Municipality of Anchorage Department of Health and Human Services
December 2012

Merrill Field Lead Monitoring Report

Overview

Merrill Field was selected by EPA as one 15 airports nationwide for inclusion in a one-year monitoring study to determine whether airports serving large numbers of piston aircraft, most of which use leaded fuel, are in compliance with the new national ambient air quality standard for lead. Specifically, compliance among airports with estimated lead emissions between 0.5 and 1.0 tons per year is being examined.* Lead emissions at Merrill Field are estimated to be 0.62 tons per year. The Municipality of Anchorage Department of Health and Human Services (DHHS) agreed to conduct this monitoring on behalf of the EPA and Alaska Department of Environmental Conservation (ADEC).

Site Selection

DHHS staff met with EPA, ADEC and Merrill Field personnel on February 9, 2011 to identify an appropriate location for lead monitoring on Merrill Field Airport. The objective was to find a location of estimated maximum lead concentration in ambient air, taking into account logistical considerations and the potential for population exposure. A location near the east end of Runway 25 was selected. It is located just north of the University of Alaska Aviation Technology Center at 2811 Merrill Field Drive. The approximate location of the site is noted as "A" in the figure below.

Airport staff estimates that about 80% of pre-flight "run-ups" at the airport occur in this vicinity. During a run-up, prior to take-off, pilots test their engines at throttle in excess of what is required for take off. Emissions during this mode are likely to be higher than other lower power modes. Thus, the lead concentrations measured at this site are likely to reflect maximum or near maximum at the airport.

Figure 1
Location of Merrill Field Lead Monitoring Site

Google Maps 2011

* The EPA used three criteria to select the 15 airports in the study: (1) estimated lead emissions greater than 0.5 tons per year; (2) an airport runway configuration that results in predominant use of one or two runways; (3) public access to ambient air within 150 meters of maximum emission point.

Sampling

Lead sampling was performed in accordance with EPA protocols outlined in 40 CFR 50 App G. A sampling platform was constructed near the east end of Runway 25 adjacent to a wind sock and nearby electrical service. Two high volume samplers were installed on the platform so that simultaneous or replicate sampling could be conducted.[†]

Figure 2
Sampling Platform and High Volume Samplers

Looking north toward platform

Looking west toward platform

High volume samplers are designed to draw approximately 2,000 cubic meters of air through a 8.5 by 11 inch glass fiber filter over a 24-hour (midnight to midnight) period. Suspended particulate, including particulate containing lead, are captured on the filter. Sampling was conducted at six day intervals beginning October 18, 2011 and concluding October 12, 2012. During most sampling periods, both high volume samplers were operated so that replicate samples could be collected to assess method precision.

Sample Analysis

Filter samples collected were analyzed for both total suspended particulate (TSP) and airborne lead in accordance with 40 CFR 50 Appendix B and Appendix G.

TSP is determined by gravimetry. Clean glass fiber filters were weighed in the DHHS laboratory before they were deployed and then weighed again after the 24-hour sampling period to determine the total particulate mass on the filter. Flow measurements made at the sampler were used to determine the total volume of air that passed through the filter during the sampling period. The TSP mass concentration (in micrograms per cubic meter) was then computed for each sample.

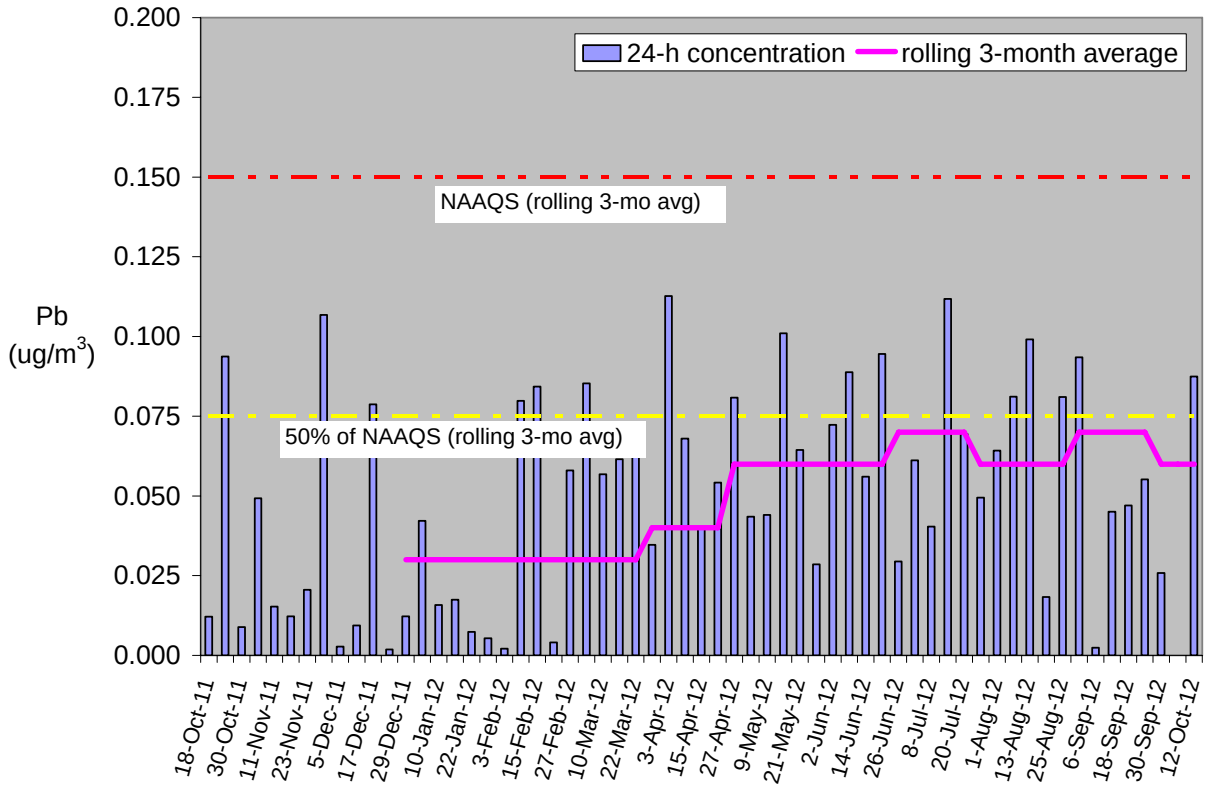
Filter samples were then delivered to the Alaska Department of Environmental Conservation Environmental Health Laboratory (ADEC EHL) for lead analysis. ADEC EHL used ICP-MS (inductively coupled plasma mass spectrometry) to determine the quantity of lead contained on each of the filter samples. These data were transmitted to DHHS. DHHS then computed the lead concentration for each filter sample from the mass quantity of lead contained on the filter and total volume of air passing through that filter.

[†] Replicate sampling provides information about the overall precision of the sampling and laboratory analysis and thus the quality of the data.

Sampling Results

Lead sampling results are presented in Figure 3. The national ambient air quality standard (NAAQS) is set as a rolling 3-month average of the samples collected during that period. A rolling 3-month average of 0.15 micrograms per cubic meter (µg/m^3) or lower is considered to be in compliance with the NAAQS. The highest 3-month average concentration measured during the Merrill Field study was 0.07 µg/m^3, about 47% of the NAAQS. Federal regulation would have required sampling to continue at Merrill Field if the highest 3-month rolling average was greater than 50% of the NAAQS (0.075 µg/m^3).

Figure 3
Merrill Field Pb Concentrations



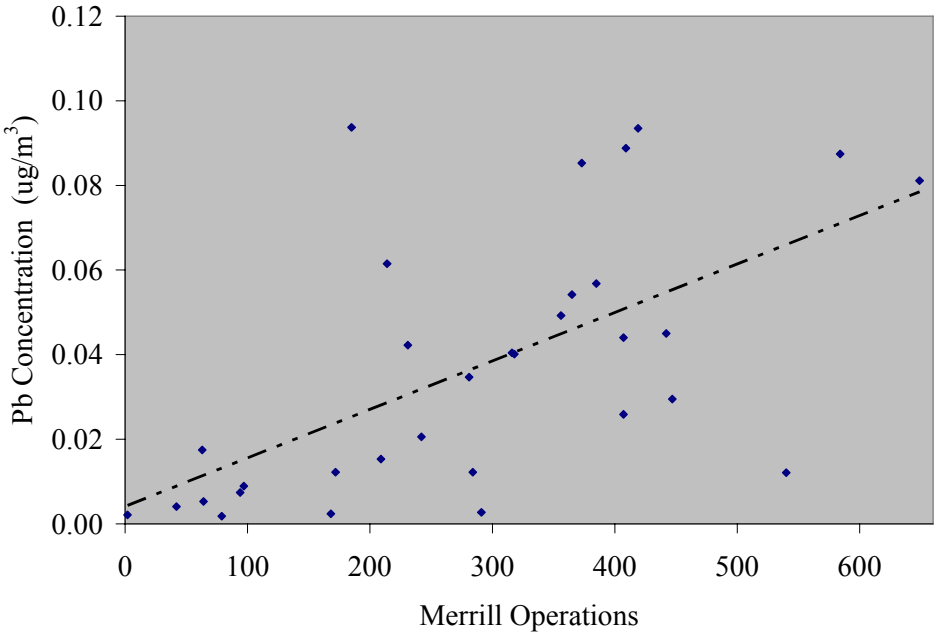
Correlation between Ambient Lead Concentration and Airport Activity and Weather Factors

Figure 3 shows that 24-hour ambient lead concentrations tended to vary considerably from sample to sample. DHHS investigated possible factors that might explain this variability. Relationships between 24-hour average lead concentrations and factors such as landing and takeoff activity, ambient temperature, wind speed and direction and poor atmospheric mixing were explored. Figure 4 shows that ambient lead concentrations were moderately correlated with airport operations As one might expect, lead concentrations tended to be higher on days with greater airport activity. On the 60 days samples were collected, total airport operations varied from 2 (on a snowy day in February) to 649 (on a sunny day in August).

Concentrations also tended to be higher when the prevailing wind direction was westerly (W) or northwesterly (NW). Under these conditions, Runway 25 was likely in use and wind flow would tend to carry air from the run-up area of the runway toward the lead sampler. When prevailing winds were from other directions, Runway 7 or 16/34 were likely to be in use. If so, run-ups would have occurred much farther away from the lead sampler. This may explain why the average lead concentrations on sample

days when the prevailing wind direction was W or NW was almost double the concentration on days when the prevailing wind was from other directions (0.067 µg/m^3 vs. 0.037 µg/m^3).

Figure 4
Relationship between Pb Concentrations and Airport Operations



DHHS also investigated the relationship between atmospheric mixing conditions and ambient lead concentrations.‡ One might expect to see higher lead concentrations when atmospheric mixing is poor. Surprisingly, there was no correlation between indicators of poor atmospheric dispersion and elevated lead concentrations. We speculate that mechanical mixing from "prop wash" and other runway activity overwhelmed the effects of ground based inversions on lead concentrations near the sampler.

Quality Assurance

A quality assurance project plan (QAPP) was established before sampling began to help ensure good data quality. Quality assurance procedures were established for the sampling performed by DHHS and the laboratory analysis performed by ADEC EHL. Third party audits were conducted quarterly to ensure that the sampler was running within required flow parameters and sample flow measurements were accurate. For the majority of sample runs, ADEC EHL analyzed both the primary and replicate sample to assess method precision. The results of replicate sampling, performed to assess overall method precision, are shown in Figure 5.

As an additional quality assurance check, replicate samples collected during four sample runs were sent to a third party EPA contract laboratory for lead analysis while the primary filter samples from those same sample runs were analyzed by ADEC EHL. In addition to assessing overall method precision, this provided an indication of the performance of ADEC EHL relative to a third party laboratory. The average difference in ambient lead concentration computed from analysis of the four primary filters analyzed by ADEC EHL and four replicate filters analyzed by the EPA contract laboratory was 0.006 µg/m^3. Filters

‡ Because there was no direct measurement of atmospheric mixing available, DHHS used surrogate parameters that are indicators of the degree of atmospheric mixing. For example, elevated carbon monoxide concentrations at Anchorage monitoring stations are indicative of ground-based temperature inversions and poor atmospheric mixing.

analyzed by the EPA contract laboratory averaged 8% higher than replicate filters analyzed by ADEC EHL.

Figure 5
Merrill Field Pb Precision