

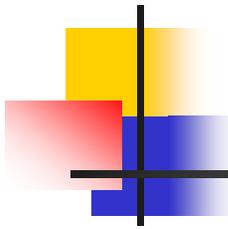
8 Hour Ozone Standard – Briefing on Air Quality Research Pertaining to Monitors and Emissions in HGB Perimeter Counties

Findings from Phase I, Phase II, Phase III, Phase IV Work
and emerging TexAQS II data

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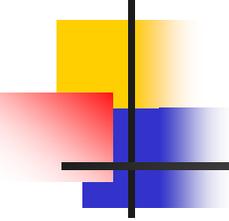
Sponsored by members of Industry in the Perimeter Counties of the
HGB Ozone Non-Attainment Area

September 13, 2006



Outline

- What are we learning from the 2006 ozone season and preliminary results from TexAQS II?
- How do these findings compare to analyses of previous ozone seasons?
- What do recent modeling analyses tell us about possible targeted strategies?

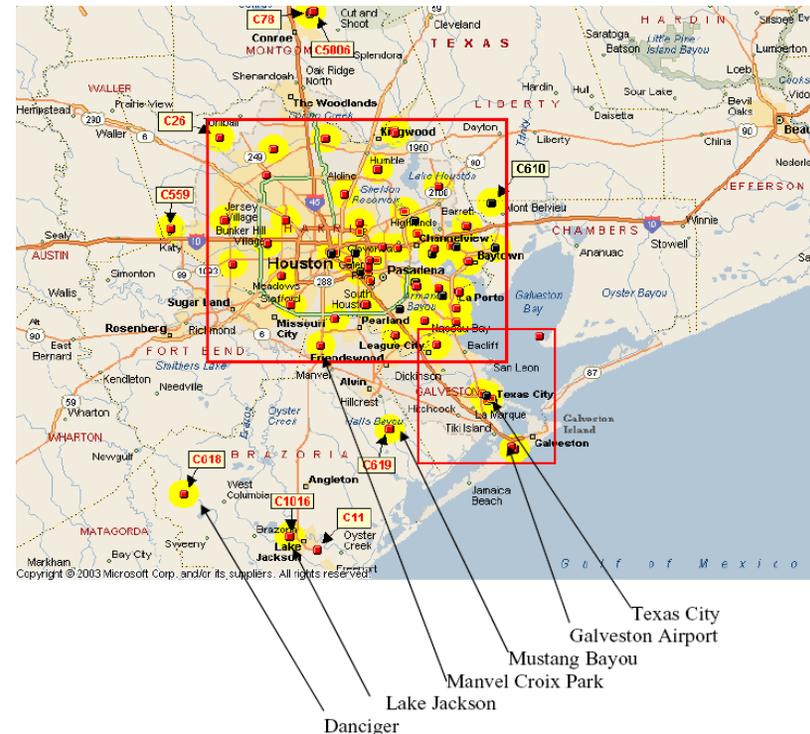


Summary of previous analyses

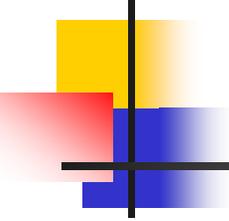
- Emission reductions required by 2009 will bring perimeter county and many Harris County monitors into attainment
- Sites in southwest Houston (especially Bayland Park), some sites in the Ship Channel (especially Deer Park), and some sites in north Houston (especially Aldine) have high residual ozone concentrations in the modeling
- Some focused strategies for Bayland Park and other monitors may be possible
- Results emerging from new monitors and from TexAQS II highlight the importance of focused strategies for monitors in west and southwest Houston; Aldine monitor may be coming into attainment and has a much lower current design value than west and southwest Houston monitors

Monitor by monitor strategies

- Understand reasons for both high model predicted and high observed ozone concentrations at specific monitors
- Focus on Bayland Park and Croquet because of their proximity to perimeter county sources in Brazoria and Galveston Counties
- Recent data indicate that monitors in west and southwest Houston are recording the highest design values



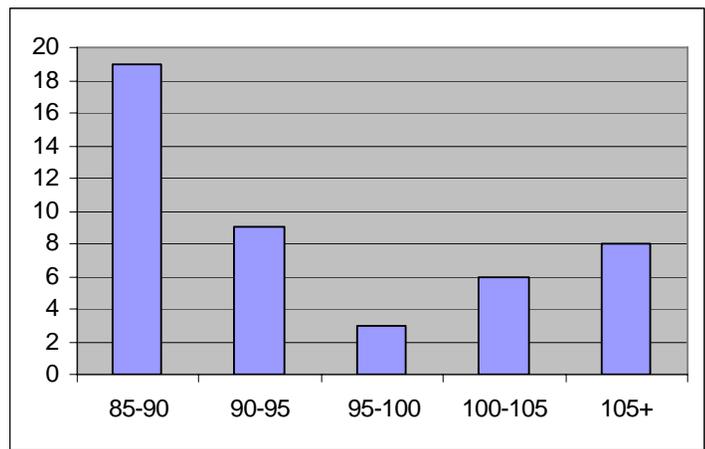
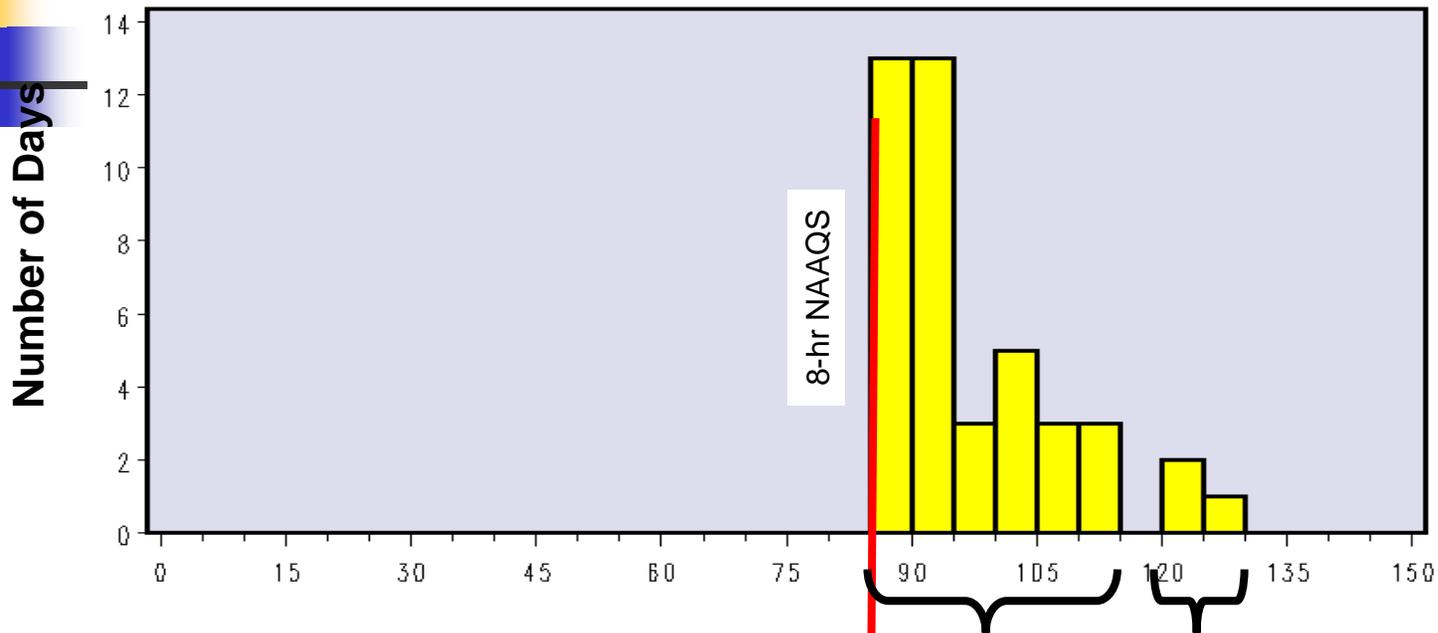
Bayland Park Monitor (through 2005)



- 2003-2005: 45 days > 85 ppb
- 2005: 13 days > 85 ppb (9 days 90 ppb or less; 4 days 100 ppb or more; 4th highest = 100)
- 2004 16 days > 85 ppb (9 days 96 ppb or less; 7 days 102 ppb or more; 4th highest = 104)
- 2003 16 days > 85 ppb (11 days 95 ppb or less; 5 days 100 ppb or more; 4th highest = 107)
- In most of the past 3 years there has been a clear break in the high values after the top 4-7 values. There would be a clear drop in the design value if one or more of the "outliers" were mitigated.

Bayland Park All Days 2002-2004

Number of Exceedance Days by Maximum 8 Hour Ozone

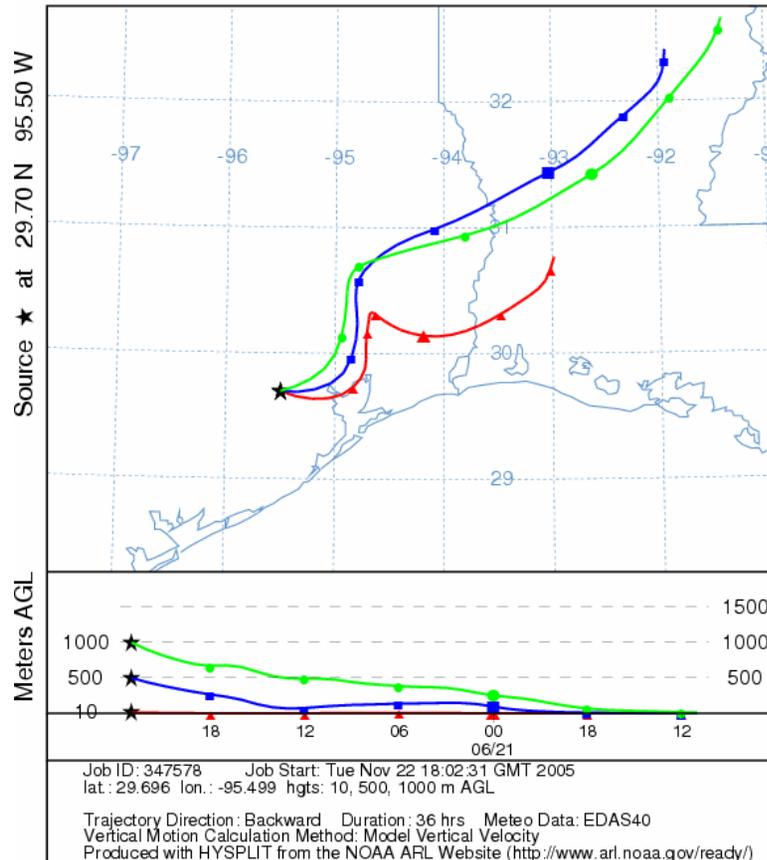


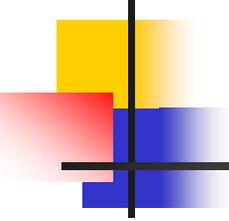
Typical Exceedances Outliers

2003-2005 Daily Maximum 8 Hour Ozone (ppb)

Trajectories on days that determine design values (2002-2005) have similar trajectories

NOAA HYSPLIT MODEL
Backward trajectories ending at 23 UTC 21 Jun 05
EDAS Meteorological Data

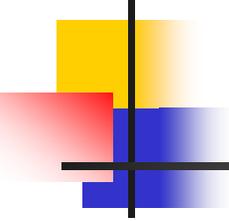




Houston Monitors in 2006 (through 9/9/2006)

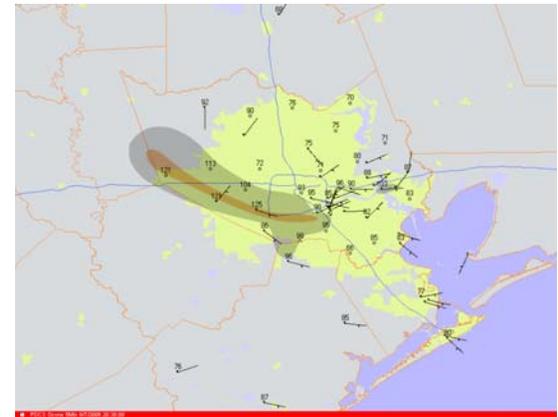
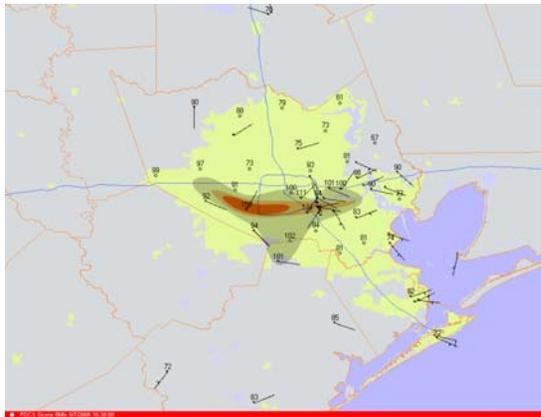
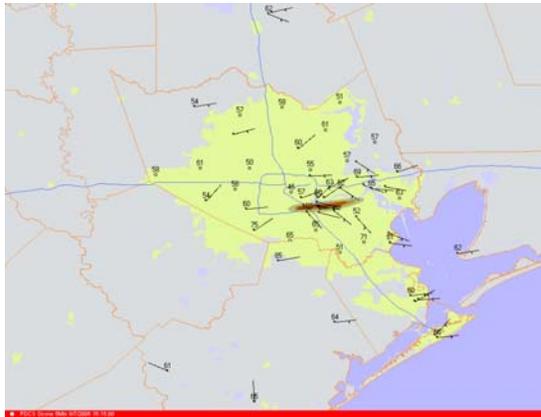
- Bayland Park: High of 124; 4th highest of 106; 6 of 11 above 100 ppb
- Aldine: 4th highest less than 85 ppb
- Deer Park: High of 121; 4th highest of 101
- Tom Bass: 4th highest of 113 ppb
- Park Place, Shell Westhollow, Bunker Hill Village and Katy Park have 4th highests of 106, 103, 106 and 107, respectively

Bayland Park Monitor (through 2006)

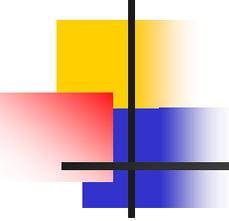


- 2003-2005: 45 days > 85 ppb
- 2006 (through 9/9): 11 days > 85 ppb (6 days less than 100 ppb; 5 days > 100 ppb; 4th highest = 106)
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Small number of days lead to all of the exceedances in west and southwest Houston, including 8/17, 8/31, 9/7

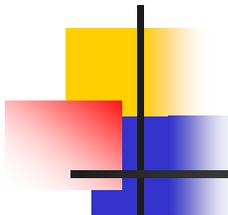


Same pattern on every day above 100 ppb at Bayland Park in 2006



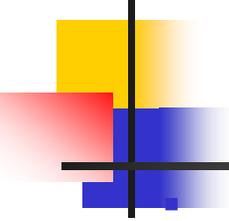
Outline

- What are we learning from the 2006 ozone season and preliminary results from TexAQS II?
- How do these findings compare to analyses of previous ozone seasons?
- What do recent modeling analyses tell us about possible strategies?



Ozone Source Apportionment Technology (OSAT) and Anthropogenic Precursor Culpability Assessment (APCA)

- Probing tool that operates within CAMx, but does not perturb the model simulation
- Uses tracer species to estimate contributions of multiple source areas, categories, and pollutant types to ozone formation
- User must define “source groupings” or combinations of geographic areas and emission categories of interest
- User must also define receptors or receptor areas.
- Ozone concentrations predicted by CAMx are attributed among the source groupings and the fraction of ozone at the receptor formed under VOC- or NO_x-limited conditions is also estimated.
- Unlike OSAT, APCA recognizes that biogenic emissions are not controllable and attributes ozone formation to biogenic emissions only when due to interaction of biogenic VOCs with biogenic NO_x.



Source Areas and Categories

Areas

- 1. Galveston (GAL)
- 2. Brazoria (BRA)
- 3. Chambers (CHA)
- 4. Ford Bend and Waller (FBW)
- 5. Montgomery and Liberty (MGL)
- 6. West Harris (WHAR)
- 7. East Harris (EHAR)
- 8. Beaumont/Port Arthur (BPA)
- 9. Dallas/Fort Worth (DFW)
- 10. Counties under SB7 (SB7)
- 11. Remainder of eastern Texas (TEX)
- 12. Louisiana (LA)
- 13. Remainder of states in regional modeling domain (REG)

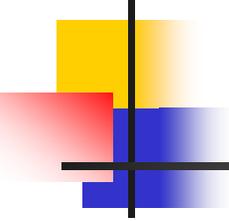
**39 Source Groupings
for Each Ozone Precursor
(NO_x or VOC) and Boundary
and Initial conditions, for a
Total of 82 Source Groupings
for each receptor**

■ Categories

- 1. Points (PTS)
- 2. Area and On-road and Non-Road Mobile (OTH)
- 3. Biogenic (BIO)

■ Other

- Boundary Conditions
- Initial Conditions

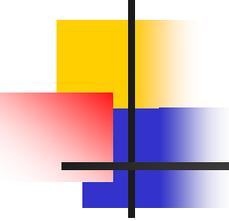


Receptors

- Examined 7x7 array of grid cells around each monitor. Averaged contribution over all hours and grid cells within array that were above an established ozone concentration threshold (70 ppb or 85 ppb).

- **Perimeter County monitors**
 - Manvel Croix
 - Lake Jackson
 - Mustang Bayou
 - Texas City
 - Galveston
 - Danciger

- **Harris County monitors**
 - Bayland Park
 - Aldine
 - Conroe
 - Deer Park
 - Seabrook
 - Lynchburg Ferry
 - Clinton
 - Croquet



Ozone Source Apportionment

- Apply APCA and OSAT to assess source contributions at key monitors using 2009 base case (with federal controls and 2007 controls) from TCEQ
- Also apply APCA and OSAT to assess ozone source apportionment after additional emission reductions (50% NO_x, 50% VOC, 50% NO_x and 50% VOC)
- Difference in source apportionment between base case and control cases provides an indication of the approximate effect of controls in different regions
- Focus on results for Bayland Park (results also available for Aldine, Croquet, and Deer Park)

Contributions from perimeter counties are small compared to other sources at targeted monitors (Bayland Park)

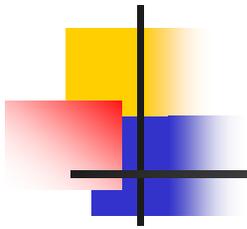
Table 4b.) Contributions of sources to ozone concentrations in the 2009 base case (in ppb), determined using APCA, at the Bayland Park monitor.

Emission type	Total for perimeter county Point Sources	East Harris County Point Sources	Regional point sources	Louisiana Point sources	West Harris County non-point, non-biogenic sources	East Harris County non-point, non-biogenic sources
Base Case (86.9 ppb total)						
NOx	1.30	2.65	4.89	2.68	19.61	1.34
VOC	0.37	1.65	0.08	0.02	2.50	0.58
50% NOx reduction (77.1 ppb total)						
NOx	0.99	2.37	4.93	2.74	15.25	1.14
VOC	0.12	0.49	0.04	0.01	0.58	0.15
50% VOC reduction (83.5 ppb total)						
NOx	1.27	2.45	4.87	2.68	18.71	1.24
VOC	0.25	1.01	0.09	0.02	1.70	0.37
50% VOC and 50% NOx (76.3 ppb total)						
NOx	0.98	2.26	4.84	2.79	15.21	1.11
VOC	0.10	0.50	0.05	0.01	0.50	0.16
Difference between base case and 50% VOC and 50% NOx case						
NOx	0.32	0.39	0.05	-0.11	4.40	0.23
VOC	0.27	1.15	0.03	0.01	2.00	0.42
NOx+VOC	0.59	1.54	0.08	-0.10	6.40	0.65

Contributions from perimeter counties are small compared to other sources at targeted monitors (Bayland Park)

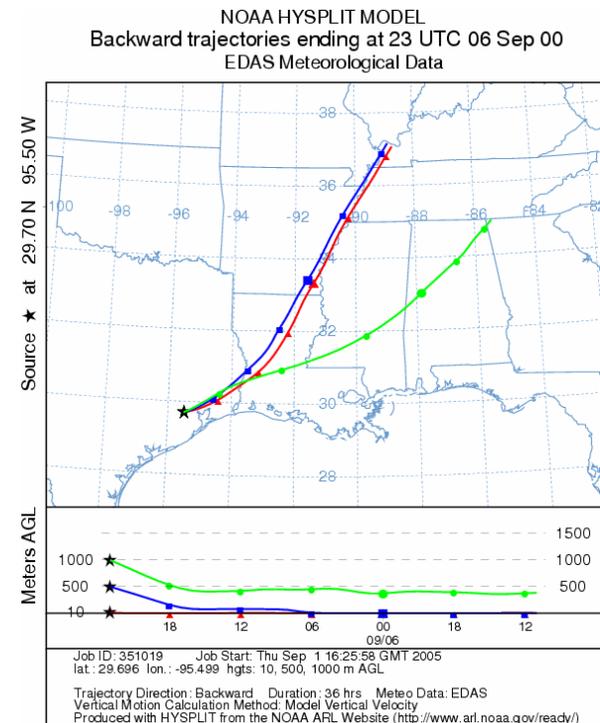
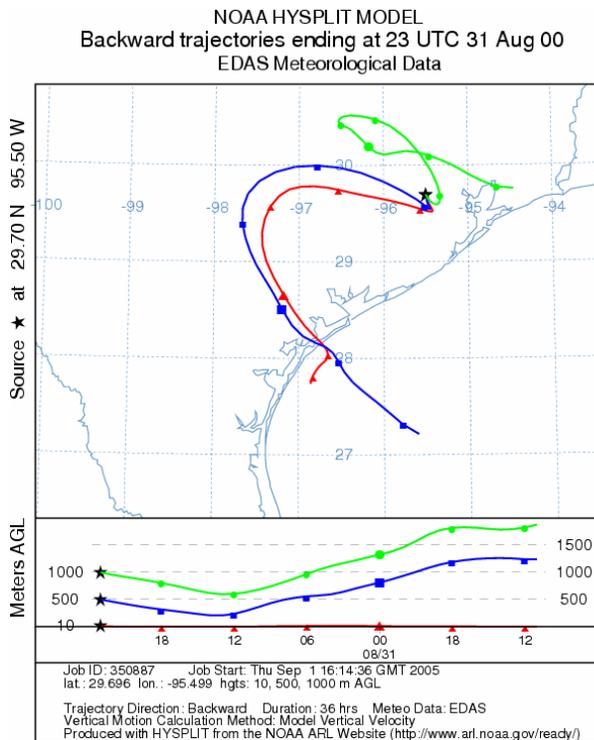
Table 3b.) Contributions of perimeter county sources to ozone concentrations in the 2009 base case (ppb), determined using APCA, at the Bayland Park monitor.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
Base Case						
NOx	0.14	0.34	0.41	0.25	0.16	1.30
VOC	0.11	0.15	0.03	0.08	0.00	0.37
50% NOx reduction						
NOx	0.13	0.25	0.29	0.18	0.14	0.99
VOC	0.04	0.05	0.01	0.02	0.00	0.12
50% VOC reduction						
NOx	0.13	0.33	0.41	0.24	0.16	1.27
VOC	0.09	0.10	0.02	0.04	0.00	0.25
50% VOC and 50% NOx						
NOx	0.13	0.25	0.29	0.17	0.14	0.98
VOC	0.03	0.04	0.01	0.02	0.00	0.10
Difference between base case and 50% VOC and 50% NOx case						
NOx	0.01	0.09	0.12	0.08	0.02	0.32
VOC	0.08	0.11	0.02	0.06	0.00	0.27
NOx+VOC	0.09	0.20	0.14	0.14	0.02	0.59



These results represent averages of high ozone days – what happens if we target days consistent with the meteorology associated with very high ozone concentrations

Compare source apportionments for 8/31 and 9/6 meteorologies



Bayland Park Source Apportionment – 2009 base case

Table 5. Ozone source contributions at Bayland Park in the 2009 base case under conditions typical of moderate ozone exceedances (8/31) and under conditions typical of unusually high ozone exceedances (9/6)

Source Grouping	APCA	
	Moderate ozone exceedances	Unusually high ozone exceedances
BC NOx	11.38	7.42
BC VOC	8.11	6.16
WHAR OTR NOx	32.40	7.40
EHAR PT NOx	0.29	6.86
EHAR OTR NOx	0.15	3.34
FBW OTR NOx	1.77	0.39
BPA PT NOx	0.16	5.10
TX PT NOx	1.28	0.11
TX OTR NOx	4.02	0.15
LA OTR NOx	3.32	4.06
REG PT NOx	2.34	8.82
REG OTR NOx	4.85	18.14
SB7 PT NOx	1.39	0.01
Brazoria plus Galveston County PT NOx	0.17	0.22
MGL PT NOx	0.02	0.27
FBW PT NOx	0.98	0.01

Source Grouping	Description
BC NOx	NOx Boundary Conditions
BC VOC	VOC Boundary Conditions
WHAR OTR NOx	West Harris County NOx Emissions (non-point, non-biogenic)
EHAR PT NOx	East Harris County Point Source NOx Emissions
EHAR OTR NOx	East Harris County Other NOx Emissions (non-point, non-biogenic)
FBW_OTR_NOx	Fort Bend and Waller Counties Other NOx Emissions (non-point, non-biogenic)
BPA PT NOx	Beaumont/Port Arthur Point Source NOx Emissions
TX PT NOx	Remaining Texas Counties including Dallas/Fort Worth Counties Point Source NOx Emissions
TX OTR NOx	Remaining Texas Counties including Dallas/Fort Worth Counties Other NOx Emissions (non-point, non-biogenic)
LA OTR NOx	Louisiana Other NOx Emissions (non-point, non-biogenic)
REG PT NOx	Regional Point Source NOx Emissions
REG OTR NOx	Regional Other NOx Emissions (non-point, non-biogenic)
SB7 PT NOx	Counties under SB7 Point Source Emissions (NOx and VOC)

Note that contributions from perimeter counties are less than 1 or 2 ppb in each case₂₀

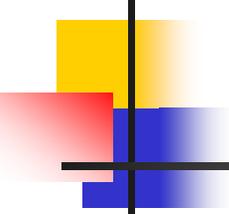
Bayland Park Source Apportionment

– 2009 base case with additional 50% NOx reduction

Source Grouping	APCA	
	Moderate ozone exceedances	Unusually high ozone exceedances
BC NOx	11.34	7.79
BC VOC	7.95	6.32
WHAR OTR NOX	23.10	5.30
EHAR PT NOx	0.23	4.71
EHAR OTR NOx	0.12	2.28
FBW OTR NOx	1.09	0.27
BPA PT NOx	0.17	5.36
TX PT NOx	1.30	0.12
TX OTR NOx	4.23	0.17
LA OTR NOx	3.31	4.17
REG PT NOx	2.32	9.00
REG OTR NOx	4.84	19.14
SB7 PT NOx	1.46	0.01
Brazoria plus Galveston County PT NOx	0.13	0.14
MGL PT NOx	0.02	0.30
FBW PT NOx	0.66	0.01

Source Grouping	Description
BC NOx	NOx Boundary Conditions
BC VOC	VOC Boundary Conditions
WHAR OTR NOx	West Harris County NOx Emissions (non-point, non-biogenic)
EHAR PT NOx	East Harris County Point Source NOx Emissions
EHAR OTR NOx	East Harris County Other NOx Emissions (non-point, non-biogenic)
FBW_OTR_NOx	Fort Bend and Waller Counties Other NOx Emissions (non-point, non-biogenic)
BPA PT NOx	Beaumont/Port Arthur Point Source NOx Emissions
TX PT NOx	Remaining Texas Counties including Dallas/Fort Worth Counties Point Source NOx Emissions
TX OTR NOx	Remaining Texas Counties including Dallas/Fort Worth Counties Other NOx Emissions (non-point, non-biogenic)
LA OTR NOx	Louisiana Other NOx Emissions (non-point, non-biogenic)
REG PT NOx	Regional Point Source NOx Emissions
REG OTR NOx	Regional Other NOx Emissions (non-point, non-biogenic)
SB7 PT NOx	Counties under SB7 Point Source Emissions (NOx and VOC)

Note that contributions from perimeter counties are less than a 1 or 2 ppb in each case



Summary

- West and southwest Houston monitors are now dominating ozone design values (8-hour average)
- Contributions from perimeter county sources are small relative to contributions from other sources (<1-2 ppb)
- Consistent meteorology leads to highest ozone concentrations, suggesting targeted reductions
- Ozone source apportionment results for days with the highest ozone concentrations are very different than for more moderate exceedance days
- Detailed observational data available for multiple examples of these days already available through TexAQS II (8/17/2006; 8/31/2006; 9/7/2006)
- Rapid science synthesis should examine these days in detail and should suggest emission reduction strategies for these types of conditions