

# Ozone Formation in the San Antonio Area

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# Introduction to Ozone Formation in the San Antonio Area

- Conceptual models:
  - Describe ozone formation within an area;
  - Are required by the EPA; and
  - Contain information on ozone, ozone precursors, meteorology, and transport.
- Bexar County was designated as nonattainment for the 2015 eight-hour ozone standard of 70 parts per billion (ppb) on July 17, 2018.
- The San Antonio area conceptual model investigates the following topics:
  - Ozone concentrations and trends;
  - Ozone precursor concentrations and trends;
  - Ozone chemistry; and
  - Meteorology and its affect on ozone.

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### **Ozone Concentrations and Trends**

# Eight-Hour Ozone Design Values





### Eight-Hour Ozone Design Values by Monitor





### Fourth-Highest Eight-Hour Ozone Values by Monitor





### Eight-Hour Ozone Exceedance Days by Month





### Regional Background Ozone During the Ozone Season



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### Ozone Precursor Concentrations and Trends



### Ozone Season Average Daily-Maximum Nitrogen Oxide (NO<sub>x</sub>) Trends



# REPORTED ONLY

### Camp Bullis Volatile Organic Compound (VOC) June 1, 2016 – February 28, 2017

# Mean Concentration (ppbC)

Ethane	
Propane	
n-Butane	
Isobutane	
Isopentane	
n-Pentane	
Isoprene	
Ethylene	
Acetylene	
Toluene	
n-Hexane	
Propylene	. 🔹 11111 1111 1111 1111 1111 1111 1111
Benzene	
1-Butene	
m/p Xylene	
Methylcyclopentane	
2,2,4-Trimethylpentane	
trans-2-Butene	• • • • • • • • • • • • • • • • • • • •
Cyclopentane	· • • • • • • • • • • • • • • • • • • •
3-Methylhexane	• • • • • • • • • • • • • • • • • • • •
Methylcyclohexane	• • • • • • • • • • • • • • • • • • •
Cyclohexane	• • • • • • • • • • • • • • • • • • •
n-Heptane	- 🗣 k shary keen keen koon kaan kinna kaap keen kary keen kaan biary bi
1,2,4-Trimethylbenzene	• • • • • • • • • • • • • • • • • • • •
1,2,3-Trimethylbenzene	•
2-Methylhexane	• * ***** **** **** **** **** **** ***** ****
o-Xylene	• a blard Assa kasa ayan kasa kasan kasa kasa kasa kasa kasa bisar ka
cis-2-Butene	•
n-Octane	•
1,3-Butadiene	•
2,2-Dimethylbutane	• * ***** **** **** **** **** **** ***
n-Decane	•
n-Nonane	•
Ethylbenzene	• • • • • • • • • • • • • • • • • • • •
1,3,5- Inmethylbenzene	• * ***** **** **** **** **** ***** *****
1-Pentene	•
trans-2-Pentene	• • • • • • • • • • • • • • • • • • • •
Styrene	• • • • • • • • • • • • • • • • • • • •
2-Methylneptane	
2,3-Dimetryipentane	
cis-2-Pentene	
2,3,4- Inmethylpentane	
2-Mathulheatene	
5-menyineptane	
2.4-Dimothidoontroo	
2,4-Dimetryipentane	
	1 1 1 1 1

Isoprene	
Ethene	
n-Butane	
Propage	
Ethane	
Propene	
Iso-Pentane	
Isobutano	
isobutane Dectado	
n-rentane Televenane	
Ioluene 1. Dutono	
1-Butene	
trans-2-Butene	
Acetylene	
p-Xylene	
1,2,3-Trimethyl Benzene	• • • • • • • • • • • • • • • • • •
n-Hexane	
cis-2-Butene	
1,2,4-Trimethyl Benzene	
1.3-Butadiene	
Methylcyclopentane	
Cyclopentane	
o-Xviene	
2.2.4-Trimethyl Pentane	
3-Methyl Hexane	
Methylovolohexane	
Benzene	
Cucloberane	
1.3.5-Trimethyl Benzene	
1,0,0 milledigi Denzene	
n-neptane	
Cans-2-Pentene	
2-Methyl Hexane	
1-Pentene	
Ethyl Benzene	•
cis-2-Pentene	****** **** **** ***** ***** ***** *****
2,2-Dimethyl Butane	************************************
n-Octane	•
n-Nonane	•
n-Decane	•
Styrene	<ul> <li>***** **** **** **** **** ***** *****</li> </ul>
2,3-Dimethyl Pentane	• • • • • • • • • • • • • • • • • • •
2-Methyl Heptane	•
n-Propyl Benzene	•
2.3.4-Trimethyl Pentane	<ul> <li>***** ***** ***** ***** ***** *****</li> </ul>
3-Methyl Heptane	• ····· ···· ····
Isopropyl Benzene (cumene)	•
2.4-Dimethyl Pentane	•

#### Mean MIR Weighted Concentration

0.8 1.0 1.2 \*Data from TCEQ.

0.6



# **Old Hwy 90 24-Hour VOC Trends**





road mobile

source trend

emissions

in Texas for

1999-2050.

August 2015.

# **On-Road Vehicle Summer Emissions**





Air Markets Program Data

(AMPD).

### Electric Generating Unit (EGU) Summer NO<sub>x</sub> Emissions





### Point Source Summer VOC Emissions for Sources > 15 Tons/Year



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### **Ozone Chemistry**



### Camp Bullis VOC/NO<sub>x</sub> Ratios June 1, 2016 – October 31, 2016





### San Antonio Northwest One-Hour Ozone and NO<sub>x</sub> Weekdays vs Weekends 2013 – 2018



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# **Meteorology and its Affect on Ozone**



# **Ozone Season Prevailing Winds**



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### **Ozone Exceedance Day Surface-Level Five-Hour Back Trajectories 2009 – 2018**





Average Daily-Maximum Eight-Hour Ozone and 500 Meter 56-Hour Back Trajectory Clusters for Ozone Season, 2009 – 2018



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### San Antonio Northwest and Calaveras Lake One-Hour Ozone by Wind Speed and Direction





- Eight-hour ozone design value trends have been flat over the last ten years.
- Ozone formation peaks from April through June and then again from August through October, with a "mid-summer minimum" occurring in July.
- High ozone typically occurs on hot sunny days with dry conditions and slow winds out of the southeast.
- Emissions located south and southeast of the area combine with urban mobile emissions to create ozone and slow winds transport it to the monitors located in the northwest.



- Ozone accumulation is further exacerbated by recirculating wind directions throughout the day.
- These conditions also create high levels of regional background ozone, which combines with the local ozone and emissions to produce high ozone levels.
- The air mass appears to be  $\ensuremath{\mathsf{NO}_{\mathsf{X}}}$  limited to transitional.
- The dominant VOC are either naturally occurring or have low ozone formation potential, meaning  $NO_X$  controls may be more effective in reducing ozone compared to VOC.





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Link to full Conceptual Model for the San Antonio area: <u>https://www.tceq.texas.gov/assets/public/implementation/air/</u> <u>sip/sipdocs/2020\_Bexar179B/179B\_SIP\_Appendix\_E\_ado.pdf</u>