NEVADA DIVISION OF ENVIRONMENTAL PROTECTION

ANALYSIS OF THE TRAILHEAD WILDFIRE IN CALIFORNIA AS AN EXCEPTIONAL EVENT AND ITS CONTRIBUTION TO HIGH OZONE CONCENTRATIONS IN FERNLEY, NEVADA

FINAL Report
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Authors
Daren Winkelman
Sheryl Fontaine

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LIST OF ACRONYMS AND ABBREVIATIONS

agl	Above ground level
amsl	Above mean sea level
AQI	Air Quality Index
AQS	Air Quality System
BAQP	Bureau of Air Quality Planning
CFR	Code of Federal Regulations
CSA	Combined Statistical Area
°F	Degrees Fahrenheit
EER	Exceptional Event Rule
FEM	Federal Equivalence Method
HMS	Hazard Mapping System
HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory
km	kilometers
m	Meters
mph	Miles per hour
NAAQS	National Ambient Air Quality Standards
NDEP	Nevada Division of Environmental Protection
NEI	National Emissions Inventory
NO	Nitrogen Monoxide
NO_x	Oxides of Nitrogen
O_3	Ozone
ppb	Parts per billion
Preparedness Level	PL
$PM_{2.5}$	Particulate Matter Smaller than 2.5 Micrometers
PM_{10}	Particulate Matter Smaller than 10 Micrometers
PST	Pacific Standard Time
tpd	Tons per day
U.S.	United States
USEPA	United States Environmental Protection Agency
UTC	Coordinated Universal Time
VOCs	Volatile Organic Compounds

ANALYSIS OF THE TRAILHEAD WILDFIRE IN CALIFORNIA AS AN EXCEPTIONAL EVENT AND ITS CONTRIBUTION TO HIGH OZONE CONCENTRATIONS IN FERNLEY, NEVADA ON JULY 3 AND 4, 2016

1.0 INTRODUCTION

The Nevada Division of Environmental Protection (NDEP) Bureau of Air Quality Planning (BAQP) operates a network of ambient air quality monitors at a variety of locations throughout the state of Nevada. In 2016, air quality monitoring was represented by eleven ambient air quality monitoring stations (Carson City (ozone [O_3], particulate matter smaller than 2.5 micrometers in diameter [$PM_{2.5}$]), Elko (particulate matter smaller than 10 micrometers [PM_{10}]), Fallon (O_3), Fernley (O_3), Pahrump (PM_{10}) and Gardnerville ($PM_{2.5}$)) under the jurisdiction of the NDEP-BAQP. The USEPA provides minimum site requirements to monitor for O_3 and PM based on Metropolitan Statistical Area population (40 Code of Federal Regulations [CFR] Part 58, Appendix D). The NDEP-BAQP's air monitoring network meets or, in most cases, exceeds the minimum network requirements. Data was collected and quality assured in accordance with 40 CFR Part 58 and submitted to the United States Environmental Protection Agency's (USEPA) Air Quality System (AQS) database. The approval letter for the 2016 NDEP-BAQP Annual Network Plan is included in Appendix A. Ambient air monitoring data is collected and data quality is assured in accordance with 40 CFR 58. The data for 2016 was certified in May 2017. The Data Certification Letter was submitted to USEPA Region IX in May 2017 as well, and is included in Appendix B.

1.1 SCOPE OF REPORT

The Trailhead Fire, located west of Volcanoville, California, started June 28, 2016 and burned 5,646 acres. On June 29, 2016, smoke from the Trailhead Fire began to impact western Nevada. Wildfire smoke continued to affect western Nevada through July 4, 2016. On July 3 and 4, 2016, the NDEP monitored one exceedance of the 2015 8-hour O_3 National Ambient Air Quality Standards (NAAQS) at the Fernley air quality monitoring site (AQS 32-019-0006), and one high associated value (hereafter referred to as "exceedances" in this document), due to the smoke plume impacts. The Trailhead Fire was 100 percent contained on July 18, 2016.

The NDEP is requesting exclusion of the July 3 and 4, 2016 8-hour O_3 data from the Fernley air monitoring site that met or exceeded the NAAQS as an exceptional event under the USEPA's regulation for *The Treatment of Data Influenced by Exceptional Events;* (81 Federal Register 68216; USEPA, 2016), known as the Exceptional Events Rule (EER; 40 CFR Parts 50 and 51). The purpose of this report is to provide documentation in support of this request. The Trailhead Fire in California was a natural event that caused exceedances of the federal standard for one of NDEP's Federal Equivalent Method (FEM) ozone monitors on July 3 and 4, 2016. The 8-hour average O_3 concentration reached 71 parts per billion (ppb) at the Fernley air monitoring station in Lyon County (AQS Site Code 32-019-0006). This document demonstrates that the 8-hour ozone exceedances on July 3 and 4, 2016 at the Fernley monitoring site meet the requirements for having been influenced by an exceptional event as stipulated in the EER. Table 1 lists the 8-hour ozone concentrations at Fernley that are included in this request.

Table 1. Eight-hour Federal Ozone Values at the Fernley Monitoring Site

Monitoring Site	AQS Number	Maximum Daily 8-hour Average O_3 Concentration (ppb)	Date	Date of Maximum
Fernley	32-019-0006	71	07/03/2016	07/03/2016
		70	07/04/2016	

The elevated ozone concentrations observed on July 3 and 4, 2016 occurred as a result of the emissions from the Trailhead Fire in California. The NDEP-BAQP has submitted the 1-hour O_3 data from the affected monitors on those days to the USEPA AQS database and has placed the appropriate AQS flags throughout the data to indicate that the data was affected by an exceptional event due to wildfire. Informational flags (IT) were also included for other ozone NDEP-BAQP monitoring sites for the same time period. This flagging indicates that the ambient air quality data was influenced by the wildfire emissions, and ensures that the data is properly represented in the regulatory process.

1.2 Exceptional Event Definition and Demonstration Criteria

The EER defines an exceptional event in 40 CFR Part 50 as an event that affects air quality, is not reasonably controllable or preventable, and is an event caused by human activity that is unlikely to recur at a particular location, or is a natural event.

The following analysis will address this definition and provide documentation to establish that the 2016 Trailhead Fire meets the criteria for classification as an exceptional event as set forth in 40 CFR Part 50. Specifically, this document provides evidence that the wildfire affected air quality by demonstrating that:

1. there was a clear causal relationship between the 8-hour O_3 concentrations at Fernley and the event;
2. the O_3 concentrations during the event were significantly higher than normal historical concentrations, and;
3. the 8-hour O_3 concentrations at Fernley would not have exceeded the standard without the emissions contributed by the Trailhead Fire.

In addition, documentation is provided demonstrating that the Trailhead Fire was a natural event whose emissions were not reasonably controllable or preventable. Finally, information regarding reasonable and appropriate actions taken to protect public health is included in Appendix C.

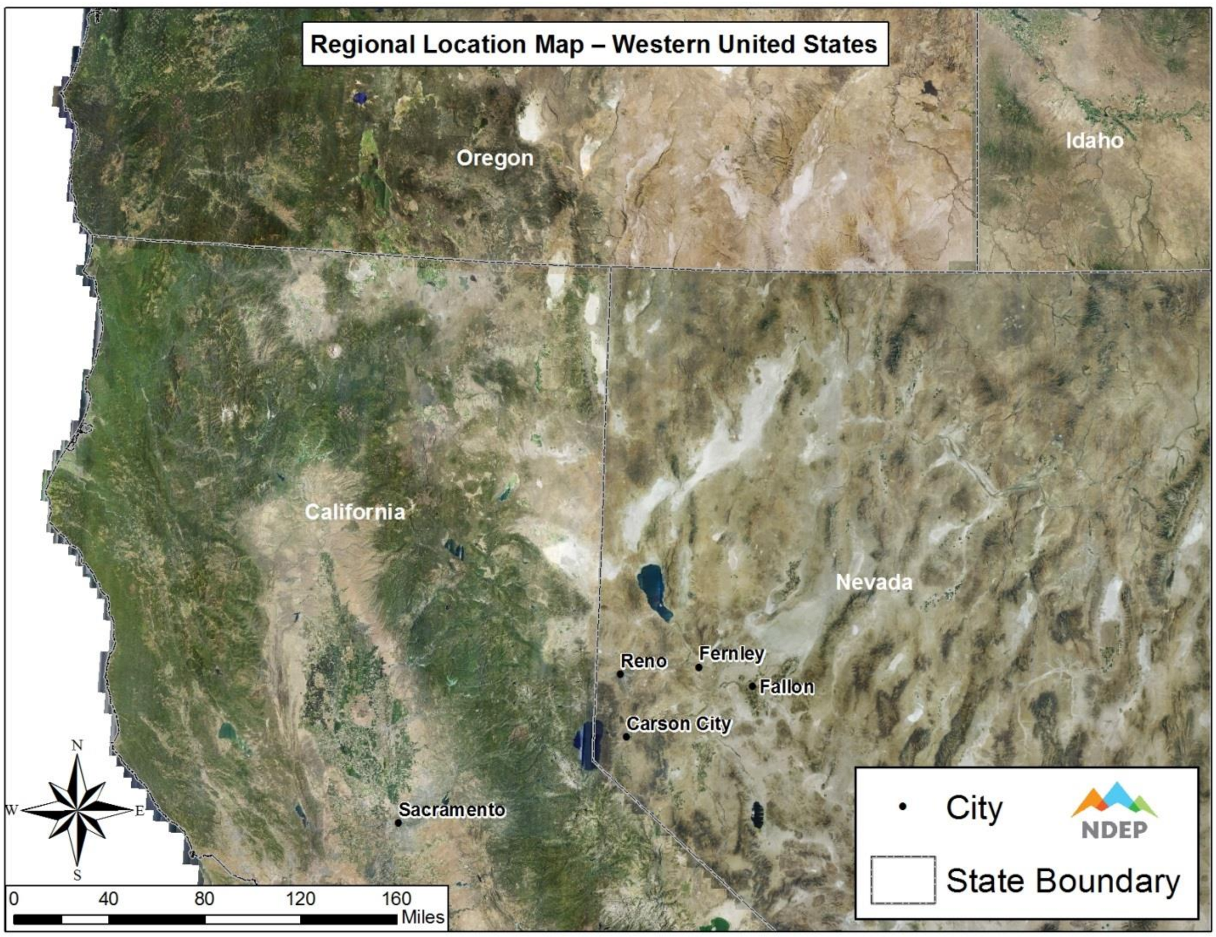
In addition to the EER, this document follows the guidance recently issued by the USEPA regarding the treatment of O_3 concentration data affected by wildfire (*Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*; USEPA, 2015). Specifically, the elevated O_3 8-hour average concentrations at the Fernley air monitoring site on July 3 and 4, 2016 were significantly higher (by more than 15 ppb) than the average concentration for this site during the month of July (2010 through 2016). The measured maximum 8-hour averages for these two days were also significantly higher (by more than 15 ppb) than non-event related concentrations during the month of July at the Fernley site.

2.0 SETTING AND BASIC CONCEPTUAL MODEL

2.1 Regional Description

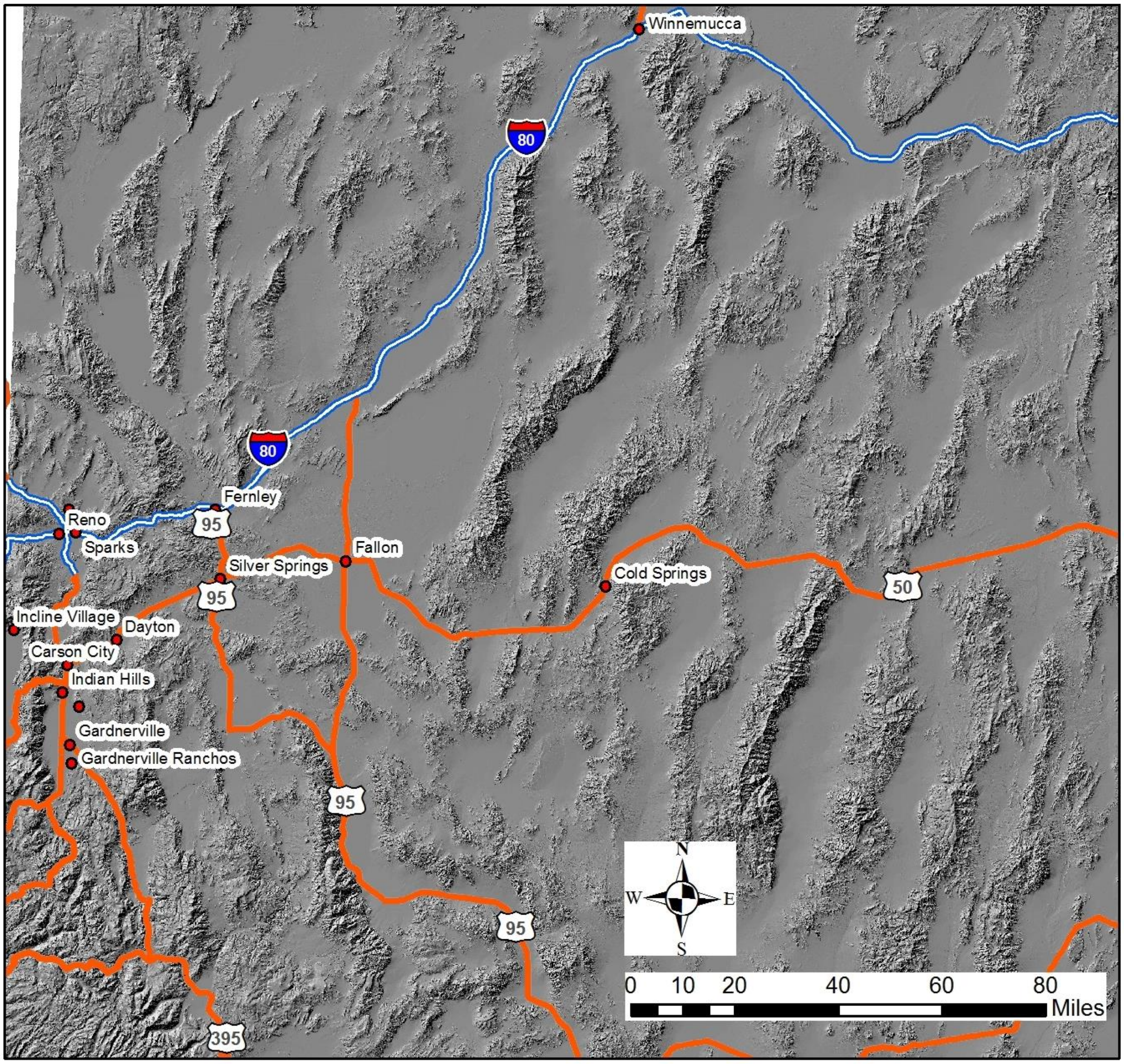
Fernley is part of Lyon County, Nevada, and is approximately 30 miles east of Reno, Nevada. Fernley is in the southeastern part of Dodge Flat and the western portion of the Fortymile Desert, along the Interstate-80 corridor. Air masses commonly flow from west to east through the Truckee River Canyon, which topographically connects the Reno-Sparks area to Fernley. The Fernley area is bordered by the Truckee Range to the northeast, the Virginia Range to the south and southwest, and the Pah Rah Range to the northwest. Pyramid Lake, the terminus of the Truckee River, lies approximately 20 miles to the northwest (Figure 1).

Figure 1. Regional Location Map



Fernley lies within the Basin and Range Physiographic Province, a region of internal drainage characterized by north- to northeast-trending mountain ranges separated by lower elevation valleys (Figure 2). The elevation in Fernley is approximately 4,100 feet above mean sea level (amsl), and the surrounding mountains exceed 7,500 feet amsl.

Figure 2. Shaded Relief Map of West-Central Nevada



2.2 CLIMATE AND WEATHER

Due to the rain shadow effect of the Sierra Nevada and other large mountain ranges to the west and southwest, moisture associated with Pacific storms rarely reaches the Fernley area. As a result, Fernley has an arid climate (an average of approximately six inches of precipitation per year), typical of the Great Basin region. Most of the precipitation in the area occurs in the winter months (between December and May). The average daily maximum temperature is approximately 94 degrees Fahrenheit (°F) in July and approximately 44 °F in January. Average daily minimum temperatures vary from 57 °F in July to 19 °F in January.

Weather conditions during the summer months of July, August, and September are typically dominated by a large, upper-level, synoptic-scale high pressure system over the western United

States (U.S.). For northern Nevada, this usually results in very warm temperatures and light to moderate west winds, generally out of the west. These winds are strongest during the afternoon hours and generally decrease overnight. When the upper-level high pressure system is located over the four-corners area (Arizona, New Mexico, Colorado, and Utah), south to southeast winds transport subtropical moisture into the southwestern deserts, resulting in afternoon and evening thunderstorms. This moisture sometimes extends as far north as northern Nevada. The accompanying monsoonal storms are accompanied by strong, gusty winds, rain, and sometimes hail. The winds associated with these storms often create blowing dust conditions with reduced visibility.

Section 3 provides a more detailed discussion of the specific meteorological conditions on each of the event days included in this request as part of the clear causal connection between the Trailhead Fire and the elevated ozone concentrations. Section 3 also provides information to demonstrate that the 8-hour ozone concentrations at Fernley on each of these days would not have exceeded the federal standard without the impacts of the wildfire emissions.

2.3 DEMOGRAPHICS

Fernley is part of the Reno-Carson City-Fernley Combined Statistical Area (CSA). This CSA includes all of Lyon and Washoe counties as well. Lyon County covers approximately 2,000 square miles and has a population of approximately 53,100. The City of Fernley has a population of approximately 19,400 (USCB, 2016).

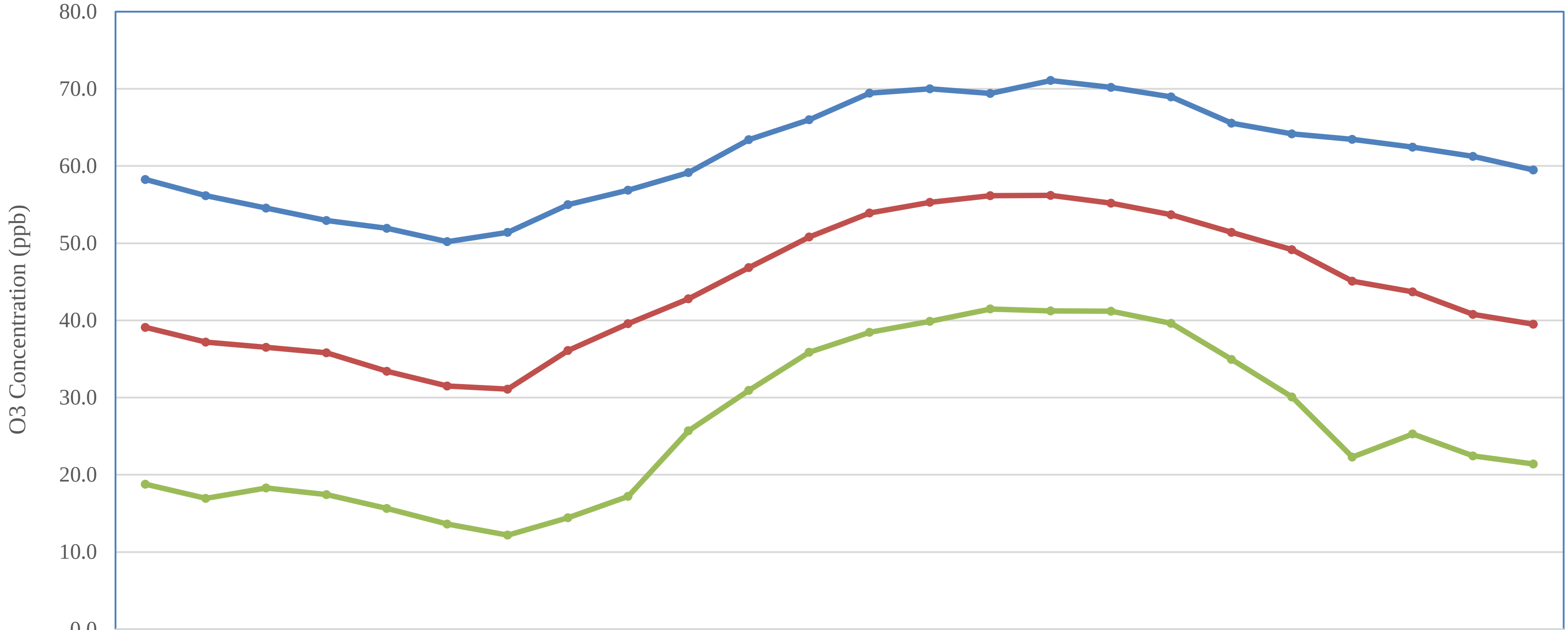
2.4 POLLUTANT SEASONALITY

Periods of high pressure and stagnant air masses, which are conducive to pollutant build up, occur during both the winter and summer seasons in northern Nevada. Particulate matter generated in winter months and the presence of ozone in the summer result in a seasonal pollutant pattern, with the highest particulate matter concentrations usually occurring during the winter months (except during wildfires) and the highest ozone concentrations observed during the summer months.

The ozone season in western Nevada therefore occurs from April through October. In general, the synoptic (large-scale) weather conditions leading to elevated ozone concentrations are slow moving, high pressure weather systems, which cause the air to subside, or sink. As the air sinks, it warms, forming a subsidence temperature inversion several hundred meters (m) above the surface that stabilizes and dries the atmosphere. This process limits vertical mixing of the boundary layer and traps pollutants below the height of the inversion. This process also limits cloud production, thereby increasing ozone photochemistry. In addition, calm surface winds are conducive to high ozone concentrations because these conditions prevent the dispersion of pollutants.

Figure 3 shows the typical summer diurnal pattern of ozone concentrations in western Nevada; the highest concentrations occur in the early to mid-afternoon, during the time of highest solar radiation. The 95th, 50th, and 5th percentiles of hourly ozone concentrations at the Fernley site are shown for all days of June, July, and August from 2012 through 2016, excluding July 3 and 4, 2016 (Figure 3).

Figure 3. Fernley Hourly Ozone Concentrations for June-August, 2012 through 2016.



	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
95%	58.3	56.2	54.6	53.0	52.0	50.2	51.4	55.0	56.9	59.2	63.4	66.0	69.5	70.0	69.4	71.1	70.2	69.0	65.6	64.2	63.5	62.5	61.3	59.5
50%	39.1	37.2	36.5	35.8	33.4	31.5	31.1	36.1	39.6	42.8	46.9	50.8	53.9	55.3	56.2	56.2	55.2	53.7	51.4	49.2	45.1	43.7	40.8	39.5
5%	18.8	17.0	18.3	17.5	15.7	13.6	12.2	14.4	17.2	25.7	30.9	35.9	38.5	39.9	41.5	41.2	41.2	39.6	34.9	30.1	22.3	25.3	22.5	21.4

2.5 CHARACTERISTICS OF NON-EVENT OZONE FORMATION

The anthropogenic emissions contributing to ozone formation include volatile organic compounds (VOCs) and oxides of nitrogen (NO_x). The main sources of these emissions are mobile sources (cars, trucks, locomotives, off-road equipment) along with stationary and area sources (industrial processes, consumer products, and pesticides). Mobile source emissions dominate the anthropogenic emissions in Lyon County, accounting for the majority of the total NO_x inventory.

VOC and NO_x emissions in Lyon County over the last decade have remained below 15 tons per day (tpd). In 2014 (the most recent National Emissions Inventory (NEI) for which VOC and NO_x values are available), VOC and NO_x precursor emissions for Lyon County were estimated at 2.3 and 3.5 tpd, respectively. Based on 2014 NEI data, VOC and NO_x emissions have decreased over the past decade despite increases in population, vehicle activity, and economic development.

2.6 CHARACTERISTICS OF WILDFIRE-RELATED OZONE FORMATION

Wildfires generate both NO_x and VOC, with different burning stages generating different types of emissions. Biogenic VOCs are generated by vegetation throughout the burning cycle. NO_x is generated primarily during the hot, flaming stage of the fire, while small reactive hydrocarbons, such as ethane and acetylene, are generated during the smoldering phase (Finlayson-Pitts and Pitts, 2000; Jaffe et al., 2008).

Very near fires, ozone concentrations can potentially be suppressed, despite the increase in ozone precursors generated by the wildfires. Bytnerowicz et al. (2010), Finlayson-Pitts and Pitts (2000), and Sandberg et al. (2002) provide several explanations why ozone can potentially be low at fire sites: 1) thick smoke can prevent sufficient UV light from reaching the surface, thereby inhibiting photochemical reactions, and 2) the wildfire plume typically contains high nitrogen monoxide (NO) concentrations, which can titrate ozone concentrations. Downwind of the fire (or at the top of the plume; Sith et al., 1981, quoted in Sandberg et al., 2002), away from fresh NO sources and with reduced aerosol optical depth, considerable amounts of ozone can be generated. The plume does not need to be very far downwind of fire emissions to generate ozone. Sith et al. (1981) found ozone beginning 10 kilometers (km) downwind of wildfires, in plumes less than one-hour old (quoted in Sandberg et al., 2002). Ozone and ozone precursors can also be transported quite far from a wildfire site (Finlayson-Pitts and Pitts, 2000 and Jaffe et al., 2008). Therefore, similar to the impacts of anthropogenic emissions in urban airsheds, the highest ozone concentrations due to wildfires are often found downwind of the area of greatest precursor emissions.

The impact of wildfires on ozone concentrations at both the local and regional level has been extensively evaluated in recent years. Field observations of ozone formation in smoke plumes from fires date back nearly 25 years when aircraft measurements detected elevated ozone at the edge of forest fire smoke plumes far downwind. More recently, aircraft flights through smoke plumes have demonstrated increased ozone concentrations of 15 to 30 ppb in California (Bush, 2008), while ozonesonde measurements in Texas found enhanced ozone aloft ranging from 25 to 100 ppb attributable to long-range transport of smoke plumes from Canada and Alaska (Morris, 2006).

In addition, air quality modeling has shown increased levels of ozone from a number of large fires. McKeen (2002) found that Canadian fires in 1995 enhanced ozone concentrations by 10 to 30 ppb throughout a large region of the central and eastern United States. Lamb (2007) found similar results simulating the impacts of fires in the Pacific Northwest in 2006, with increases of over 30 ppb. Junquera (2005) further found that within 10 km of a fire, ozone concentrations could be enhanced by up to 60 ppb. Finally, in one of the most recent studies, Pfister (2008) simulated the large 2007 fires in both northern and southern California and found ozone increases of approximately 15 ppb in many locations, concluding that "Our findings demonstrate a clear impact of wildfires on surface ozone nearby and potentially far downwind from the fire location, and show that intense wildfire periods frequently can cause ozone levels to exceed current health standards."

3.0 CLEAR CAUSAL RELATIONSHIP

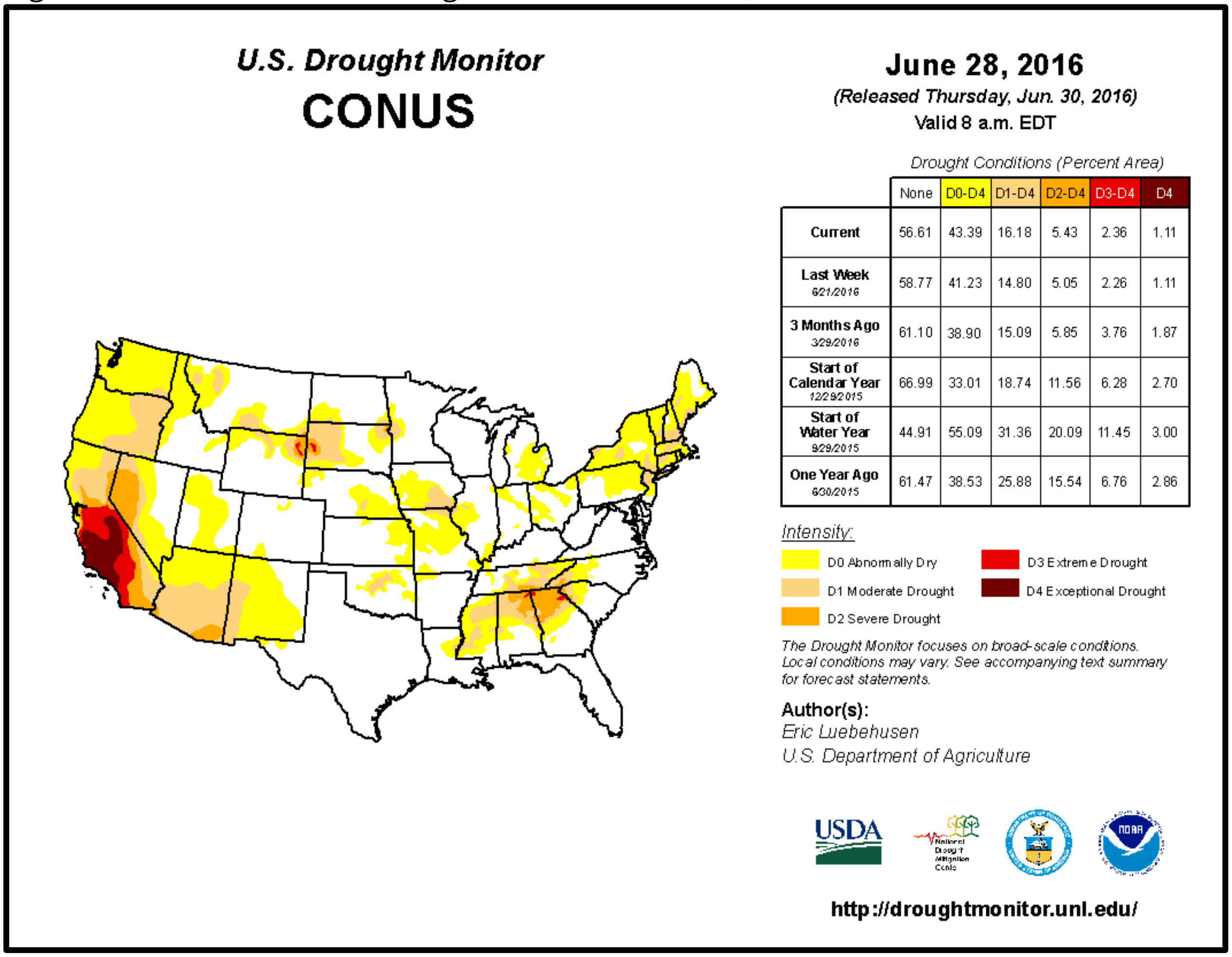
This section demonstrates a clear causal relationship between the Trailhead Fire and the 8-hour ozone exceedances that occurred at the Fernley monitor on July 3 and 4, 2016. Specifically, this section provides evidence that: 1) the wildfire occurred, 2) the smoke plume from the wildfire reached the Fernley monitor, and 3) that the pollutants within the smoke plume increased ozone concentrations at the Fernley monitor.

This comprehensive weight of evidence includes: documentation of the extensive nature of the fire; a meteorological analysis; satellite imagery; $PM_{2.5}$ air quality data from upwind monitoring locations in Washoe County; ozone air quality data; ozone chemistry leading to elevated 8-hour ozone concentrations; forward and backward trajectories showing that emissions from the wildfire was transported to the Fernley monitoring location; and finally a discussion of how the 8-hour ozone concentrations exceed the normal non-event related concentrations for the Fernley ozone monitor.

3.1 DESCRIPTION OF THE EVENT

Wildfire activity typically begins to increase through the United States in late spring. Temperatures during the winter months leading into the 2016 wildfire season were generally above normal for the much of the United States, including northern California. Most of the Pacific Northwest, northern California, and parts of the Great Basin received normal to slightly above normal precipitation, generally as rain instead of the more-typical snow; however, severe to exceptional drought conditions continued to worsen across much of California, Nevada, and southern Oregon. The warm trend continued into the spring across most of the nation, with above normal temperatures stretching from the Pacific Northwest and northern California, east through the central states. The summer of 2016 was the warmest in California on record. As a result, drought conditions continued to worsen in the west, where severe to exceptional drought continued across much of California, Nevada, and Oregon (NICC, 2016). The North American Drought Monitor for June 2016 showed severe to exceptional drought over the far west (Figure 4).

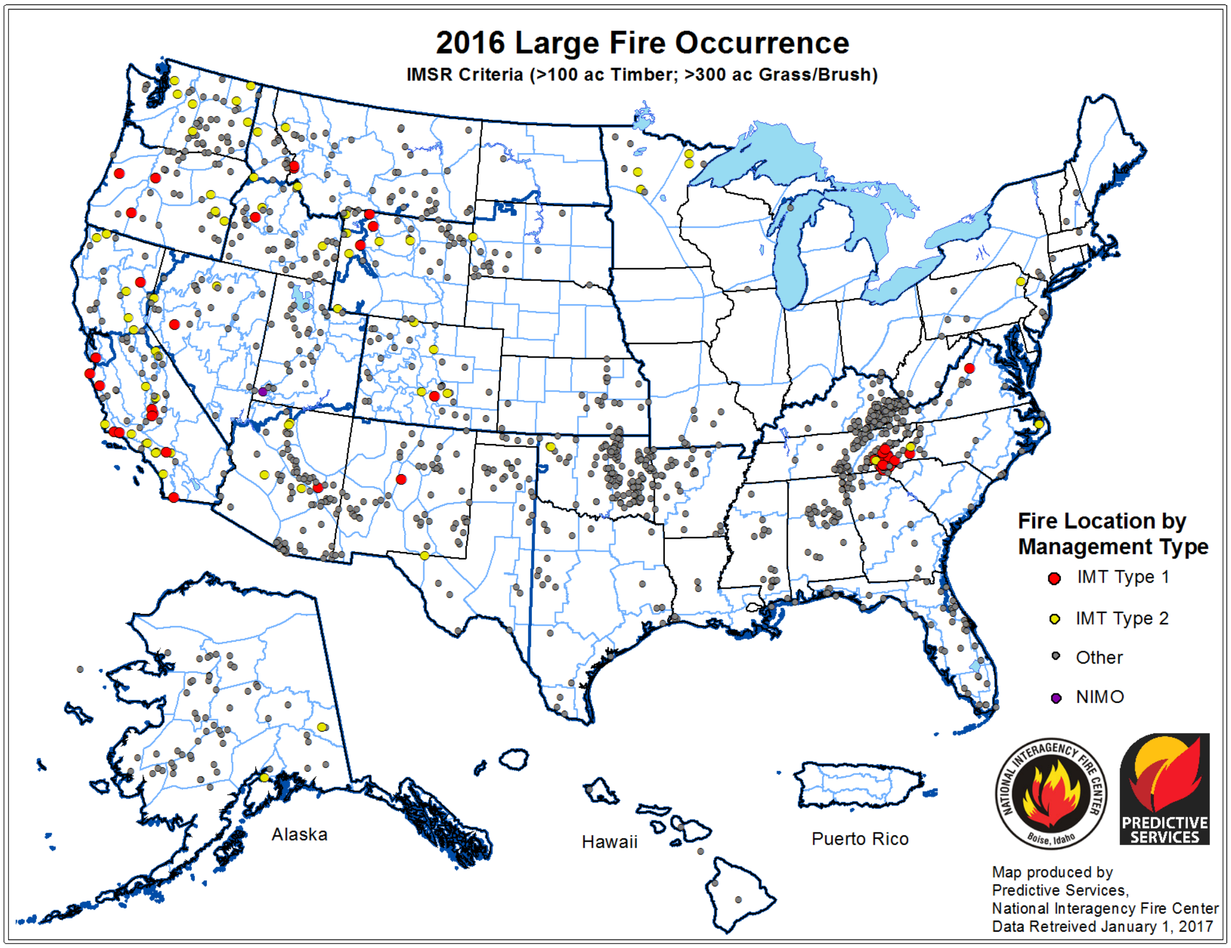
Figure 4. United States Drought Conditions June 28, 2016.



Although conditions were present to support significant fire activity throughout the summer fire season, for the most part these conditions fell within the normal range and fire activity was generally normal, potentially due to the significant decrease in lightning strikes as compared to recent years (Rolinski, 2017).

Although most of the fire activity in the United States was below normal in 2016, numerous fires in California contributed to smoke being transported to Nevada. There were approximately 242 significant fires in the Pacific Northwest; 68 of those fires were in California. The national Preparedness Level (PL) was elevated to PL 2 on June 7, 2016 then was raised to PL 3 on July 26 where it remained for three and a half weeks. On August 20 it was raised further to PL 4 where it remained for two weeks. On September 3 the PL dropped to 3 and quickly dropped to PL 2 three days later. On September 30 the PL was lowered to 1 where it remained for the rest of the calendar year (NICC, 2016). By the end of the 2016 fire season, due to large wildland fires, a total of 560,815 acres were burned in California. Figure 5 shows the locations of large wildfires during the 2016 fire season.

Figure 5. Large Wildfires in the United States – 2016.



The Trailhead Fire started on June 28, 2016 in the Middle Fork American River Canyon in central California. Although the cause of the fire remains under investigation, there was no lightning in the area at the time. Smoke from the Trailhead Fire impacted areas in northern California and western Nevada. Figure 6 provides a map of the location of the Trailhead Fire origin as well as the Fernley, Nevada monitoring site. Table 2 shows the number of acres burned by the Trailhead Fire on July 2, 3, and 4, 2016.

Figure 6. Location Map of the Trailhead Fire Start Location and the Fernley, Nevada Monitoring Site.

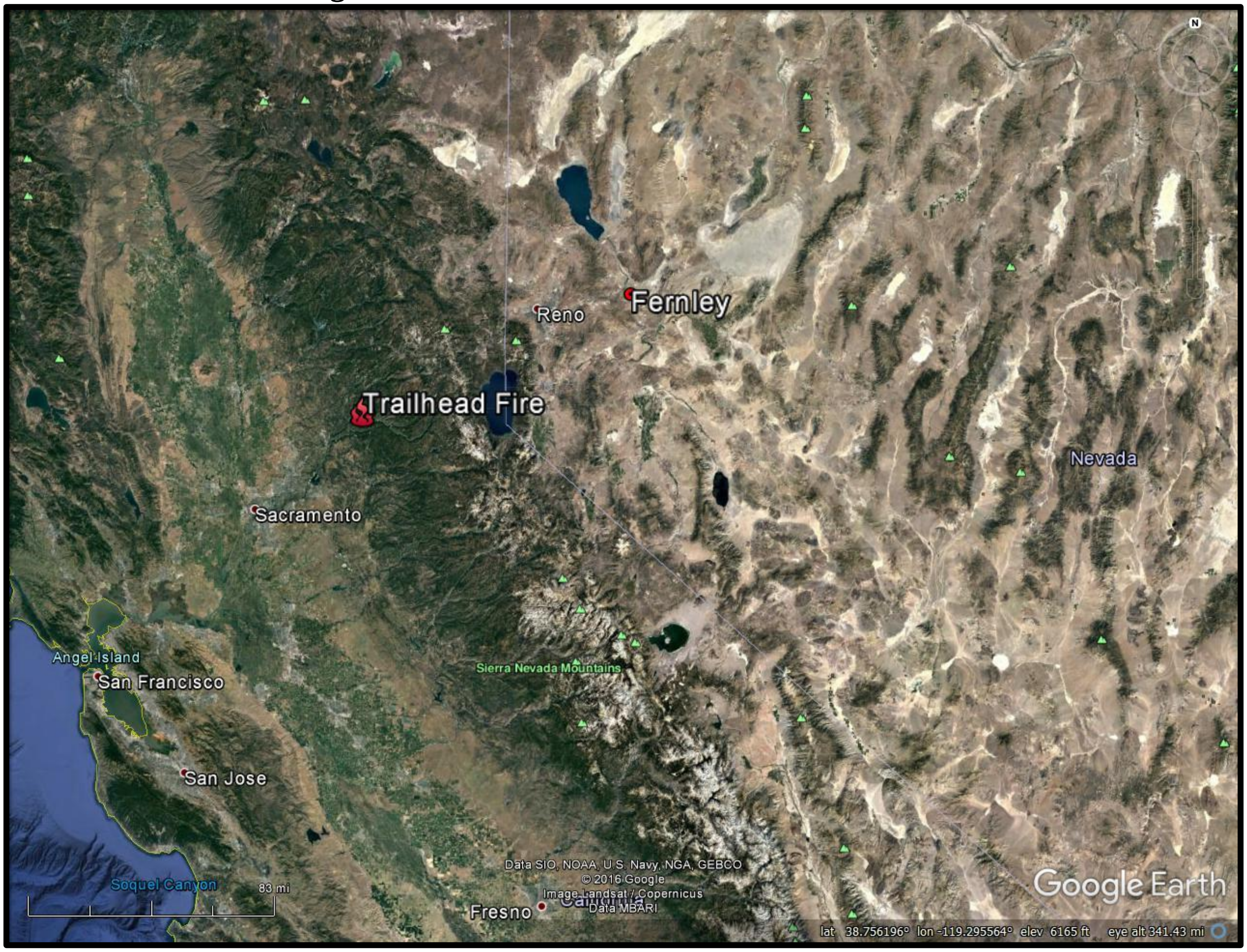


Table 2. Acres Burned for the Trailhead Fire from July 2 through 4, 2016.

NAME	FIRE START		TOTAL ACRES BURNED BY DATE		
	LATITUDE	LONGITUDE	7/2/2016	7/3/2016	7/4/2016
Trailhead Fire	38.969	-120.854	836	+1,657	+400

USDA, 2016; http://www.predictiveservices.nifc.gov/intelligence/intelligence.htm
Numbers after the '+' indicate an increase in acreage burned from the previous day.

Air quality in northern Nevada was moderate to poor from July 2 through 5, 2016 due to smoke from the Trailhead Fire. AirNow Air Quality Index (AQI) maps showing air quality from June 28 through July 5, 2016 are included in Appendix C. Many air quality monitors in northern Nevada recorded elevated ozone concentrations during this time, along with increased concentrations of particulate matter. Figures 7 and 8 provide satellite images illustrating the extent of the smoke impacts on July 3 and 4, 2016.

Figure 7. Satellite Imagery of Smoke Plume – July 3, 2016.

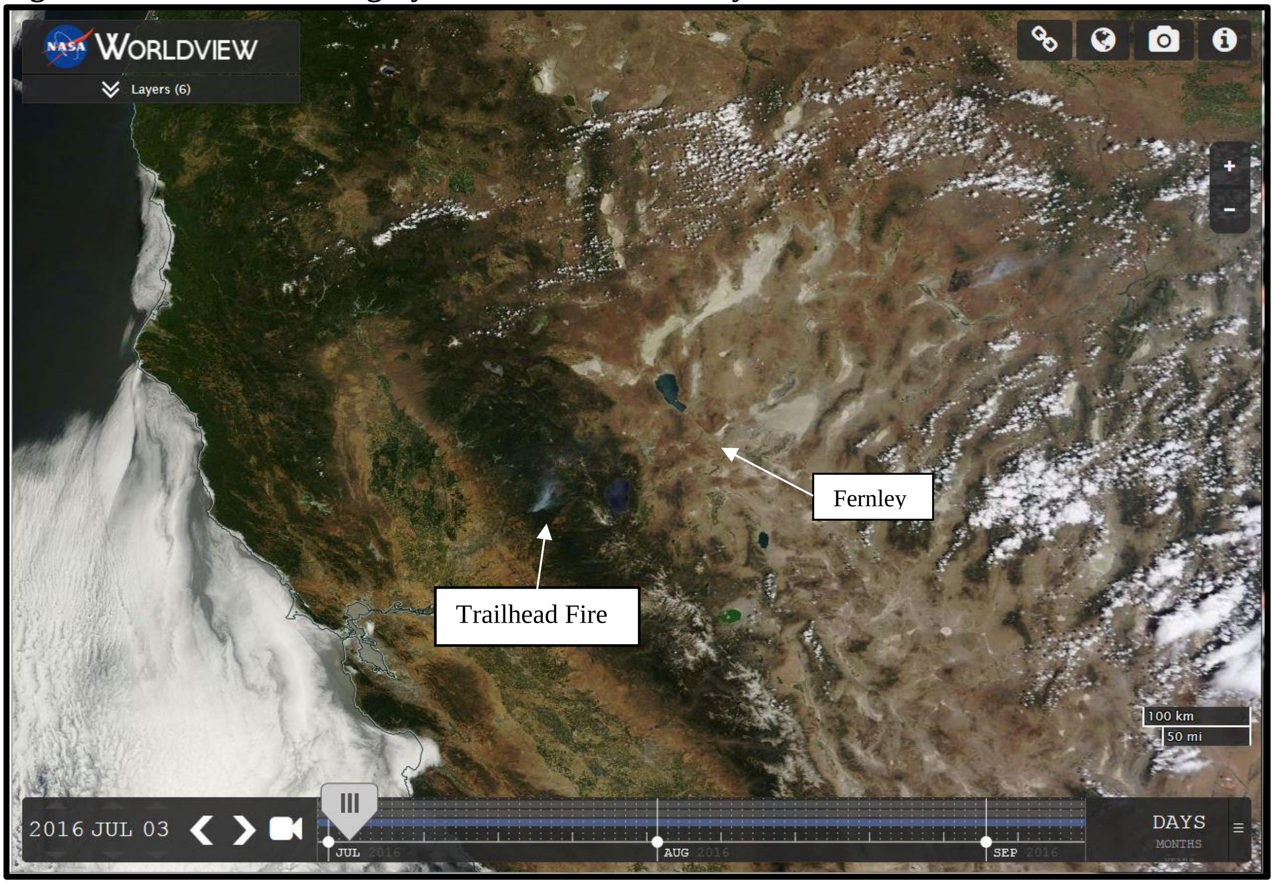
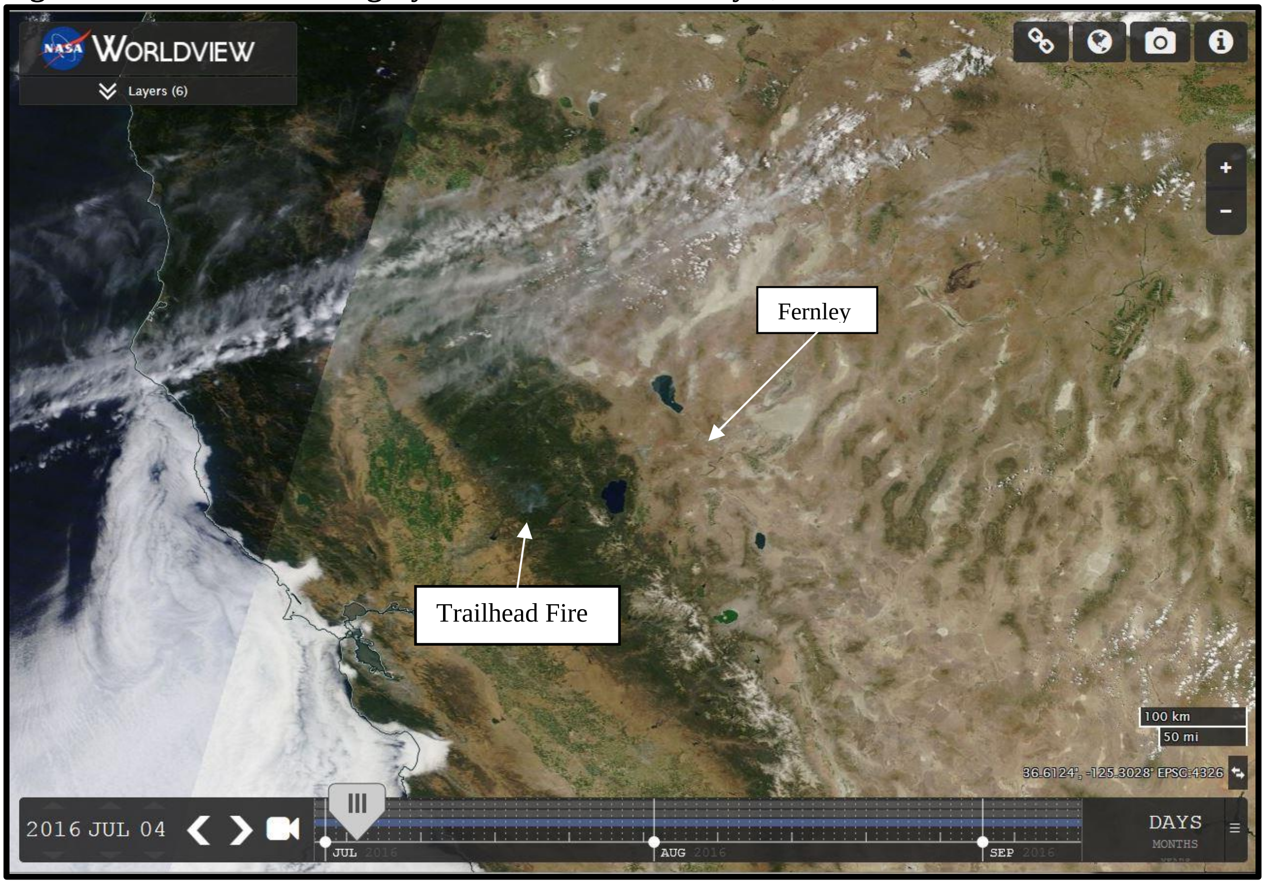


Figure 8. Satellite Imagery of Smoke Plume – July 4, 2016.



3.2 METEOROLOGICAL CONDITIONS AND TRANSPORT PATTERNS

Substantial amounts of NOx and VOCs were generated from the Trailhead Fire, causing the 8-hour ozone exceedances at Fernley on July 3 and 4, 2016. Due to the buoyancy of fire plumes, these precursors were mixed throughout the boundary layer, making them available for long-range transport.

Figures 9 through 14 show the 500 millibar heights and winds for the period June 29, 2016 through July 5, 2016. During the period from June 29 through July 4, 2016, when smoke from the Trailhead Fire moved into northwestern Nevada, a high pressure system located over the four corners region was beginning to move south and east. Upper level winds were out of the south on June 29, 2016. As the high moved south and east, an upper level low moved into the Pacific Northwest, causing upper level winds in northern Nevada to shift from the south to the southwest from June 30 through July 4, 2016. These southwest upper level winds transported smoke and associated ozone precursors from the Trailhead Fire into northern Nevada. By July 5, 2016, with the continued approach of a low pressure system into the Pacific Northwest, upper level winds became more westerly, resulting in smoke from the Trailhead Fire being directed away from northern Nevada (Figures 9 through 14).

Figure 9. Upper-Level Pressure and Winds – June 29, 2016

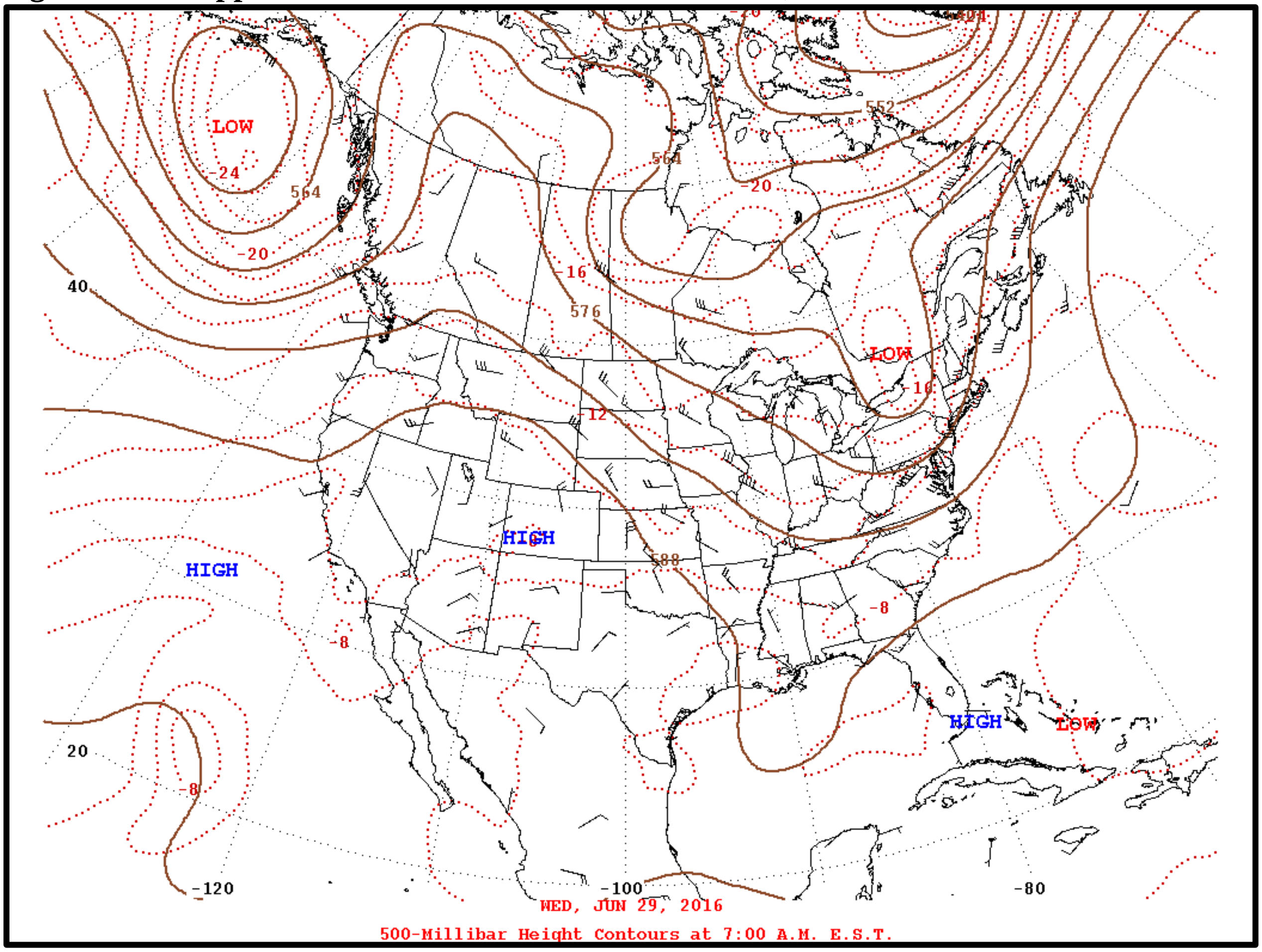


Figure 10. Upper-Level Pressure and Winds – June 30, 2016

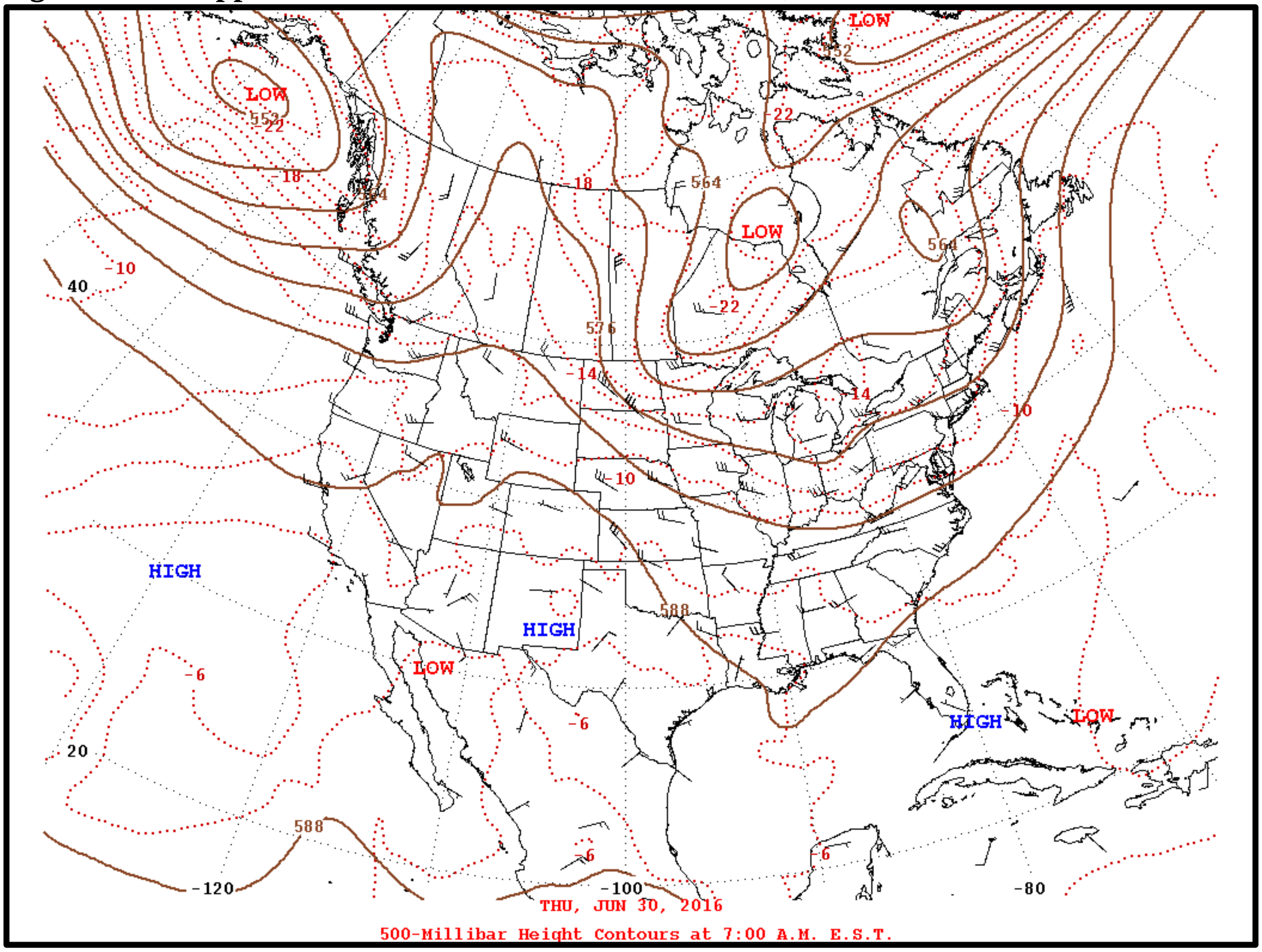


Figure 11. Upper-Level Pressure and Winds – July 1, 2016

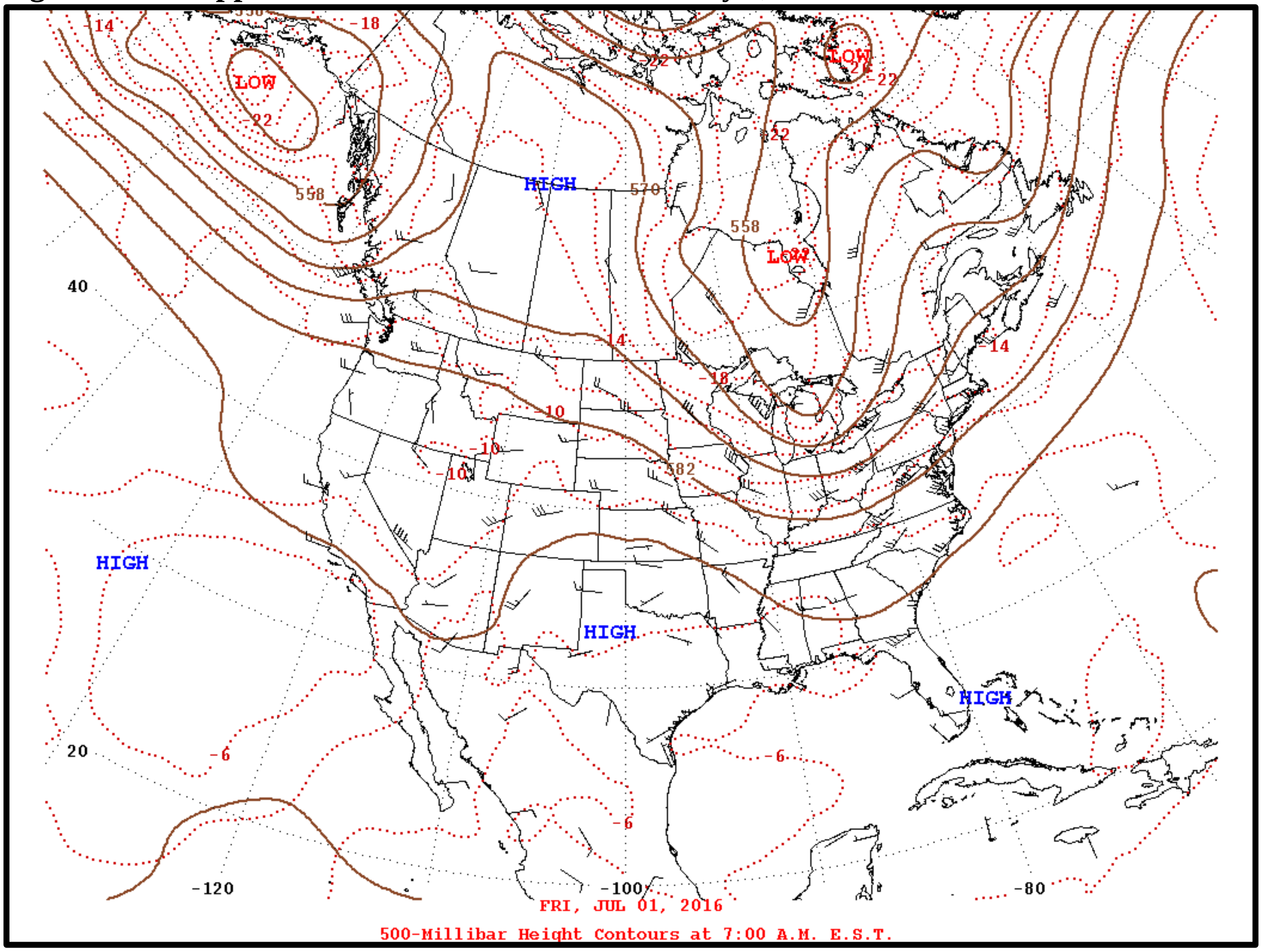


Figure 12. Upper-Level Pressure and Winds – July 2, 2016

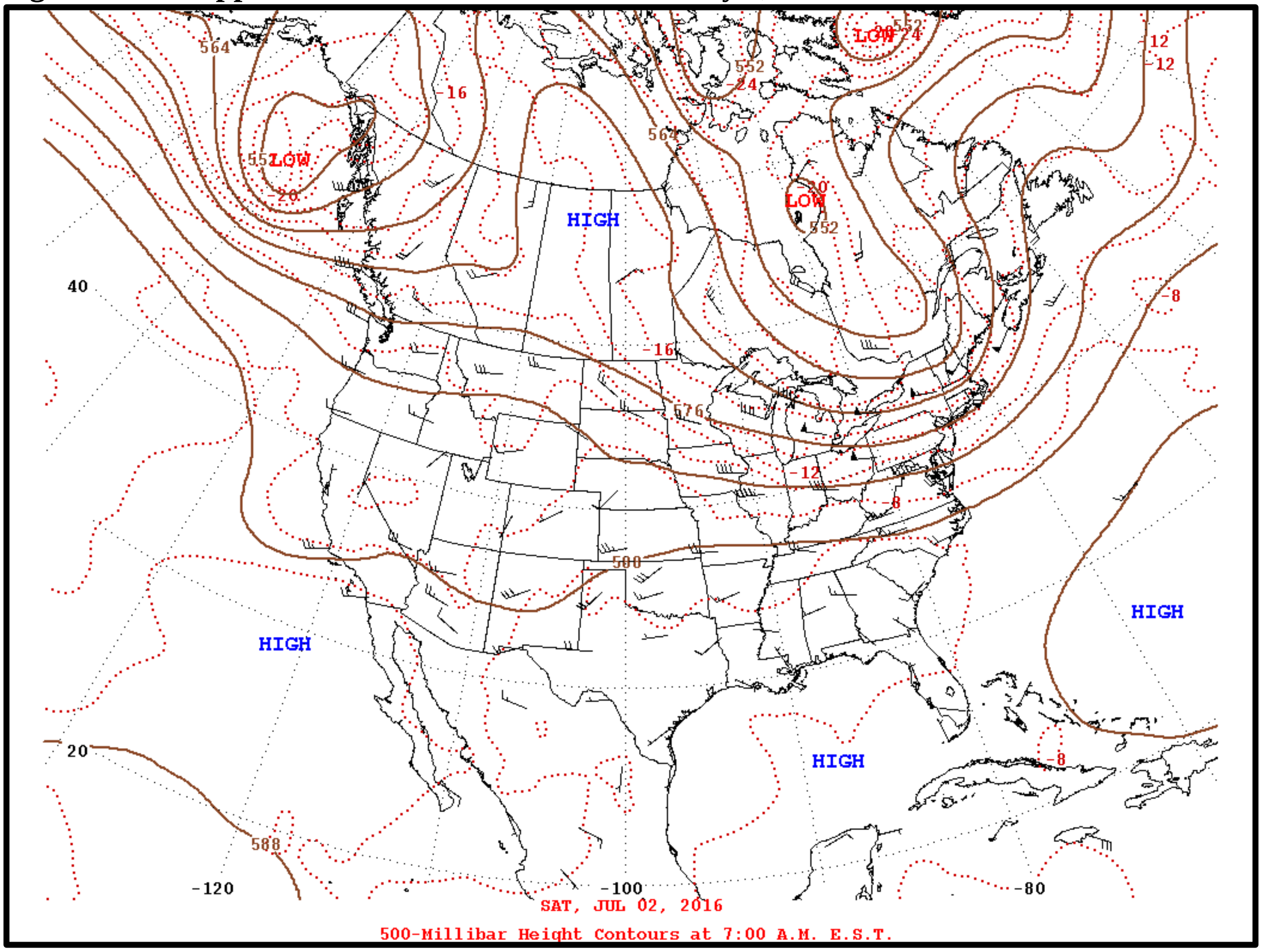


Figure 13. Upper-Level Pressure and Winds – July 3, 2016

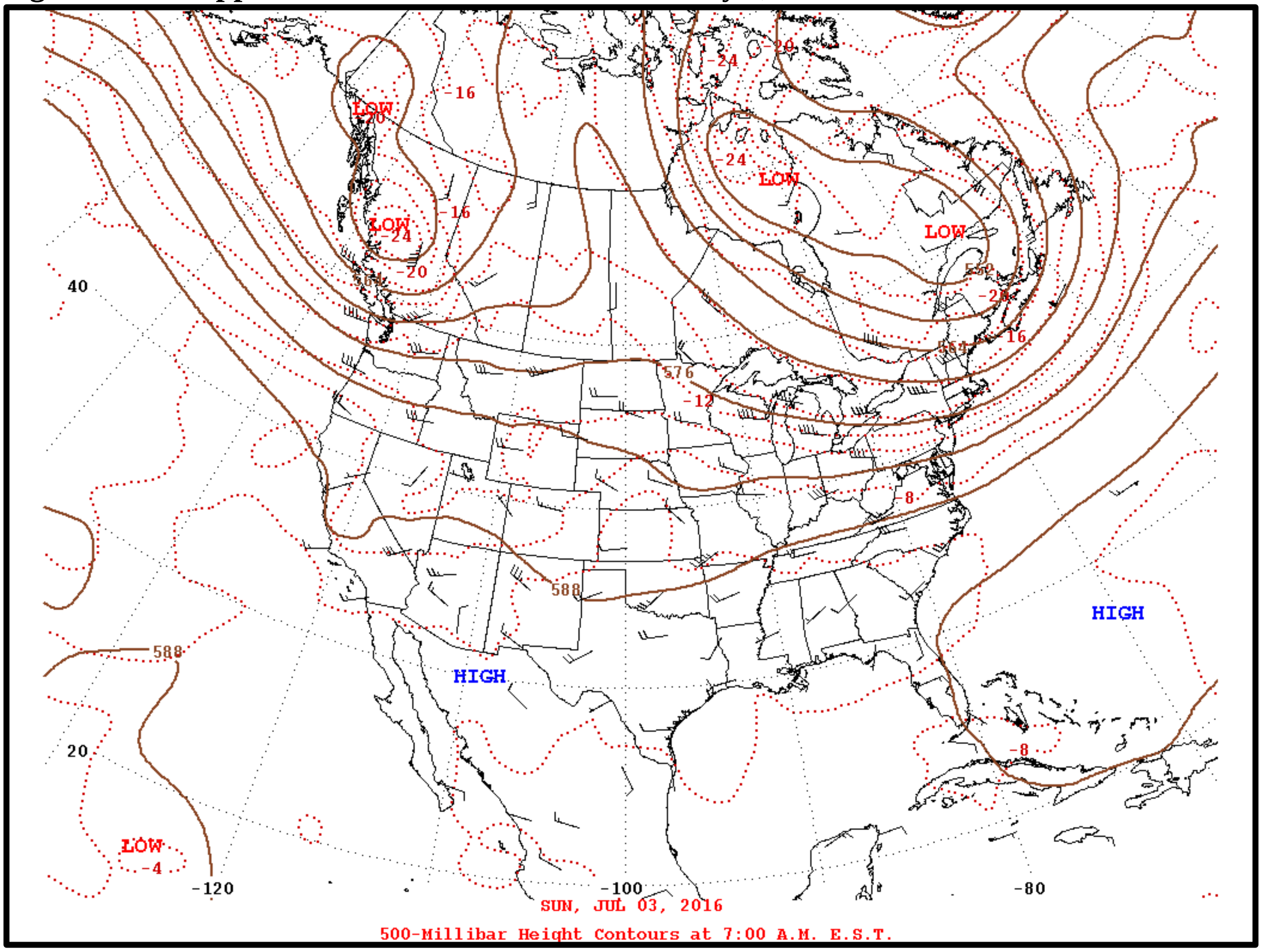


Figure 14. Upper-Level Pressure and Winds – July 4, 2016

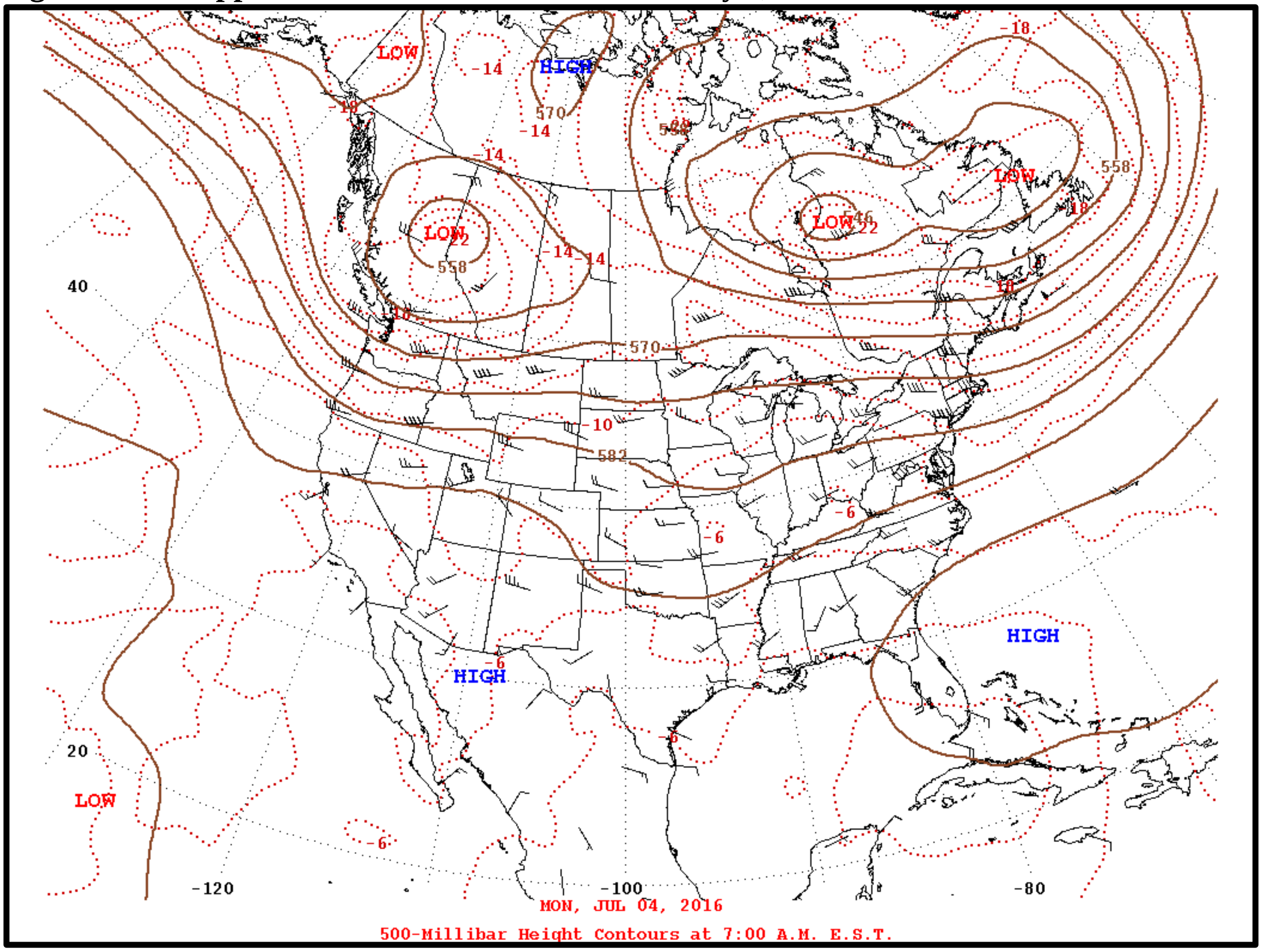
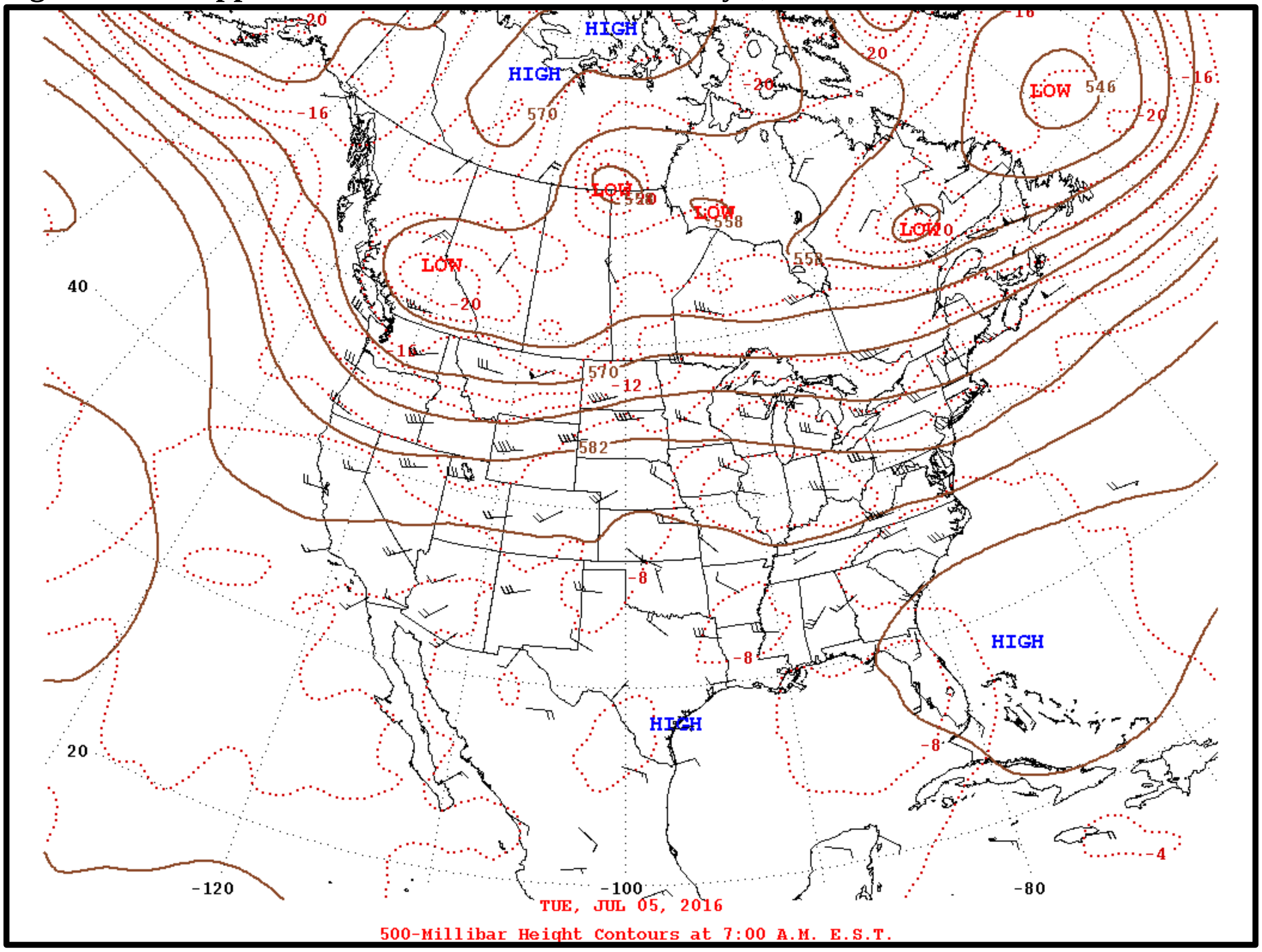


Figure 15. Upper-Level Pressure and Winds – July 5, 2016



Temperature and surface wind data was analyzed from June 26 through July 11, 2016. Because there are no topographic barriers between them, the weather conditions in Reno, Nevada are considered representative of those in Fernley. Summer surface winds in Reno, Nevada generally range from the northwest to southwest; Figure 16 shows wind speeds and directions for all days in June, July, and August from 2012 through 2016. For the two-week period before and after the event days, as well as on the event days themselves, surface winds were typical of summer winds in the area (Figures 17 and 18). Both upper level and surface winds transported wildfire precursor emissions to the Fernley area.

Table 3 shows the temperatures and wind speeds for the Reno-Tahoe International airport for the two weeks before and after the exceedances. Wind speeds in northern Nevada for early July average between 7 and 8 miles per hour (mph). Winds throughout the two-week period before and after the event days were generally light, but increased slightly on July 3 and 4.

Figure 16. Wind Rose for Desert Research Institute (Reno, Nevada), June 1 through August 31, 2012 through 2016

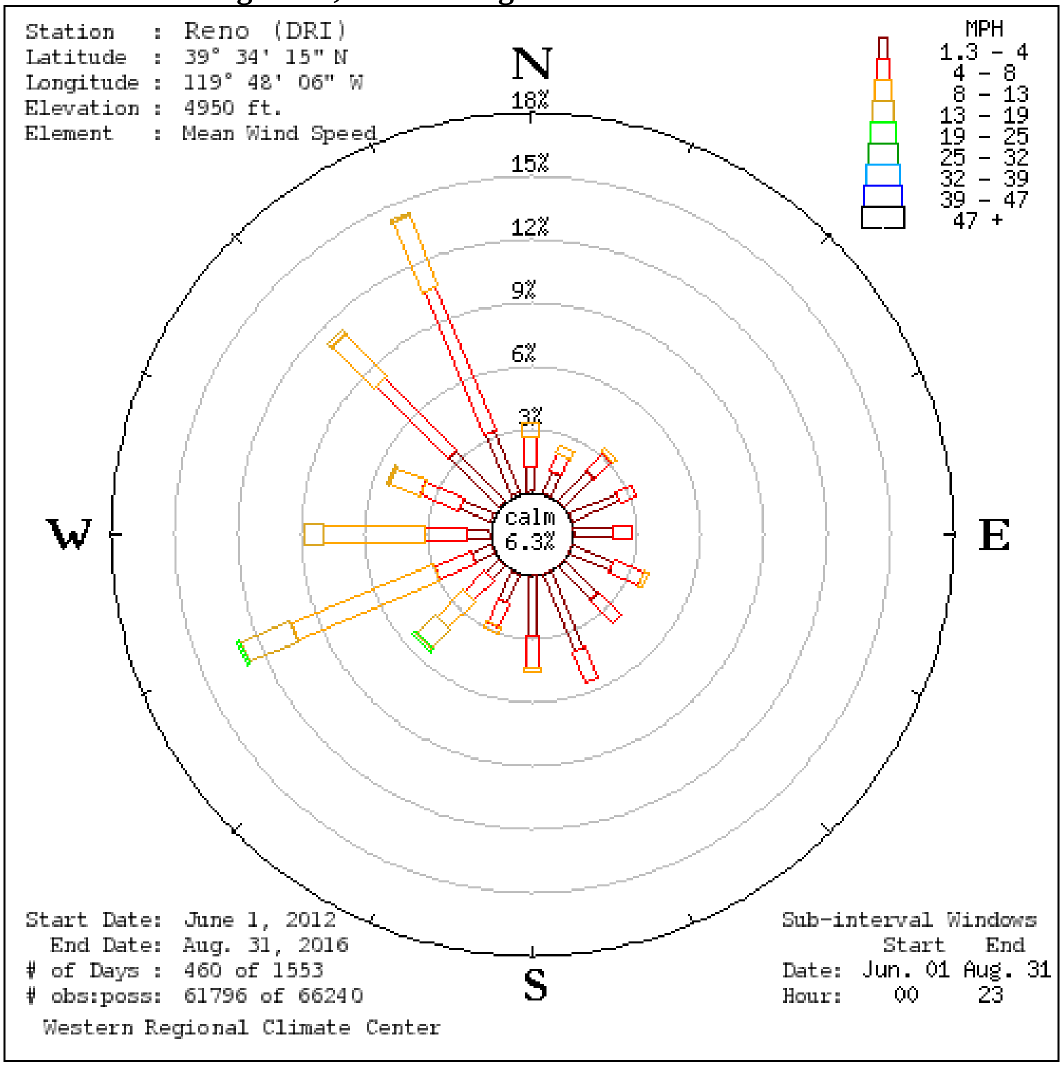


Figure 17. Wind Rose for Desert Research Institute (Reno, Nevada), June 26, 2016 through July 11, 2016

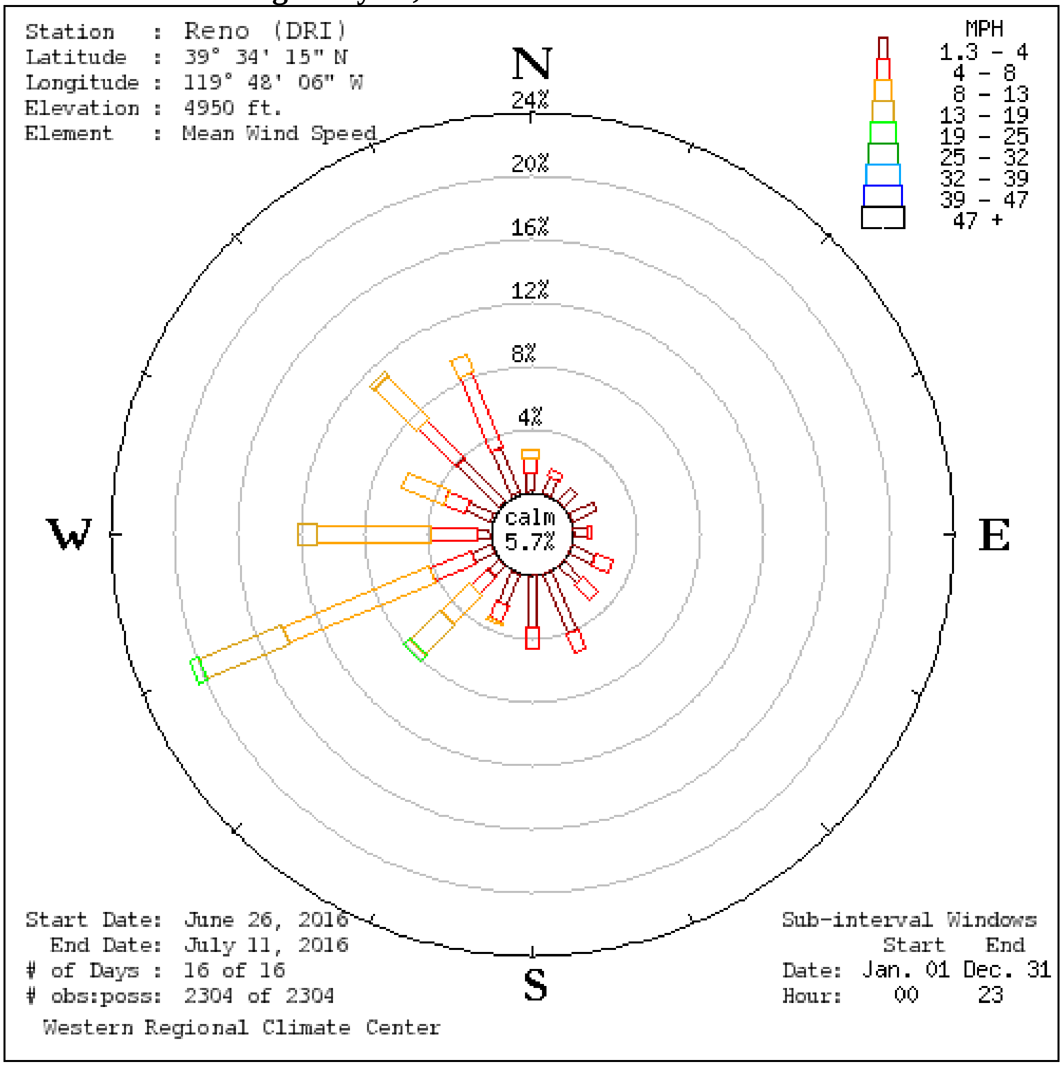


Figure 18. Wind Rose for Desert Research Institute (Reno, Nevada), July 3-4, 2016

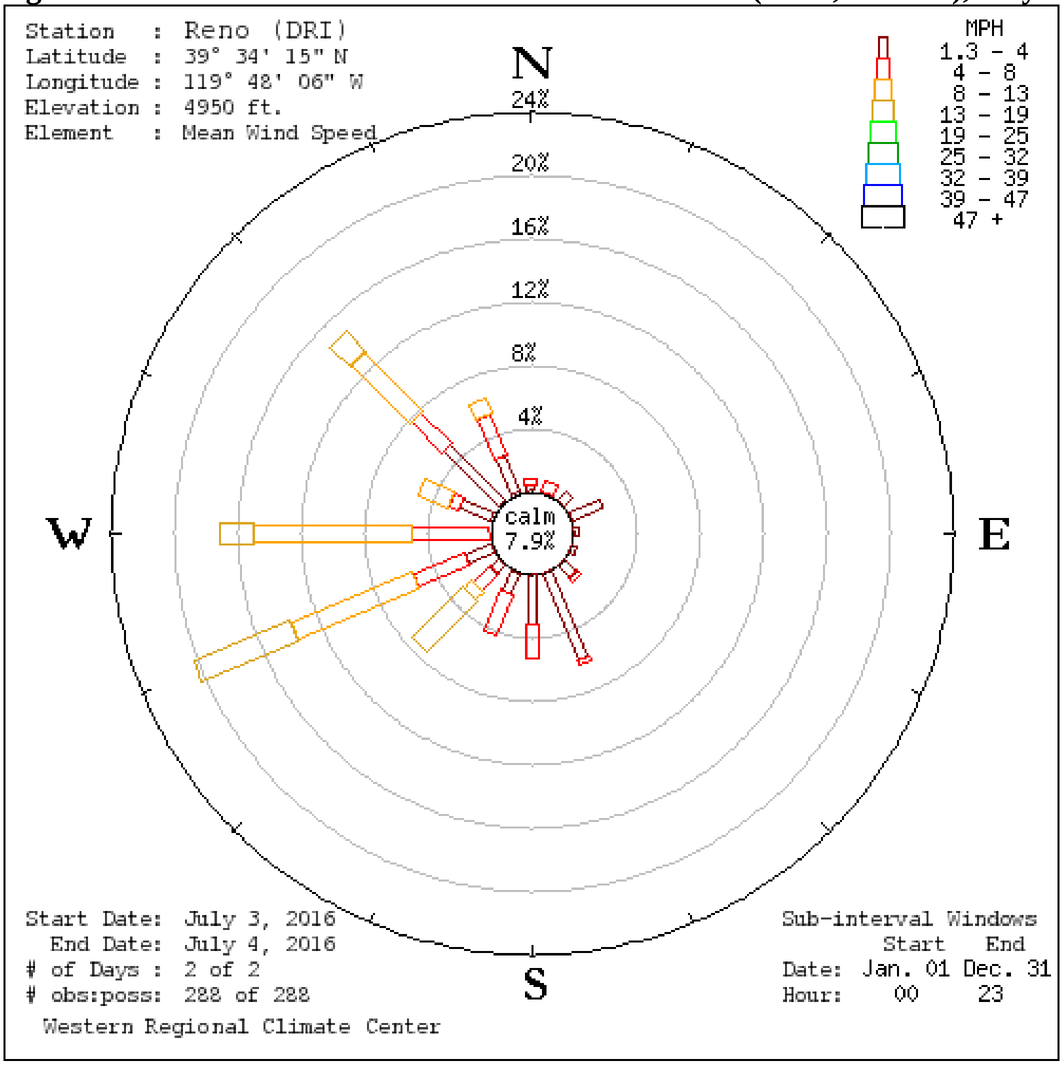


Table 3. Historical and Event-Related Temperature Data for Reno-Tahoe Airport

	Non-event							Trailhead Fire		Non-event						
	06/26	06/27	06/28	06/29	06/30	07/01	07/02	07/03	07/04	07/05	07/06	07/07	07/08	07/09	07/10	07/11
Ozone																
8-hour Maximum Concentration (ppb)	56	55	55	61	53	61	66	71	70	68	66	57	49	25	47	41
Maximum Temperature																
Observed (°F)	98	100	101	100	100	99	97	95	93	91	90	91	88	86	80	86
Historical Average (°F)	87	88	88	88	89	89	89	90	90	90	91	91	91	91	92	92
Wind Speed																
Observed (mph)	7.6	5.6	6.4	8.0	7.5	7.5	7.3	7.9	10.4	10.1	9.2	6.9	8.7	15.0	11.9	5.9

In general, higher temperatures are associated with higher surface ozone concentrations (Jacob and Winner, 2009). Temperatures in Reno, Nevada were generally higher than historical averages for the approximate two-week period surrounding the event days. However, ozone concentrations at the Fernley site were within the range of historical concentrations except on the two event days, when they were significantly higher. This suggests that the elevated ozone concentrations were caused by smoke from the Trailhead Fire as opposed to high temperatures. Surface winds also increased slightly on the event days, supporting the interpretation that smoke from the fire was transported to the Fernley site and caused the elevated ozone concentrations.

In the desert portions of northern Nevada, visibilities are typically very good. Strong low-level inversions in the winter months result in pooling of cold air at the surface, and can lead to an accumulation of locally generated pollution being trapped under the inversion, causing a decrease in visibility. This phenomenon only occurs during the cold months of the year. Reductions in visibility in the summer occur under three conditions: 1) heavy rain from thunderstorms; 2) blowing dust from thunderstorm downdrafts; and 3) smoke from wildfires. Visibility at the Reno-Tahoe International Airport was reduced to eight miles on the afternoons of July 2 and 3, 2016. There were no thunderstorms in northern Nevada on July 2, 3, and 4, 2016; therefore, the observed decrease in visibility cannot be attributed to windblown dust or rain, but was due to smoke from the Trailhead Fire.

To further demonstrate that smoke from the Trailhead Fire impacted the Fernley ozone monitoring site, trajectory analyses were created using the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT; Stein, 2015; Rolph, 2016) tool in the AirNow Tech online platform. HYSPLIT trajectories were generated for July 3 and 4, 2016; both forward (from the fire forward 24 hours) and backward (from the site back 24 hours) trajectories were analyzed. The Trailhead Fire origin is approximately 150 km away from the Fernley ozone monitor. The emissions from the fire therefore traveled a considerable distance, including passing over significant topographic features. Because of this distance, as well as the heat of the plume, the smoke plume dispersed upward into the atmosphere. To account for this vertical motion, and the fact that the HYSPLIT models do not account for turbulence or vertical mixing within the troposphere, trajectories were generated at 100 m, 700 m, and 1,500 m above ground level (agl). These heights are representative of the base, middle, and top of the typical daytime planetary boundary layer, and are consistent with the *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations* (USEPA, 2015). HYSPLIT trajectories are shown in Figures 19a through 20b, for July 3 and 4, 2016, respectively. According to the *Guidance on the Preparation of Exceptional Events Demonstrations for Wildfire Events that May Influence Ozone Concentrations*, the starting heights of trajectories should be between 100 and 1,500 m agl to avoid terrain interference and to stay within the mixed layer of the atmosphere (USEPA, 2015). Forward trajectories were initiated from the Trailhead Fire origin at 1800 Coordinated Universal Time

(UTC; 1000 Pacific Standard Time (PST)) on July 2, 2016 and at 2200 UTC (1400 PST) on July 3, 2016, and were run forward for 24 hours. Backward trajectories were initiated from the Fernley ozone monitoring site beginning at 1800 UTC (1000 PST) July 3, 2016 and 2200 UTC (1400 PST), also for 24 hours. These times correspond to the hour of the maximum daily 8-hour average at the Fernley site on the two event days. Forward trajectories from the fire origin show that the air mass above the fire traveled to and over the Fernley monitoring site. Backward trajectories from the Fernley monitoring site show that the air mass above the Fernley site during the exceedances traveled to Fernley from the area of the Trailhead Fire smoke plume.

Figures 19a through 20b also show Hazard Mapping System (HMS) smoke plumes for July 3 and 4, 2016. The smoke plume from the Trailhead Fire was clearly transported to and impacted the Fernley monitoring site. The HYSPLIT trajectories also intersect with the smoke plume from the Trailhead Fire, providing more evidence that the plume impacted the site.

Figure 19a. AirNow Tech Image of Active Fires, HMS Smoke Plumes, 8-Hour Ozone Concentrations, and Forward HYSPLIT Trajectories – July 2, 2016 (24 hours)

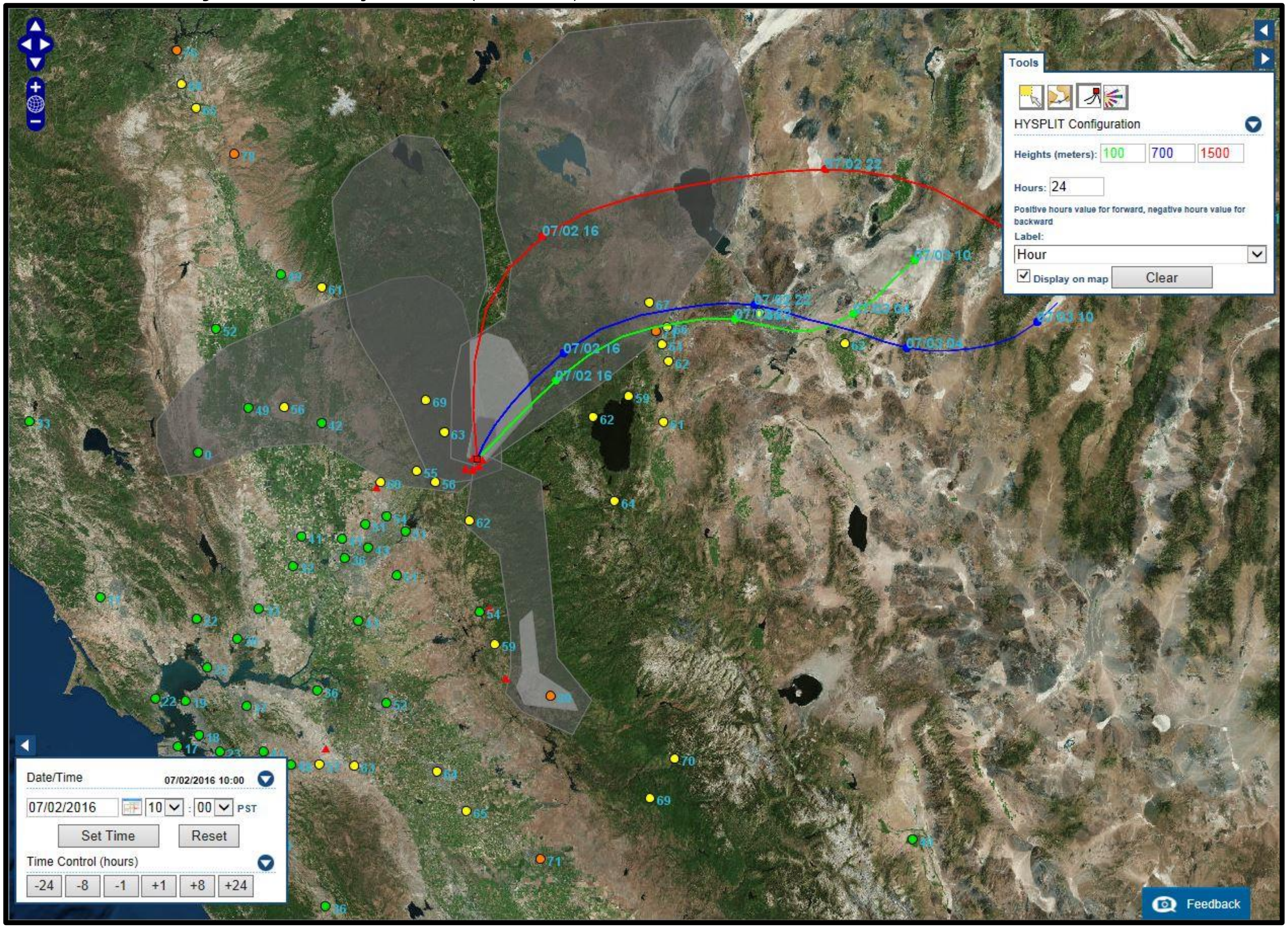


Figure 19b. AirNow Tech Image of Active Fires, HMS Smoke Plumes, 8-Hour Ozone Concentrations, and Backward HYSPLIT Trajectories – July 3, 2016

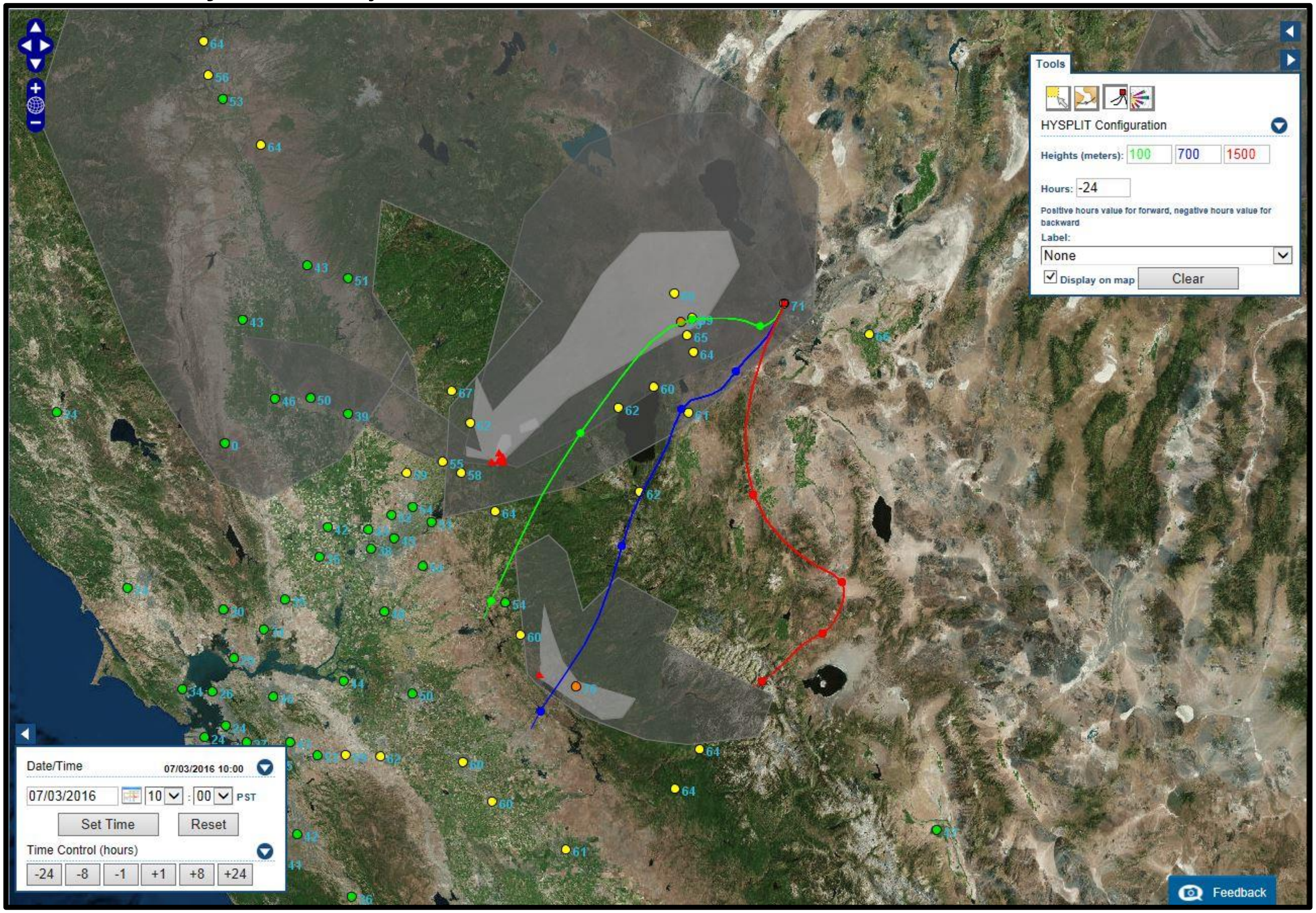


Figure 20a. AirNow Tech Image of Active Fires, HMS Smoke Plumes, 8-Hour Ozone Concentrations, and Forward HYSPLIT Trajectories – July 3, 2016 (24 hours_

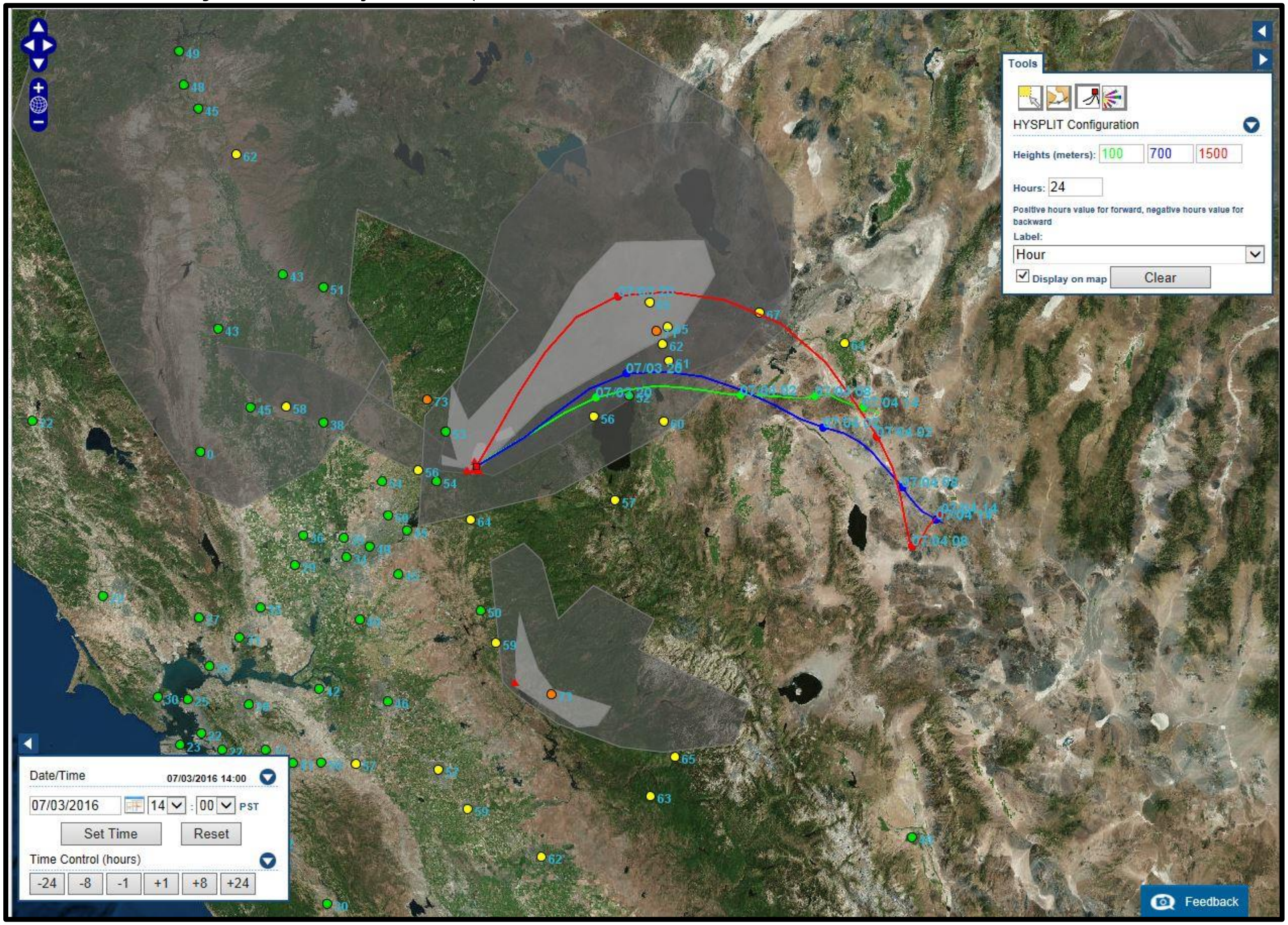
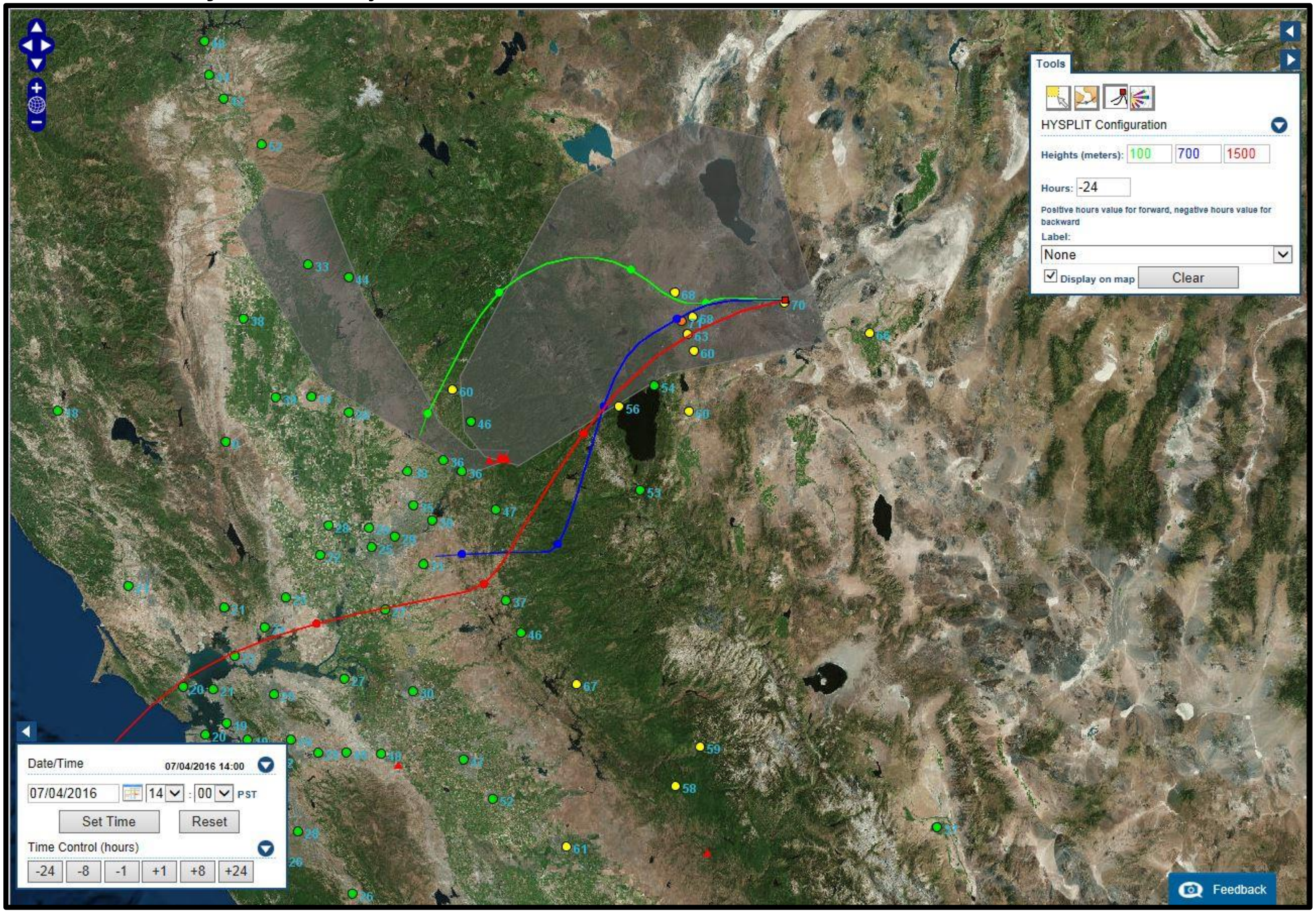


Figure 20b. AirNow Tech Image of Active Fires, HMS Smoke Plumes, 8-Hour Ozone Concentrations, and Backward HYSPLIT Trajectories – July 4, 2016



3.3 $PM_{2.5}$ CONCENTRATIONS AND SPECIATION

$PM_{2.5}$ is directly emitted during combustion. Elevated concentrations of $PM_{2.5}$ were measured at air monitors in Washoe County from June 29, 2016 through July 4, 2016, providing additional evidence that emissions from the Trailhead Fire reached ground level monitors in northern Nevada. Speciation data from the Washoe County $PM_{2.5}$ samples show elevated levels of organic and elemental carbon, also indicative of wildfire smoke (WCAQMD, 2017).

3.4 OZONE CHEMISTRY AND CONCENTRATIONS

On July 3 and 4, 2016, the NDEP monitored exceedances of the 2015 8-hour O_3 NAAQS, with concentrations reaching 71 ppb. Wildfire smoke and O_3 precursors from the Trailhead Fire were transported east into Nevada on upper level winds. Ozone concentrations were elevated across Nevada, including the O_3 exceedances at the Fernley monitoring site. Ozone exceedances were also recorded at air monitoring sites in Reno, Nevada, within the Washoe County Air Quality Monitoring District. Table 4 lists O_3 concentrations across the NDEP-BAQP ambient air monitoring network for the seven days before and after the event, highlighting the exceedances at the Fernley site. Figure 21 shows the hourly ozone concentrations measured by ozone monitors within the NDEP-BAQP monitoring network for the same time period.

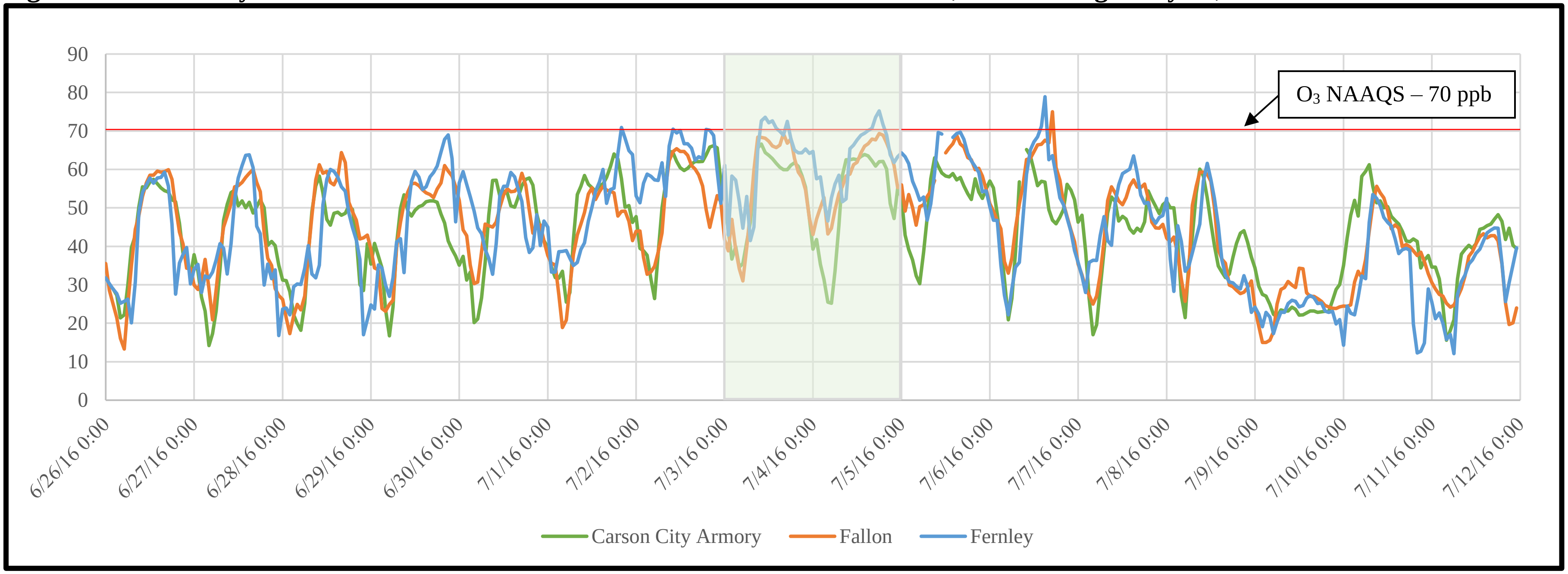
In addition to elevated ozone concentrations, $PM_{2.5}$ and NOx concentrations measured in Reno, Nevada (approximately 30 miles west) were elevated on July 2, 3, and 4, 2016 (WCAQMD, 2017). This supports the interpretation that the increase in wildfire smoke increased NOx concentrations, which subsequently increased O_3 levels. The elevated ozone and ozone precursor concentrations throughout western Nevada demonstrate that the wildfire smoke impacts were regional and were consistent with dispersion from the Trailhead Fire, more than 100 km away.

Although, as discussed earlier, NO from fires can result in ozone titration very close to the source of a fire, Fernley is sufficiently far enough downwind (150 km) that a reduction in ozone concentrations due to this phenomena was unlikely. In addition, while the increased smoke from the fire may have reduced the amount of solar insolation, thereby potentially reducing photochemical activity, this was offset by the substantially increased levels of ozone precursors generated by the fire, resulting in a net ozone enhancement.

Table 4. **Maximum Daily 8-hour Ozone Concentrations (in ppb) Across the Monitoring Network for June 26, 2016 through July 11, 2016.**

	Non-event							Trailhead Fire		Non-event						
Site	06/26	06/27	06/28	06/29	06/30	07/01	07/02	07/03	07/04	07/05	07/06	07/07	07/08	07/09	07/10	07/11
Carson City	55	51	50	50	53	58	63	62	62	58	58	50	48	46	51	45
Fallon	58	56	59	56	54	53	62	67	66	65	66	54	53	30	49	41
Fernley	56	55	55	61	53	61	66	71	70	68	66	57	49	25	47	41

Figure 21. **Hourly Ozone Concentrations for Network Monitors from June 26, 2016 through July 11, 2016.**



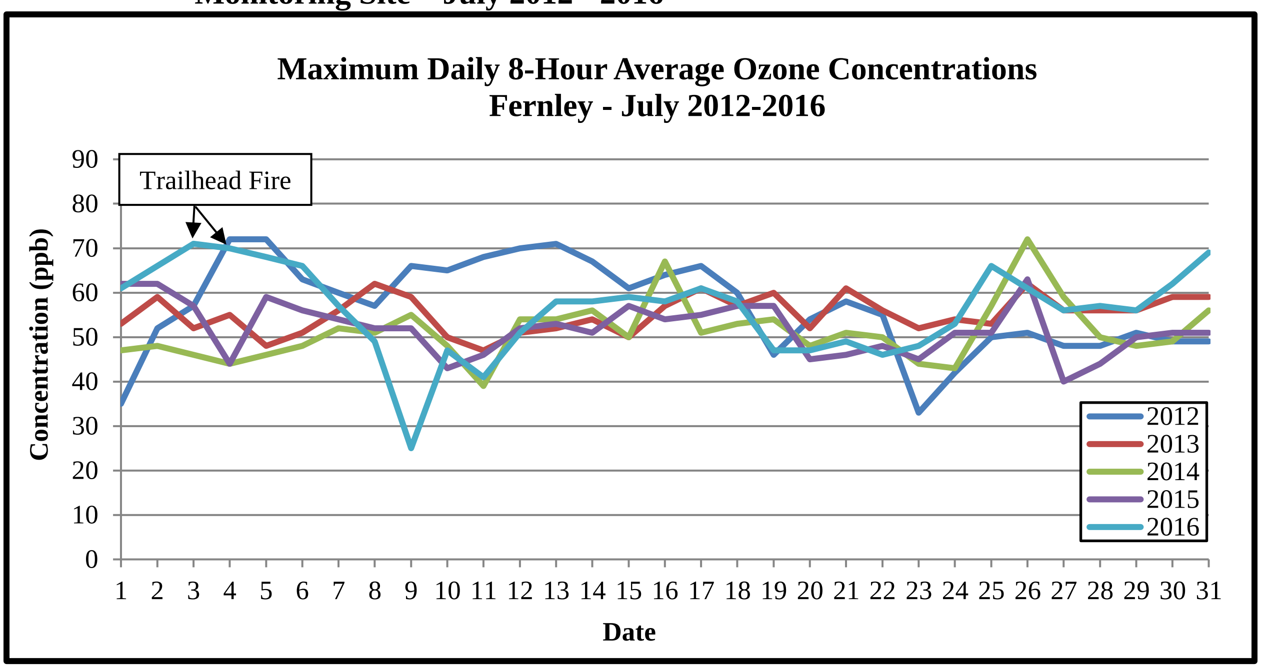
The increased precursor emissions from the fire throughout the western U.S. resulted in substantial amounts of ozone formation, leading to the 8-hour ozone exceedances at Fernley on July 3 and 4, 2016. Section 2.6 summarizes the key mechanisms by which emissions from wildfires can increase ozone, as well as past research that documents increases in ozone formation downwind of wildfires.

The daily maximum 8-hour ozone concentrations at the Fernley site on July 3 and 4, 2016, were more than 15 ppb higher than the average and median maximum daily 8-hour ozone concentrations historically measured during the month of July at the Fernley site (2012 through 2016). The measured concentrations were approximately two standard deviations higher than the mean ozone concentrations at the site for the month of July (Table 5). In addition to the exceedances at Fernley, ozone was elevated throughout much of northern Nevada; air quality monitors in Washoe County also recorded exceedances of the 8-hour ozone standard.

3.5 Beyond Historical and Background Concentrations

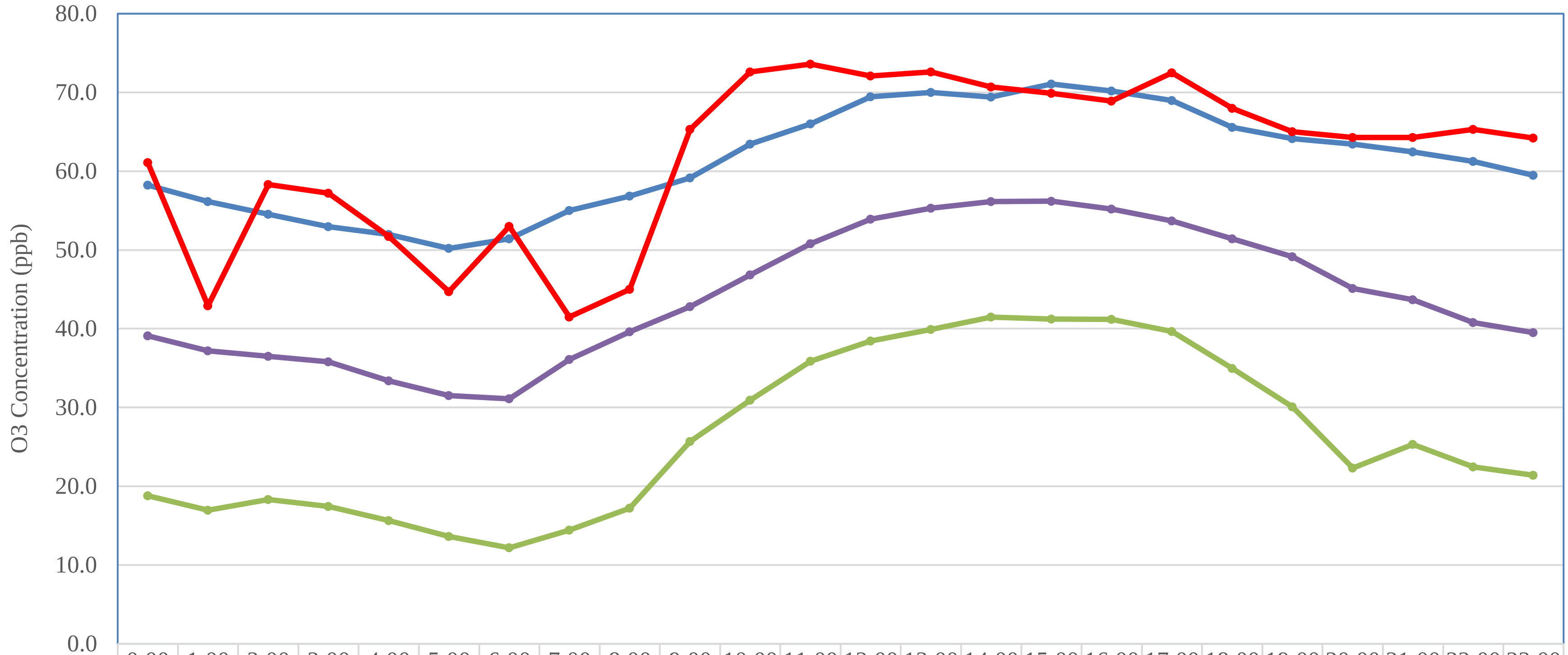
Ozone concentrations in western Nevada are historically at their highest in the afternoon during the summer months. The measured 8-hour ozone concentrations at the Fernley monitoring site on July 3 and 4, 2016 were significantly higher than the average and median concentrations for the month of July, as well as for similar non-event day concentrations. Figure 22 shows a time-series plot of 8-hour ozone concentrations at the Fernley site for all July days from 2012 through 2016.

Figure 22. Maximum Daily 8-Hour Average Ozone Concentrations at the Fernley Ozone Monitoring Site – July 2012 - 2016



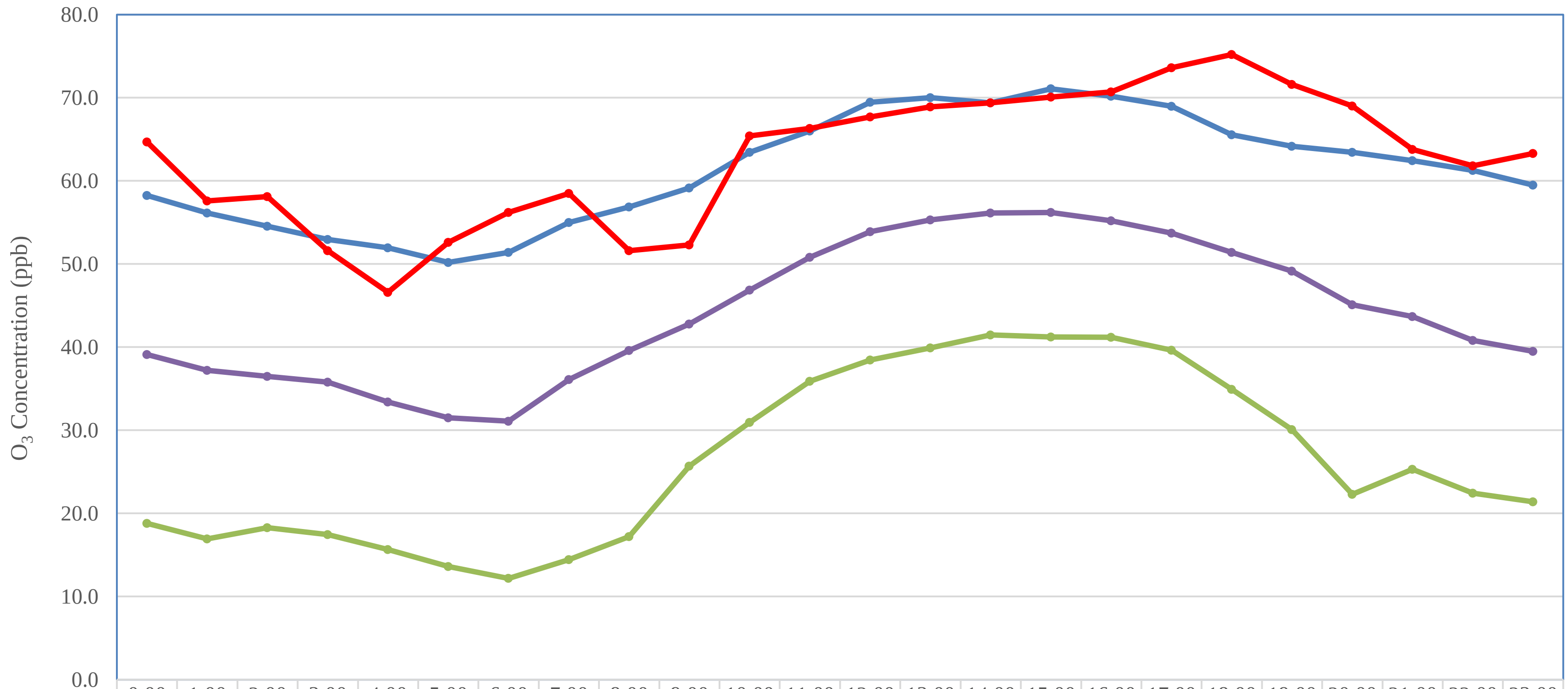
On both two event days, the one-hour ozone concentrations were above the 95th percentile for summer ozone concentrations (June through August, 2012 through 2016, excluding July 3 and 4, 2016) for several hours on both days (Figures 23 and 24).

Figure 23. Fernley Hourly Ozone Concentrations for June-August, 2012 through 2016, with July 3, 2016.



	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
95%	58.3	56.2	54.6	53.0	52.0	50.2	51.4	55.0	56.9	59.2	63.4	66.0	69.5	70.0	69.4	71.1	70.2	69.0	65.6	64.2	63.5	62.5	61.3	59.5
50%	39.1	37.2	36.5	35.8	33.4	31.5	31.1	36.1	39.6	42.8	46.9	50.8	53.9	55.3	56.2	56.2	55.2	53.7	51.4	49.2	45.1	43.7	40.8	39.5
5%	18.8	17.0	18.3	17.5	15.7	13.6	12.2	14.4	17.2	25.7	30.9	35.9	38.5	39.9	41.5	41.2	41.2	39.6	34.9	30.1	22.3	25.3	22.5	21.4
3-Jul-16	61.1	42.9	58.3	57.2	51.7	44.7	53	41.5	45	65.3	72.6	73.6	72.1	72.6	70.7	69.9	68.9	72.5	68	65	64.3	64.3	65.3	64.2

Figure 24. Fernley Hourly Ozone Concentrations for June-August, 2012 through 2016, with July 4, 2016.



	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
95%	58.3	56.2	54.6	53.0	52.0	50.2	51.4	55.0	56.9	59.2	63.4	66.0	69.5	70.0	69.4	71.1	70.2	69.0	65.6	64.2	63.5	62.5	61.3	59.5
50%	39.1	37.2	36.5	35.8	33.4	31.5	31.1	36.1	39.6	42.8	46.9	50.8	53.9	55.3	56.2	56.2	55.2	53.7	51.4	49.2	45.1	43.7	40.8	39.5
5%	18.8	17.0	18.3	17.5	15.7	13.6	12.2	14.4	17.2	25.7	30.9	35.9	38.5	39.9	41.5	41.2	41.2	39.6	34.9	30.1	22.3	25.3	22.5	21.4
4-Jul-16	64.7	57.6	58.1	51.6	46.6	52.6	56.2	58.5	51.6	52.3	65.4	66.3	67.7	68.9	69.4	70.1	70.7	73.6	75.2	71.6	69	63.8	61.8	63.3

Historical data from the Fernley site show that the average ozone concentration for July from 2012 through 2016, (excluding July 3 and 4, 2016) is 54.0 ppb. This data is summarized in Table 5 and shown graphically in Figure 25.

Table 5. July Maximum Daily 8-Hour Average Ozone Statistics for Fernley

	2012-2016		2012	2013	2014	2015	2016	
	All Data	No Fire					All Data	No Fire
Mean	54.3	54.0	56.8	55.2	51.3	51.9	56.2	55.0
Median	54	54	57	56	50	52	58	58
Std. Dev.	8.0	7.8	10.4	4.1	6.6	5.9	9.8	9.4
Max.	72	72.	72	62	72	63	71	69

Concentrations are in ppb.

Figure 25. Historical Data – July Ozone FEM Mean and Maximum Daily 8-Hour Average Concentrations for Fernley

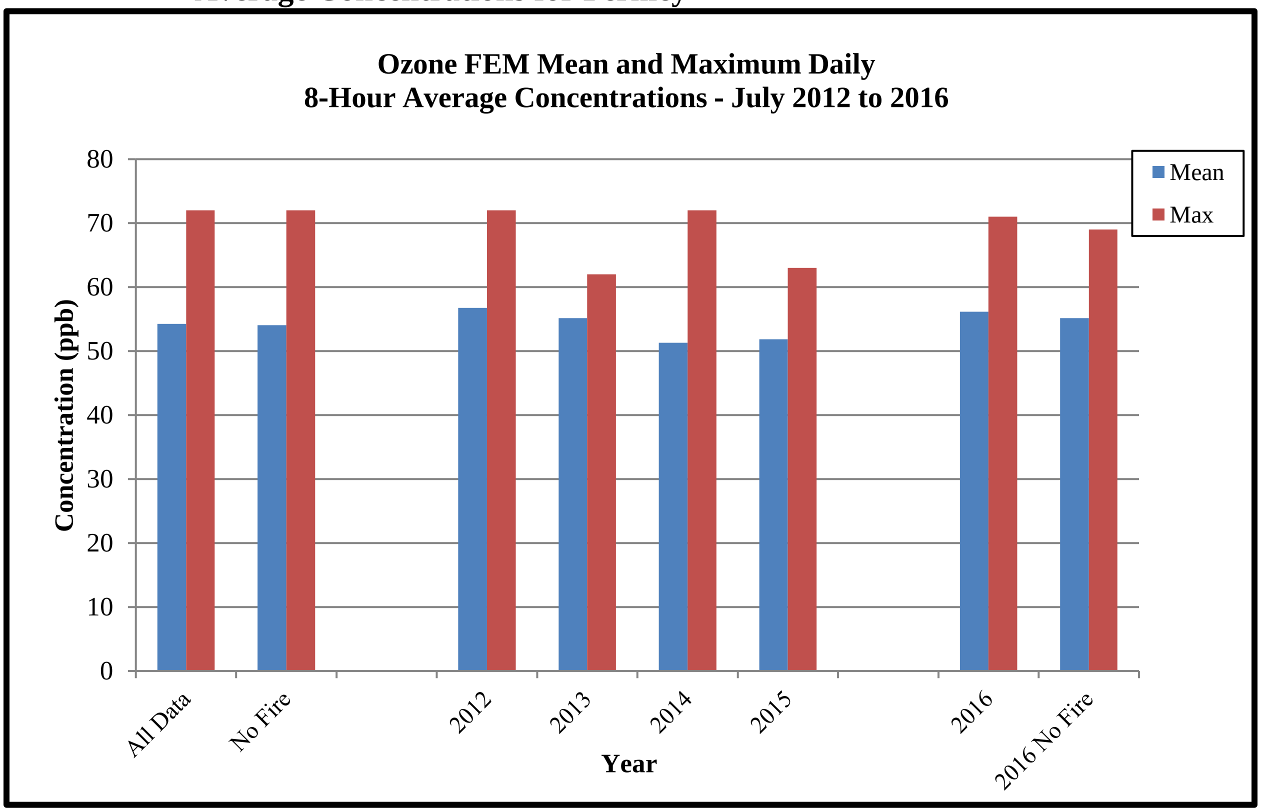
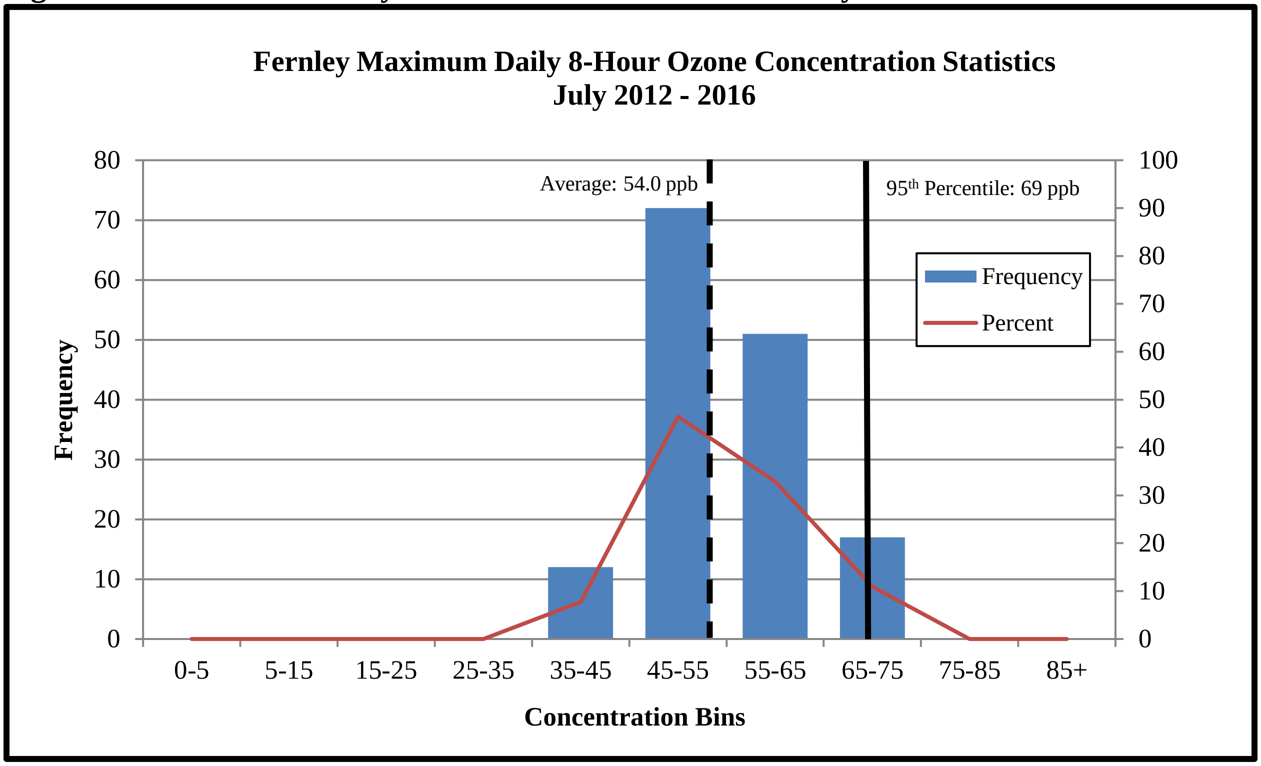


Figure 16 shows the number of July days over the five-year period 2012 through 2016 when the maximum 8-hour ozone concentration fell within established concentration bins of 10 ppb. The curve on the graph represents the percentage for days that fall within each concentration bin. Both wildfire event days (July 3 and 4, 2016) exceed the 95th percentile (Figure 26).

Figure 26. Historical July Ozone Concentrations at Fernley



To NDEP's knowledge, there were no other unusual local ozone precursor emissions in or upwind from Fernley before or during the event days.

4.0 SUMMARY

The Trailhead Fire started on June 28, 2016 and smoke from the fire began impacting northern Nevada on June 29. Smoke from the fire caused the 8-hour exceedances at the Fernley ozone monitoring site on July 3 and 4, 2016. This summary documents the transport of emissions from the fire to northern Nevada. Wildfire emissions transported both at the surface and aloft affected northern and western Nevada on July 3 and 4, 2016, causing the 8-hour ozone exceedances at Fernley.

This document has demonstrated a clear causal relationship between the emissions from the Trailhead Fire and the 8-hour exceedances at Fernley on July 3 and 4, 2016 based on the following evidence:

- Meteorological and trajectory analyses document the transport of smoke and emissions from the Trailhead Fire, demonstrating that these emissions reached northern and western Nevada, including Fernley;

- Satellite images show evidence of smoke reaching Fernley. Airport observations document smoke and limited visibility, indicating that the smoke mixed down to the surface;

- Evidence of broad surface level impacts of the Trailhead Fire is further demonstrated by increased $PM_{2.5}$ concentrations in Washoe County, upwind of the Fernley site;

- Pollution in the plume increased ozone concentrations consistent with the science of the conceptual model for the event. Ozone levels were anomalously elevated throughout northern Nevada, including the exceedances at Fernley. This regional increase in ozone, consistent with the extent and timing of increase in $PM_{2.5}$, indicates that it is more likely that the fire emissions increased ozone due to increased precursors, rather than decreased ozone due to decreased solar insolation or increased ozone titration; and

- The concentrations of 71 and 70 ppb at Fernley are well above normal historical levels.

5.0 CRITERIA FOR THE DEFINITION OF AN EXCEPTIONAL EVENT

The criteria in 40 CFR §50.1(j) for an event to meet the definition of an exceptional event need to be met for the measured exceedances to qualify for exclusion. These criteria are:

- The event affects air quality;
- The event is not reasonably controllable or preventable; and
- The event is unlikely to reoccur at a particular location or [is] a natural event.

5.1 AFFECTS AIR QUALITY

As stated in the preamble to the EER, the event in question is considered to have affected air quality if it can be shown that there is a clear causal relationship between the monitored exceedances and the event, and that the event is associated with a measured concentration in excess of normal historical concentrations. These criteria are demonstrated in Section 3. The media releases provided in Appendix C also provide evidence that the Trailhead Fire affected air quality in the vicinity of the Fernley monitor. Given the information presented in this demonstration, the NDEP concludes that the Trailhead Fire in early July 2016 affected air quality at the Fernley ozone monitoring site.

5.2 NOT REASONABLY CONTROLLABLE OR PREVENTABLE

The EER defines a wildfire as an unplanned, unwanted wildland fire. The Trailhead Fire was a natural event occurring on wildland in California. NDEP BAQP is not aware of any evidence clearly demonstrating that prevention or control efforts beyond those actually taken would have been reasonable. Therefore, emissions from the Trailhead Fire were not reasonably controllable or preventable.

5.3 NATURAL EVENT

Based on the evidence provided in this demonstration, the Trailhead Fire is a "Natural Event" as defined in 40 CFR 50.1(k). Although the cause of the fire is still under investigation, "…wildfires on wildland initiated by accident or arson are considered natural events, and on a case-by-case basis this treatment for wildfires may bear on the appropriate treatment of accidental and arson-set structural fire," (USEPA, 2016).

The Trailhead Fire meets the definition of "wildfire" predominantly occurring on "wildland" as defined in 40 CFR 50.1(n) and (o). The Trailhead Fire occurred on federal and state-owned lands.

6.0 PROCEDURAL REQUIREMENTS

6.1 FLAGGING OF DATA

The NDEP BAQP has submitted the ozone data from the Fernley monitor to the USEPA AQS database and has placed the appropriate flags on the data indicating that the data was affected by exceptional events due to wildfires (Flag RT, requesting exclusion due to wildland fires). Informational flags (IT) were also included for other NDEP BAQP ozone monitoring sites for the same time period. Such flagging ensures that the air quality data is properly represented in the overall air quality planning process.

6.2 PUBLIC OUTREACH DURING EVENT

An air agency requesting exclusion of air quality data affected by an exceptional event must take appropriate and reasonable actions to protect public health from exceedances or violations of the national ambient air quality standards. At a minimum, the agency must:

- Provide for prompt public notification whenever air quality concentrations exceed or are expected to exceed an applicable ambient air quality standard;
- Provide for public education concerning actions that individuals may take to reduce exposures to unhealthy levels of air quality during and following an exceptional event; and
- Provide for the implementation of appropriate measures to protect public health from exceedances or violations of ambient air quality standards caused by exceptional events.

The public was notified of air quality being affected by ozone from the Trailhead Fire via AQI updates, National Weather Service Smoke Text Products, and NDEP's public website. The AQI maps and Smoke Text Products are provided in Appendix C.

6.3 Public Comment Period

The NDEP BAQP has prepared this documentation to demonstrate that these exceedances were due to a wildland fire natural event, in accordance with the USEPA EER. The documentation in support of this demonstration and request for the treatment of the data associated with these exceedances as exceptional events was posted on the NDEP website at http://ndep.nv.gov/admin/public.htm requesting review and comment by the public for a minimum of 30 days. Public comments were directed to:

Sheryl Fontaine, Ambient Air Monitoring Branch
Nevada Division of Environmental Protection
Bureau of Air Quality Planning
901 South Stewart Street, Suite 4001
Carson City, Nevada 89701
Email: sfontaine@ndep.nv.gov

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APPENDIX A

NDEP BAQP Annual Network Plan Approval Letter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

OCT 26 2016

Mr. Danilo Dragoni
Chief, Bureau of Air Quality Planning
Nevada Division of Environmental Protection
901 South Stewart Street, Suite 4001
Carson City, Nevada 89701

Dear Mr. Dragoni:

Thank you for your submission of the 2016 *Ambient Air Monitoring Network* Plan for the State of Nevada in June 2016. We have reviewed the submitted document based on the requirements set forth under 40 CFR 58. Based on the information provided in the plan, the U.S. Environmental Protection Agency (EPA) approves all portions of the network plan except those specifically identified below.

Please note that we cannot approve portions of the annual network plan for which the information in the plan is insufficient to judge whether the requirement has been met, or for which the information, as described, does not meet the requirements as specified in 40 CFR 58.10 and the associated appendices. EPA Region 9 also cannot approve portions of the plan for which the EPA Administrator has not delegated approval authority to the regional offices. Accordingly, the first enclosure (*A. Annual Monitoring Network Plan Items where EPA is Not Taking Action*) provides a listing of specific items of your agency's annual monitoring network plan where EPA is not taking action. The second enclosure (*B. Additional Items Requiring Attention*) is a listing of additional items in the plan that EPA wishes to bring to your agency's attention.

The third enclosure (*C. Annual Monitoring Network Plan Checklist*) is the checklist EPA used to review your plan for overall items that are required to be included in the annual network plan along with our assessment of whether the plan submitted by your agency addresses those requirements.

The first two enclosures highlight a subset of the more extensive list of items reviewed in the third enclosure. All comments conveyed via this letter (and enclosures) should be addressed (through corrections within the plan, additional information being included, or discussion) in next year's annual monitoring network plan.

If you have any questions regarding this letter or the enclosed comments, please feel free to contact me at (415) 947-4134 or Anna Mebust at (415) 972-3265.

Sincerely,

Gwen Yoshimura, Acting Manager
Air Quality Analysis Office

Enclosures:

A. Annual Monitoring Network Plan Items where EPA is Not Taking Action
B. Additional Items Requiring Attention
C. Annual Monitoring Network Plan Checklist

cc (via email): Daren Winkelman, NDEP

APPENDIX B

NDEP BAQP 2016 Data Certification Letter

NEVADA DIVISION OF
ENVIRONMENTAL PROTECTION

STATE OF NEVADA
Department of Conservation & Natural Resources
Brian Sandoval, Governor
Bradley Crowell, Director
Greg Lovato, Administrator

May 1, 2017

Ms. Alexis Strauss
Acting Regional Administrator
U.S. EPA – Region 9
75 Hawthorne Street
San Francisco, CA 94105

RE: Submittal of the State of Nevada 2016 Data Certification Package

Dear Ms. Strauss:

Pursuant to 40 CFR Part 58, state and local government monitoring organizations must annually certify their data. Certification for the year 2016 means that (1) the ambient concentration data and the quality assurance data from January 1, 2016 through December 31, 2016 are completely submitted to the Air Quality System (AQS) by the State of Nevada, Primary Quality Assurance Organization (PQAO) 0757, and (2) the ambient data are accurate to the best of my knowledge taking into consideration the quality assurance findings. This process has taken into account the results of periodic verification, precision and accuracy checks, and any other relevant performance assessments.

Therefore, as Chief of the Bureau of Air Quality Planning for the State of Nevada, I certify that all data from the NDEP State and Local Air Monitoring System (SLAMS) and the Special Purpose Monitor (SPM) reported to EPA Region 9, enclosed on the AMP 600 summary report, have met the data certification criteria described in 40 CFR Part 58, for the year 2016.

If you have any questions or comments, please contact Daren Winkelman of my staff, at 775-687-9342, or e: dwinkelman@ndep.nv.gov.

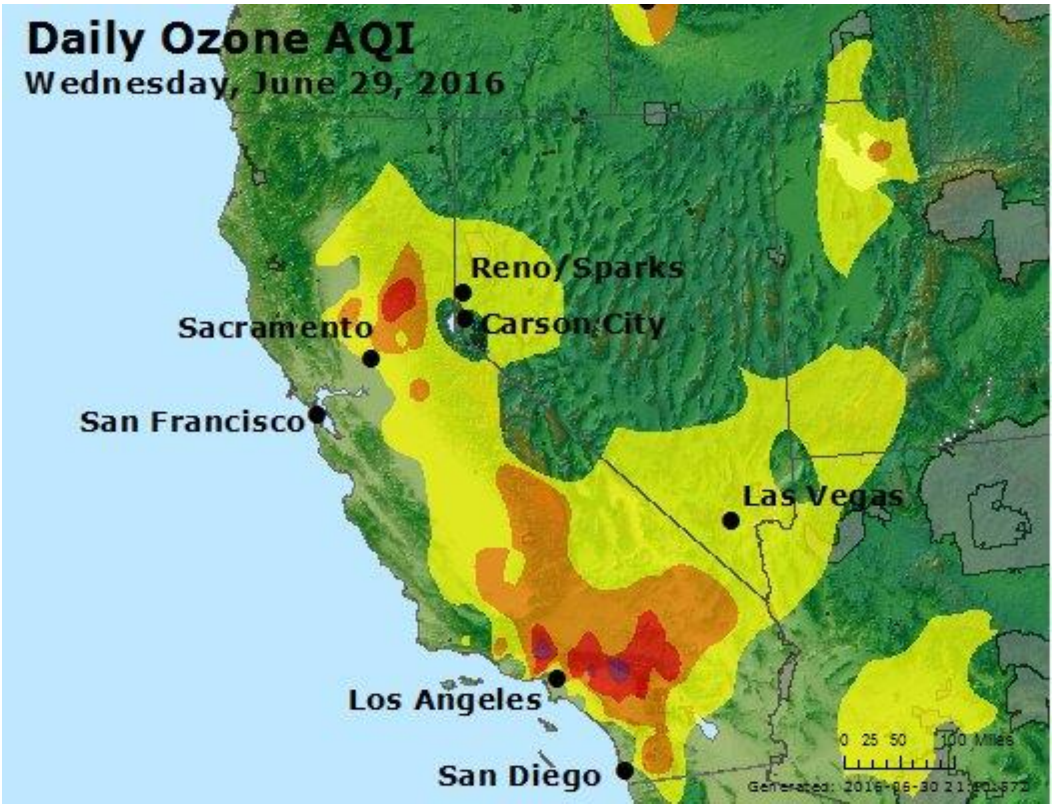
Sincerely,

Danilo Dragoni, Chief
Bureau of Air Quality Planning

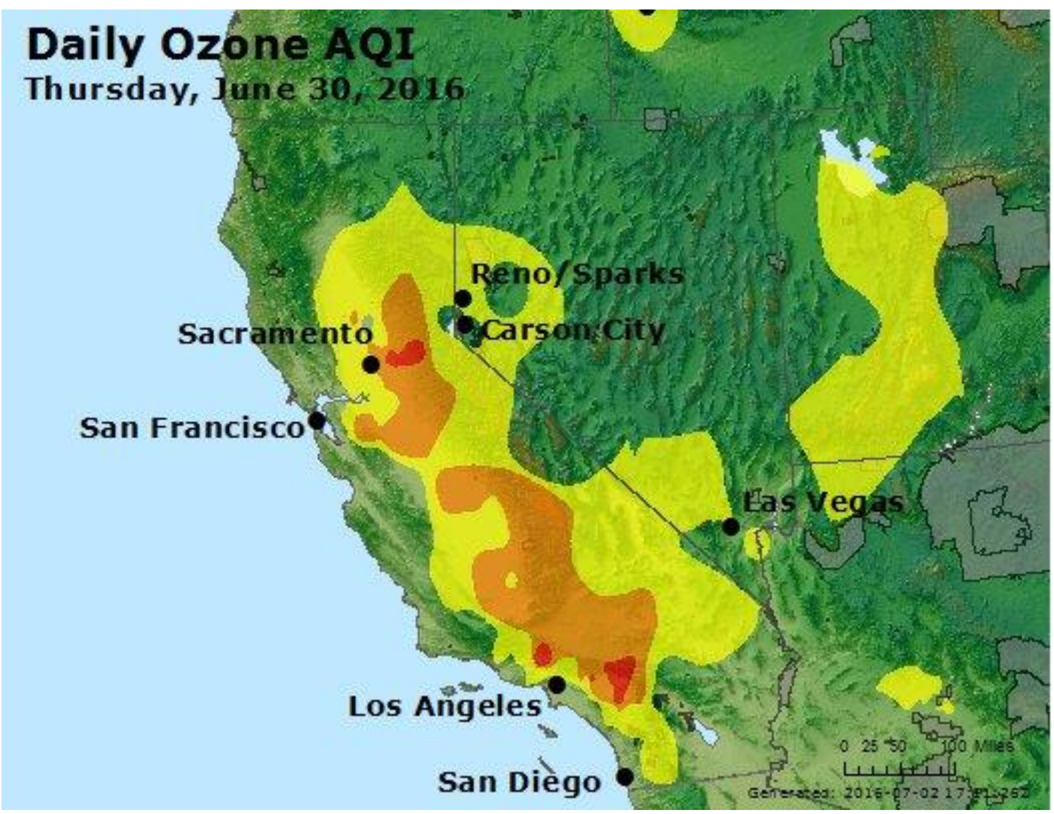
DD/dw
Enclosure

APPENDIX C

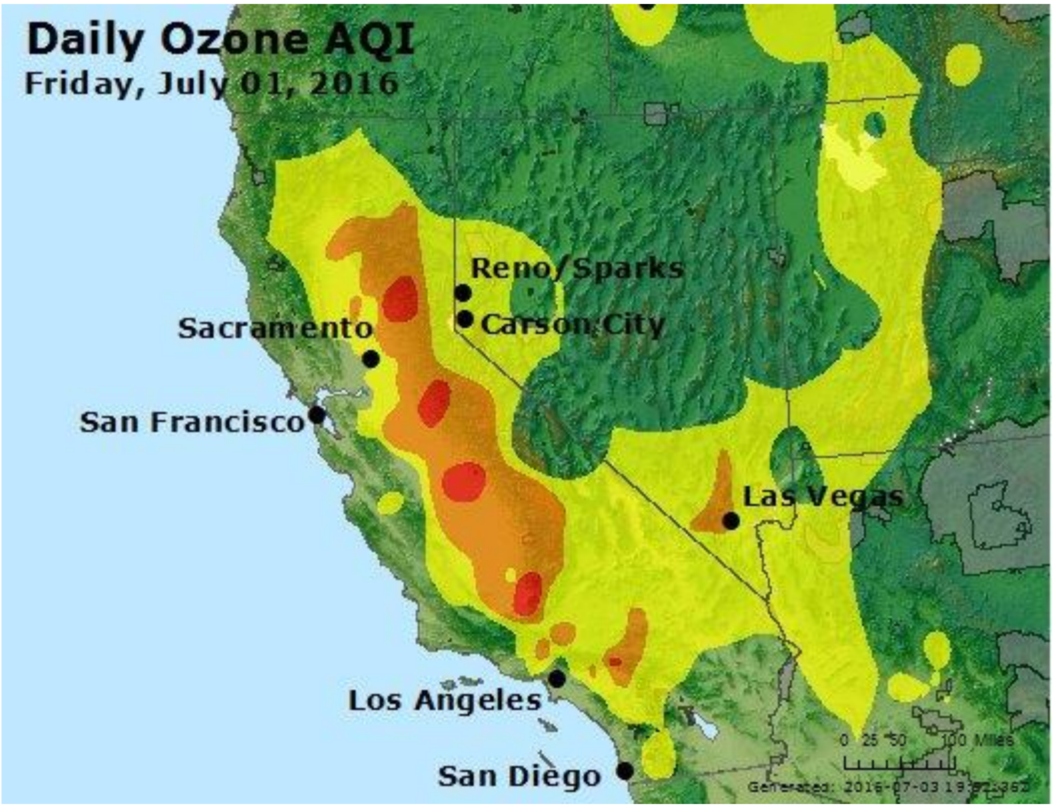
Sample Public Notifications



AirNow Ozone AQI from June 29, 2016.

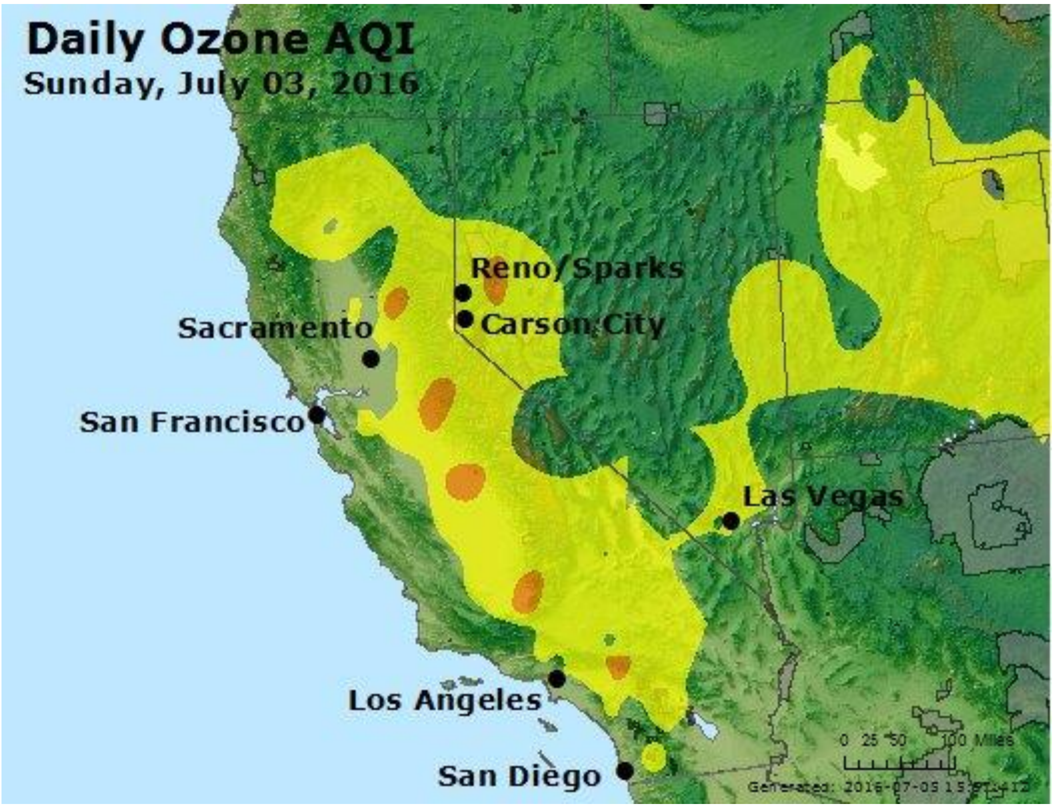


AirNow Ozone AQI from June 30, 2016.

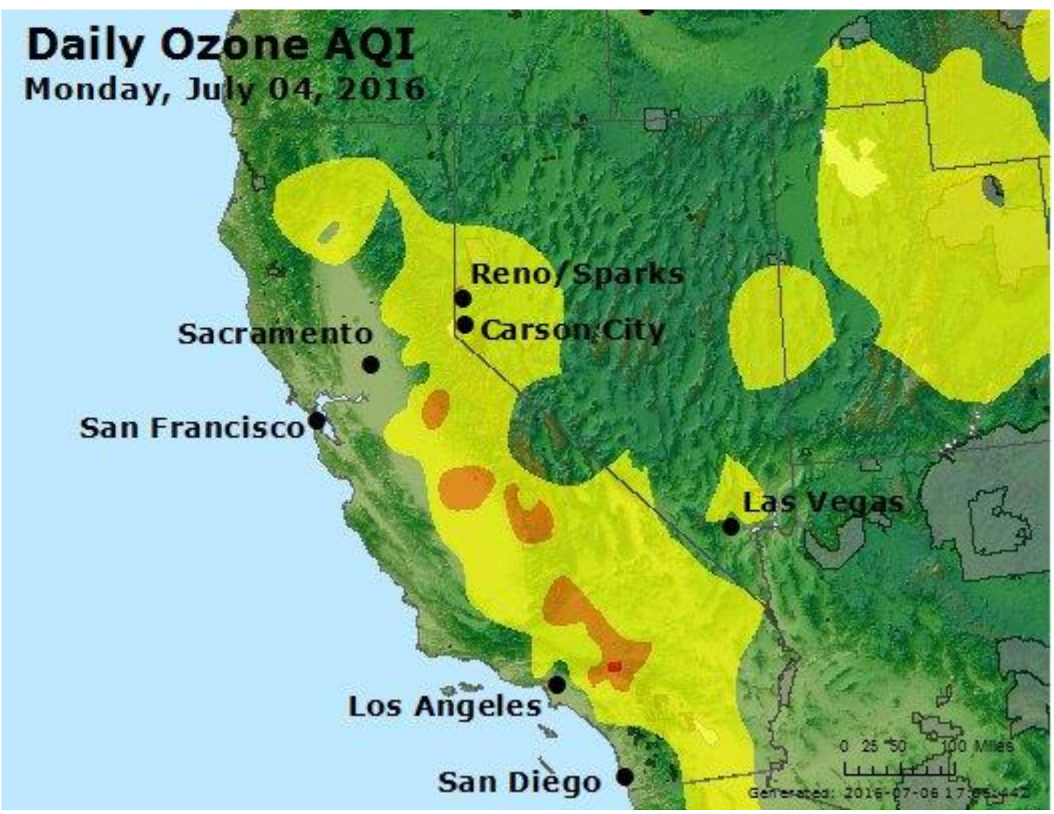


AirNow Ozone AQI from July 1, 2016.

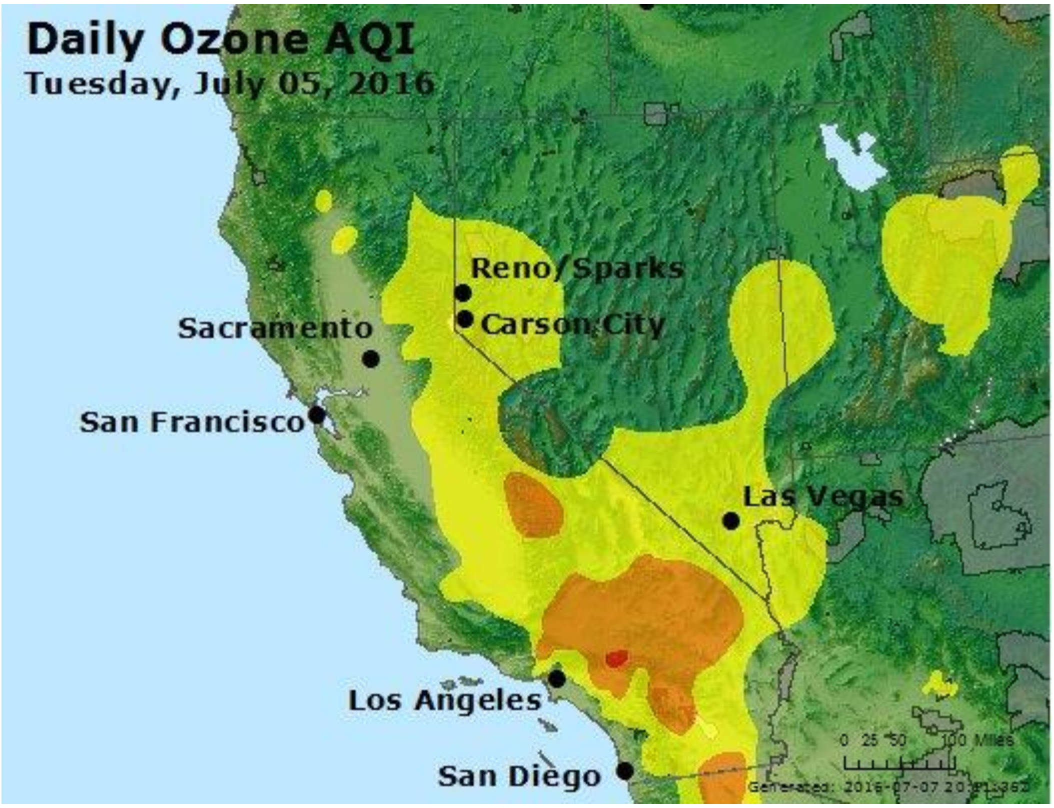
AirNow Ozone AQI from July 2, 2016.



AirNow Ozone AQI from July 3, 2016.



AirNow Ozone AQI from July 4, 2016.



AirNow Ozone AQI from July 5, 2016.

Saturday, July 02 2016

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY
THROUGH 0200Z July 3, 2016

SMOKE:
Southern Canada to Northwestern Canada and Alaska:
A large area of light remnant smoke from fires over the Northwest Territories, northern Saskatchewan and northern Alberta extends from portions of southern Ontario northern Michigan and extends northwest to portions of northwest Canada and eastern Alaska. An area of moderate density smoke was seen over the Northwest Territories. Multiple light to heavy density smoke plumes were seen moving north in northeast Alberta, northern Saskatchewan and southeast of Great Slave Lake in the Northwest Territories. Another group of wildfires in northeast Manitoba were seen emitting light to moderate density smoke to the south.

California:
An area of light to moderate density smoke was seen fanning out to the north and west from the wildfire named Pine in Ventura county. Another wildfire in the Sierra foothills named Trailhead was emitting a light to heavy density smoke plume to the northeast.

DUST:
Gulf of Mexico/Texas/Lower Mississippi River Valley/Southeast US:
An area of Saharan dust was seen spanning from the western portions of the Gulf of Mexico north into eastern Texas, and eastern Oklahoma. This area of dust possibly mixed with remnant smoke and sulfates in the Lower Mississippi River Valley and the Southeast US. Cloud cover obscured the extent of this aerosol to the north.

-Cronin

THIS TEXT PRODUCT IS PRIMARILY INTENDED TO DESCRIBE SIGNIFICANT AREAS OF SMOKE ASSOCIATED WITH ACTIVE FIRES AND SMOKE WHICH HAS BECOME DETACHED FROM THE FIRES AND DRIFTED SOME DISTANCE AWAY FROM THE SOURCE FIRE. TYPICALLY OVER THE COURSE OF ONE OR MORE DAYS. AREAS OF BLOWING DUST ARE ALSO DESCRIBED. USERS ARE ENCOURAGED TO VIEW A GRAPHIC DEPICTION OF THESE AND OTHER PLUMES WHICH ARE LESS EXTENSIVE AND STILL ATTACHED TO THE SOURCE FIRE IN VARIOUS GRAPHIC FORMATS ON OUR WEB SITE:

JPEG: http://www.ospo.noaa.gov/Products/land/hms.html
GIS: http://www.firedetect.noaa.gov/viewer.htm
KML: http://www.ssd.noaa.gov/PS/FIRE/kml.html
ANY QUESTIONS OR COMMENTS REGARDING THIS PRODUCT SHOULD BE SENT TO SSDFireTeam@noaa.gov

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Unless otherwise indicated:

- Areas of smoke are analyzed using GOES-EAST and GOES-WEST Visible satellite imagery.

- Only a general description of areas of smoke or significant smoke plumes will be analyzed.
- A quantitative assessment of the density/amount of particulate or the vertical distribution is not included.
- Widespread cloudiness may prevent the detection of smoke even from significant fires.

Sunday, July 3, 2016

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY
THROUGH 1730Z July 3, 2016

SMOKE:
Beaufort Sea/Northwestern to South Central Canada/Great Lakes Region:
An extensive area of light remnant smoke from fires in the Northwest Territories, northern Saskatchewan, northern Alberta, and north Manitoba extends southeastward from the Beaufort Sea to southern Ontario and the northern Great Lakes. Moderately dense to dense smoke is especially prevalent over the Northwest Territories directly north of the bulk of the fire activity.

Alaska:
A patch of thin remnant smoke is analyzed over northern Alaska, with nearby fires the likely cause. Off the western and southwestern coasts of the state, additional aerosol is observed that is thought to be remnant smoke from wildfires in Siberia that is now drifting east.

Western US:
Areas of thin to moderately dense smoke are seen over parts of northern California, Nevada, northwest Utah, and southeast Idaho. This smoke is largely from the Trailhead fire in California and the Hot Pot fire in northern Nevada.

DUST:
Gulf of Mexico/Texas Coast/Lower Mississippi River Valley/Southeast US:
An area of Saharan dust was seen over western and central portions of the Gulf of Mexico north to the Texas coast. Some of this dust possibly mixed with remnant smoke and sulfates also appears over parts of the Lower Mississippi River Valley and the Southeast US eventually disappearing beneath cloud cove just off the coast of North Carolina.

Eastern Caribbean/Bahamas/South Florida:
A large area of optically thick Saharan dust can be seen pushing westward across the Caribbean Sea from the Leeward Islands to just east of Jamaica. Other smaller separate areas of Saharan dust can also be seen crossing the Bahamas and far southern Florida/northwest Cuba

UNKNOWN AEROSOL:
New England/Canadian Maritimes:
A faint aerosol is seen along/off the coast of New England stretching from eastern Massachusetts east-northeast across the southern tip of Nova Scotia and then northeast along the coast as it wraps into a surface low over western Newfoundland. The composition and origin of this aerosol is not known.

Sheffler

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THE SOURCE FIRE IN VARIOUS GRAPHIC FORMATS ON OUR WEB SITE:

JPEG:   http://www.ospo.noaa.gov/Products/land/hms.html
GIS:    http://www.firedetect.noaa.gov/viewer.htm
KML:    http://www.ssd.noaa.gov/PS/FIRE/kml.html
ANY QUESTIONS OR COMMENTS REGARDING THIS PRODUCT SHOULD BE SENT TO
SSDFireTeam@noaa.gov
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- Widespread cloudiness may prevent the detection of smoke even from significant fires.

Sunday, July 3, 2016

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY
THROUGH 0100Z July 4, 2016

SMOKE:
Northwestern to South Central Canada/Great Lakes Region:
An extensive area of light density remnant smoke from fires in the Northwest Territories, northern Saskatchewan, northern Alberta, and northern Manitoba extends southeastward from northwest Nunavut to southern Ontario and the northern Great Lakes. Moderately dense to dense smoke is especially prevalent over the Northwest Territories directly north of the bulk of the fire activity. Numerous wildfires were seen in between cloud cover emitting light to heavy density smoke to the north in northern Saskatchewan and southeast of Great Slave Lake in the Northwest Territories. Wildfires in northern Manitoba were producing light to moderate density smoke to the west.

California/Nevada:
Areas of thin to moderately dense remnant smoke were seen over parts of northern and southern California, and Nevada. This smoke is largely from the Trailhead fire in California, the fire named Pine in Ventura County California and the Hot Pot fire in northern Nevada. The Pine fire was fanning light to moderate density to the southwest and northwest while the Trailhead fire in the Sierra foothills continues to emit a light to moderate density smoke plume to the northeast into western Nevada. The Hot Pot brush fire in west-central Elko county Nevada was seen spreading quickly to the east-northeast in shortwave IR imagery. A light to heavy density smoke plume was emanating to the east-northeast from this brush fire although clouds obscured the full extent of this smoke to the east.

DUST:
Eastern Caribbean/Bahamas/South Florida:
A large area of optically thick Saharan dust can be seen pushing westward across the Caribbean Sea from the Leeward Islands to just east of Jamaica. Other smaller separate areas of Saharan dust can also be seen crossing the Bahamas and far southern Florida/northwest Cuba although clouds began to obscure the extent of this dust in the afternoon and evening.

-Cronin

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Saturday, July 4, 2016

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY
THROUGH 1815Z July 4, 2016

SMOKE:
Northwestern to South Central Canada:
An extensive area of light density remnant smoke from fires in the Northwest Territories, northern Saskatchewan, northern Alberta, and northern Manitoba extends southeastward from northwest Nunavut to southeast Ontario/southwest Quebec. Moderately dense to dense smoke is especially prevalent over the Northwest Territories directly north of the bulk of the fire activity.

North Utah/Northwest Colorado/South Wyoming:
An area of moderately dense to dense smoke has moved from northern Utah eastward today crossing southern Wyoming and northwest Colorado. This remnant smoke is primarily from the Hot Pot brush fire in west-central Elko county Nevada. However, two smoke producing fires in the Sierra Nevada yesterday may have also contributed to this area of smoke.

North Dakota/Northwest Minnesota/Southern Manitoba:
An area of thin remnant smoke observed over eastern North Dakota, northwest Minnesota, and southern Manitoba is likely from the brush fire in Nevada.

Alaska:
Remnant smoke is seen from the northern coast of the Alaska stretching northeast across the Arctic waters and ice. In addition a small patch of thin smoke is observed off the west coast of Alaska between areas of cloud cover. All of this smoke is primarily believed to be from Siberian wildfires.

DUST:
Eastern Caribbean/Bahamas/South Florida/Southeast Gulf of Mexico/Western Atlantic:
An expansive area of optically thick Saharan dust can be seen pushing westward across almost the entire Caribbean Sea from the Leeward Islands to just east of the Yucatan Peninsula. The dust extends north across Hispanola and eastern Cuba over much of the Bahamas and into part of the western Atlantic. Saharan dust can also be seen spreading west across southern Florida and the southeastern Gulf of Mexico.

Western and Northern Gulf of Mexico/Southern Plains/Lower Mississippi River Valley/Southeast US:
A broad area of aerosol that is believed to be mostly African dust is present across the western and northern portions of the Gulf of Mexico extending inland across central Texas/far southern Oklahoma, the Lower Mississippi River Valley, and much of the Southeast US disappearing beneath cloud cover over North Carolina. Other aerosols including a small amount of remnant smoke may be mixed with the elevated dust. Remnant smoke coming from Mexican oil rigs in the Bay of Campeche could be seen over the western Gulf as well.

Central Nunavut:
A swath of aerosol thought to be elevated dust is seen moving west along

the northwestern shore of Hudson Bay becoming mixed with the extensive area of remnant smoke over northwest Canada. The origin of the dust is not known.

UNKNOWN AEROSOL:
Northeast US/Canadian Maritimes:
A faint aerosol is seen moving off the coast of the Northeastern US states and across Nova Scotia, Newfoundland, and the Gulf of St. Lawrence. While the composition of the aerosol can not be fully determined, it seems plausible that this could be remnant smoke from the wildfires in Canada, possibly mixed with other unknown aerosols.

Great Lakes Region:
An area of aerosol is observed moving northward across far northeast Iowa, southeast Minnesota, Wisconsin, Lake Michigan, Michigan, and Lake Superior towards southern Ontario. There is a possibility that this aerosol is dust although it is uncertain if this is the case given the wide array of aerosols and sources across the United States today.

Sheffler

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Sunday, July 4, 2016

DESCRIPTIVE TEXT NARRATIVE FOR SMOKE/DUST OBSERVED IN SATELLITE IMAGERY
THROUGH 0200Z July 5, 2016

SMOKE:
Northwestern to South Central Canada:
An extensive area of light density remnant smoke from fires in the Northwest Territories, northern Saskatchewan, northern Alberta, and northern Manitoba extends southeastward from northwest Nunavut to southeast Ontario/southwest Quebec. Moderately dense to dense smoke is especially prevalent over the Northwest Territories directly north of the bulk of the fire activity. Numerous wildfires were seen in between cloud cover emitting light to heavy density smoke to the west-northwest in northern Saskatchewan and southeastern portions of the Northwest Territories. Wildfires in northern Manitoba were producing light to moderate density smoke to the west and west-southwest.

Nebraska/Kansas/Northeast Colorado/Southern Wyoming:
An area of light to moderate density remnant smoke has moved from northern Utah eastward today crossing southern Wyoming, northeast Colorado into western Nebraska and north-central Kansas. This remnant smoke is primarily from the Hot Pot brush fire in west-central Elko county Nevada. However, two smoke producing fires in the Sierra Nevada yesterday may have also contributed to this area of smoke. The western extent of this area of smoke was obscured by clouds.

California:
The fire named Pine in southern California was fanning light to moderate density smoke to the southwest and north while the Trailhead fire in the Sierra foothills continues to emit a light to moderate density smoke plume to the northeast into western Nevada.

DUST:
Eastern Caribbean/Bahamas/South Florida/Southeast Gulf of Mexico/Western Atlantic:
An expansive area of optically thick Saharan dust can be seen pushing westward across almost the entire Caribbean Sea from the Leeward Islands to the Yucatan Peninsula. The dust extends north across Hispanola and eastern Cuba over much of the Bahamas and into part of the western Atlantic.

Western and Northern Gulf of Mexico/Southern Plains/Lower Mississippi River Valley/Southeast US:
A broad area of aerosol that is believed to be mostly diffuse Saharan dust is present across the western and northern portions of the Gulf of Mexico extending inland across central Texas/far southern Oklahoma, the Lower Mississippi River Valley, and much of the Southeast US disappearing beneath cloud cover over North Carolina. Other aerosols including a small amount of remnant smoke may be mixed with the elevated dust. Remnant smoke coming from Mexican oil rigs in the Bay of Campeche could be seen over the western Gulf as well.

Nevada:
A small area of blowing dust/sand originating from the Carson sink was seen in west-central Nevada moving east-southeast from the source region.

UNKNOWN AEROSOL:
Northeast US/Canadian Maritimes:
A faint aerosol is seen moving off the coast of the Northeastern US states and across Nova Scotia, Newfoundland, and the Gulf of St. Lawrence. While the composition of the aerosol can not be fully determined, it seems plausible that this could be remnant smoke from the wildfires in Canada, possibly mixed with other unknown aerosols.

-Sheffler/Cronin

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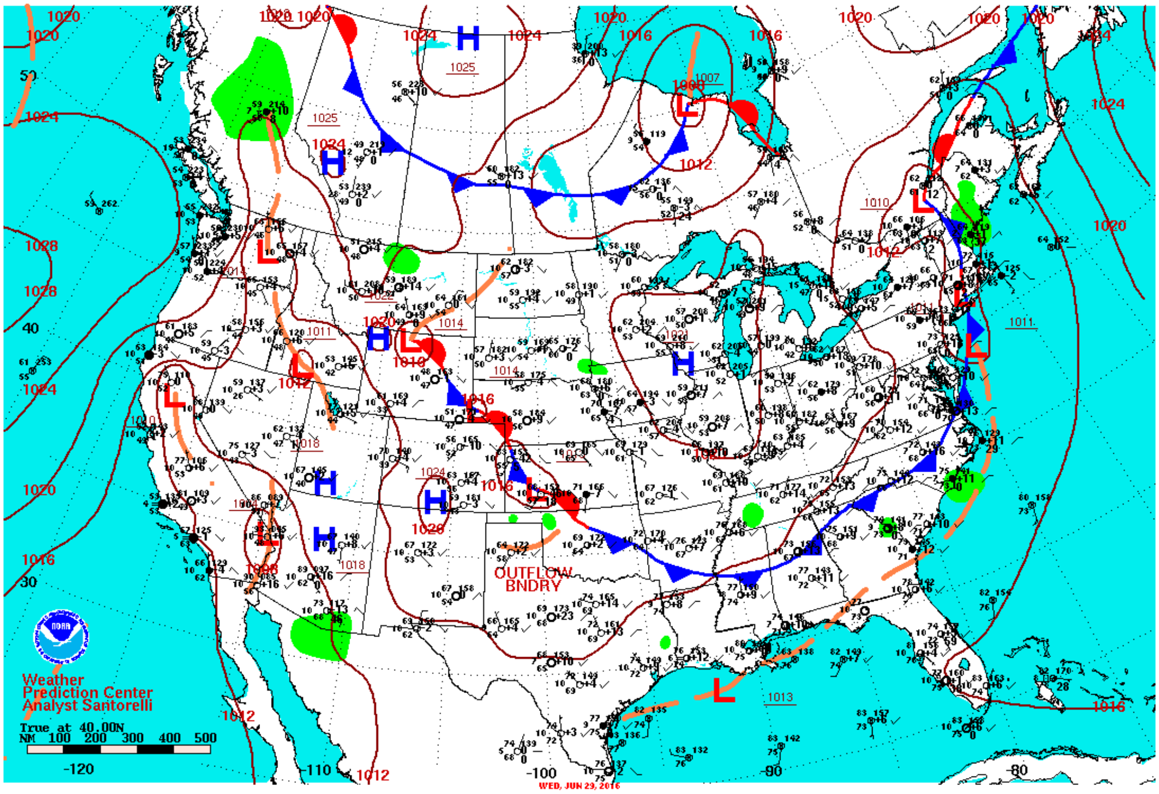
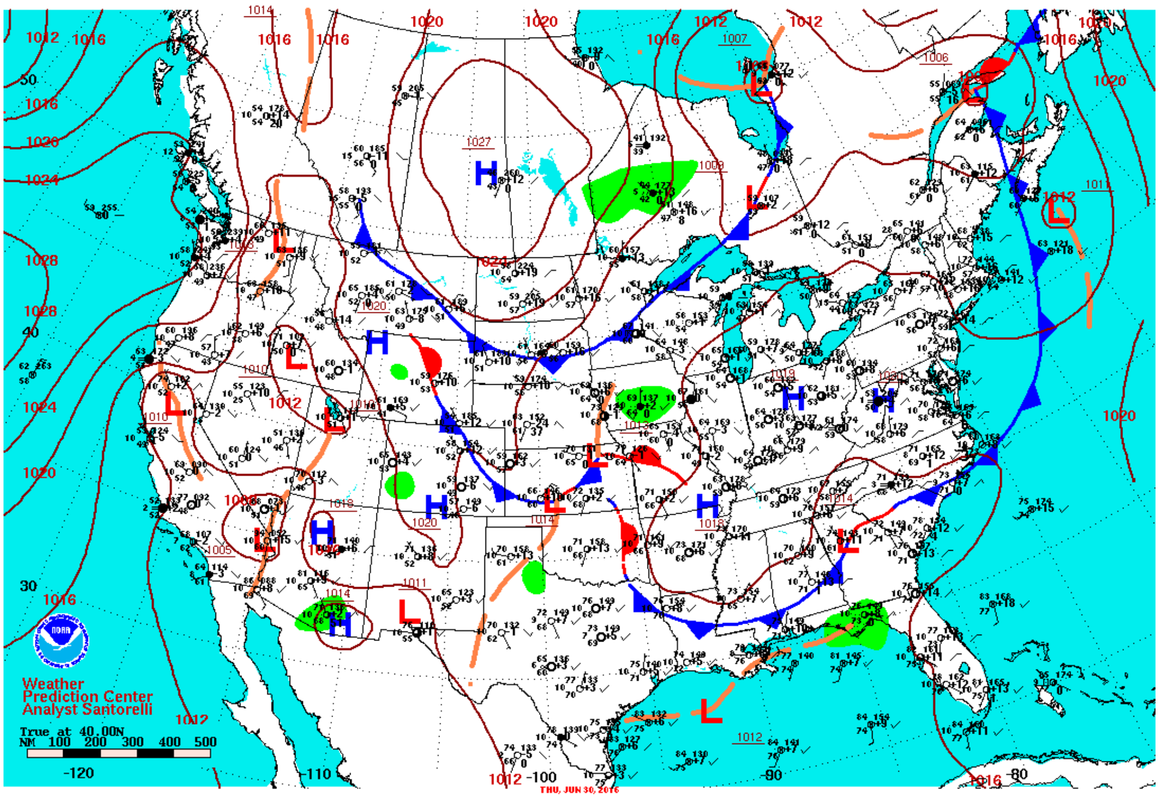
APPENDIX D

Surface Weather Maps for the Fernley Area – June 29 through July 5, 2016



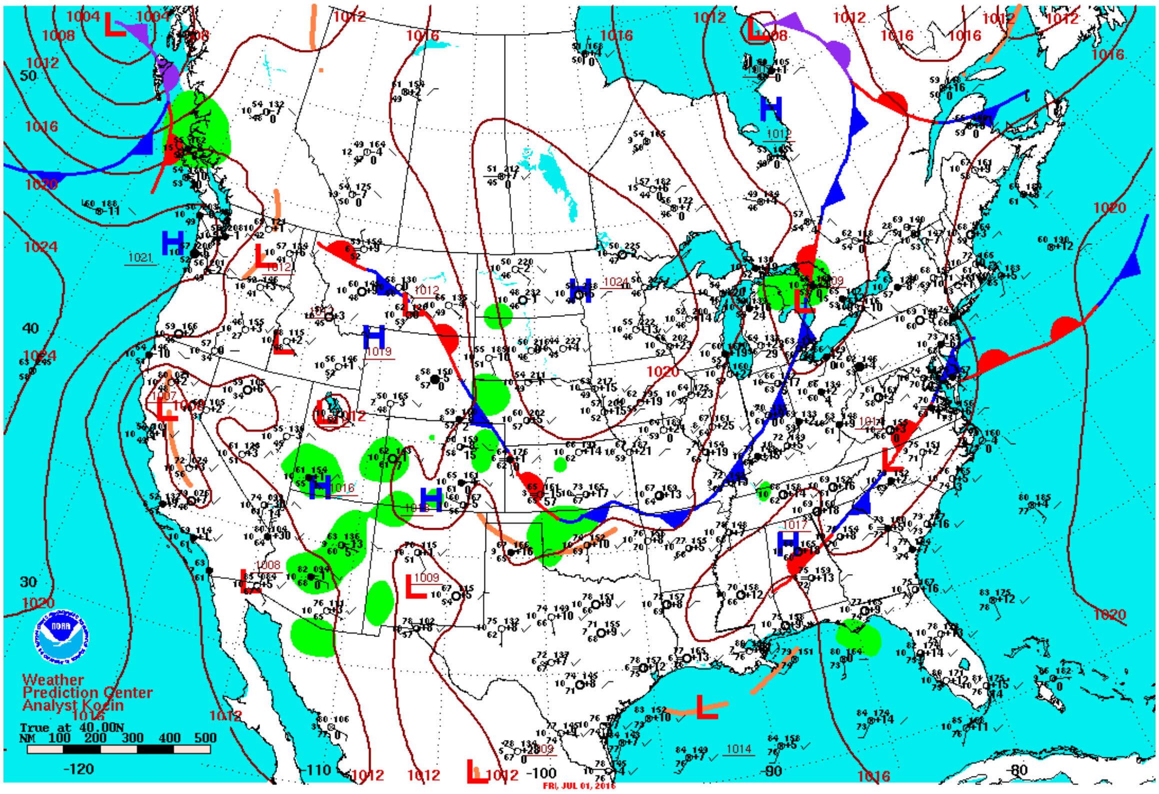
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – June 29, 2016



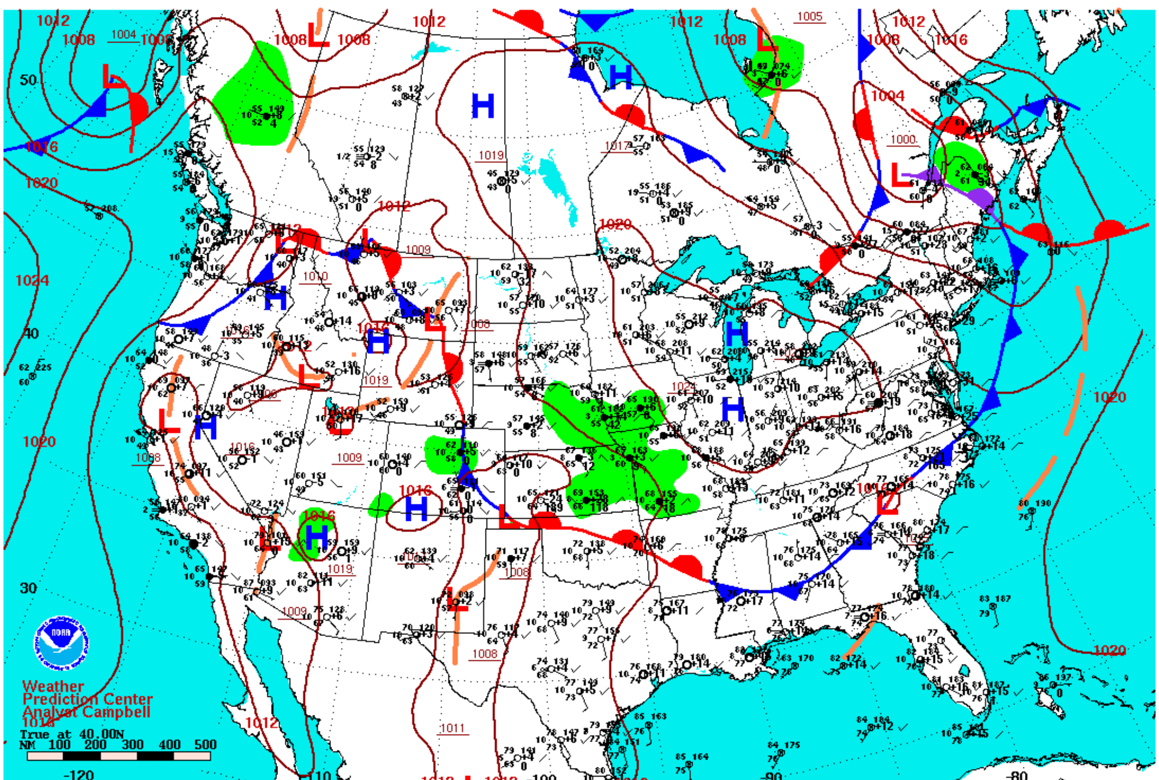
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – June 30, 2016



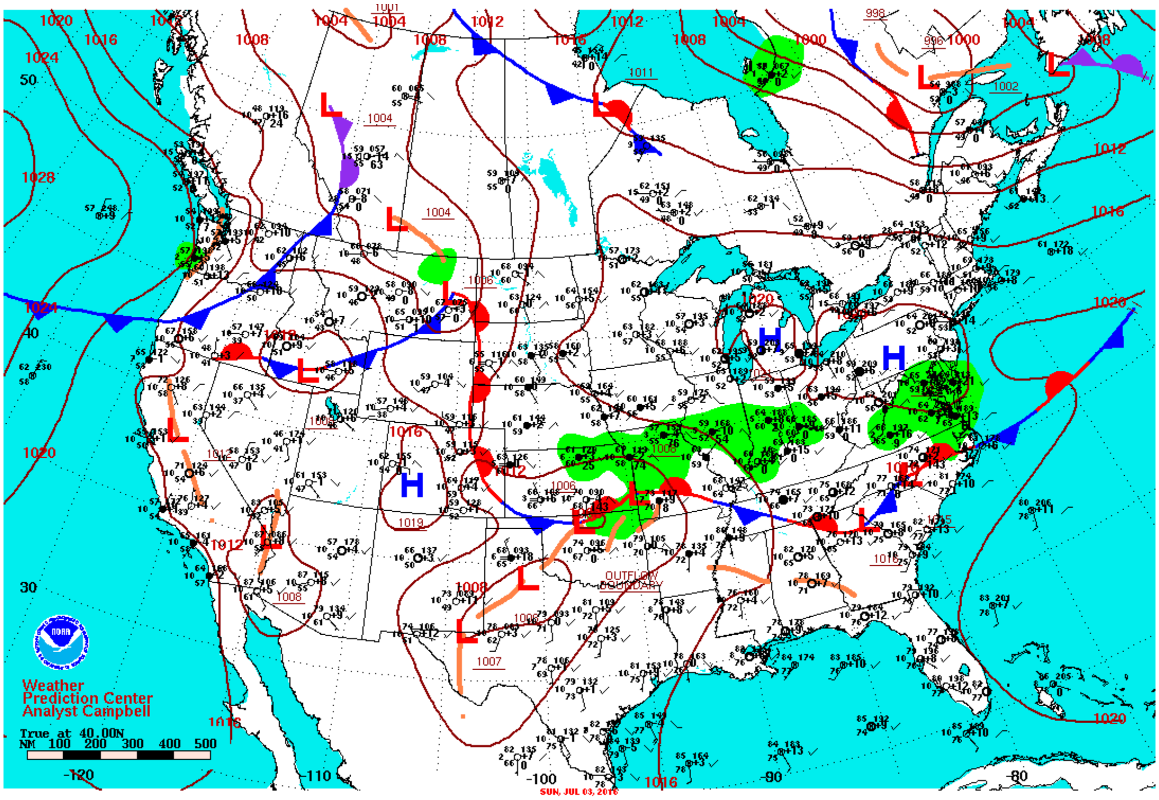
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – July 1, 2016



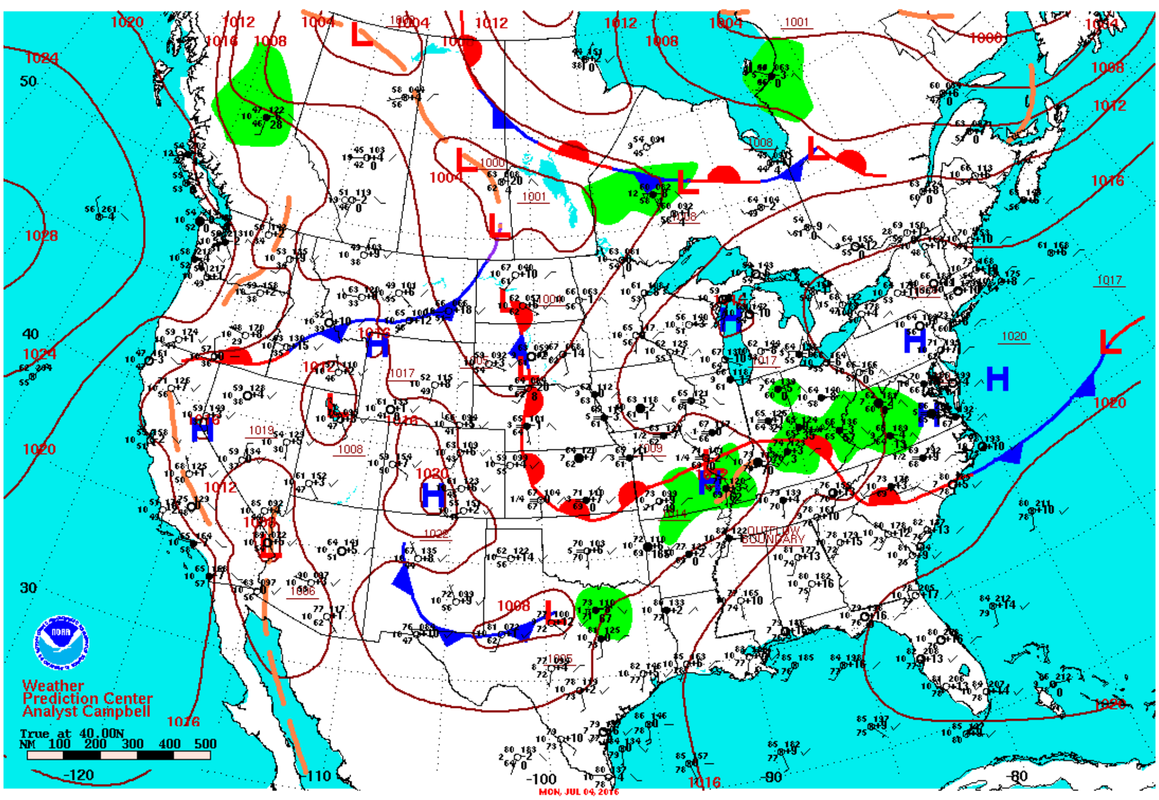
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – July 2, 2016



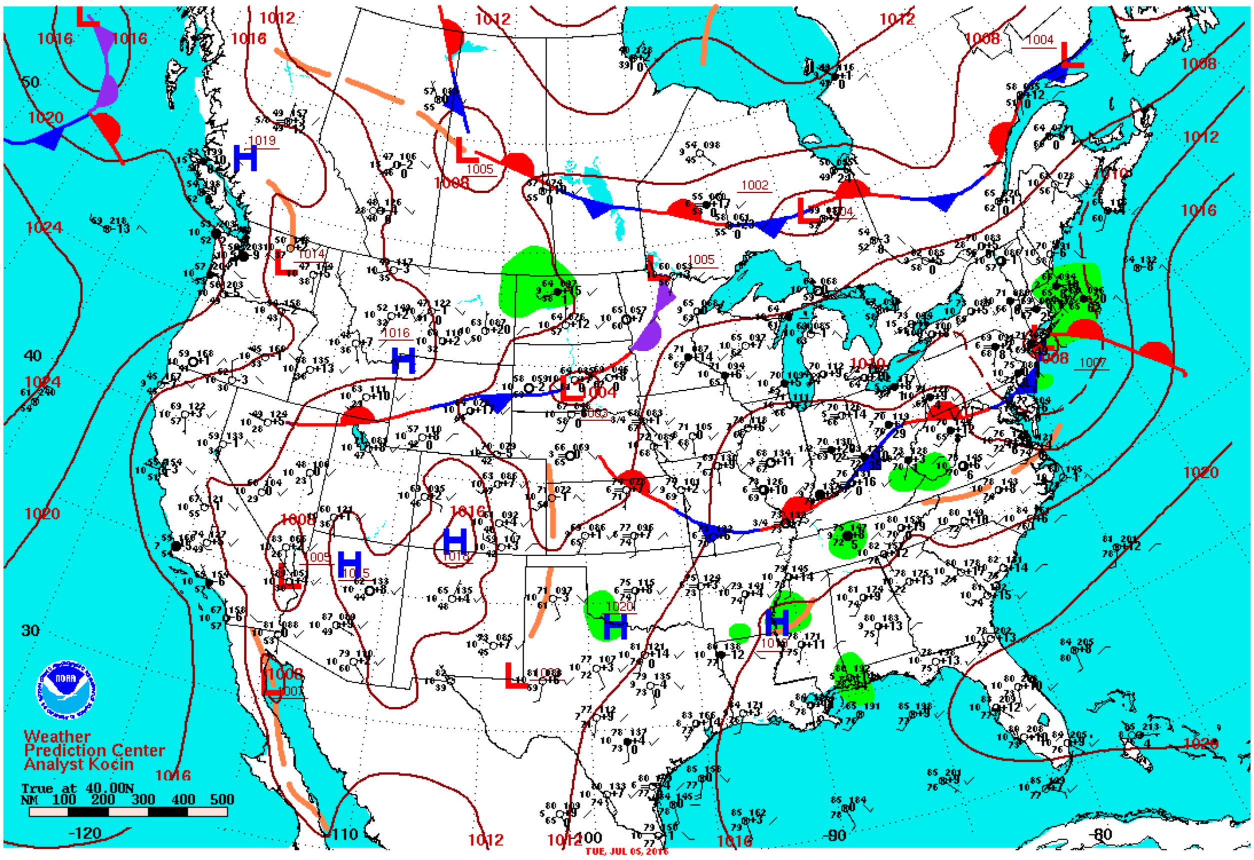
Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – July 3, 2016



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – July 4, 2016



Surface Weather Map and Station Weather at 7:00 A.M. E.S.T.

Surface Weather Map – July 5, 2016