

# **PM2.5 Exceptional Event – Independence Day Fireworks**

**Event Date – July 4, 2014**

**Ogden Monitoring Station**



*Utah Department of*  
**Environmental Quality**

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## Definition of Event

The Code of Federal Regulations (CFR) provides the definition and criteria for determining whether air quality data is impacted by an exceptional event. The 40 CFR 50.1 (j) definition states that “exceptional event means an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event.” The demonstration to justify data exclusion, as outlined in 40 CFR 50.14, specifies that the following evidence must be provided:

1. The event meets the definition of an exceptional event;
2. There is a clear causal relationship between the measurements under consideration and the event that is claimed to have affected air quality in the area;
3. The event is associated with a measured concentration in excess of normal historical fluctuations, including background;
4. There would have been no exceedance or violation but for the event; and
5. The fireworks event was held on July 4, Independence Day, as part of a traditional or national culture event (40 CFR 50.14 (b)(2)).

## Introduction

The Division of Air Quality (DAQ) and the Environmental Protection Agency have recognized a pattern of historical exceedances at the Ogden monitoring station from fireworks for the national 4<sup>th</sup> of July holiday.

An exceedance of the 24-hr PM<sub>2.5</sub> standard of 35 µg/m<sup>3</sup> occurred on July 4, 2014 at a concentration of 81.7 µg/m<sup>3</sup>. DAQ has investigated the event and has determined that the exceedance was due to neighborhood fireworks celebrating the national 4<sup>th</sup> of July holiday.

## Event Location

The City of Ogden is located north of Salt Lake City in Weber County. The Ogden monitoring station (shown with yellow push-pin label) is located adjacent to the Ogden Community Action Center. Metrological and 1-minute PM<sub>2.5</sub> measurements, presented in the next section, indicate that neighborhood use of fireworks influenced this year’s exceedance.



## Fireworks Visual Confirmation

A camera was mounted at the monitoring station directed towards the south, capturing images of the parking lot, a grass field and the adjacent residential neighborhood. The camera is set to collect an image every five minutes. Photo number 1 shows the day light hour view. Photo number 2 was taken at 9:30 p.m., showing the only image captured of illegal fireworks set-off on the grass field.



Photo 1



Photo 2

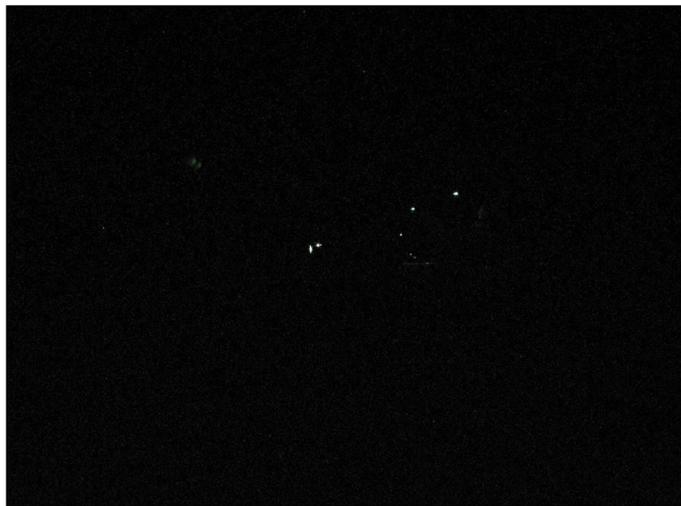


Photo 3

Photo number 3 is a sample of the many duplicate images captured on the 4<sup>th</sup>. The white spots are legal fireworks being shot off in the residential neighborhood. We discovered that the camera is not able to capture good images of fireworks at night time unless the fireworks are directly in front of the station, as in photo number 2.

A DAQ staffer visited the station around 10 p.m. He verified that there was no illegal fireworks use at the time but that the residential neighborhoods, especially the one to the south, were ablaze with legal fireworks (see photo number 4). He also confirmed that the air was stagnant and smoke filled, as shown in photo number 5.



Photo 4



Photo 5

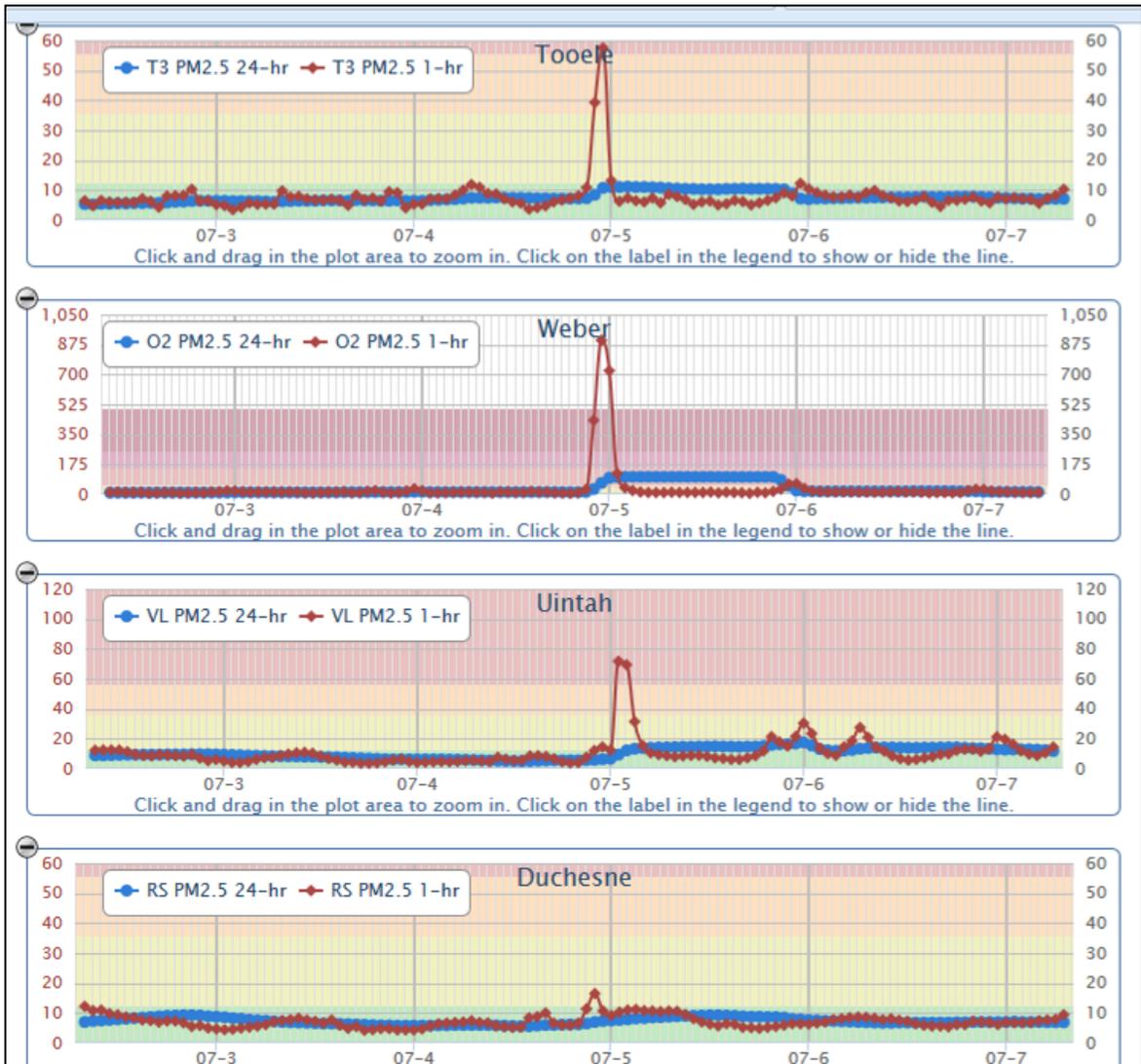
## Affect Air Quality

### Fireworks Chemistry

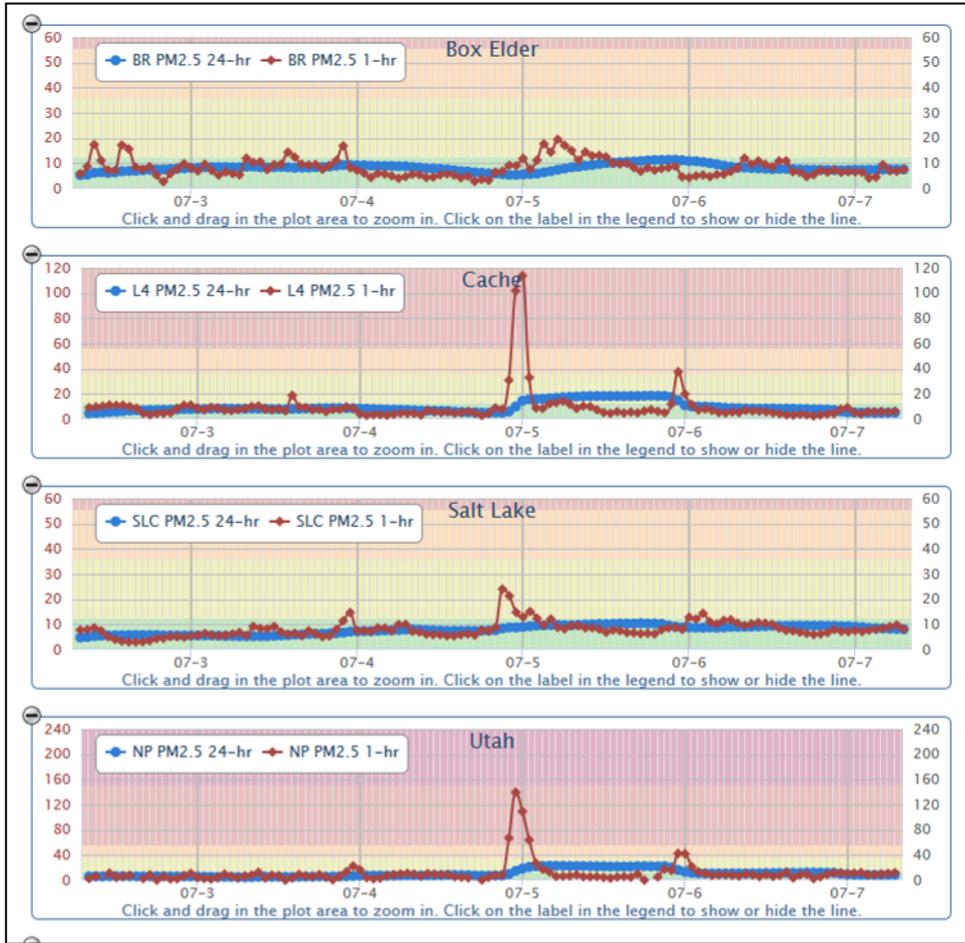
Fireworks consist of 75% gunpowder (potassium nitrate), 15% carbon and 10% sulfur. Metal compounds and other elements are added to generate desired color and or pyrotechnic effects. The materials react with each other when heat is applied from a fuse. The reaction results in the development of particulate matter and gases, including carbon monoxide (CO), which is measured at the Ogden monitoring station.

### Regional Air Quality

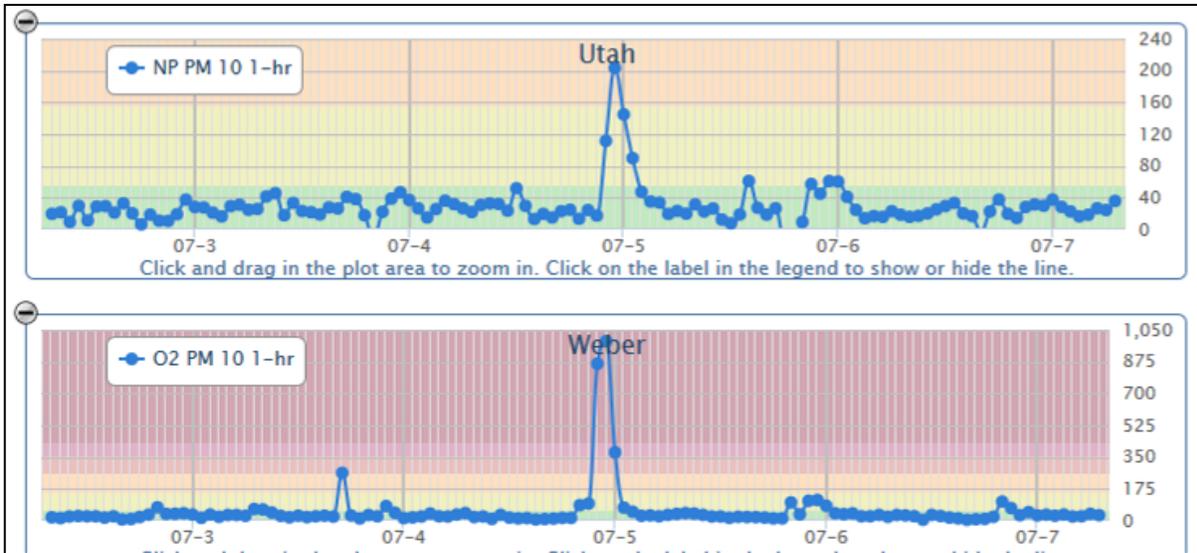
PM2.5 is a sensitive indicator of fireworks emissions. Continuous PM2.5 monitors across the Utah monitoring network showed dramatic PM2.5 peaks during the late evening hours on the 4<sup>th</sup> of July, consistent with when fireworks are set-off. Fireworks are permitted on the 4<sup>th</sup> and three days after the 4<sup>th</sup>, which explains the smaller peaks in the evening hours at some locations after the 4<sup>th</sup> of July.



Utah Division of Air Quality – Ogden Fireworks Exceptional Event  
Event Date July 4, 2014



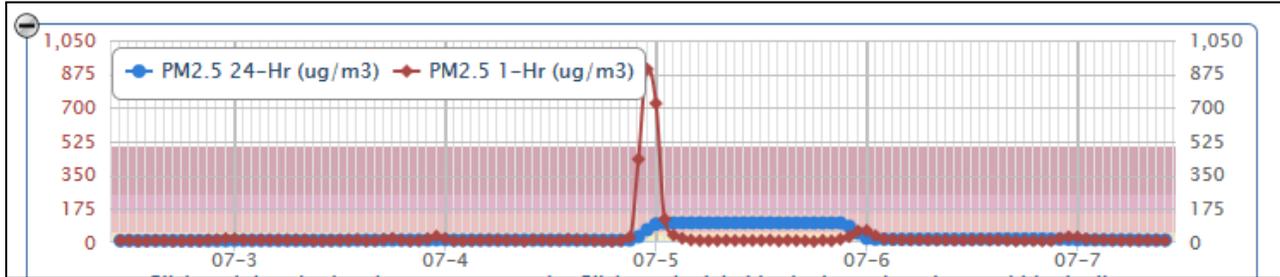
Continuous PM10 monitors operating on the 4<sup>th</sup> of July in Provo (Utah County) and at



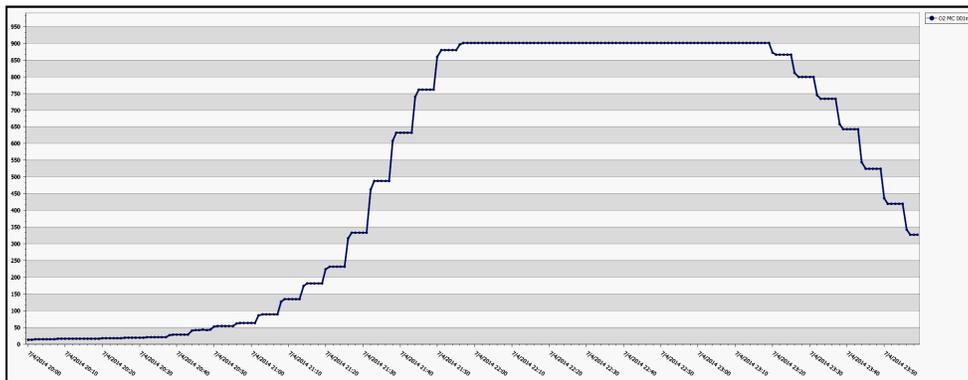
Ogden (Weber County) also showed dramatic peaks during the late evening on the 4<sup>th</sup> of July, when fireworks are set-off.

### Ogden Monitoring Station

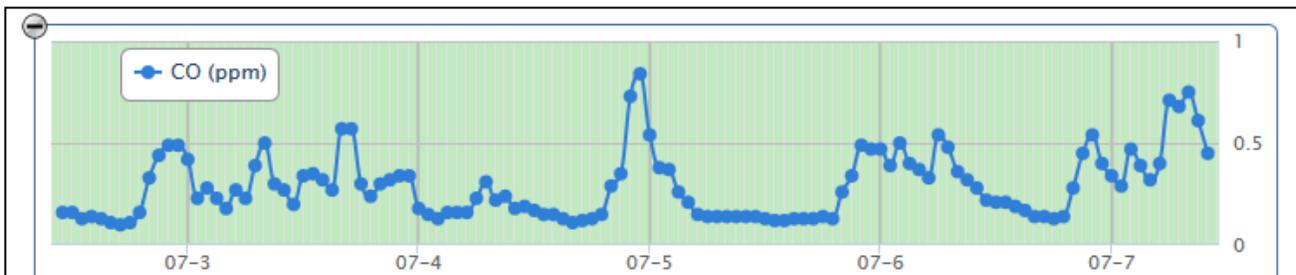
The trend chart presents the continuous PM2.5 values before and after the 4<sup>th</sup> of July for the Ogden monitoring station. A spike in PM2.5 occurred on July 4, corresponding with the time when fireworks are set-off, lingering in the atmosphere into July 5. The hourly concentration on the 4<sup>th</sup> peaked at 900.5  $\mu\text{g}/\text{m}^3$  at 11p.m. and at 62.8  $\mu\text{g}/\text{m}^3$  at 1 a.m. on the 5<sup>th</sup>.



The following graph presents the PM2.5, 1-minute concentrations from 8 to 11:50 p.m. Elevated levels started at 8:40 p.m.



Elevated carbon monoxide levels correspond well with the PM2.5 peaks on the 4<sup>th</sup> and 5<sup>th</sup>, during traditional fireworks hours.

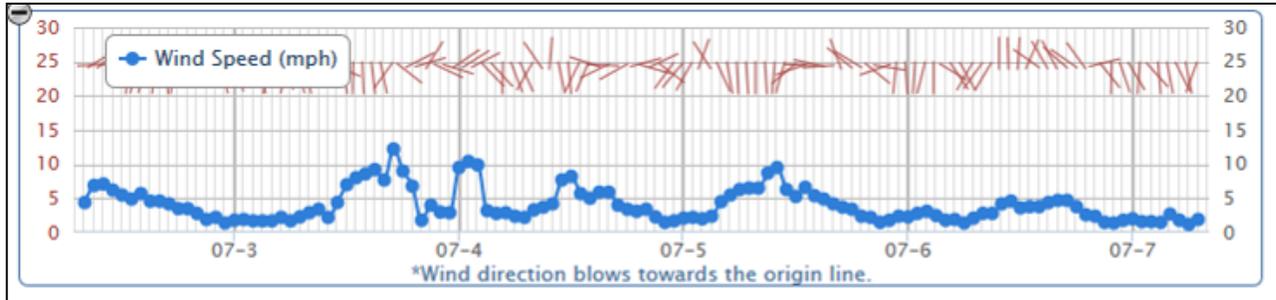


PM2.5 filter values before, during and after the 4<sup>th</sup> of July for the Ogden monitoring station:

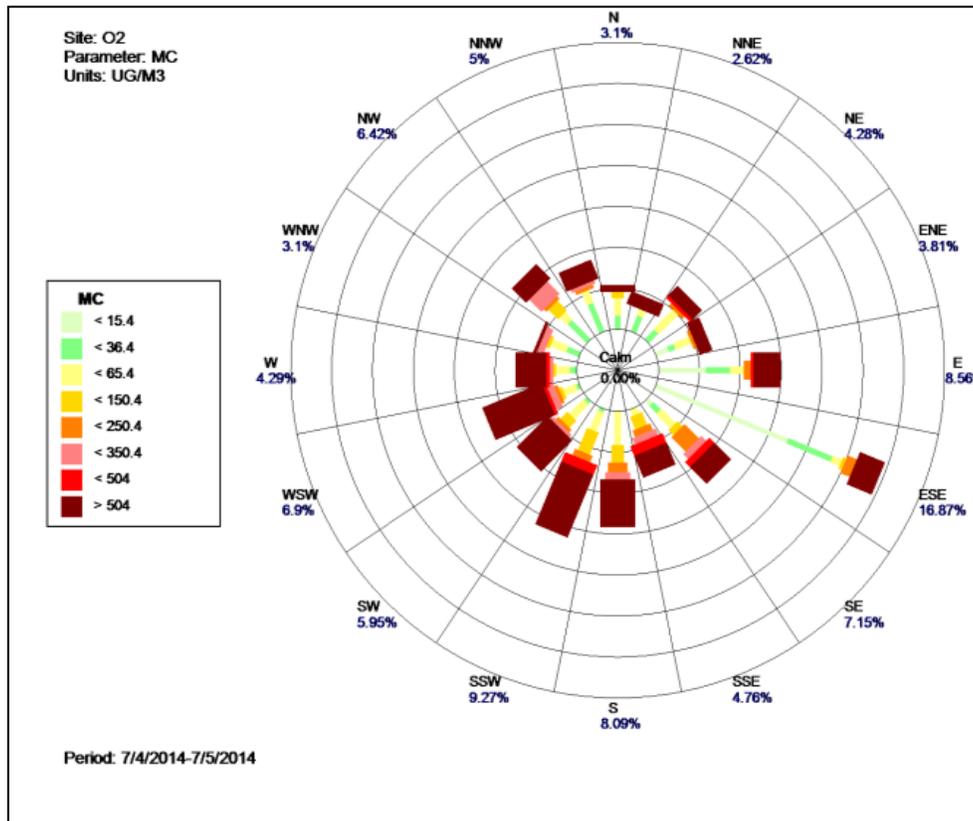
- July 3, 2014 – 9.7  $\mu\text{g}/\text{m}^3$
- July 4, 2014 – 81.7  $\mu\text{g}/\text{m}^3$
- July 5, 2014 – 15.6  $\mu\text{g}/\text{m}^3$

## Meteorological Conditions

Meteorological data from the Ogden monitoring station shows that the late night winds on the 4<sup>th</sup> of July were mostly from the south-southwest and mostly stagnant. The wind speed from 9 p.m. to midnight ranged from 1.5 – 2.3 mph. Localized impact at the Ogden monitoring station would be expected with these stagnant conditions.



A 1-minute period, pollution wind rose of PM<sub>2.5</sub> concentration vs. wind direction plotted from 7 p.m. on July 4<sup>th</sup> to 2 a.m. on the 5<sup>th</sup>, shows that fireworks emissions were generally coming from the residential neighborhoods surrounding the monitoring station, with the highest concentration coming from the neighborhood to the south-southwest. This pollution wind rose is consistent with the report made by the DAQ staffer who noted that the surrounding neighborhoods were ablaze with fireworks and that stagnant smoke was evident throughout the area.



## Normal Historical Fluctuation

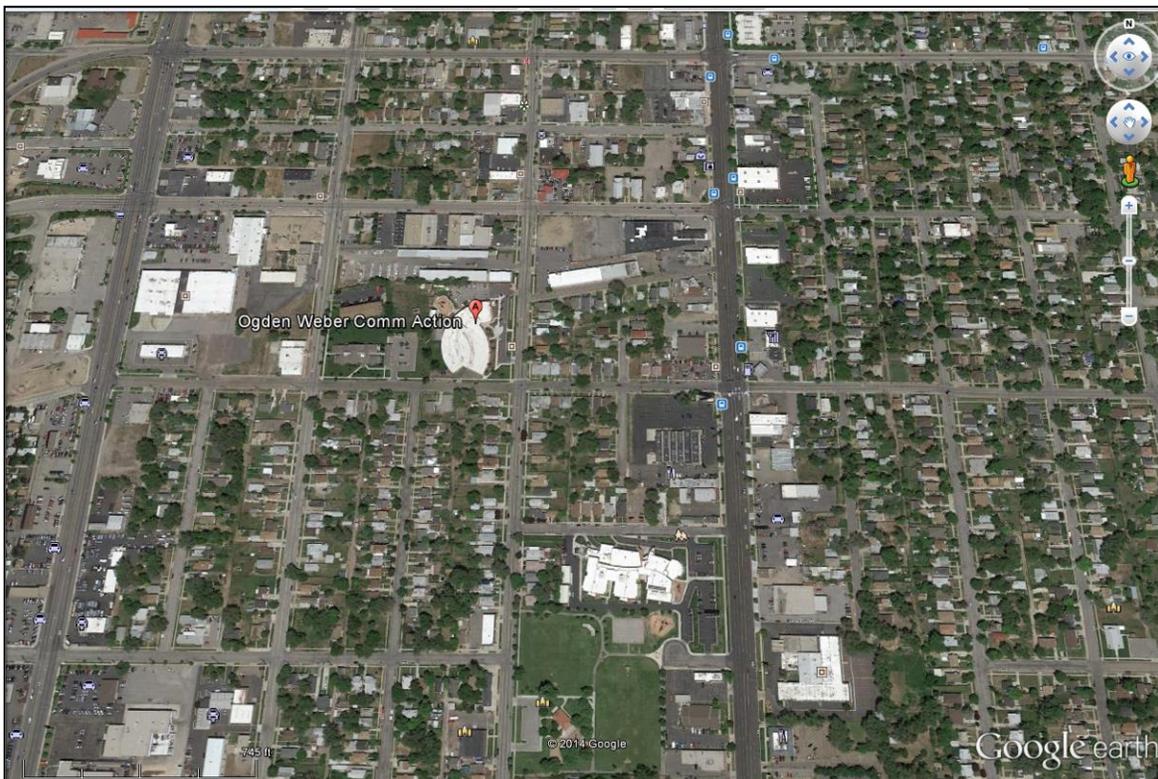
The table below presents the annual mean and maximum values 24-hr filter values (including data for winter time inversion, influences from wildfires and fireworks) for the Ogden monitoring station from its inception in 2001 to 2013. The range of the annual mean is 9.1- 14.6  $\mu\text{g}/\text{m}^3$ . The measured value for this event is 81.7  $\mu\text{g}/\text{m}^3$ . Two of the maximum values were on the 4<sup>th</sup> of July holiday. The remaining maximum values are due to winter time inversions.

Ogden 24-hr Filter PM2.5

Year	Observations	Annual Mean ( $\mu\text{g}/\text{m}^3$ )	Annual Max ( $\mu\text{g}/\text{m}^3$ )	Date of Max Value
2001	50	12.4	66.6	December 30
2002	119	14.6	108.3	July 4
2003	118	9.9	38.3	December 20
2004	118	13.9	74.2	February 15
2005	115	10.5	42.4	January 19
2006	120	9.8	47.6	January 26
2007	121	11.7	76.8	January 30
2008	358	9.9	46.7	January 25
2009	343	10.2	56.4	January 22
2010	341	9.2	56.1	January 11
2011	347	9.1	64.6	January 7
2012	341	9.1	63.7	July 4
2013	332	9.9	67.2	January 9

## Causal Relationship

1. Setting off fireworks results in the generation of particulate matter and gases, including CO, which is measured at the Ogden monitoring station. Elevated levels of PM10, PM2.5 and CO were measured at the station during the evening hours of the 4<sup>th</sup> of July holiday celebration.
2. Visual images were collected verifying that the surrounding residential neighborhoods were the source of legal fireworks use that inundated the entire area with smoke.
3. Stagnant wind conditions at the Ogden monitoring station during the evening hours of the 4<sup>th</sup> of July would support localized fireworks emissions impact upon the monitoring station. The Google Earth image highlights the location of the Ogden Weber Community Action Center, which is adjacent to the monitoring station and the surrounding residential areas. The image confirms the presence of suburban areas that would support legal use of street level fireworks.

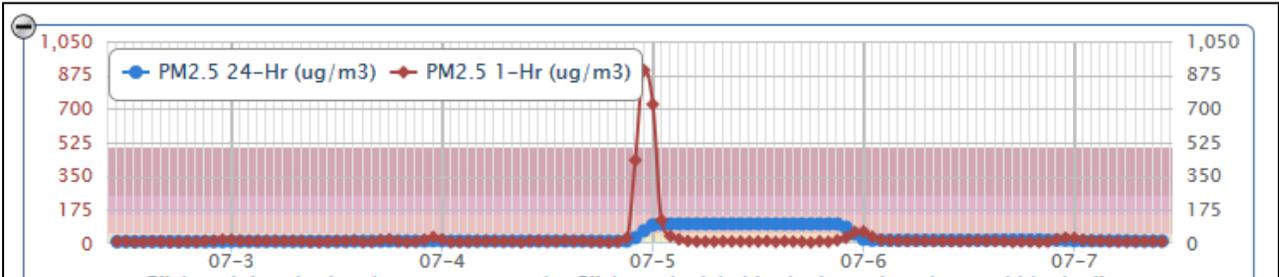


A DAQ staffer visited the station around 10 p.m. and was able to confirm heavy fireworks activity in the residential neighborhoods and subsequent smoke that stagnated around the monitoring station.

4. DAQ and the Environmental Protection Agency have recognized a pattern of historical exceedances at the Ogden monitoring station from fireworks for the national 4<sup>th</sup> of July holiday.

## No Exceedance or Violation But For the Event

The trend chart shows a dramatic PM2.5 peak during the evening hours of July 4, when fireworks would be expected to be set-off.



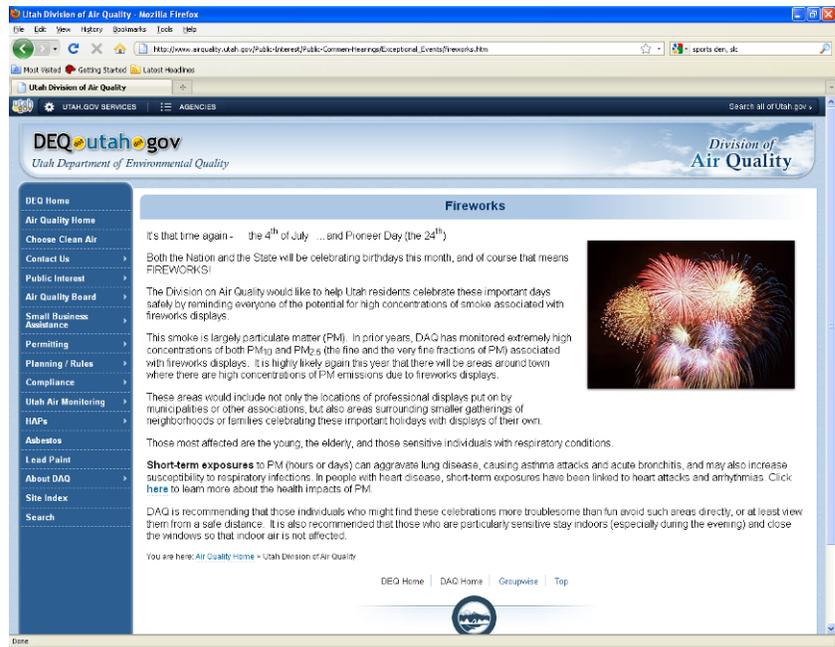
There were no other known anthropogenic events which could have contributed to the level of PM2.5 measured on July 4<sup>th</sup>.

## Mitigation

### Utah Air Quality Public Notifications

The DAQ web page provides information on fireworks events, explaining the type of air quality impact from fireworks and warning sensitive populations to stay indoors.

DAQ issued its annual press release regarding air quality and health impact from fireworks on July 2. The press release included notification to two Spanish-speaking stations to assure that Spanish speakers living in Ogden could be informed. The major local networks provided segments about fireworks.



### ***Control of Illegal Fireworks***

The city of Ogden has in place ordinance 11-6-3, section D, that prohibits the use of fireworks in open areas, parks and city property. Consequently, firework use around the monitoring station is illegal. DAQ has maintained a long-standing dialogue with the local fire authority regarding the use of fireworks around the monitoring station. The Deputy Chief has assured DAQ that they patrol the area, confiscate fireworks when used illegally and issue violations. The fire trucks have at least one Spanish speaking fireman who can communicate with the local Spanish community. Further, the fire company hands out flyers about fireworks use in English and Spanish.

### **Conclusion**

1. There is a clear causal relationship between the PM<sub>2.5</sub> measurement under consideration and the event that is claimed to have affected air quality. Carbon monoxide and PM<sub>10</sub> data provide supporting evidence;
2. The event is associated with a measured concentration in excess of normal historical fluctuations, including background;
3. There would have been no exceedance or violation but for the event based on pre and post particulate matter values and because there were no other known events that could have produced comparable levels of short term emissions; and
4. The fireworks was set-off on July 4, Independence Day, as part of a traditional or national culture event (40 CFR 50.14 (b)(2));
5. Consequently, the event meets the conditions under which EPA may exclude the data.