

# Public Health Impacts from the Sacramento Trestle Fire

An Analysis of Air Quality Data by the

California Environmental Protection Agency

Office of Environmental Health Hazard Assessment (OEHHA)



August 3, 2007

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### **BACKGROUND:**

At 6:00 pm Thursday March 15, 2007, a wooden train trestle caught fire northeast of downtown Sacramento, California. The fire spread quickly, and by 6:30 pm approximately 1300 feet of the trestle were engulfed in flame. The trestle, largely constructed of creosote-treated wood ties and structural beams, continued to burn uncontained for 48 hours.

Smoke from the fire was most intense during the first two days of the event. Initially, a large column of black smoke rose directly from the site in a vertical plume, flattening out at 1400-2000 feet elevation (see pictures, Appendix A). Predominant weather conditions throughout most of the fire allowed the thick black smoke to disperse high in the atmosphere, reducing exposures in the Sacramento area. Late Friday night and into Saturday morning, however, portions of Sacramento, Yolo, and Sutter counties were impacted with smoke as the weather and wind conditions changed. Particulate matter concentrations rose dramatically at one air monitoring location to levels considered unhealthy for sensitive groups. Fortunately, the worst air quality readings measured at this site lasted only a matter of hours before clearing. Particulate matter concentrations may have been higher for longer periods of time in areas that were not monitored for air quality during the fire.

OEHHA assisted the California Air Resources Board (ARB) in identifying the major potential health impacts during the fire. Following the fire, the Sacramento Metropolitan Air Quality Management District asked OEHHA to review the air monitoring data and discuss the potential health impacts from exposure to trestle fire smoke in greater detail.

### **TOXICITY OF THE TRESTLE FIRE SMOKE:**

Smoke is a complex mixture of tiny particles and thousands of individual chemicals. Smoke varies in the type and kind of toxic constituents released, largely due to the nature of the burning material and chemical reactions within the fire, itself. A majority of the trestle wood was treated with creosote, a tarry substance rich in polycyclic aromatic hydrocarbons. The smoke from the Trestle fire, therefore, may have contained a higher amount of certain toxic chemicals and may have been more irritating than simple wood smoke. However, the smoke from the Trestle fire was similar enough to ordinary wood smoke such that the resulting health effects were likely the same as from a wildland fire.

#### **A. Chemical Constituents**

Wood smoke contains thousands of chemicals. The toxicity of many of these individual chemicals is not well-known. However, the toxicity of specific classes of chemicals present in smoke can provide information on the health risks following smoke exposure. Wood smoke is irritating to the eyes, nose, and the upper and lower respiratory tracts because of the presence of nitrogen dioxide, sulfur oxides, and aldehydes, and possibly other chemicals whose irritant properties are not yet known. The cumulative irritant effect of these chemicals may play a role in smoke-triggered asthma attacks.

## **B. Particulate Matter**

Wood smoke contains many tiny particles (or, “particulate matter”) which can be inhaled into the deep lung. Exposure to one group of particulates, referred to as PM<sub>10</sub> because they are 10 μm (10 millionths of a meter) or less in diameter, is associated with increased emergency room admissions for patients with lung and heart disease. Epidemiological studies, primarily in elderly individuals with preexisting health conditions, have shown that a 10 μg/m<sup>3</sup> increase in the 24 hour-average PM<sub>10</sub> concentration is associated with a 1 to 2 percent increase in daily mortality. Public exposure to wildfire smoke is also associated with increased emergency room visits. PM<sub>2.5</sub>, or particulate matter that is 2.5 μm or less in diameter, is present in wood smoke and may be more toxic than PM<sub>10</sub>.

## **C. Carcinogens**

Wood smoke contains a number of known cancer-causing chemicals (“carcinogens”). One group of carcinogens called polycyclic aromatic hydrocarbons (PAHs) are formed from virtually all types of combustion, including wood burning, operating automobile and diesel engines, and tobacco smoking. PAHs are found in the creosote used to preserve wood timbers. As a result, PAHs may have been released when the trestle burned, thus contributing to an increase in the carcinogenicity of the Trestle fire smoke. Other carcinogenic substances in wood smoke, such as benzene and 1,3-butadiene, may have been present, as well. (See Appendix B for data.) Short one- or two-day exposures to smoke events, such as the Trestle fire, are not very significant when compared to long-term daily exposure to cancer causing substances commonly found in urban air. For example, Sacramento area residents are often exposed to wood smoke in the winter months that may be concentrated due to an inversion layer. Likewise, air in metropolitan areas regularly contains the carcinogens benzene, 1,3-butadiene, and PAHs from automobile and diesel exhaust. Even if smoke from the Trestle fire contained elevated concentrations of carcinogens, the increased risk of cancer would be very small relative to the cancer risk attributed to a person’s overall lifetime exposure to these chemicals.

## **D. Air Monitoring Results**

The California Air Resources Board (ARB) conducted air monitoring for particulate matter at six sites in the general vicinity of the fire from Friday morning through Saturday night, March 16-17. Results from ARB indicated that between 7 pm and midnight on March 16<sup>th</sup> particulate matter (PM<sub>2.5</sub>) concentrations rose dramatically to levels between 104 and 1084 μg/m<sup>3</sup>. The levels then dropped to 8 μg/m<sup>3</sup>. (See Appendix A for data.) Peak concentrations were well above the 24-hour Federal Ambient Air Quality standard for PM<sub>2.5</sub> of 35 μg/m<sup>3</sup> and clearly of concern for public health<sup>a</sup>. There were no significant exceedances in particulate matter readings during the fire in areas surrounding Sacramento, as indicated by reports from neighboring air districts. Anecdotal evidence indicates that individuals in the impacted area may have experienced at least transient adverse effects from exposure to smoke during these times. Dr. Glennah Trochet, Public Health Officer for Sacramento County, reported no increase in hospital or emergency room admissions due to smoke inhalation.

The Center for Toxicology and Environmental Health (CTEH) was retained by Union Pacific Railroad to conduct air sampling and analysis at the Trestle fire site and in the surrounding community starting Friday morning and commencing 24 hours after the fire was out. In total, CTEH collected thousands of readings and analyzed air samples for a variety of chemicals, metals, and particulate matter. Preliminary results have been shared with the California Environmental Protection Agency (Cal/EPA), the US Environmental Protection Agency (US EPA), and the Sacramento Metropolitan Air Quality Management District. In addition, a US EPA

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<sup>a</sup> This analysis was based on final validated data from the California Air Resources Board.

Federal On-Scene Coordinator was at the site overseeing the air sampling by the Union Pacific contractor for the duration of the fire.

Overall, the concentrations of chemicals detected by CTEH were in the parts per billion (ppb) range and within levels typically found in ambient urban air<sup>b</sup>. Exceptions to this were “grab samples” taken directly at the fire. Those samples, obtained by hand-held instruments and summa canisters, indicated the presence of chemicals at concentrations much higher than ambient air. However, the majority of off-site samples recorded by CTEH showed concentrations of chemicals within the normal range. Therefore, it is not clear whether the community-based samples reflected typical Sacramento air pollution or chemicals generated from the Trestle fire. It is possible that because of the meteorology, the CTEH monitors may not have detected the smoke plume. This would have resulted in apparently lower concentrations of chemicals than what was experienced by some neighborhoods directly impacted by the smoke.

#### SUMMARY:

Emergency air monitoring is difficult under the best circumstances. The window of opportunity to collect samples is limited, as can be the availability of equipment or analytical techniques. The fickle nature of atmospheric conditions may also make it difficult to fully characterize a plume’s chemical or particulate constituents. During the Trestle fire, air sampling was conducted by both public entities and private contractors at multiple locations in proximity to the fire. However, air sampling at these locations may not have fully characterized public exposure because the smoke plume migrated over a considerable area. Information on the toxicology of wood smoke indicates that exposure to cancer-causing chemicals would be small relative to lifetime exposures, even though levels of some carcinogens may have exceeded normal ambient concentrations during the fire. This is consistent with the data collected during the Trestle fire, although monitors set up to identify chemicals in the smoke may not have detected the plume. Exposure to particulate matter was the primary immediate health hazard of concern during the Trestle fire. Meteorology was generally favorable in terms of limiting public exposure to the smoke. However, some short-duration exposures occurred because of weather conditions. Individuals most vulnerable to the health effects of particulate matter were most likely those with pre-existing cardiovascular disease or respiratory disease, such as asthma or chronic obstructive pulmonary disease. Many people may have experienced irritation from the smoke, with symptoms subsiding after the fire was completely out.

#### APPENDICES:

**Appendix A** - Union Pacific Railroad Trestle Fire Preliminary Air Quality Monitoring Data Report, Prepared by California Air Resources Board (ARB), March 21, 2007.

**Appendix B** - Sacramento Trestle Fire Preliminary Assessment of UPRR Air Monitoring Data, Prepared by California Air Resources Board (ARB), April 17, 2007.

#### REFERENCES:

Wildfire Smoke: A Guide for Public Health Officials, available online at [http://www.oehha.ca.gov/public\\_info/emergency/reports.html](http://www.oehha.ca.gov/public_info/emergency/reports.html)

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<sup>b</sup> This analysis was based on preliminary data from the Center for Toxicology and Environmental Health (CTEH). Although a significant difference between the preliminary and validated CTEH data is not expected, the authors caution that the results of the analysis may change if the final values also change. Validated data can be provided upon its availability, if requested.

# **APPENDIX A:**

## **Union Pacific Railroad Trestle Fire Preliminary Air Quality Monitoring Data Report**

**Prepared by California Air Resources Board (ARB)**

**March 21, 2007**

Union Pacific Railroad Trestle Fire  
Preliminary Air Quality Monitoring Data Report  
Prepared by California Air Resources Board (ARB)  
March 21, 2007  
ver. 2

The ARB monitoring effort focused on small diameter particulate matter that can penetrate into the lower lung and cause acute respiratory response in susceptible individuals. Hourly air monitoring data were collected in and around the incident beginning Friday mid-morning and continued well into Sunday after the fire was out. Information was provided to the local air district several times during the incident.

ARB conducted monitoring at six PM 2.5 sites in the general area of the fire. These included 1) a single fixed network site at 13<sup>th</sup> and T Street, 2) a site at the incident command just north of the fire, 3) two sites in East Sacramento, one at Mercy Hospital, and one at East Lawn Cemetery, and 4) two nearby sites just across the American River south of the fire.

The plume patterns appeared to fall into several regimes. In one, the particles carried well aloft and were transported in the direction of the winds between 800 and 1500 feet. This was typical of the early hours of the event when the hot fire temperatures lofted the particulates. In those cases, ground level monitors showed little evidence of the plume reaching ground level.

As the temperature of the flames abated and atmospheric conditions changes, the plume tended to come closer to the ground. The changing character of the fire and the degree of suppression activity affected the height of the plume. That, coupled with light and variable winds, intermittently created high, yet usually transient PM concentrations at ground level. Residents widely reported either a characteristic smell, or actually smoky conditions.

ARB staff monitored the event from Thursday evening until Saturday using weather and plume models and, and from Friday through Sunday, with air monitoring.

### **Thursday, March 15, 2007**

At the fire's outset, the winds were northwesterly for a few hours, then changed direction to southeasterly which carried smoke toward the North Area. As the atmospheric mixing height decreased, a distinct odor was observed widely by residents in the area.

## **Friday, March 16, 2007**

The ARB was requested by the Sacramento Air Quality Management District (District) and the County Hazmat office for assistance in assessing the impact of the fire. ARB staff arrived on scene mid-morning and established a PM 2.5 monitor just north and upwind of the incident.

The dominant daytime wind direction on Friday was northwesterly. The ARB meteorologists, using forecasted winds and plume models, recommended two additional monitoring sites in the East Sacramento area. The data and graphs are attached. With the exception of a one-hour high concentration recorded at the outset of monitoring at the East Lawn site, there did not appear to be any significant impacts in the area. In the area, late evening PM<sub>2.5</sub> concentrations reached approximately 30 ug/m<sup>3</sup> in conjunction with light evening winds and a ground level temperature inversion. Those conditions made for poor dispersion.

As shown in the attached data table and graphs, smoke concentrations rose dramatically at the Incident Site between the 7 pm and midnight with hourly readings of 322, 104, 264, 1084, and 201 ug/m<sup>3</sup>, respectively. Heavy smoke was reported north of the incident site at hotels, businesses, and by people out in the evening. The health impacts of short-term exposure to high particulate matter concentrations are not precisely known. However, there are reasons to believe that such exposures could affect those with respiratory disease, such as asthma, and those with pre-existing cardiovascular disease, as 24-hr exposures are known to do. By early morning levels had already dropped. Persistence of these high levels could have led to further public health recommendations along the lines of the recommendations found in Table 3 from Wildfire Guide: A Guide for Public Health Officials (attached). Although the smoke from the trestle fire probably differed in some respects from a wildfire smoke, these recommendations are still useful. PM 2.5 concentrations at the incident site dropped quickly (8 ug/m<sup>3</sup>), and by shortly after midnight returned to normal for the remainder of the early morning.

## **Saturday, March 17, 2007**

The early morning winds (5-7 am) were light and variable. PM 2.5 levels increased again at the Incident site and at the ARB monitor directly across the American River (AmRiver 2). The PM<sub>2.5</sub> levels returned to normal once the atmospheric mixing conditions improved. The fire and debris piles were significantly smaller on Saturday morning as to Friday evening.

### **Health**

PM 2.5 1-hour readings help confirm the plume movement but may be difficult to relate to a health consequence. The 24-hour National Ambient Air Quality Standard for PM<sub>2.5</sub> is 35 ug/m<sup>3</sup>. However, the specific fire guidance below may be more useful in evaluating the effects of short duration high concentrations events.

**Wildfire Guide - A Guide for Public Health Officials.** This document was written by the California Office of Environmental Health Hazard Assessment, the U.S. Environmental Protection Agency; and the Missoula County Health Department, with input from individuals in several other state and federal agencies, in particular the California Department of Health Services, the California Air Resources Board, and editorial support Washington State Department of Health.

It is available on the OEHHA web page at:  
[http://www.oehha.ca.gov/air/risk\\_assess/wildfire.html](http://www.oehha.ca.gov/air/risk_assess/wildfire.html)

For further information about this preliminary report, please contact Jeff Cook at 916.322.3726, or by email at [jcook@arb.ca.gov](mailto:jcook@arb.ca.gov).

Attachments

**Table 3. Recommended Actions for Public Health Officials**

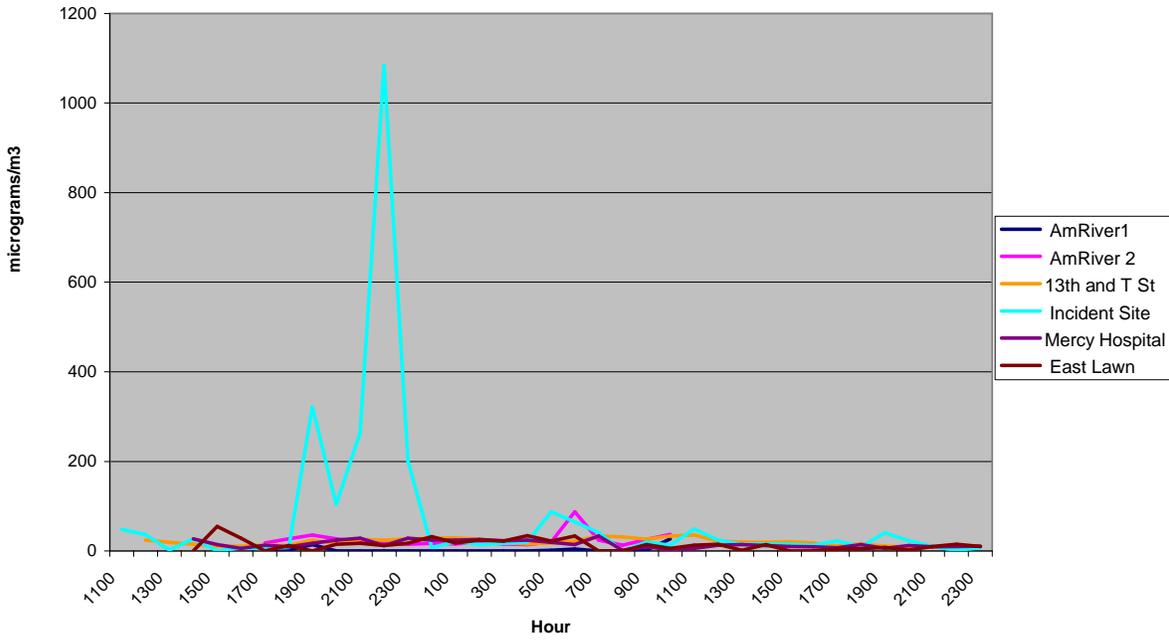
Category	PM <sub>2.5</sub> or PM <sub>10</sub> Levels (µg/m <sup>3</sup> , 1- to 3-hr avg.)	Visibility - Arid Conditions (miles)	Recommended Actions
Good	0 - 40	> 10	If smoke event forecast, implement communication plan
Moderate	41 - 80	6 – 9	<ul style="list-style-type: none"> <li>- Issue public service announcements (PSAs) advising public about health effects/symptoms and ways to reduce exposure</li> <li>- Distribute information about exposure avoidance</li> </ul>
Unhealthy for Sensitive Groups	81 - 175	3 – 5	<ul style="list-style-type: none"> <li>- If smoke event projected to be prolonged, evaluate and notify possible sites for clean air shelters</li> <li>- If smoke event projected to be prolonged, prepare evacuation plans</li> </ul>
Unhealthy	176 - 300	1.5 - 2.5	<ul style="list-style-type: none"> <li>Consider “Smoke Day” for schools (i.e., no school that day), possibly based on school environment and travel considerations</li> <li>- Consider canceling public events, based on public health and travel considerations</li> </ul>
Very Unhealthy	301 - 500	1 – 1.25	<ul style="list-style-type: none"> <li>- Consider closing some or all schools (However, newer schools with a central aircleaning filter may be more protective than older, leakier homes. See “Closures”, below )</li> <li>- Cancel outdoor events (e.g., concerts and competitive sports)</li> </ul>
Hazardous	> 500	< 0.75	<ul style="list-style-type: none"> <li>- Close Schools</li> <li>- Cancel outdoor events (e.g., concerts and competitive sports)</li> <li>- Consider closing workplaces not essential to public health</li> <li>- If PM level projected to continue to remain high for a prolonged time, consider evacuation of sensitive populations</li> </ul>

**Source: Wildfire Guide - A Guide for Public Health Officials**

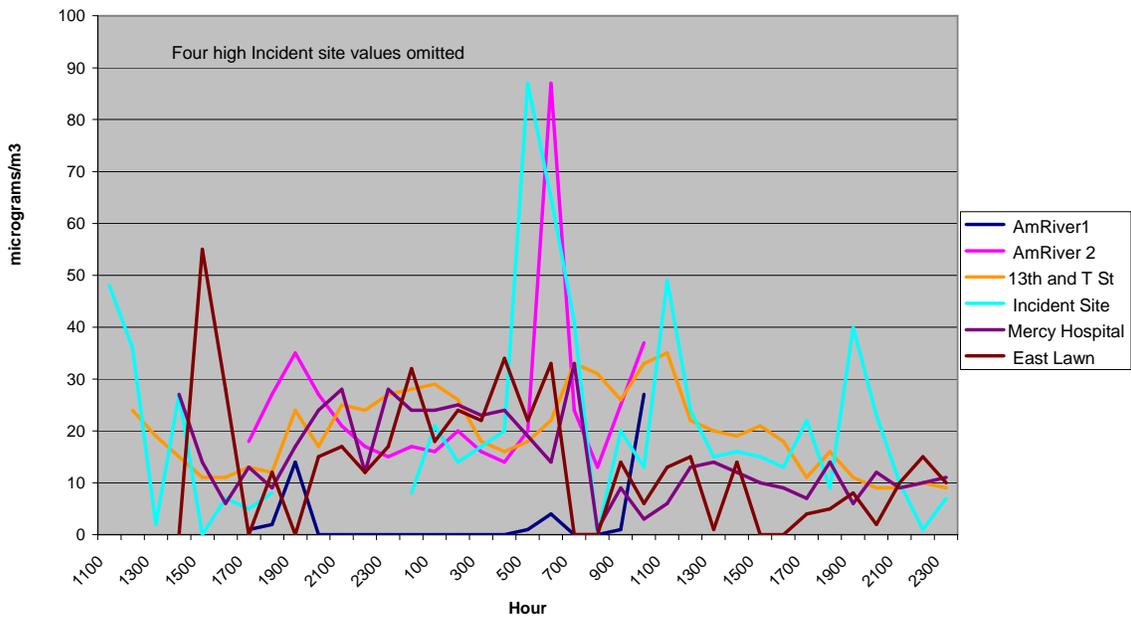
Plume Characteristics on Friday March 16, 2007  
Northwest winds



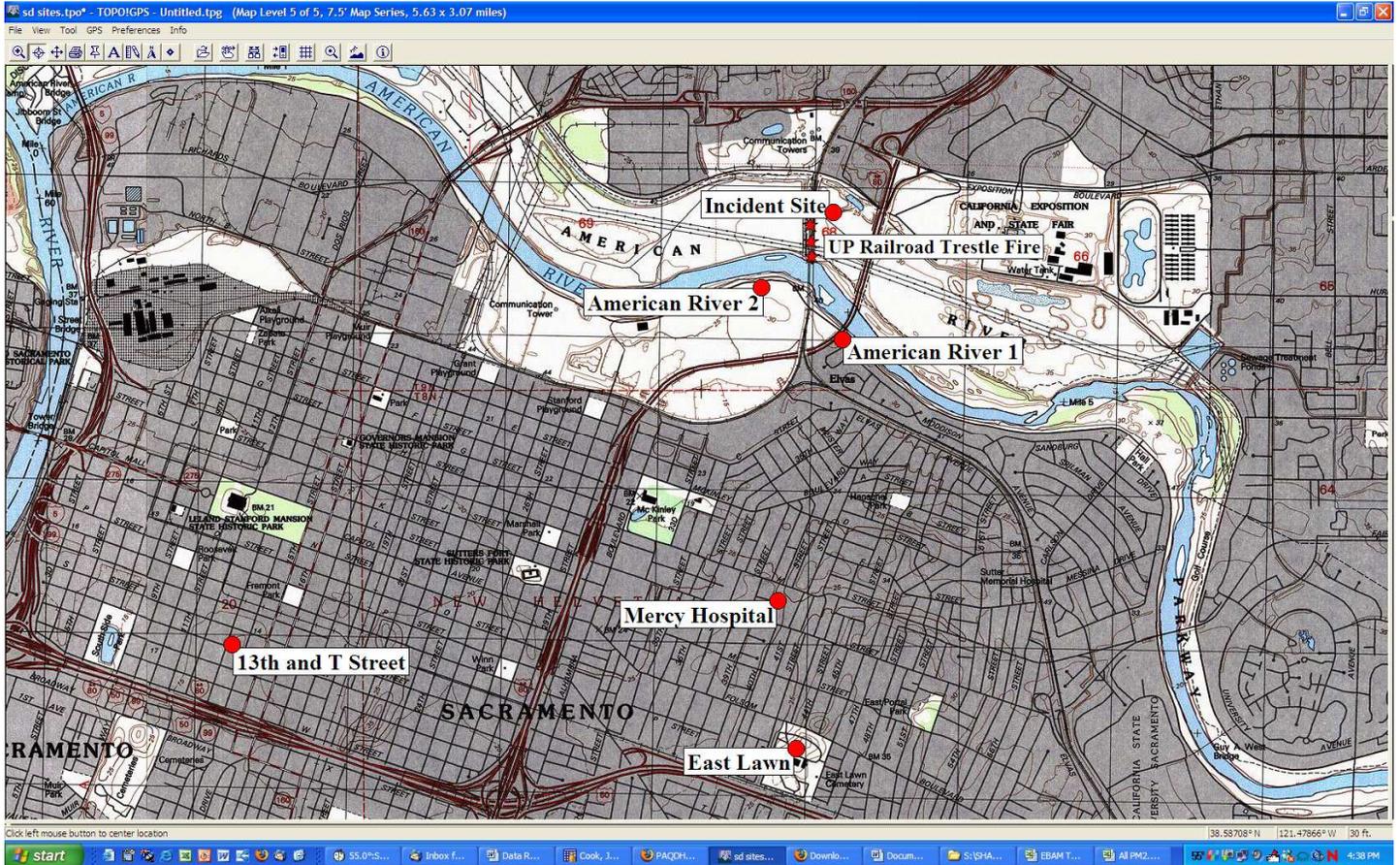
**ARB PM2.5 Monitoring  
UP Railroad Trestle Fire  
Friday, March 16 thru March 17, 2007  
Pacific Daylight Time**



**ARB PM2.5 Monitoring  
UP Railroad Trestle Fire  
Friday, March 16 thru March 17, 2007  
Pacific Daylight Time**



# Location of ARB PM2.5 Monitoring Site Locations



ARB PM2.5 Data (1 hour)  
UP Railroad Trestle Fire

Day	Begin Hour (PDT)	AmRiver1	AmRiver 2	13th and T St	Incident Site	Incident	Mercy Hospital	East Lawn
16	1100				48	Incident		
16	1200			24	36			
16	1300			19	2			
16	1400			15	27		27	0
16	1500			11	0		14	55
16	1600			11	7		6	28
16	1700	1	18	13	5		13	0
16	1800	2	27	12	8		9	12
16	1900	14	35	24		322	17	0
16	2000	0	27	17		104	24	15
16	2100	0	21	25		264	28	17
16	2200	0	17	24		1084	12	12
16	2300	0	15	27		201	28	17
17	0	0	17	28	8		24	32
17	100	0	16	29	21		24	18
17	200	0	20	26	14		25	24
17	300	0	16	18	17		23	22
17	400	0	14	16	20		24	34
17	500	1	20	18	87		19	22
17	600	4	87	22	65		14	33
17	700	0	24	33	41		33	0
17	800	0	13	31	0		1	0
17	900	1	25	26	20		9	14
17	1000	27	37	33	13		3	6
17	1100			35	49		6	13
17	1200			22	24		13	15
17	1300			20	15		14	1
17	1400			19	16		12	14
17	1500			21	15		10	0
17	1600			18	13		9	0
17	1700			11	22		7	4
17	1800			16	9		14	5
17	1900			11	40		6	8
17	2000			9	23		12	2
17	2100			9	10		9	10
17	2200			10	1		10	15
17	2300			9	7		11	10

# **APPENDIX B:**

## **Sacramento Trestle Fire Preliminary Assessment of UPRR Air Monitoring Data**

**Prepared by California Air Resources Board (ARB)**

**April 17, 2007**

Sacramento Trestle Fire  
 Preliminary Assessment of UPRR Air Monitoring Data  
 Prepared by California Air Resources Board (ARB)  
 April 17, 2007

The Union Pacific Rail Road, through its contractor, CTEH, conducted an extensive air monitoring effort beginning the morning after the fire began. They monitored in the plume and in the immediate area for particulate matter and chemical constituents of the burning creosote soaked timbers. They also conducted on-site and off-site sampling as was warranted. The sampling included short interval grab samples and longer term canister, filter, and sorbent tube samples for different chemical species. The constituents monitored included toxic chemicals that were potentially emitted from combustion of wood soaked in creosote together with other non-toxic species.

The sampling and analytical methods used were appropriately sensitive to allow there to be comparisons made to an acute response health metrics. They were generally not sensitive enough to track the full movement or composition of the plume in the community. CTEH used a mix of stationary and portable devices and was able to conduct mobile monitoring when, in one occasion, the plume migrated off-site and reached a local community.

Summary of Samples

		Parameter	Sites	Values
<b>15-Mar</b>				
<b>16-Mar</b>	Intermittent	Creosol	9	all non-detect
	“	VOC Species	6	detected
	“	Phenol	9	3 detected
	“	Metals (21)	4	4 detected
	“	BaP	13	all non-detect
<b>17-Mar</b>	“	Creosol	10	all non-detect
	“	VOC Species	6	detected
	“	Phenols	10	all non-detect
	“	BaP	10	all non-detect
<b>18-Mar</b>	“	VOC Species	5	detected
	“	Creosols	5	all non-detect
	“	Phenols	5	all non-detect
	“	BaP	5	all non-detect
<b>16-18 Mar</b>	Real time	PM	69	all detected
		VOC	56	4 detected
		CO	66	12 detected
		Phenol	6	all non-detect
		Creosol	10	all non-detect
		Hydrocarbon	2	all non-detect
		Benzene	5	all non-detect
		Formaldehyde	4	all non-detect

We examined the source level samples taken in the plume and on-site ambient samples taken. We compared the two to one another and compared them to ambient samples taken in the state and in the Sacramento area over the past year (Roseville).

Particulate matter levels were the most serious pollutant of concern during the fire. This in part was due to its potential to cause an almost immediate adverse response in susceptible individuals. An adverse reaction to PM can occur at relatively low levels relative to the chemical constituents found in an open fire. While there may be chemically induced reaction included in the response to particulate matter, the levels at which the chemicals themselves cause acute adverse effects were not detected.

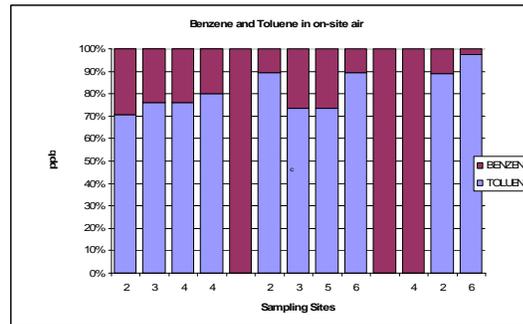
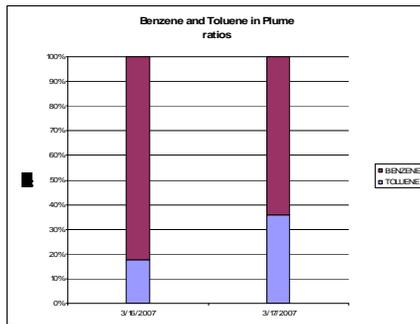
The ambient monitoring conducted at on-site locations rarely detected the particulate and chemicals in the plume. The heat from the fire, especially initially, carried the pollutant load aloft and well above the community. The plume was carried in several directions over the 48 hours of the fire and did not, except for as noted below, reach ground level in a coherent and highly concentrated manner. Of almost 1600 hydrocarbon gas and semi-volatile species samples, only about 8 percent recorded detectible levels, however. Of those, about one-third were samples taken in, or immediately adjacent to, the plume. The chemical by-products of the fire were generally not detected at the on-site sampling locations. Most of the anticipated chemicals of concern were either not detected or at very low levels.

Of the pollutants expected from a fire, all were low. This coincides with the ARB sampler on-site that indicated the plume essential did not contact the on-site samplers. For the ambient samples, creosols (19 samples) and benzo(a)pyrene (28 samples) levels were all below detection. Phenols were detected in three of 16 samples, and all metals samples were below detection. In-plume grab samples for some pollutants indicated a relatively higher concentration, but the levels were low relative to safe acute health levels. We would have expected to see elevated levels of potassium, a key indicator of biomass burning, however, all samples were below detectable levels. The LOD was relatively high, however.

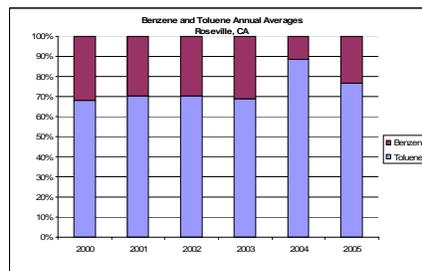
Benzene and toluene were chemicals of concern. Both have toxic properties and were evident in the plume at levels 10 to 20 times above what is observed in community air. However, even samples obtained in the plume did not reach acute levels of concern. Evidence the plume was not detected on-site comes from the relative proportion of the two compounds in the plume and at the on-site samplers. The proportions of both compounds occurred in distinctly different ratios compared to the ground levels samplers. The plume indicated benzene occurred at substantially greater concentrations than toluene, while the opposite was true in the on-site ground level samples, and in samples typical of community air.

## Benzene and Toluene Ratios: Plume v. On-site v. Community sites

The first graph represents the ratio of benzene to toluene in the two grab samples taken in the smoke.



On-site samples, in the second graph, while recording lower concentration, were distinctly different. They are more indicative of the samples taken at Roseville (below), where motor vehicle emissions are the dominant source of benzene and toluene.



### Evening of March 16-17

Weather conditions were different during the late evening and early morning of March 16-17, and the plume never dispersed as it came off the fire. CTEH monitored in the area northeast for the fire and recorded high particulate matter levels, in the milligram range, and moderate levels of carbon monoxide. Toxic monitoring off site was limited, but it did not appear, even as a class of compounds (volatile organic gases), that they did exceed acute levels of concern. Several PaH compounds at the on-site locations that were normally below detect, however, reported positive values during this time. These two locations (sites 2 and 6) were likely encompassed in the late evening's plume. The notable occurrences include the only two chrysene detected values, several benzo(a)anthracene and flouranthene recorded levels, and two of the three phenol and pyrene detected values.

### Unusual Event

The fire was declared to be out on Saturday, March 17, however, per USEPA's direction, sampling continued into Sunday. Of particular note is the high ambient toluene value, equal to or greater than the grab samples in the plume, that occurred on the 17<sup>th</sup>, nearly one day after the fire was fully contained. The concentration was substantially higher than other ambient samples and did not seem to correspond to increases in other pollutants.

### Real time monitoring

CTEH conducted real time monitoring using fixed on-site devices and portable units. The VOC readings showed four detected values of 56 reported. High levels of particulate matter and carbon monoxide were observed by portable monitors off-site during the evening. These were useful in identifying the impact area of the smoke using PM and CO levels. Concentrations were high for several hours, in the unhealthful to hazardous level for sensitive individuals.

All of the manual tube samples were below detection. These included supplemental benzene readings, phenols, and creosols taken at various locations.

### Fire Samples v. Community Air

Below is a comparison of selected air samples from the fire (grab and on-site) to ambient statewide and regional peak values.

#### **BaP:**

Grab:	ND
On site (ambient):	<200 ng/m <sup>3</sup>
State (ambient):	3-3.5 ng/m <sup>3</sup>
Region (ambient):	0.8-1.0 ng/m <sup>3</sup>

The LOD for the monitoring that took place was ~200 ng/m<sup>3</sup>. It is associated with higher concentrations and short term acute effects. The detection limits were significantly higher than the maximum ambient levels observed in the state (3-4 ng/m<sup>3</sup>) over the last 5 years. BaP generally is the most toxic of the regularly measured PaH compounds, and is generally used as the sentinel species for the class as a whole.

#### **Toluene:**

Grab:	17,55 ppb
On site (ambient):	6-96 (ave 20)
State (ambient):	12-27 ppb
Region (ambient):	2-27 ppb

#### **Acetone:**

Grab:	220 ppb
On site (ambient):	20 ppb

State (ambient) : 27-71 ppb  
Region (ambient): 10-27 ppb

**Benzene:**

Grab: 79, 99 ppb  
On-site: <5 ppb  
Peak in state: 4-7 ppb  
Peak in Region: 0.5-1.0 ppb

**1,3 butadiene:**

Grab: 12 ppb  
On site: <5 ppb  
State: 0.75 - 2.8 ppb  
Region: 0.16- .22 ppb

**Potassium:**

On site: <20 ug/m3  
Peak State: 2-9 ug/m3

**Conclusions**

It appears from the high percentage of non-detected values of compounds expected to occur in a fire of this type that the plume largely was not detected by the on-site monitors. Lower detection limits would have indicated the presence of other compounds; however, the LODs used were selected to compare the results to known acute health metrics. The exception was the late evening of the 16<sup>th</sup> and early into the 17<sup>th</sup>. Two on-site locations (Site 2 and 6) were, in part, in the path of the plume and recorded increases in several species. None reached the levels of concern. Portable particulate and carbon monoxide measurements made by CTEH off-site throughout the period, documented well the presence of heavy smoke in the area north and east of the fire. Those increased levels agree with the on-site ARB sampler for that time, and would have very likely resulted in an increase in adverse response in the community had the event occurred during daytime.