for:

- Drum Bay; Segment 2435OW; Assessment Units (AUs) 2435OW_01 (area adjacent to Christmas Bay) and 2435OW_02 (remainder of Drum Bay).

The criteria used for assessing attainment of the oyster waters use are expressed as the number of colony-forming units (cfu) of fecal coliform bacteria per hundred milliliters (100 mL) of water. Using the fecal coliform criteria in the 2010 Texas Surface Water Quality Standards (TCEQ 2010c), if the minimum sample requirement during the assessment period is met, the oyster waters use is not supported when:

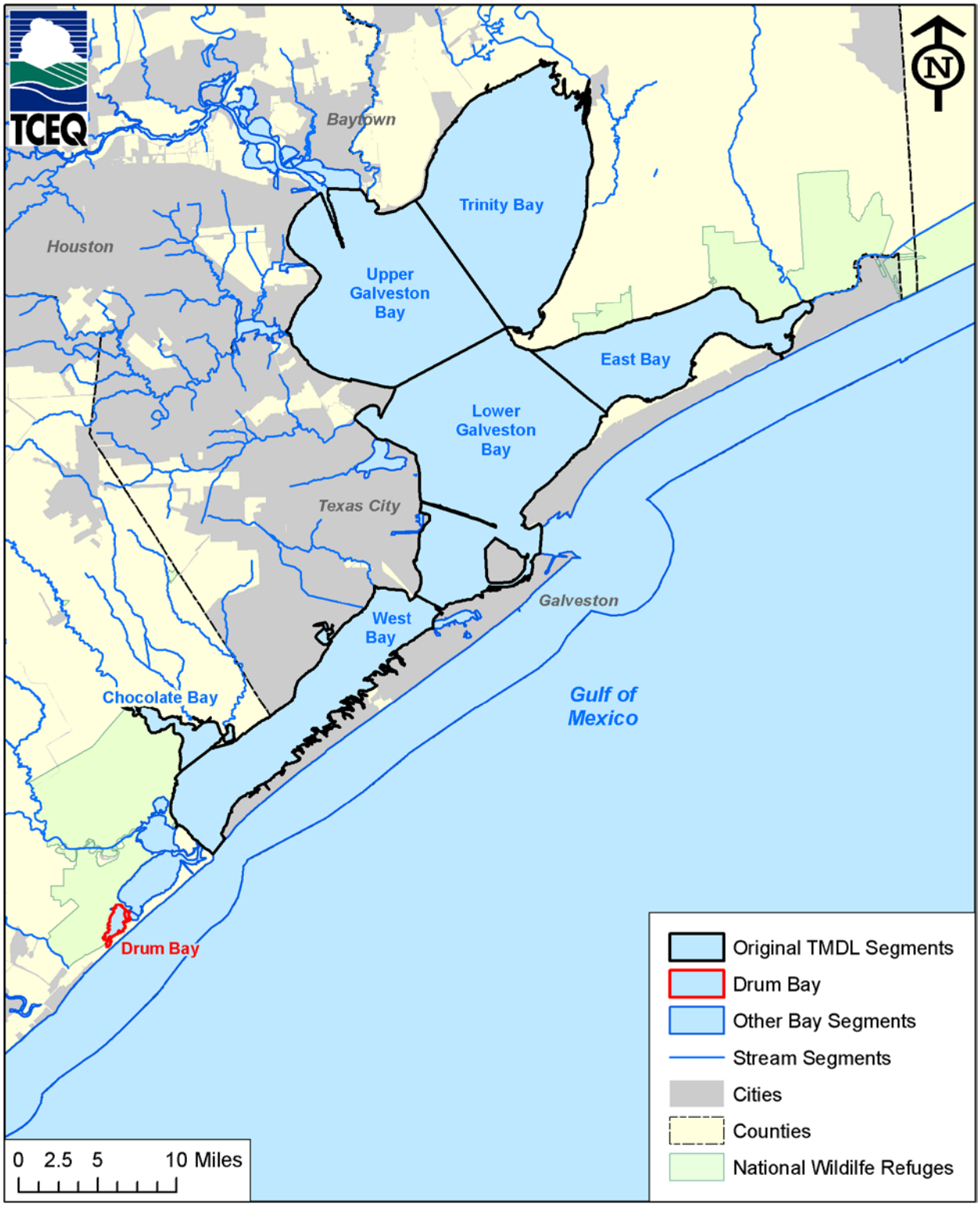


Figure 1. Galveston Bay System [a]

[a] This map was developed by the TMDL Program of the TCEQ. No claims are made to the accuracy or completeness of the data or to its suitability for a particular use.

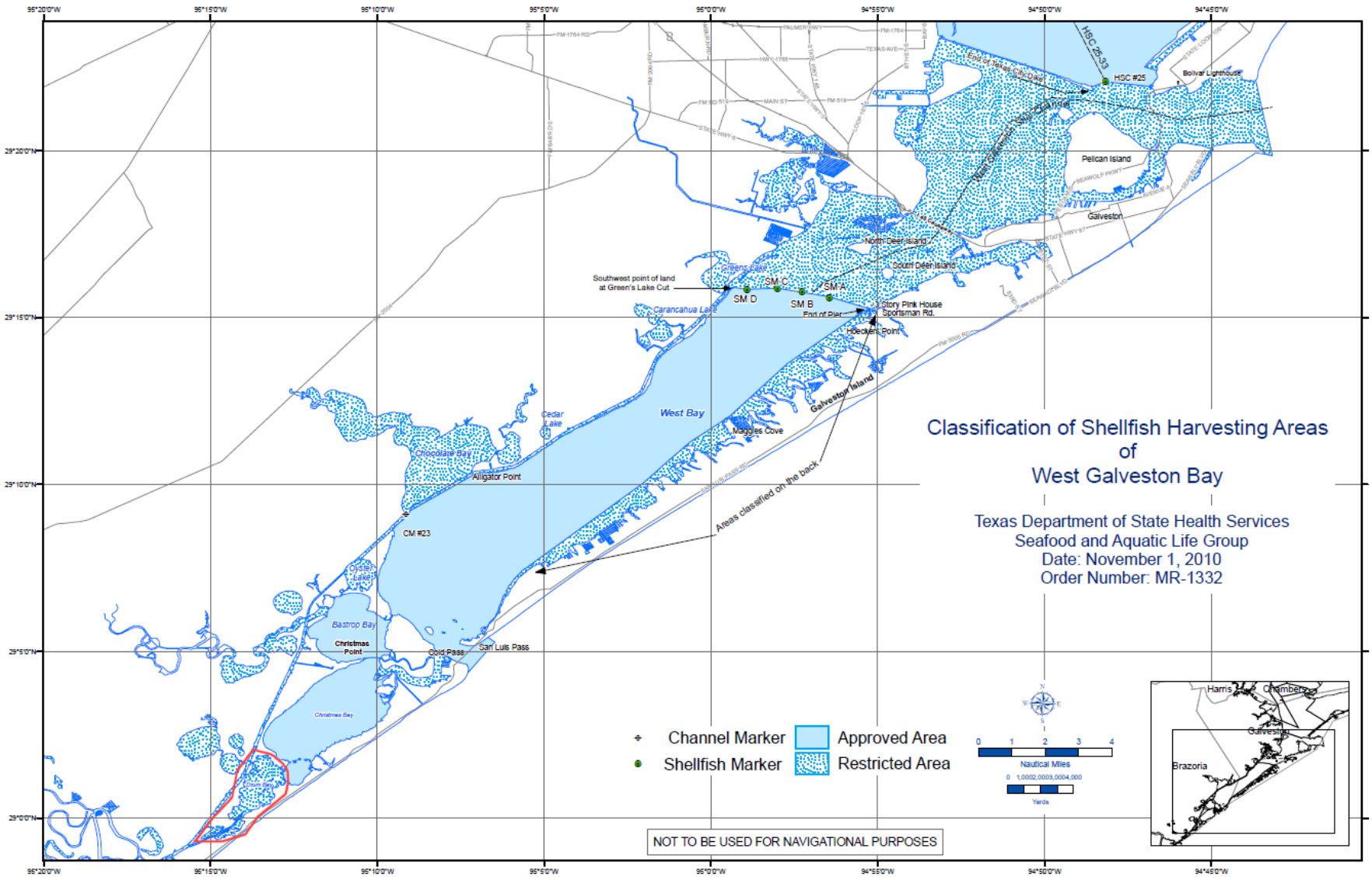


Figure 2. Classification of Shellfish Harvesting Areas of West Galveston Bay (Drum Bay circled in red)

Addendum Two to Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast

Two TMDLs for Bacteria in Drum Bay

For Segment 2435OW
Assessment Units 2435OW_01 and 2435OW_02

Introduction

The Texas Commission on Environmental Quality (TCEQ) adopted the total maximum daily loads (TMDLs) Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast: Segments 2421, 2422, 2423, 2424, 2432, and 2439 (TCEQ 2008) on 8/20/2008. The TMDLs were approved by the United States Environmental Protection Agency (EPA) on 2/4/2009. This is an addendum to that original TMDL document.

Drum Bay (Segment 2435OW) was inadvertently not included in the Draft 2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d) (TCEQ 2010a; the Integrated Report), and the TCEQ and EPA reached an agreement to allow it to be addressed through an update to the Water Quality Management Plan (WQMP).

This addendum includes information specific to Drum Bay that has been added to the adopted TMDL. Figure 1 shows Drum Bay's location in relation to the original TMDL segments.

Background Information

This TMDL addresses an impairment to the oyster waters use identified as a "Restricted Harvest Zone" (RHZ) by the Texas Department of State Health Services (DSHS). The RHZ pertinent to this TMDL is described and illustrated by a map in the DSHS publication *Classification of Shellfish Harvesting Areas of West Galveston Bay* (DSHS 2010; Figure 2). The DSHS publication describes the RHZ for Drum Bay as: "All of Drum Bay following a line from Rattlesnake Point 162 degrees southeast to the marsh, then south and west to the Intracoastal Waterway."

This TMDL addresses elevated fecal coliform concentrations in the restricted area for:

- Drum Bay; Segment 2435OW; Assessment Units (AUs) 2435OW_01 (area adjacent to Christmas Bay) and 2435OW_02 (remainder of Drum Bay).

The criteria used for assessing attainment of the oyster waters use are expressed as the number of colony-forming units (cfu) of fecal coliform bacteria per hundred milliliters (100 mL) of water. Using the fecal coliform criteria in the 2010 Texas Surface Water Quality Standards (TCEQ 2010c), if the minimum sample requirement during the assessment period is met, the oyster waters use is not supported when:

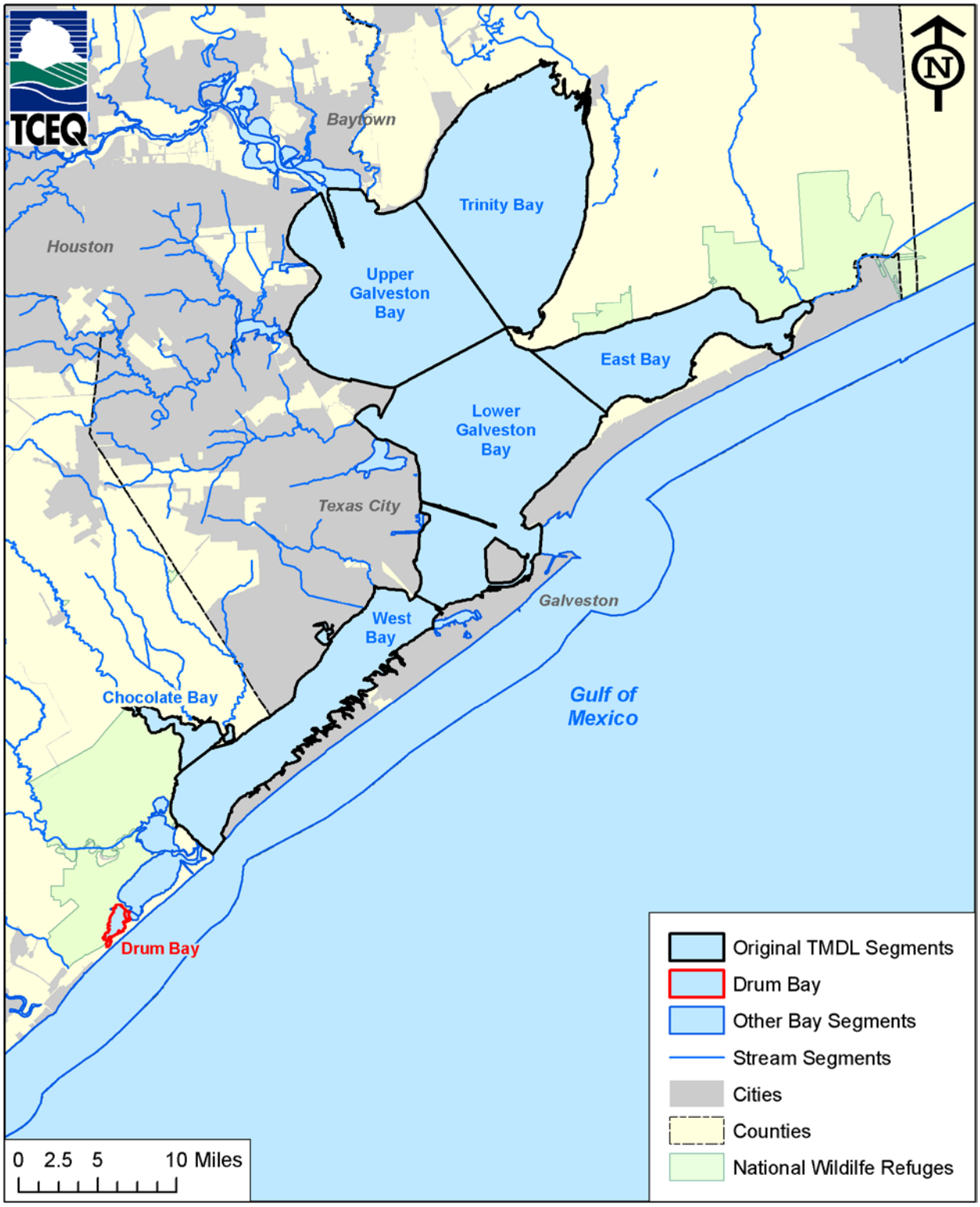


Figure 1. Galveston Bay System [a]

[a] This map was developed by the TMDL Program of the TCEQ. No claims are made to the accuracy or completeness of the data or to its suitability for a particular use.

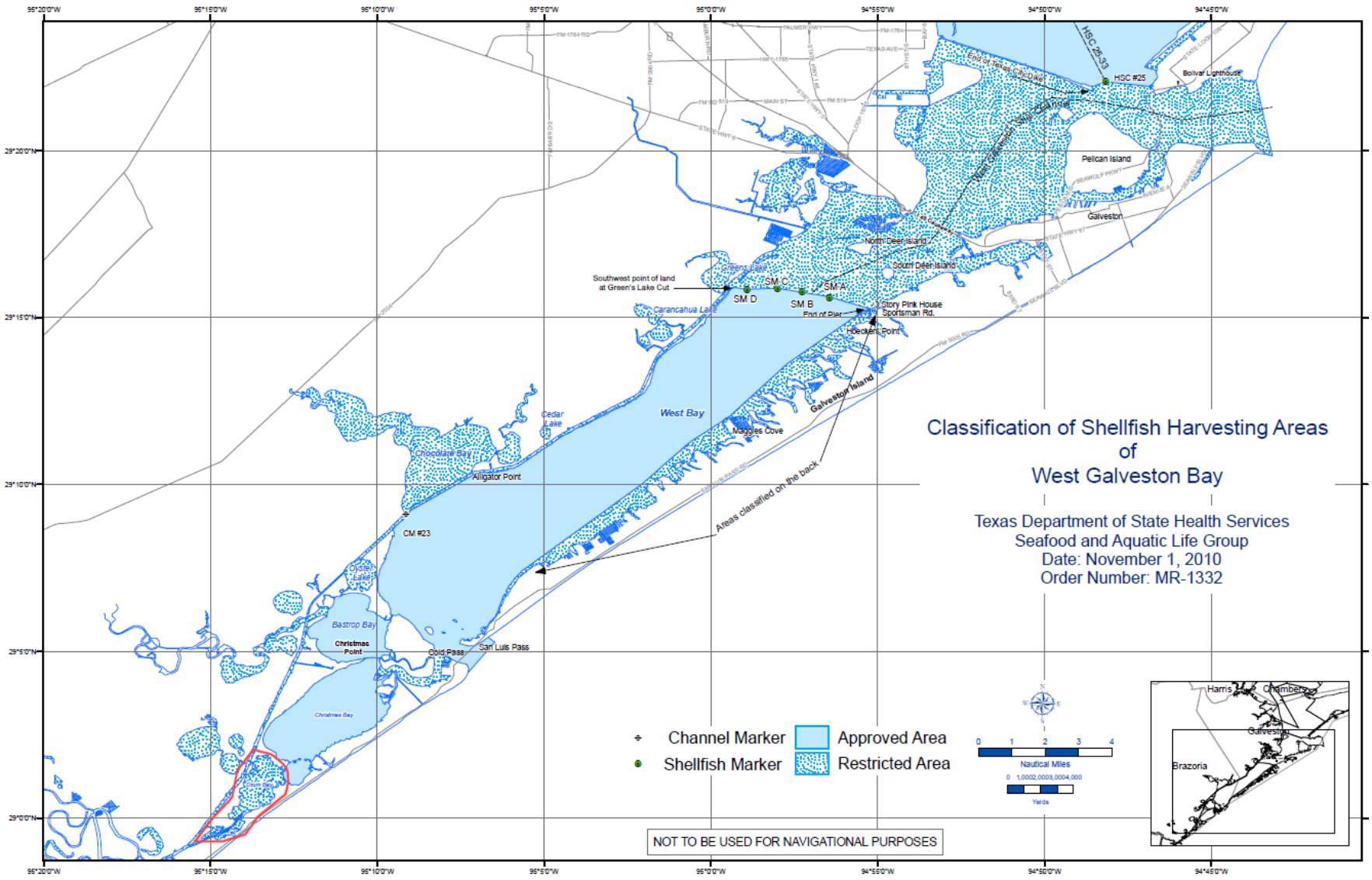


Figure 2. Classification of Shellfish Harvesting Areas of West Galveston Bay (Drum Bay circled in red)

- the median fecal coliform concentration in bay and gulf waters, exclusive of 1,000-foot shoreline buffer zones, exceeds 14 cfu per 100 mL; AND/OR
- more than 10 percent of all samples exceed 43 cfu per 100 mL.

However, DSHS may use other factors in addition to a simple application of the Water Quality Standards to determine the classification of oyster harvest zones. Additionally, the TCEQ bases its list of impaired oyster waters on the DSHS classifications rather than on its own assessments of the fecal coliform data for these water bodies (TCEQ 2010b).

Drum Bay Information

Drum Bay has an area of about 1.97 square miles (5.10 square kilometers), based on the TCEQ's definition of the segment (Figure 3). As shown in Figure 3, the DSHS designation of the RHZ for Drum Bay does not perfectly coincide with the TCEQ's designation of the Drum Bay impaired AUs, extending slightly farther to the southwest on the DSHS map.

Drum Bay is located at the southwestern end of the Galveston Bay system. It is bordered by Christmas Bay to the northeast, Follets Island to the southeast, and Brazoria National Wildlife Refuge to the west. The Gulf Intracoastal Waterway is just inland from Drum Bay along its western edge. Drum Bay has an average depth of 1.1 feet (GBNEP 1991).

In the original TMDL, the 90th percentile criterion was found to be the most critical condition for examining the fecal coliform data, and that applies to the Drum Bay data as well. This percentile represents the most stringent conditions that are likely to result in attainment of the water quality standard. Table 1 updates Table 3 in the original TMDL, and is based on fecal coliform data provided by DSHS. The date range for the data is 12/01/2001 – 11/30/2008. This matches the dates for data used in the 2010 Integrated Report.

Table 1. Bacteria Concentration in Drum Bay

Segment Number	Segment Name	Number of Samples in RHZ	RHZ Median (cfu/100 mL of Fecal Coliform)	RHZ 90th Percentile (cfu/100 mL of Fecal Coliform)	Exceedances at Sampling Locations within RHZ
2435OW	Drum Bay	245	8	79	Yes

Table 2 updates Table 5 in the original TMDL, and is based on the same DSHS data used in Table 1. The 90th percentile criterion was used to determine the percent reduction goals. Since all stations are below the median criterion, the load reductions based on attainment of the 90th percentile criterion are also protective of the median criteria. DSHS provided data for five stations associated with Drum Bay. Four of these stations fall within the 1,000-foot shoreline buffer. This area is subject to the contact recreation standard, and the oyster waters standard would normally not apply. However, due to the very small size of this bay, all stations are included in the table.

During previous WQMP updates related to the original TMDL report, a method was developed to consistently determine when regulated dischargers should be given individual wasteload allocations (WLAs). Specifically, facilities discharging within one stream mile of the listed segments should be given individual WLAs. There are no permitted discharges to Drum Bay. Therefore, there are no WLAs to add or revise in Table 6 or Appendix A in the original TMDL document. Should permits be issued to wastewater dischargers in the future, the permits should include individual WLAs determined through the regular WQMP update process.

Storm water flowing into Drum Bay is not regulated. There are no marinas on Drum Bay. These were identified as potential sources of bacteria in certain areas covered by the original TMDL, but are not pertinent here.

Table 2. Endpoint Target Reductions at Sampling Stations

Sampling Station	Number of Samples[a]	Median[b]	90th Percentile[b]	Exceedance Identified	Median Reduction to Meet End-point	90th Percentile Reduction to Meet End-point
FRE-11[c]	49	10	55	Yes	N/A	22%
FRE-24	49	11	79	Yes	N/A	46%
FRE-25	49	7	47	Yes	N/A	8%
FRE-26	49	11	49	Yes	N/A	12%
FRE-31	49	8	616	Yes	N/A	93%

a. Samples used in assessing bacteria concentrations were collected during the 2010 assessment period (12/01/2001 – 11/30/2008).

b. All concentrations are reported in cfu/100 mL.

c. Station FRE-11 is the only station outside the 1,000-foot shoreline buffer area.

The original TMDL report established concentration-based TMDLs and load allocations expressed in terms of bacteria concentrations. Table 3 below updates Table 11 in the original document.

Table 3. TMDL Indicator Bacteria for Drum Bay

Water Body	TMDL Indicator Parameter
Drum Bay (2435OW_01 & 2435OW_02)	Fecal coliform 90th percentile < 43 cfu/100 mL

Table 4 presents concentration-based limits (load allocations) for indicator bacteria in the source categories associated with the Upper Gulf Coast project, including Drum Bay. These load allocations will apply year-round to each source category of pollution in the watershed (e.g., urban runoff, on-site sewage facilities (OSSFs), wastewater treatment facilities (WWTFs), boat discharges). Compliance with these load allocations will ensure protection of the water quality and benefi-

cial uses of the bay. Table 4 in this addendum is a reproduction of Table 12 from the original TMDL document.

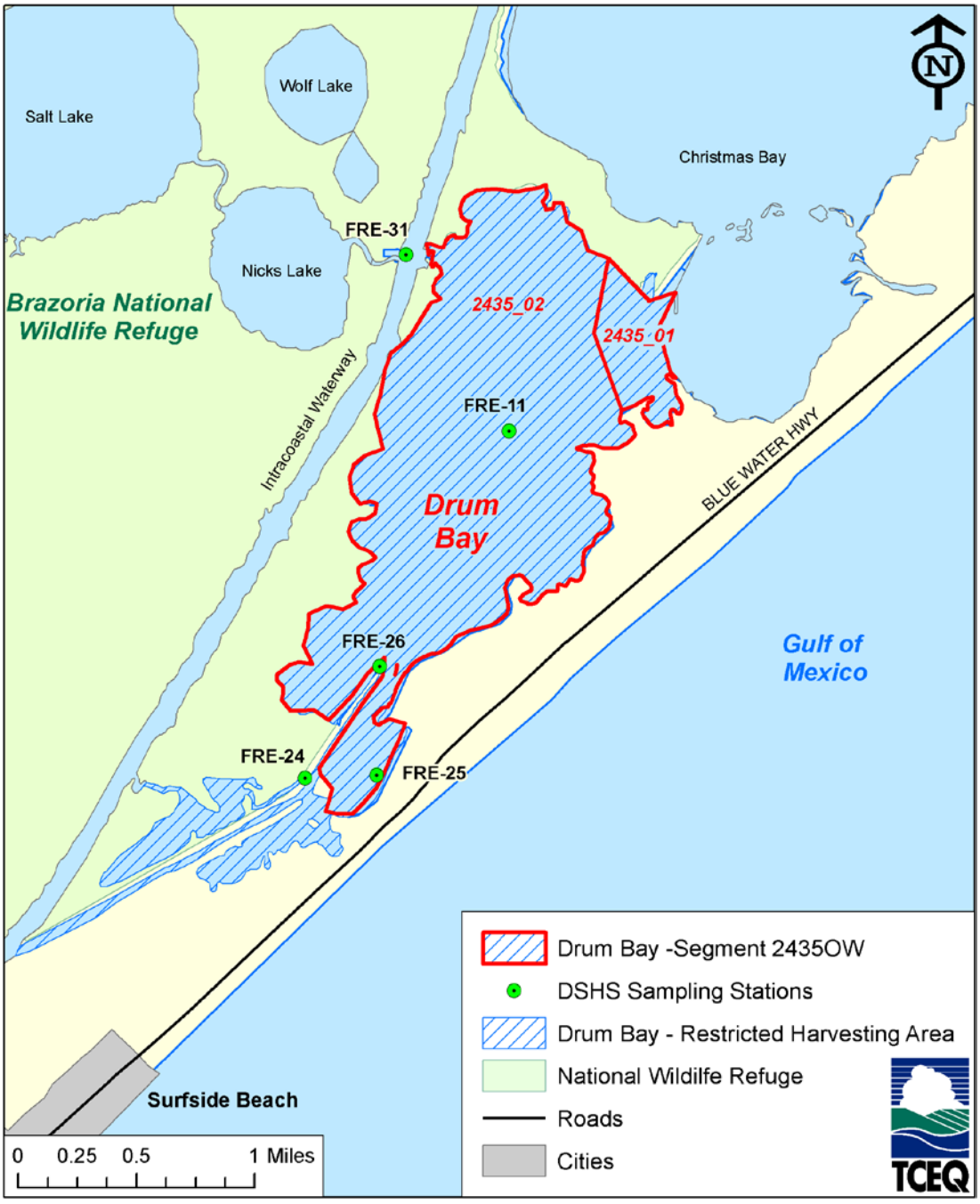


Figure 3. Drum Bay[a]

[a] This map was developed by the TMDL Program of the TCEQ. No claims are made to the accuracy or completeness of the data or to its suitability for a particular use.

Table 4. Concentration-Based Pollutant Wasteload and Load Allocations for Upper Gulf Coast Segments[a]

Discharge Type	Fecal coliform densities for Discharges to the RHZ	For Discharges to Adjacent Watersheds and the 1,000 foot Buffer Zone[b]
Wasteload Allocations		
Mechanical WWTFs[c]	Discharges directly to the RHZ are not possible[d]	Fecal Coliform 200 per 100 mL OR *E. coli* 126 per 100 mL OR Enterococcus 35 per 100 mL
Wetland WWTFs	Discharges directly to the RHZ are not possible[d]	Wetland systems are measured based on detention time. Human waste must be detained for at least 21 days in sun light before reaching the bay system, unless individual permit requires additional time.
Municipal Separate Storm Sewer Systems (MS4s)[c]	Discharges directly to the RHZ are not possible[e]	Numerical concentrations requirements are unreasonable for storm water runoff. This TMDL will require MS4s to follow implementation of bacteria reduction efforts and best management practices.
Load Allocations		
OSSFs	Discharges directly to the RHZ are not possible[e]	0 per 100 mL
Recreational Boat and Ship Discharges	0 per 100 mL	0 per 100 mL
Marina	Discharges directly to the RHZ are not possible[d]	0 per 100 mL
Non-Regulated Municipal Runoff	Discharges directly to the RHZ are not possible[e]	Numerical concentrations requirements are unreasonable for storm water runoff. Incentive based options will be developed for municipalities with non-regulated runoff. Bacteria reductions will be achieved through the implementation of the resulting implementation plan.
Direct Deposition into Segment[f]	The reduction of wildlife or changing natural background conditions is not the intended goal of a TMDL.	The reduction of wildlife or changing natural background conditions is not the intended goal of a TMDL.

a. Allocations are applicable year-round. WLAs apply to any sources (existing or future) subject to regulation by a Texas Pollutant Discharge Elimination System (TPDES) permit.

b. All concentrations limits within the 1,000-foot buffer zone will be based on the geometric means of the applicable indicator bacteria.

c. Regulated entities may use indicator bacteria other than fecal coliform, as listed in individual TPDES permits. Indicator bacteria concentrations for each permit must be consistent with the applicable water quality standard for the receiving water. Dischargers releasing effluent into a segment buffer zone shall meet those water quality standards.

d. Discharges to RHZ are not possible for WWTFs and Marinas because DSHS implements safety perimeters known as Prohibited Harvest Zones around this source to protect against any unauthorized discharges of raw sewage.

e. Discharges to RHZ are not possible because TCEQ implements a 1,000-foot buffer zone around this source designated as contact recreation.

f. The listed segments contain wildlife and unmanaged animals and are therefore potential sources.

Median Fecal Coliform Capacity of Restricted Harvest Zone Assessment Units

Table 5 updates the table in the first addendum to the original TMDL that gave the capacity of the restricted oyster water assessment units based on the oyster waters criterion for fecal coliform (14 cfu/100mL; the median concentration).

Table 5. Median RHZ Capacity in Drum Bay

Segment Name	RHZ Assessment Unit	Area (Sq. Mi.)	Average Depth (Ft.)	Volume (Cu. Ft)	Median RHZ Capacity (cfu)
Drum Bay	2435OW_01	0.15	1.1	4,569,270	1.81E+10
Drum Bay	2435OW_02	1.82	1.1	55,689,892	2.21E+11

References

DSHS 2010. Classification of Shellfish Harvesting Areas of West Galveston Bay. Texas Department of State Health Services. <www.dshs.state.tx.us/ WorkArea/linkit.aspx? LinkIdentifier=id&ItemID=8589935647>.

GBNEP 1991. An Environmental Inventory of the Christmas Bay Coastal Preserve. Publication GBNEP-7. Galveston Bay National Estuary Program. <http://gbic.tamug.edu/ gbeppubs/7/gbnep-7.html>.

TCEQ 2006. 2006 Texas Water Quality Inventory and 303(d) list. <www.tceq.texas.gov/assets/public/compliance/monops/water/06twqi/ 2006_303d.pdf>.

TCEQ 2008. Six Total Maximum Daily Loads for Bacteria in Waters of the Upper Gulf Coast: Segments 2421, 2422, 2423, 2424, 2432, and 2439. Texas Commission on Environmental Quality. <www.tceq.state.tx.us/assets/public/ implementation/water/ tmdl/74uppercoast/74-uppercoast_tmdlapproved.pdf>.

TCEQ 2010a. Draft 2010 Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d). Texas Commission on Environmental Quality. <www.tceq.texas.gov/water quality/assessment/10twqi/10twqi>.

TCEQ 2010b. Guidance for Assessing and Reporting Surface Water Quality in Texas. Texas Commission on Environmental Quality. <www.tceq.texas.gov/assets/public/compliance/monops/water/10twqi/ 2010_guidance.pdf>.

TCEQ 2010c. Texas Surface Water Quality Standards. Texas Commission on Environmental Quality. <www.tceq.texas.gov/waterquality/standards/ 2010standards.html>.

Revised Tables

Tables and table numbers from the original TMDL report, revised based on the information in this addendum

Revised Table 1. Characteristics of Impaired Segments of Galveston Bay

Segment Name	Segment Number	Year Listed	Area (square kilometers)	Percent Area in the RHZ
Upper Galveston Bay	2421	1996	299.1	47%
Trinity Bay	2422	2000	317.5	48%
East Bay	2423	1998	148.9	25%
West Bay	2424	1996	195.3	37%
Chocolate Bay	2432	1996	21.1	100%
Drum Bay[1]	2435OW	2010	5.1	100%
Lower Galveston Bay	2439	1996	362.4	27%

[1] Inadvertently not included in the first published 2010 Integrated Report

Revised Table 3. Bacteria Concentrations in Impaired Segments of Galveston Bay

Segment Number	Segment Name	Number of Samples in RHZ	RHZ Median (cfu/100 mL of Fecal Coliform)	RHZ 90th Percentile (cfu/100 mL of Fecal Coliform)	Exceedances at Sampling Locations within RHZ
2421	Upper Galveston Bay	947	8.0	130.0	Yes
2422	Trinity Bay	376	2.0	33.0	Yes
2423	East Bay	199	2.0	36.2	Yes
2424	West Bay	515	5.0	49.0	Yes
2432	Chocolate Bay	37	5.0	61.0	Yes
2435OW	Drum Bay	245	8	79	Yes
2439	Lower Galveston Bay	707	2.0	49.0	Yes

Revised Table 4. Use Attainment of Segments of Galveston Bay

Segment Number	Segment Name	Recreational Use	Oyster Use	Parameter
2421	Upper Galveston Bay	Fully Supporting	Dependent upon specific location	Bacteria
2422	Trinity Bay	Fully Supporting	Dependent upon specific location	Bacteria
2423	East Bay	Fully Supporting	Dependent upon specific location	Bacteria
2424	West Bay	Fully Supporting	Dependent upon specific location	Bacteria
2432	Chocolate Bay	Fully Supporting	Non-Supporting	Bacteria
2435OW	Drum Bay	Fully Supporting	Non-Supporting	Bacteria
2439	Lower Galveston Bay	Fully Supporting	Dependent upon specific location	Bacteria

Revised Table 5. Endpoint Target Reductions at Sampling Stations in Project Segments

Station	Number of Samples[a]	Median[b]	90th Percentile[b]	Exceedance Identified	Median Reduction	90th Percentile Reduction
Segment 2421, Upper Galveston Bay: Station and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
13305	5	10.0	18.0	No		
14546	35	23.0[c]	130.0[d]	Yes	39%	67%
14556	67	11.0	73.6	Yes		42%
14560	107	5.0	110.0	Yes		61%
14562	105	5.0	97.6	Yes		56%
14570	116	5.0	79.0	Yes		46%
14571	107	13.0	174.0	Yes		75%
14572	107	10.0	110.0	Yes		61%
14580	58	79.0	920.0	Yes	82%	95%
14581	120	7.5	110.0	Yes		61%
14582	120	2.0	49.0	Yes		12%
Segment 2422, Trinity Bay: Stations and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
13314	62	2.0	23.0	No		
13315	66	2.0	15.0	No		
14548	62	6.0	49.0	Yes		12%
14549	60	5.0	51.1	Yes		16%

Station	Number of Samples[a]	Median[b]	90th Percentile[b]	Exceedance Identified	Median Reduction	90th Percentile Reduction
16838	64	2.0	16.1	No		
17092	62	2.0	22.4	No		
Segment 2423, East Bay: Stations and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
14527	56	2.0	24.5	No		
14528	47	2.0	97.4	Yes		56%
14529	49	2.0	13.8	No		
14530	47	2.0	63.8	Yes		33%
Segment 2424, West Bay: Stations and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
13321	37	13.0	33.0	No		
14607	37	2.0	3.2	No		
14608	37	11.0	49.0	Yes		12%
14618	36	2.0	17.0	No		
14620	37	11.0	49.0	Yes		12%
14621	37	5.0	33.0	No		
14622	36	13.5	94.5	Yes		54%
14623	37	11.0	73.6	Yes		42%
16839	37	8.0	99.4	Yes		57%
16840	37	2.0	9.2	No		
16841	37	2.0	19.4	No		
16842	37	5.0	73.6	Yes		42%
16844	37	5.0	33.0	No		
Segment 2439, Lower Galveston Bay: Stations and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
14576	120	4.0	79.0	Yes		46%
14577	122	8.0	79.0	Yes		46%
14584	122	2.0	49.0	Yes		12%
14594	54	4.0	20.5	No		
14595	53	5.0	49.0	Yes		12%
14597	57	2.0	10.0	No		

Station	Number of Samples[a]	Median[b]	90th Percentile[b]	Exceedance Identified	Median Reduction	90th Percentile Reduction
Segment 2432 Chocolate Bay: Stations and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
14610	37	5.0	61.0	Yes		30%
Segment 2435OW Drum Bay: Stations and Sampling Results					**Reductions Needed to Meet Endpoint Concentrations**	
FRE-11c	49	10	55	Yes		22%
FRE-24	49	11	79	Yes		46%
FRE-25	49	7	47	Yes		8%
FRE-26	49	11	49	Yes		12%
FRE-31	49	8	616	Yes		93%

a. Samples used in assessing bacteria concentrations were collected during the years 2001 through 2008 (varies by station).

b. All concentrations are reported in cfu/100 mL.

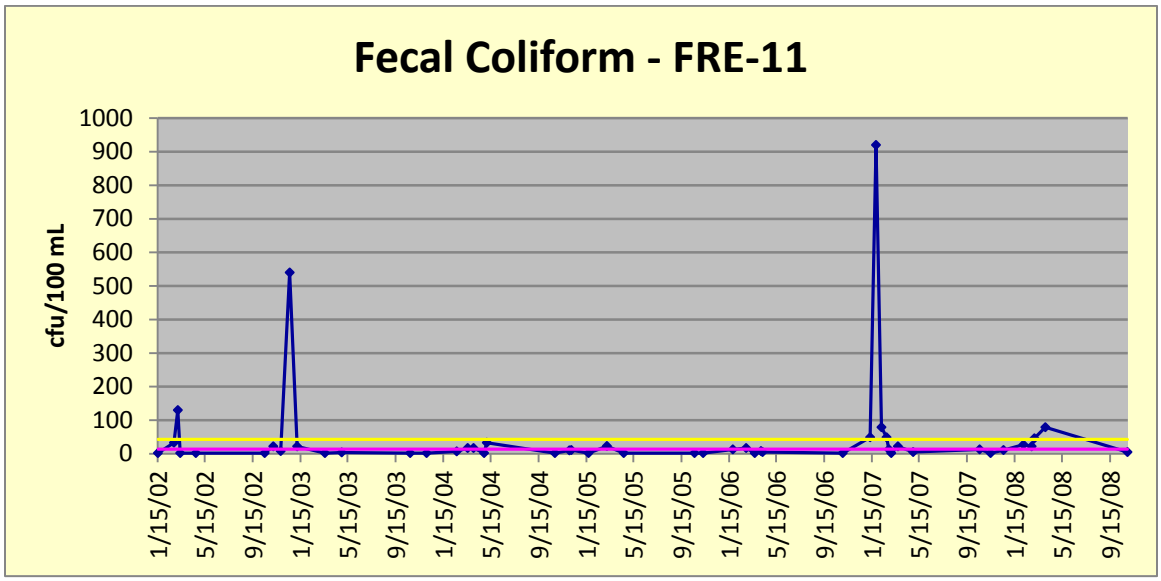
c. Pink shading indicates concentrations exceed the median criterion.

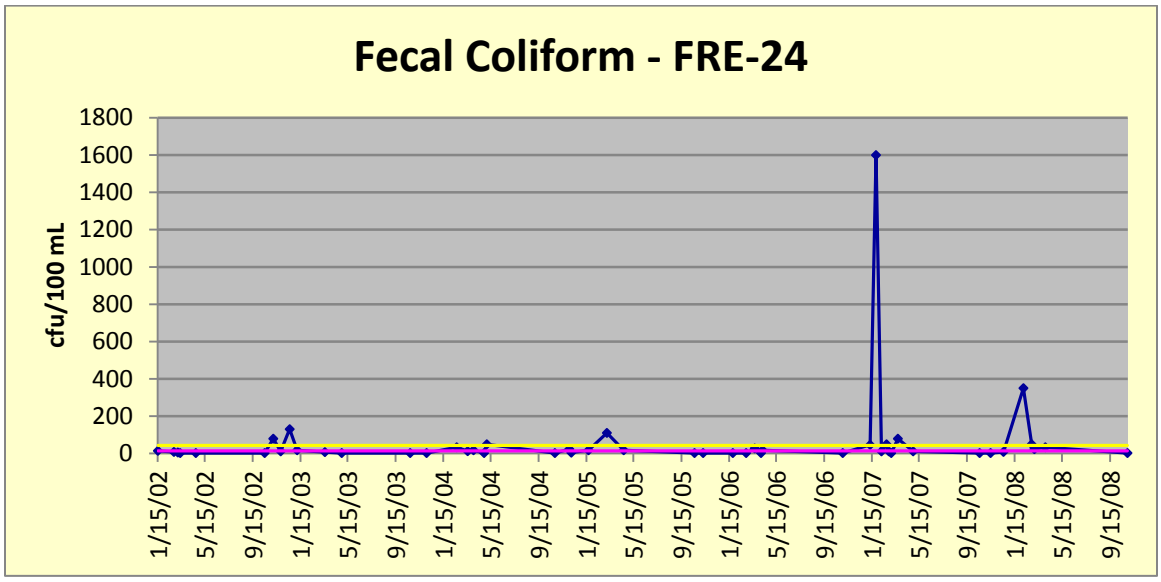
d. Gray shading indicates concentrations exceed the 90th percentile criterion.

Revised Table 11. Total Maximum Daily Loads of Indicator Bacteria for Galveston Bay System Segments

Segment Name	TMDL Indicator Parameter
Upper Galveston Bay Trinity Bay East Bay West Bay Chocolate Bay Lower Galveston Bay Drum Bay	Fecal coliform 90th Percentile < 43 cfu/100 mL

Revisions to Appendix B:
Temporal Trends in Bacteria Samples

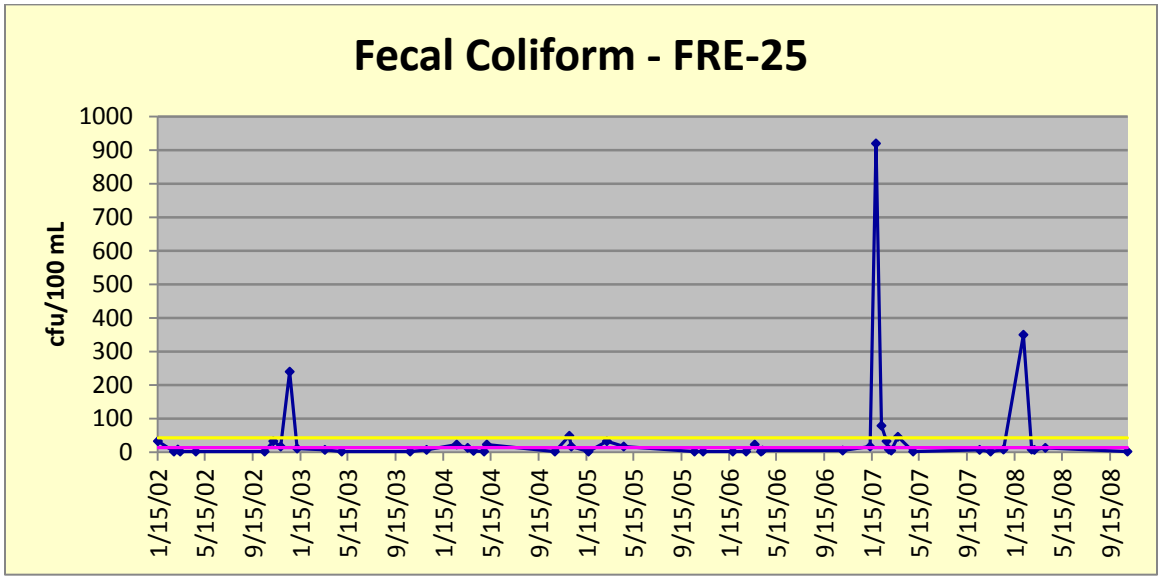


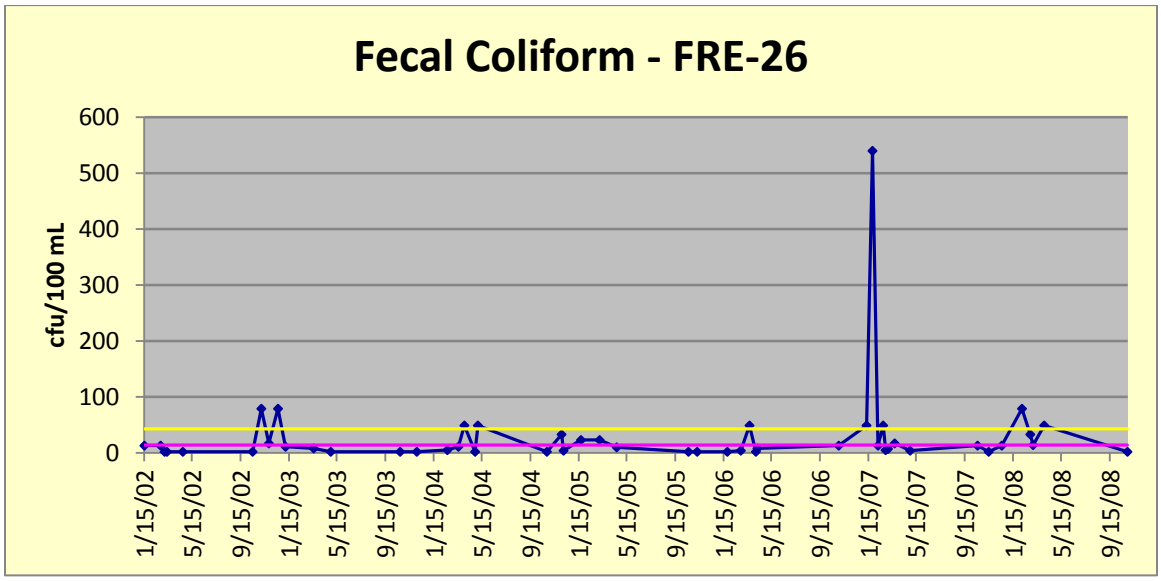


Yellow Line = 90th percentile criterion (43 cfu/100mL)

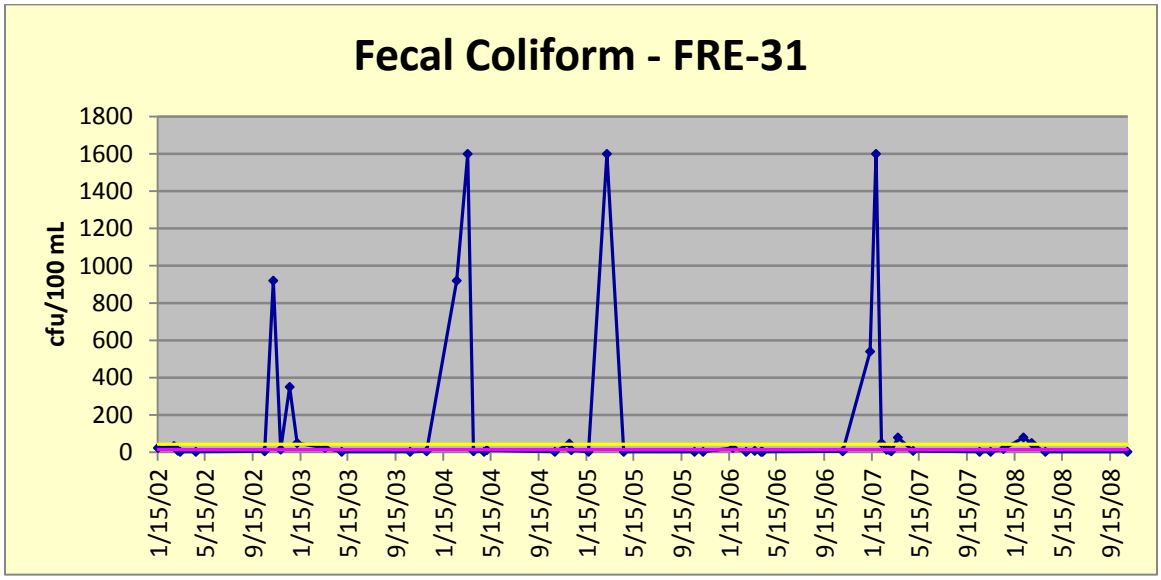
Red Line = median criterion (14 cfu/100mL)

Yellow shaded border = concentrations at station exceeded 90th percentile criterion.





Yellow Line = 90th percentile criterion (43 cfu/100mL)
Red Line = median criterion (14 cfu/100mL)
Yellow shaded border = concentrations at station exceeded 90th percentile criterion.



Yellow Line = 90th percentile criterion (43 cfu/100mL)

Red Line = median criterion (14 cfu/100mL)

Yellow shaded border = concentrations at station exceeded 90th percentile criterion.

Revised First Addendum: Median Fecal Coliform Capacity of Restricted Harvest Zone Assessment Units

Based on the Oyster Waters criterion of 14 cfu/100mL (the median concentration), the capacity of the restricted oyster water assessment units are listed below.

Segment Name	RHZ Assessment Unit	Area (Sq. Mi.)	Average Depth (Ft.)	Volume (Cu. Ft)	Median RHZ Capacity (cfu)
Upper Galveston Bay	2421_01	16.8	9.5	4,449,392,640	1.76E+13
Upper Galveston Bay	2421_02	48.2	9.5	12,765,519,360	5.06E+13
Trinity Bay	2422_01	64.4	7.5	13,465,267,200	5.34E+13
East bay	2423_01	52.1	3.5	5,083,626,240	2.02E+13
Chocolate Bay	2432_01	7.6	3.5	741,565,440	2.94E+12
West Bay	2424_02	17.1	5	2,383,603,200	9.45E+12
Drum Bay	2435OW_01	0.15	1.1	4,569,270	1.81E+10
Drum Bay	2435OW_02	1.82	1.1	55,689,892	2.21E+11
Lower Galveston Bay	2439_01	38.4	3.5	3,746,856,960	1.49E+13