

STEALTHFUL: STATE OF MICHIGAN NMC AND WMU FLIGHT SCHOOL AIRCRAFT RELEASE LEAD OVER MICHIGAN COMMUNITIES

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Public concern about toxic lead has focused on lead-based paint and lead in drinking water, but another source of lead – fallout from the air – has gone under the radar. **In Michigan, Traverse City area and Battle Creek area residents are gradually learning that the State of Michigan flight schools based in their communities have been surreptitiously emitting lead (Pb) over areas of the communities for nearly a half century and continue to do so. One flight school is run by Northwestern Michigan College (NMC) and the other is run by Western Michigan University (WMU). Elsewhere across the U.S., other communities have found themselves in similar straits. Clearly, we are not yet done dealing with the environmental and public health impacts and legacy of lead.**

Piston-engine aircraft, the plane of choice for the General Aviation (GA) sector that encompasses the vast majority of small planes and flight school aircraft, were long ago exempted from the 1970's-era phase out of leaded gasoline. GA and its handmaiden, the Federal Aviation Administration (FAA) have done essentially nothing over the past half century to transition the fleet of roughly 220,000 piston-engine aircraft to unleaded fuel. The vast majority of piston-engine aircraft use leaded aviation gas. Thus, for most of the general aviation fleet in the U.S. the aircraft noise (combination of propeller and engine noise) from these aircraft is a clear indication, or what is called a proxy, for lead emissions. **The sound of these aircraft is the sound of lead being emitted into the environment. This has been and remains a guarded secret of the GA sector in our country and elsewhere around the world.**

The Centers for Disease Control state that no safe blood lead level (BLL) in children has been identified and even low levels of lead in blood are associated with developmental delays, difficulty learning, and behavioral issues. The effects of lead poisoning can be permanent and disabling. A recent peer-reviewed research study published by the National Academy of Sciences (McFarland et al., 2022) reports that:

Millions of adults alive today were exposed to high levels of lead as children. While these exposures were deemed harmless at the time, animal studies and epidemiological evidence accrued in the intervening years reveal that such exposures likely disrupted healthy development across multiple organ systems (particularly the brain, bone, and cardiovascular systems), resulting in subtle deficits to important outcomes, such as cognitive ability, fine motor skills, and emotional regulation, that may

influence the trajectory of a person's life (e.g., their educational attainment, health, wealth, and happiness). These deficits largely persist across time and, in some cases, worsen and are now hypothesized to put individuals at risk for difficult-to-treat chronic and age-related diseases, including cardiovascular disease and dementia.

Make no mistake. The health impacts, particularly in children, of lead exposure have been known for decades. It is only more recently that the long-term effects of those exposures in adults who decades ago were exposed to lead as children continue to play out, while at the same time the biomechanisms responsible for the effects continue to be identified and understood.

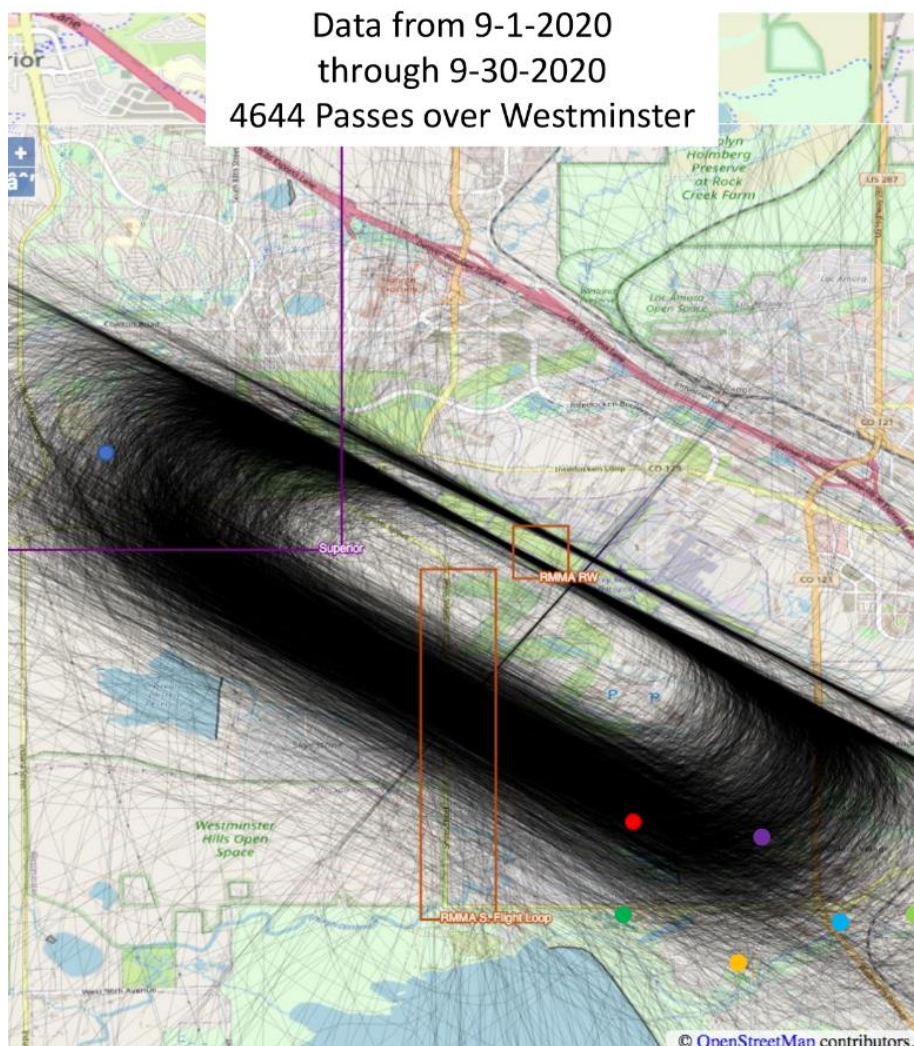
On October 20, 2023, the EPA published in the *Federal Register* its [*Finding That Lead Emissions From Aircraft Engines That Operate on Leaded Fuel Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare*](#). During 2022, the FAA embarked on its Eliminate Aviation Gasoline Lead Emissions (EAGLE) program. EAGLE has as its objective the elimination of leaded aviation fuels in piston-engine aircraft by the end of 2030. As recently reported in the February 2024 issue of *Aviation Consumer*, the EAGLE process is fraught with problems and approaches that almost assure delay and raise the prospect of outright failure.

Having done nothing for a half century as concerns phasing out leaded aviation gas mounted, the FAA has an extremely difficult task, as the GA community is deeply entrenched with its embrace of a massive fleet of lead-fuel dependent aircraft.

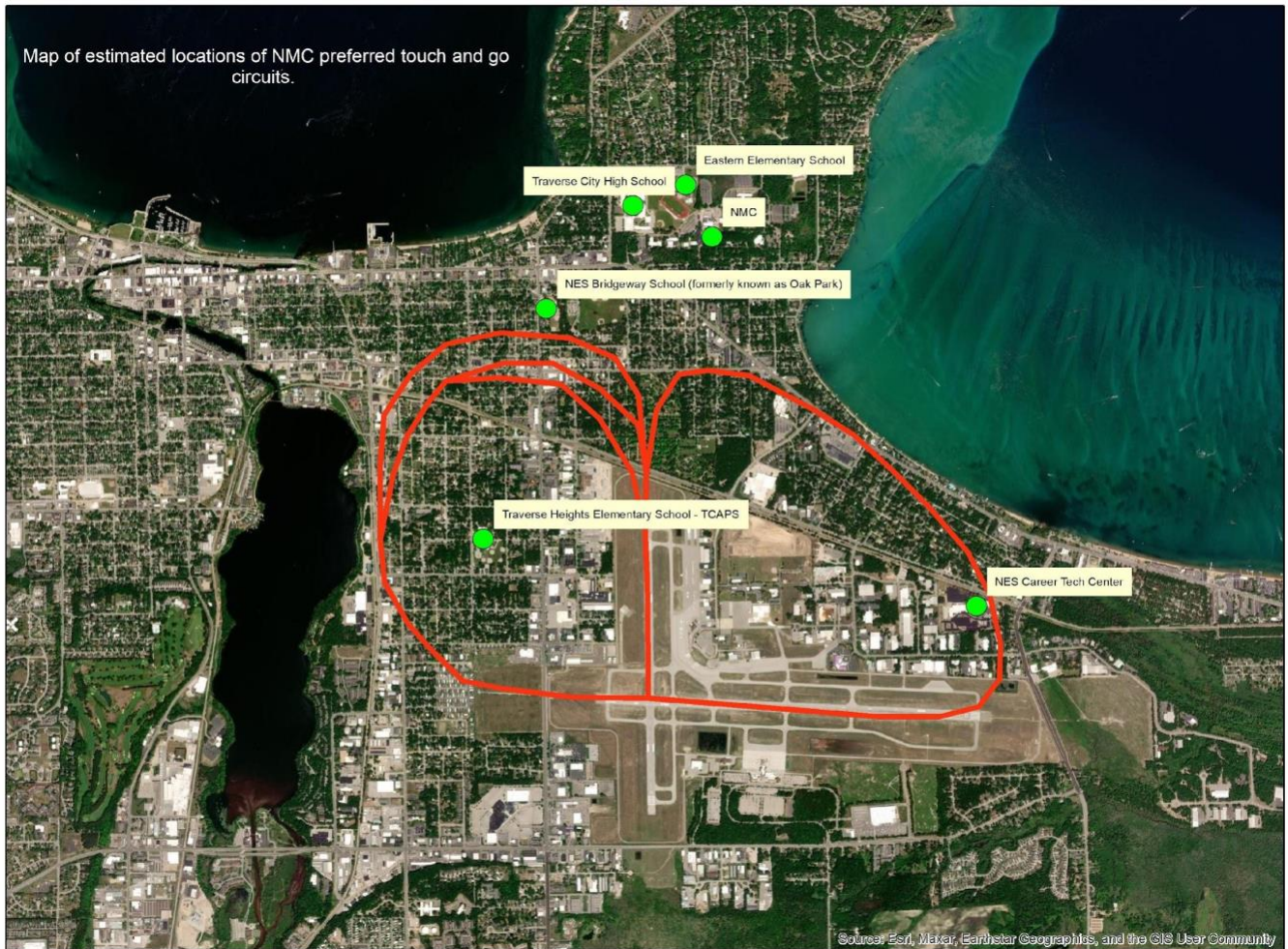
The predominant flight pattern used by flight schools is known as a touch-and-go loop or circuit, which is used to maximize the number of takeoff and landing operations conducted by pilots training in these schools. During each circuit, neurotoxic nanoparticulate lead (Pb) is typically being emitted by each aircraft involved, and typically there are multiple aircraft aloft at any given time. That is, these are moving sources of lead (Pb) emissions. It has been estimated that roughly 250 lbs of lead (Pb) particulates are emitted each year by NMC and roughly 1250 lbs per year for WMU, in both cases in the near-airport and immediate airport settings. Over the roughly half-century record of these two flight schools, approximately 12,500 lbs of lead for NMC and 63,000 lbs for WMU have been emitted. While the flight schools in the past were smaller, the lead content of aviation gas was higher – nearly twice as high.

During 2019, the NMC flight school reportedly used roughly 64,000 gallons of leaded aviation gas, known as 100 LL (*100 Octane Low Lead*). The lead content is low compared to what was once used, but each gallon of 100 LL contains 2.1 grams of lead per gallon. During the 2018, 2019, 2020, 2021, 2022 and 2023 fiscal years the WMU flight school used 190,555, 199,838, 158,293, 287,071, 247,035 and 271,727 gallons, respectively, of 100 LL, for a 6-year total of 1,354,519 gallons. Both of these programs continue to grow their enrollments over time.

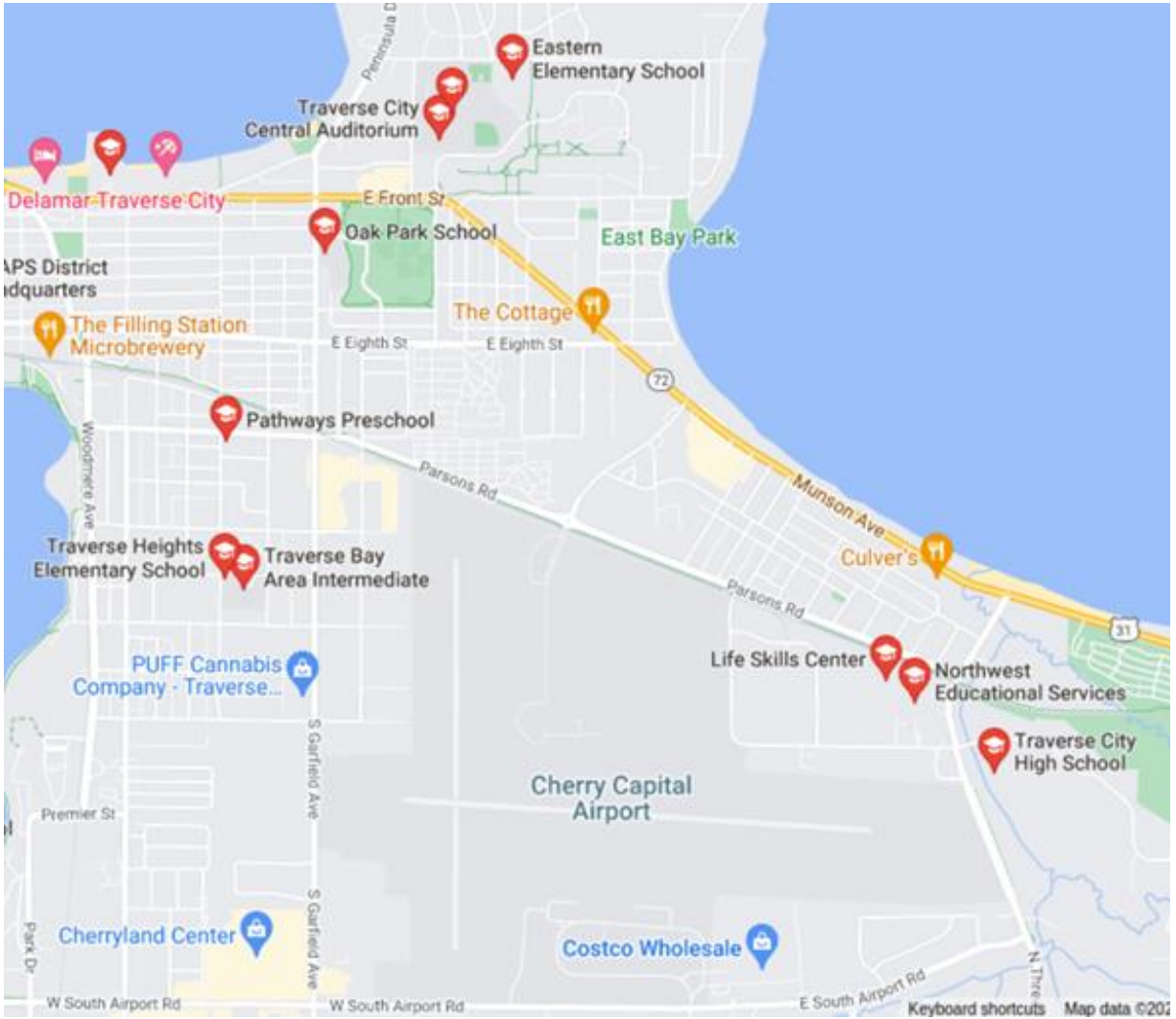
For those unfamiliar with touch-and-go flight operations, a map of flight paths over a one-month period in the vicinity of the Westminster, Colorado, airport, which has several flight schools, is presented below. This map, from a [presentation](#) by Robert Boutelle, Ph.D., to the Westminster City Council on August 7, 2023, illustrates what an accumulation of one month's worth of touch-and-go flight paths look like near an airport with significant flight school activity by lead-emitting piston-engine aircraft. The distance on the ground in this image is approximately 4.3 miles.



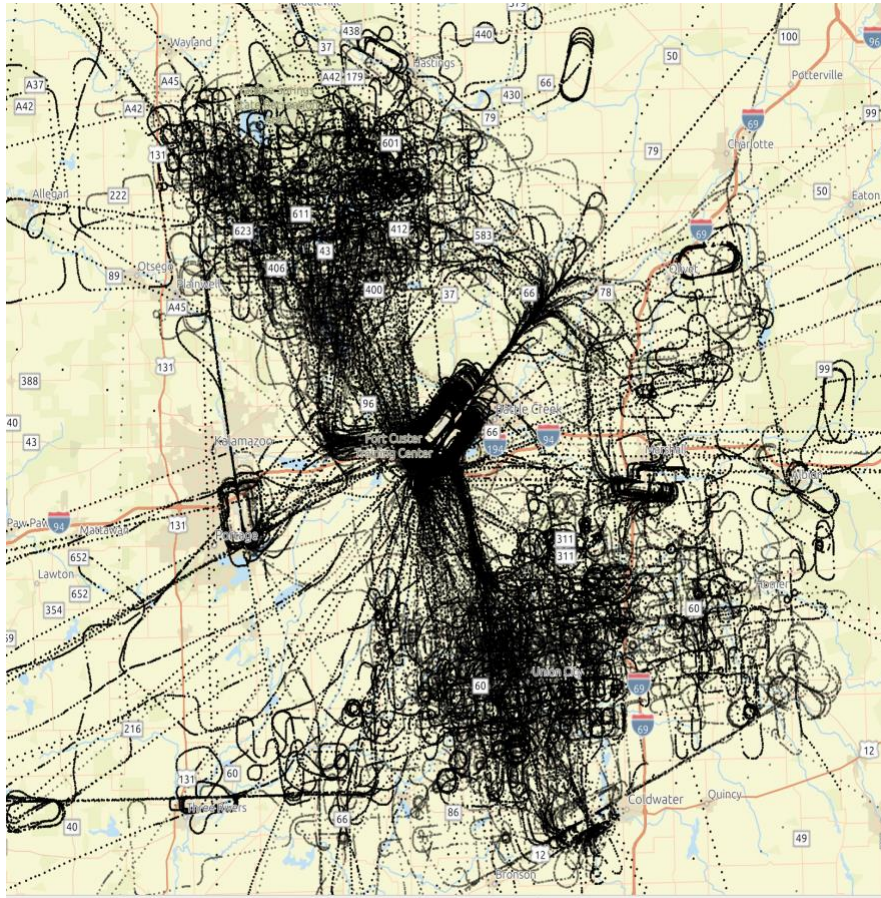
The estimated predominant flight paths used by NMC flight school aircraft in Traverse City in past years, still ongoing as of October 2023 (verified) and presumably ongoing at this time, are approximately as shown in the image below. NMC would not provide their flight path information when asked to do so in writing in 2020.



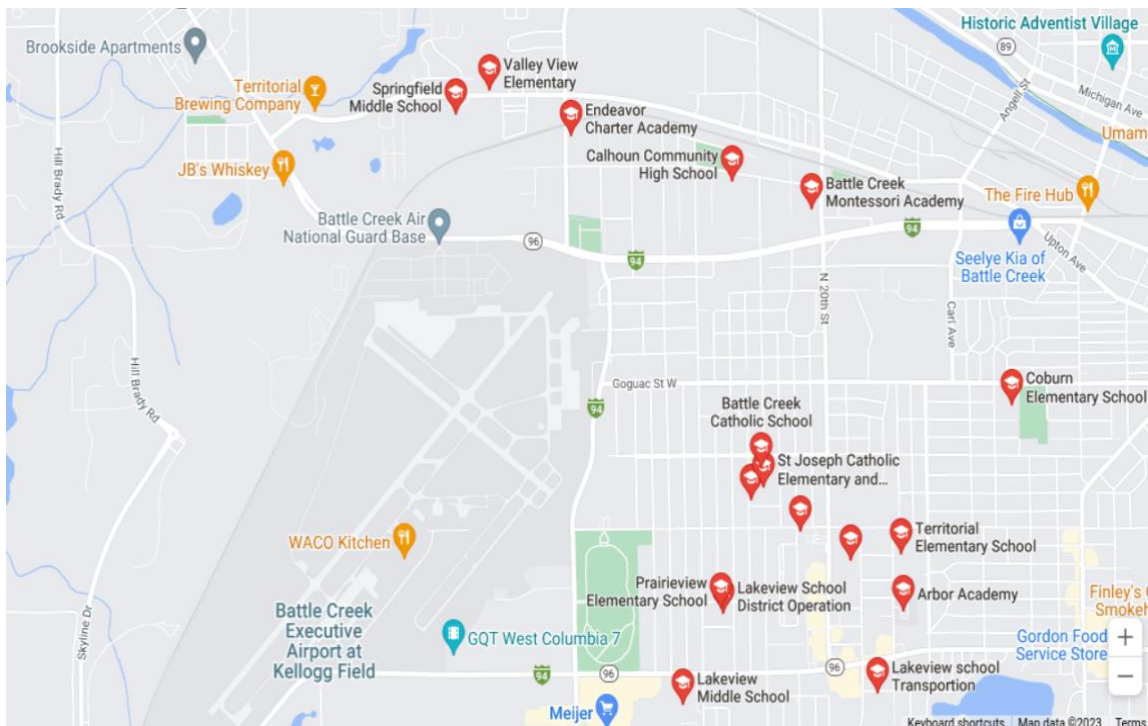
NMC Cherry Capital Airport flight school operations are conducted over and in the vicinity of Traverse City neighborhoods, with surreptitious emissions of nanoparticulate neurotoxic lead (Pb) over and near locations where schools and children are to be found. See the map, below, sourced in December of 2023 from Google Maps, to see the near-airport schools in the community.



Below is an illustration of flight path data for 2 days in October of 2023, for the Battle Creek W.K. Kellogg Airport area, where WMU operates its flight school. The data include all flight operations, but the WMU flight school is the principal operator. The WMU flight patterns at that time appear to be more random than shown above for Traverse City or Westminster, perhaps in an effort by WMU flight school management to distribute their lead emissions over a greater area. If so, this is an example of the *dilution as a solution to pollution* mindset. WMU has been asked about this, but they did not respond. There are quite a few schools in the near airport areas of Battle Creek. Dilution of lead exposure does not result in no lead exposure.



Below is a map (c. 12/2023 from Google Maps) showing schools near the Battle Creek, MI, airport, where WMU operates its flight school.

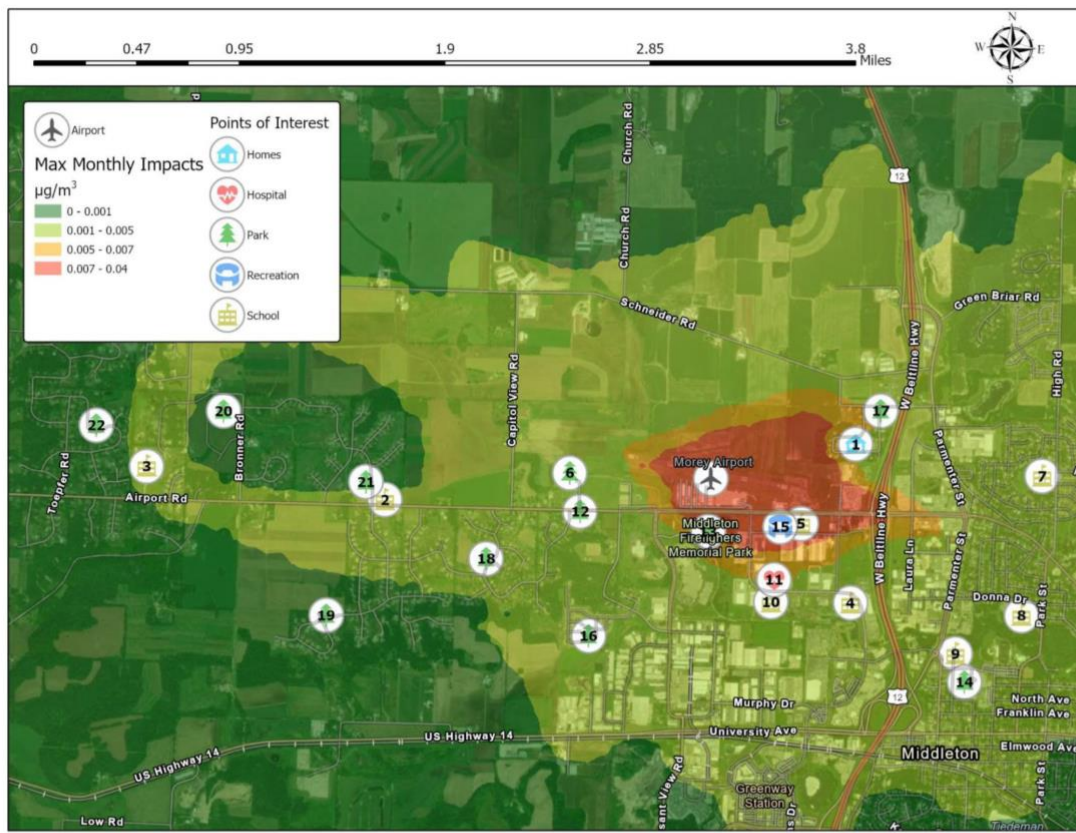


Lead emissions from NMC and WMU flight school piston engine aircraft are problematic for children and others who live beneath and downwind of the flight school flight paths for a number of factual reasons:

- Depending on the flight school and on other factors, but especially up until the present time, flight school aircraft generally repeat the same flight paths, upwards of thousands or tens of thousands or more times each year.
- Lead emissions from flight school aircraft are particulates, and they are primarily nanoparticles.
- Aircraft lead emissions are tasteless, invisible to the human eye, and odorless.
- Lead is a heavy element and lead particulates are heavier than air, settling from higher to lower elevation over time – through a process known as dispersion, which depends on wind speed, atmospheric conditions and other factors.
- Nanoparticulate lead emissions from flight school piston-engine aircraft and ground level exposures to lead by inhalation generally occur under fair-weather low-windspeed conditions and at relatively low elevation.
- Aviation-sourced lead emissions result in ground level concentrations of lead that result in lead exposure, for example, via inhalation.
- Lead is a potent neurotoxin, especially for children; the Centers for Disease Control and Prevention, or CDC, indicate that **there is no safe level for lead exposure in children.**
- Like other nanoparticles, nanoparticulate lead is readily taken up in children’s lungs and transported by blood to tissues and bone as part of normal growth.
- The medical effects of lead are numerous, and lead has also been found to have epigenetic effects (changes to chromosomal DNA functioning with altered gene expression) that are heritable.
- State of Michigan NMC and WMU flight schools have been releasing lead over the Traverse City and Battle Creek communities for roughly 50 years and continue to do so.
- The aviation industry and particularly these two flight schools have had remarkable success at covering up their historic and ongoing surreptitious neurotoxic lead emissions from their touch-and-go flight school piston-engine aircraft operations.

There is good evidence for probable lead exposures at ground level associated with high levels of piston-engine aircraft activity near airports. A 2022 air quality modeling [study](#) applied EPA’s flagship air contaminant dispersion modeling software, AERMOD, to simulate conditions at the Middleton Wisconsin Municipal Airport – Morey Field area. AERMOD simulations yielded estimates of the maximum monthly ambient air quality lead

concentrations (mass per unit volume) at ground level associated with piston-engine aircraft operations. See the illustration below. Concentrations can be mapped to exposures and exposures can be used to forecast public



Town of Middleton/City of Middleton Municipal Airport – Morey Field C29 Lead Modeling Report
Trinity Consultants

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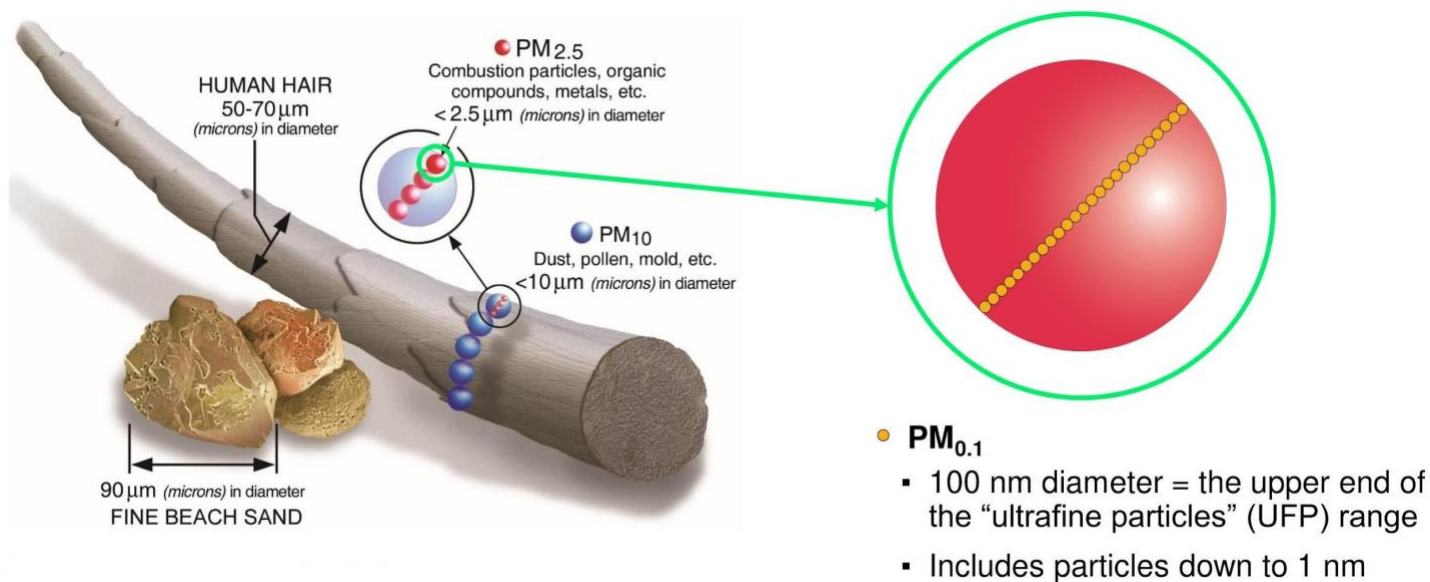
health impacts using standard toxicological methodologies – this is the stuff of air quality regulation and, of course, class-action lawsuits.

A companion Town of Middleton-funded [study](#) featuring monitoring of actual ambient lead concentrations around Morey Field yielded results showing good agreement between the AERMOD simulation results shown above and measured ground-level ambient air lead concentrations.

The Town of Middleton also funded a study by the U.S. Geological Survey (Schachter and Stuntebeck, 2024), the results of which are highly relevant. The USGS looked at overall lead concentrations together with lead isotope ratios of water from six residential wells near Morey Field. The isotope ratios for lead found in the wells closely match the ratio for lead in the aviation gas (100LL) in use at Morey Field. Thus, aviation-sourced lead is also a groundwater supply contaminant. This provides an ingestion pathway for exposure, on top of inhalation.

The nanoparticulate nature of piston-engine aircraft lead (Pb) emissions was documented by [Griffith \(2020\)](#), but this characteristic has been known for the past 15-20 years or more. Translocation (uptake) of nanoparticulate contaminants by the body via the lungs is an insidiously efficient process that readily brings nanoparticulate lead (Pb) into the bloodstream and then on to organs and tissues (see, e.g., [Hak Soo Choi and colleagues \(2010\)](#)). Data documenting elevated blood lead (Pb) levels (BLLs) of children living near airports and the relationship of those BLL data to piston-engine aircraft activity have been reported by [Miranda and colleagues \(2011\)](#), [Zahren and colleagues \(2017\)](#) and [Zahren and colleagues \(2023\)](#). Given what is known, it is to be expected, tragically, that children’s blood, tissue and organ lead (Pb) levels have the potential to be indicative of prior sustained exposure to aviation-sourced nanoparticulate lead (Pb) if they have spent significant time in near-airport neighborhoods and school settings with high levels of piston-engine aircraft activity. A multitude of studies, not cited here, relate lead exposure to adverse physical and mental health outcomes related to lead (Pb) toxicity in humans. Finally, there are deleterious impacts in mammalian cells due to the response(s) to lead (Pb) exposure during early life and even in mature adults. Research has demonstrated that these impacts can be associated with heritable epigenetic changes such as DNA methylation and chromatin remodeling, which individually and collectively have negative effects on gene regulation. See, for example, the peer-reviewed publication by [Sen and colleagues \(2015\)](#). All of the scientific journal publications cited in this paragraph are peer-reviewed.

Nanoparticulates refers to particles smaller than approximately 100 nanometers or 1/10,000,000 of a meter. A nanometer is a billionth of a meter and the micron (symbolized by μm) is a millionth of a meter. PM 10 and PM 2.5, where PM indicates particulate matter, are particle-size thresholds used in air-quality regulations, science, toxicology and monitoring. The following illustration was developed by TSI Inc. and is reproduced



here to help visualize what is meant by nanoparticulates. The red sphere(s), shown in comparison to a human hair and particles of fine beach sand, are 2.5 microns in size. The orange spheres superimposed on a single red PM 2.5 sphere are 0.1 microns or 100 nanometers in size. When a person inhales nanoparticulates, due to their extremely small size, these particulates have a tendency to readily enter the blood stream.

Inquiries and Notifications Concerning NMC and WMU Flight School Lead Emissions 2021-2024

As noted above, due to the general aviation industry's capture of the FAA (and the EPA) over the past half century, these agencies have generally been silent, with no notification to the public in areas of prospective impact about what has been and is ongoing as far as GA lead emissions and lead exposures.

Many of the entities that I have contacted have responded with silence or have been dismissive. Members of the news media have been either dismissive, indicated that they were busy, or were non-responsive. But some individuals and organizations have responded and expressed concern.

Michigan Department of the Environment, Great Lakes and Energy (EGLE) staff have indicated on several occasions that these aircraft lead emissions are not under their jurisdiction. At least some of their perspective relates to EGLE staff's understanding that in the few aviation settings investigated, monitoring for lead indicates that air quality remains in compliance with the National Ambient Air Quality Standard (NAAQS) for lead. However, the NAAQS for lead is probably not protective of human health for lead nanoparticulates. In fact, there is a great disconnect between how environmental regulations approach lead in air and how public health entities approach lead exposure in humans. The environmental regulators say that a certain small amount of lead in air, which is the NAAQS for lead, is acceptable. The public health sector indicates that *any* lead exposure is unsafe, particularly for children. Further, it is probable that technology typically used for lead monitoring of ambient air fails to adequately detect nanoparticulates ([Tiwari, et al., 2022](#)).

Michigan Department of Health and Human Services (DHHS) staff are reportedly in the process of completing a toxicological assessment of aviation lead impacts for the Cherry Capital Airport in Traverse City and perhaps the W.K. Kellogg Airport in Battle Creek. My present understanding is that their assessment is in an extended state of revision and internal review; such an assessment is non-trivial and cannot and should not be done hurriedly, though at this point, the internal review has become a very long-lived, possibly perpetual or possibly an intentionally dead-end, process.

Trustees, Administrators and Program Directors at NMC & WMU have generally responded, if they have responded, that they are entitled to run their flight schools as they do and that they comply with all laws and regulations. The trustees at NMC, in writing, more or less tossed the administrators and program director under the bus, indicating, in so many words, that they rely on those individuals to do the right things. The respondents tend to rationalize that the end (training pilots) justifies the means, implying that collateral damage to childrens' health and overall public health – a profound environmental injustice – is acceptable to them as individuals, to the institution, and to the State of Michigan. They acknowledge the challenges and express hope, even confidence, that the FAA will eventually solve the problem of leaded aviation gas use across the general aviation fleet. There has yet been no mention by them of pilot training using electric trainers that are coming into use in the U.S., Canada and internationally. Instead, they speak to prospective future aviation gas solutions that are to be developed under the auspices of the FAA, which has done little to nothing in this regard over the past half century.

It is past time for the State of Michigan, together with NMC & WMU administrators, to inform the residents of the Traverse City and Battle Creek communities of what the State and these two institutions are doing and have been doing as concerns lead emissions and lead exposures during the past half century. As part of conversations facilitated by an impartial third party, the State, NMC and WMU should solicit community input on what the State and these institutions need to be doing going forward as concerns their present and historic emissions of neurotoxic lead nanoparticulates over the communities where the two flight schools operate, and as concerns the corresponding exposures and toxicological effects.

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About the Author

Charlie Schlinger, Professional Engineer, Registered Geologist, Certified Professional Geologist, is a Michigan resident and Flint native. He has spent most of his adult life and professional career in the west and southwest. Charlie earned his B.S. degree at the University of Michigan in Flint, and received his Ph.D. from The John Hopkins University. Later in his career, he went on to earn a Master's Degree in Civil & Environmental Engineering from Utah State University. Early on, he was a professor at the University of Utah and subsequently was an engineering professor at Northern Arizona University (NAU), where he has emeritus standing. At Utah he managed or led geophysics and geomagnetism research funded by the National Science Foundation, Smithsonian Institution, NASA, and others. At NAU he covered water resources and geotechnical engineering along with surveying. For the past 27 years much of his professional focus has been on civil and environmental engineering in support of tribal communities, schools & organizations, principally in the areas of water resources, water quality and water infrastructure. You can contact Charlie via email at lastgoodcountry@gmail.com.