Review of Northeast Texas
2014 Ozone Season

Presentation to the NETAC
Policy and Technical Committees

December 4, 2014

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Today’s Presentation

• Update on ozone Design Values and trends
• Implications for attainment
• Review of 2014 ozone season
Northeast Texas CAMS Monitors

[Map of Northeast Texas with monitoring sites indicated]
In 2014, 4th high value decreased relative to 2013 for all three monitors; lowest values ever measured

Downward trend since 2011 at all monitors
• In recent years, less correlation between weather conditions and ozone than in 2002-6
  – Consistent with expected effect of emissions reductions
• 2014 weather not conducive to ozone formation
• In recent years, less correlation between weather conditions and ozone than in 2002-6
  – Consistent with expected effect of emissions reductions
• 2014 weather not conducive to ozone formation
All three monitors attain the 2008 NAAQS of 75 ppb
2014 had lowest recorded design values for Longview and Tyler
Only Karnack currently attains a NAAQS in the 60-70 ppb range
4th High Ozone Values Needed to Attain the NAAQS in 2015

- Upper table shows 4th high value needed in 2015 for monitors to achieve NAAQS of 60-75 ppb
- Lower table shows recent range of values of 4th high MDA8 for all three monitors
- Recent values low enough to attain 70-75 ppb NAAQS, but not 60-65 ppb NAAQS

<table>
<thead>
<tr>
<th>Design Value (ppb)</th>
<th>4th Highest Daily Max 8-hour Average Ozone (ppb)</th>
<th>4th Highest MDA8 Range since 2011 (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Longview (C19)</td>
<td>Tyler (C82)</td>
</tr>
<tr>
<td>75</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>70</td>
<td>75</td>
<td>75</td>
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<td>60</td>
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<tr>
<td>60</td>
<td>45</td>
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<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>4th Highest MDA8 Range since 2011 (ppb)</th>
<th>Longview (C19)</th>
<th>Tyler (C82)</th>
<th>Karnack (C85)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>66-82</td>
<td>66-78</td>
<td>66-76</td>
</tr>
</tbody>
</table>
# 2014 Days with 8-hour Ozone > 65 ppb

<table>
<thead>
<tr>
<th>Day</th>
<th>Longview</th>
<th>Tyler</th>
<th>Karnack</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 25</td>
<td>57</td>
<td>66</td>
<td>50</td>
</tr>
<tr>
<td>May 3</td>
<td>64</td>
<td>62</td>
<td>71</td>
</tr>
<tr>
<td>May 4</td>
<td>62</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>May 5</td>
<td>75</td>
<td>70</td>
<td>69</td>
</tr>
<tr>
<td>May 16</td>
<td>63</td>
<td>67</td>
<td>66</td>
</tr>
<tr>
<td>July 5</td>
<td>66</td>
<td>40</td>
<td>49</td>
</tr>
<tr>
<td>July 23</td>
<td>73</td>
<td>53</td>
<td>34</td>
</tr>
<tr>
<td>September 8</td>
<td>66</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>4th high value</td>
<td>66</td>
<td>66</td>
<td>66</td>
</tr>
</tbody>
</table>

Shading shows monitor with highest value of daily maximum 8-hour ozone.
# 2014 Days with 8-hour Ozone > 65 ppb

<table>
<thead>
<tr>
<th>Day</th>
<th>Monitor</th>
<th>Power Plant Impact</th>
<th>≥60 ppb Regional Contribution</th>
<th>Possible HRVOC Impact</th>
<th>Unknown Local Contribution</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-Apr</td>
<td>Tyler</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tyler urban plume impact. Regional background ~50 ppb, easterly winds</td>
</tr>
<tr>
<td>3-May</td>
<td>Karnack</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>High regional background, southerly winds</td>
</tr>
<tr>
<td>4-May</td>
<td>Tyler, Karnack</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>High regional background, southerly winds</td>
</tr>
<tr>
<td>5-May</td>
<td>Longview, Tyler, Karnack</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>High regional background, moderate ozone throughout the day, southerly winds</td>
</tr>
<tr>
<td>16-May</td>
<td>Tyler, Karnack</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td>High regional background; southerly winds</td>
</tr>
<tr>
<td>5-Jul</td>
<td>Longview</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>Low regional background, easterly winds; high SO₂ indicates coal-fired power plant impact</td>
</tr>
<tr>
<td>23-Jul</td>
<td>Longview</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td>Low regional background, stagnant /northerly winds; possible HRVOC impact</td>
</tr>
<tr>
<td>8-Sep</td>
<td>Longview</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>Moderate regional background, southerly winds; coal-fired power plant plume impact</td>
</tr>
</tbody>
</table>

- At 65 ppb threshold, transport from the south becomes more important
- Evaluated all days for possible fire impacts
  - No days selected for further analysis as exceptional events
  - Full high ozone day analysis will be shown in Conceptual Model Update report
April 25, 2014

- Regional background ~50 ppb
- Light easterly winds
- High ozone at Tyler
  - Peaks at 2 pm and 6 pm
  - Little SO\(_2\) at Tyler
  - Easterly wind direction suggests Tyler urban plume impact
April 25, 2014

Tyler

NOAA HYSPLIT MODEL
Backward trajectories ending at 1900 UTC 25 Apr 14
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Location</th>
<th>8hr-O$_3$ (ppb)</th>
<th>1hr-O$_3$ (max-ppb/time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longview</td>
<td>57</td>
<td>62/4pm</td>
</tr>
<tr>
<td>Tyler</td>
<td>66</td>
<td>72/2pm</td>
</tr>
<tr>
<td>Karnack</td>
<td>50</td>
<td>52/1pm</td>
</tr>
</tbody>
</table>

Source ★ at 32.34 N 95.42 W

Meters AGL

Job ID: 138046   Job Start: Wed Sep 10 16:52:54 UTC 2014
Source 1 lat.: 32.3440079 lon.: -95.415/515 hgs: 500, 1000, 2500 m AGL
Trajectory Direction: Backward   Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 25 Apr 2014 - NAM12
May 3, 2014

- May 3-5 saw high ozone throughout East Texas
- High ozone at Karnack
- High regional background >60 ppb, light southerly winds
- Not possible to isolate cause(s) of local contribution
- Large NOx peak in evening
  - NOx source near monitor?
May 3, 2014

Karnack

NOAA HYSPLIT MODEL
Backward trajectories ending at 2100 UTC 03 May 14
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Location</th>
<th>8hr-(\text{O}_3) (ppb)</th>
<th>1hr-(\text{O}_3) (max-ppb/time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longview</td>
<td>64</td>
<td>67/5pm</td>
</tr>
<tr>
<td>Tyler</td>
<td>62</td>
<td>64/1pm</td>
</tr>
<tr>
<td>Karnack</td>
<td>71</td>
<td>77/5pm</td>
</tr>
</tbody>
</table>

Source ★ at 32.67 N, 94.17 W

Meters AGL

Job ID: 136829
Job Start: Wed Nov 26 15:04:26 UTC 2014
Source 1 lat: 32.670000 lon: -94.170000 hgt: 50, 500, 1000 m AGL
Trajectory Direction: Backward    Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 3 May 2014 - NAM12
May 4, 2014

High ozone at Tyler and Karnack
- Ozone remained high overnight at Tyler, but not at Karnack
- Ozone higher at midday at Tyler and Karnack than Longview; cause(s) unclear

High regional background >60 ppb

Low SO$_2$ and NOx concentrations at Tyler

Stronger southerly winds, HYSPLIT back trajectories extend over San Antonio-Austin areas
May 4, 2014

### Tyler

NOAA HYSPLIT MODEL  
Backward trajectories ending at 1700 UTC 04 May 14  
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Location</th>
<th>8hr-O₃ (ppb)</th>
<th>1hr-O₃ (max-ppb/time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longview</td>
<td>62</td>
<td>64/3pm</td>
</tr>
<tr>
<td>Tyler</td>
<td>66</td>
<td>72/12pm</td>
</tr>
<tr>
<td>Karnack</td>
<td>66</td>
<td>71/1pm</td>
</tr>
</tbody>
</table>
May 4, 2014

- Moderate southerly winds
- NOx peaks in morning and evening at Karnack coincide with ozone minima not present at other monitors
- Source of NOx unclear
  - Back trajectory passes over gas fields, Martin Lake EGU, I-20
  - SO$_2$ monitoring at Karnack would help distinguish among these sources
May 5, 2014

- High ozone at Longview, Tyler and Karnack, unusual diurnal cycle
- 5 pm peak at Longview, with low SO$_2$ and NOx concentrations
- High regional background ~55 ppb
  - High nocturnal ozone
  - Southerly winds
- Ozone transport from areas of Texas to the south
May 5, 2014

- Ozone > 50 ppb all day, and peaks at 8 pm
- Strong southerly winds
- Little SO₂ or NOx
- Possible ozone transport from south Texas
May 5, 2014

- High regional background
- Late afternoon peak at Karnack
- NOx present in early morning
- Moderate ozone in southeast Texas on May 4
May 5, 2014

**Location**

<table>
<thead>
<tr>
<th>Location</th>
<th>8hr-O₃ (ppb)</th>
<th>1hr-O₃ (max-ppb/time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longview</td>
<td>75</td>
<td>85/5pm</td>
</tr>
<tr>
<td>Tyler</td>
<td>70</td>
<td>76/8pm</td>
</tr>
<tr>
<td>Karnack</td>
<td>69</td>
<td>73/4pm</td>
</tr>
</tbody>
</table>

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**NOAA HYSPLIT MODEL**

Backward trajectories ending at 0200 UTC 06 May 14
NAM Meteorological Data

**Tyler**

Source: 32°34'40.07'' N 94°47.17'' W
Job ID: 142493
Trajectory Direction: Backward
Duration: 48 hrs

**Longview**

Source: 32°38'38.00'' N 94°47.17'' W
Job ID: 142276
Trajectory Direction: Backward
Duration: 48 hrs

**Karnack**

Source: 32°36'17.00'' N 94°47.17'' W
Job ID: 142239
Trajectory Direction: Backward
Duration: 48 hrs
May 16, 2014

- High ozone at Tyler and Karnack
  - Relatively strong, shifting winds
- High regional background >60 ppb
  - High ozone throughout East Texas
- Low SO$_2$ and NOx concentrations during afternoon peak ozone period
May 16, 2014

- Little NOx at Karnack
- Unclear which local sources contribute to ozone enhancement at Tyler and Karnack
May 16, 2014

**Tyler**
NOAA HYSPLIT MODEL
Backward trajectories ending at 2100 UTC 16 May 14
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Meters AGL</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>26</th>
<th>28</th>
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**Karnack**
NOAA HYSPLIT MODEL
Backward trajectories ending at 2000 UTC 16 May 14
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Meters AGL</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>26</th>
<th>28</th>
<th>30</th>
<th>32</th>
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<tbody>
<tr>
<td>500</td>
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<td></td>
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<td>2500</td>
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<td></td>
</tr>
</tbody>
</table>

**Location** | **8hr-O₃ (ppb)** | **1hr-O₃ (max-ppb/time)**
--- | --- | ---
Longview | 63 | 69/4pm
Tyler | 67 | 75/4pm
Karnack | 66 | 75/3pm
July 5, 2014

- High ozone at Longview
- Regional background < 50 ppb
- Low ozone across most of East Texas
- SO₂ peak in morning hours
  - Coal-fired power plant impact at Longview
July 5, 2014

2 pm: Time of Ozone Peak

Location

8hr-$O_3$ (ppb) 1hr-$O_3$ (max-ppb/time)

Longview 66 74/2pm

Tyler 40 44/4pm

Karnack 49 51/11am
July 23, 2014

Back Trajectories Ending at 11 AM

- High ozone at Longview
- Stagnant, shifting winds
- Low regional background < 40 ppb
- Elevated NOx in the morning hours at Longview, little SO$_2$
- Possible HRVOC impact
  - Rapid ozone formation
  - Northerly winds during period leading up to peak ozone
- SO$_2$ at Tyler in the morning indicates coal-fired power plant plume impact
July 23, 2014

Longview

NOAA HYSPLIT MODEL
Backward trajectories ending at 1600 UTC 23 Jul 14
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Location</th>
<th>8hr-O$_3$ (ppb)</th>
<th>1hr-O$_3$ (max-ppb/time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longview</td>
<td>73</td>
<td>87/11am</td>
</tr>
<tr>
<td>Tyler</td>
<td>53</td>
<td>56/12pm</td>
</tr>
<tr>
<td>Karnack</td>
<td>34</td>
<td>38/3am</td>
</tr>
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C19

Job ID: 141975
Job Start: Wed Nov 26 18:47:03 UTC 2014
Source 1 lat: 32.380000 lon: -94.710000 hgt: 50, 500, 1000 m AGL
Trajectory Direction: Backward Duration: 24 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 23 Jul 2014 - NAM12
September 8, 2014

- High ozone at Longview
- Light southerly winds
- Low regional background, 35-45 ppb
- Longview SO₂ data missing from 12-4 pm
- Back trajectory suggests Martin Lake impact, ozone enhancement in plume ~25 ppb
HIGH 1-HOUR OZONE DAYS
• High 1-hour ozone at Longview, 87 ppb
• Regional background < 50 ppb
• 3 pm ozone peak is coal-fired power plant plume impact
  – SO₂ peak coincides with ozone peak
  – Wind direction indicates Martin Lake impact
August 5, 2014

Longview
NOAA HYSPLIT MODEL
Backward trajectories ending at 2000 UTC 05 Aug 14
NAM Meteorological Data

<table>
<thead>
<tr>
<th>Location</th>
<th>8hr-(\text{O}_3) (ppb)</th>
<th>1hr-(\text{O}_3) (max-ppb/time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longview</td>
<td>53</td>
<td>87/3pm</td>
</tr>
<tr>
<td>Tyler</td>
<td>38</td>
<td>39/1pm</td>
</tr>
<tr>
<td>Karnack</td>
<td>39</td>
<td>44/4pm</td>
</tr>
</tbody>
</table>

C19

Source ★ at 32.38 N 94.71 W

Meters AGL

Job ID: 110254  Job Start: Fri Sep 12 13:57:12 UTC 2014
Source lat.: 32.378610  lon.: -94.711900  hghts: 500, 1000, 2500 m AGL

Trajectory Direction: Backward  Duration: 48 hrs
Vertical Motion Calculation Method: Model Vertical Velocity
Meteorology: 0000Z 5 Aug 2014 - NAM12
In recent years, less correlation between weather conditions and ozone than in 2002-6
  - Consistent with expected effect of emissions reductions

2014 weather not conducive to ozone formation