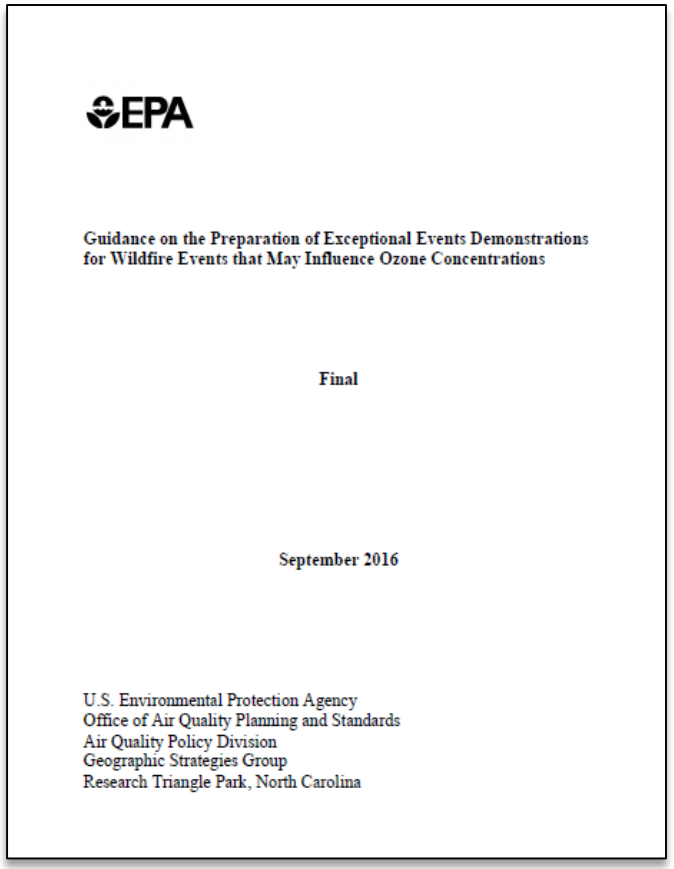
EXCEPTIONAL EVENTS UPDATES
Case Study: Wildfire Ozone Event in Washoe County, Nevada

Ben Gibson
U.S. EPA / Office of Air Quality Planning & Standards / Air Quality Policy Division
Emissions Inventory Conference – Baltimore, MD
August 14, 2017

Overview

- Initial Notification Process
- Components of a Wildfire Ozone Demonstration
  - Conceptual Model
  - Clear Causal Relationship
- Examples of Evidence and Analysis
  - Tier 1
  - Tier 2
  - Tier 3


EPA

Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations

Final

September 2016

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Policy Division
Geographic Strategies Group
Research Triangle Park, North Carolina

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Initial Notification: Washoe County, Nevada

Communication tool used to assess regulatory significance and critical path analysis

- Applicable NAAQS
- Affected Regulatory Decision
- Area Name/Designation Status
- Design Value Period
- Event Narrative
- Event Specific Concentrations
- Design Value Calculations

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Initial Notification: Washoe County, Nevada

Initial Notification of Potential Exceptional Event Information Summary

Submitting Agency: Washoe County Health District, Air Quality Management Division
Agency Contact: Daniel Inouye, Branch Chief
Date Submitted: November 10, 2016
Applicable NAAQS: 2015 8-Hour Ozone
Affected Regulatory Decision[1]: Attainment of the 2015 8-Hour Ozone NAAQS
Area Name/Designation Status: Washoe County Attainment Area
Design Value Period: 2014-2016

Narrative: Smoke from several wildfires throughout the West in July and August 2016 impacted the Reno/Sparks area. The smoke impacts contributed to several exceedances of the National Ambient Air Quality Standards (NAAQS) for Ozone (O_3) and elevated levels of Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) at several sites in the Washoe County Health District, Air Quality Management Division's (AQMD) monitoring network. The AQMD requests that the Regional Administrator for Region IX of the U.S. Environmental Protection Agency (EPA) accept this Initial Notification so Exceptional Events Demonstration documents can be prepared to petition for the exclusion of the air quality monitoring data effected from these fires from the normal planning and regulatory requirements under the Clean Air Act (CAA) in accordance with the Exceptional Events Rule (EER).

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Initial Notification: Washoe County, Nevada

Table A: Information specific to each flagged site day that may be submitted to EPA in support of the affected regulatory decision listed above

Date(s) of Event	NAAQS	Type of Event (high wind, volcano, wildfires/prescribed burns, other[2])	AQS Flag	Site AQS ID	POC	Site Name	Monitor Concentration
07/02/2016	Ozone	Wildfires	RT	32-031-0016	1	Reno3	0.073 ppm
07/03/2016	Ozone	Wildfires	RT	32-031-0016	1	Reno3	0.073 ppm
07/04/2016	Ozone	Wildfires	RT	32-031-0016	1	Reno3	0.073 ppm
07/25/2016	Ozone	Wildfires	RT	32-031-0016	1	Reno3	0.071 ppm

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Initial Notification: Washoe County, Nevada

Table C: Summary of Maximum Design Value (DV) Site Information for **8-Hour Ozone** (Effect of EPA Concurrence on Maximum Design Value Site Determination)

Maximum DV site (AQS ID) **without EPA concurrence** on any of the events listed in Table A above	Design Value 0.072 ppm	Design Value Site Reno3 (32-031-0016)	Comment Design value assumes concurrence with the 2015 Wildfire Ozone EE.
Maximum DV site (AQS ID) **with EPA concurrence** on all events listed in Table A above	Design Value 0.070 ppm	Design Value Site Reno3 (32-031-0016)	Comment Design value assumes concurrence with the 2015 Wildfire Ozone EE.

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Conceptual Model

- Description of the geographic area
  - Maps of relevant monitors
- Typical non-event O_3 formation and meteorology
  - Average O_3 daily profiles
  - Seasonal variation
- Summary of fires
  - Description of the wildfires
  - Locations of specific fires, fire maps
- Event specific O_3 concentrations
  - Identify regulatory significance

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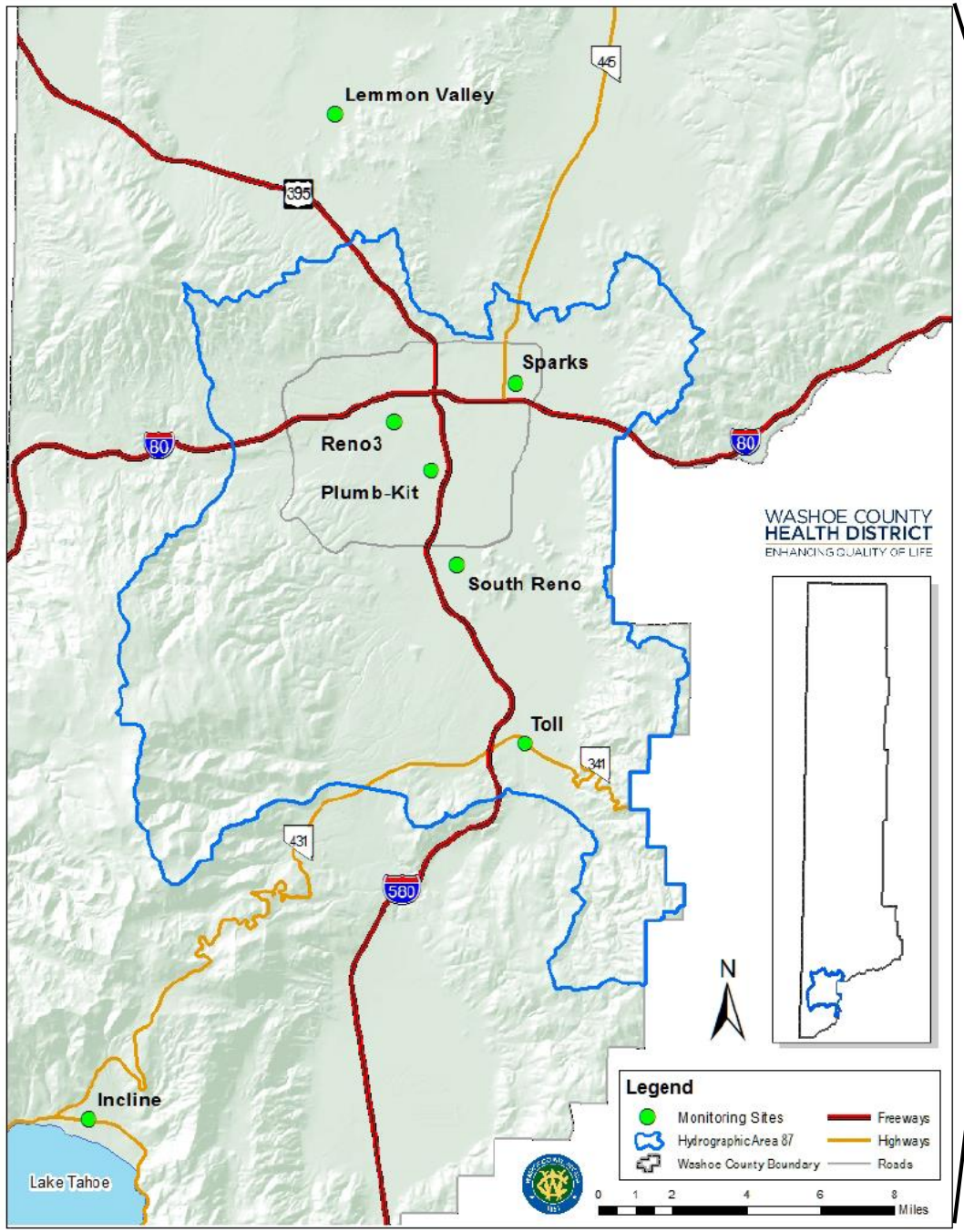
Conceptual Model

Figure 1.2: Washoe County Health District - AQMD Ambient Air Monitoring Sites



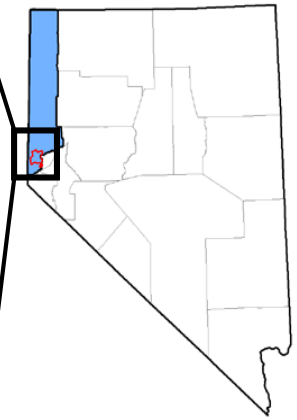
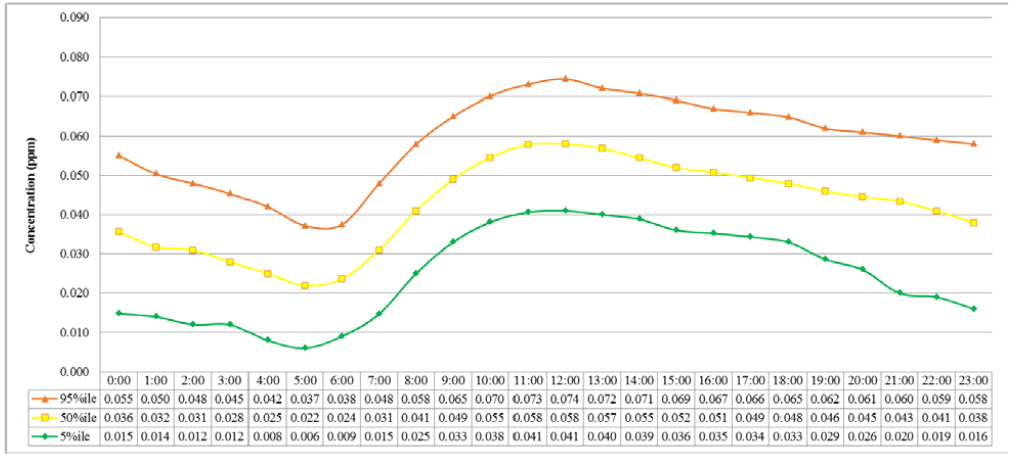


Table 1.3: 8-hour Summertime O_3 Concentrations at Reno3 (2011-2016)

Percentile	Concentration (ppm)
100	0.075
99	0.073
98	0.072
95	0.069
90	0.067
50	0.057

Figure 1.4: Typical Summertime 1-hour O_3 Diurnal Pattern at Reno3 (2011-2015)



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95%ile	0.055	0.050	0.048	0.045	0.042	0.037	0.038	0.048	0.058	0.065	0.070	0.073	0.074	0.072	0.071	0.069	0.067	0.066	0.065	0.062	0.061	0.060	0.059	0.058
50%ile	0.036	0.032	0.031	0.028	0.025	0.022	0.024	0.031	0.041	0.049	0.055	0.058	0.058	0.057	0.055	0.052	0.051	0.049	0.048	0.046	0.045	0.043	0.041	0.038
5%ile	0.015	0.014	0.012	0.012	0.008	0.006	0.009	0.015	0.025	0.033	0.038	0.041	0.041	0.040	0.039	0.036	0.035	0.034	0.033	0.029	0.026	0.020	0.019	0.016

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Conceptual Model

Figure 2.20: Trailhead Fire Perimeter Map July 4, 2016

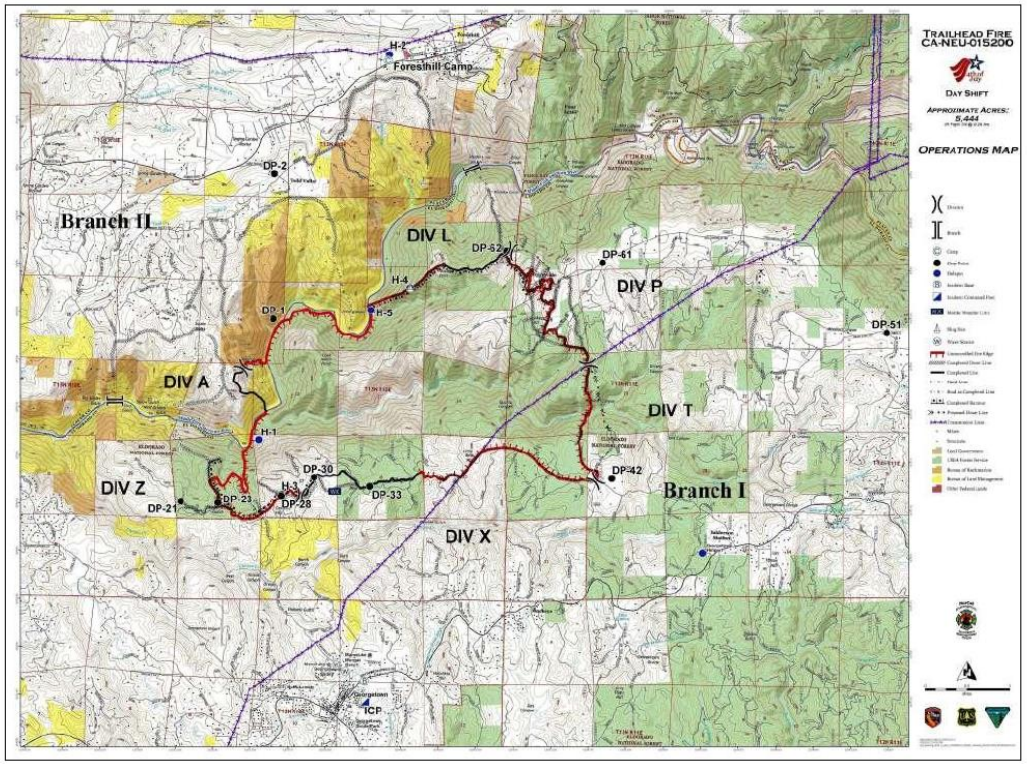
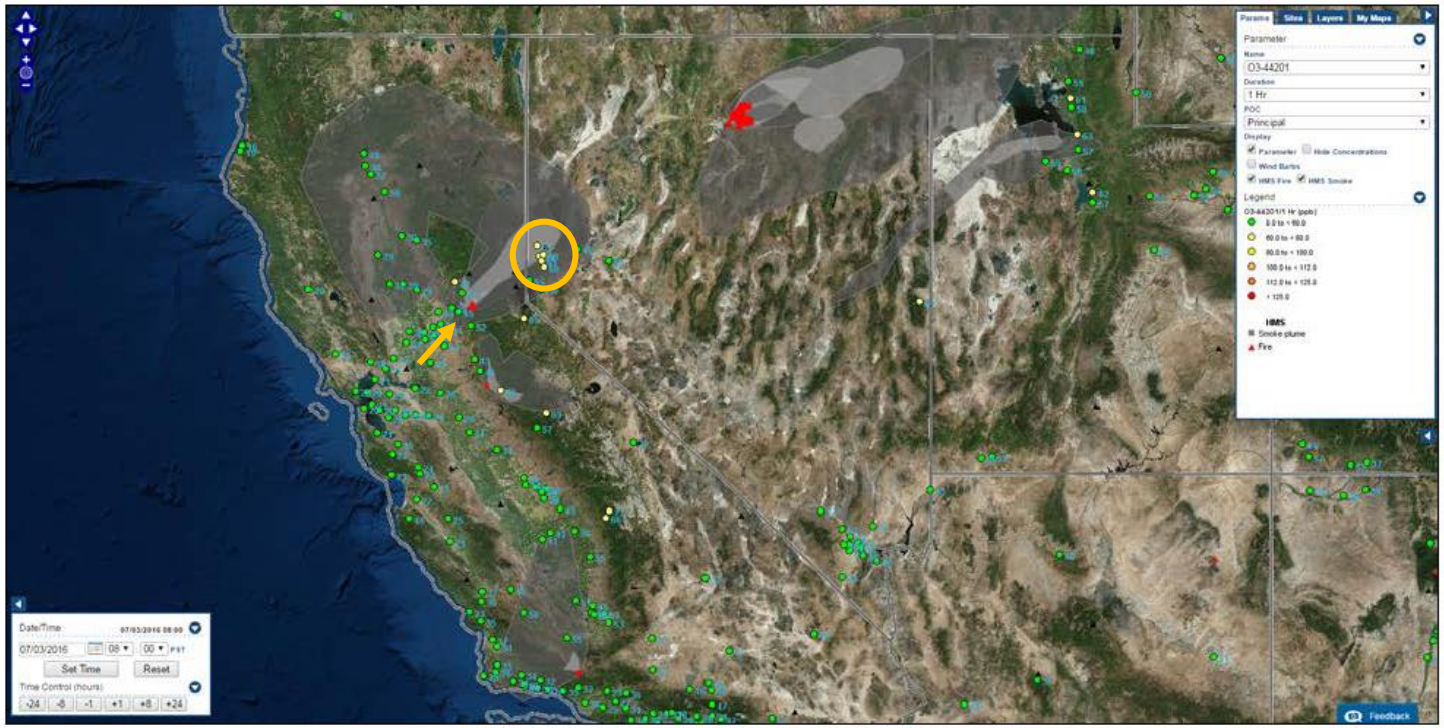


Figure 2.16: AirNow Tech Image of Active Fires, Smoke Plumes, and O_3 for July 3, 2016



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Conceptual Model

Table 2.1: 8-hour O_3 Concentrations (ppm) for June 25-July 11, 2016

								Exceptional Event	Exceptional Event	Exceptional Event							
	Non-Event			Trailhead Fire Episode							Non-Event						
Monitoring Site	6/25	6/26	6/27	6/28	6/29	6/30	7/1	7/2	7/3	7/4	7/5	7/6	7/7	7/8	7/9	7/10	7/11
Reno3	0.058	0.062	0.059	0.057	0.067	0.063	0.067	0.073	0.073	0.073	0.068	0.052	0.055	0.047	0.041	0.050	0.052
Sparks	0.055	0.059	0.054	0.052	0.059	0.060	0.061	0.066	0.069	0.068	0.062	0.060	0.052	0.045	0.033	0.046	0.047
Toll	0.052	0.056	0.053	0.054	0.057	0.055	0.059	0.063	0.065	0.063	0.060	0.059	0.051	0.046	0.046	0.051	0.046
South Reno	0.054	0.058	0.054	0.055	0.059	0.057	0.058	0.065	0.066	0.065	0.063	0.056	0.052	0.047	0.044	0.049	0.047
Lemmon Valley	0.055	0.056	0.050	0.051	0.064	0.058	0.065	0.069	0.067	0.070	0.062	0.060	0.054	0.047	0.037	0.048	0.047
Incline	0.053	0.054	0.046	0.047	0.048	0.051	0.055	0.059	0.061	0.060	0.056	0.057	0.045	0.046	0.040	0.046	0.044

In this exceptional event demonstration, AQMD is requesting to exclude all hourly O_3 data from the Reno3 monitoring site for July 2 0000 Pacific Standard Time (PST) through July 4, 2016 2300 PST from comparison to the NAAQS. Exclusion of the data caused by this exceptional event will have a regulatory impact on the attainment designation of the 2015 8-hour O_3 NAAQS.

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Tier 1

Wildfire events that clearly influence O_3 exceedances or violations in areas that typically experiences lower O_3 concentrations. This tier is associated with an O_3 concentration that is clearly higher than non-event related concentrations, or occur outside of the area's normal O_3 season.

Key Factor

Seasonality or distinctive level of the monitored O_3 exceedance

- *Outside normal O_3 season*
- *5-10 ppb higher than non-event related concentrations*

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Tier 1

Figure 3.2: Reno3 8-Hour Daily O_3 Maximums June-August, 2011-2016

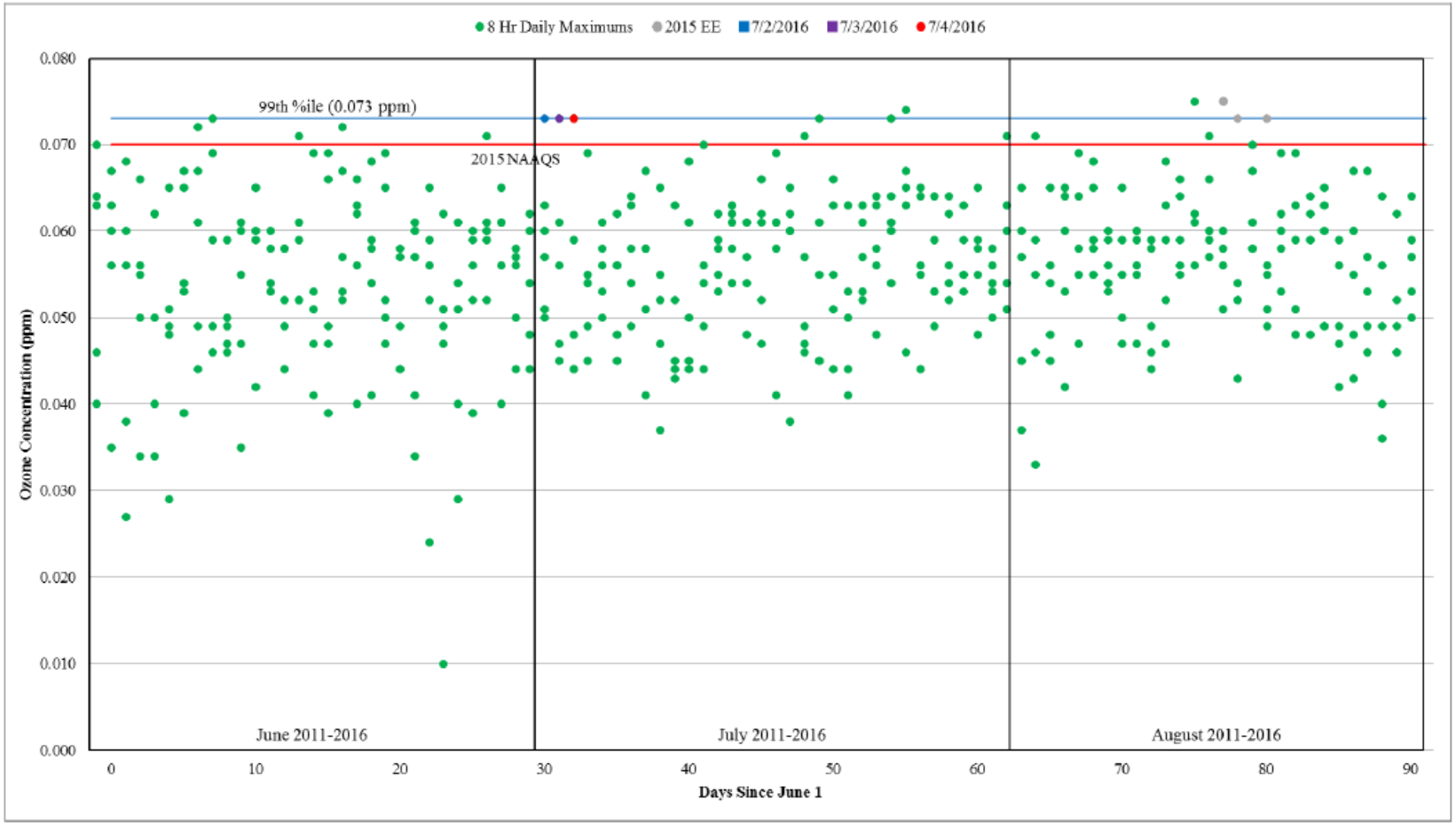

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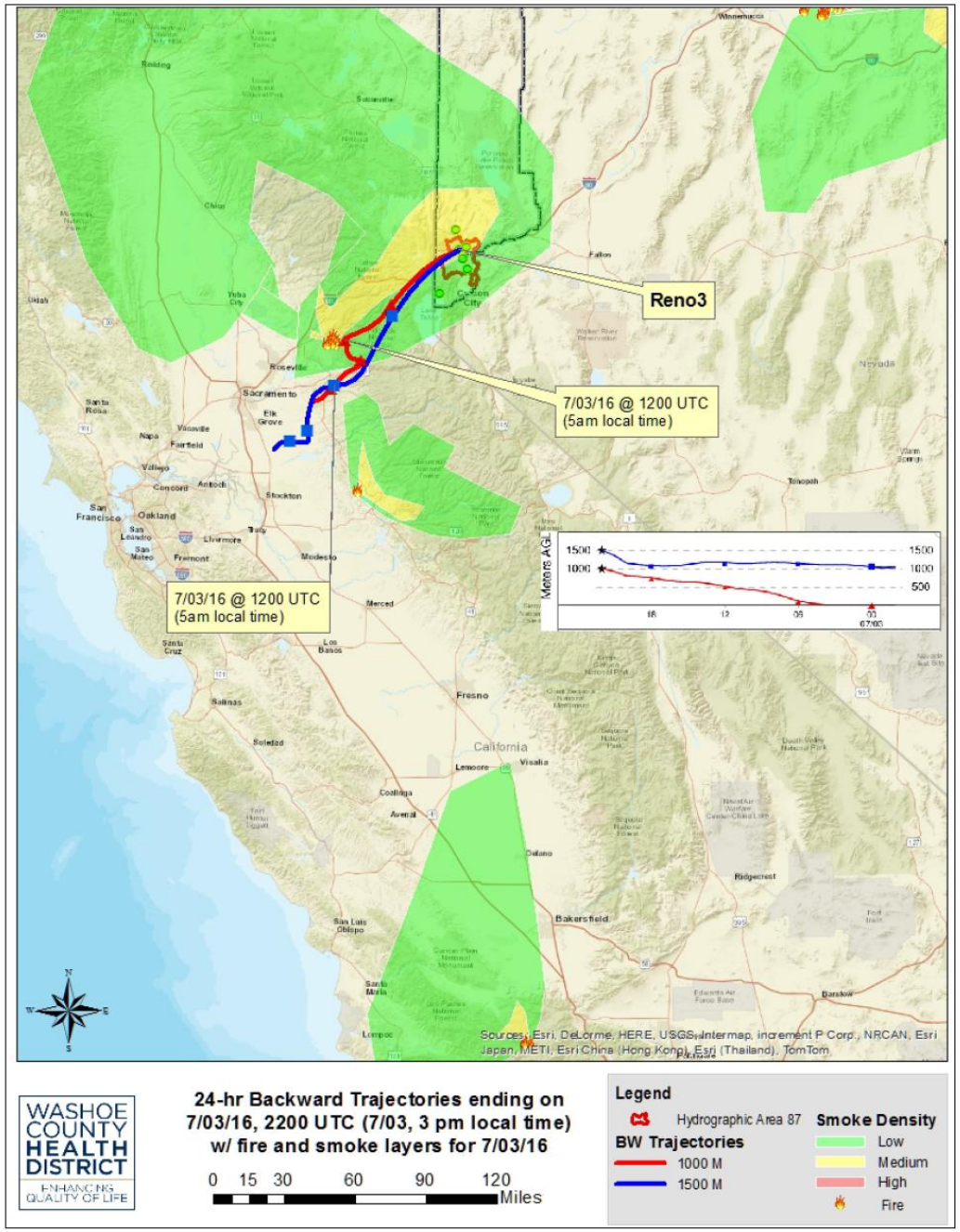
Figure 3.16: 24-Hour Backward HYSPLIT Trajectories and HMS Detected Smoke Plume on July 3, 2016



Clear Causal Relationship: Tier 1

Evidence that the wildfire emissions were transported to the monitor.

Potential analyses include:

- Trajectory analysis
- Satellite imagery with evidence of the plume impacting the ground

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Clear Causal Relationship: Tier 1

Evidence of ground impact: media reports, photographs, NWS forecasts, pollutant concentrations, visibility data

Figure 2.31: National Weather Service Tweet from June 29, 2016

Figure 2.33: KRNV News Tweet from July 2, 2016


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Area Forecast Discussion
National Weather Service Reno NV
230 AM PDT SUN JUL 3 2016

.SYNOPSIS...
Dry and breezy conditions will prevail for the upcoming week.
Smoke and haze from the Trailhead fire will move across much of
the region each afternoon and evening through the holiday weekend,
and may continue beyond the weekend. A slow cooling trend
continues with daytime temperatures near average starting
Tuesday.

&&

.SHORT TERM...

Several days of dry and breezy conditions are expected across the
eastern Sierra and western NV, as the upper low that produced
thunderstorms in recent days exits to the south and weakens.

The main weather impact for the next few days will be smoke from
the Trailhead wildfire spreading east of the Sierra crest each
afternoon and evening. This fire has been consuming several
hundred acres of dense timber each day in steep rugged terrain,
creating challenging conditions for fire suppression efforts. We
have extended mention of smoke and haze to Monday for now, but
smoke from this fire could be with us for a while. Trajectory
models indicate the highest concentrations of smoke affecting the
Reno-Carson-Tahoe regions each day, then spreading into portions
of the NV Basin and Range and Mineral-Lyon Counties each evening,
producing reduced air quality. People sensitive to these smoky
conditions should take extra precautions and limit outdoor
activity, especially during the late afternoon and evening hours.
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Tier 2

Wildfire events that do not meet the criteria of Tier 1

Key Factor #1

Fire emissions and distance of fire(s) to affected monitoring site location

- *Q/D >= 100 tons/km*

Key Factor #2

Comparison of the event-related O_3 concentration with non-event high O_3 concentrations

- *99^{th} or higher percentile of 5-year distribution*
- *One of the four highest values within 1 year*

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Tier 2

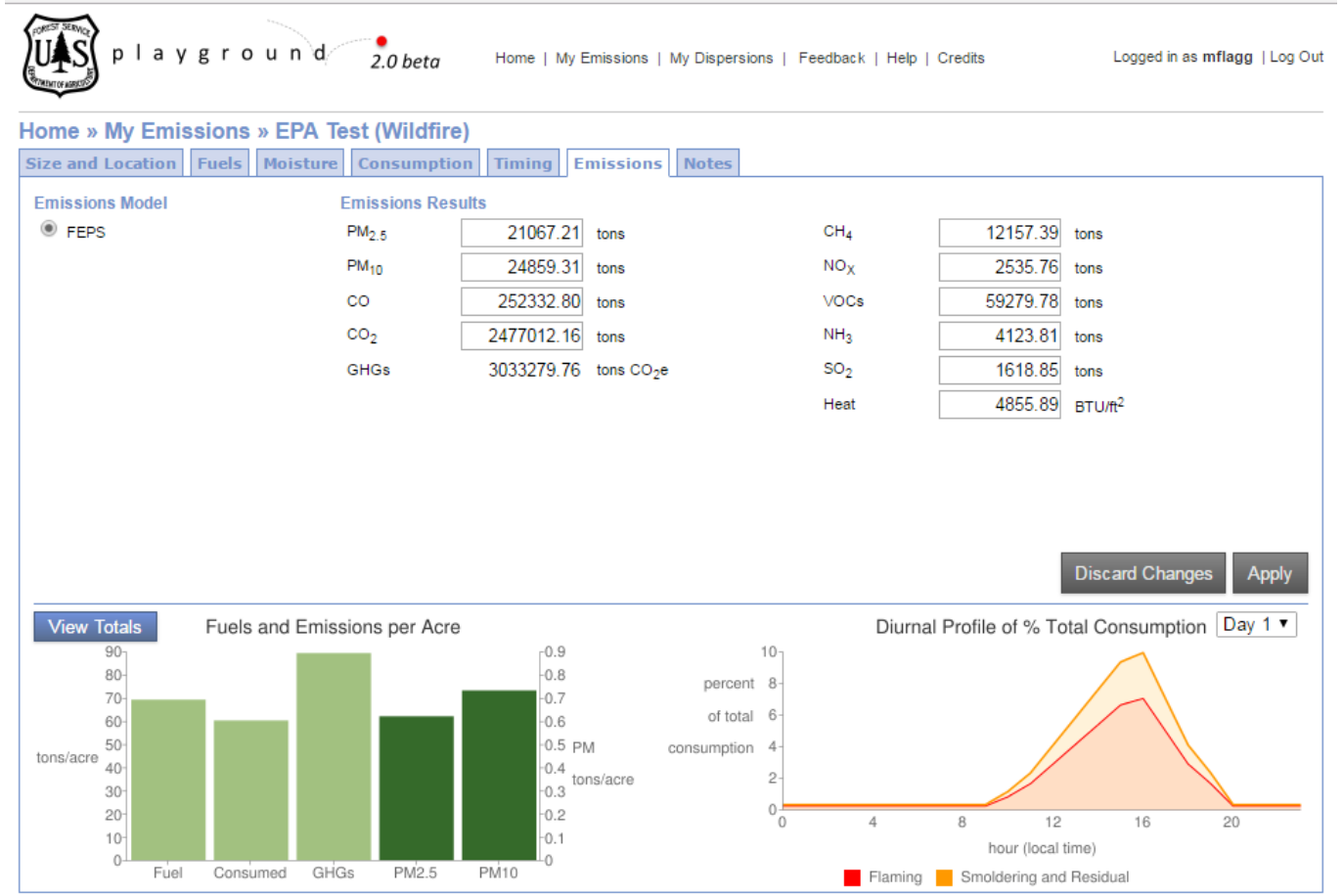

Table 3.1: Q/D Calculations for the Trailhead Fire

Date	Distance (km)	Acres	Emissions (tons)	Q/D (tpd/km)	Multi-day Q/D (tpd/km)
June 28, 2016	105	350	106	1.00	1.00
June 29, 2016	105	914	276	2.63	3.63
June 30, 2016	105	887	268	2.55	6.18
July 1, 2016	105	1,067	322	3.07	9.25
July 2, 2016	105	718	217	2.06	11.31
July 3, 2016	105	1,508	455	4.34	15.65
July 4, 2016	105	121	37	<1	16.00

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Tier 2

Figure 3.1: Reno3 8-Hour Daily O_3 Maximums June-August, 2011-2016

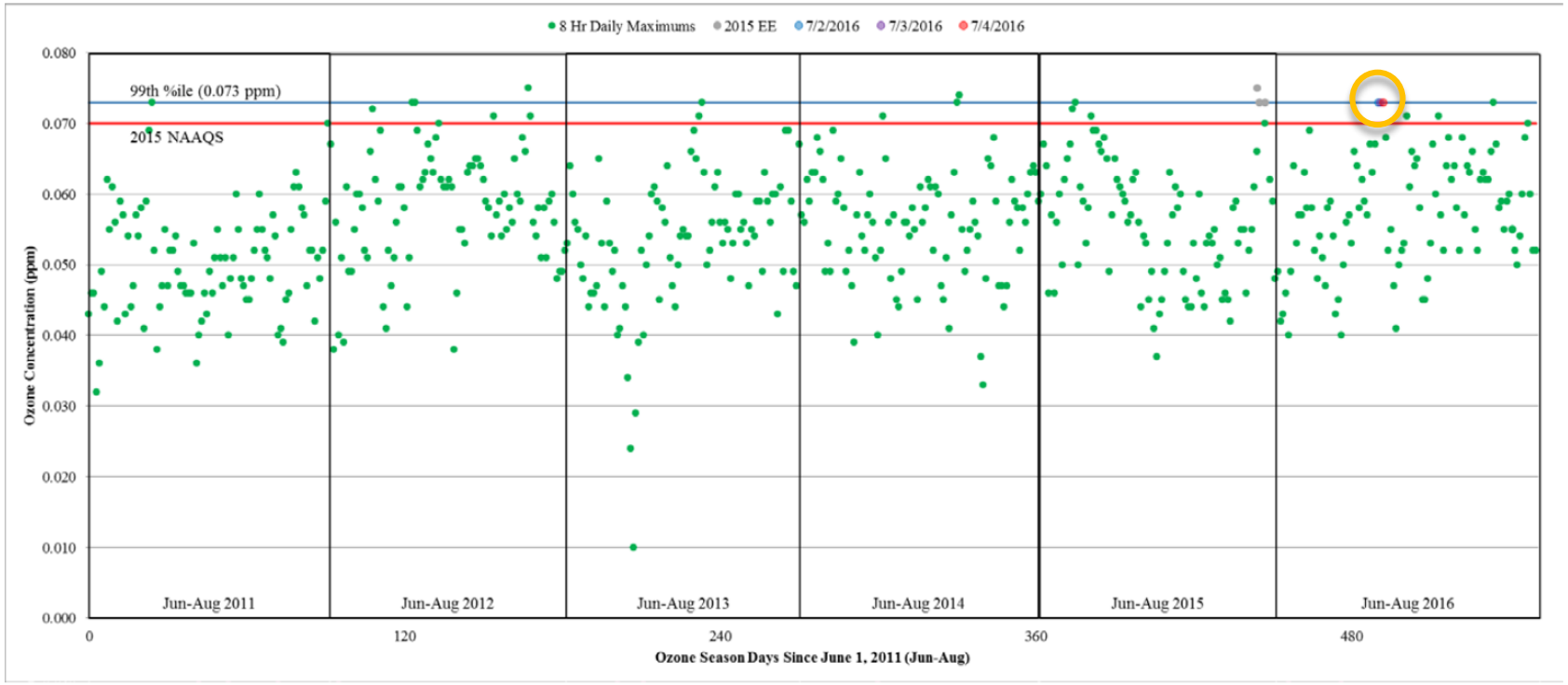

Table 1.3: 8-hour Summertime O_3 Concentrations at Reno3 (2011-2016)

Percentile	Concentration (ppm)
100	0.075
99	0.073
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95	0.069
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Clear Causal Relationship: Tier 2

(1) Tier 1 key factor analysis and evidence

(2) Tier 2 key factor analyses

(3) Tier 2 additional evidence that the emissions from the wildfire affected the monitored O_3 concentration

a) Supporting information (photographic evidence of smoke, visibility data, media reports, area forecasts)

b) Concentrations of O_3 and other wildfire-relevant pollutants ($PM_{2.5}$, CO, NO_x, VOCs)

c) Evidence of changes in spatial/temporal patterns of relevant pollutants

d) Analyses of tracers or indicators specifically of fire emissions (e.g. PM speciation such as organic carbon or levoglucosan, pollutant ratios such as $PM_{2.5}$/CO or $PM_{2.5}$/PM_{10})

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Clear Causal Relationship: Tier 2

Figure 2.22: Reno3 O_3, NOx, and $PM_{2.5}$ Hourly Concentrations for June 25 through July 11, 2016

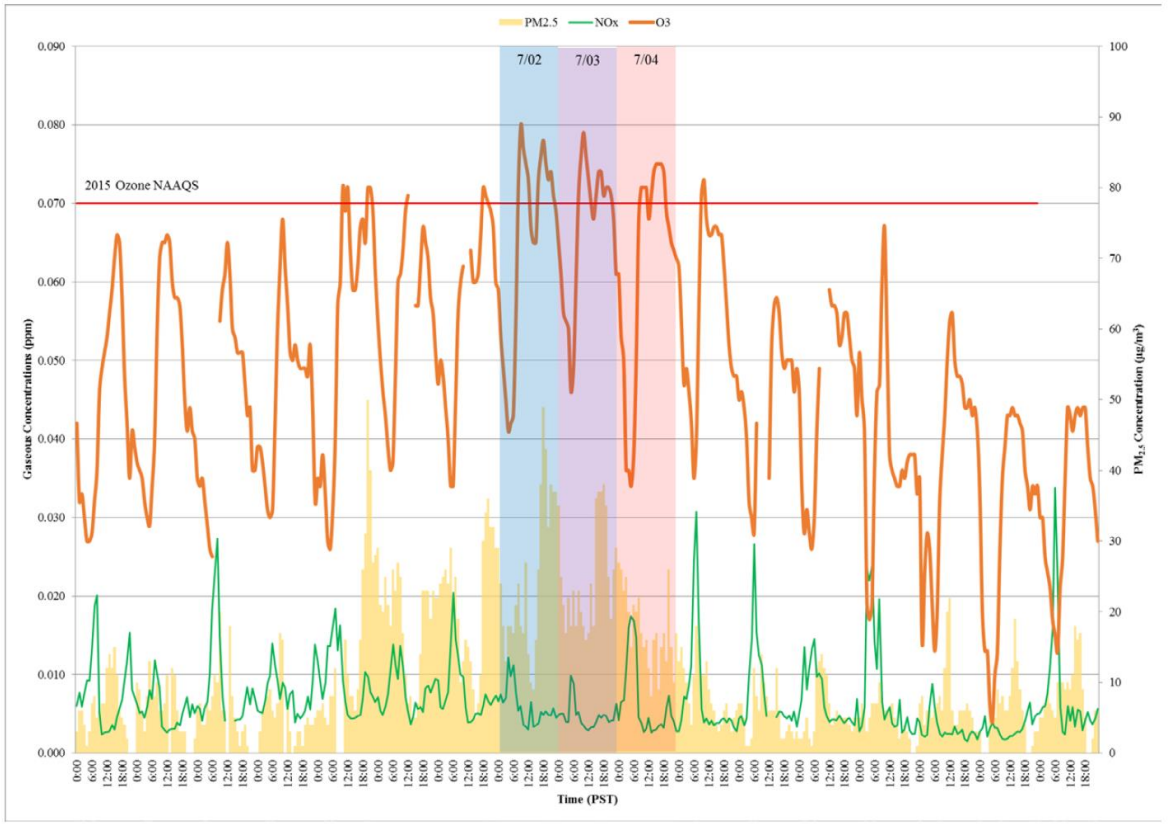
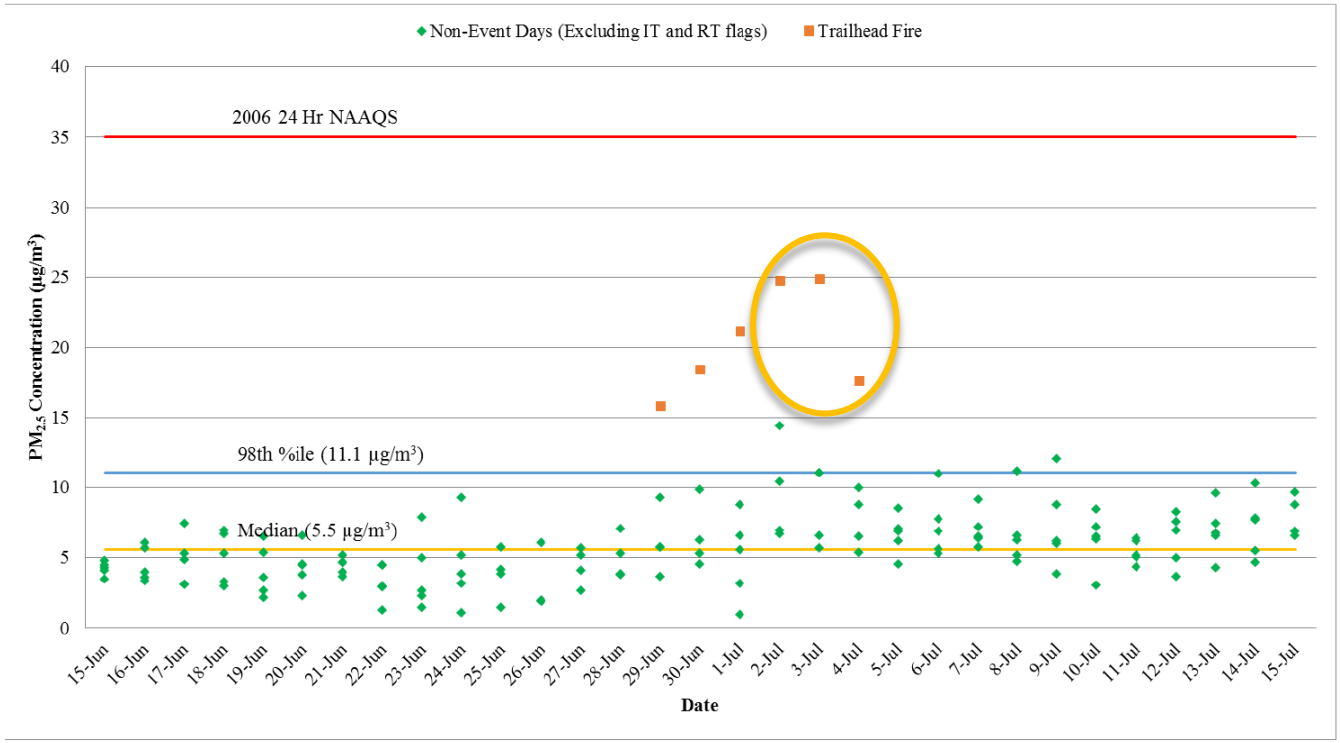


Figure 3.19: Reno3 24-Hour $PM_{2.5}$ Averages for June through July 2012-2016



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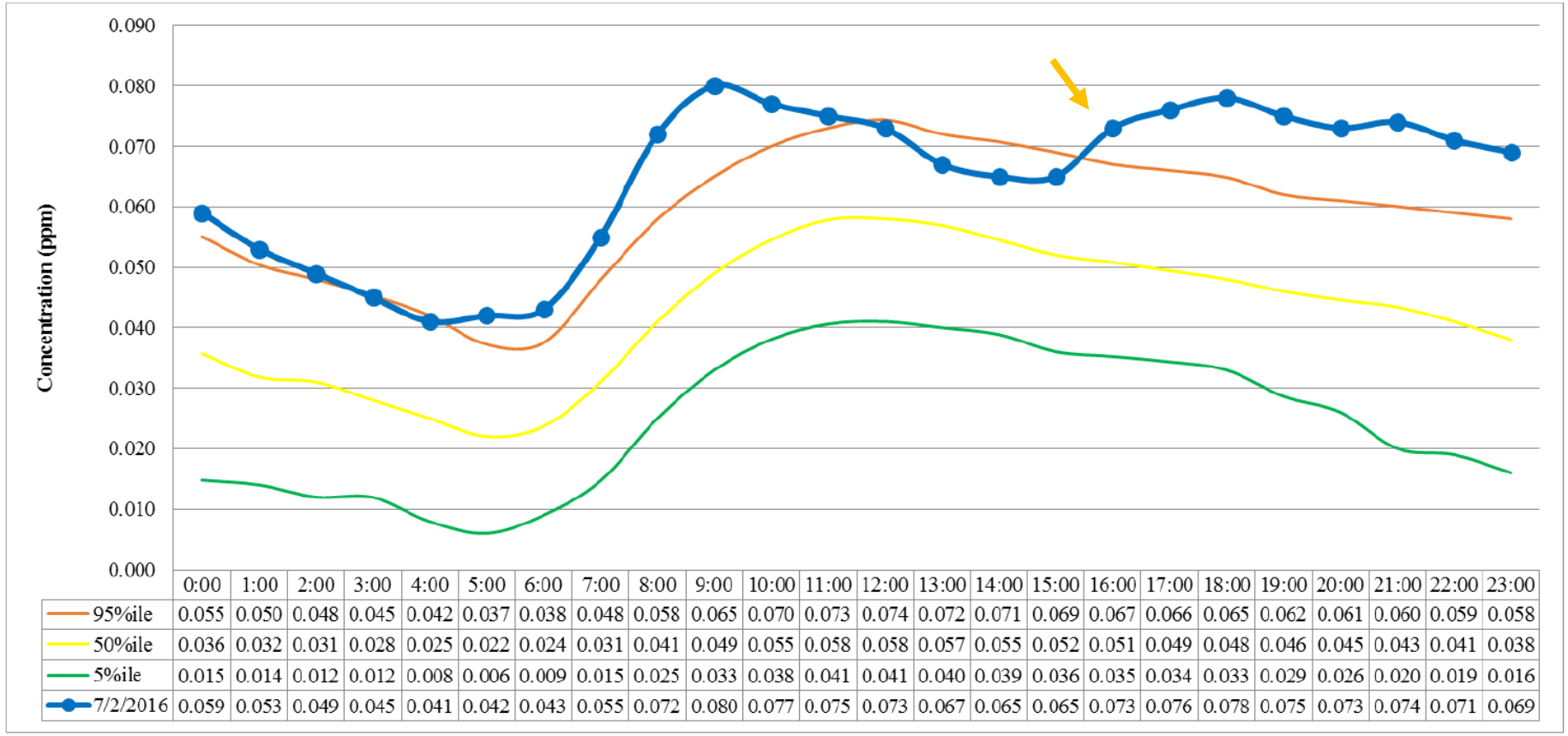
Clear Causal Relationship: Tier 2

Figure 3.7: Percentiles for Hourly Seasonal O_3 for 2011-2015 with July 2, 2016



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95%ile	0.055	0.050	0.048	0.045	0.042	0.037	0.038	0.048	0.058	0.065	0.070	0.073	0.074	0.072	0.071	0.069	0.067	0.066	0.065	0.062	0.061	0.060	0.059	0.058
50%ile	0.036	0.032	0.031	0.028	0.025	0.022	0.024	0.031	0.041	0.049	0.055	0.058	0.058	0.057	0.055	0.052	0.051	0.049	0.048	0.046	0.045	0.043	0.041	0.038
5%ile	0.015	0.014	0.012	0.012	0.008	0.006	0.009	0.015	0.025	0.033	0.038	0.041	0.041	0.040	0.039	0.036	0.035	0.034	0.033	0.029	0.026	0.020	0.019	0.016
7/2/2016	0.059	0.053	0.049	0.045	0.041	0.042	0.043	0.055	0.072	0.080	0.077	0.075	0.073	0.067	0.065	0.065	0.073	0.076	0.078	0.075	0.073	0.074	0.071	0.069

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Clear Causal Relationship: Tier 2

Figure 3.28: Elemental & Organic Carbon Concentrations during the 2016 Trailhead Fire

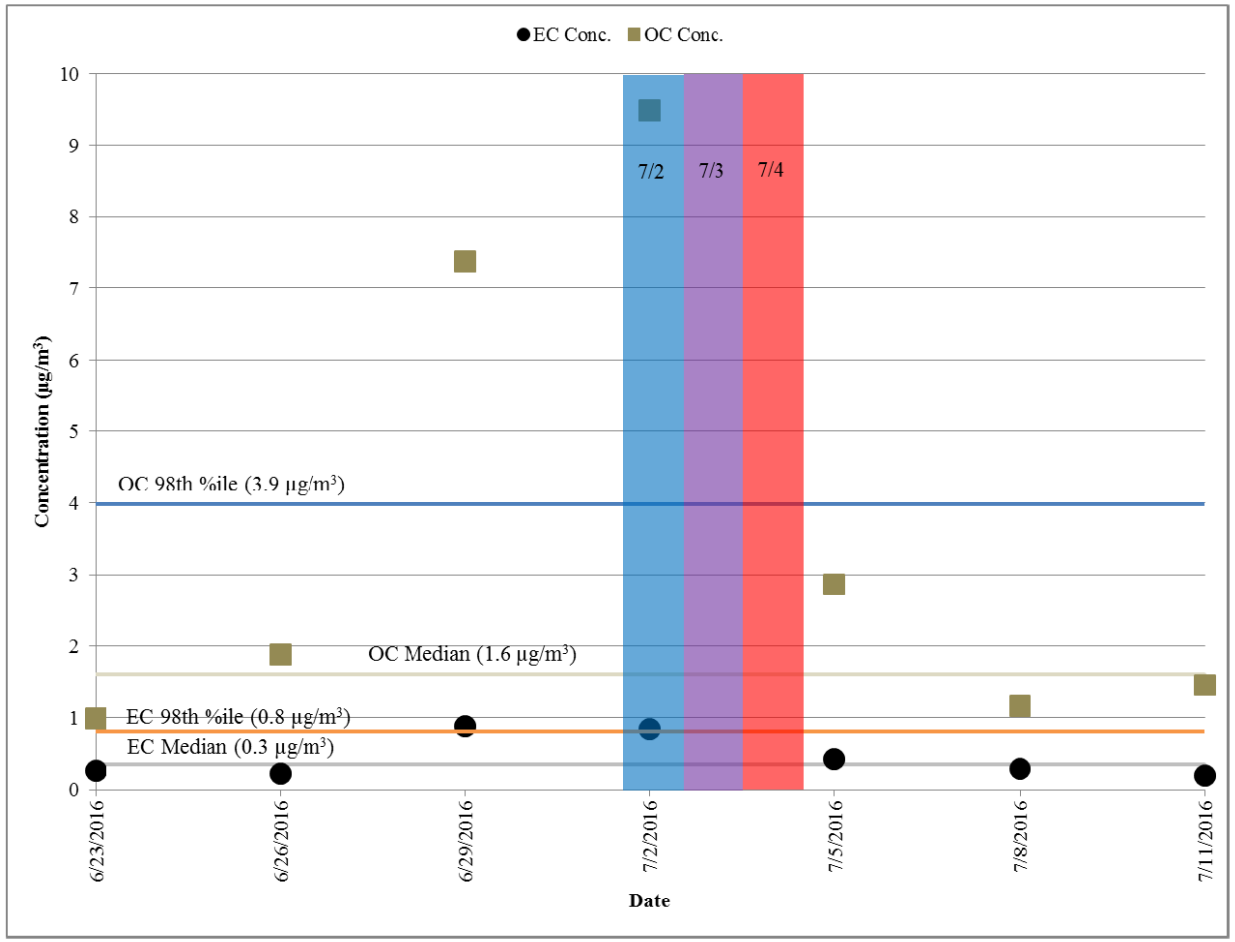

Figure 3.29: Hourly Reno3 $PM_{2.5}$ and CO for July 2, 2016

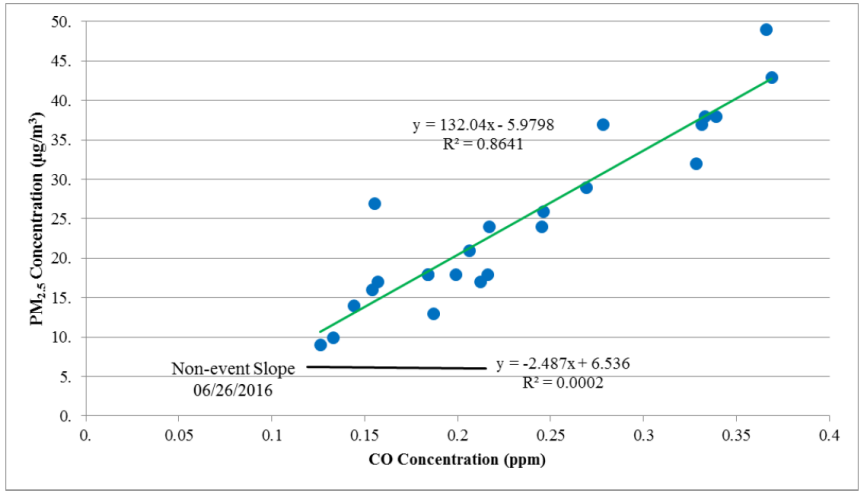

Table 3.3: $PM_{2.5}/PM_{10}$ Ratio

Date	24 Hour Average (µg/m³)		$PM_{2.5}/PM_{10}$
	$PM_{2.5}$	PM_{10}	
6/28	6.2	12.7	0.49
6/29	15.8	27.0	0.58
6/30	18.4	30.0	0.61
7/1	21.1	34.0	0.62
7/2	24.7	39.6	0.62
7/3	24.8	39.7	0.62
7/4	17.5	28.2	0.62
7/5	8.5	18.1	0.47

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Tier 3

Wildfire events that do not meet the criteria of Tier 2

(1) Tier 1 key factor analysis and additional evidence
(2) Tier 2 key factor analyses and additional evidence
(3) Tier 3 additional analysis that the fire caused the exceedance
   a) Analysis of data that shows unusual temporal or spatial features in affected data are clearly caused by fire emissions
   b) Comparison of O_3 concentrations on Meteorologically Similar Days (Matching Day Analysis)
   c) Statistical Regression Modeling
   d) Photochemical Modeling

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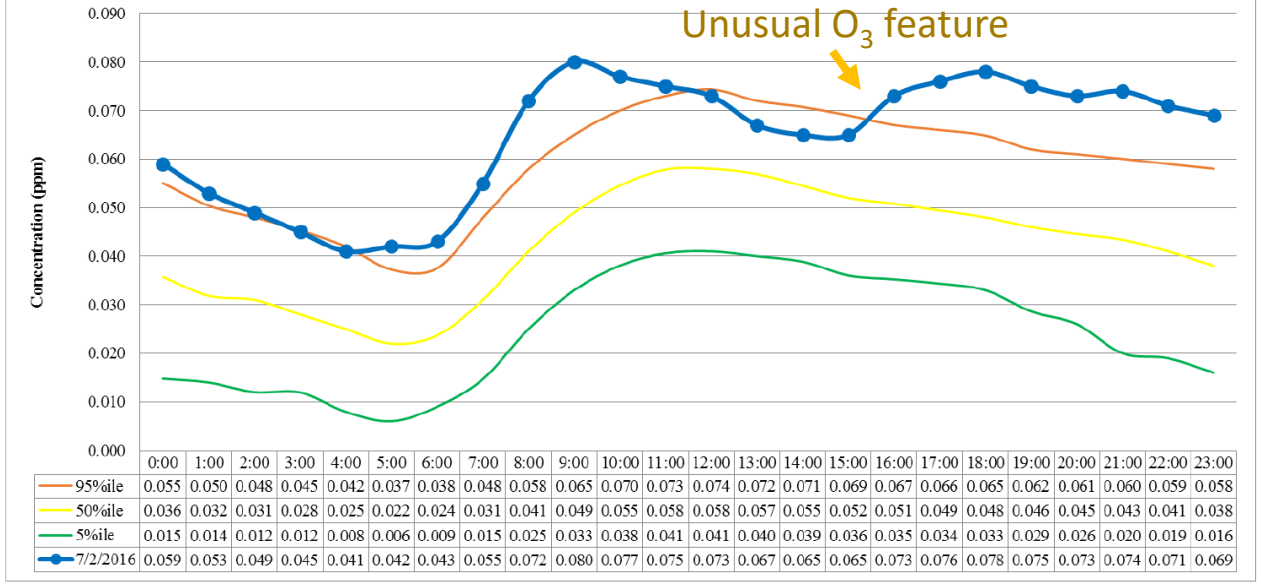
Clear Causal Relationship: Tier 3

Figure 3.7: Percentiles for Hourly Seasonal O_3 for 2011-2015 with July 2, 2016



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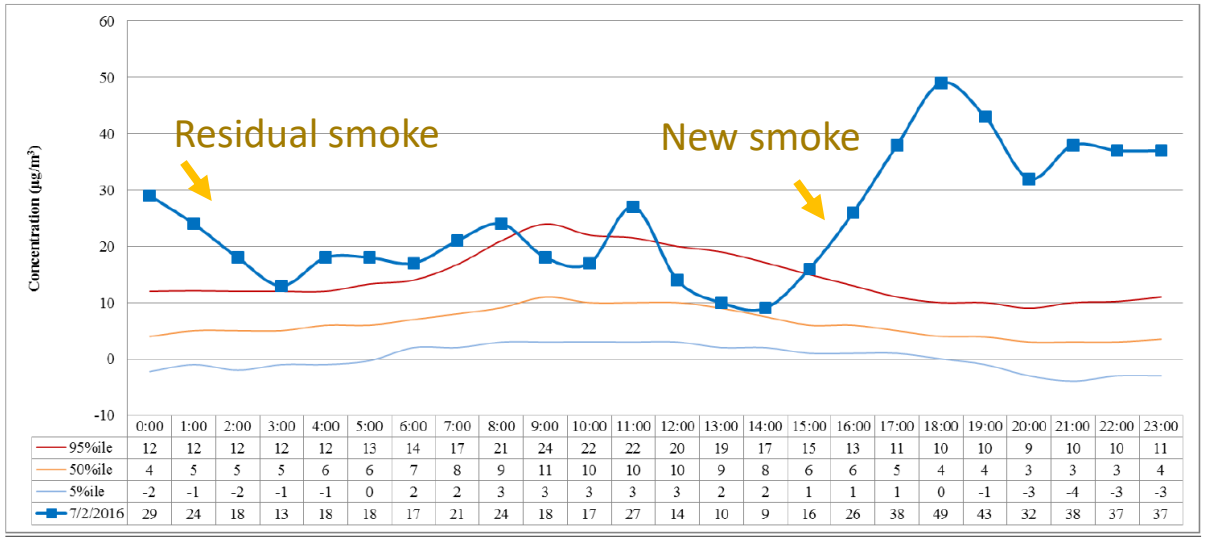
50%ile	0.036	0.032	0.031	0.028	0.025	0.022	0.024	0.031	0.041	0.049	0.055	0.058	0.058	0.057	0.055	0.052	0.051	0.049	0.048	0.046	0.045	0.043	0.041	0.038
5%ile	0.015	0.014	0.012	0.012	0.008	0.006	0.009	0.015	0.025	0.033	0.038	0.041	0.041	0.040	0.039	0.036	0.035	0.034	0.033	0.029	0.026	0.020	0.019	0.016
7/2/2016	0.059	0.053	0.049	0.045	0.041	0.042	0.043	0.055	0.072	0.080	0.077	0.075	0.073	0.067	0.065	0.065	0.073	0.076	0.078	0.075	0.073	0.074	0.071	0.069

Figure 3.24: Percentiles for Hourly Seasonal $PM_{2.5}$ for 2011-2016 with July 2, 2016



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95%ile	12	12	12	12	12	13	14	17	21	24	22	22	20	19	17	15	13	11	10	10	9	10	10	11
50%ile	4	5	5	5	6	6	7	8	9	11	10	10	10	9	8	6	6	5	4	4	3	3	3	4
5%ile	-2	-1	-2	-1	-1	0	2	2	3	3	3	3	3	2	2	1	1	1	0	-1	-3	-4	-3	-3
7/2/2016	29	24	18	13	18	18	17	21	24	18	17	27	14	10	9	16	26	38	49	43	32	38	37	37

Area Forecast Discussion
National Weather Service Reno NV
245 AM PDT FRI JUL 1 2016

Trailhead fire smoke and haze...By this evening, hazy conditions are possible around Reno-Sparks-Truckee northward across the Sierra Valley. Smoke trajectory model forecasts indicate a greater amount of haze and smoke for the late afternoon-evening hours on Saturday around the Reno-Tahoe regions due to an earlier onset of west breezes. All of these smoke/haze projections assume that significant smoke plumes flare up each day. MJD

Area Forecast Discussion
National Weather Service Reno NV
251 AM PDT SAT JUL 2 2016

Main change to the short term forecast was increasing the haze and smoke areas today and Sunday as the Trailhead fire west of the Sierra crest is likely to burn actively for at least the next couple of days. Winds will become more favorable for spreading smoke across the I-80 corridor into Reno-Sparks and northward into the Sierra Valley and southern Lassen County from mid-afternoon through much of the evening, and eastward into parts of the West Central NV Basin and Range. The Tahoe basin should be spared from

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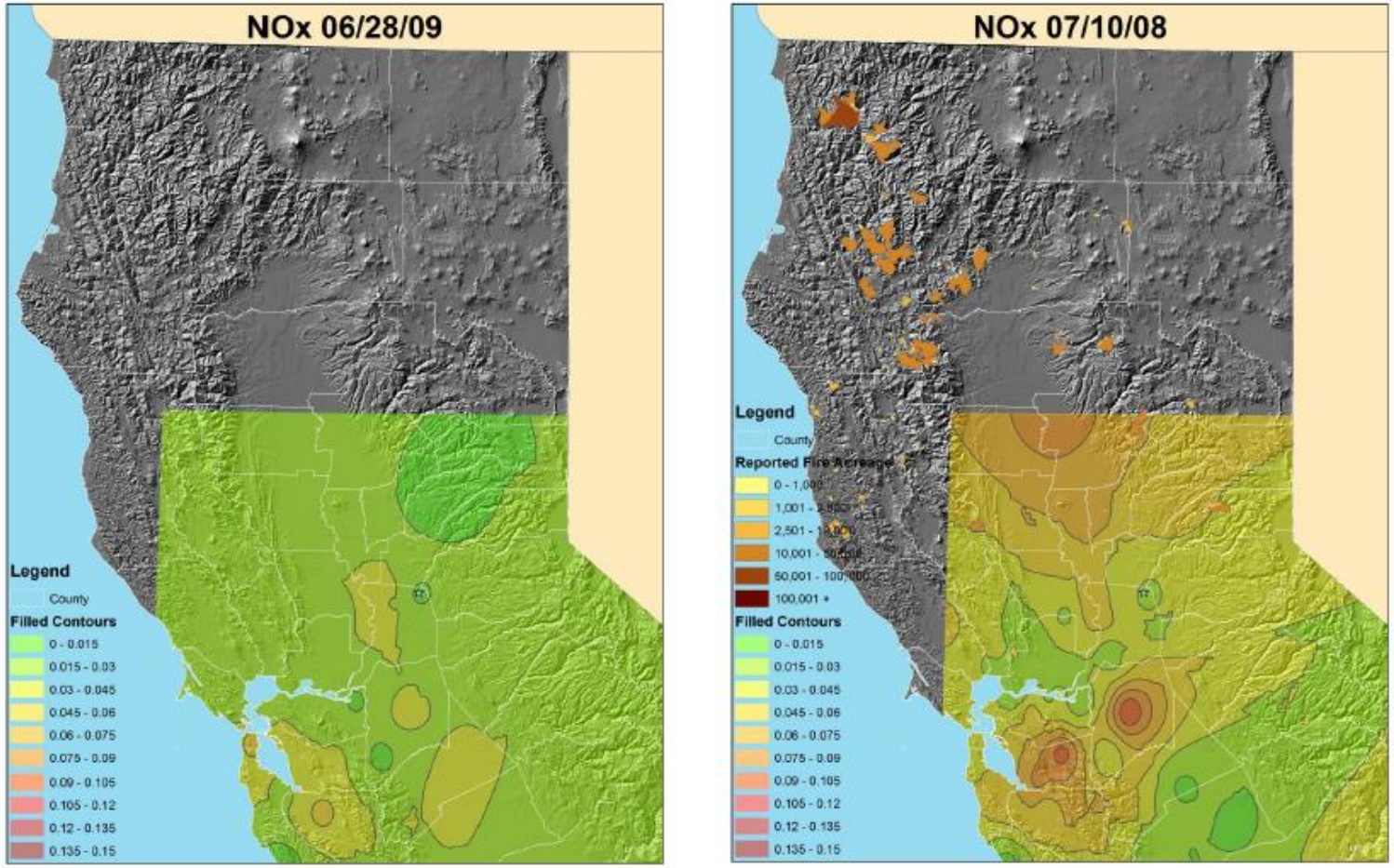
Clear Causal Relationship: Tier 3

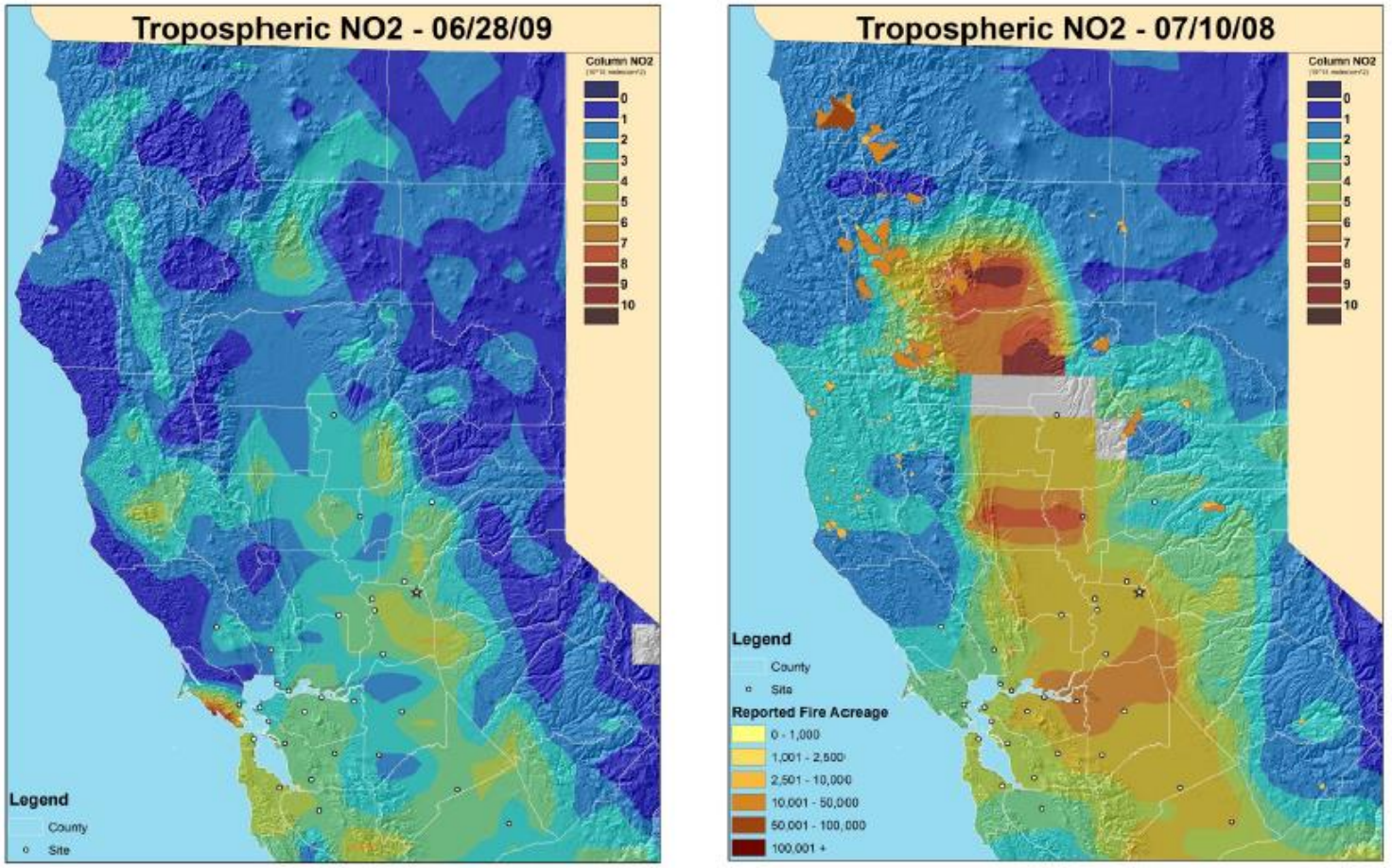
Maximum 1-hour Surface NO_x Concentrations on Surrogate and Fire Days



For illustration and discussion purposes only

Clear Causal Relationship: Tier 3

Tropospheric NO_2 Concentrations on Surrogate and Fire Days



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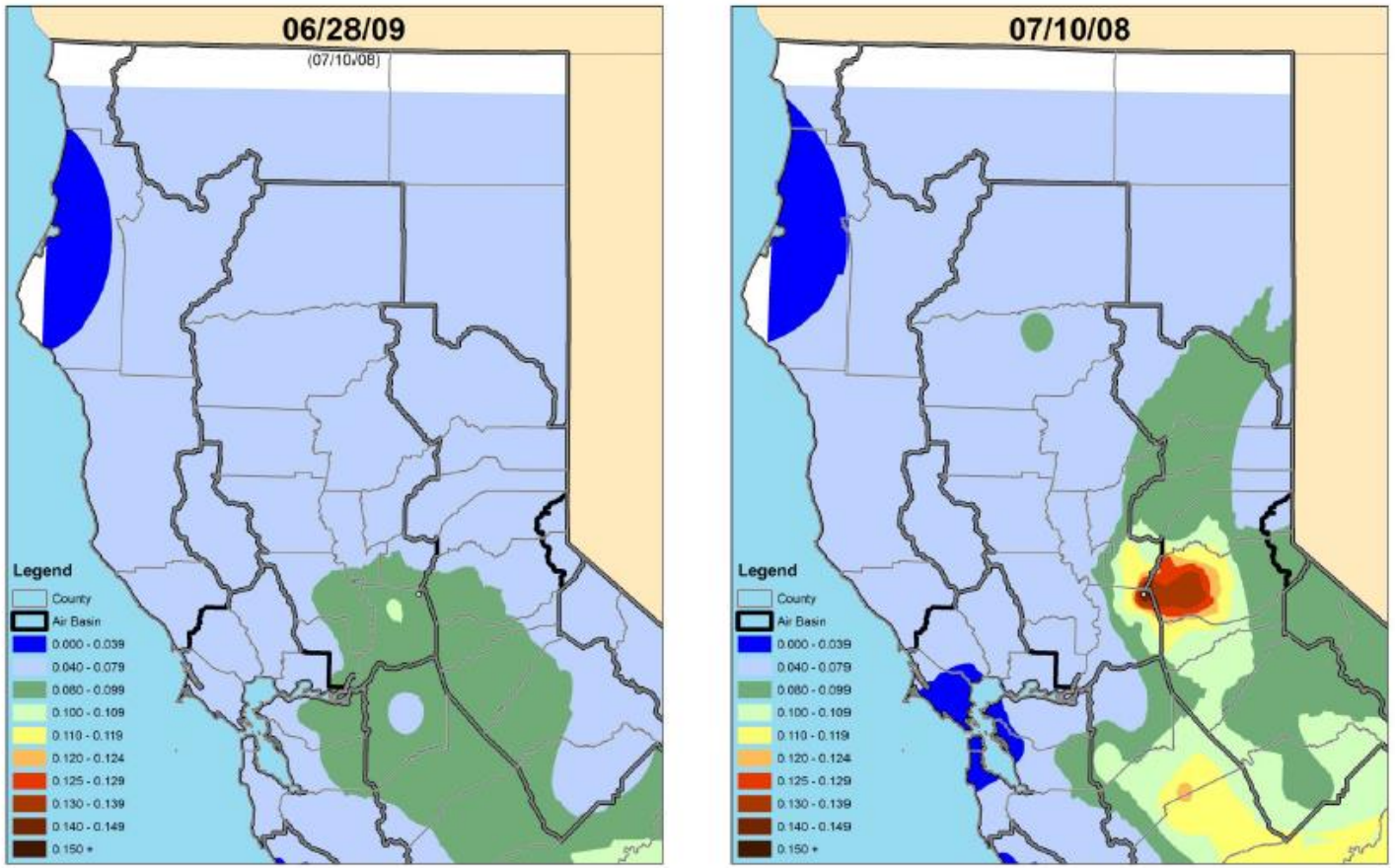
Clear Causal Relationship: Tier 3

Maximum 1-hour Ozone Concentrations on Surrogate and Fire Days



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Questions and Comments