Endangered Health

The Threat to Public Health from the Proposed F-35 Basing at Burlington International Airport

Current scientific consensus confirms that health effects of aviation noise, in both children and adults, are far more severe than the Air Force acknowledges

A report produced by the Stop-the-F35 Coalition, Vermont

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This report is addressed to the people of Vermont and to all of those involved in the decision-making process regarding basing the F-35 at Burlington International Airport. It is also addressed to the Vermont Department of Health as a response to its F-35 Public Health Review. We appreciate the efforts made by Dr Chen and the Department of Health to respond to community concerns regarding health impacts of the F-35 at BIA. In this document we present a request for further analysis and action by the department.

I Introduction

If the F-35 is based at Burlington International Airport, thousands of people in the surrounding communities will be exposed to high levels of noise pollution. The scientific consensus that has emerged over the past ten years demonstrates that noise pollution at the level anticipated in most of Winooski, and large parts of S. Burlington, and Williston—a 65 dB average daily noise level—is associated with cardiovascular disease and cognitive impairment in children. The scientific community now regards the evidence as *sufficient*—the term used to indicate the highest level of confirmation in scientific research—to establish the connection between noise pollution and disease.

Extreme noise has direct and involuntary physiological effects. It increases levels of stress hormones and neurotransmitters that raise blood pressure, leading to cardiovascular disease in adults and children. There are further implications for children because their brains are in the process of development.

Over 20 studies have shown negative effects of noise on reading and memory in children: epidemiological studies report effects of chronic noise exposure. Exposure during critical periods of learning at school can impair development and have a lifelong effect on educational attainment. The WHO estimates that 50% of the children in the 65 dB noise zone will suffer cognitive impairment. Additionally, altering neurotransmitter levels can lead to psychiatric disorders later in life for these children.

The Air Force, in the *F-35A Draft Environmental Impact Statement*, does not acknowledge the severity of the risk because it unjustifiably rejects the 65 dB health effect threshold. Instead, the Air Force inaccurately proposes a 75 dB threshold, claiming that few if any health effects would result from the F-35. How does the Air Force justify a higher threshold? It relies on outdated studies and ignores the last decade of research.

While F-35 proponents downplay health effects, they do acknowledge "community concern" and they have an answer to this concern: *mitigation*. They say that once the planes are here, efforts will be made to mitigate the noise impact.

But no credible plan, with the exception of avoidance (rejecting the planes), has been proposed or implemented, here or elsewhere, that would even begin to adequately reduce the noise. Homes are currently being torn down in South Burlington as a result of F-16 noise, demonstrating the ineffectiveness of mitigation measures. In the case of the F-35, tearing down the 3,000 homes in the projected noise zone and displacing the 8,500 residents is not a realistic or acceptable option. Mitigation is an empty promise.

II Overview

Does the F-35 at BIA pose a threat to public health?

The *F-35A Operational Draft Environmental Impact Statement* (DEIS) tells us that if the F-35, a high-performance, supersonic, tactical military jet aircraft, is based at Burlington International Airport, approximately 8500 people (using 2010 census data) will be living in a 65 dB DNL noise zone[1] deemed incompatible with residential use by the FAA. The planes are expected to be in Burlington for forty years, and the potential health effects of the F-35 have raised concerns in the community. In order to assess any potential public health threat, it is necessary to determine whether there is scientific evidence of negative health effects at the 65 dB daily average level at which thousands of people will be exposed, and if so, what the effects are likely to be.

The DEIS evaluates fifteen environmental categories such as noise, air quality, safety, environmental justice, and so forth. It finds that Burlington is the only one among the six locations under consideration that will suffer "unavoidable adverse environmental impact" in the areas of noise, land use, and environmental justice. Health issues and related scientific studies are discussed in Volume II of the DEIS, but in Volume I, where environmental impacts are assessed in detail, and in the Summary of Environmental Consequences ES-72, the only mention of health impact is under the category of Environmental Justice (Airspace) where it is stated, "…nor would there be any special health or safety risks to children".

Thus, in assessing the environmental consequences of basing the F-35 at BIA, the Air Force does not acknowledge ***any*** negative health impacts on either children or adults.

The Air Force apparently finds no health impacts because it claims none exist below 75 dB DNL. Since the great majority of people (approximately 8,000 according to 2010 census data) will be exposed at the 65-74 dB DNL level, while comparatively few (587 people) at 75 dB DNL or above, the Air Force seems to argue that the F-35 does not present a significant or unmanageable public health threat. If the Air Force is correct regarding the 75 dB DNL (or perhaps 80 dB DNL, as we see below) effect threshold, and leaving aside for the moment the troubling matter of the 587 people exposed at that level, there would be little impediment from a public health standpoint to basing the F-35 in a residential area. The position of the Air Force can be summarized as follows:

1. The Air Force claims that "…<u>there is little likelihood of hearing loss below an average sound level of 75 dB DNL.</u> Near military airbases, noise levels above 75 dB may occur… [however] no research results to date have definitively related permanent hearing impairment to aviation noise." DEIS Vol II page C-27. "The

[1] DNL is calculated by averaging the sound level over 24 hours (with greater weight given to nighttime hours) for one year.

threshold for assessing PHL [potential hearing loss] is exposure to noise levels 80 dB DNL and greater." DEIS BR4-24.

2. The Air Force further claims that, "most studies of non-auditory health effects of long term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential non-auditory health effects." For example, the DEIS quotes a 1990 NIH paper as follows: "The non-auditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an 8-hour day)." The Air Force concludes that "**…there is no scientific basis for a claim that potential health effects exist for aircraft time average sound levels below 75 dB".** (emphasis added) DEIS Vol II, pages C28-29.

But the Air Force is mistaken. Its position is based on old data, completely ignores the most recent ten years of research on cardiovascular and cognitive issues, is contradicted by the World Health Organization[2] and the consensus opinion of leading experts in the field of noise and health, and must therefore be rejected.

This was clear to us from our reading of the recent literature, but for further confirmation, we contacted Wolfgang Babisch, who is unquestionably one of the leading authorities in the world on the relationship between noise and health and one of the principle authors of the landmark WHO study, *Burden of Disease from Environmental Noise*, as well as other recent major studies. Here is what Dr. Babisch said in his reply to us:

> *I confirm that there is largely consensus amongst noise experts that average noise levels during the day >65 dB (A)[3] and during the night >55 dB (A) are associated with an increased risk of cardiovascular diseases. These data are derived from road traffic noise studies.[4] Studies regarding commercial aircraft noise showed effects at even lower noise levels. Regarding cognitive impairment in children due to aircraft noise at schools effect level are lower than L_{day} 65 dB.*[5]

We wish to stress that Babisch is not merely one expert speaking of his opinion. He is a leading expert speaking of the consensus among experts today. We believe his statement constitutes a conclusive determination of the central question regarding health effects of the F-35: the scientific consensus confirms cognitive impairment in children and

[2] WHO, *Burden of Disease from Environmental Noise*, 2011
[3] dB(A) is an expression of the relative loudness of sounds in air as perceived by the human ear.
[4] See discussion below regarding the greater impact of military jets compared to commercial jets
[5] Statement byWolfgang Babisch, 1/10/2013. See full text in appendix A. L_{day} is the average daily sound level.

cardiovascular disease resulting from exposure to 65 dB (and below) average daily noise levels,[6] the levels which the F-35 will impose on 8,500 people in this community.

Elsewhere, Babisch has written,

> *It is well understood that noise levels below the hearing damaging criterion cause annoyance, sleep disturbance, cognitive impairment, physiological stress reactions, endocrine imbalance, and cardiovascular disorders.*[7]
>
> The evidence is regarded as *sufficient by most experts, for noise levels greater than > 65 dB (A) (L_{dn})*[8], to demonstrate increased risk of cardiovascular diseases.[9]

Of the four levels of confirmation used in international scientific research—sufficient, limited, inadequate, or lacking—we see here the highest level of confirmation.

It is thus clear that the Air Force is mistaken with regard to the most fundamental factor in assessing the health impact of the F-35. Not only is there scientific evidence, but there is a scientific consensus among experts of negative health effects at average noise levels of 65 dB and even below 65 dB for cardiovascular disorders and cognitive impairment from commercial aircraft noise. And since it is generally understood that the greater intensity of military jet noise is more damaging than commercial jet noise, certainly not less damaging[10], the potential health impact of the F-35 can be expected to be greater. Since more than 8500 people would be exposed, the conclusion is inescapable, based on the consensus opinion of experts, that the F-35 in Burlington would present a threat to public health.

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[6] The 70 dB effect level found in the Passchier-Vermeer study cited by the Department of Health in the Public Health Review is from 2000. It is precisely the research of the past ten years that has confirmed the consensus 65 dB and below effect level.

[7] Babisch W. Cardiovascular effects of noise. Noise Health 2011; 13:201-4

[8] L_{dn} is the day-night equivalent sound level

[9] Babisch, op. cit.

[10] See discussion of this topic on page 18 below

Our Request to the Vermont Department of Health

We fully understand that it is not within the authority of the Vermont Department of Health to decide whether or not to base the F-35 at BIA, and we do not ask you to make that decision. Rather, as representatives of the affected community, we ask that you take specific steps and make certain recommendations that will help to protect public health. Your role is indispensable. The protection of public health cannot in this case be entrusted to the Air Force, because, as we have seen, the Air Force is in sharp disagreement with expert opinion with regard to the effect threshold. Therefore, we ask the Department of Health to review the literature and make a determination regarding the following questions:

1. Does the Department of Health find a scientific basis for the claim of health effects at 65 dB DNL?
2. If so, does the department find that the presence of the F-35 in Burlington may pose a threat to public health due to the thousands of people that would be exposed at 65 dB DNL and above?
3. If so, does the Department of Health also find that no specific, concrete, feasible mitigation plan has been proposed, in the DEIS or elsewhere, that would reliably reduce the impact below the effect threshold?

If the Department finds in the affirmative regarding these questions, then, with due consideration and respect, we ask the Department to recommend to the Air Force and the congressional delegation a delay in the basing decision at BIA until such time as an objective, full-scale health review can be conducted.

III Supplement

How the Air Force reached an erroneous conclusion regarding the effect threshold

Regarding cardiovascular effects and cognitive impairment, the Air Force arrived at the erroneous 75 dB effect threshold by relying exclusively on older studies. All studies cited in the DEIS pertaining to cognition and cardiovascular effects were conducted prior to 2003, and most are from the 1970s, 1980s, and 1990s. Missing from the DEIS is the entire body of scientific research conducted from 2003 to the present, including the landmark study by WHO, *Burden of Disease from Environmental Noise*. It is precisely the research of the last ten years that has created sufficient evidence to form a scientific consensus regarding the 65 dB effect threshold.

Mitigation—an empty promise

> *To the extent practicable, mitigation measures would be applied to reduce potential effects to acceptable levels. However, noise impacts that cannot be mitigated could occur. Some of these impacts could be considered adverse or annoying to potentially affected individuals.*[11]

The DEIS states that, once the basing decision is made, "following the publication of the ROD, a mitigation plan will be prepared…"[12] Only after an irreversible, long-term decision is made that will, according to the Air Force, negatively impact the community, will the Air Force develop a mitigation plan. That is a great concern because there is no known mitigation method that is feasible and that would reduce the impacts below the effect threshold. Nowhere do we find such a plan proposed. Nowhere do we find credible evidence that adjustments of throttle settings, restrictions on hours of flight (already built into the DEIS), or changes in other procedures would reduce the impact below the effect threshold. In fact, we find ample acknowledgement in DoD documents that there is no known solution and that new research is needed to address the problem.[13] A change in flight patterns is unlikely to be practicable.[14] Aside from avoiding the impact altogether, the only effective mitigation is the abandonment of neighborhoods, the displacement of individuals and families, and the demolition of homes as is currently being carried out in South Burlington in response to F-16 noise. With the F-35, such an approach is not feasible given the size of the affected population. The FAA has indicated that soundproofing is at best only minimally helpful. For one thing, normal life involves much time spent outside or inside with windows open.

The Department of Defense does not currently know how to reduce the noise generated by high performance jet fighters such as the F-35.

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[11] DEIS Vol 1, 2.4.2
[12] Ibid, 2-43
[13] Vide infra
[14] The FAA, for example, will not arbitrarily move noise from one community to another. It is generally believed that noise relief for one community should not come at the expense of another.

The DoD is aware of the issues and impacts on the environment from noise generated by high performance supersonic military aircraft such as the F-35 Lightning II Joint Strike Fighter (JSF), F-22, and F/A-18 E/F. Current and potential U.S. and international noise regulations and policies threaten to impact future basing considerations as well as operations and training requirements. Research and development activities focused on reducing the noise generated by high performance supersonic aircraft are limited.

These noise levels are already causing significant pressure for reductions in aircraft numbers and/or available airspace for training and operations. Likewise, Veterans Administration claims related to hearing impairment are the single highest category of claims, and are increasing. Changes in operational and flight procedures can reduce the impacts to the surrounding communities but cannot eliminate all safety and environmental impacts. Research efforts are needed to understand, and effectively reduce, the noise from these jet engines.[15]

According to the FAA, "land acquisition and relocation is the only alternative that would eliminate the residential incompatibility" and "…noise barriers provide little, if any, reductions of noise from aircraft that are airborne and can be seen over the barrier." *(2008 FAA Report, pages 29 and 35).* As Dr. Babisch has indicated, the best mitigation is avoidance and prevention. Once the decision is made to base the F-35 in Burlington, it will be too late to prevent harm.

Cardiovascular Health Effects

The F-35 Public Health Review (PHR) by the Vermont Department of Health states that when effects are found they are not consistently significant, and it is difficult to control for confounding factors. On the contrary, more recent research has enabled experts to form a consensus view regarding the effect threshold which now makes it possible both to assess risk and recommend preventative measures.[16]

It is well understood that noise levels below the hearing damaging criterion cause annoyance, sleep disturbance, cognitive impairment, physiological stress reactions, endocrine imbalance, and cardiovascular disorders.

Persistent changes in endogenous risk factors due to noise-induced dysregulation and disturbed metabolic function, promote the development of chronic disorders such as atherosclerosis, hypertension, and ischemic heart diseases in the long run.

Noise from transportation is by far the most widespread source of noise exposure, causing most annoyance and public health concerns. . With

[15] Full scale military tactical aircraft engine noise source / mechanism identification, Oct 25, 2012
[16] WHO, op. cit.

respect to noise mitigation measures, the avoidance and prevention of physical health effects plays an exceptional role in public health

The question at present is no longer whether noise causes cardiovascular effects, it is rather: what is the magnitude of the effect in terms of the exposure-response relationship (slope) and the onset or possible threshold (intercept) of the increase in risk

The evidence is regarded as '***sufficient' by most experts, for noise levels greater than > 65 dB (A)*** ($L_{dn)}$, to demonstrate increased risk of cardiovascular diseases.[17]

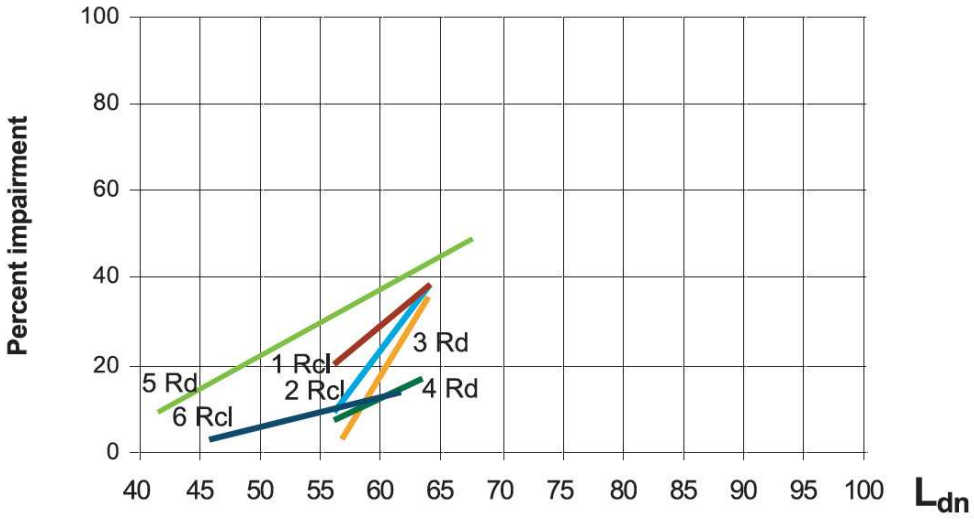
[17] Babisch, W., op. cit.

Cognitive Impairment in Children

"Over 20 studies have shown negative effects of noise on reading and memory in children: epidemiological studies report effects of chronic noise exposure." "Exposure during critical periods of learning at school could potentially impair development and have a lifelong effect on educational attainment."[18] The studies show a linear relationship between level of noise exposure and degree of cognitive impairment.

WHO: Environmental Noise and Cognitive Impairment in Children

Fig. 3.1. Exposure-response curves from different epidemiological studies



Notes. Rd = reading; Rcl = memory, recall
1 = recall, children, old airport *(10)*.
2 = recall, children, new airport *(10)*.
3 = reading, children, old airport *(10)*.
4 = reading, children, new airport *(10)*.
5 = reading, children *(11)*.
6 = free recall, children *(17)*.

WHO estimates 50 % of children in the 65 dB zone will develop noise induced cognitive impairment.[19] The F-35 dramatically expands the 65 dB zone. We believe this represents an unacceptable public health hazard.

[18] WHO, op.cit.
[19] WHO, op.cit., page 50

Table 3.2. Estimated number of children aged 7–19 years in Sweden with noise-induced cognitive impairment and DALYs per year due to noise-induced cognitive impairment (NICI)

Age group and noise exposure level	No. of children aged 7–19 exposed	Percentage of children who will develop NICI	No. of children with NICI	DALYs lost for NICI
7–19 years, < 55 L_{dn}	1 012 817	0	0	0.0
7–19 years, 55–65 L_{dn}	282 993	20	56 599	339.6
7–19 years, 65–75 L_{dn}	163 838	50	81 919	491.5
7–19 years, > 75 L_{dn}	29 789	75	22 342	134.1
Total	1 489 437		160 859	965.2

Source: WHO *Burden of Disease from Environmental Noise*

Cognitive impairment of children means more than lower test scores in school. Well established evidence of noise induced hormonal and neurotransmitter disruption and hearing loss[20] at an early age affect brain development, thus providing a biologically plausible explanation for cognitive impairment. Neurotransmitter disturbance in children can lead to an increase in psychiatric disorders later in life with staggering costs to individuals and society, according to Dr. Roger Boshes, Professor of Psychiatry at Harvard Medical School. Dr. Boshes explains that the human brain continues to develop through the second decade of life. Alteration of adrenaline and norepinephrine levels in children, which have been well demonstrated from chronic noise exposure, can cause irreversible alterations in brain architecture.[21]

The PHR states that, "There is little evidence in the research literature that specifically addresses the effects of aircraft noise on cognitive development". However, a search of the literature reveals over a dozen such studies.[22]

"Both the RANCH and Tyrol studies indicate that aircraft noise may be ***worse for cognition*** (emphasis added) than road traffic noise. For aircraft noise, exposure evidence from the Munich study seems to indicate that LAeq = 60 may be a dividing line, but the RANCH study results suggest more of a linear association between aircraft noise exposure and impairment of reading comprehension."[23] Professor Eberhard Greiser, the lead investigator in a German Federal Environmental Agency study of aircraft noise health effects, said,

[20] Anderson, K, Brain-Development-Hearing-Loss.pdf, Minnesota Dept. of Education, 2011
[21] Appendix B .Statement by Dr. RA Boshes, Professor of Psychiatry, Harvard Medical School
[22] See, for example, Haines, et al, "A follow up study of effects of chronic aircraft exposure on child stress response and cognition," International Journal of Epidemiology, 2001
[23] WHO, op. cit., page 46

Jet noise is more dangerous than any other kind of road-traffic or rail noise because it is especially acute and sharp and it induces stress hormones.[24]

Therefore, transportation noise studies that do not specifically address jet noise may understate the severity of the likely health effects of the F-35. There is evidence in various studies associating exposure to high levels of jet noise in children with the development of psychological symptoms such as helplessness, which further contributes to impairment.[25]

Noise induced cognitive impairment in children may therefore be understood to be the result of hearing loss, hormonal and neurotransmitter disruption, and psychological disorders together affecting brain development, structure and function.

Air Pollution

The F35 draft EIS addresses 7 air pollutants in jet exhaust:

- Carbon monoxide,
- sulfur dioxide,
- nitrogen dioxide,
- VOCs
- particles PM_{10}
- $PM_{2.5}$
- CO_2e

The report concludes that the F-35 will not negatively impact regional air quality. Regional air quality is currently in compliance with federal standards. The presence of the F35 may even produce a small improvement in comparison to the F16 baseline.

There are two problems with this analysis

1. Only ***regional*** air quality is addressed. ***Local air quality*** with respect to the seven pollutants (and other key pollutants ignored by the DEIS), where most of the harmful health impacts occur, is not monitored and assessed. While F-35 operations at BTV may not have a large impact on regional air quality (encompassing 14 counties in VT and NY), they may have a significant impact on neighborhoods adjacent to the airport. Pollution from airports tends to be localized within a few kilometers, according to Professor Ronald Henry of UCLA.

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[24] http://www.time.com/time/specials/packages/article/0,28804,1929071_1929070_1947782,00.html

[25] Evans et al, "Community Noise Exposure and Stress in Children," "Evidence that noise can function as a stressor includes elevated psychophysiological activation, greater psychosomatic symptoms of anxiety and nervousness, and deficits in motivation indicative of helplessness ~Cohen *et al*., 1986; Evans, 2001; Ising, Babisch, and Kruppa, 1999; Ising and Braun, 2000; Kryter, 1994; Lercher, 1996; Medical Research Council, 1997!."

2. Three key pollutants in jet exhaust that are widely recognized as having a major impact on health, contributing to cancer and respiratory disease, are not addressed in the DEIS: Black carbon, polycyclic aromatic hydrocarbons, and ultrafine particles. UCLA Medical Center study of Santa Monica airport[26] and EPA study of TF Green airport in RI[27] demonstrate the critical significance of local measurement of these pollutants is assessing health impact of airport operations.

The DEIS makes no mention of black carbon or ultrafine particles. It does mention polycyclic aromatic hydrocarbons but states that emissions are unlikely to reach levels considered adverse and thus would not create health risks to humans living adjacent to airfields or under the flight path. Therefore, polycyclic aromatic hydrocarbons were not evaluated. However, no evidence or monitoring to support this claim is offered.

One possible explanation for the omissions of ultrafine particles in the DEIS could be a failure to consider recent studies that have altered the way the concentrations of these particles are evaluated. It has recently been demonstrated is a study by Carnegie Mellon University that the number of UFPs in jet exhaust is multiplied by a factor of 35 after exposure to sunlight.[28] So measuring the particles initially present in the exhaust results in gross underestimation. The health impact is felt locally, not regionally. All of this escapes notice in the DEIS.

The health impact of the F35 cannot be adequately understood in the absence of an adequate assessment of pollution levels in the neighborhoods surrounding the airport. Such an analysis is not presented in the DEIS and is not available through the State of Vermont. In fact the state does not monitor air quality at BTV. However, based on the findings of the UCLA and EPA studies, it is not unlikely that there are dangerous levels of hazardous pollutants in the neighborhoods adjacent to BTV and that the F35 would worsen the problem.

Furthermore, we know of no monitoring of health trends in the neighborhoods near the airport, even though studies done at community airports elsewhere have shown health impacts. Here, the baseline for pollution levels and health status in the affected area is unknown.

Like BIA, the Santa Monica airport is located in the midst of residential neighborhoods, but unlike BIA, it does not also house a military installation. The UCLA Medical Center study found a substantial health impact from airport related air and noise pollution.[29]

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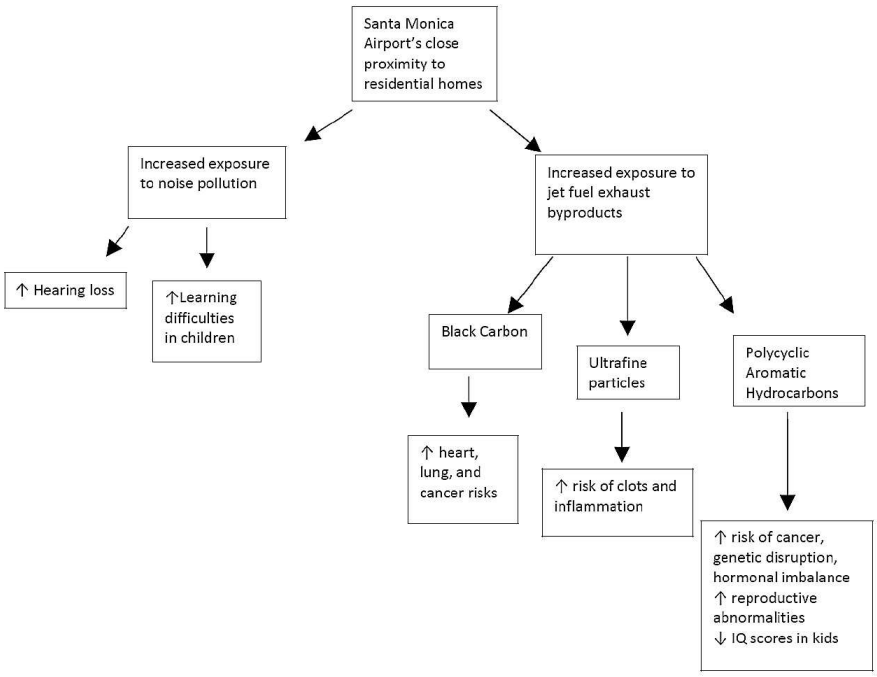
[26] Santa Monica Airport Health Impact Assessment, UCLA Medical Center, 2010
[27] TF Green Airport Air Monitoring Study, EPA, 2007
[28] http://www.wired.com/wiredscience/2011/05/airplane-exhaust-oil-toxins/

[29] Santa Monica Airport Health Impact Assessment, 2010



Source: UCLA Medical Center study

Acute Exposure Effects: Hearing Loss

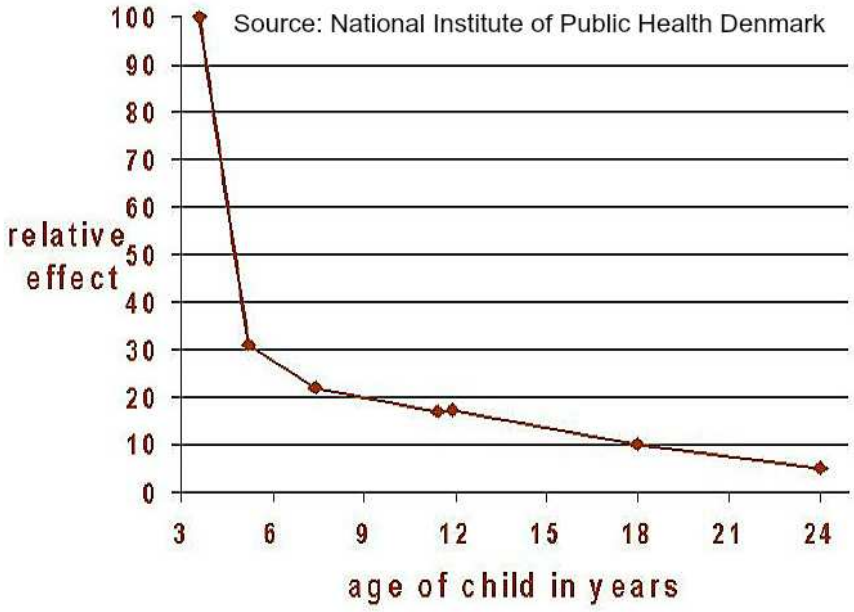
> *The relationship between noise levels and hearing loss and the mechanism of cell-death is well established and understood. While the process is the same, individuals vary in their sensitivity. Some people are more sensitive than others and will lose hearing at lower levels of noise exposure. This is common in all biological responses to both the environment and disease.*[30]

The Public Health Review (PHR) states that there are many sources of noise in the everyday environment that have sound levels similar to or greater than the F-35. But of the examples given, all are of lower sound level than the F35 except football stadiums and sirens. What is significant here is the vast *quantitative* difference in occurrence compared to the projected F-35 exposure. By contrast with the very occasional, limited exposure to the noise sources mentioned in the PHR, such as leaf blowers and snow mobiles, each F-35 overflight blankets thousands of people in the community with high decibel noise. The DEIS projects 7296 F-35 airfield operations per year or approximately 28 operations per day. On a quantitative basis F-35 noise would dwarf other sources of noise pollution. The comparatively small community exposure to rock concerts, snow mobiles and the like, serves to illustrate the unique severity of military jet noise impact on the community. Even commercial air traffic at BIA is a minor source of noise pollution compared to military jets. According to the DEIS, F-16 noise currently "dominates" the noise contours and "the contribution of civilian aircraft is negligible compared to the military aircraft contribution" to airport noise (BR4-21).

[30] http://www.nrac.navy.mil/docs/2009_FINAL_Jet_Noise_Report_4-26-09.pdf, page 28

The hearing loss threshold of L_{max} 114 in the Ising study mentioned in the PHR is just below the 115 L_{max} of the F-35, and thus is a cause for concern. The PHR mentions the OSHA 115 dB hearing loss prevention standard of 15 minutes or less and the "more conservative" NIOSH standard of 28 seconds per day. The two widely divergent standards are presented on an equal footing without an explanation of the difference, leaving the reader uncertain as to which is correct. But as NIOSH explains, the 28 second per day standard is superior because, unlike the older OSHA standard, it is based on contemporary risk assessment techniques and the latest scientific information not available at the time the OSHA standards were promulgated. The OSHA standard is outmoded, but unfortunately is not identified as such in the PHR, leaving the reader in confusion.

Furthermore, the NIOSH standard is meant to apply to adults. But infants and children may be more susceptible to noise induced hearing loss than adults. A study by the National Institute of Public Health Denmark has shown the relative impact of noise on hearing loss by age.[31]



If the Danish study is correct, then the NIOSH standards which may be adequate for adults may be inadequate to protect infants and young children. Other subgroups also have greater vulnerability.

[31] Bistrup, ML, Health Effects of Noise on Children, National Institute of Public Health Denmark, 2001

Vulnerable groups not represented in occupational noise standards

3.10. Vulnerable Groups

Protective standards are essentially derived from observations on the health effects of noise on "normal" or "average" populations. The participants of these investigations are selected from the general population and are usually adults. Sometimes, samples of participants are selected because of their easy availability. However, vulnerable groups of people are typically underrepresented. This group includes people with decreased personal abilities (old, ill, or depressed people); people with particular diseases or medical problems; people dealing with complex cognitive tasks, such as reading acquisition; people who are blind or who have hearing impairment; fetuses, babies and young children; and the elderly in general (Jansen 1987; AAP 1997). These people may be less able to cope with the impacts of noise exposure and be at greater risk for harmful effects.

Persons with impaired hearing are the most adversely affected with respect to speech intelligibility. Even slight hearing impairments in the high-frequency range may cause problems with speech perception in a noisy environment. From about 40 years of age, people typically demonstrate an impaired ability to understand difficult, spoken messages with low linguistic redundancy. Therefore, based on interference with speech perception, a majority of the population belongs to the vulnerable group.

Children have also been identified as vulnerable to noise exposure (see Agenda 21: UNCED 1992). The evidence on noise pollution and children's health is strong enough to warrant monitoring programmes at schools and preschools to protect children from the effects of noise. Follow up programmes to study the main health effects of noise on children, including effects on speech perception and reading acquisition, are also warranted in heavily noise polluted areas (Cohen et al. 1986; Evans et al. 1998).

Source: WHO, Guidelines for Community Noise

Speech Interference

> *Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities in the home, such as radio or television listening, telephone use, or family conversation, gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Research has shown that the use of the SEL metric will measure speech interference successfully, and that a SEL exceeding 65 dB will begin to interfere with speech communication* [DEIS Vol II page C-20]

If speech interference begins above SEL 65 dBA and the F-35 generates SEL 118 dBA at 1000 feet AGL (DEIS), with each 10 dB increase corresponding to a doubling of the perceived sound, we should expect increased speech interference. Residents of Winooski, South Burlington, Williston, and Burlington who live near the airport experience frequent speech interference as a result of current F-16 operations. Principals and teachers at area schools have reported the need to repeatedly stop instruction and wait

until the F-16s have flown over. Small children cover their ears and exhibit high levels of stress response. The Chamberlin School is especially heavily impacted. Since the DEIS makes clear that the F-35 will dramatically expand the noise zone, it is impossible to escape the conclusion that there will be a substantial increase in speech interference.

Annoyance

The PHR observes that, "a day-night sound level of 65 dB corresponds to 12 to 13 percent of the exposed population being highly annoyed." What should be noted, however, is the difference in annoyance depending on the source. As we see here, commercial aircraft noise is more annoying than rail or road traffic noise at the same average level. There is also evidence that military jet noise is more annoying than commercial jet noise.[32]

Table 1. % A and % HA at various noise exposure levels (Lden) for aircraft, road traffic, and rail traffic

Lden	Aircraft		Road traffic		Rail traffic	
	%A	%HA	%A	%HA	%A	%HA
45	11	1	6	1	3	0
50	19	5	11	4	5	1
55	28	10	18	6	10	2
60	38	17	26	10	15	5
65	48	26	35	16	23	9
70	60	37	47	25	34	14
75	73	49	61	37	47	23

Source: European Commission, 2002

Crash Risk—the F-22 is the model

> *The F-22A was introduced in 2002, and provided the Air Force with the most current engine and stealth capabilities. This new technology is akin to the F-35A in that it is a new airframe with similar flight capabilities. With that in mind, it is possible that projected mishap rates for the F-35A may be comparable to the historical rates of the F-22A.* DEIS BR4-46.

With a small number of planes flying, the F-22 has had 7 crashes since introduction in 2005, most recently in November 2012 at Tyndall AF Base in Florida. Overall rate for the F-22, and thus the expected rate for the F-35, is 8.59 Class A mishaps per 100,000

[32] The subjective disturbance caused by military low-altitude flight noise was essentially greater than that due to ordinary flight noise (in the neighborhood of civil airports). Ising et al. Annoyance and Health Risk Caused by Military Low Altitude Flight Noise, 1990

flying hours.[33] For the F-16 the rate is variously reported as 3.5 or 4.5 per 100,000 hours. Since 1982 there has been an average of 13 F-16 crashes per year.[34] Thus, the anticipated crash rate of the F-35 is approximately twice that of the current F-16.

The greater noise impact of military compared to commercial jets

High performance, supersonic military aircraft use engines designed differently from commercial jets. This difference results in intense noise levels far exceeding commercial jet noise. Therefore, studies based on the impact of commercial air traffic may understate the effects of military aircraft.

> *Newer* [tactical military] *aircraft generate intense noise levels well above any current commercial or transport category aircraft in all operational modes. These noise levels are already causing significant pressure for reduction in aircraft numbers and/or available airspace for training and operations*[35]
>
> *Military engines for tactical aircraft have lower bypass ratios, which mean the exhaust jet velocities need to be high to produce thrust. The jet noise dominates over other noise sources for tactical aircraft and is a strong function of the jet exhaust velocity. Commercial engines for subsonic aircraft use larger diameter fans to provide most of the thrust, which allow the jet exhaust velocity to decrease. Higher bypass ratios* [used in commercial jet aircraft] *reduce both noise and fuel consumption, which is fortunate for commercial jet engines and unfortunate for high thrust-to-weight military engines*[36]

Health Equity

The highest concentration of recent immigrants and racial minorities in Vermont is found in Winooski. 76% of the housing units in Winooski are within the F-35 noise zone. Since the mission of the Vermont Department of Health includes the goal of reducing and eliminating racial and ethnic health disparities and improving the health status of racial and ethnic populations, the proposed introduction of the F-35 at BIA is especially problematic. It is precisely the ethnic and racial minority populations of Vermont that are targeted for increased health risk by the F-35.

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[33] DEIS BR4-47

[34] Regarding F-16 safety see: Five Air Force F-16s Crashed in July http://abcnews.go.com/US/story?id=92679&page=1#.UOipbayDl8E

[35] Ibid

[36] http://www.nrac.navy.mil/docs/2009_FINAL_Jet_Noise_Report_4-26-09.pdf

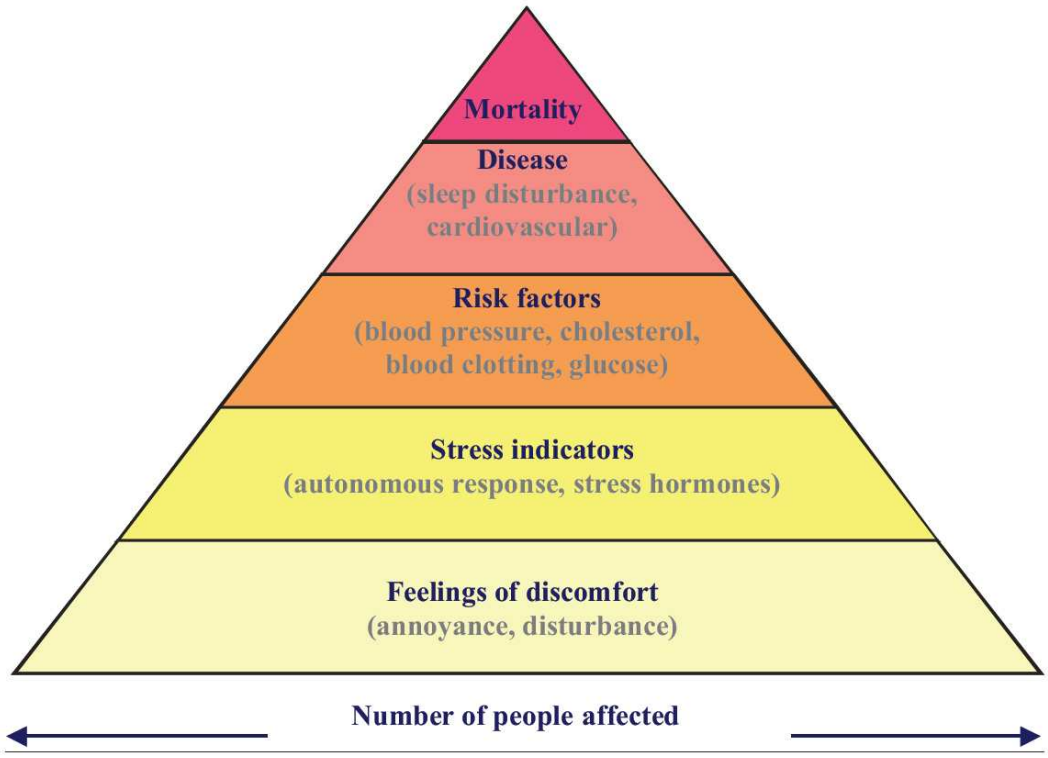
The Precautionary Principle

The Precautionary Principle states that when the health of humans and the environment is at stake, it may not be necessary to wait for scientific certainty to take protective action. When an activity raises threats of harm to the environment or human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. With regard to hearing loss, since the actual peak noise levels of the F-35 and duration of exposure are not known, the precautionary principle should be applied.

However, with regard to cardiovascular effects and cognitive impairment in children, the biological plausibility, the cause and effect relationships, and the exposure—response relationships are now established at a level of sufficiency making it unnecessary to invoke the Precautionary Principle.

IV Conclusion

There is now consensus among leading experts in the field of noise and health that significant health effects occur for children and adults at the noise levels produced by the F-35. According to the WHO these health effects lead to increased risk of a lower quality of life, of loss of productivity, of loss of healthy years of life, and of premature death. With regard to the F-35 at BIA, one segment of the population would be victimized—the individuals living in the projected F-35 noise zone. And yet, in spite of the agreement among experts, and in spite of the large population affected, the Air Force and the congressional delegation do not acknowledge any health risk. The wide discrepancy between expert opinion on the one hand, and the position of the Air Force and the congressional delegation on the other, has led to confusion. It is vital that both the public and decision makers be correctly informed on a matter of such long term consequence, *before* an irreversible decision is finalized. The Vermont Department of Health is uniquely positioned to play a constructive role in assessing the risk, informing leaders and the public, and recommending necessary prevention.



Source: Babisch *(3)*.

WHO, *Burden of Disease from Environmental Noise*, 2011

Appendix A: Statement by Wolfgang Babisch, January 10, 2013 email

Dear Mr. Joseph,

I confirm that there is largely consensus amongst noise experts that average noise levels during the day >65 dB(A) and during the night >55 dB(A) are associated with an increased risk of cardiovascular diseases. DNL is a weighted day/night average noise level that equals approximately Lday. These data are derived from road traffic noise studies. Studies regarding commercial aircraft noise showed effects at even lower noise levels. Regarding cognitive impairment in children due to aircraft noise at schools effect level are lower than Lday 65 dB. WHO recommends that average noise levels during the night should not exceed 40 dB (A) to enable undisturbed sleep, 55 dB (A) are considered as an interim target in situations where the 40 dB (A) is not achievable in the short run. According to occupational health, average noise levels of 80-85 dB (A) during an 8 hr working shift can cause hearing loss in the long run. Single noise events should not exceed 135 dB(C, time constant "peak"). With respect to Lmax (time constant "fast") it is common to consider approx. 120 dB (A) as a criterion. In Germany we had investigated the impact of low flying fighters on the hearing of children. We concluded that Lmax of an overflight should not exceed 115 dB (A). However, the hazardous factor in mock attack training areas was not only the sound energy but also the steep noise level increase (>= 60 dB/sec) which inhibits the effectiveness of inner ear protection mechanisms. The combination of >115 dB (A) and >60 dB/sec was the reason for limiting the minimum flight altitude to 300m. In close distance to an air base the level increase is not as steep because of the lower speed of the aircraft.

WHO Burden of Disease from Environmental Noisehttp://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf. WHO Night Noise Guidelines for Europe http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

Regards

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Appendix B

Statement by Roger A. Boshes, M.D., PhD, Assistant Clinical Professor of Psychiatry, Harvard Medical School, email, January 18, 2013

Note: I asked Dr. Boshes to assess the likely long-term effects in children of chronic exposure to high levels of military jet noise. Since we know from studies by the WHO and others that adrenaline and norepinephrine are elevated by high noise levels, I asked for his views on the implications.

From: "Boshes, Roger (DMH)" <roger.boshes@state.ma.us>
To: Richard Joseph <rj.1618@yahoo.com>
Sent: Friday, January 18, 2013 5:29 PM
Subject: Neurotransmitters, trauma, and long term rewiring of neural circuits

One of the most unexpected findings of neuroscience over the last 100 years has been the appreciation that the human brain is very much a work-in-progress at the time of birth. The conventional wisdom had been that the major physiological change accompanying growth and development occurred at puberty. All other major systems were thought to be fully formed. We now understand that the human brain goes through enormous changes over the first two decades of life and, in fact, remains capable of change into senescence – you can teach an old dog new tricks!

Nowhere is this clearer than in the area of mental illness. Virtually all medical conditions have a major genetic component. Patterns of disease run in families. This is also true for mental illnesses. The single dramatic exception to this latter observation is the post-natal acquisition of conditions within the spectrum of anxiety disorders including generalized anxiety disorder, panic disorder with or without agoraphobia, phobias, and obsessive-compulsive disorder. It is widely accepted within the psychiatric field that children exposed to emotional, physical, or sexual trauma develop a lifelong condition of post traumatic stress disorder which can manifest itself as any or all of the conditions within the anxiety spectrum or even include disturbances of thought or mood. This pattern of illness is indistinguishable from the genetically transmitted forms of anxiety disorders.

The mechanism involved in the permanent over activation of the Reticular Activating System is not precisely understood but is thought to involve the neurotransmitter epinephrine or adrenaline. Adrenaline is not only a neurotransmitter; it also acts as a hormone mediating the “fight or flight” mechanism in a chordate which produces redistribution of blood flow from the gut and other core area to the peripheral muscles necessary for flight or fight, increased heart rate to facilitate blood flow, rapid breathing to improve oxygenation of the blood, piloerection to make the animal appear larger, etc. Many of these physical phenomena are associated with anxiety and panic.

We believe that when an immature brain is traumatized, emotionally, sexually, physically (including sensory bombardment), developing neural circuits involving the cellular architecture that mediates the above-described physiological and emotional responses are altered leading to up-regulation or super-sensitization so that they are constantly “On Alert.” This leads to perturbation in glucocorticoids with the possibility of further damage to the victim. It is not reversible

Currently, oceanographers and marine biologists studying marine mammals are protesting against the US Navy's plans to study seismic shocks for military purposes. Experts predict these tests will kill hundreds of thousands of dolphins, whales, seals and other marine mammals by creating unimaginable stress levels mediated by epinephrine. These seismic effects are identical to sensory shocks such as sound blasts experienced by mammals on land. The young marine mammals that are not immediately killed will also experience a form of PTSD as their developing brain architecture is permanently altered.

Appendix C

Resolution of the Burlington Board of Health on the basing of the F-35 at BIA

Resolution relating to: F-35 Joint Strike Fighter Basing at the Burlington Air Guard Station,

Burlington Board of Health, City of Burlington, 13th day of January in the Year Two Thousand Thirteen

Resolved by the City of Burlington Board of Health, as follows:

That WHEAREAS, The Board of Health is charged with the "prevention, removal or destruction of public health hazards and the mitigation of public health risks," and

WHEREAS, the Board of Health is charged with providing guidance to the City of Burlington on health and safety matters, and

WHEREAS the City of Burlington-owned Burlington International Airport is considered the preferred site for first round basing of the F-35 Joint Strike Fighter, and

WHEREAS the Burlington Board of Health jurisdiction is limited to the City of Burlington, Vermont, and

WHEREAS the Burlington Board of Health has taken public and expert testimony regarding the health effects of the F-35, and

WHEREAS the Burlington Board of Health has concluded that noise has been associated with the following health effects: hearing loss, stress, sleep disturbance, heart attacks, hypertension and stroke, and delayed reading and verbal comprehension, and

WHEREAS the Burlington Board of Health has concluded that aircraft engines produce numerous toxic combustion by-products, and

WHEREAS the Burlington Board of Health has concluded that while every aircraft carries a risk of crashing, that there is an unknown safety rating on the F-35, and

WHEREAS the Burlington Board of Health has concluded that the population at greatest risk of possible adverse health effects from the basing of the F-35 at Burlington International Airport likely falls outside the City of Burlington.

NOW,THEREFORE, BE IT RESOLVED that the Burlington Board of Health was unable to come to a definitive conclusion on the public health risk to Burlington residents from the F-35 aircraft without access to the noise modeling data from which the Air Force constructed their sound contours and without a health impact assessment.

The City of Burlington Board of Health recognizes the extensive public engagement process and detailed research that are documented in the Board of Health approved and published minutes of meetings

conducted in October and November of 2012, and as such recommends the Council give consideration to the following actions:

1. Request that the Vermont Department of Health Commissioner conducts or directs a Health Impact Assessment on this multi-jurisdiction public health issue following the CDC guidelines.

2. Request that the Vermont Department of Health Commissioner obtain the noise modeling data for independent expert analysis.

3. Pursue FAA funding to mitigate airport noise to cover expenses such as:
   a. Hiring a noise mitigation expert
   b. Buying out homes deemed unsuitable due to elevated noise levels
   c. Constructing a sound barrier
   d. Employing individual home mitigation strategies

4. Ensure a robust hearing protection program for airport city employees.

BE IT FURTHER RESOLVED that the Burlington Board of Health recognizes that the best noise mitigation strategy is to engineer noise controls on the F-35 and as such recommends that our Federal Congressional Delegation take the lead in this effort. Furthermore, the Board recommends that the Air Guard investigate flight patterns that reduce public disturbance and that the Commissioner of Health form an oversight committee that includes members of the public whose two primary functions are:

1. To participate in the health impact assessment conducted by the Vermont Department of Health, and

2. Advise on noise mitigation strategies.

The Burlington Board of Health reserves the right to re-evaluate our conclusions if new information becomes available.

Austin Sumner, MD, MPH - Chair

David Casey, RN

Mary D. Hart R.N
Mary Hart, RN

Caroline Tassey, APRN

William Ward, Health Officer

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