City of Eagle

Air Quality Monitoring

for Sulfur Dioxide

October 2013 – April 2014

January 30, 2015

Air Quality Division

Air Monitoring
&
Quality Assurance
Program

619 E. Ship Creek Ave. #249
Anchorage, AK 99501

Phone: (907) 269-7577
Fax: (907) 269-7508

www.state.ak.us/dec/

This page intentionally left blank

Introduction

Figure 1 Windfall Mountain smoke emissions July 18, 2013, Courtesy of National Park Service.

In late September 2012 smoke was noticed near the confluence of the Tatonduk and Yukon Rivers within the Yukon-Charley Rivers National Preserve. The smoke was emanating from fissures along the ridgeline of Windfall Mountain, emissions from what is believed to be an underground oil shale fire. Area residents, recreational dog mushers, and other wintertime travelers along the river described an acute exposure to the smoke as highly irritating, acidic, and choking, with the strong smell of sulfur. During long-term wintertime temperature inversions smoke and gaseous pollution can be trapped close to the ground. A plume will drift along constraints in the topography, such as mountain valleys or river drainages. On one occasion, local residents observed a smoke plume over the Yukon River as far south as Eagle. Numerous photos have been taken of the fire location. In coordination with the Doyon native corporation, the National Park Service conducted an on-the-ground survey of the fire site on July 13, 2013. Figure 1 is aerial photograph taken during that investigation which shows the smoke emissions from the Windfall Mountain ridge line. Local residents from the City of Eagle and the National Park Service (NPS) from the Yukon-Charley Rivers National Preserve were concerned about potential health effects from exposure to the smoke and pollution. They contacted the State of Alaska Department of Environmental Conservation (DEC). DEC offered to assist the City of Eagle with a short-term monitoring program to assess ambient air concentrations of sulfur dioxide (SO_2).

Sulfur dioxide was selected for the monitoring program because SO_2 is the primary pollutant associated with combustion of sulfur compounds often associated with oil shale and other carbonaceous deposits. Sulfur dioxide is a pungent toxic gas and strong respiratory irritant. The US Environmental Protection Agency (EPA) established the national ambient air quality standard (NAAQS) for SO_2 at 75 parts per billion (ppb) as the daily maximum 1-hour average.

Methods

In coordination with the City of Eagle, DEC set up an ambient air quality monitoring site near the river at the City Fire Hall. The City of Eagle is located along the western bank of the Yukon

Figure 2 Windfall Mountain Fire & City of Eagle

River. Figure 2 is a Google™ Earth graphic showing the locations of the Windfall Mountain fire and the Yukon River valley leading to the City of Eagle.

The Fire Hall was selected to house the monitoring installation because of its proximity to the river and the probability of assessing SO_2 concentrations from a smoke plume moving up river from the Windfall Mountain fire. The air quality at this location would also be representative of a number of residences and businesses located along the river bank. Figure 3 shows the location of the Fire Hall monitoring location in the City of Eagle and proximity to the river.

The monitoring equipment consisted of a sample manifold, an SO_2 analyzer, a calibration system, and a data acquisition system. The sample manifold was made of Teflon® tubing which penetrated the eastern wall of the Fire Hall, the side of the building facing the river. The inlet extended one meter away from the exterior wall and was protected with an attracted inverted funnel to prevent precipitation from being drawn into the sample line. Ambient air was drawn into the sample inlet through the Teflon® tubing, through a particulate filter to remove any dust, and into a Thermo Environmental Instruments, Inc. Model 43C pulse-fluorescence SO_2 analyzer. The analyzer measured the SO_2 concentration of the ambient air every 60 seconds producing a voltage signal representative of the concentration. The SO_2 analyzer was electronically connected to an Environmental Systems Corporation (ESC) Model 8800 data acquisition system to record the 1-minute voltage signals, convert the signals to engineering units of concentration as

Figure 3 City of Eagle Fire Hall Monitoring Site

ppb, calculate the intermediate 1-minute concentrations into 1-hour averages and store the 1-hour averages into memory. The data acquisition system was connected to a modem and phone line to facilitate data communications with the DEC base computer in Anchorage. The monitoring system was equipped for routine quality control checks with a calibration system consisting of an Environics Model 6103 multi-gas calibrator, a zero air generator, and a compressed gas cylinder of SO_2 calibration gas. The Environics calibrator is a programmable gas dilution system which uses mass flow controllers to precisely blend calibration gas from a certified cylinder with zero air to produce a range of different concentrations. The zero air generator is a device which takes room air, removes moisture, scrubs contaminants, and provides pure dry air to the calibrator at a prescribed pressure and flow. The cylinder of SO_2 calibration gas is available from specialty gas vendors, the concentration is certified in accordance with EPA protocols, and traceable to the National Institute of Standards and Technology (NIST).

The monitoring instrumentation, auxiliary equipment, and system configuration was in accordance with the federal regulations for ambient air monitoring under *Title 40, Code of Federal Regulations, Parts 50, 53, and 58.* Monitoring procedures and data review were performed in accordance with the *EPA Quality Assurance Handbook for Air Pollution Measurement Systems*.

The monitoring system was installed at the Fire Hall on October 2, 2013 and data collection commenced on October 7, 2013 at 11:00 hours. The SO_2 analyzer was configured to measure concentrations in the range of 0 to 500 ppb. Automated quality control (QC) checks were performed on a weekly basis. The calibration system was plumbed into the sample manifold to inject calibration gas when activated. Every Monday morning shortly after midnight, the programmable calibrator actuated to challenge the SO_2 analyzer first with zero air followed by two up-scale concentrations of calibration gas; a span gas concentration of 400 ppb and then a precision gas concentration of 100 ppb. The 1-minute data from the automated zero, span, and precision QC checks were downloaded and analyzed weekly. Every 24-hours the monitoring data were downloaded from the on-site data logger via modem to the DEC base computer. To assure the quality of the data, the DEC project manager reviewed the data on a daily basis and prepared data summaries on a monthly basis. Two City employees were trained to perform standard operating procedures including routine maintenance, visual inspections and keep a weekly checklist of observations and activities. The DEC project manager maintained routine communications with the site operators to discuss the status of the monitoring installation and any observations of smoke plumes along the river. The monitoring system collected data throughout the winter season ending on April 30, 2014. The monitoring instrumentation and auxiliary equipment were demobilized and removed from the site on June 17, 2014.

Results & Discussion

There are three factors which affect the concentration of SO_2 along the Yukon River Valley:

1. The level of combustion activity and the amount of sulfur contained in the deposit at the Windfall Mountain fire site. This determines the emission rate or how much pollutions is produced from the fire site.
2. The meteorological conditions in the area of Windfall Mountain and along the Yukon River Valley in terms of surface winds and especially the strength and duration of wintertime temperature inversions.
3. The distance the plume travels from the emission source, Windfall Mountain.

The level of combustion and emission rate from the Windfall Mountain fire site cannot be determined and can be assumed to be variable. If surface winds are moderate to brisk, smoke and other gaseous pollutants will quickly disperse. A wintertime temperature inversion, frequent in interior Alaska, is a meteorological phenomenon where an upper layer of warmer air traps a layer of colder air close to the ground and prevents the dispersion of pollutants. If the ambient temperature is well below 0° F, the winds are calm, and the level of the inversion drops down to 10 meters (30 feet); the smoke and pollutants can remain relatively concentrated and drift along the confines of the local terrain. If the inversion condition persists, the farther the plume can travel. Obviously, the greater the distance from the emission source, the greater the opportunity for dispersion. Using an approximate measurement from Google™ Earth, the City of Eagle is 17 air miles from Windfall Mountain. As measured along the river, the distance is approximately 24 miles.

The monitoring program in the City of Eagle operated from October 7, 2013 through April 30, 2014. During this wintertime period the DEC monitoring system did not record any SO_2 concentrations that approached the EPA NAAQS for SO_2, which is set at 75 ppb. Figure 4 is a graphic representation of the monitoring data.

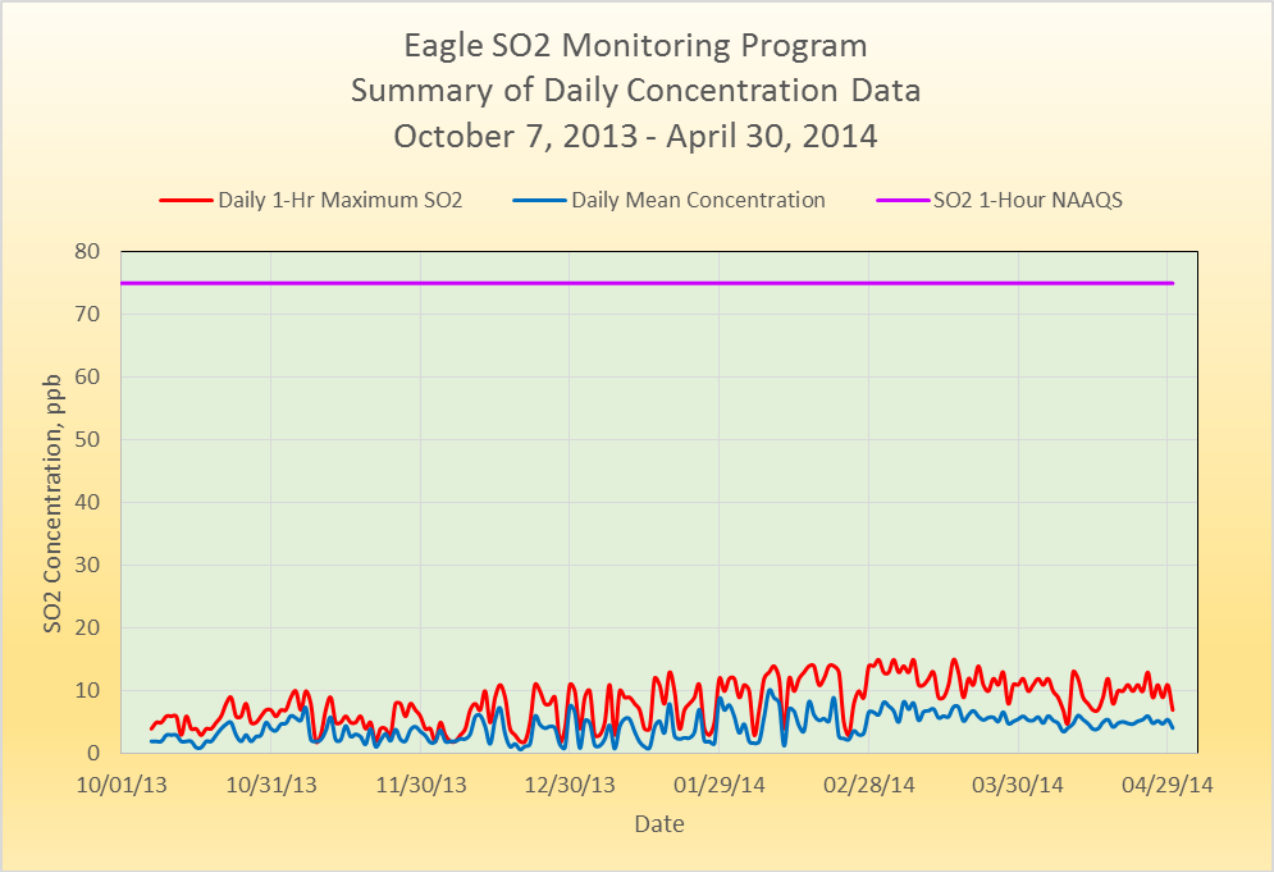

Figure 4 Chart of the Eagle SO_2 Monitoring Data

The blue line represents the average SO_2 concentration recorded for each 24-hour period. The red line represents the maximum 1-hour average SO_2 concentration recorded over each daily period. The purple straight line near the top of the chart represents the EPA NAAQS. The SO_2 NAAQS is established at 75 ppb as a daily maximum 1-hour concentration. The 1-hour NAAQS for SO_2 is referred to as the primary standard in that it was established to protect human health, especially the most vulnerable individuals; children, elderly, and those persons with pre-existing health conditions such as asthma or other chronic pulmonary diseases. The average SO_2 concentration for the entire monitoring period was 4 ppb. The maximum 1-hour SO_2 average recorded during the monitoring season was 15 ppb. These are very low concentrations and represent normal background concentrations which are probably attributed to the combustion of fuel oil for home heating, vehicle emissions or combustion of other fossil fuels.

These data would support the conclusion that emissions from the Windfall Mountain underground fire did not impact the City of Eagle during this monitoring period.

The complete monitoring data file, log records, and all quality control checks are on file at the Alaska Department of Environmental Conservation, Division of Air Quality office located at 619

East Ship Creek Avenue, Suite 249, Anchorage, Alaska 99501. Questions may be referred to Bob Morgan, the monitoring project manager at bob.morgan@alaska.gov or (907) 269-3070.

Acknowledgements

DEC wishes to thank the City of Eagle and the National Park Service for their logistical support and coordination for the installation, and on-going operation of the monitoring program. DEC wishes to thank the following individuals:

- Don Woodruff, the City Mayor, for general coordination of the program
- Pat Sanders and Ed Christensen of the National Park Service for housing and transportation during site visits;
- Steve Hamilton, city employee and site operator, who looked in on the equipment nearly every day; and
- All the friendly citizens of the City of Eagle who were very helpful during our site visits.

Reference Citations

Investigation of an Oil Shale Fire at Windfall Mountain, An Initial Assessment of an In-Situ Formation Fire, Linda Stromquist, National Park Service, Natural Resource Data Series NPS/YUCH/NHRDS-2014/733, November 2014

Fire on the mountain near the Yukon River, Ned Rozell, Alaska Science Forum, Article #2241, October 9, 2014

Title 40, Code of Federal Regulations, Part 50, National Primary and Secondary Air Quality Standards,

Title 40, Code of Federal Regulations, Part 53, Ambient Air Monitoring Reference and Equivalent Methods

Title 40, Code of Federal Regulations, Part 58, Ambient Air Surveillance

EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II Ambient Air Quality Monitoring Program, US Environmental Protection Agency, EPA-454/B-13-003, May 2013

Personal discussions with Pat Sanders and Ed Christainsen at the Yukon-Charley Rivers National Preserve and David Helmer, local residence and recreational dog musher.