

Summary Report

Background and Results Highlights

On October 24, 2015, the South Coast Air Quality Management District (SCAQMD) received the first air quality complaints resulting from sulfur type odors associated with the natural gas leak at Well SS-25 of the Southern California Gas Company's (SoCalGas) Aliso Canyon facility (Facility). In response to these complaints and to characterize the ambient levels of air pollutants resulting from this leak, the SCAQMD and the California Air Resources Board (CARB) commenced air quality monitoring measurements on October 26, 2015. These air monitoring efforts included extensive stationary and mobile air measurements in and around the Facility, both in the Porter Ranch residential neighborhood and other nearby communities. Through February 11, 2016, SCAQMD received over 2340 complaints regarding odors from the leak. The odors were predominantly from compounds (including mercaptans) added to natural gas to identify leaks that can be sensed at very low threshold levels (around or below 1 part per billion - ppb). The human nose is very sensitive and has the ability to detect odors that are below the detection level of any currently available monitoring device.

Notable results from the air monitoring efforts include:

- Methane levels in ambient air were periodically higher than typical levels in communities near the Aliso Canyon Facility during the leak (October 2016 to February 2016);
- Methane levels sharply declined after the leak was sealed in February 2016;
- Ambient air results were shown to be consistently within the SCAQMD and CARB air quality criteria <https://www.arb.ca.gov/research/aliso_canyon/aliso-canyon-criteria-description.pdf> for over a year after the leak was sealed;
- Levels of air toxics measured after the closure of the leaking well were within the range of levels measured elsewhere in the Los Angeles Basin;
- Long-term concentrations of air toxics were found to be substantially lower than the health-based reference exposure levels (REL) for long-term exposures; and
- Mobile air monitoring surveys conducted throughout the Porter Ranch community for over a year since the closure of the leaking well detected methane concentrations close to background levels.

Pursuant to the Aliso Canyon air monitoring plan <<http://www.aqmd.gov/docs/default-source/compliance/aliso-cyn/aliso-canyon-monitoring-plan.pdf?sfvrsn=4>>, some fixed monitoring sites were removed in late July 2016, but SCAQMD continued its stationary and mobile air monitoring efforts until June 2017. A more detailed discussion on these air monitoring results is provided in a companion technical report that is currently being finalized.

SoCalGas has installed eight permanent infrared monitors on the southern perimeter of the Aliso Canyon Facility and will continue monitoring methane concentrations in real-time. The data from these fence-line monitors are displayed on this publicly-available website: <<https://socalgas.esriemcs.com/MethaneMonitoring/>>.

SCAQMD efforts that will continue include:

- Consistently review data from existing continuous methane monitors;
- Respond to air quality concerns;
- Re-deploy monitoring efforts if necessary;
- Periodic on-site SCAQMD inspections; and
- Fund and oversee a health study.

Methodology and Approach

In order to fully characterize the spatial and temporal variations of methane and other air contaminants of concern, a combination of fixed-site and mobile air measurements were carried out inside the SoCalGas Aliso Canyon Facility and within the neighboring communities from October 2015 through June 2017. The monitoring plan, sampling equipment, and measurement techniques used in this study have been thoroughly discussed in a separate document which can be found here: <<http://www.aqmd.gov/docs/default-source/compliance/aliso-cyn/aliso-canyon-monitoring-plan.pdf?sfvrsn=4>>

A combination of continuous, short-term, and time integrated air monitoring was conducted at eight community locations and one background sampling locations (Figure 1). Table 1 summarizes the air pollutants that were measured in near-real time at all sites within the Porter Ranch community and at the background station in Reseda.

Table 1. List of continuous measurements at different sampling locations.

Air Pollutants	Sampling site #
Methane	1,2,3,4,5,6,7,8, Reseda
Hydrogen Sulfide	3
Benzene	4,5,7
Total sulfur	4

Time-integrated and triggered air samples were collected at Sites #3, #4, #6 and analyzed to measure the concentrations of volatile organic compounds (VOCs), methane (CH₄), carbon monoxide (CO), carbon dioxide (CO₂), ethane (C₂H₆), sulfur odorant additives (t-Butyl Mercaptan and tetrahydrothiophene), and carbonyls.

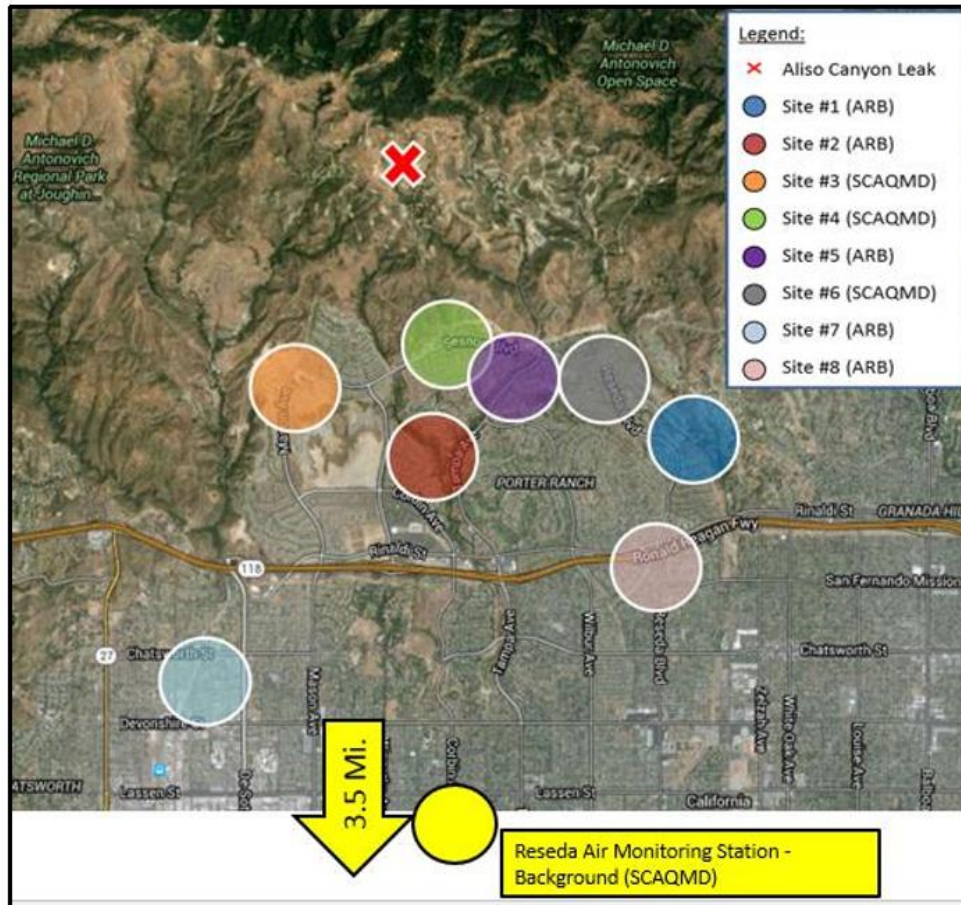


Figure 1. Fixed-site air monitoring locations operated by the SCAQMD and CARB.

Starting on December 21, 2015, SCAQMD initiated extensive mobile methane monitoring surveys in communities near the Facility and throughout the San Fernando Valley (SFV) to better characterize methane concentrations and gradients and to support the fixed-site methane monitoring efforts.

Results

Methane was the main air pollutant released as a result of the natural gas leak. The stationary air monitoring results indicate that levels of methane in ambient air were higher than typical levels in communities near the Aliso Canyon Facility during the leak. However, the daily-average concentrations of methane did not exceed the criteria established by SCAQMD and CARB at any of the monitoring locations after the leaking SS-25 Well was sealed on February 18, 2017 (Figure 2).

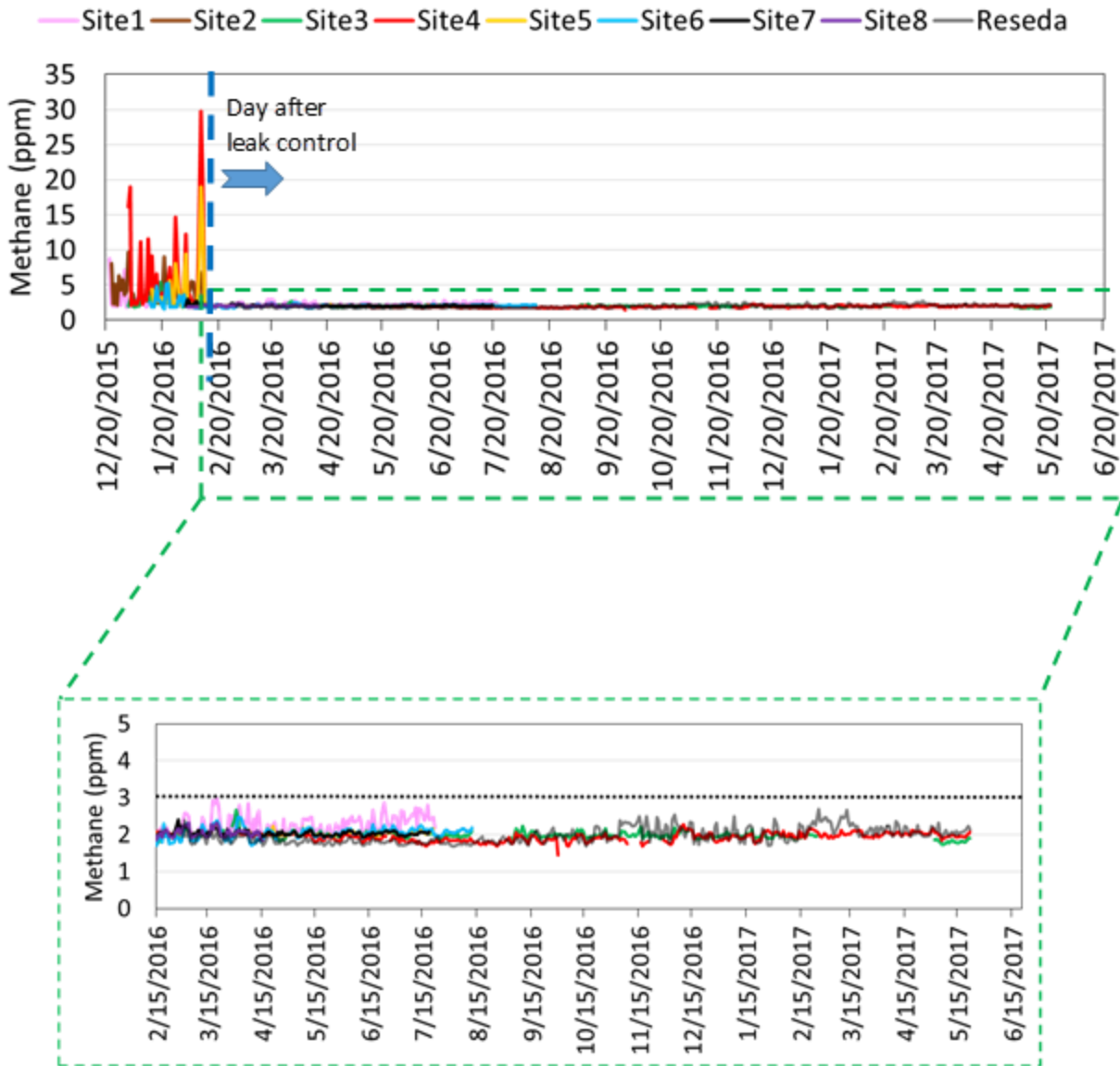


Figure 2. 24-hr average concentrations of methane measured at all monitoring locations. The dotted line represents the 24-hr average methane concentration criteria (3 ppm) set by CARB and SCAQMD for this study.

Results from the mobile surveys also indicate that when the leak was on-going, elevated levels of methane (sometimes as high as 70 ppm) were observed over short intervals (e.g., seconds to minutes) on the northern portion of this community. After the Well SS-25 was sealed, methane levels measured by the mobile platform south of the Aliso Canyon Facility and throughout the SFV were almost always close to background (~2 ppm). Figure 3 shows three representative maps of methane concentration measured by the mobile platform in the Porter Ranch area during the

leak and two days and three months after the leak was controlled.

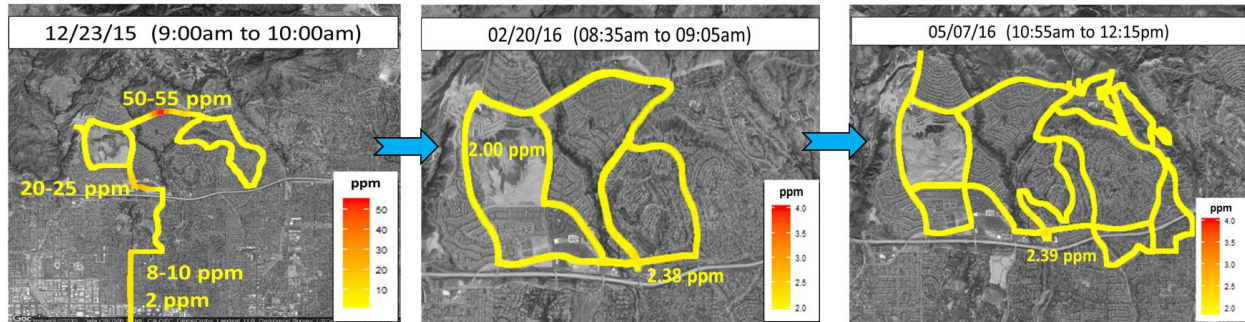


Figure 3. Three representative maps of methane concentrations measured by the mobile platform in Porter Ranch.

Similar to methane, marked reductions in the ambient concentrations of toxic VOCs (e.g., benzene, toluene, ethylbenzene, xylene, styrene) were observed after the leaking Well was sealed. While detectable, the measured concentrations of the aforementioned species from nearly all of the collected air samples were always below the chronic health-based RELs. Figure 4 shows the concentrations of selected toxic VOCs detected from the majority of the air samples at Sites #3, #4, #6, and the Reseda station after the closure of the SS-25 Well. A more detailed discussion on the levels and trends of the measured VOCs can be found in the companion technical report.

Hourly concentrations of hydrogen sulfide (H_2S) were mostly at or below the detection limit for this compound, and the highest H_2S ambient levels observed during this monitoring campaign were always below 5 ppb, which is lower than even the chronic health-based REL for this compound (about 7 ppb). The other two sulfur odorant additives to natural gas (i.e., t-Butyl mercaptan and tetrahydrothiophene) were below detection limits in all of the air samples collected by the SCAQMD at multiple locations throughout the Porter Ranch community during and after the leak. Sulfur odorants can be detected by the human nose at very low levels, and odors can cause health symptoms at levels below the detection limits of any currently available monitoring device.

The long-term average concentrations of all of measured air toxics during this event, including the carbonyl compounds formaldehyde and acetaldehyde, were substantially lower than the chronic health-based RELs. Additionally, a comparison of the air toxic levels following the full closure of the SS-25 Well with the fourth Multiple Air Toxics Exposure Study ([MATES IV](#)) measurements indicate that the concentrations of all air toxics measured in Porter Ranch and other part of the SFV were either within the range or lower than what was measured elsewhere in the Los Angeles Basin (Figure 4). A more detailed discussion on the comparison between the ambient levels of all VOCs measured during this study and the corresponding MATES IV concentrations is provided in the companion report.

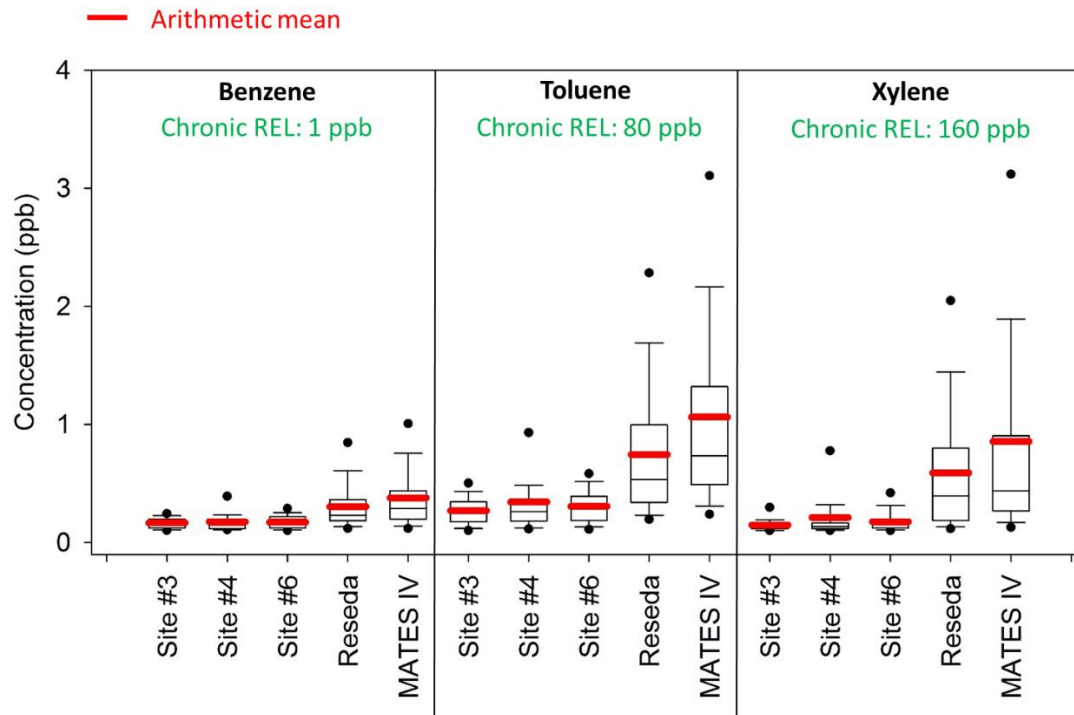


Figure 4. Concentrations of selected toxic VOCs from MATES IV and the 24-hr integrated samples collected at Sites #3, #4, #6, and the Reseda Station after the closure of the SS-25 Well. A Reference Exposure Level (REL) is the level of a chemical in the air that is not anticipated to pose a significant non-cancer health risk. In California, RELs are established by the California Office of Environmental Health Hazard Assessment. Black dots represent the 5th and 95th percentiles.

Conclusions

The results from this extensive air monitoring campaign indicate that the ambient concentrations of measured air pollutants related to natural gas in the communities near the Aliso Canyon Facility decreased dramatically following the full closure of the SS-25 Well and then gradually returned to background levels. The mobile monitoring data collected inside of the Facility showed a steady decrease of ambient methane levels around the SS-25 Well after the leak was fully contained on February 18, 2016. However, due to off-gassing of residual methane around the wellhead, elevated methane concentrations in the vicinity of SS-25 persisted for several months following the closure of the Well. These off-gassing events did not result in any considerable methane increase in the ambient air within the adjoining communities.

Overall, the results from this nearly 20-month long study demonstrate that after the SS-25 well was sealed, air quality in the Porter Ranch area and surrounding communities has returned to typical background levels for over a year, and that the measured air toxics in this community have been within the typical levels observed elsewhere in the Los Angeles Basin and substantially lower than the health-based RELs.