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

Findings from Phase I and Phase II Work

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

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Agenda

- Phase I work: Design Values, Relative Reduction Factors (RRFs) and Back Trajectory Calculations
- Phase II work: Source apportionment using photochemical models and sensitivity of RRFs to emission reductions
- Closing Remarks and Path Forward

Sponsor Companies

Members of Industry have contracted with UT to better understand the current and future projected 8-hour ozone concentrations for monitors located in the perimeter counties.

- BASF
- BP
- Chevron Phillips
- ConocoPhillips
- Dow Chemical
- Innovene
- Lyondell Chemical
- Sterling Chemicals

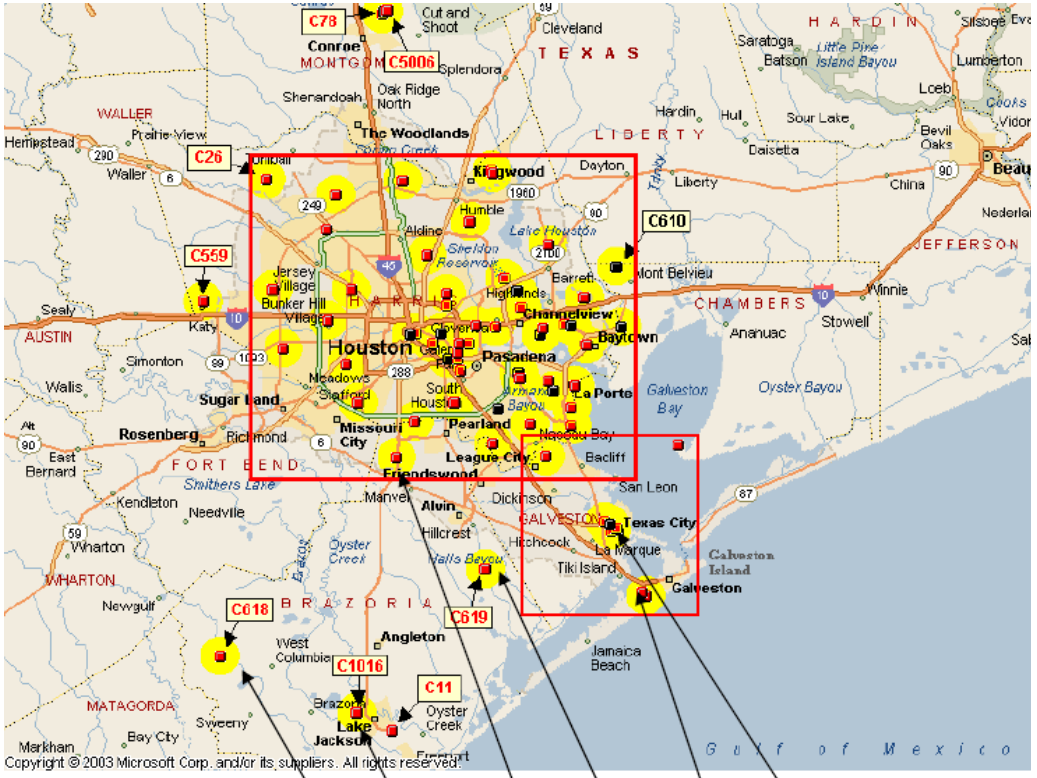
Objectives of Phase I Research

- Understand the 8-Hr Ozone Design Value for each monitor in the perimeter counties based on the most current monitoring data
- Understand which meteorological conditions typically lead to higher ozone levels in the perimeter counties
- Project the future 8-Hr Ozone levels based on the SIP controls in place for the former 1-Hr Ozone standard
- Photochemical modeling work is based on the year 2000 modeling episode for HGB
- Evaluate the impact of rapid ozone formation on ozone design values for perimeter co. ozone monitors

Phase I Findings

- Emission reductions of ozone precursors that will be implemented by 2007 will be nearly sufficient to bring perimeter county monitors into attainment with the ozone (8-hour average NAAQS)
- Demonstrating attainment may be most difficult at the Manvel Croix Park monitor

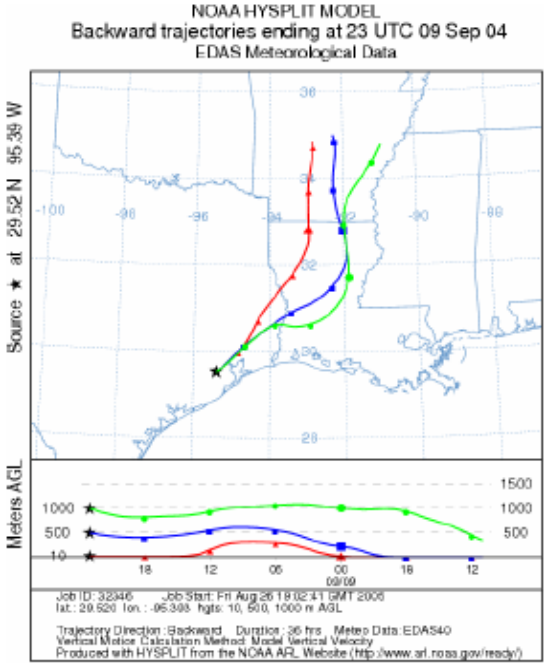
Perimeter County Monitor Locations

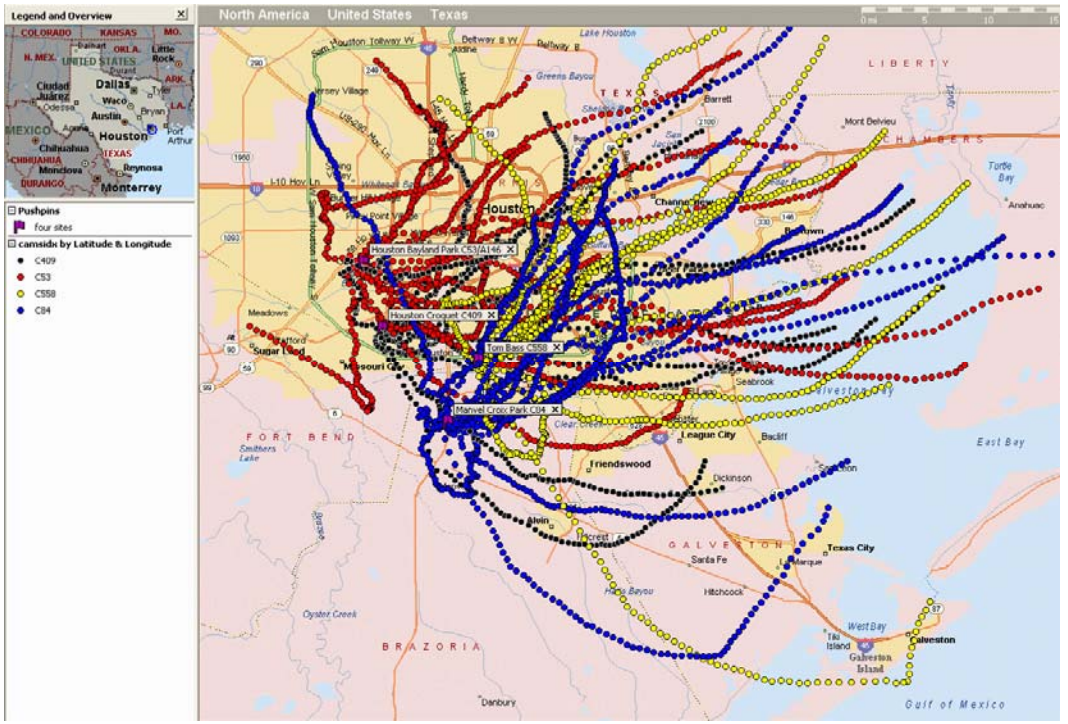


RRF Calculations Based on February 2005 EPA Guidance

Site	2003-2005 Design Value	Avg. model base case ozone conc., for days with ozone conc. above threshold	Days with ozone above threshold conc. in base case	RRF, 2000-2007, based on current model and SIP	Modeled RRF*DV
Perimeter counties					
C 618 Dancinger (2003-2005, 2-full year, 1 partial year average)	<85	85.4	4	0.913	<85
C 619 Mustang Bayou (2003-2005, 2- full year, 1 partial year average)	93	90.3	6	0.880	<85
C 1016 Lake Jackson (2003-2005, 2- full year, 1 partial year average)	<85	84.0	4	0.910	<85
C 34 Galveston Airport (2003-2005, 3-year average)	87.0	86.7	6	0.981	85.3
C 620 Texas City (2003-2005, 2-full year, 1 partial year average)	89.6	88.3	9	0.954	85.5
C 84 Manvel Croix Park (2003-2005, 3-year average)	97.3	95.0	10	0.895	87.1
C53 Bayland Park (2003-2005, 3-year average)	103.6	91.5	11	0.955	98.9
C409 Croquet (2003-2005, 3-year average)	98.0	95.8	10	0.935	91.7

Phase I Findings

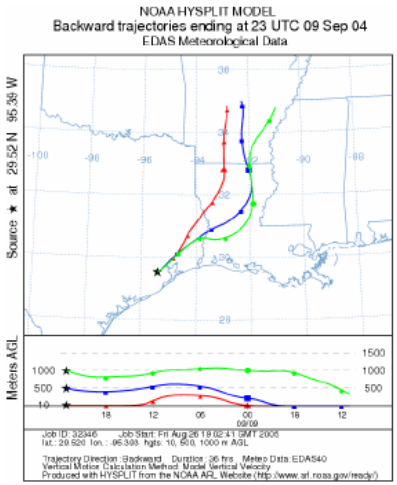




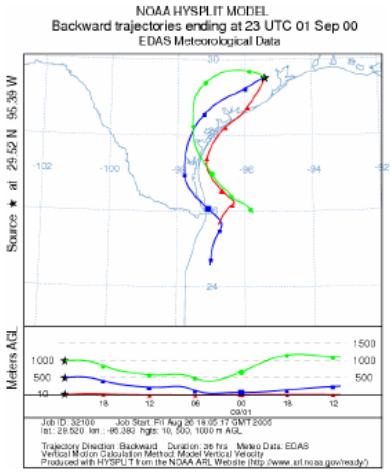
- Monitor by monitor analysis of back trajectories on the days with the 4 highest 8-hour averaged ozone concentrations each year lead to a picture of the types of meteorology that needs to be modeled

Phase I Findings (continued)

- Conditions on most (but not all) days with high ozone concentrations observed at perimeter county monitors involve transport from Harris County into the perimeter counties
- The current photochemical modeling episode has only a limited number of days when meteorological conditions replicate the conditions that lead to high observed ozone concentrations



a.)



b.)

Figure 2a.) Back trajectory calculated with the NOAA HYSPLIT model for the air arriving at the Manvel Croix site on September 9, 2004 (8-hour averaged ozone concentration of 116); this back trajectory is typical of back trajectories for days when this monitor records high 8-hour averaged ozone concentrations

Figure 2b.) Back trajectory calculated with the NOAA HYSPLIT model for the air arriving at the Manvel Croix site on September 1, 2000 (modeled day with high ozone concentration); modeled days with high ozone concentrations exhibited a variety of back trajectories

Findings (continued)

- Rapid ozone formation may influence ozone design values in perimeter counties

Table 7 Four Highest 8-hour averaged ozone concentrations at perimeter county monitoring sites (2002-2004), with rapid ozone concentration gradients identified

Site/year	*Highest*	*Second-highest*	*Third-highest*	*Fourth-highest*
Galveston C34 2002	*99 (9/20)*	*96 (9/14)*	*95 (6/23)*	*93 (8/3)*
Galveston C34 2003	*141 (8/24)*	*111 (3/23)*	*103 (10/21)*	*92 (6/8)*
Galveston C34 2004	*111 (9/17)*	*109 (9/6)*	*89 (7/24)*	*88 (9/30)*
Galveston C34 2005	*88 (6/1)*	*88 (4/12)*	*82 (10/18)*	*81 (8/6)*
Manvel Croix Park C84, 2002	*109 (9/13)*	*107 (9/12)*	*107 (8/28)*	*92(8/30)*
Manvel Croix Park C84, 2003	*111 (5/23)*	*102 (5/29)*	*99 (5/28)*	*97 (9/7)*
Manvel Croix Park C84, 2004	*116 (9/9)*	*112 (8/3)*	*108 (9/29)*	*103 (9/11)*
Manvel Croix Park C84, 2005	*100 (9/20)*	*100 (6/21)*	*96 (10/17)*	*93 (5/5)*
Danciger C618, 2002	*NA*	*NA*	*NA*	*NA*
Danciger C618, 2003	*86 (9/27)*	*85 (9/6)*	*77 (9/25)*	*75 (10/20)*
Danciger C618, 2004	*104 (8/7)*	*102 (9/9)*	*93 (7/20)*	*85 (9/30)*
Danciger C618, 2005	*96 (6/20)*	*83 (9/05)*	*82 (6/21)*	*82 (5/5)*
Mustang Bayou C619, 2002	*NA*	*NA*	*NA*	*NA*
Mustang Bayou C619, 2003	*109 (9/27)*	*109 (9/7)*	*102 (9/6)*	*95 (8/25)*
Mustang Bayou C619, 2004	*103 (8/10)*	*103 (7/26)*	*100 (9/28)*	*100 (9/17)*
Mustang Bayou C619, 2005	*85 (6/21)*	*84 (7/30)*	*84 (7/29)*	*84 (4/8)*
Texas City C620, 2002	*NA*	*NA*	*NA*	*NA*
Texas City C620, 2003	*117 (8/24)*	*90 (8/23)*	*86 (9/8))*	*85 (9/25)*
Texas City C620, 2004	*114 (9/6)*	*109 (7/13)*	*105 (7/25)*	*98 (9/28)*
Texas City C620, 2005	*92 (4/8)*	*91 (6/1)*	*87 (9/4)*	*86 (8/30)*
Lake Jackson C1016, 2003	*NA*	*NA*	*NA*	*NA*
Lake Jackson C1016, 2003	*102 (9/27)*	*96 (9/6)*	*86 (9/7)*	*79 (9/19)*
Lake Jackson C1016, 2004	*88 (9/28)*	*86 (8/7)*	*84 (7/26)*	*81 (9/30)*
Lake Jackson C1016,2005	*84 (7/30)*	*84 (4/14)*	*81 (5/5)*	*78 (9/04)*

Purple = 50+ ppb/hr
Red = 40-50 ppb/hr
Yellow = 30-40 ppb/hr

Phase II

- Monitors in perimeter counties may be close to attainment, but do emissions in perimeter counties influence ozone concentrations in Harris County?
- Apply APCA, OSAT and DDM to assess source contributions at key monitors using 2007 attainment demonstration from TCEQ
- Also, using 2007 attainment demonstration for 1-hour averaged ozone concentrations as a starting point, assess the monitor by monitor impact on RRFs of emission reductions and assess strategies for attainment

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 NOx-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 NOx.

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 (NOx 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

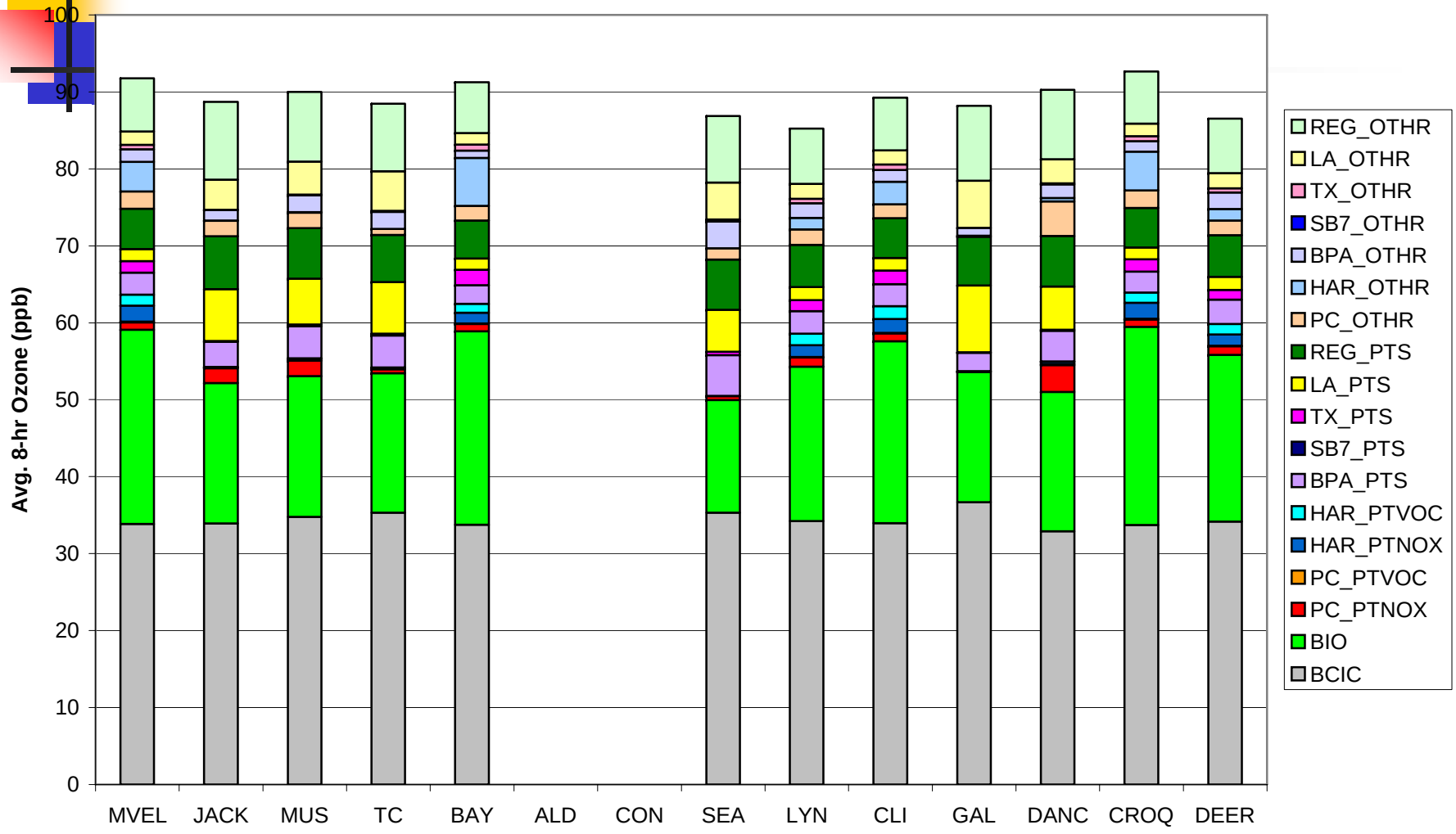
OSAT summaries

- Since the full OSAT analysis identifies 82 source groupings for each receptor, some type of summary is needed
- Summaries consolidate source groupings and show average contribution of each
- Other methods for presenting the analysis results are possible; suggestions are welcome

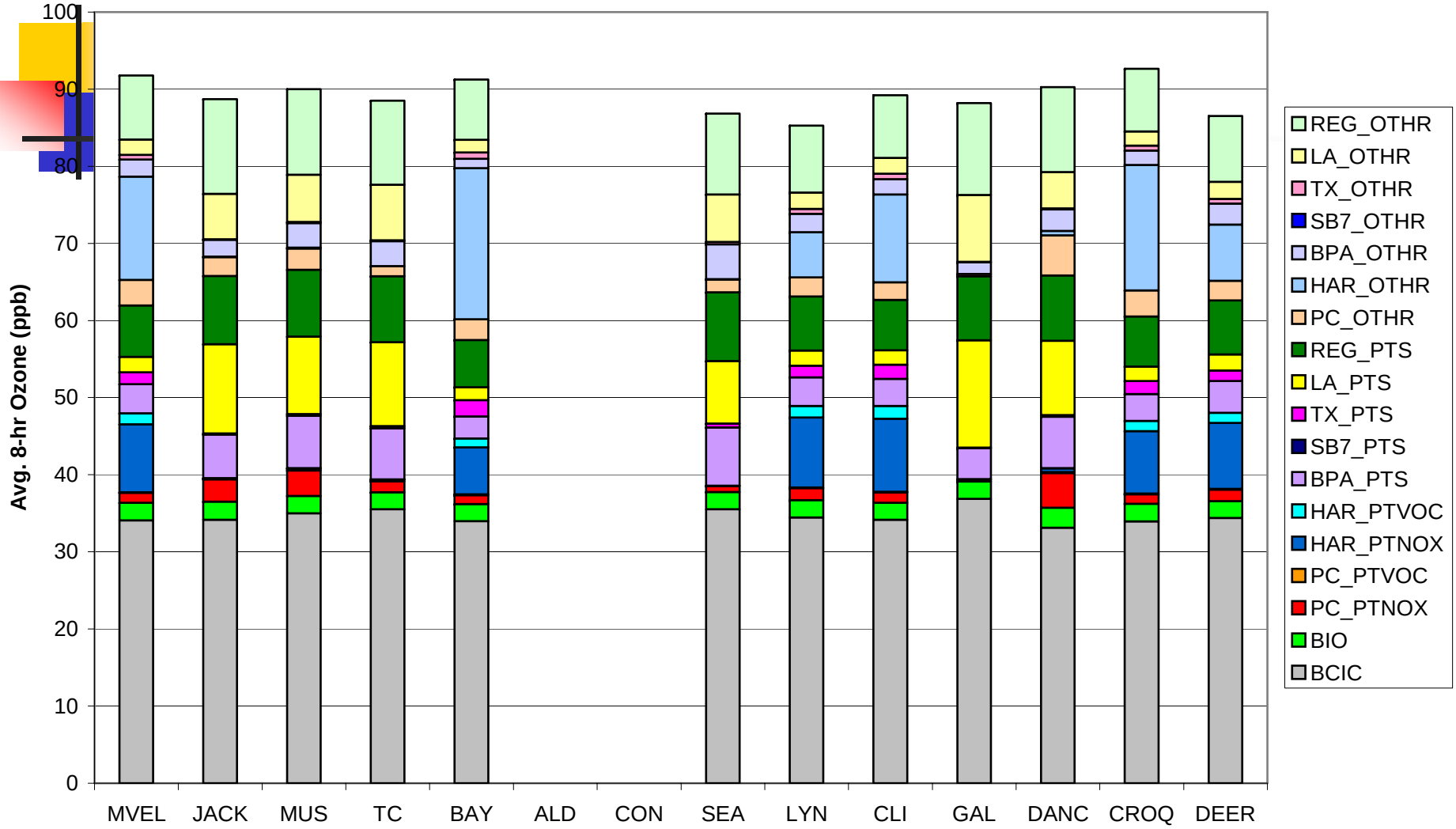
Key Questions

- How much do perimeter county point sources contribute to ozone formation at monitors in perimeter counties?
- How much do perimeter county point sources contribute to ozone formation at key monitors in Harris County?
- Are there daily variations in the contribution of perimeter county point sources?

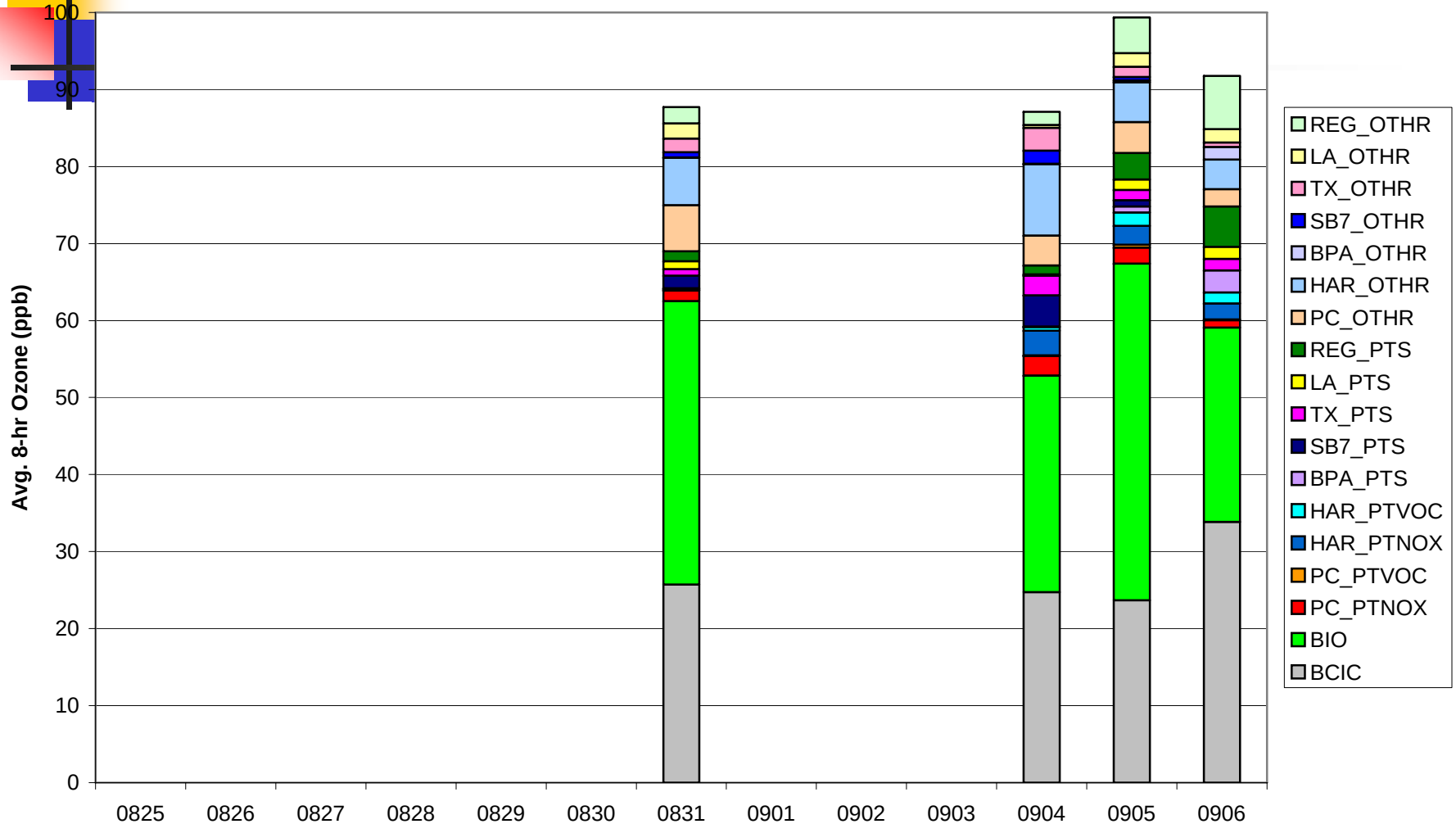
OSAT average contributions to 8-hr ozone concentrations greater than 85 ppb in the vicinity of Houston Area monitors on September 6th



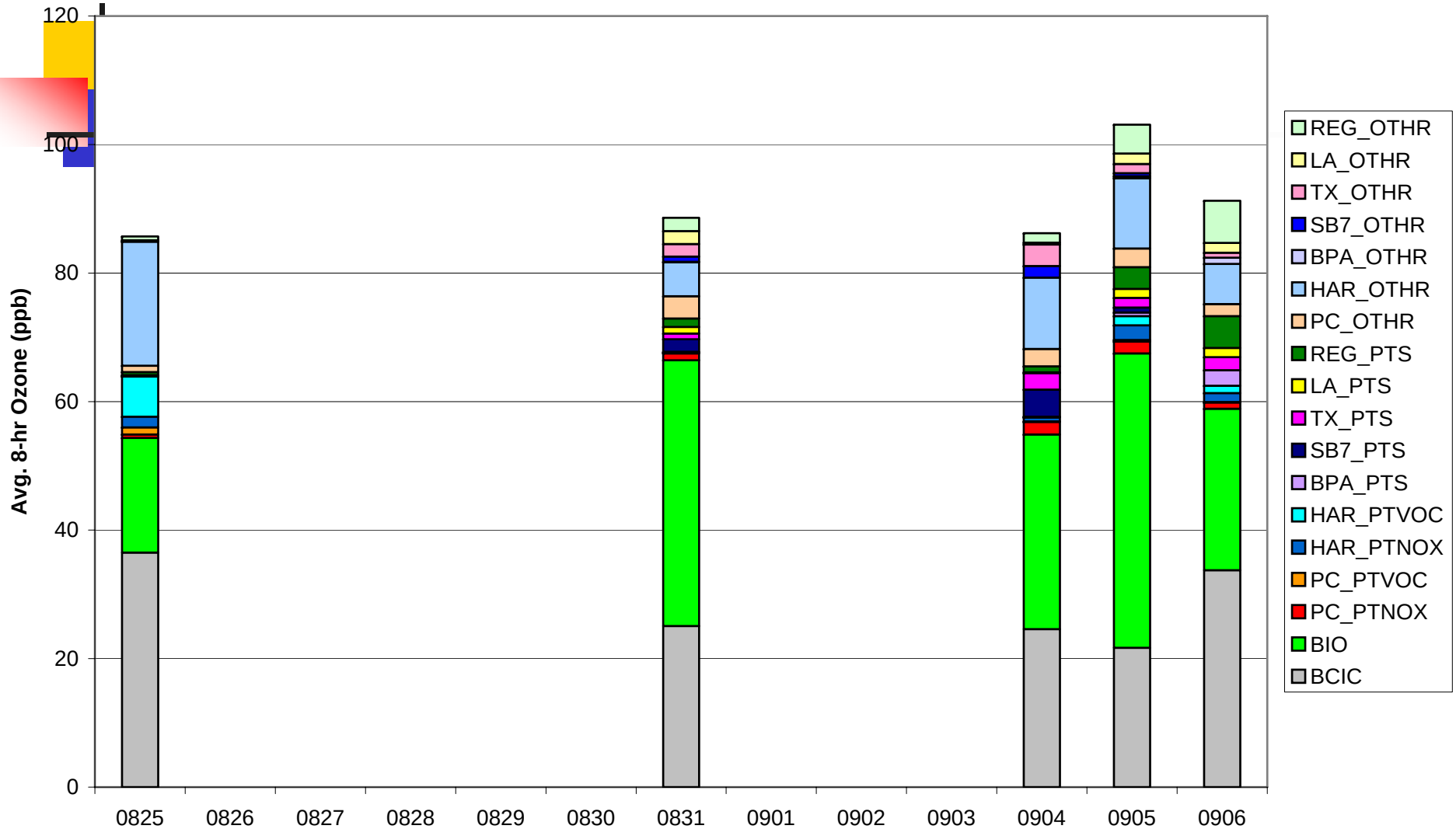
APCA average contributions to 8-hr ozone concentrations greater than 85 ppb in the vicinity of Houston Area monitors on September 6th



OSAT average contributions to 8-hr ozone concentrations greater than 85 ppb in the vicinity of the Manvel Croix (MVEL) monitor



OSAT average contributions to 8-hr ozone concentrations greater than 85 ppb in the vicinity of the Bayland Park (BAY) monitor



How much do perimeter county point sources contribute to ozone formation at key monitors in Harris County?

Table 4a.) Contributions of perimeter county point sources to ozone concentrations (in ppb), determined using OSAT, at the Bayland Park monitor. Contributions are averaged over all days with modeled concentrations in excess of 85 ppb in the vicinity of the monitor location.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
NOx	0.08	0.11	0.32	0.08	0.67	1.26
VOC	0.13	0.08	0.04	0.04	0.02	0.31

Table 4b.) Contributions of perimeter county sources to ozone concentrations (in ppb), determined using OSAT, at the Croquet monitor. Contributions are averaged over all days with modeled concentrations in excess of 85 ppb in the vicinity of the monitor location.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
NOx	0.12	0.15	0.41	0.12	0.73	1.53
VOC	0.03	0.03	0.03	0.03	0.02	0.14

Table 4c.) Contributions of perimeter county sources to ozone concentrations (in ppb), determined using OSAT, at the Deer Park monitor. Contributions are averaged over all days with modeled concentrations in excess of 85 ppb in the vicinity of the monitor location.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
NOx	0.26	0.33	0.36	0.21	0.40	1.56
VOC	0.05	0.11	0.03	0.02	0.01	0.22

How much do perimeter county point sources contribute to ozone formation at key monitors in Harris County?

Table 5a.) Contributions of perimeter county sources to ozone concentrations (in ppb), determined using APCA, at the Bayland Park monitor. Contributions are averaged over all days with modeled concentrations in excess of 85 ppb in the vicinity of the monitor location.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
NOx	0.18	0.24	0.76	0.14	0.73	2.05
VOC	0.13	0.08	0.04	0.04	0.02	0.31

Table 5b.) Contributions of perimeter county sources to ozone concentrations (in ppb), determined using APCA, at the Croquet monitor. Contributions are averaged over all days with modeled concentrations in excess of 85 ppb in the vicinity of the monitor location.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
NOx	0.24	0.36	0.91	0.20	0.80	2.51
VOC	0.03	0.03	0.03	0.03	0.02	0.14

Table 5c.) Contributions of perimeter county sources to ozone concentrations (in ppb), determined using APCA, at the Deer Park monitor. Contributions are averaged over all days with modeled concentrations in excess of 85 ppb in the vicinity of the monitor location.

Emission type	Brazoria County	Galveston County	Fort Bend and Waller Counties	Chambers County	Montgomery and Liberty Counties	Total for perimeter counties
NOx	0.40	0.92	0.74	0.30	0.44	2.80
VOC	0.05	0.11	0.03	0.02	0.01	0.22

Phase II

- Monitors in perimeter counties may be close to attainment, but do emissions in perimeter counties influence ozone concentrations in Harris County?
- Perform APCA, OSAT and DDM source apportionments to assess source contributions at key monitors
- Also, using 2007 attainment demonstration for 1-hour averaged ozone concentrations as a starting point, assess the monitor by monitor impact on RRFs of emission reductions and assess strategies for attainment

Attainment demonstration

- Start with 2007 attainment demonstration for ozone with concentrations averaged over 1 hour
- Perform additional reductions in VOC and NOx emissions in various source categories (initial simulations are across the board, 8-county, reductions in point, area/non-road and mobile sources)
- Calculate, monitor by monitor, RRF per ton of emission reductions

ΔRRF per ton of NOx or VOC reduction for multiple monitors (preliminary results)

	NOx_area	NOx_mobile	NOx_point	VOC_area	VOC_mobile	VOC_point
Manvel	0.00024	0.00024	0.00036	0.00012	0.00012	0.00012
Jackson	0.00020	0.00012	0.00028	0.00000	0.00000	0.00004
Mustang	0.00036	0.00024	0.00056	0.00000	0.00000	0.00008
Texas City	0.00004	0.00000	0.00020	0.00016	0.00020	0.00020
Bayland	0.00028	0.00036	0.00020	0.00012	0.00024	0.00012
Aldine	0.00048	0.00064	0.00024	0.00012	0.00024	0.00008
Conroe	0.00064	0.00108	0.00060	0.00000	0.00000	0.00000
Seabrook	0.00016	0.00008	0.00016	0.00012	0.00016	0.00020
Lynchburg	0.00004	0.00008	0.00008	0.00016	0.00020	0.00028
Clinton	0.00012	0.00016	0.00012	0.00016	0.00020	0.00024
Galveston	0.00016	0.00008	0.00024	0.00008	0.00008	0.00008
Dancinger	0.00024	0.00016	0.00044	0.00000	0.00000	0.00004
Croquet	0.00028	0.00036	0.00024	0.00012	0.00020	0.00008
DeerPark	0.00004	0.00004	0.00012	0.00016	0.00020	0.00024

Attainment demonstration methodologies

- How much should emissions be reduced in each emission category? (evaluate x_i)
- Max emission reduction possible>X_i>0
- For site j, RRF_j>Σ RRF per ton_{ij}*X_i
- Estimate RRFs based on additional 80% reduction in emissions, beyond those required in 2007, applied uniformly over the 8-county area

- X_1= area source NOx
- X_2= mobile source NOx
- X_3= point source NOx
- X_4= area source VOC
- X_5= mobile source VOC
- X_6= point source VOC

(emission reductions applied across the board in each category across all 8 counties)

Interpreting Results of the Analysis

- These results assume that emission reductions will only occur in the Houston/Galveston area
- The primary utility of the results is to identify limiting monitors and approximate magnitudes of reductions that will be required

Additional 80% Reduction Scenario

	2003-5 Design Value	RRF after 80% reductions in all categories	Design Value after 80% controls
Manvel	97.30	0.8668	84.34
Jackson	85.00	0.9282	78.90
Mustang	93.00	0.8674	80.67
Texas City	89.60	0.9016	80.78
Bayland	103.60	0.9015	93.40
Aldine	92.60	0.8417	77.95
Conroe	86.00	0.8152	70.11
Seabrook	92.30	0.8963	82.73
Lynchburg	98.30	0.8796	86.46
Clinton	95.00	0.8868	84.25
Galveston	87.00	0.9279	80.73
Dancinger	85.00	0.9106	77.40
Croquet	98.00	0.8857	86.80
DeerPark	100.60	0.8927	89.80

Summary

- RRF analyses suggest that significant emission reductions will be required to achieve NAAQS for Harris County monitors; Bayland Park, Deer Park, Croquet, Lynchburg Ferry monitors likely to be limiting

Agenda

- Phase I work: Design Values, Relative Reduction Factors (RRFs) and Back Trajectory Calculations
- Phase II work: Source apportionment using photochemical models and sensitivity of RRFs to emission reductions
- Closing Remarks and Path Forward

Future Topics

- Evaluate ozone precursor emissions in the perimeter counties and impact of the emissions on selected ozone monitors in Harris County for expanded episode and new episodes as appropriate
- Evaluate future control strategies and the impact of ozone concentrations at the perimeter county monitors
- All future studies will be shared with TCEQ and other interested parties as they are finalized