



South Coast

Air Quality Management District

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**INFORMATION ADVISORY & STATUS UPDATE  
ODORS AT THE SANTA MARGARITA WATER DISTRICT'S  
UPPER OSO RESERVOIR**

(November 18, 2009)

**Background on Odors from the Reservoir**

On Wednesday, October 28, 2009, the South Coast Air Quality Management (AQMD) started to receive odor complaints at our 1-800-CUT-SMOG 24-Hours/Day air quality complaint line regarding sulfur (rotten eggs) type odors in the neighborhoods around the Upper Oso Reservoir, located in the cities of Mission Viejo and Rancho Santa Margarita. The Upper Oso Reservoir is a recycled water reservoir in Orange County and is owned and operated by the Santa Margarita Water District (SMWD). The number of odor complaints received by AQMD in the latter parts of October and early parts of November continued to increase from one or two per day to over 40 complaints on November 11, 2009, where the odor intensity was at its peak in the residential neighborhood just southwest of the Reservoir and 241 Toll Road.

Upon receipt of the first odor complaints, AQMD responded to the odor complaints and launched an investigation to identify the source of the odor complaints (which was determined to be the Upper Oso Reservoir), contacted SMWD to determine cause of the odors and began conducting air monitoring and sampling in the areas surrounding the Reservoir. Also SMWD initiated a number of efforts to mitigate the odors by taking various remediation activities. As a result, the intensity of the odors and the number of odor complaints have decreased significantly since November 11, 2009 and based on the recent remediation activities, it is anticipated that the odors will continue to diminish in the surrounding areas.

**Health Effects Associated with the Odors from the Reservoir**

*Based on the results of the AQMD's ambient air sampling and analysis done in the residential and commercial areas, AQMD believes that although the type and concentration of odorous compounds released from the Reservoir have caused the residents around the Reservoir some discomfort, irritation, nuisance and other temporary symptoms, the health effects should be of a transient or temporary nature and are not considered alarming or a long-term health concern.* Below please find more detailed information about what has caused the foul odors from the Reservoir, the results of ambient air monitoring conducted by AQMD, the potential health impacts and health risks associated with exposure to the odorous compounds released from the Reservoir and the activities undertaken by AQMD and SMWD to investigate and mitigate the odors.

### **What Has Caused the Odors?**

Due to the recent change in weather conditions the Upper Oso Reservoir has experienced a natural process known as “algae bloom” which used up the oxygen in the water and caused sulfates throughout the reservoir to convert to sulfides, resulting in the release of Sulfur (rotten eggs) type odors. During the summer, the reservoir splits into two layers of water, with the top warmer layer containing adequate amounts of oxygen, but the bottom colder layer with low levels of oxygen. During autumn, the top layer of water cools down and eventually sinks to the bottom, pushing the bottom layer up to the top. The recent cooler temperatures and wind patterns have caused a sudden and accelerated algae bloom which has resulted in the release of the sulfur compounds into the air.

### **What Are the Results of AQMD’s Ambient Air Monitoring?**

AQMD has taken over 100 instantaneous ambient air readings around the Reservoir and in the residential and commercial areas surrounding the Reservoir. These measurements were taken using a hand held Hydrogen Sulfide (H<sub>2</sub>S) analyzer with a lower detection limit of 0.005 parts per million (ppm). This instrument responds to H<sub>2</sub>S and several other sulfur compounds and provides a quick instantaneous reading of the concentrations present in the air. AQMD has also collected several ambient air samples in Tedlar Sampling Bags and brought the samples back to the AQMD Laboratories in Diamond Bar for a more detailed analysis of the samples. The results of our sampling and analysis have indicated that the foul odors released from the Reservoir contained a number of odorous sulfur compounds such as H<sub>2</sub>S and are described in more detail below.

The results of AQMD’s air sampling have shown that:

- Concentrations of sulfur compounds, which include H<sub>2</sub>S, in the residential areas have been in most cases at or below the detection limit of 0.005 ppm with occasional short term readings in the range of 0.010 to 0.015 ppm, with the exception of readings taken on November 11, 2009, which were in the range of 0.08 to 0.17 ppm.
- Concentrations of sulfur compounds, which include H<sub>2</sub>S, in the commercial areas have been in the range of 0.005 to 0.018 ppm, with the exception of readings taken on November 11, 2009, which were in the range of 0.03 to 0.26 ppm.
- Concentrations of sulfur compounds, which include H<sub>2</sub>S, around the edges of the Reservoir have been in the range of 0.013 to 0.37 ppm with the highest concentrations measured on November 4 and 11, 2009.
- Concentration of sulfur compounds, which include H<sub>2</sub>S, in the Boy Scout Camp located at the northeast part of the Reservoir have been in the range of from below the detection level of 0.005 to 0.30 ppm. Therefore, as a precaution, the scheduled Boy Scouts campout event for Saturday and Sunday, November 14 and 15, 2009 was cancelled.
- The results of Tedlar Bag Samples taken by AQMD were consistent with the concentration levels measured with the hand held H<sub>2</sub>S analyzer used by AQMD.

SMWD has also taken some ambient air samples and has informed AQMD that the results of the ambient air samples taken by SMWD are consistent with AQMD's findings.

**What is H<sub>2</sub>S and What Are the Health Effects at Different Exposure Levels?**

H<sub>2</sub>S is a colorless gas with an odor similar to that of rotten eggs. It is formed during bacterial decomposition of sulfur-containing organic substances and can be present in sewer gas, some natural gas and geothermal hot springs. The odor threshold in air ranges between 0.008 and 0.13 ppm. At 0.01 ppm H<sub>2</sub>S, it is estimated that at least half of the exposed population will experience a distinct odor, and about 10% will experience a strong odor. The state of California has established an ambient air quality standard (AAQS) for H<sub>2</sub>S at a level of 0.03 ppm for a 1-Hour averaging period. The state H<sub>2</sub>S standard is based on odor and is set at a level to significantly reduce odor annoyance. H<sub>2</sub>S can be irritating to the air ways and in addition to odor, some individuals exposed to H<sub>2</sub>S may also report headache and nausea depending on the exposure duration.

The U.S. Environmental Protection Agency (EPA) has established Acute Exposure Guideline Levels (AEGLs) for many hazardous substances. AEGLs represent threshold exposure limits for the general public. The AEGLs are set at three levels, ranging from 1 to 3, which are distinguished by increasing potential for health effects.

**AEGL level 1** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.

**AEGL level 2** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

**AEGL level 3** is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

The AEGL-1, AEGL-2 and AEGL-3 levels for H<sub>2</sub>S for various exposure durations or averaging periods are as follows:

**SUMMARY OF AEGL VALUES FOR HYDROGEN SULFIDE (H<sub>2</sub>S)**

<b>Averaging Period</b>	<b>10 – Minute</b>	<b>30 – Minute</b>	<b>1 – Hour</b>	<b>4 – Hour</b>	<b>8 - Hour</b>
<b>AEGL-1 (Nondisabling)</b>	<b>0.75 ppm</b>	<b>0.60 ppm</b>	<b>0.51 ppm</b>	<b>0.36 ppm</b>	<b>0.33 ppm</b>
<b>AEGL-2 (Disabling)</b>	<b>41 ppm</b>	<b>32 ppm</b>	<b>27 ppm</b>	<b>20 ppm</b>	<b>17 ppm</b>
<b>AEGL-3 (Lethality)</b>	<b>76 ppm</b>	<b>59 ppm</b>	<b>50 ppm</b>	<b>37 ppm</b>	<b>31 ppm</b>

Also the workplace standard set for H<sub>2</sub>S exposure by the U.S. Occupational Safety and Health Administration (OSHA) is a maximum of 20 ppm for 8-Hour exposure.

### **What are the Health Impacts and Risks of Exposure to Odors from the Reservoir?**

Based on the ambient monitoring measurements conducted by AQMD, none of the H<sub>2</sub>S concentrations measured in the residential or commercial areas around the Reservoir exceeded the AEGL-1 or other AEGL levels. The highest H<sub>2</sub>S instantaneous (1 minute or less) concentrations measured by AQMD in the residential and commercial areas around the Reservoir were 0.17 ppm and 0.26 ppm, respectively. Due to the shifting wind directions, short-term peak values would normally tend to be higher than those averaged over longer periods of time, such as one hour or eight hours as expressed in the lowest AEGL levels. Also the instantaneous measurements include the instrument response to both H<sub>2</sub>S and other sulfur compounds (which based on AQMD's lab sample analysis are also present along with H<sub>2</sub>S), nevertheless the measurements (H<sub>2</sub>S plus other sulfur compounds) are still well below the AEGL-1 levels for 8-Hour exposures to H<sub>2</sub>S.

*Therefore, based on the results of the AQMD's ambient air samplings and analysis, AQMD believes that although the type and concentration of odorous compounds released from the Reservoir have caused the residents around the Reservoir some discomfort, irritation, nuisance and other temporary symptoms, the health effects should be of a transient or temporary nature and are not considered alarming or of a health concern.* In addition, based on the recent 24-Hour surveillances conducted by AQMD Inspectors in the areas surrounding the Reservoir, AQMD has not detected any concentrations above 0.016 ppm. The concentrations over the weekend dropped down to 0.008 ppm levels in the area and the odor intensity has shown a significant downward trend.

The AQMD will continue to monitor the Reservoir and areas surrounding the Reservoir for the near future and will be available to respond to any odor problems at the Reservoir and in the surrounding community. If any public members experience any odor or other air quality problems, they should immediately contact AQMD at 1-800-CUT-SMOG. AQMD's air quality complaint line is available 24 hours per day.

### **What has AQMD Done About the Odor Complaints?**

Upon receipt of the first odor complaints, AQMD dispatched Inspectors to the field to investigate the complaints and source of the odors. Since October 28, 2009, AQMD has been engaged in the following activities:

- Conducted over fifteen individual investigations and inspections in response to odor complaints utilizing more than four different Inspectors.
- Conducted around the clock 24 hours surveillance since Friday, November 13, 2009 utilizing more than half a dozen different Inspectors.
- Taken over 100 different instantaneous ambient air samples using hand held H<sub>2</sub>S analyzer monitoring instruments and Tedlar Sampling Bags (where the

samples are brought back and analyzed at the AQMD Laboratories in Diamond Bar) at various locations around the Reservoir and in the neighboring residential and commercial areas in the vicinity of the Reservoir.

- Issued a Notice of Violation (NOV) to SMWD for causing a public nuisance as a result of the numerous complaints received on November 11, 2009, due to odors from the Reservoir.
- Has continued around the clock surveillance, complaint response and field investigations and will maintain a high level of activity until the situation at the Reservoir has returned to normal.
- Coordinated and conducted a conference call between AQMD, SMWD, County of Orange Health Care Agency, Orange County Fire and others to ensure protection of public health and safety.

### **What has SMWD Done About the Odors?**

SMWD has also immediately initiated a number of remediation activities to mitigate the odors and to restore the conditions of the Reservoir. These include the followings:

- Sent out a couple of mail notification and status update about the odor situation to over 11,000 surrounding residents and businesses
- Conducted daily sampling of the water in the Reservoir to monitor its conditions relative to the oxygen content, temperature and algae conditions
- Implemented reservoir/lake management remediation activities
- Utilized ozone generation system to pump ozone (oxygen-rich air) into the Reservoir
- Added a number of deep water diffusers and surface aeration pumps to increase Reservoir oxygen levels
- Added to the Reservoir 18 million gallons of fresh water along with other high oxygen water to enhance lake recovery
- Conducted surface agitation with boats to increase oxygen levels
- Dispersed over 16,000 additional pounds of oxidation compounds into the Reservoir using specialized boats
- Conducted air quality monitoring around the Reservoir by collecting over a dozen air samples with canisters and Tedlar sampling bags and analyzed them for sulfur compounds including H<sub>2</sub>S

### **Who Are AQMD and SMWD?**

AQMD is the largest local air pollution control agency in the state and has jurisdiction for all of Orange County and the non-desert portions of Los Angeles, San Bernardino and Riverside Counties. This encompasses a population of almost 17 million (over 40% of the state's population) and an area of over 10,000 square miles. Although the air quality in this region has significantly improved over the past few decades due to AQMD's efforts, the region still has the worst air quality in the nation relative to the smog (Ozone) and fine particulate matter (PM<sub>2.5</sub>).

SMWD is Orange County's second-largest water district, serving more than 155,000 residents and businesses in Mission Viejo, Rancho Santa Margarita, Coto de Caza, Las Flores, and inland southern Orange County, including the communities of Ladera Ranch and Talega and covers an area of approximately 52,000 acres. SMWD owns and operates the Upper Oso Reservoir, which with a capacity of 1.3 billion gallons of recycled water is one of the largest recycled water reservoirs in Orange County.