



**Trend Analysis of Ozone Concentrations in the City of Houston and Vicinity (2004-2008)**

City of Houston  
Mayor's Office of Environmental Programming

August 10, 2009  
Alex Wagner and Loren Raun, PhD.

**Introduction:** The City of Houston and surrounding area have been in non-attainment of the EPA ozone standard since a standard was set in 1977. Currently, the counties that make up the Houston-Galveston-Brazoria area (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller) are classified as ‘severe non-attainment’ with a maximum attainment date of June 15, 2019. Although attainment of the ozone standards is an important regulatory measure of air quality, additional analyses are necessary to appreciate the full extent of the health impact of Houston’s ozone levels and whether that impact is increasing or decreasing to a statistically significant level over time. Such analyses include trends of an array of statistical metrics of ozone concentration (mean, median and maximum), and the trend of the degree of attainment of intermediate health based thresholds, on a community rather than regional level. The intermediate health based thresholds are those designated by EPA<sup>1</sup> (e.g., unhealthy for sensitive population groups). These specific analyses provide a more complete understanding of the direction and progress of ozone air quality improvements.

**Method:** One hour ozone data collected from all available monitor locations in the Houston vicinity (2004-2008) were obtained from the Texas Commission on Environmental Quality. The data from each monitor were assessed to determine the percentage of data missing each year. Only monitors with five, or if five weren’t available four, years of data with no more than 10% missing values were retained for analysis. Thirty-two monitors had data which met these criteria.

The one hour data were aggregated by monitor to obtain the daily monitor maximum 8 hour average ozone concentration. The daily monitor maximum 8 hour average concentrations were further aggregated by monitor into the following annual statistical metrics: average, median, maximum, and the percentage of days above the concentration threshold which is considered unhealthy for sensitive groups and unhealthy for the general population. The Mann Kendall test for trend was conducted at each monitor for each annual metric described above to identify statistically significant annual trends (5 and 10% error rate,  $\alpha=0.05$  and  $0.10$  as noted). The trend analysis was conducted on the following annual statistical metrics related to ozone:

- Annual average of the maximum daily 8 hour average (ppbV)
- Total number of days a monitor exhibited a daily maximum 8 hour average that was above the ozone concentration considered unhealthy for sensitive groups of the population (days)
- Annual maximum of daily 8 hour maximums (ppbV)
- Annual median of daily 8 hour maximums (ppbV)
- % of measurements above the unhealthy level for sensitive groups (%)
- % of measurements above the unhealthy level (%)
- % of measurements above the very unhealthy level (%)
- Standard deviation of Annual average of the maximum daily 8 hour average (ppbV)

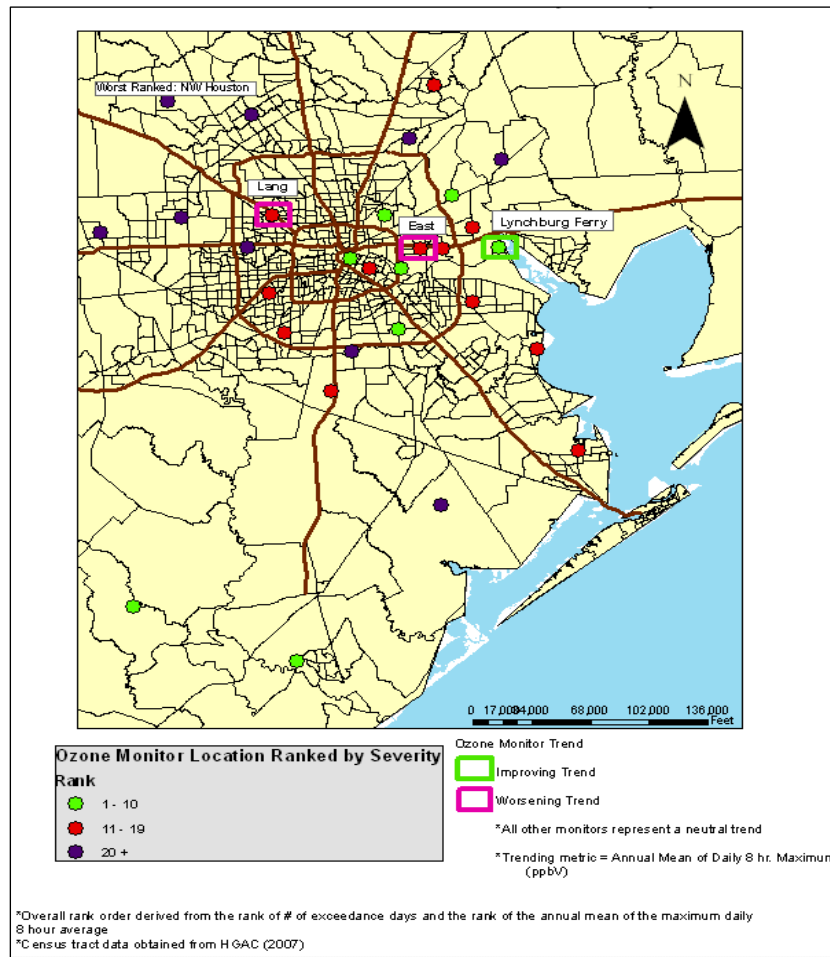
Because a decreasing, increasing or lack of trend is likely to be of more interest at a monitor with high concentrations than one with low concentrations, additional analysis was conducted to rank the monitors according to severity of concentration.

---

<sup>1</sup> “EPA; Air Quality for Ozone” <http://airnow.gov/index.cfm?action=static.consumer>”

**Summary of Results:** The individual monitor results indicate that the vast majority of monitors exhibit no statistically significant trend for any of the metrics, with very few decreasing trends and some possessing an increasing, or worsening, trend. A worsening trend was found in 18.2 % of all the monitors for one or more metrics; 42.4 % show an improving trend for one or more of the metrics; 48.5 % show a neutral trend for all metrics; no monitors show an improving trend for every metric. The monitor that was ranked lowest in terms of ozone severity was Lynchburg Ferry. This monitor is also the only monitor showing a statistically significant decreasing trend, at the 5% error rate or  $\alpha=0.05$ , in ozone concentrations in the past five years (2004-2008). On the other hand, the monitor with the highest ozone concentrations according to the rank is Aldine. Aldine ozone concentrations were found to have a statistically significant, at the 10% error rate or  $\alpha=0.10$ , increasing trend in the past five years (2004-2008).

The figure below depicts the ozone monitor locations spatially, the ozone concentration severity based on the average rank, and the annual trend of the ozone concentration. The ozone concentration severity rank is the average rank order (from lowest to highest) of: the number of days a location exceeded the ozone concentration considered unhealthy for sensitive people and the annual average of the maximum daily 8-hr average concentration. The ranks fell into roughly three clustered groups: low, medium and high. Although there is no distinct spatial pattern to the ozone severity rank, it appears that in general, the lowest locations are in the southeast side and the highest dominate the northwest side of the City (Appendix B). The trend analysis indicates that improving trends in the City are restricted to the southeast quadrant. Other spatial analyses comparing ozone concentration severity and trend to median income, do not indicate spatial patterns (Appendix C).



**Figure 1:** 2008 HGB-Area Ozone\_Monitor Locations Spatially, Ozone Concentration Severity Based on Average Rank, and Annual Trend of Ozone Concentration

**Detailed Results:** Table 1 lists the monitors in the Houston vicinity that were analyzed in this assessment. The table includes the name of the monitor along with an indication of whether the monitor is considered an EPA validated monitor, the number of data years used in the trend analysis and the overall ozone trend result. In Table 1, the overall ozone trend result at a monitor was considered improving if any of the statistical metrics evaluated showed statistically significant improvement at the 5% error rate or  $\alpha=0.05$  significance level. The individual metric trend analysis and ranking results are provided in Appendix A.

**Table 1: List of Ozone Monitors<sup>2</sup>**

Monitor Analyzed	EPA Validated Monitor	Years Analyzed in Trend	Overall Ozone Trend Result <sup>3</sup>
Aldine	X	5 years	Neutral
Atascocita		4 years	Neutral
Bayland Park	X	5 years	Neutral
Bunker Hill		4 years	Neutral
Channelview	X	5 years	Neutral
Clinton	X	5 years	Neutral
Conroe	X	5 years	Neutral
Croquet	X	5 years	Neutral
Crosby Library		5 years	Neutral
Dancinger		5 years	Neutral
Deer Park 2	X	5 years	Neutral
East	X	5 years	Worsening
Houston Regional	X	5 years	Neutral
HRM Hayden		5 years	Neutral
Katy Park		4 years	Neutral
Kingwood Library		4 years	Neutral
Lake Jackson		5 years	Neutral

<sup>2</sup> Three EPA validated monitors were not included in this analysis, due to insufficient data: Clute, Galveston Airport and San Jacinto Monument; monitor locations not evaluated because of insufficient 2008 measured data include (< 90% recovered): Wallisville, Baytown Wetlands, Clear Brook, Clear Creek, and Clear Lake

<sup>3</sup> Overall trend result is considered improving if an improving trend (i.e, decrease) was found in the number of days above the unhealthy for sensitive groups threshold or annual average, median or maximum of the daily peak 8 hour average.

Monitor Analyzed	EPA Validated Monitor	Years Analyzed in Trend	Overall Ozone Trend Result <sup>3</sup>
Lang	X	5 years	Worsening
Lynchburg Ferry		5 years	Improving
Manvel Croix Park	X	5 years	Neutral
Meyer Park		4 years	Neutral
Monroe	X	5 years	Neutral
Mustang Bayou		5 years	Neutral
N. West Harris County	X	5 years	Neutral
North Wayside	X	5 years	Neutral
Seabrook	X	5 years	Neutral
Sheldon		5 years	Neutral
Texas Avenue	X	5 years	Neutral
Tom Bass		4 years	Neutral
TX City 34 <sup>th</sup>	X	5 years	Neutral
West Hollow	X	5 years	Neutral
West Houston		5 years	Improving

Figure 2 depicts the 2008 annual average of the maximum daily 8 hour average concentration and the trend of this statistic over the previous 5 years. The monitor with the lowest and highest annual average of the maximum daily 8 hour average concentration is at Lynchburg Ferry and at Aldine, respectively. The only statistically significant trends of this statistic over the past five years when the trend was evaluated at a 5% error rate are an improving trend at the Lynchburg Ferry monitor and worsening trends at the East and Lang monitors. When the error rate was raised to 10% rate ( $\alpha=0.10$ ), the monitors at North Wayside and Aldine were found to exhibit a worsening trend. The most important result may be that the Aldine monitor exhibits the highest annual average of the maximum daily 8 hour average concentration in the region in addition to a statistically significant worsening trend (10% error rate or rate ( $\alpha=0.10$ )).

**Figure 2:** 2008 Annual Average of the Maximum Daily 8 hour Average and 2004-2008 Trend Results in HGB Area

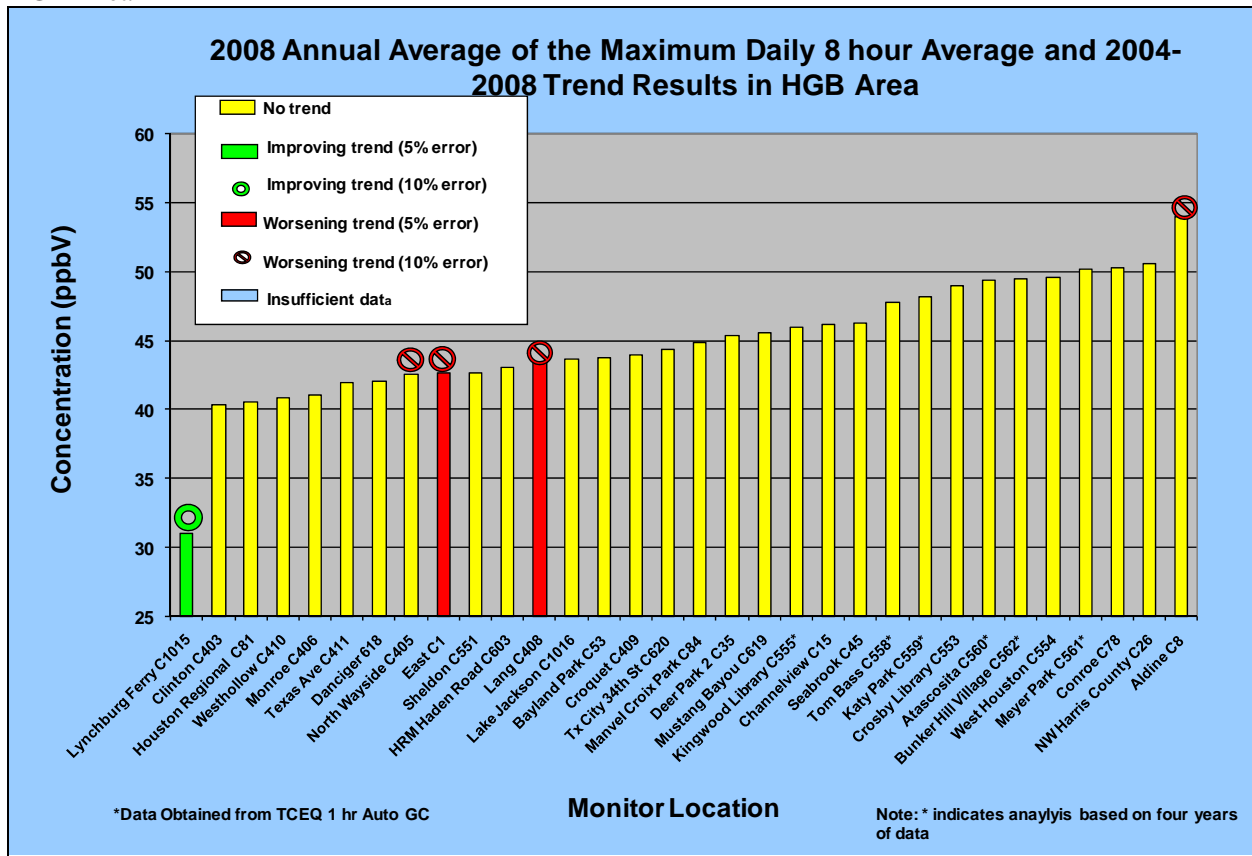
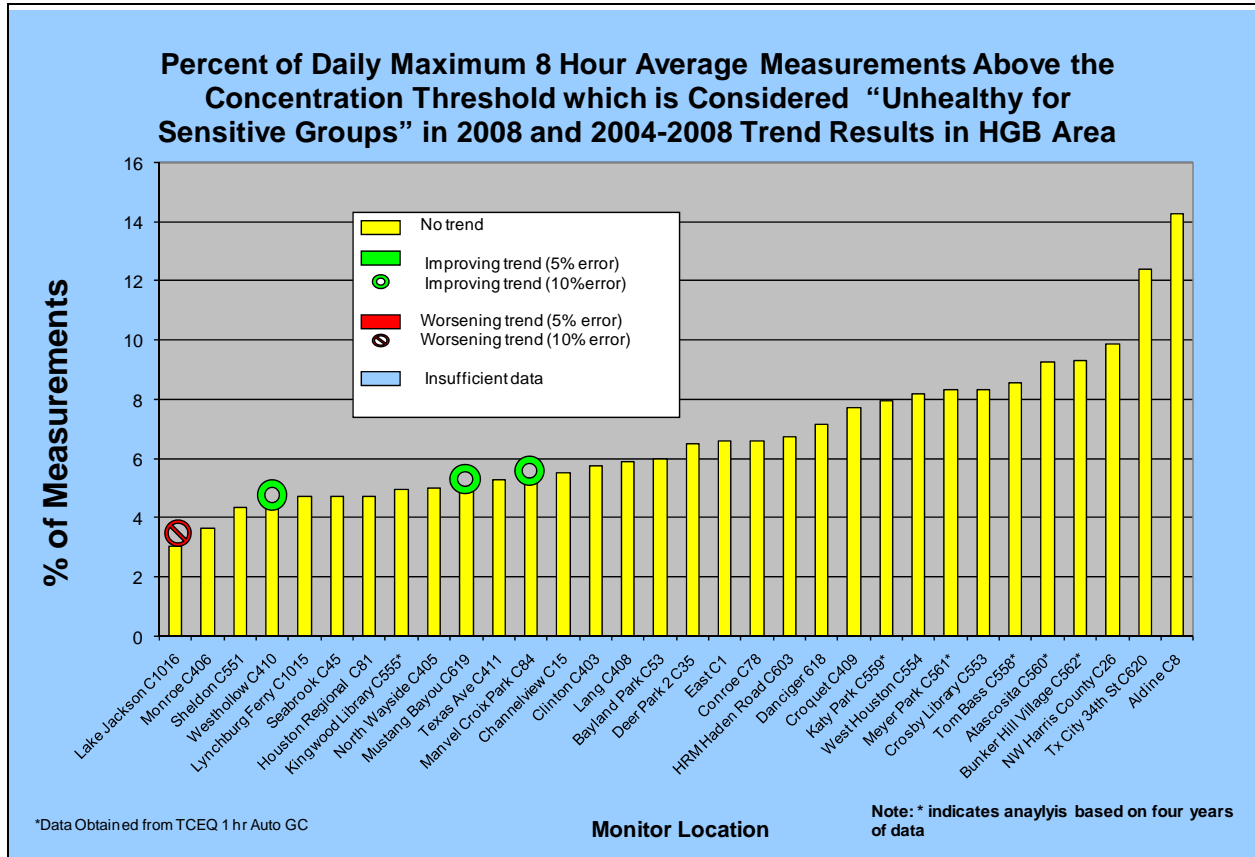


Figure 3 depicts the percent of the daily maximum 8 hour average measurements that were above the concentration threshold considered unhealthy for sensitive groups during 2008 and the trend of this statistic over the previous 5 years. Only neutral trends were found when the trend test was applied at a 5% error rate ( $\alpha=0.05$ ). When the trend test was applied with a 10% error rate ( $\alpha=0.10$ ), three monitors showed an improving trend and one a worsening trend.

**Figure 3:** Percent of Daily Maximum 8 Hour Average Measurements above the Concentration Threshold which is considered “Unhealthy for Sensitive Groups” in 2008 and 2004-2008 Trend Results in HGB Area



# Appendix A

## Trend Analysis Results for all Metrics:

Downward trend
  Upward trend
  Insufficient data
  4 yr sample period

Monitor Location	Acceptable data for most recent years?	Total number of days above the unhealthy for sensitive groups threshold					Downward trend (95%)?	Downward trend (90%)?	Total number of days above the very unhealthy for sensitive groups threshold					Downward trend (95%)?	Downward trend (90%)?	
		2004	2005	2006	2007	2008			2004	2005	2006	2007	2008			
East C1	5 year	14	1	24	5	23	no	no	1	0	0	0	0	0	no	no
Aldine C8	5 year	13	12	10	15	52	no	no	0	0	0	0	0	5	no	no
Channelview C15	5 year	11	12	10	6	20	no	no	0	0	0	0	0	1	no	no
NW Harris County C26	5 year	11	23	19	14	36	no	no	0	1	0	0	0	0	no	no
Deer Park 2 C35	5 year	17	26	13	9	23	no	no	1	0	1	0	0	2	no	no
Seabrook C45	5 year	20	23	15	13	17	no	no	0	1	1	0	0	0	no	no
Bayland Park C53	5 year	25	31	18	11	21	no	no	0	0	2	0	0	1	no	no
Conroe C78	5 year	5	17	12	6	24	no	no	0	1	0	0	0	0	no	no
Houston Regional C81	5 year	4	15	13	0	17	no	no	1	0	0	0	0	1	no	no
Manvel Croix Park C84	5 year	30	23	26	10	19	no	yes	1	0	1	0	0	0	no	no
Clinton C403	5 year	15	8	5	2	20	no	no	1	0	0	0	0	1	no	no
North Wayside C405	5 year	9	1	7	5	18	no	no	1	0	0	0	0	0	no	no
Monroe C406	5 year	17	27	12	3	13	no	no	0	0	0	0	0	0	no	no
Lang C408	5 year	9	3	5	1	21	no	no	1	0	0	0	0	0	no	no
Croquet C409	5 year	24	23	10	3	27	no	no	0	0	0	0	0	0	no	no
Westhollow C410	5 year	21	22	19	10	15	no	yes	0	0	2	0	0	1	no	no
Texas Ave C411	5 year	15	3	10	4	19	no	no	1	0	0	0	0	0	no	no
Sheldon C551	5 year	12	9	10	1	15	no	no	0	0	0	0	0	1	no	no
Crosby Library C553	5 year	13	15	11	5	30	no	no	0	1	0	0	0	1	no	no
West Houston C554	5 year	17	27	24	13	30	no	no	2	0	1	0	0	1	no	no
Kingwood Library C555*	4 year	6	14	12	3	18	no	no	0	1	0	0	0	0	no	no
Tom Bass C558*	4 year	33	31	23	14	31	no	no	1	1	1	1	0	0	no	no
Katy Park C559*	4 year	15	27	20	10	29	no	no	1	0	1	0	0	3	no	no
Atascosita C560*	4 year	7	14	18	4	33	no	no	0	1	0	0	0	1	no	no
Meyer Park C561*	4 year	7	28	19	15	30	no	no	0	0	0	0	0	0	no	no
Bunker Hill Village C562*	4 year	0	33	25	13	34	no	no	0	0	1	0	0	1	no	no
HRM Haden Road C603	5 year	14	11	20	3	24	no	no	0	0	1	0	0	0	no	no
Dancier 618	5 year	21	13	12	5	14	no	no	0	0	0	0	0	0	no	no
Mustang Bayou C619	5 year	20	19	14	13	25	no	no	0	0	0	0	0	0	no	no
Tx City 34th St C620	5 year	24	18	8	6	18	no	no	0	0	0	0	0	0	no	no
Lynchburg Ferry C1015	acceptable data for 2003-2007	18	14	11	2	9	yes	yes	1	1	0	0	0	0	no	yes
Lake Jackson C1016	5 year		7	9	3	17	no	no	0	0	0	0	0	0	no	no

Monitor Location	Acceptable data for most recent years?	Annual maximum of daily 8 hour maximums (ppbV)					Downward trend (95%)?	Downward trend (90%)?	Annual average of maximum daily 8 hr averages (ppbV)					Downward trend (95%)?	Downward trend (90%)?
		2004	2005	2006	2007	2008			2004	2005	2006	2007	2008		
East C1	5 year	125.6	77.0	111.3	77.8	107.0	no	no	35.1	35.4	39.7	35.6	42.6	up	up
Aldine C8	5 year	103.0	101.1	102.1	95.4	123.0	no	no	40.8	44.0	41.2	42.0	54.0	no	up
Channelview C15	5 year	104.9	104.9	104.9	104.9	118.0	no	no	39.8	43.1	41.4	39.2	46.2	no	no
NW Harris County C26	5 year	113.3	116.8	103.1	100.6	105.0	no	no	42.4	46.7	45.3	42.5	50.6	no	no
Deer Park 2 C35	5 year	118.6	104.5	121.4	98.8	131.0	no	no	40.8	44.1	42.3	39.5	45.4	no	no
Seabrook C45	5 year	105.9	118.0	119.6	94.9	105.0	no	no	41.5	46.2	44.0	42.1	46.3	no	no
Bayland Park C53	5 year	114.1	106.1	124.3	92.1	118.0	no	no	41.6	44.8	42.5	38.2	43.8	no	no
Conroe C78	5 year	104.1	123.5	110.0	78.5	107.0	no	no	42.4	47.1	46.2	40.7	50.3	no	no
Houston Regional C81	5 year	125.4	101.8	101.9	72.0	123.0	no	no	32.1	41.0	38.0	30.4	40.6	no	no
Manvel Croix Park C84	5 year	116.0	100.1	121.2	100.9	104.0	no	no	42.8	43.7	43.5	38.8	44.9	no	no
Clinton C403	5 year	118.9	98.4	90.0	79.6	118.0	no	no	35.2	35.9	29.5	31.2	40.3	no	no
North Wayside C405	5 year	122.5	80.3	95.4	85.5	115.0	no	no	35.0	36.8	37.8	35.6	42.6	no	up
Monroe C406	5 year	107.0	107.0	106.0	93.0	107.0	no	no	37.2	43.4	40.5	32.1	41.1	no	no
Lang C408	5 year	125.4	90.0	95.3	82.1	113.0	no	no	31.1	32.7	32.1	32.9	43.4	up	up
Croquet C409	5 year	114.0	109.5	109.7	82.6	114.0	no	no	40.3	42.1	37.4	34.2	44.0	no	no
Westhollow C410	5 year	108.3	103.8	126.6	105.1	123.0	no	no	37.8	42.7	41.6	38.1	40.9	no	no
Texas Ave C411	5 year	118.5	90.8	95.8	82.0	108.0	no	no	34.9	36.3	32.8	34.4	41.9	no	no
Sheldon C551	5 year	105.4	103.9	100.0	84.9	138.0	no	no	40.2	44.9	42.1	37.6	42.7	no	no
Crosby Library C553	5 year	105.0	125.3	99.9	112.5	143.0	no	no	42.0	47.2	44.0	41.1	49.0	no	no
West Houston C554	5 year	123.5	104.3	118.5	93.0	119.0	no	no	39.4	46.2	44.3	40.7	49.6	no	no
Kingwood Library C555*	4 year	87.8	122.1	101.8	86.6	102.0	no	no	41.5	45.6	42.5	38.9	46.0	no	no
Tom Bass C558*	4 year	121.5	121.5	119.8	118.0	114.0	no	yes	44.1	45.7	43.6	40.1	47.8	no	no
Katy Park C559*	4 year	118.3	103.9	120.0	96.9	138.0	no	no	41.3	46.3	43.8	40.4	48.1	no	no
Atascosita C560*	4 year	94.3	117.0	102.9	84.4	140.0	no	no	41.7	47.5	44.7	40.7	49.4	no	no
Meyer Park C561*	4 year	110.1	107.6	103.6	96.9	106.0	no	no	40.6	47.6	44.8	41.2	50.2	no	no
Bunker Hill Village C562*	4 year	53.6	103.5	121.8	90.1	132.0	no	no	27.4	45.7	44.2	39.6	49.5	no	no
HRM Haden Road C603	5 year	113.5	92.6	117.6	81.0	111.0	no	no	35.8	41.1	39.9	36.7	43.1	no	no
Danciger 618	5 year	104.1	96.4	87.1	90.9	110.0	no	no	41.4	43.3	42.3	38.0	42.0	no	no
Mustang Bayou C619	5 year	103.8	85.5	91.9	97.9	103.0	no	no	44.2	45.6	42.1	42.8	45.5	no	no
Tx City 34th St C620	5 year	114.5	92.5	92.5	94.3	112.0	no	no	44.3	43.9	42.0	39.4	44.4	no	no
Lynchburg Ferry C1015	accpetable data for 2003-2007	116.4	118.0	111.5	80.3	108.0	no	yes	42.6	42.5	40.6	36.1	31.0	yes	yes
Lake Jackson C1016	5 year	88.5	84.6	84.0	81.0	101.0	no	no	38.3	41.3	39.6	37.0	43.7	no	no

Monitor Location	Acceptable data for most recent years?	Annual median of daily 8 hour maximims (ppbV)					Downward trend (95%)?	Downward trend (90%)?	% of measurements above unhealthy for sensitive groups threshold					Downward trend (95%)?	Downward trend (90%)?
		2004	2005	2006	2007	2008			2004	2005	2006	2007	2008		
East C1	5 year	30.8	33.8	35.4	34.8	40.0	up	up	3.6	0.3	6.2	1.4	5.1	no	no
Aldine C8	5 year	37.8	42.9	37.1	40.6	51.0	no	no	2.5	2.5	2.4	4.2	10.1	no	up
Channelview C15	5 year	37.0	41.0	38.9	37.6	44.0	no	no	2.5	3.4	2.5	1.7	4.4	no	no
NW Harris County C26	5 year	39.4	45.4	41.8	39.4	49.0	no	no	2.9	5.7	4.7	3.4	8.2	no	no
Deer Park 2 C35	5 year	35.9	41.1	38.3	37.3	44.0	no	no	3.7	6.7	0.0	2.2	4.5	no	no
Seabrook C45	5 year	38.0	43.6	41.3	40.3	45.0	no	no	4.4	5.9	3.6	3.6	3.3	no	yes
Bayland Park C53	5 year	35.6	42.8	38.0	35.4	41.0	no	no	4.7	7.6	2.8	3.0	4.3	no	no
Conroe C78	5 year	40.9	46.7	44.1	39.8	51.0	no	no	1.1	4.5	2.7	1.7	6.1	no	no
Houston Regional C81	5 year	28.4	39.0	34.1	28.9	38.0	no	no	0.6	3.6	3.0	0.0	4.2	no	no
Manvel Croix Park C84	5 year	37.2	40.9	39.3	36.9	44.0	no	no	6.4	5.6	6.4	2.6	4.8	no	yes
Clinton C403	5 year	30.0	32.0	26.3	28.3	38.0	no	no	3.6	2.0	1.4	0.6	4.9	no	no
North Wayside C405	5 year	30.9	34.4	33.9	33.5	41.0	no	no	2.2	0.3	1.9	1.4	3.6	no	no
Monroe C406	5 year	31.8	39.5	37.3	29.6	39.0	no	no	3.6	6.5	1.9	0.8	3.4	no	no
Lang C408	5 year	26.5	29.8	27.8	30.5	41.0	up	up	2.2	0.8	1.4	0.3	5.0	no	no
Croquet C409	5 year	35.1	38.9	33.8	32.1	41.0	no	no	5.8	5.4	1.9	0.8	6.9	no	no
Westhollow C410	5 year	33.0	40.4	37.8	34.6	39.0	no	no	5.0	5.4	3.3	2.5	2.0	yes	yes
Texas Ave C411	5 year	28.8	33.1	28.8	31.9	39.0	no	no	3.9	0.9	3.0	1.1	3.6	no	no
Sheldon C551	5 year	37.1	43.9	39.2	37.1	43.0	no	no	2.7	2.0	2.2	0.3	3.8	no	no
Crosby Library C553	5 year	39.6	46.0	41.6	39.8	47.0	no	no	3.3	3.6	2.7	1.1	7.5	no	no
West Houston C554	5 year	34.7	43.6	40.2	37.3	46.0	no	no	3.6	6.4	4.4	3.6	6.0	no	no
Kingwood Library C555*	4 year	39.5	45.4	39.9	37.3	45.0	no	no	2.6	3.1	3.0	0.8	4.1	no	no
Tom Bass C558*	4 year	38.8	42.4	39.3	37.3	45.0	no	no	7.6	6.8	4.9	3.0	6.9	no	no
Katy Park C559*	4 year	37.0	43.6	40.4	37.9	46.0	no	no	4.5	6.1	3.8	2.5	6.3	no	no
Atascosita C560*	4 year	38.1	47.3	41.8	39.3	48.0	no	no	4.7	3.3	4.4	1.1	7.0	no	no
Meyer Park C561*	4 year	35.9	45.3	40.9	38.4	49.0	no	no	3.4	7.1	4.9	3.8	6.9	no	no
Bunker Hill Village C562*	4 year	29.1	43.4	40.3	36.3	46.0	no	no	0.0	7.9	4.2	3.6	6.8	no	no
HRM Haden Road C603	5 year	32.0	38.5	36.1	35.0	41.0	no	no	3.7	3.2	5.0	0.8	5.6	no	no
Danciger 618 Mustang Bayou C619	5 year	39.0	41.4	41.0	36.8	45.0	no	no	5.2	3.6	3.3	1.4	6.6	no	no
Tx City 34th St C620	5 year	40.1	43.2	39.4	40.8	44.0	no	no	4.2	5.4	3.9	3.4	4.2	no	no
Lynchburg Ferry C1015	accpetable data for 2003-2007	39.4	41.4	39.4	37.4	0.0	yes	yes	5.3	5.2	2.3	1.7	10.1	no	no
Lake Jackson C1016	5 year	38.9	38.4	36.9	33.1	42.5	no	no	4.1	3.4	2.5	0.6	4.1	no	no
	5 year	34.1	39.3	37.8	35.5	36.5	no	no	2.7	2.0	2.5	0.8	2.0	no	yes

Monitor Location	Acceptable data for most recent years?	% of measurements above unhealthy threshold					Downward trend (95%)?	Downward trend (90%)?	% of measurements above very unhealthy threshold					Downward trend (95%)?	Downward trend (90%)?
		2004	2005	2006	2007	2008			2004	2005	2006	2007	2008		
East C1	5 year	0.0	0.0	0.6	0.0	1.4	no	no	0.3	0.0	0.0	0.0	0.0	no	no
Aldine C8	5 year	1.1	0.8	0.6	0.0	2.7	no	no	0.0	0.0	0.0	0.0	1.4	no	no
Channelview C15	5 year	0.5	0.0	0.3	0.0	0.8	no	no	0.0	0.0	0.0	0.0	0.3	no	no
NW Harris County C26	5 year	0.3	0.6	0.6	0.6	1.6	no	up	0.0	0.3	0.0	0.0	0.0	no	no
Deer Park 2 C35	5 year	0.9	0.6	0.8	0.3	1.4	no	no	0.3	0.0	0.3	0.0	0.6	no	no
Seabrook C45	5 year	1.1	0.3	0.3	0.0	1.4	no	no	0.0	0.3	0.3	0.0	0.0	no	no
Bayland Park C53	5 year	2.2	1.1	1.7	0.0	1.4	no	no	0.0	0.0	0.6	0.0	0.3	no	no
Conroe C78	5 year	0.3	0.0	0.5	0.0	0.6	no	no	0.0	0.3	0.0	0.0	0.0	no	no
Houston Regional C81	5 year	0.3	0.6	0.5	0.0	0.3	no	no	0.3	0.0	0.0	0.0	0.3	no	no
Manvel Croix Park C84	5 year	1.7	0.8	0.6	0.3	0.6	no	yes	0.3	0.0	0.3	0.0	0.0	no	no
Clinton C403	5 year	0.3	0.3	0.0	0.0	0.6	no	no	0.3	0.0	0.0	0.0	0.3	no	no
North Wayside C405	5 year	0.0	0.0	0.0	0.0	1.4	no	no	0.3	0.0	0.0	0.0	0.0	no	no
Monroe C406	5 year	1.1	1.1	1.4	0.0	0.3	no	no	0.0	0.0	0.0	0.0	0.0	no	no
Lang C408	5 year	0.0	0.0	0.0	0.0	0.8	no	no	0.3	0.0	0.0	0.0	0.0	no	no
Croquet C409	5 year	0.8	1.1	0.8	0.0	0.9	no	no	0.0	0.0	0.0	0.0	0.0	no	no
Westhollow C410	5 year	1.2	0.9	1.4	0.3	2.0	no	no	0.0	0.0	0.5	0.0	0.3	no	no
Texas Ave C411	5 year	0.0	0.0	0.0	0.0	1.7	no	no	0.3	0.0	0.0	0.0	0.0	no	no
Sheldon C551	5 year	0.5	0.6	0.6	0.0	0.3	no	no	0.0	0.0	0.0	0.0	0.3	no	no
Crosby Library C553	5 year	0.3	0.3	0.3	0.3	0.6	no	no	0.0	0.3	0.0	0.0	0.3	no	no
West Houston C554	5 year	0.6	1.1	1.9	0.0	1.9	no	no	0.6	0.0	0.3	0.0	0.3	no	no
Kingwood Library C555*	4 year	0.0	0.6	0.3	0.0	0.8	no	no	0.0	0.3	0.0	0.0	0.0	no	no
Tom Bass C558*	4 year	2.1	1.7	1.1	0.5	1.7	no	no	0.3	0.3	0.3	0.3	0.0	no	yes
Katy Park C559*	4 year	0.3	1.4	1.4	0.3	0.8	no	no	0.3	0.0	0.3	0.0	0.8	no	no
Atascosita C560*	4 year	0.0	0.3	0.5	0.0	2.0	no	no	0.0	0.3	0.0	0.0	0.3	no	no
Meyer Park C561*	4 year	1.4	0.5	0.3	0.3	1.4	no	no	0.0	0.0	0.0	0.0	0.0	no	no
Bunker Hill Village C562*	4 year	0.0	1.1	2.5	0.0	2.2	no	no	0.0	0.0	0.3	0.0	0.3	no	no
HRM Haden Road C603	5 year	0.3	0.0	0.3	0.0	1.1	no	no	0.0	0.0	0.3	0.0	0.0	no	no
Danciger 618	5 year	0.5	0.3	0.0	0.0	0.6	no	no	0.0	0.0	0.0	0.0	0.0	no	no
Mustang Bayou C619	5 year	1.4	0.0	0.0	0.3	0.8	no	no	0.0	0.0	0.0	0.0	0.0	no	no
Tx City 34th St C620	5 year	1.4	0.0	0.0	0.0	1.6	no	no	0.0	0.0	0.0	0.0	0.8	no	no
Lynchburg Ferry C1015	accpetable data for 2003-2007	0.6	0.3	0.6	0.0	0.6	no	no	0.3	0.3	0.0	0.0	0.0	no	no
Lake Jackson C1016	5 year	0.0	0.0	0.0	0.0	0.3	no	no	0.0	0.0	0.0	0.0	0.7	no	no

Monitor Location	Acceptable data for most recent years?	% of measurements above very unhealthy for sensitive groups threshold					Downward trend (95%)?	Downward trend (90%)?	Standard deviation average of maximum daily 8 hr average					Downward trend (95%)?	Downward trend (90%)?
		2004	2005	2006	2007	2008			2004	2005	2006	2007	2008		
East C1	5 year	3.8	0.3	6.7	1.4	6.6	no	no	17.8	14.9	18.6	15.4	20.1	no	no
Aldine C8	5 year	3.6	3.4	3.0	4.2	14.2	no	no	17.9	17.5	16.1	16.5	20.8	no	no
Channelview C15	5 year	3.0	3.4	2.8	1.7	5.5	no	no	17.0	16.6	15.7	15.1	16.9	no	no
NW Harris County C26	5 year	3.2	6.6	5.3	3.9	9.9	no	no	17.2	17.2	16.1	16.1	17.6	no	no
Deer Park 2 C35	5 year	4.9	7.3	3.7	2.5	6.5	no	no	18.5	18.8	17.6	16.1	20.5	no	no
Seabrook C45	5 year	5.5	6.4	4.1	3.6	4.7	no	no	17.8	18.2	16.1	16.0	17.6	no	no
Bayland Park C53	5 year	6.8	6.4	5.1	3.0	6.0	no	no	20.8	20.0	18.5	16.4	20.2	no	no
Conroe C78	5 year	1.4	4.8	3.3	1.7	6.6	no	no	13.7	15.3	15.2	13.3	16.5	no	no
Houston Regional C81	5 year	1.1	4.2	3.6	0.0	4.7	no	no	16.9	18.5	17.3	14.3	18.9	no	no
Manvel Croix Park C84	5 year	8.4	6.5	7.2	2.9	5.3	no	yes	20.4	18.8	18.2	16.7	18.3	no	yes
Clinton C403	5 year	4.2	2.3	1.4	0.6	5.7	no	no	18.6	17.6	15.5	16.7	20.4	no	no
North Wayside C405	5 year	2.5	0.3	1.9	1.4	5.0	no	no	16.9	15.6	15.6	15.9	18.1	no	no
Monroe C406	5 year	4.6	7.6	3.3	0.8	3.6	no	no	18.2	19.2	17.1	14.0	17.5	no	no
Lang C408	5 year	2.5	0.8	1.4	0.3	5.9	no	no	17.7	16.1	15.8	15.4	18.7	no	no
Croquet C409	5 year	6.6	6.5	2.7	0.8	7.7	no	no	20.1	19.4	16.3	14.0	20.0	no	no
Westhollow C410	5 year	6.2	6.3	5.2	2.8	4.4	no	yes	19.7	18.1	18.0	16.7	20.5	no	no
Texas Ave C411	5 year	4.1	0.9	3.0	1.1	5.3	no	no	19.5	17.7	17.4	16.0	19.3	no	no
Sheldon C551	5 year	3.3	2.5	2.8	0.3	4.3	no	no	16.0	16.2	15.5	14.4	19.6	no	no
Crosby Library C553	5 year	3.6	4.1	3.0	1.4	8.3	no	no	14.9	16.4	14.7	14.7	18.3	no	no
West Houston C554	5 year	4.7	7.5	6.6	3.6	8.2	no	no	19.2	19.1	18.0	16.9	19.2	no	no
Kingwood Library C555*	4 year	2.6	3.9	3.3	0.8	4.9	no	no	14.7	16.2	14.9	13.7	16.5	no	no
Tom Bass C558*	4 year	10.1	8.7	6.3	3.8	8.6	no	no	20.7	20.3	18.4	17.6	19.6	no	no
Katy Park C559*	4 year	5.2	7.4	5.5	2.8	8.0	no	no	17.7	18.1	17.2	16.1	19.0	no	no
Atascosita C560*	4 year	4.7	3.9	4.9	1.1	9.3	no	no	16.6	16.6	15.7	14.4	19.4	no	no
Meyer Park C561*	4 year	4.8	7.7	5.2	4.1	8.3	no	no	18.9	18.2	16.9	16.0	18.4	no	no
Bunker Hill Village C562*	4 year	0.0	9.0	7.1	3.6	9.3	no	no	9.5	19.9	19.1	17.1	19.8	no	no
HRM Haden Road C603	5 year	4.0	3.2	5.5	0.8	6.7	no	no	17.2	18.0	18.2	15.7	19.1	no	no
Danciger 618	5 year	5.8	3.9	3.3	1.4	7.2	no	no	17.5	17.1	16.0	15.7	20.1	no	no
Mustang Bayou C619	5 year	5.6	5.4	3.9	3.7	5.0	no	yes	18.5	17.5	16.7	16.3	18.3	no	no
Tx City 34th St C620	5 year	6.7	5.2	2.3	1.7	12.4	no	no	19.9	18.1	16.4	16.1	26.6	no	no
Lynchburg Ferry C1015	acceptable data for 2003-2007	5.0	4.0	3.1	0.6	4.7	no	no	17.3	17.2	16.2	14.1	17.1	no	yes
Lake Jackson C1016	5 year	0.0	2.0	2.5	0.8	3.0	no	up	16.8	17.3	15.5	14.9	22.6	no	no

## Appendix B

Figure C-1: **Overall Monitor Rank Order** = Average of the rank order of the ‘Annual average of the maximum daily 8 hour average and the rank order of the ‘Number of exceedance days exceeding the 75 ppbV standard

\*Higher rank => greater ozone concentration

Monitor Site	Overall Rank
Aldine C8	32
NW Harris County C26	31
Bunker Hill Village C562*	28.5
Atascosita C560*	27.5
West Houston C554	27
Meyer Park C561*	27
Crosby Library C553	26
Conroe C78	25.5
Tom Bass C558*	25.5
Katy Park C559*	24
Mustang Bayou C619	20.5
Croquet C409	19
Channelview C15	18
Deer Park 2 C35	18
Bayland Park C53	15.5
HRM Haden Road C603	15.5
Seabrook C45	15
Manvel Croix Park C84	15
Kingwood Library C555*	15
East C1	14
Lang C408	14
Tx City 34th St C620	12.5
North Wayside C405	9.5
Lake Jackson C1016	9.5
Texas Ave C411	9
Clinton C403	8
Sheldon C551	7
Houston Regional C81	5
Danciger 618	5
Westhollow C410	4.5
Monroe C406	3.5
Lynchburg Ferry C1015	1

# Appendix C

Figure B-1: 2008 HGB Area Ozone Monitor Location Ranked by Severity and Median Income

