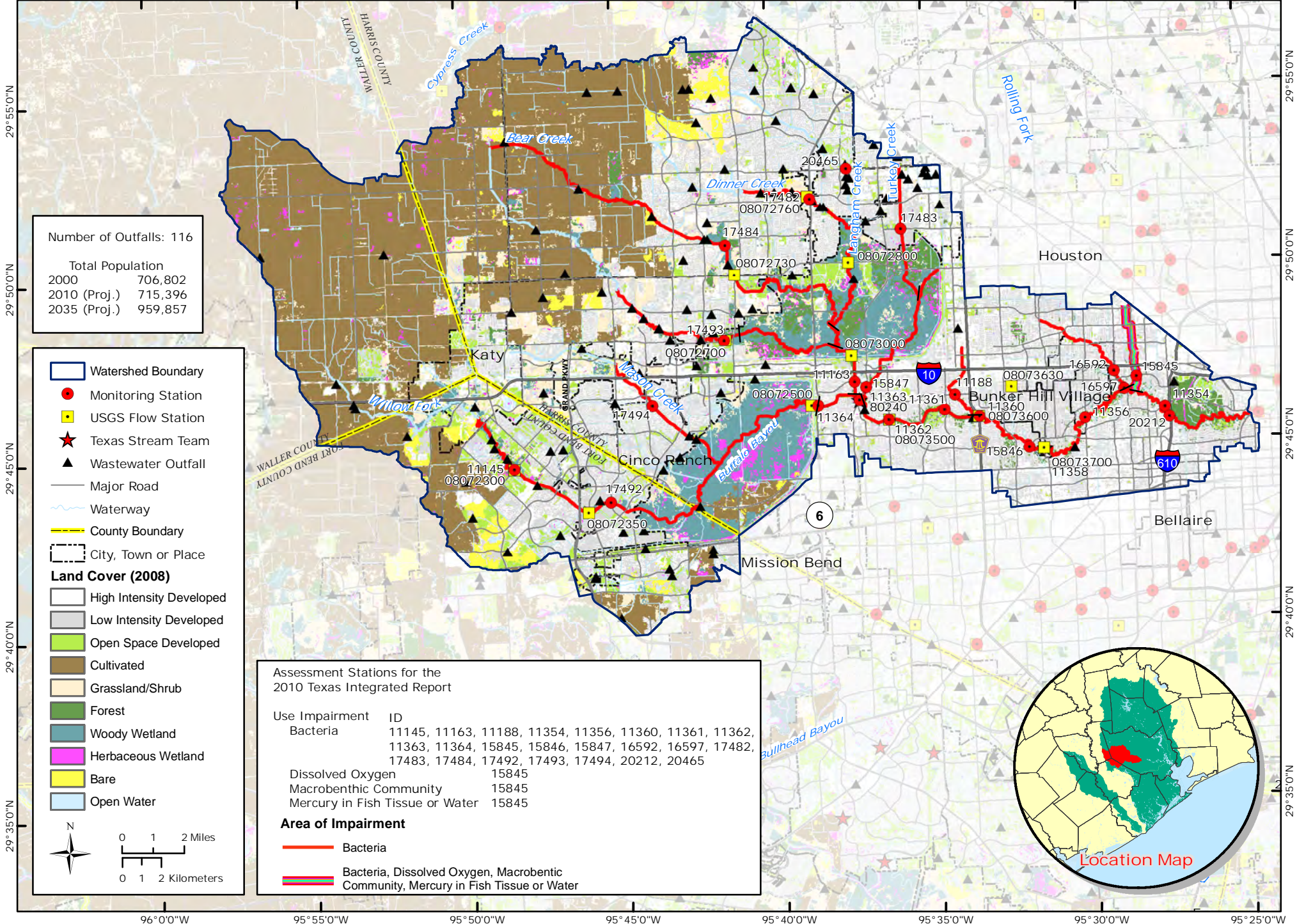


BUFFALO BAYOU ABOVE TIDAL - SEGMENT 1014

96°0'0"W 95°55'0"W 95°50'0"W 95°45'0"W 95°40'0"W 95°35'0"W 95°30'0"W 95°25'0"W



Number of Outfalls: 116

Total Population
 2000 706,802
 2010 (Proj.) 715,396
 2035 (Proj.) 959,857

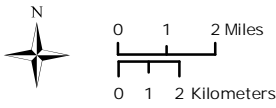
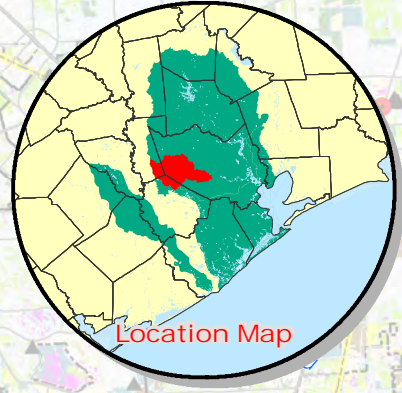
- Watershed Boundary
- Monitoring Station
- USGS Flow Station
- ★ Texas Stream Team
- ▲ Wastewater Outfall
- Major Road
- ~ Waterway
- County Boundary
- City, Town or Place

- Land Cover (2008)**
- High Intensity Developed
 - Low Intensity Developed
 - Open Space Developed
 - Cultivated
 - Grassland/Shrub
 - Forest
 - Woody Wetland
 - Herbaceous Wetland
 - Bare
 - Open Water

Assessment Stations for the 2010 Texas Integrated Report

Use Impairment	ID	
Bacteria	11145, 11163, 11188, 11354, 11356, 11360, 11361, 11362, 11363, 11364, 15845, 15846, 15847, 16592, 16597, 17482, 17483, 17484, 17492, 17493, 17494, 20212, 20465	
	Dissolved Oxygen	15845
	Macrobenthic Community	15845
	Mercury in Fish Tissue or Water	15845

- Area of Impairment**
- Bacteria
 - Bacteria, Dissolved Oxygen, Macrobenthic Community, Mercury in Fish Tissue or Water



96°0'0"W 95°55'0"W 95°50'0"W 95°45'0"W 95°40'0"W 95°35'0"W 95°30'0"W 95°25'0"W

Segment Number:	1014	Name:	Buffalo Bayou Above Tidal		
Length:	24 miles	Watershed Area:	358 square miles	Designated Uses:	Intermediate Aquatic Life; Contact Recreation
Number of Active Monitoring Stations:	23	Texas Stream Team Monitors:	3	Permitted Outfalls:	138
Description:	<p>From a point immediately upstream of Shepherd Drive upstream to SH 6</p> <p>Sub-Segment 1014A: Bear Creek (unclassified water body)—From the confluence with South Mayde Creek to a point upstream of an unnamed tributary 1.24 km (0.77 mi) north of Langenbaugh Road</p> <p>Sub-Segment 1014B: Buffalo Bayou/Barker Reservoir (unclassified water body)—From Barker Dam upstream to the Willow Fork Buffalo Bayou confluence</p> <p>Sub-Segment 1014E: Langham Creek (unclassified water body)—From the Bear Creek confluence upstream to the Dinner Creek confluence</p> <p>Sub-Segment 1014H: South Mayde Creek (unclassified water body)—From the Buffalo Bayou confluence upstream to the confluence with an unnamed tributary 0.62 km (0.39 mi) east of Barker-Cypress Road</p> <p>Sub-Segment 1014K: Turkey Creek (unclassified water body)—From the South Mayde Creek confluence upstream to 0.17 km (0.1 mi) south of Clay Road</p> <p>Sub-Segment 1014L: Mason Creek (unclassified water body)—From the Buffalo Bayou confluence upstream to Mason Road</p> <p>Sub-Segment 1014M: Newman Branch (Neimans Bayou) (unclassified water body)—From the Buffalo Bayou confluence to 0.1 km (0.06 mi) upstream of Hammerly Blvd</p> <p>Sub-Segment 1014N: Rummel Creek (unclassified water body)—From the Buffalo Bayou Tidal confluence to 1.2 km (0.75 mi) upstream to IH-10</p> <p>Sub-Segment 1014O: Spring Branch (unclassified water body)—From the Buffalo Bayou Tidal confluence to 1.4 km (0.87 mi) upstream of Long Point Road</p>				

Degree of Impairment and Overall Trends						
Segment ID	Dissolved Oxygen	Bacteria	Nutrients	PCBs/Dioxin	Chlorophyll <i>a</i>	Other
1014		100	100			
1014A		100	100			
1014B		100	100			
1014C						
1014E		92	92			
1014H		59	59			
1014K		100	57			
1014L		58	58			
1014M	100	100				100
1014N		100				
1014O		100				

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
11145	Buffalo Bayou at Greenbusch Road	Quarterly	H-GAC	Field, Conventional, Bacteria, Flow
11163	South Mayde Creek at Memorial Drive	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11188	Rummel Creek at Memorial Drive	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11354	Buffalo Bayou at Woodway Drive	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll- <i>a</i>
11356	Buffalo Bayou at Voss Road	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11360	Buffalo Bayou at West Beltway 8	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11361	Buffalo Bayou at Wilcrest Drive	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11362	Buffalo Bayou at Dairy-Ashford	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria, Chlorophyll- <i>a</i> (Qtrly)
11362	Buffalo Bayou at Dairy-Ashford	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll- <i>a</i> , Flow
11363	Buffalo Bayou at Eldridge Road	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11364	Buffalo Bayou at SH 6	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
15845	Buffalo Bayou at Chimney Rock Road	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
15846	Buffalo Bayou at Briar Forest Avenue	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
15847	Turkey Creek at Memorial Drive	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
16592	Spring Branch Creek at Wirt Rd	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
16597	Neimans Bayou at Memorial Dr	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
16597	Neimans Bayou at Memorial Dr	Five Times / Year	COH / HHS	Flow, 24-Hour DO

17482	Langham Creek at SH 6	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17483	Turkey Creek SE of Tanner Road & north of Eldridge Parkway	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17484	Bear Creek at Old Greenhouse Road	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17492	Buffalo Bayou at South Mason /PeekRoads	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17493	South Mayde Creek at Groeschke/Dulaney Roads	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17494	Mason Creek at Park Pine Drive	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
20212	Buffalo Bayou at Loop 610 southbound Feeder Road	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
20465	Horsepen Creek at FM 529	Quarterly	H-GAC	Field, Conventional, Bacteria, Flow

Segment 1014

Standards

Temperature (°C):	33
Dissolved Oxygen (24-Hr Average) (mg/L):	3.0
Dissolved Oxygen (Absolute Minima) (mg/L):	2.0
pH (standard units):	6.5-9.0
<i>E. coli</i> (MPN/100 mL) (grab):	394
<i>E. coli</i> (MPN/100 mL) (geometric mean):	126
Chloride (mg/L as Cl):	110
Sulfate (mg/L as SO ₄):	65
Total Dissolved Solids (mg/L):	600

Screening Levels

Ammonia (mg/L):	0.33
Nitrate-N (mg/L):	1.95
Orthophosphate Phosphorus (mg/L):	0.37
Total Phosphorus (mg/L):	0.69
Chlorophyll- <i>a</i> (µg/L):	14.1

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	I	I	Entire segment	<ul style="list-style-type: none"> - WWTP non-compliance, overflows, collection system by-passes - Small, privately-run WWTP - Developments with septic tanks - Rapid urbanization and increased impervious cover 	<ul style="list-style-type: none"> - 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

				<ul style="list-style-type: none"> - 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 	<p>against power outages at lift stations or provide alternative power supplies during outages</p> <ul style="list-style-type: none"> - Regionalize wastewater treatment to prevent or minimize number of small package plants and reduce septic tank dependency - Require larger partials of land in developments platted to use OSSF - 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 contamination. - Improve construction oversight to minimize TSS discharges to waterways. - Implement stream fencing or alternative water supplies to keep livestock out of waterways - Promote and implement Water Quality Management Plans for individual agricultural properties
<p>Low Dissolved Oxygen Concentrations</p>	<p>I</p>	<p>I</p>	<p>1014M</p>	<ul style="list-style-type: none"> - 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 - Vegetative canopy removed - Excessive nutrients and organic matter from agricultural production 	<ul style="list-style-type: none"> - Improve compliance and enforcement of existing storm water quality permits - Improve operation and maintenance of existing WWTP and collection systems - Regionalize wastewater treatment to minimize number of small package plants and reduce OSSF dependency - More public education regarding pet waste disposal - More public education regarding household fats, oils, and grease disposal; and - More stringent OSSF maintenance and education - Conserve or plant canopy trees and habitat along

					<ul style="list-style-type: none"> - waterways - Work with drainage districts and agencies to change practices of clear cutting - Maintain riparian buffer areas between along all waterways - Create and implement Water Quality Management Plans for individual agricultural properties
Elevated Nutrients	C	C	1014, 1014A, 1014B, 1014E, 1014H_01 1014H_02 1014K_01, 1014L	<ul style="list-style-type: none"> - WWTP effluent, sanitary sewer overflows, and malfunctioning OSSFs - Agricultural runoff from row crops, pastures, and fallow fields - Fertilizer runoff from urbanized properties such as landscaped areas, residential lawns, and sport fields 	<ul style="list-style-type: none"> - Monitor phosphorus levels at WWTFs to determine if controls are needed. - Implement <i>YardWise</i> and <i>Watersmart</i> landscape practices - Create and implement Water Quality Management Plans for individual agricultural properties - Maintain riparian buffer areas between along all waterways

Segment Discussion

Watershed Characteristics: This segment extends from the heavily developed areas of Houston’s urban core west and north through dense residential areas to the primarily rural and agricultural areas of western Harris County. Buffalo Bayou Above Tidal drains into Buffalo Bayou Tidal and then into the Houston Ship Channel and the Galveston Bay system. It drains an area that includes both Barker and Addicks reservoirs in its western portion and thus is affected greatly by the amount of water being released at any given time from their dams. Large tracts of land in the northwest areas of the segment are dedicated to cultivated crops or ranch activities. East of State Highway 6, the Bayou is primarily a wooded waterway immediately adjacent to parkland (Terry Hershey Park) or primarily affluent urban residential areas and golf courses. There are not an appreciable number of industrial facilities in this segment. Because of the narrow and deep profile of the Bayou, recreational activity consists primarily of canoeing and kayaking and limited swimming in some areas.

Water Quality Issues: All of the watershed sub-segments have bacteria levels high enough to render them impaired under the contact recreation standard of a geometric mean of 126 MPN/100mL. One assessment unit (AU) of one sub-segment (1014H_02) was not listed on the 2008 Texas Integrated Report (IR), but, subsequently, was listed as impaired on the *Draft* 2010 IR. The bacteria levels ranged from geomeans of 410 to 2,829 MPN/100mL, or moderate to significant impairment. However, in areas of Buffalo Bayou bacteria levels can fluctuate greatly based on releases from the Addicks and Barker dams upstream. The watershed generally supports the aquatic life use, although one sub-segment (1014M) had impairments for both dissolved oxygen (DO) and macrobenthic and fish communities. The DO impairments remained relatively the same as that in the 2008 IR for that sub-segment although one sub-segment (1014N) listed as having a concern in 2008 was not listed in 2010. Eight of the 12 Buffalo Bayou watershed sub-segments had select nutrients concerns with all eight listed for nitrate nitrogen (nitrate) and orthophosphate phosphorous (OP). Seven were listed for total phosphorus (TP) and one was listed for ammonia nitrogen (ammonia). In comparison, the 2008 IR also had eight sub-segments listed but only seven were listed for nitrate, six for TP, and none for ammonia. OP represented the largest change, with only two sub-segments listed in 2008 as compared to eight listed in 2010. In general, nutrient concerns and concentrations grew in the watershed.

Special Studies/Projects: During the past five years this segment has been subject to one TMDL project, the Buffalo/Whiteoak Bayous TMDL for bacteria. This segment is part of the geographic area for the Bacteria Implementation Plan which is currently being finalized. For more information, please refer to the detailed discussions of the Buffalo/Whiteoak Bayous TMDL and the BIG located at the beginning of the water quality section in the 2011 Basin Summary Report.

Trends: Regression analysis of watershed-level data revealed statistically significant trends for six water quality parameters. There were three trends found in the data from the classified segment and four trends found in the data from the unclassified tributaries. The two most noteworthy trends are chlorophyll *a* and *E. coli*. After maintaining a constant level from 2000 to 2005, the mean chlorophyll *a* concentration in the classified portions of the bayou has been steadily increasing. The concentration is, however, still well below the screening level. *E. coli* concentrations in the unclassified portions have been significantly decreasing since 2005, but unlike chlorophyll *a*, *E. coli* concentrations are well above the water quality standard.

Regression analysis on data from 20 individual monitoring stations revealed 71 significant trends. In the data from stations 17482, 17484, and 17493, there are eight, seven, and nine significant trends, respectively. These three are all the most upstream stations on adjacent tributaries and each of them show significant trends in ammonia, nitrate, pH, specific conductance, sulfate, and TP. At station 11163, the nitrate concentrations increased in mid-2008 and few measurements have been recorded below the screening level since. Beginning in mid-2008, OP levels at station 11356, one of the most downstream stations, have been gradually increasing. They, too, have not been below screening levels since. At station 16592, which is on a downstream tributary, sulfate levels have been showing little consistency since early-2004 and the station has been recording much higher sulfate levels since that time. It is also worth mentioning that many of the water quality parameters that are tested throughout the entire watershed were elevated during early to mid-2009. Sulfate concentrations at station 17482 and TP at station 17484 are good examples of the elevated parameters during this time. Runoff from urban lawn and landscaping, sanitary sewer overflows, and bat/bird colonies in the watershed are the most likely causes of the impairments and concerns.

Recommendations:

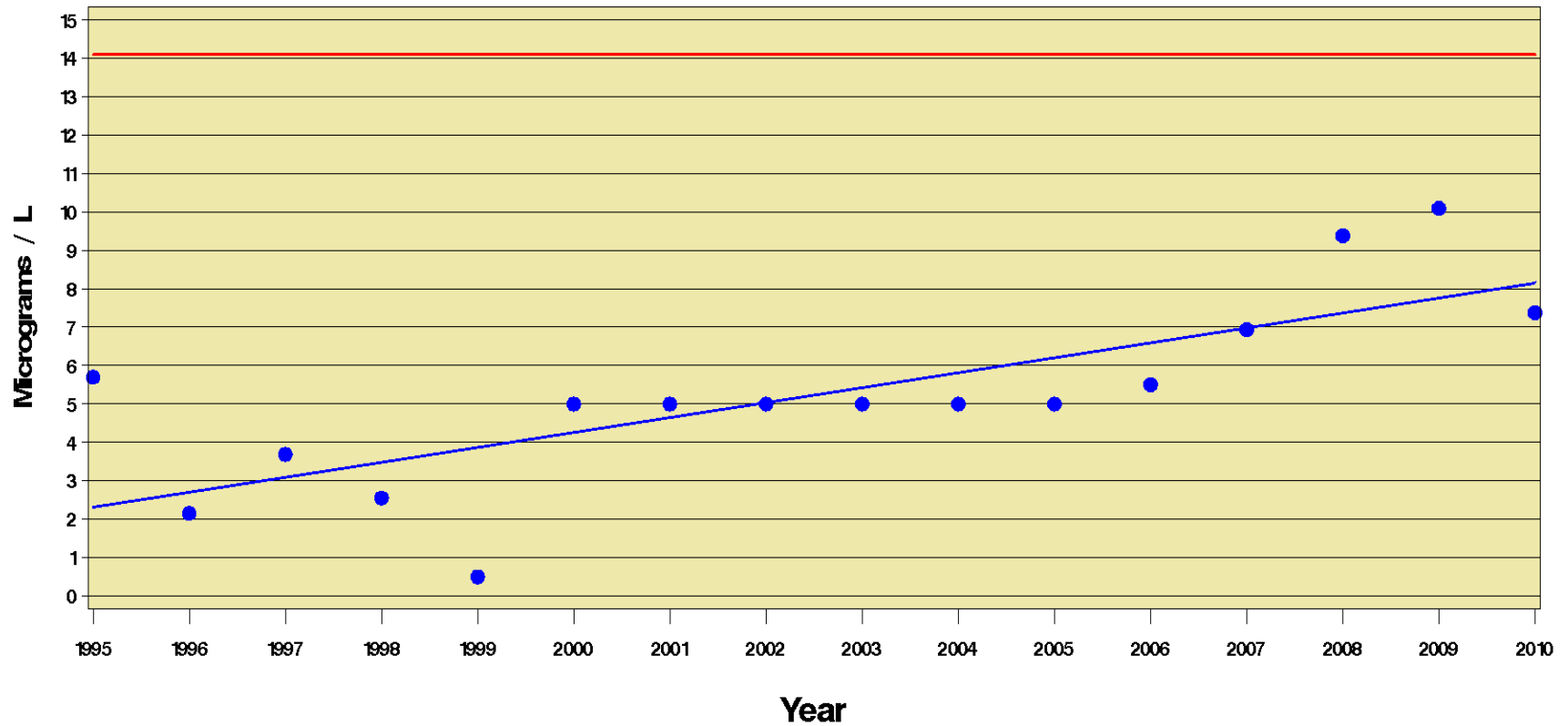
- Address the various concerns found in this segment summary through stakeholder participation in the BIG.
- Continue collecting water quality data to support actions associated with watershed protection plan development and future modeling.
- Work with local partner and contract labs to lower detection limits for nutrients

Buffalo Bayou Above Tidal

Segment: 1014 Parameter: Chlorophyll a Annual Median

Water Body Type: Classified Freshwater Stream

2010 Nutrient Screening Level : 14.1 Micrograms / L



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

Trend is significant at p= 0.0007 R-Square = 0.5733 T-Value = 4.337 Number of samples: 84

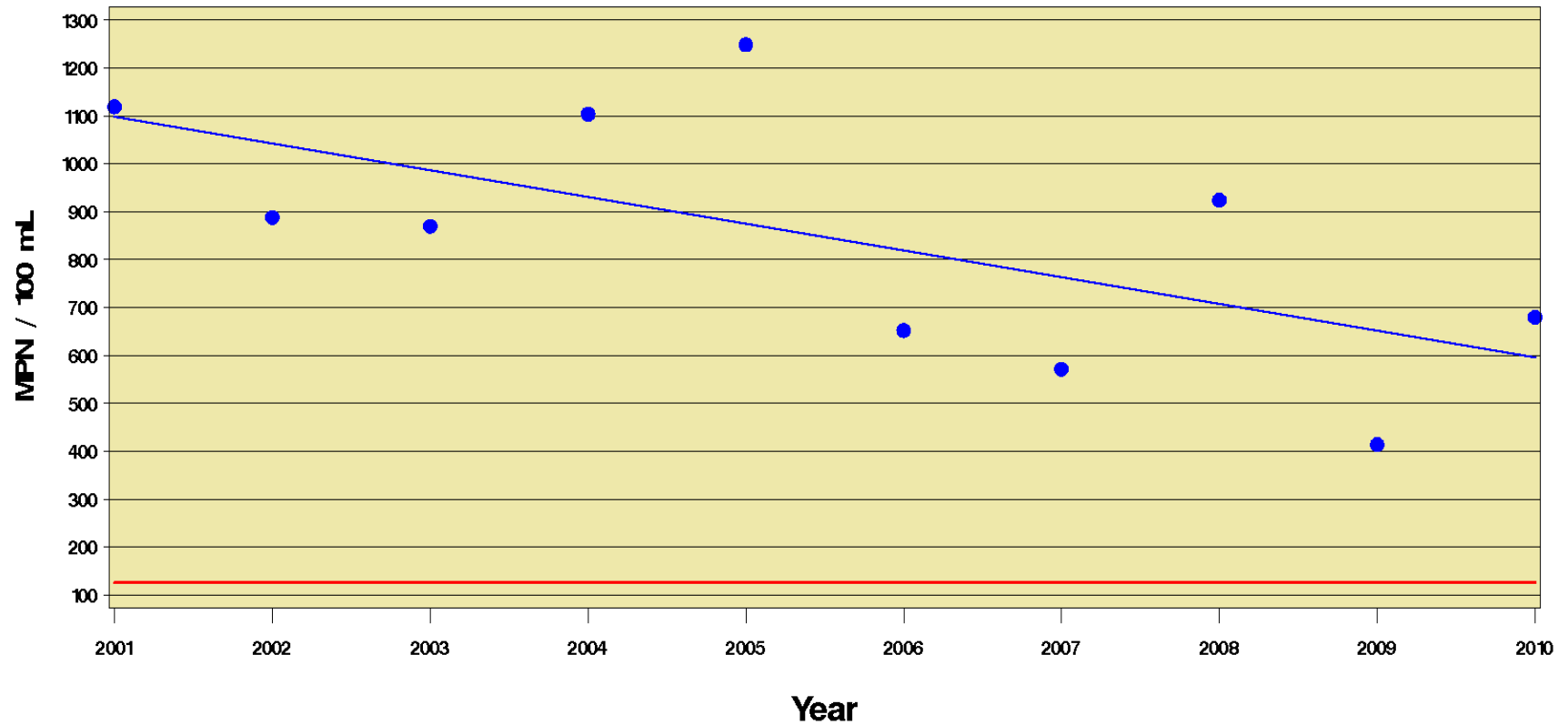
If present, the dashed red line indicates the 2010 Nutrient Screening Level

Buffalo Bayou Above Tidal

Segment: 1014 Parameter: E. Coli Annual Geometric Mean

Water Body Type: Unclassified Freshwater Stream

2010 Water Quality Standard : 126 MPN / 100 mL



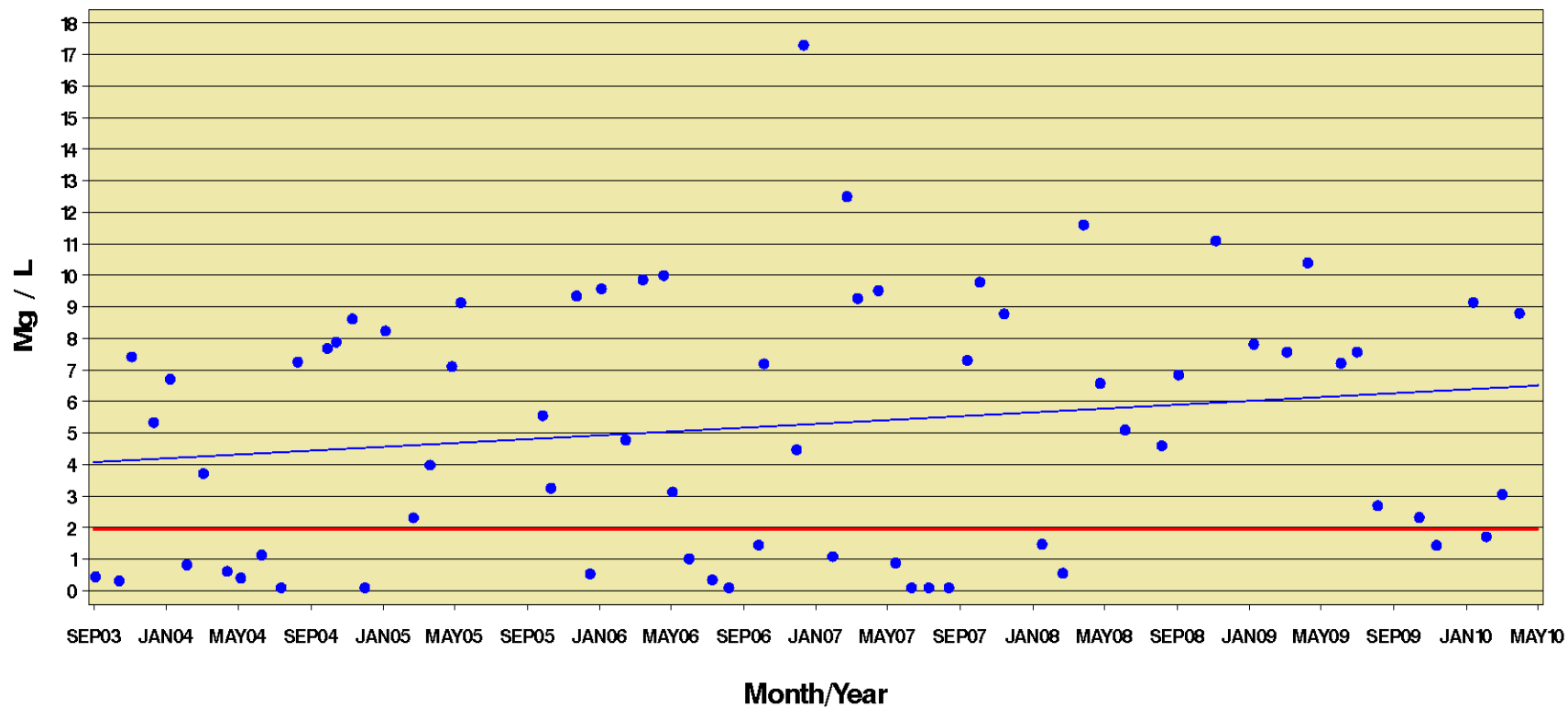
Trends are considered significant if the p-value is < 0.10

Trend is significant at p= 0.0494 R-Square = 0.4008 T-Value = -2.313 Number of samples: 983

If present, the dashed red line indicates the 2010 Water Quality Standard

Buffalo Bayou Above Tidal

Station: 11163 Segment: 1014 Parameter: Nitrate-N
2010 Nutrient Screening Level: 1.95 Mg / L
Assessment Unit: 1014H_01



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

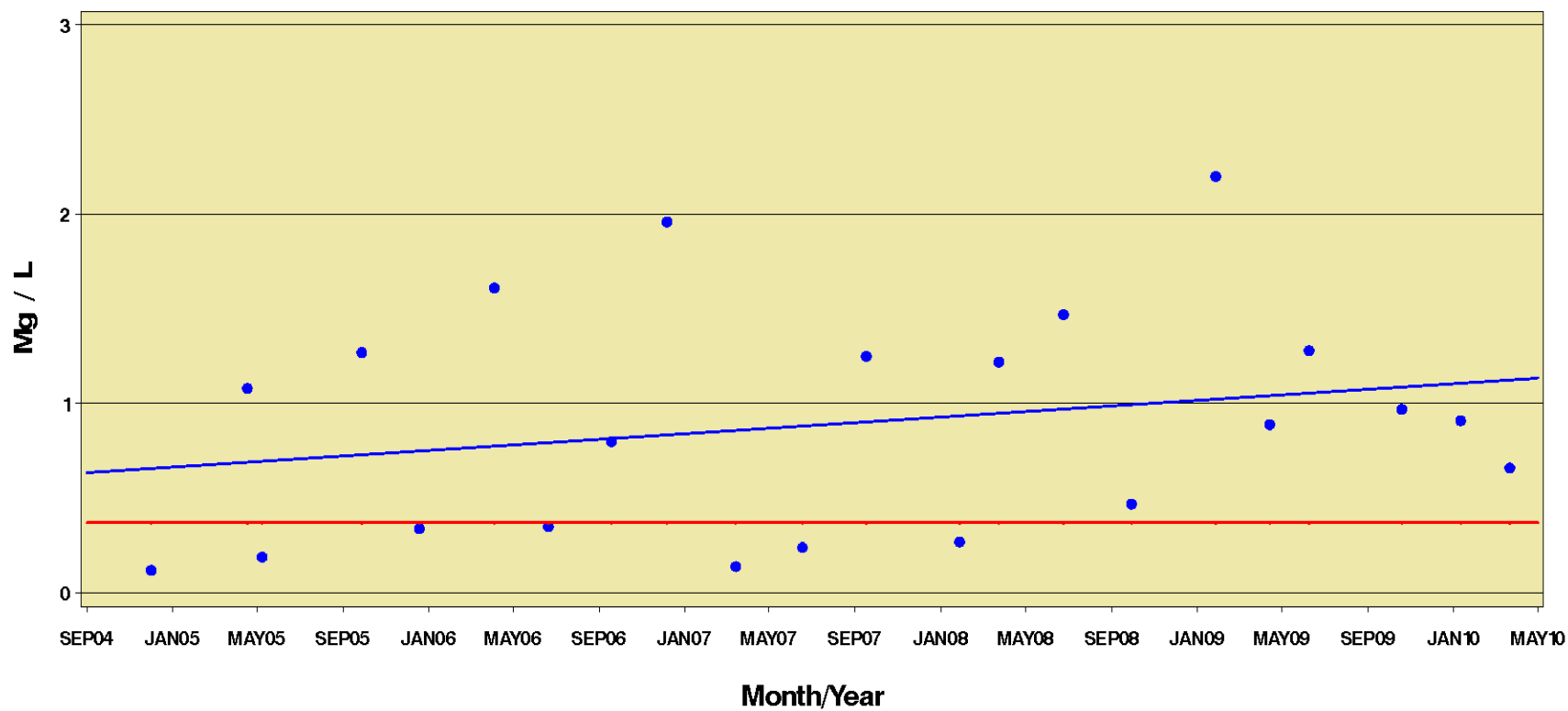
Trend is significant at $p=0.1047$ R-Square= 0.0394 T-Value= 1.6450 Number of Samples= 68

The blue regression line applies to the plot of actual values ; regression statistics are derived from regression of log-transformed data

Red line indicates the applicable 2010 Nutrient Screening Level

Buffalo Bayou Above Tidal

Station: 11356 Segment: 1014 Parameter: Orthophosphate—P
2010 Nutrient Screening Level: 0.37 Mg / L
Assessment Unit: 1014_01



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

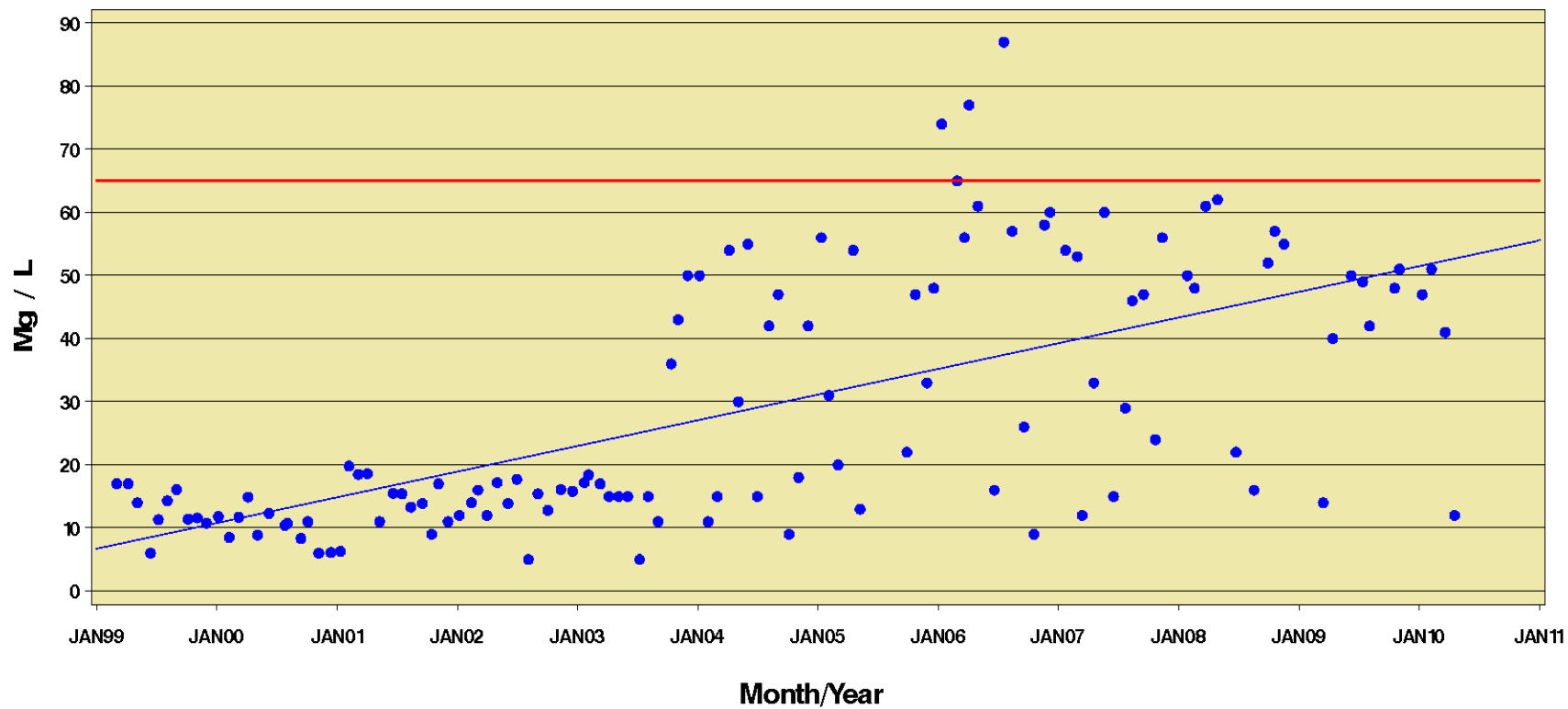
Trend is significant at p= 0.0965 R-Square= 0.1320 T-Value= 1.7440 Number of Samples= 22

The blue regression line applies to the plot of actual values ; regression statistics are derived from regression of log-transformed data

Red line indicates the applicable 2010 Nutrient Screening Level

Buffalo Bayou Above Tidal

Station: 16592 Segment: 1014 Parameter: Sulfate
2010 Water Quality Standard: 65 Mg / L
Assessment Unit: 1014O_01



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

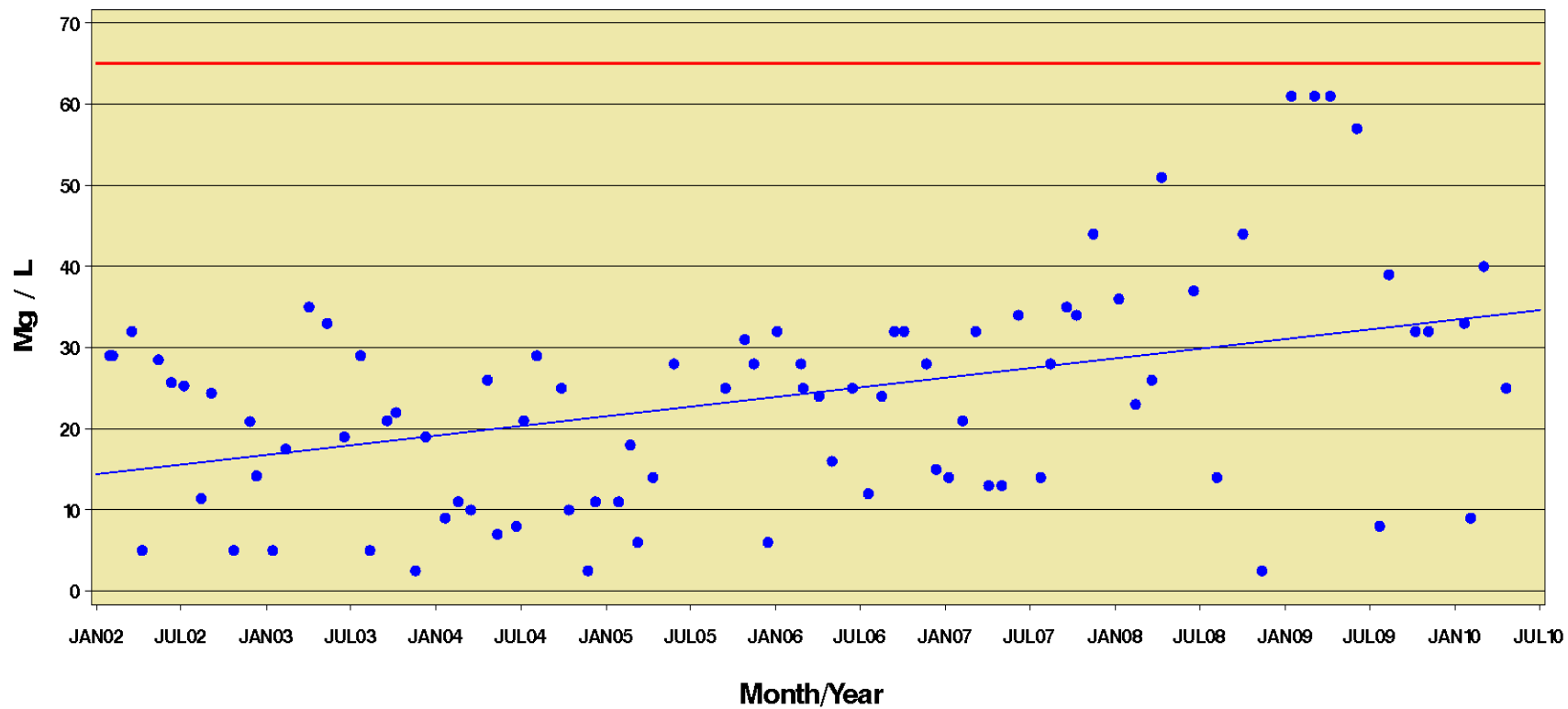
Trend is significant at $p=0.0000$ R-Square= 0.4585 T-Value= 10.0810 Number of Samples= 122

The blue regression line applies to the plot of actual values ; regression statistics are derived from regression of log-transformed data

Red line indicates the applicable 2010 Water Quality Standard

Buffalo Bayou Above Tidal

Station: 17482 Segment: 1014 Parameter: Sulfate
2010 Water Quality Standard: 65 Mg / L
Assessment Unit: 1014E_01



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

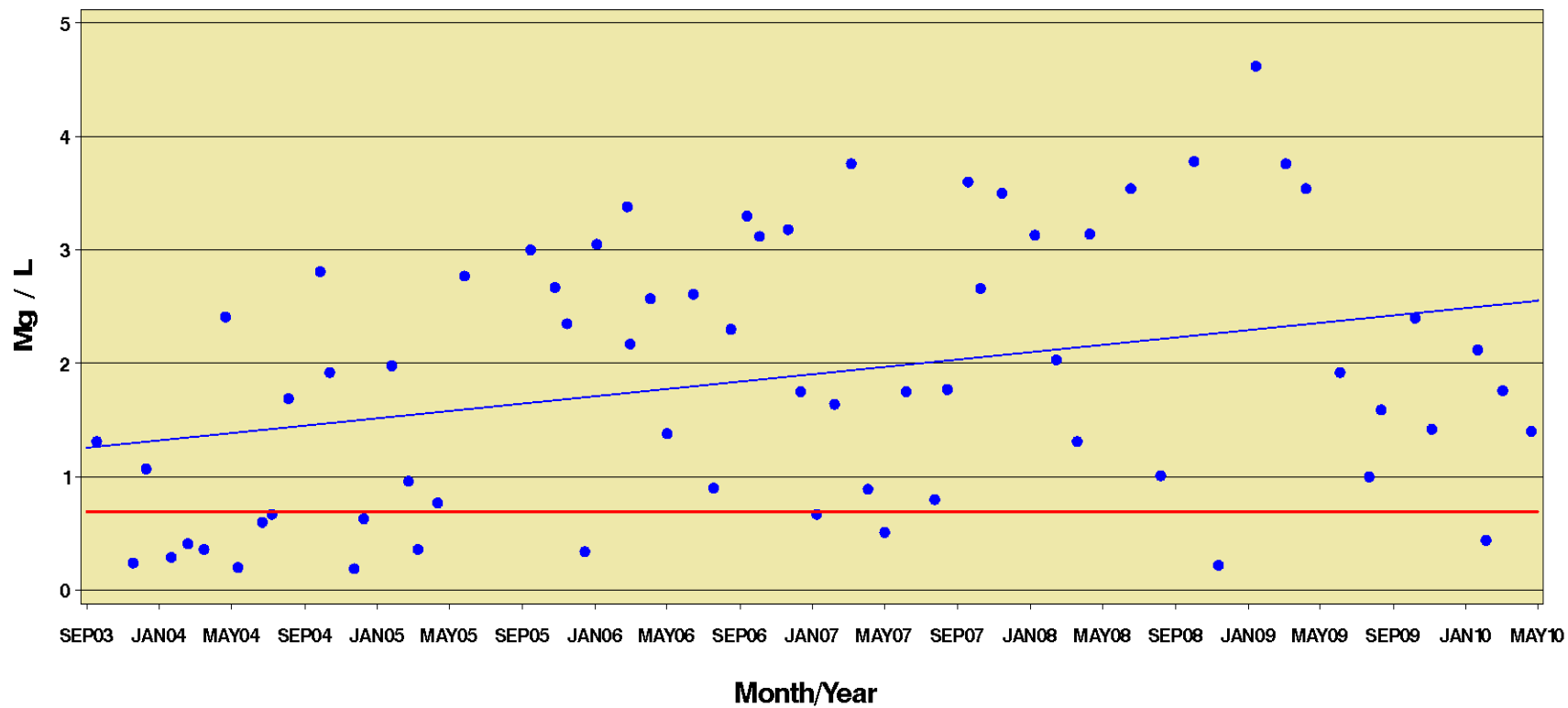
Trend is significant at $p=0.0025$ R-Square= 0.1029 T-Value= 3.1230 Number of Samples= 87

The blue regression line applies to the plot of actual values ; regression statistics are derived from regression of log-transformed data

Red line indicates the applicable 2010 Water Quality Standard

Buffalo Bayou Above Tidal

Station: 17484 Segment: 1014 Parameter: Total Phosphorus
2010 Nutrient Screening Level: 0.69 Mg / L
Assessment Unit: 1014A_01



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

Trend is significant at p= 0.0037 R-Square= 0.1227 T-Value= 3.0160 Number of Samples= 67

The blue regression line applies to the plot of actual values ; regression statistics are derived from regression of log-transformed data

Red line indicates the applicable 2010 Nutrient Screening Level