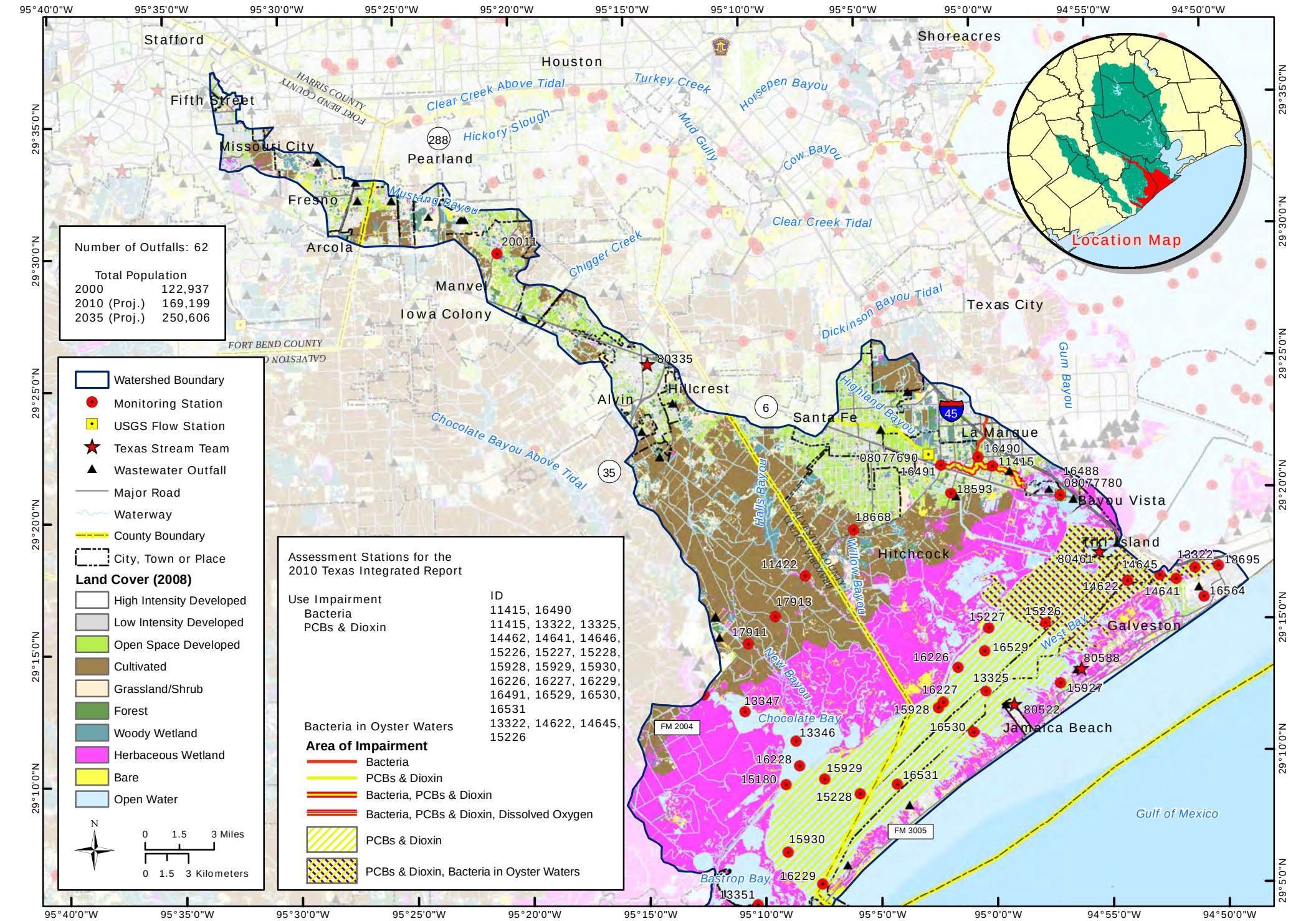
WEST BAY - SEGMENT 2424



Segment Number:	2424	Name:	West Galveston Bay		
Area:	69.3 square miles	Miles of shoreline	63.6 miles	Designated Uses:	Contact Recreation; High Aquatic Life Use; Oyster Waters
Number of Active Monitoring Stations:	15	Texas Stream Team Monitors:	4	Permitted Outfalls:	17

Description:

A 179.5 square kilometer (69.3 square mile) portion of the Galveston Bay system located on the landward side of Galveston Island, extending from the Galveston Causeway (IH-45) in Galveston County to the western side of San Luis Pass and the eastern shore of Mud Island in Brazoria County

Sub-Segment 2424A: Highland Bayou (unclassified water body)—From Jones Bay confluence to Avenue Q 0.8 km (0.5 mi) north of SH 6 between Arcadia and Alta Loma in Galveston County

Sub-Segment 2424C: Marchand Bayou (unclassified water body)—From Highland Bayou confluence to 0.72 km (0.45 mi) north of IH 45 in Galveston County

Sub-Segment 2424D: Offatts Bayou (unclassified water body)—Located on the east end of Galveston Island, running parallel with the southern terminus of IH 45, and joins West Bay near Teichman Point

Degree of Impairment and Overall Trends

Segment ID	Dissolved Oxygen	Bacteria	Nutrients	PCBs/Dioxin	Chlorophyll *a*	Other
2424				100		
2424A	100	98		100	88	
2424B					100	
2424C	100	100				
2424D				100	61	
2424E					100	
2424F						
2424G						

Indicates general improvement Indicates general degradation Numbers indicate percent of segment impaired

FY 2011 Active Monitoring Stations				
Site ID	**Site Description**	**Frequency**	**Monitoring Entity**	**Parameter Groups**
11415	Highland Bayou at Fairwood Rd	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a
13322	Offat Bayou opposite canal	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a
13325	West Bay near Carancahua Reef	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll-a
13325	West Bay near Carancahua Reef	Once/ Year	TCEQ	Benthics, Metals in Sediment
14622	West Bay at Range Marker D	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a
14645	Offatts Bayou off CM 18	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a
16226	West Bay at 97gb032	Quarterly	TCEQ	Filed, Conventional, Bacteria, Chlorophyll-a
16227	West Bay at 97gb033	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll-a
16229	West Bay at 97gb035	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll-a
16488	Highland Bayou upstream of SH 6 bridge	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a
16490	Marchand Bayou tidal at FM 519	Quarterly	EIH	Field, Conventional, Bacteria
16491	Highland Bayou at FM 2004	Quarterly	EIH	Field, Conventional, Bacteria
16564	Lake Madeline at Beluche Drive	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a
18593	Diversion Canal at 2nd Street	Quarterly	EIH	Field, Conventional, Bacteria
18695	English Bayou mid bayou	Quarterly	EIH	Field, Conventional, Bacteria, Chlorophyll-a

Segment 2424

Standards		**Screening Levels**	
Temperature (°C):	35	Ammonia-N (mg/L):	0.10
Dissolved Oxygen *(24-Hr Average)* (mg/L):	4.0	Nitrate-N (mg/L):	0.17
Dissolved Oxygen *(Absolute Minima)* (mg/L):	3.0	Orthophosphate Phosphorus (mg/L):	0.19
pH (standard units):	6.5-9.0	Total Phosphorus-P (mg/L):	0.21
Enterococci (MPN/100mL) (grab):	89	Chlorophyll-*a* (µg/L):	11.6
Enterococci (MPN/100mL) (geometric mean):	35		
Fecal Coliform in Oyster Waters (CFU/100mL) (median/grab):	14/43		

Water Quality Issues Summary					
Issue	**2008 Assessment**	***Draft* 2010 Assessment**	**Affected Area**	**Possible Causes/Influences / Concerns Voiced by Stakeholders**	**Possible Solutions / Actions To Be Taken**
Elevated Levels of Bacteria causing impairment for contact recreation and oyster harvesting	I	I	2424A_02, 2424A_03, 2424A_04, 2424A_05, 2424C_01, and 2424OW_02	- WWTP non-compliance, overflows, collection system by-passes - Small, privately-run WWTP - Developments with septic tanks - Rapid urbanization and increased impervious cover - Constructed storm water controls failing - Direct and dry weather discharges - Waste haulers illegal discharges/improper disposal - Improper or no pet waste disposal - Animal waste from agricultural production, hobby farms, and riding stables - Improper disposal of waste from boats	- Increase monitoring requirements for self-reporting - Impose new or stricter bacteria limits than those designated by TCEQ - Require all systems to develop and implement a utility asset management program and protect against power outages at lift stations or provide alternative power supplies during outages - Regionalize wastewater treatment to minimize number of small package plants and reduce OSSF dependency - Require larger partials of land in developments platted to use OSSFs - More public education regarding OSSF operations and maintenance - More public education regarding pet waste disposal - Improve storm water controls in new developments by adding bacteria reduction measures - Improve compliance and enforcement of existing storm water quality permits to minimize contaminated runoff - Improve construction oversight to minimize TSS discharges to waterways - Implement stream fencing or alternative water supplies to keep livestock out of or away from waterways - Promote and implement Water Quality Management Plans for individual agricultural

					properties - Protect or install vegetative buffers along waterways
Low Dissolved Oxygen Concentrations	I	I	2424A 2424C_01	- Excessive nutrients and organic matter from WWTP effluent, sanitary sewer overflows, malfunctioning OSSFs, illegal disposal of grease trap waste, biodegradable solid waste such as grass clippings and pet waste - Excessive nutrients and organic matter from agricultural production, and related activities	- Improve operation and maintenance of existing WWTP and collection systems - Regionalize wastewater treatment to minimize number of small package plants and reduce OSSFs dependency - More public education regarding pet waste disposal - More public education regarding disposal of household fats, oils, and grease - More stringent OSSF maintenance and education - Improve compliance and enforcement of existing storm water quality permits - Create and implement Water Quality Management Plans for individual agricultural properties - Install and/or maintain riparian buffer areas between agricultural fields and waterways - Work with drainage districts and agencies to change practices of clear cutting channeling waterways
Dioxin/PCBs	I	I	2424 2424A and 2424D	- Concentrated deposits outside boundaries of the waste pits located adjacent to San Jacinto River and I-10 bridge - Unknown industrial or urban sources	- Remove or contain contamination from locations already identified - Encourage additional testing to locate all unknown sources/deposits
Elevated Chlorophyll *a* Concentrations	C	C	2424A_03 2424A_05 2424B_01 2424D_02 and 2424E	- Fertilizer runoff from surrounding watershed promote algal growth in waterways - Nutrient loading from WWTPs effluent, sanitary sewer overflows, and malfunctioning OSSFs promote algal growth	- Improve storm water controls in new developments - Improve compliance and enforcement of existing storm water quality permits. - Support/continue/initiate public education regarding nutrients and consequences - Reduce or manage fertilizer runoff from agricultural areas

Segment Discussion:

Watershed Characteristics: The West Galveston Bay watershed encompasses the bay side of Galveston Island, a barrier island and many coastal wetlands on the landward side of the bay. There are also several classified and unclassified bays and tributaries that drain into the bay system. Development in the area has increased significantly in the past 10 years and is expected to continue growing at a steady pace.

The bay side of Galveston Island includes sporadically placed low intensity developments, grasslands with coastal scrub and wetlands. On the mainland, the communities of Hitchcock, La Marque, Bayou Vista, and Tiki Island, are located west of IH-45 and are drained by Highland and Marchand Bayous to Jones Bay. Most of the land cover in this sub-watershed is low intensity, mixed residential and commercial development. Areas with animal waste from agricultural production and domestic animal facilities are common in the southwestern and northwestern portion of the sub-watershed.

Further south along the coast is the Diversionary Canal and Basford Bayou. These water bodies drain parts of Santa Fe and Hitchcock. Low intensity, residential and commercial developments are found in the upper reach but grasslands are the dominant cover in the lower sub-watershed. The unclassified Willow Bayou drains the southern portion of Santa Fe and Hitchcock. Small ranchettes, grasslands and agriculture are most common in this area, especially upstream of FM 2004.

Still further down the coast, the next unclassified sub-watershed is Mustang Bayou. Grasslands, Chinese Tallow forests and small agricultural production and domestic animal facilities dominate the upper portion. In the middle of the watershed is the City of Alvin with low and high intensity residential and commercial developments. Downstream of Alvin are small ranchettes giving way to big farms with large tracts of cultivated land. New and Persimmon Bayous converge with Mustang Bayou in the tidal section downstream of a large petrochemical complex and eventually flow into the mid section of Chocolate Bay.

Water Quality Issues: This segment does not support its recreation, fish/shellfish consumption, and aquatic life designations. Most of the Assessment Units (AU) in the segment 2424A and one AU in the segment 2424C are listed as impaired for bacteria in both the *Draft* 2010 Texas Integrated Report (IR) and the 2008 IR. In the data set from December 2001 through November 2008, more than 36% of the enterococci samples collected exceeded the single grab criteria of 89 MPN/100ml and reported a geometric mean (geomean) higher than the standard of 35MPN/100mL.

Segments 2424A and 2424C are also impaired for dissolved oxygen (DO). In AU 2424A were found impairments of DO 24-hour minimum and DO grab minimum because more than 33% of the measurements taken were below the DO 24-hour minimum and more than 35% of the samples were below the DO grab minimum standard of 3.0 mg/L. The segment 2424C is impaired for DO, reporting 73.5% of the samples below the DO grab min standard. DO concerns were reported in several AU of the assessed area as well. In the 2008 IR, only the segment 2424C is listed as a cause of impairment for low DO levels.

Due to elevated levels of dioxin and PCBs in edible tissue as well as high fecal coliform concentrations in oyster waters, the Texas Department of State Health Services issued a Limited Consumption Fish and Shellfish Advisory for this water body.

Finally, there is a water quality concern regarding chlorophyll *a* in both the 2010 and 2008 reports because several AUs showed higher values than is the maximum required by the standard (11.6µg/L) in more than 36% of the measurements.

Special Studies/Projects: This segment is included in one TMDL project, the Galveston Bay System Survey for Dioxin and PCBs, which is currently under way. For more information, please refer to the detailed discussions located at the beginning of the water quality section in the 2011 Basin Summary Report regarding Dioxin and PCB contamination.

Trends: TCEQ identified a number of water quality impairments and concerns in the West Bay (Segment 2424) in the Draft 2010 IR. Six of the 15 AUs established in the watershed are impaired or have concern for depressed DO, five AUs are impaired for bacteria, and 10 are impaired due to PCBs and dioxin compounds in fish tissue. Chlorophyll *a* concentrations are a concern in six assessment units. These impairments and concerns exist primarily in the unclassified tidal streams that flow into the bay.

Analysis of pooled data from stations in the West Bay, differentiated by classification status, suggests that dissolved oxygen concentrations are increasing in both classified and unclassified areas of the watershed. Chlorophyll *a* in increasing slightly, ammonia is decreasing in the unclassified areas but increasing in classified waters, suspended solids is decreasing in both classified and unclassified AU, and sulfate is decreasing in unclassified estuaries.

The dataset analyzed by H-GAC contains data from 27 monitoring stations in the West Bay watershed, in both tidal streams and estuarine environments. Unsurprisingly, the analysis of pooled data from the watershed, which are frequently subject to significantly differing influences, can obscure patterns that appear when data are analyzed from individual monitoring stations. While no trend in enterococci density was suggested by the analysis of pooled data, statistically significant trends were identified at five stations in unclassified AUs on the basis of single-sample results. Analysis of the annual geometric mean produced a significant trend for two of these AUs (Offatts Bayou and English Bayou) and revealed a trend in Offatts Bayou obscured by single-sample analysis. Each of these water bodies is located on Galveston Island and is surrounded by a residential area where many homes are present at the water's edge. Overall, evidence for the existence of any enterococci trends is fairly weak. It is compromised by small sample sizes (typically around 20), the relatively short period during which this parameter has been collected, and outliers at either the early or late period of the period of record. These weakly supported trends are positive (i.e., bacterial density is increasing), but few individual samples have exceeded 35 MPN/100 mL at stations where the trends were identified. Plots of single sample enterococci results and annual geometric means from station 18695 on English Bayou is reproduced below for illustrative purposes and probably represents the "most significant" enterococcal trend in the watershed identified by H-GAC.

DO is trending higher at 4 of the 27 stations in the watershed. None are located in AUs that TCEQ considers impaired. H-GAC did not identify any statistically significant trends suggesting DO is declining anywhere in the watershed.

Samples collected at 22 stations are routinely analyzed for chlorophyll *a,* and significant positive trends were identified seven stations. A downward trend was suggested at one station. The value of the trends identified at these stations is limited by the relatively small sample sizes and gaps of one to two years between sampling events (in most cases). A sufficient number of samples were collected at station 13325 in AU 2424_01 to allow one to conclude that a trend exists at that location (57 samples between 1995 and 2010, with no significant gaps in monitoring effort) The trend is also evident in analysis of the annual median concentration. The remaining trends may reflect long-term tendencies but further monitoring is necessary to assess the validity of this claim. A plot of chlorophyll *a* data from station 13325 follows. Plots of chlorophyll *a* combined with phosphate concentrations also follow. There appears to be a relationship between increased phosphorus and chlorophyll *a* concentrations but the pattern is complex.

In general, ammonia nitrogen is trending lower in the watershed but there are exceptions. A positive trend was revealed by regression analysis of both single-sample and annual median concentrations of samples collected at stations 11325 and 13322. Positive and negative trends were detected for other nutrients of interest. Positive chlorophyll *a* trends of varying degrees of strength were found at four stations in AU 2424_01 but all nitrate nitrogen, total phosphorus, and orthophosphate trends suggested by the analysis were negative. Again, interpretation of these results is hampered by the fairly small sample size and infrequent monitoring of these parameters.

Recommendations:

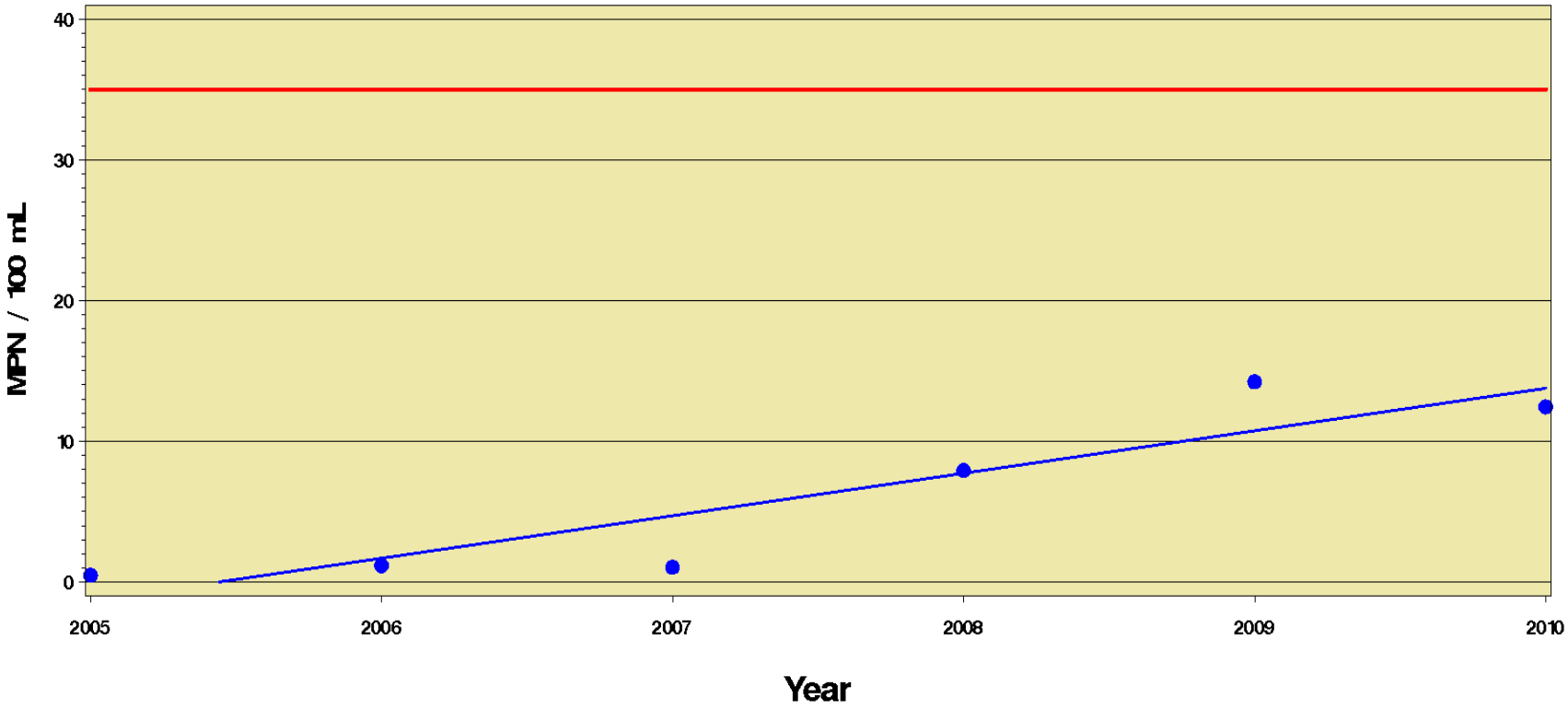
- Increase the number of yearly representative stations to provide consistent time series. Need fewer stations with more data.
- Support Galveston Bay Foundations efforts to complete Oyster Waters TMDL on this segment.
- Address the various concerns found in this segment summary through stakeholder participation.
- Continue collecting water quality data to support actions associated with future watershed protection plan development and/or modeling.
- Work with local partner and contract labs to lower detection limits for nutrients.

West Bay

Monitoring Station: 18695 Segment: 2424 Assessment Unit: 2424E_01

Parameter: Enterococci Annual Geometric Mean

2010 Water Quality Standard: 35 MPN / 100 mL



Trends are considered significant if the p-value is < 0.10

Trend is significant at p= 0.0104 R-Square = 0.8383 T-Value = 4.554 Number of Samples= 21

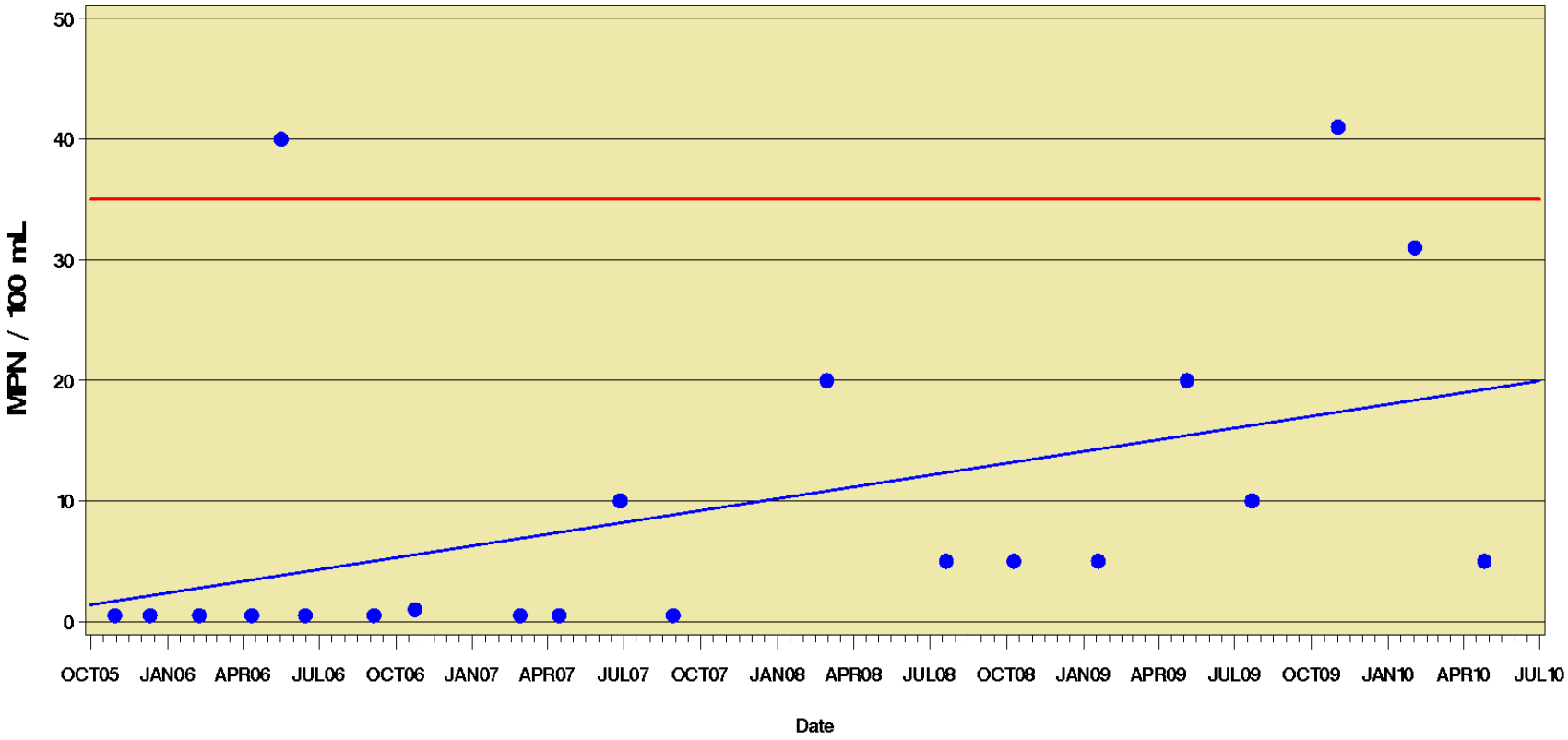
Red line indicates the applicable 2010 Water Quality Standard

West Bay

Station: 18695 Segment:2424 Parameter: Enterococci

2010 Water Quality Standard: 35 MPN / 100 mL

Assessment Unit: 2424E_01



Trends are considered significant if the p–value is < 0.10

Trend is significant at p= 0.0005 R–Square= 0.4808 T–Value= 4.195 Number of Samples= 21

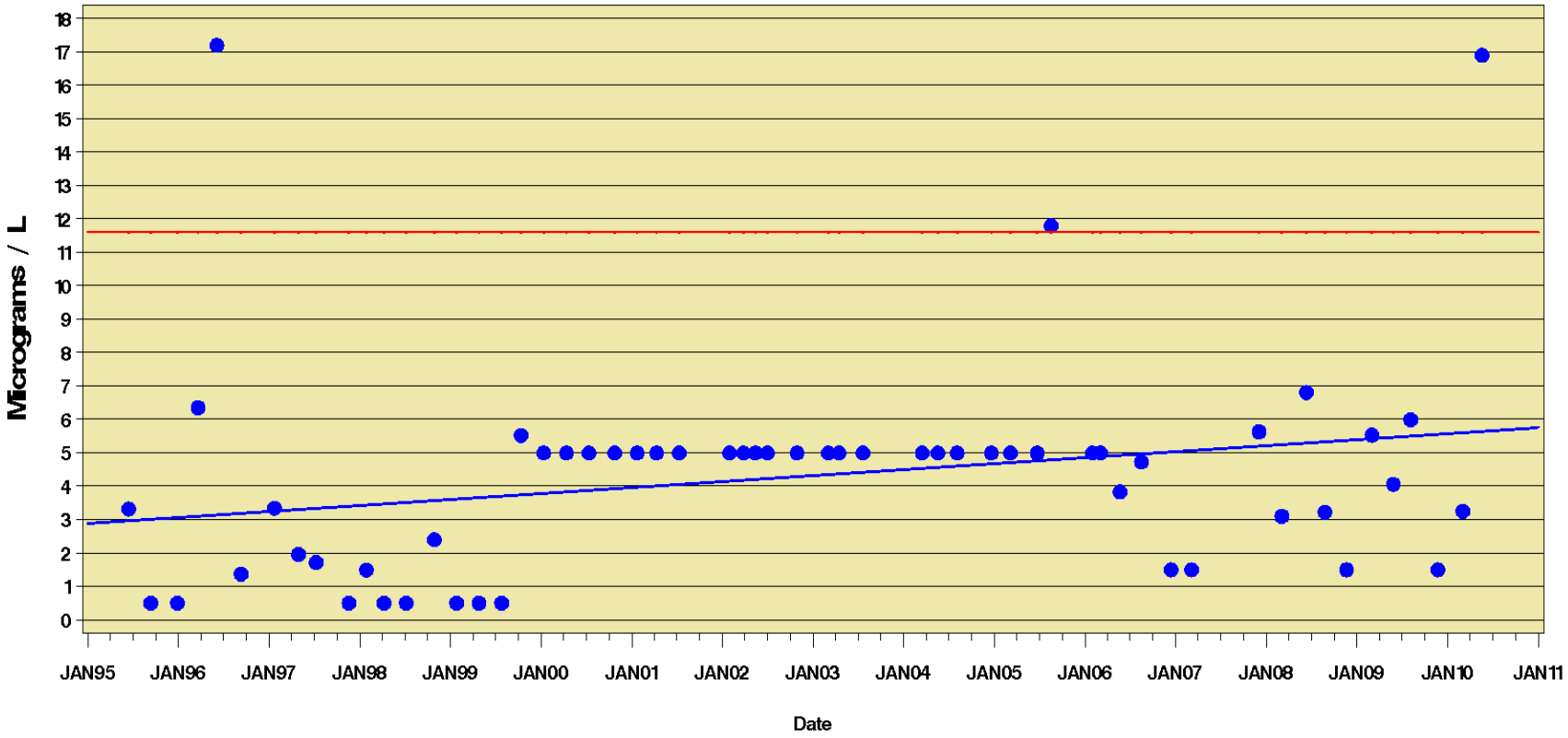
Red line (if present) indicates the applicable 2010 Water Quality Standard

West Bay

Station: 13325 Segment:2424 Parameter: Chlorophyll a

2010 Nutrient Screening Level: 11.6 Micrograms / L

Assessment Unit: 2424_01



Trends are considered significant if the p–value is < 0.10

Trend is significant at p= 0.0024 R–Square= 0.1557 T–Value= 3.185 Number of Samples= 57

Red line (if present) indicates the applicable 2010 Nutrient Screening Level

Chlorophyll—a and Total Phosphorus Concentrations

Segment: 2424 Watershed: West Bay

Station: 13325 Assessment Unit: 2424_01