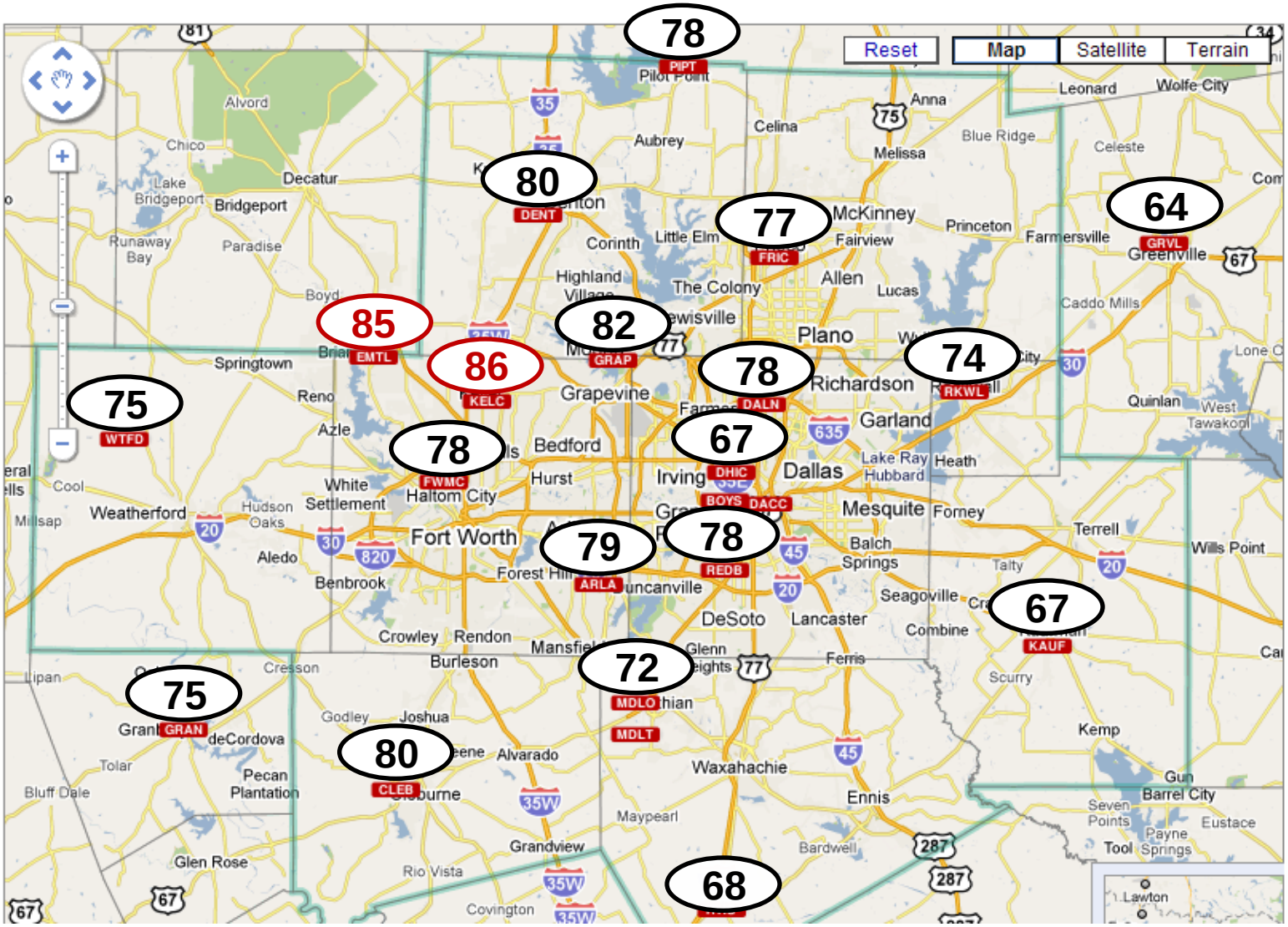
2006/2012 DFW Modeling Update

Doug Boyer
Air Modeling & Data Analysis

DFW Photochemical Modeling Technical Committee
November 5, 2010

2010 Design Values*

8 days ≥ 85 ppb



*2010 Design values as of November 4, 2010 and are subject to change

Modeling in SIP Development
The Big Picture

Base Case	Day-specific emissions; replicate what actually happened
Baseline Case	Typical emissions; used in Relative Response Factor (RRF) to predict future design values
Future Base Case	Apply future growth + on-the-books controls to estimate future ozone
Control Strategy Testing	Determine control strategies that will effectively reduce ozone
SIP	Document modeling procedures

Updated Modeling Inputs: Upstream Oil and Gas

- 2006 and 2012 Texas Oil and Gas Production
  - Calculated emissions are based on a new Eastern Research Group (ERG) study (2010 report) using 2006 and June 2010 natural gas production.
  - Previous estimates included DFW minor source controls in 2008, which were projected back to 2006.
- Texas Oil and Gas Drill Rigs
  - 2006 and 2012 were projected from 2008 ERG emissions using BakerHughes.com and RigData.com drill rig counts.
  - 2012 Barnett Shale projections are county-specific.
- 2012 Louisiana Haynesville Shale Emissions
  - Aggressive scenario from Environ's Northeast Texas Air Care (NETAC) work
  - Louisiana Drill Rigs (48 tpd NO_X); Point Sources (8 tpd NO_X)

DFW Compressor Engine Emission Factors

DFW Compressor Engines	Rich Burn <500 hp (g/hp-hr)	Lean Burn <500 hp (g/hp-hr)
2006 *	13.96	9.47
2010 †	0.5	0.7

* 2006 natural gas compressors did not have rules in DFW and East Texas.

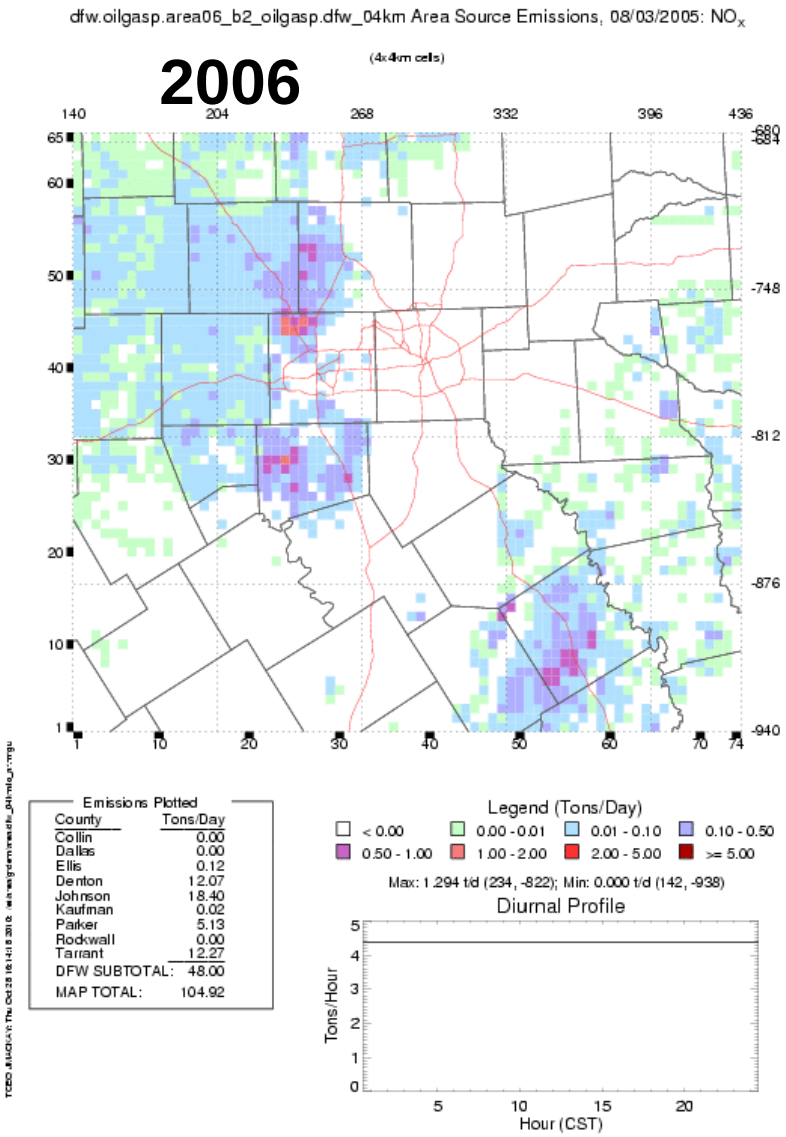
- Average DFW emission rates from 2007 study/survey of Barnett Shale producers and CENRAP oil and gas study

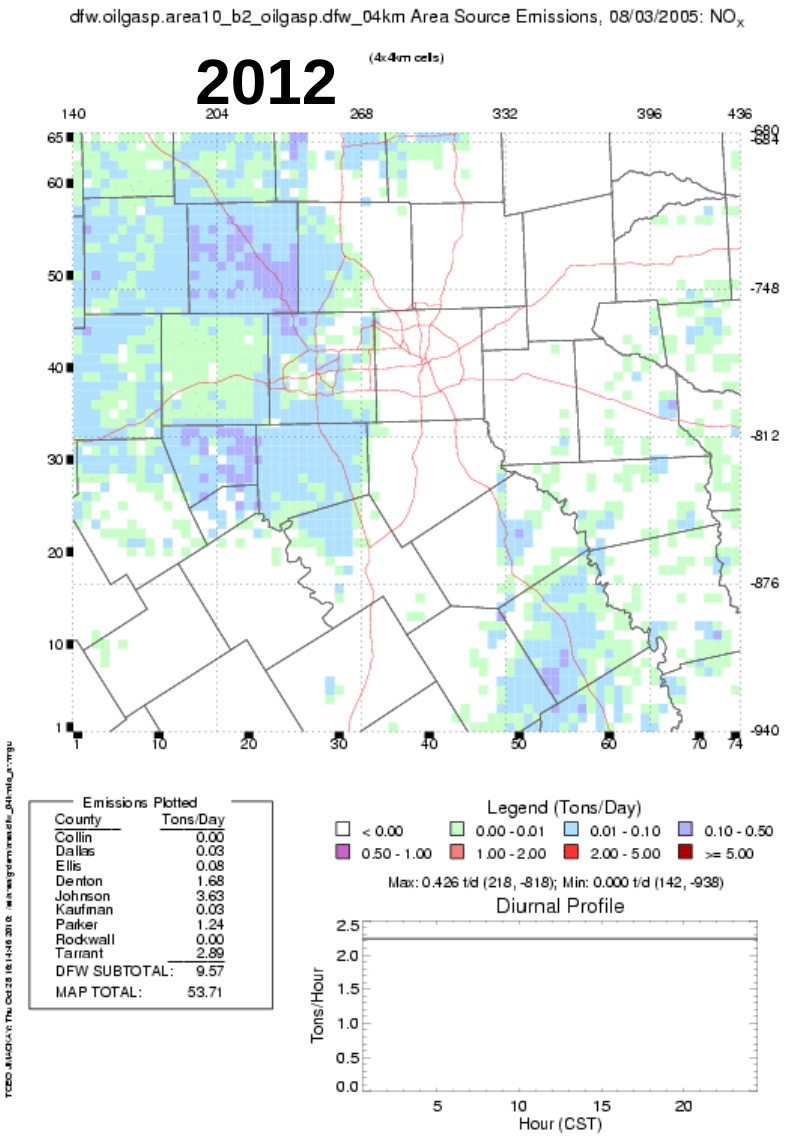
† 2010 compressors have DFW minor source (§117.2110 March 2009/2010) and East Texas Combustion Rule (§117.3310 March 2010) rules applied.

Compressor Engine NO_X Emissions

County	2006 NOx TPD	2006 VOC TPD	2012 NOx TPD	2012 VOC TPD
Collin	0.0	0.0	0.0	0.0
Dallas	0.0	0.0	0.0	0.0
Denton	**11.8**	0.4	**0.8**	0.5
Ellis	0.0	0.0	0.0	0.0
Johnson	**19.2**	0.5	**2.5**	1.3
Kaufman	0.0	0.0	0.0	0.0
Parker	**4.7**	0.1	**0.4**	0.3
Rockwall	0.0	0.0	0.0	0.0
Tarrant	**13.1**	0.5	**2.2**	1.3
Dallas-Fort Worth 9-County Total	**48.8**	**1.4**	**5.9**	**3.3**
Barnett Shale 23 county Total	**66.4**	**2.2**	**36.4**	**4.4**

2006 and 2012 Oil and Gas Production Geographic Distribution (NO_X)

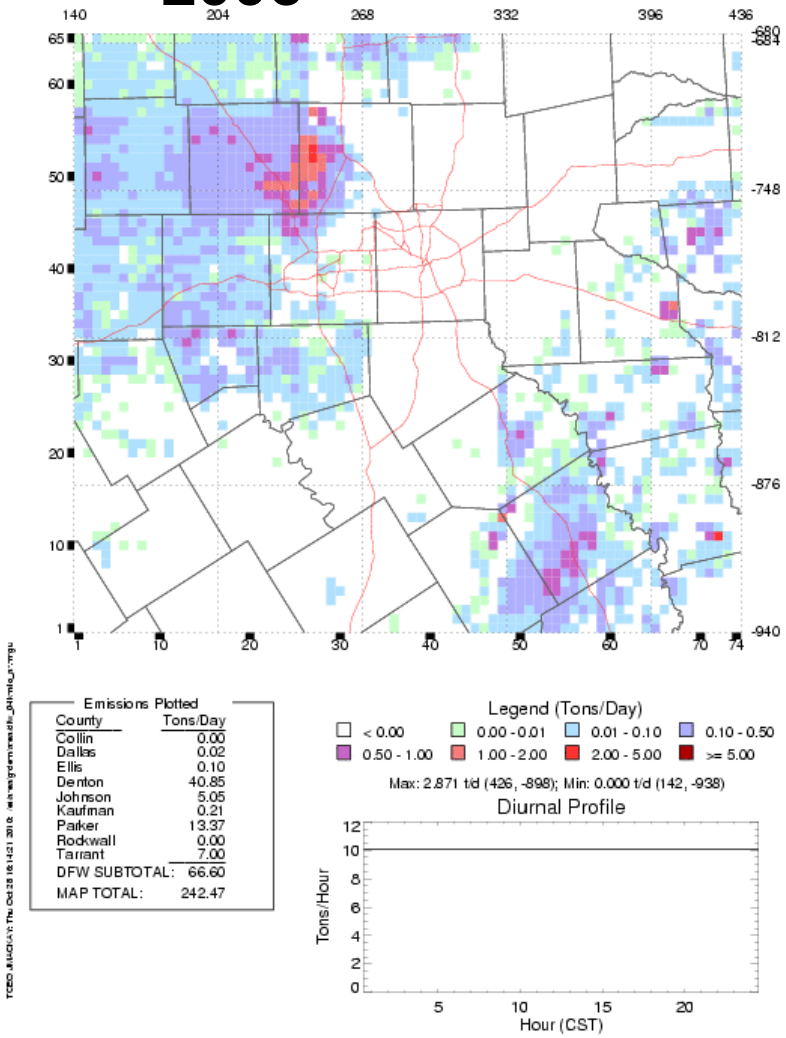




2006 and 2012 Oil and Gas Production Geographic Distribution (VOC)

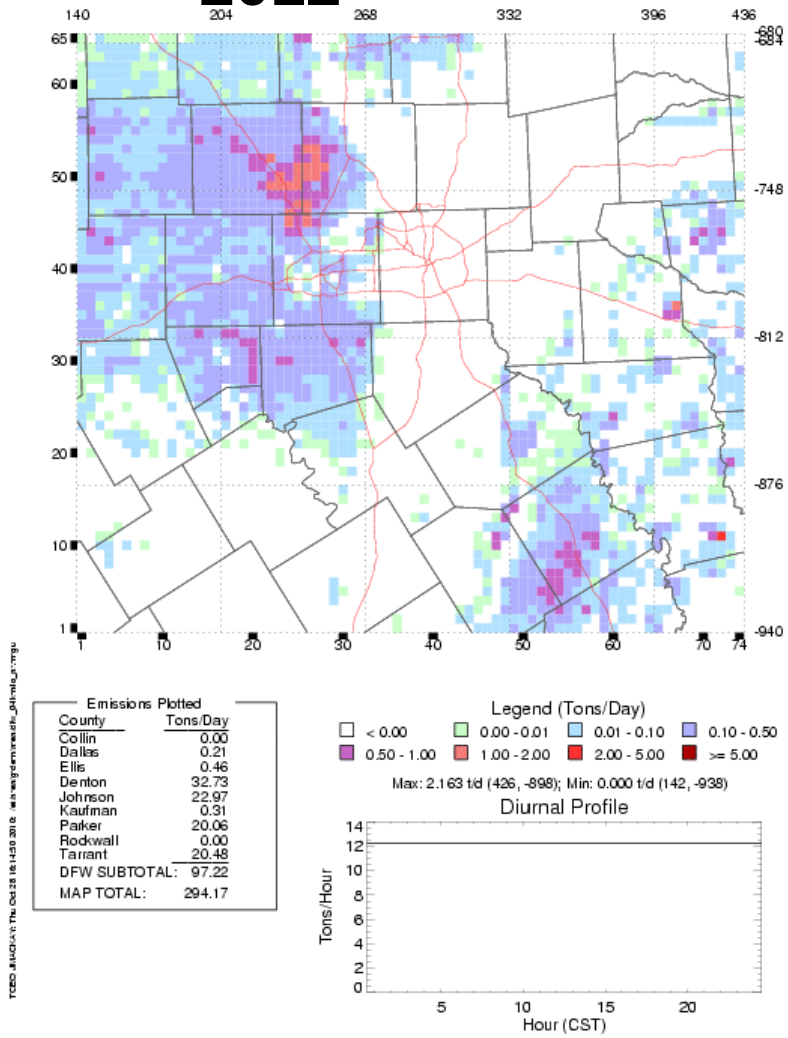
dfw.oilgasp.area06_b2_oilgasp.dfw_04km Area Source Emissions, 08/03/2005: VOC

2006

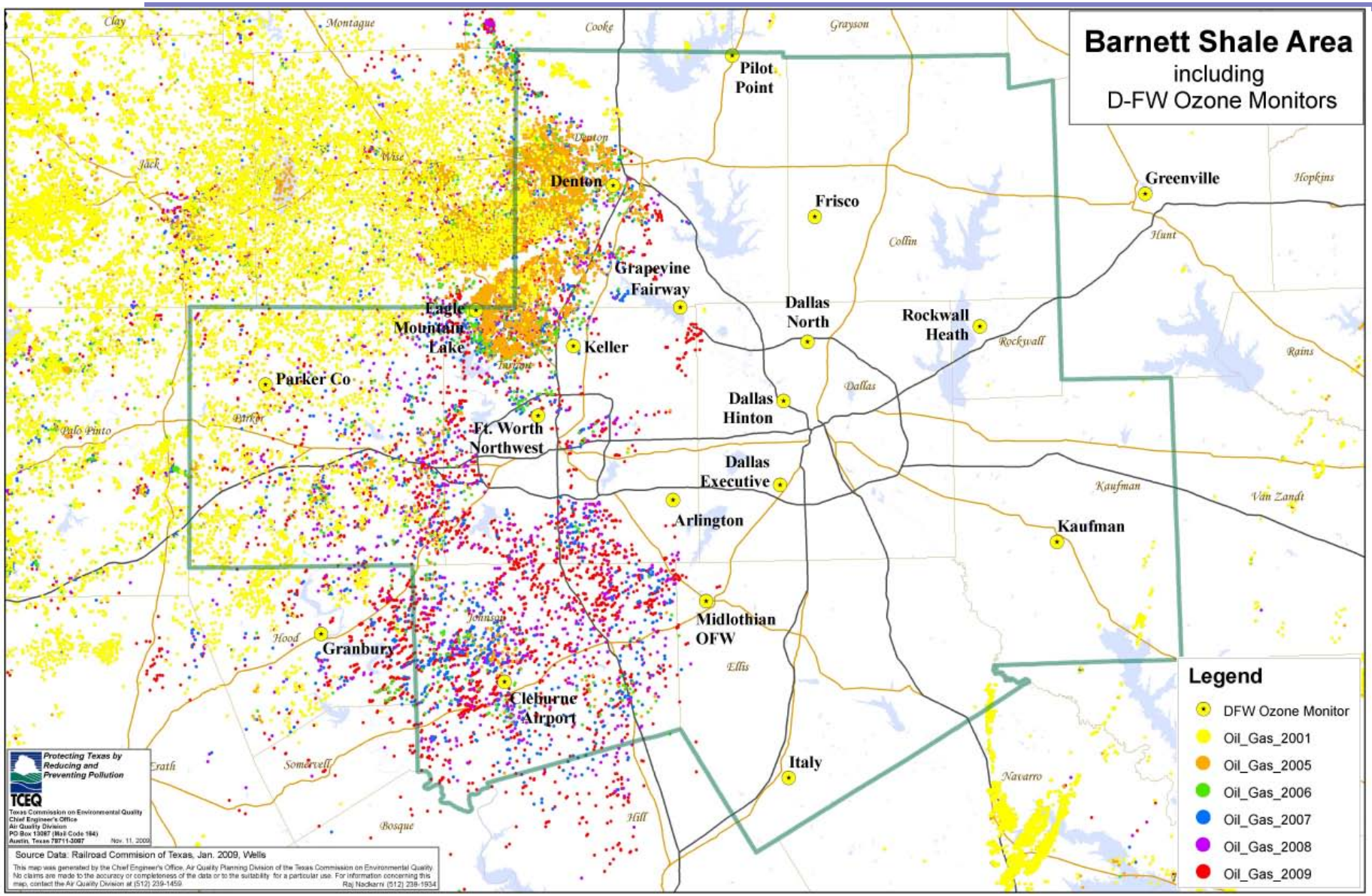


dfw.oilgasp.area10_b2_oilgasp.dfw_04km Area Source Emissions, 08/03/2005: VOC

2012

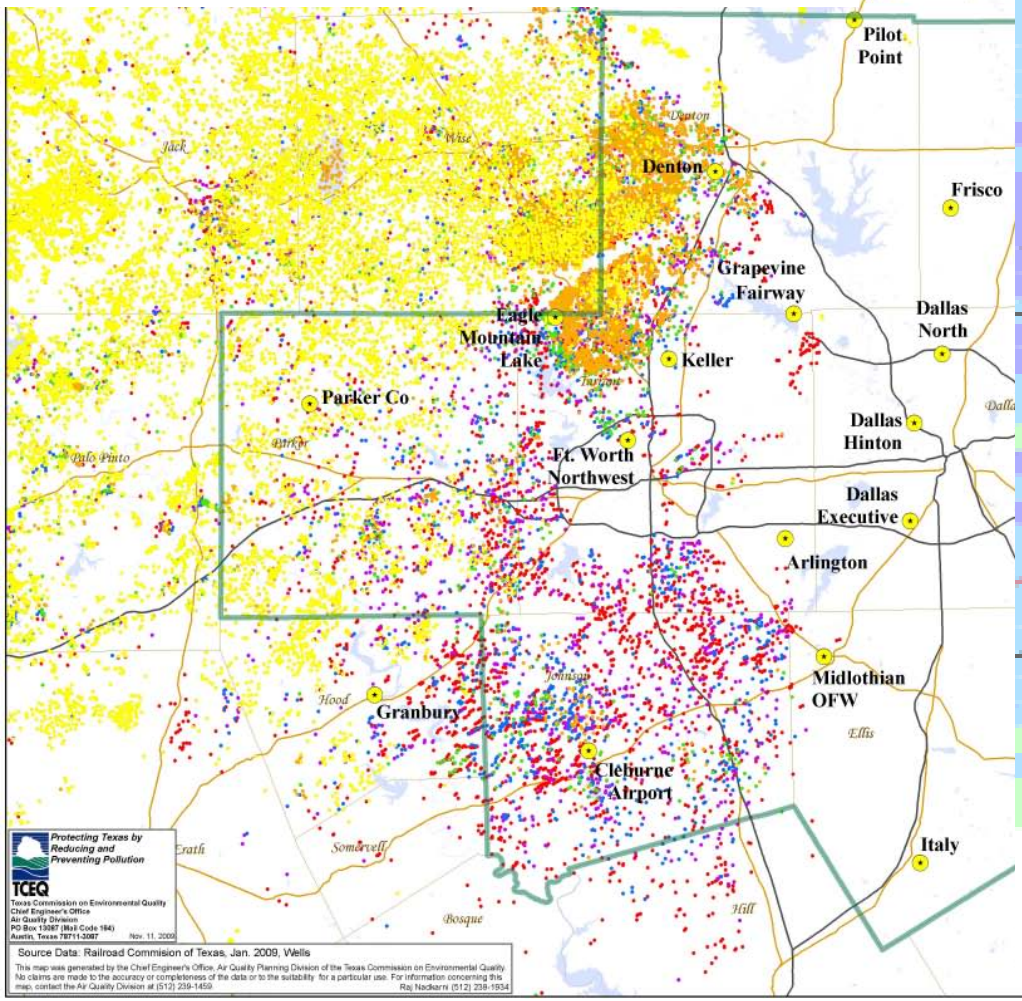


Texas Railroad Commission Well Locations 2001-2009

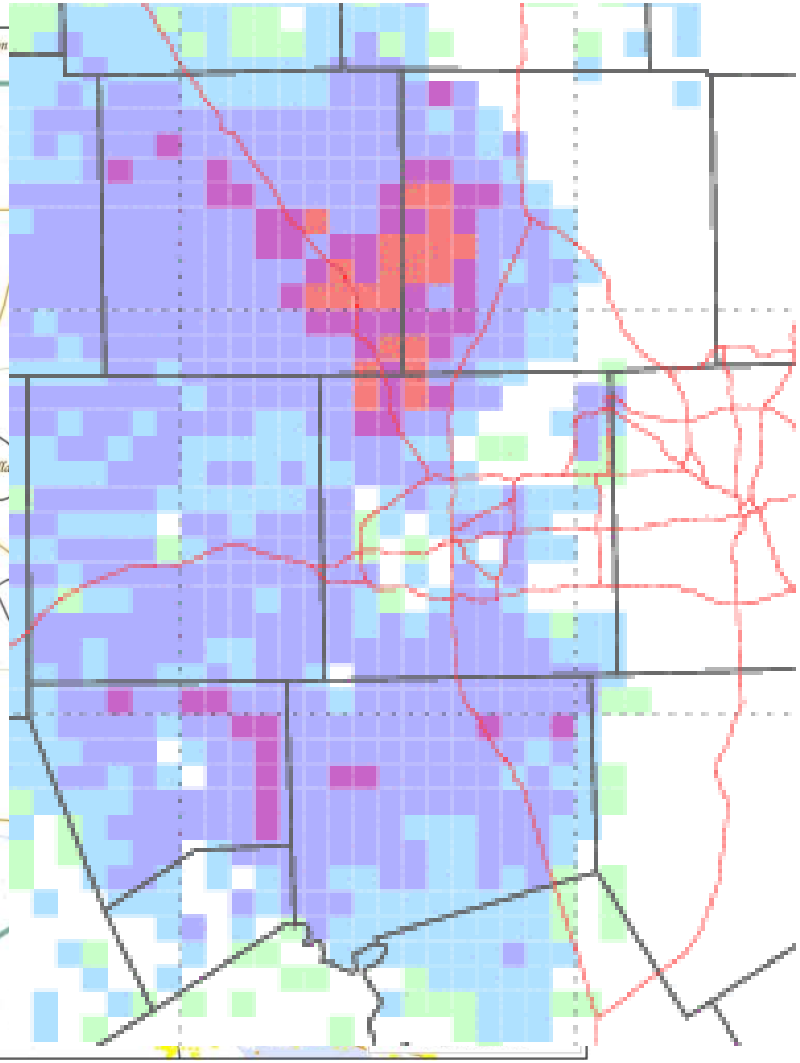


2006 and 2012 Oil and Gas Production Geographic Distribution

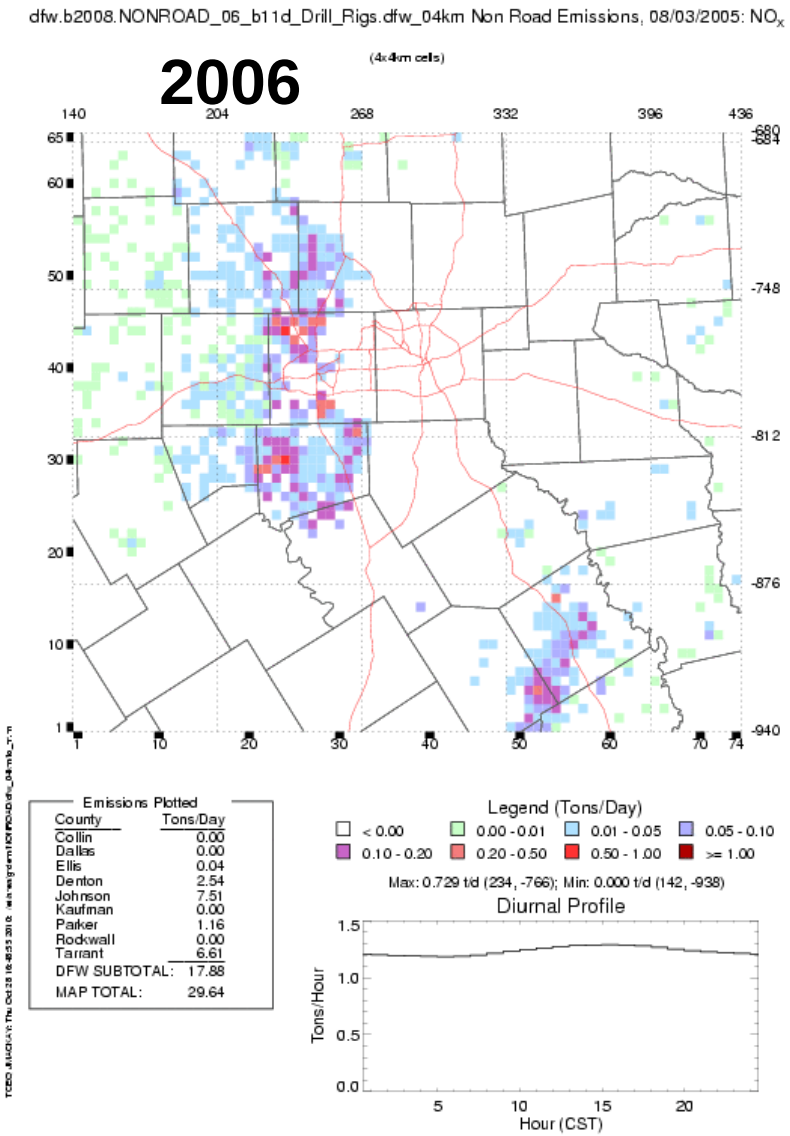
Texas Railroad Commission Well Locations 2001-2009

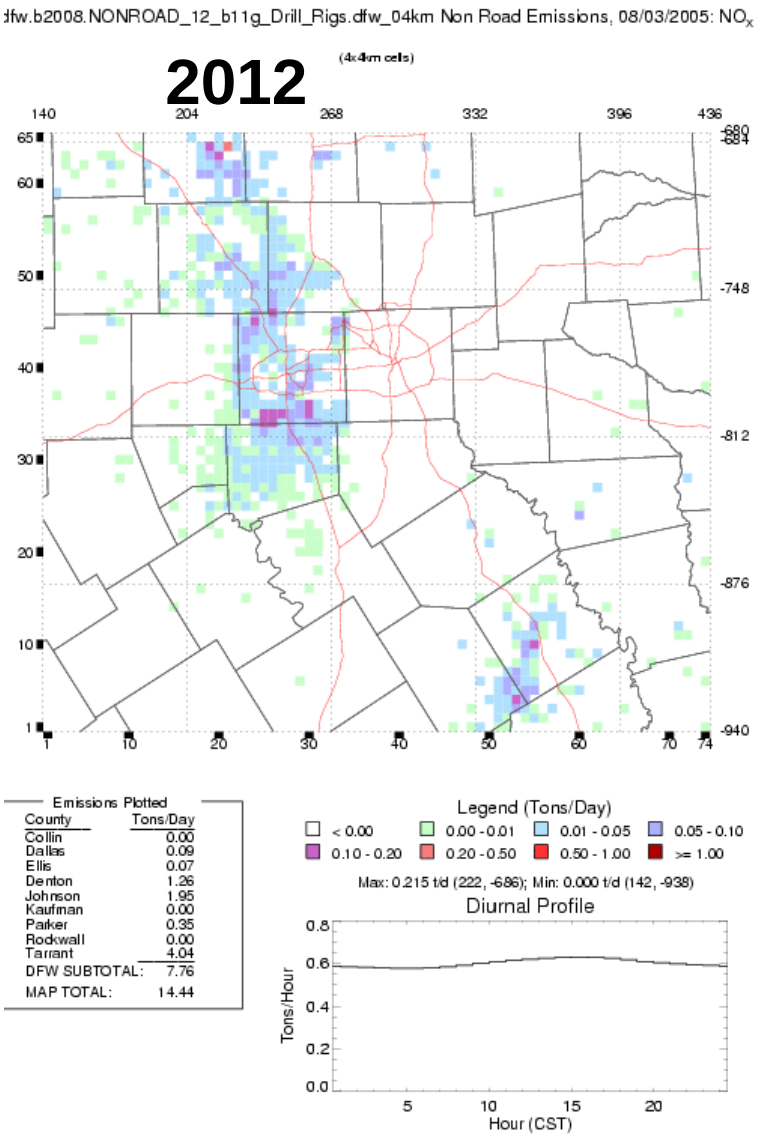


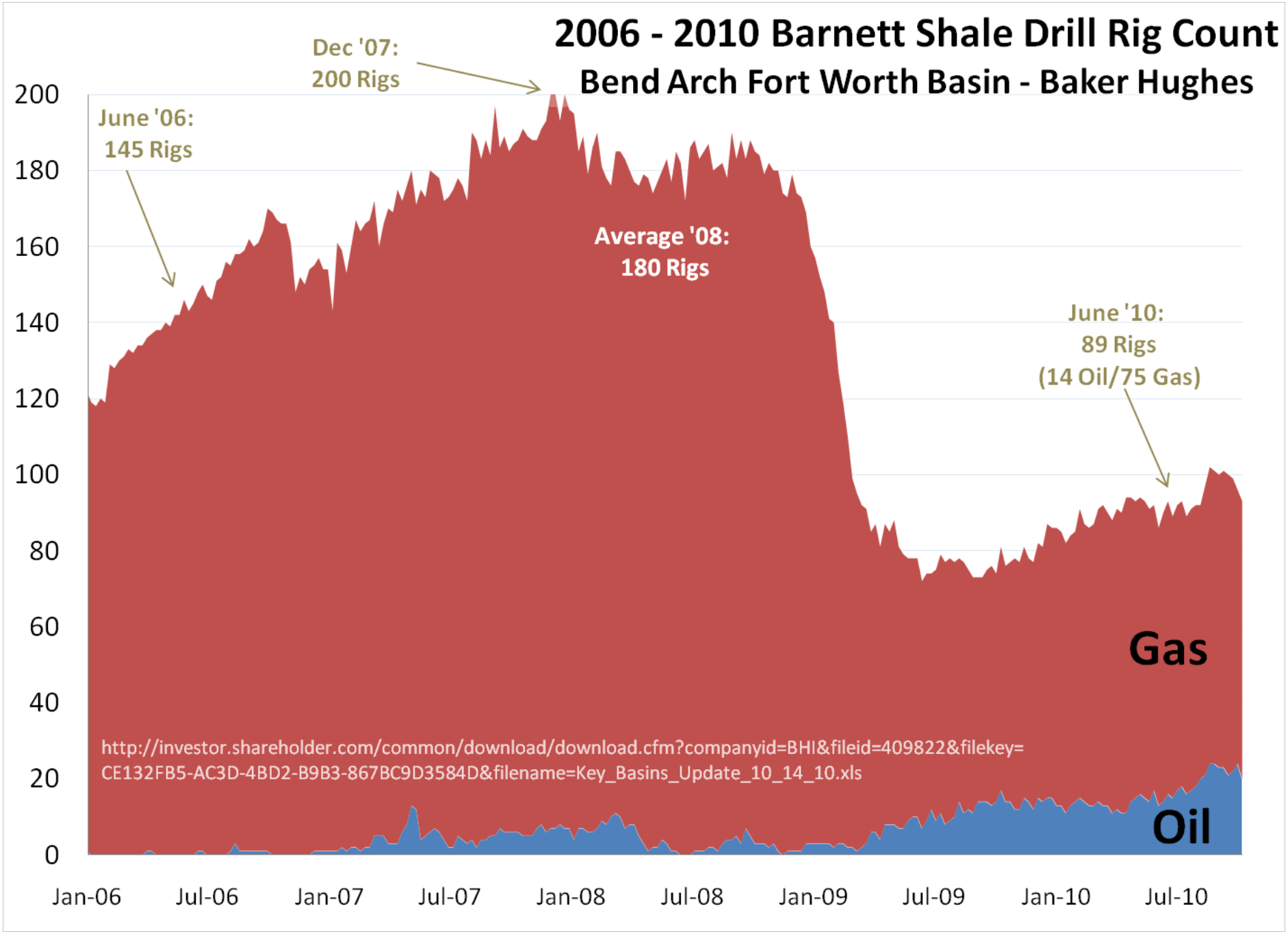
2012 Production



2006 and 2012 Oil and Gas Drilling Geographic Distribution (NO_X)



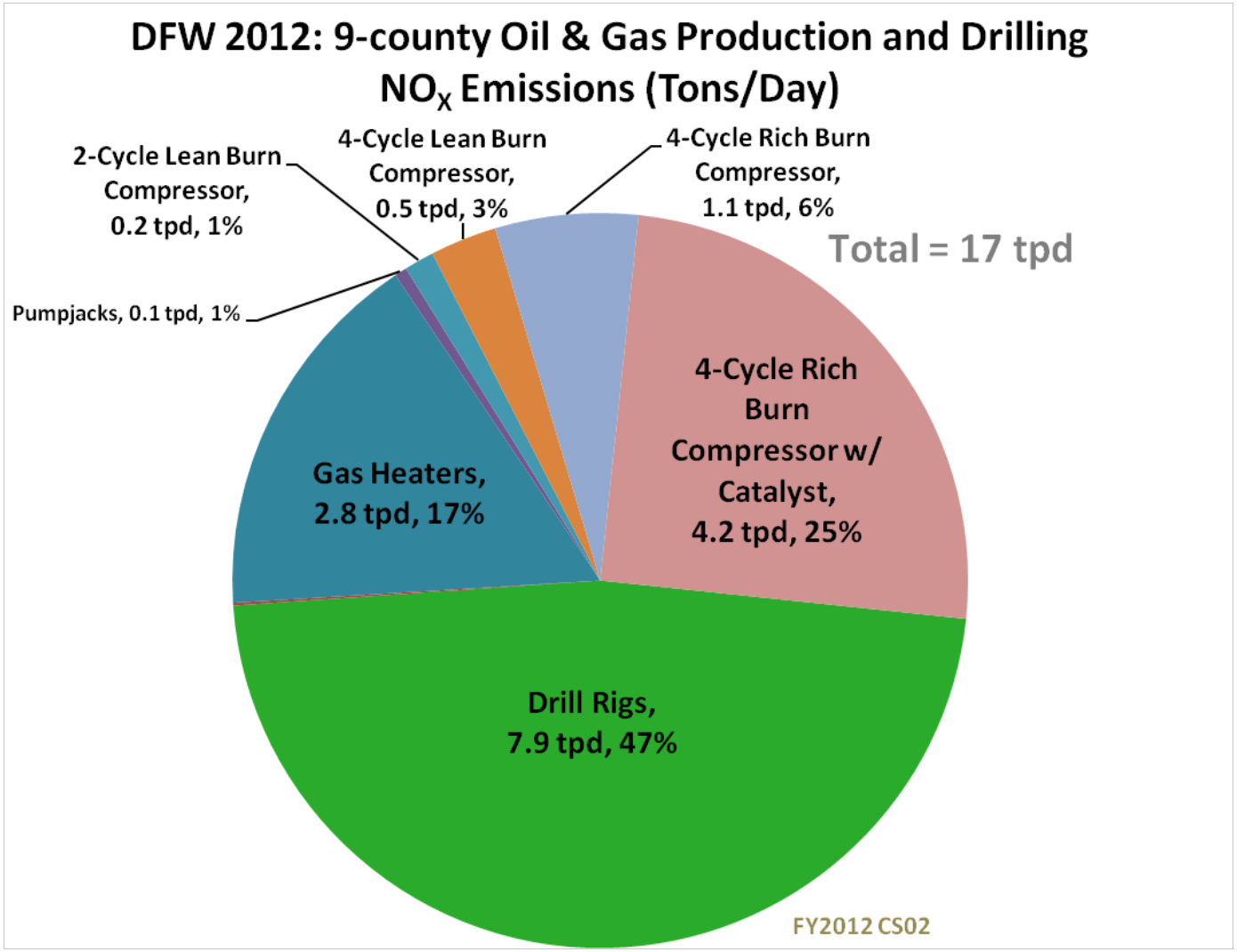



2006 - 2010 Barnett Shale Drill Rig Count
Bend Arch Fort Worth Basin - Baker Hughes
Dec '07:
200 Rigs
June '06:
145 Rigs
Average '08:
180 Rigs
June '10:
89 Rigs
(14 Oil/75 Gas)
Gas
Oil
http://investor.shareholder.com/common/download/download.cfm?companyid=BHI&fileid=409822&filekey=CE132FB5-AC3D-4BD2-B9B3-867BC9D3584D&filename=Key_Basins_Update_10_14_10.xls
200
180
160
140
120
100
80
60
40
20
0
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Jul-10

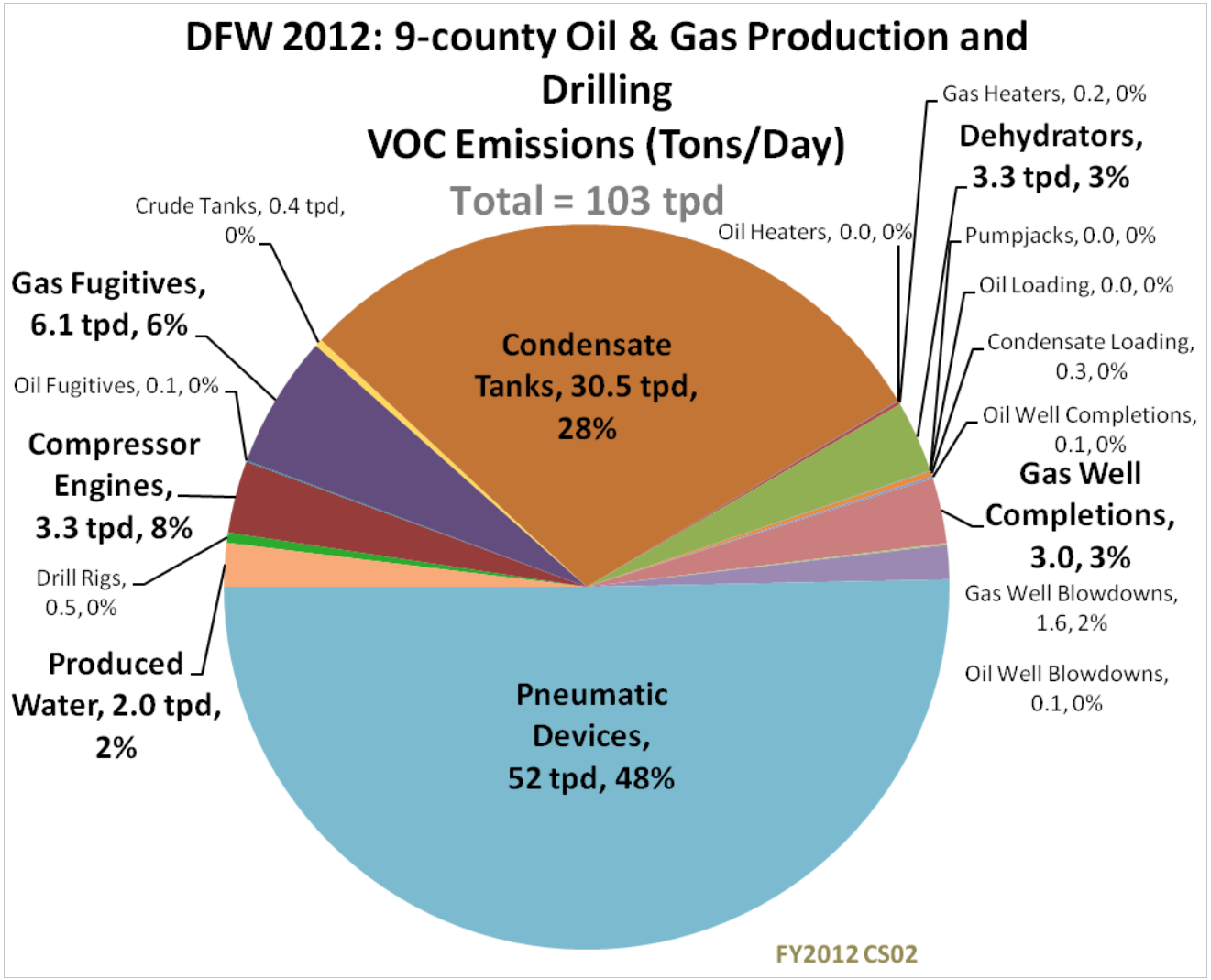
2006 and 2012 DFW 9-County Oil and Gas Emission Estimates

Oil & Gas Category	2006 NO_x TPD	2012 NO_x TPD	2006 VOC TPD	2012 VOC TPD
Drill Rigs	**18.0**	**7.9**	1.0	0.5
2-Cycle Lean Burn Compressor	1.3	0.2	0.0	0.1
4-Cycle Lean Burn Compressor	0.8	0.5	0.2	0.2
4-Cycle Rich Burn Compressor	**46.2**	1.1	1.0	0.1
4-Cycle Rich Burn Compressor w/ Catalyst	0.6	**4.2**	0.1	2.9
Oil Fugitives			0.0	0.1
Gas Fugitives			2.5	6.1
Crude Tanks			0.2	0.4
Condensate Tanks			**40.6**	**30.5**
Oil Heaters	0.0	0.0	0.0	0.0
Gas Heaters	1.2	2.8	0.1	0.2
Dehydrators			1.3	3.3
Pumpjacks	0.1	0.1	0.0	0.0
Oil Loading			0.0	0.0
Condensate Loading			0.3	0.3
Oil Well Completions			0.1	0.1
Gas Well Completions			3.0	3.0
Oil Well Blowdowns			0.1	0.1
Gas Well Blowdowns			0.7	1.6
Pneumatic Devices			**21.5**	**52.0**
Produced Water			0.5	2.0
Total (Tons/Day)	**68.1**	**16.7**	**73.1**	**103.3**

Preliminary 2012 DFW Emissions: Oil and Gas NO_X Detail



Preliminary 2012 DFW Emissions: Oil and Gas VOC Detail

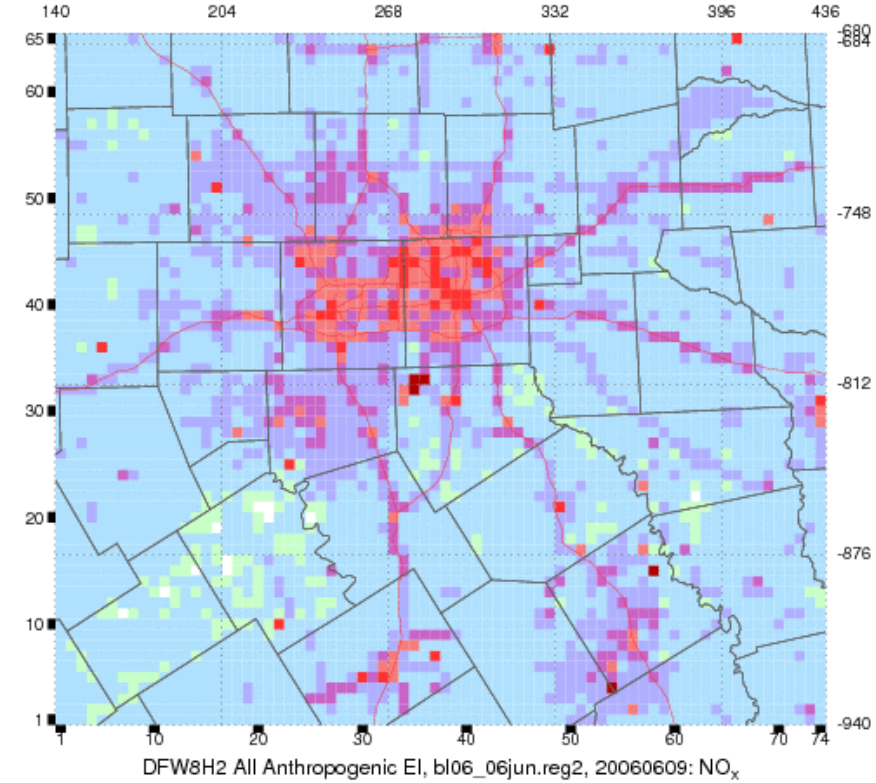


2006 Baseline

Category	2006 NOx Tons/day	%	2006 VOC Tons/day	%
On-road Mobile	234	48%	120	24%
Area w/o Oil/Gas	16	3%	210	42%
Elevated Points	45	9%	8	2%
Low-level Points	5	1%	28	6%
Non-Road	85	17%	63	13%
Off-Road	40	8%	6	1%
Oil & Gas Production*	**48 (+38)**	**10%**	**67 (+27)**	**13%**
Oil & Gas Drilling	18	4%	1	0%
9-County Total	491		504	

Friday, June 9; Reg2 emissions; ()= diff from Reg1b

2006 Anthropogenic NO_x



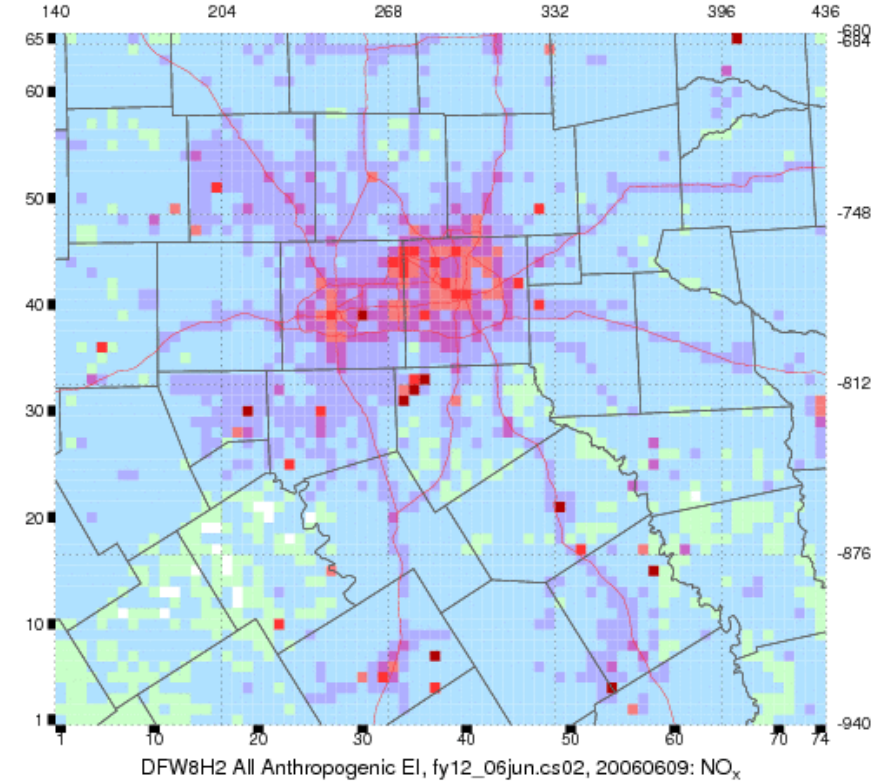
*** Previous 2006 Baseline (Reg1b) Oil & Gas Production NOx = 10 tpd; VOC = 40 tpd**

2012 Future Baseline

Category	2012 NO_X Tons/day	%	2012 VOC Tons/day	%
On-road Mobile	131	39%	93	18%
Area w/o Oil/Gas	18	5%	237	46%
Elevated Points	64	19%	7	1%
Low-level Points	1	0%	24	5%
Non-Road†	64 (-2)	19%	45	9%
Off-Road	37	11%	6	1%
Oil & Gas Production*	9 (-12)	3%	103 (+56)	20%
Oil & Gas Drilling*	8 (-12)	2%	0 (-1)	0%
9-County Total	332 (-26)		515 (+55)	

Friday, June 9; cs02 emissions; ()= diff from cs01

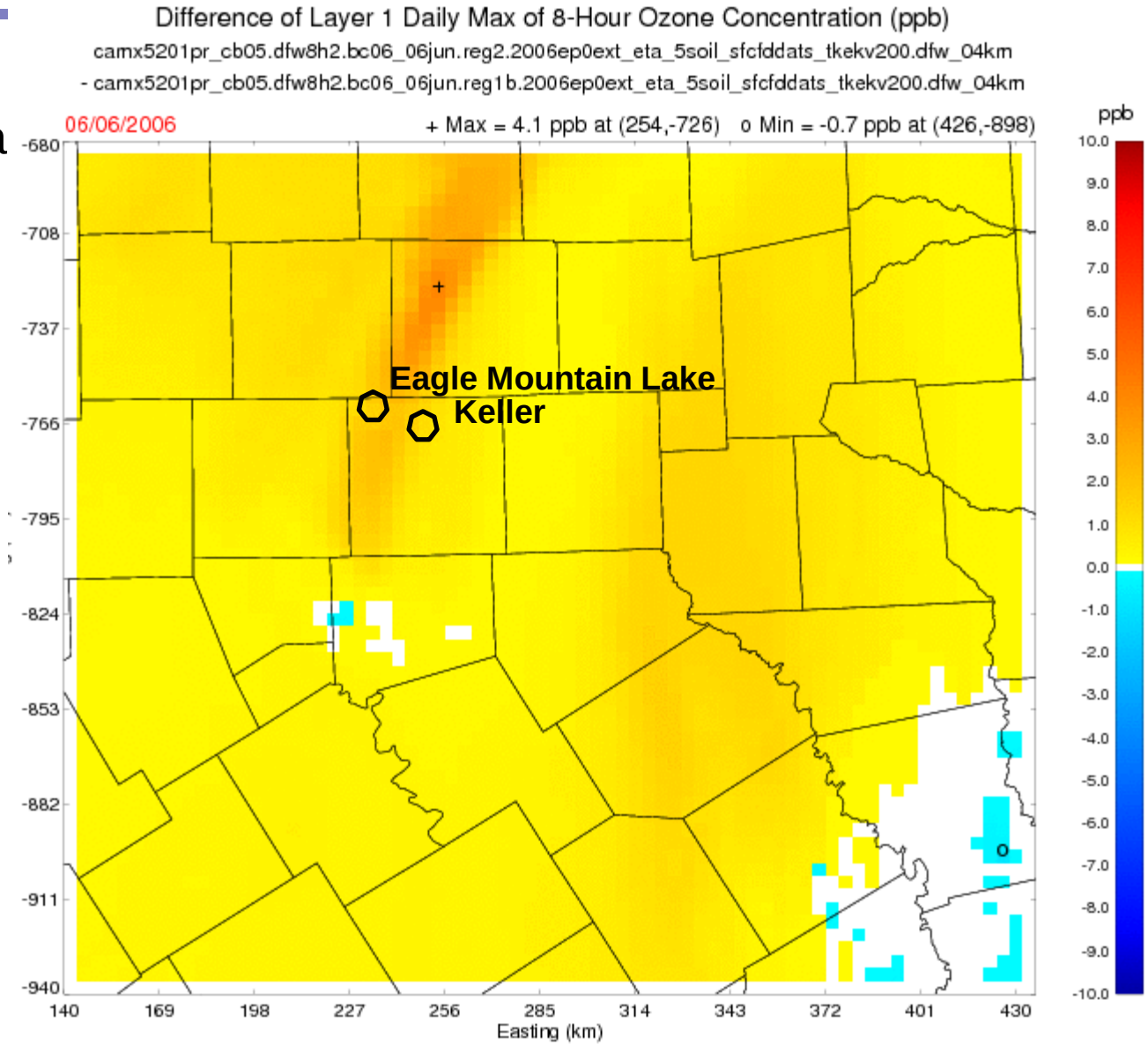
2012 Anthropogenic NO_X



† Non-Road now has Texas Low Emission Diesel applied.
*** Oil & Gas Production from June 2010;**
Drilling from 2010 w/ 2012 NONROAD engine fleet turnover

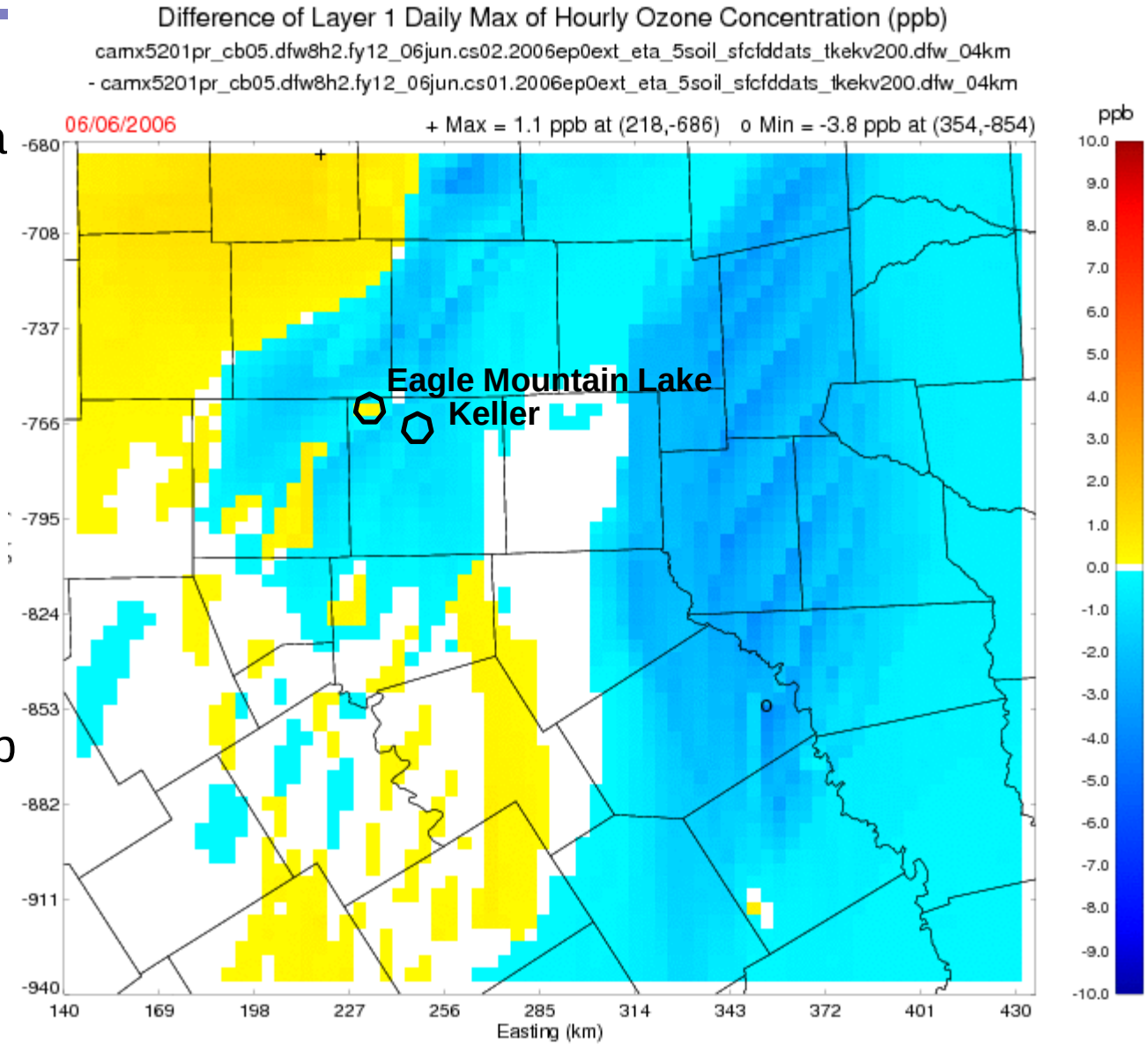
2006: Impact of new Texas Oil & Gas

- Difference of 8-hour daily maxima between 2006 oil and gas updates
- 2006 Oil and Gas emissions **increased** with the latest update; ozone followed.
- Increases of 0-4 ppb seen throughout the 9-county area (day-dependent)



2012: Impact of new Texas Oil & Gas

- Difference of 8-hour daily maxima between 2012 oil and gas updates
- 2012 Oil and Gas emissions **decreased** with the latest update; ozone followed.
- Decreases of 0-3 ppb seen throughout the 9-county area (day-dependent)



DFW Area Design Value Comparisons

DFW Monitor	Current 2010 Design Value (ppb)+	Current 2010 4th High (ppb) +	Prelim. 2012 CS01 DV_F*	Updated Future Design Value CS02 2012 DV_F*
Keller C17	**86**	**85**	77.0	76.0
Eagle Mountain Lake C75	**85**	80	**80.0**	**76.8**
Grapevine Fairway C70	82	83	77.0	75.8
Denton Airport South C56	80	74	76.6	75.9
Cleburne Airport C77/C682	80	78	75.9	74.5
Arlington Muni. Airport C61	79	79	74.1	73.3
Pilot Point C1032	78	78	74.4	72.1
Ft. Worth Northwest C13	78	80	70.7	70.0
Dallas North No.2 C63	78	71	70.9	69.8
Dallas Exec. Airport C402	78	78	71.7	70.8
Frisco C31/C680	77	74	70.6	69.5
Parker County C76	75	70	67.6	66.8
Granbury C73/C681	75	77	67.3	66.4
Rockwall Heath C69	74	73	67.1	65.8
Midlothian OFW C52/A137	72	72	63.7	62.9
Italy C1044/A323	68	63	62.4	61.6
Kaufman C71/A304/X071	67	64	61.2	59.5
Dallas Hinton St. C401/C60	67	75	72.4	69.5
Greenville C1006/A198	64	64	61.1	59.3

+ current as of 11/4/2010

FY2012 cs01 FY2012 cs02

* 2012 Future Design Values are preliminary and expected to change.

Next Modeling Steps

- Continue Evaluating Emission Inventories and Model Performance
- Retrospective and Weekend/Weekday Analyses
- Perform an updated Source Apportionment Run
  - Determine ozone formation sensitivity to NO_X and VOC

DFW Modeling Web Sites

- DFW Eight-Hour Ozone SIP Modeling Web Site
  http://www.tceq.state.tx.us/implementation/air/airmod/data/dfw8h2

CAMx Modeling Files for the May 29–July 2, 2006 DFW Ozone Episode

Run Case	Run Name	Model	MET	EI	BC/IC	Other Input	Job Control	Output	Release Date
Base Case	bc06_06jun.reg1b. 2006ep0ext_eta_5soil_sfcfddats_tkekv200	CAMx 5.20.1pr CB05	go	go	go	go	go	go	Oct. 15, 2010
Baseline Case	bl06_0jun.reg1b. 2006ep0ext_eta_5soil_sfcfddats_tkekv200	CAMx 5.20.1pr CB05	go	go	go	go	go	go	Oct. 15, 2010
Year 2012 Case	fy12_06jun.cs01. 2006ep0ext_eta_5soil_sfcfddats_tkekv200	CAMx 5.20.1pr CB05	go	go	go	go	go	go	Oct. 15, 2010

- DFW Modeling File FTP Site
  ftp://ftp.tceq.state.tx.us/pub/OEPAA/TAD/Modeling/DFW8H2/

Questions?

Doug Boyer – DFW Modeling Project Manager
dboyer@tceq.state.tx.us
512 239-1523

The Air Modeling & Data Analysis Section contributed to these results.

Contact: amda@tceq.state.tx.us

air modeling data analysis