Acoustical Analysis of the Private Motocross Track Proposed by Thomas and Blake Baggett

Report No. 13-0108
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Contents

1.0 INTRODUCTION

Power Acoustics, Inc. has evaluated the acoustical aspects relating to the proposed Private Motocross Track located on a 76 acre property within the City of Leesburg Florida.

The acoustical study consisted of:

1.) Defining existing sound levels in the vicinity of the property through a baseline ambient sound survey, and
2.) estimating sound levels expected from the proposed private motocross training area and determining impacts to nearby properties.

2.0 PROJECT DESCRIPTION

The proposed Private Motocross Track is located directly east of County Road 48 and approximately ½ mile north of North Austin Merritt Road in the City of Leesburg Florida, parcel number 32-20-24-000300000700. The property is approximately 76 acres in size.

The private motocross training facility will be used primarily during weekdays from 9:00 AM to 2:00 PM as shown in Table 1.

Table 1. Blake Baggett Personal Training Schedule During Season

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
ride 9 AM - 2 PM	ride 9 AM - 2 PM	off	ride 9 AM - 2 PM	away Travel to Race	away At Race	away Travel Home

Off-season training during October, November and December is split between Florida and California. Days will vary from Monday to Saturday.

A map depicting the proposed training facility is shown in Figure 1. The closest properties currently used as residences exist primarily south and northwest of the proposed training area.

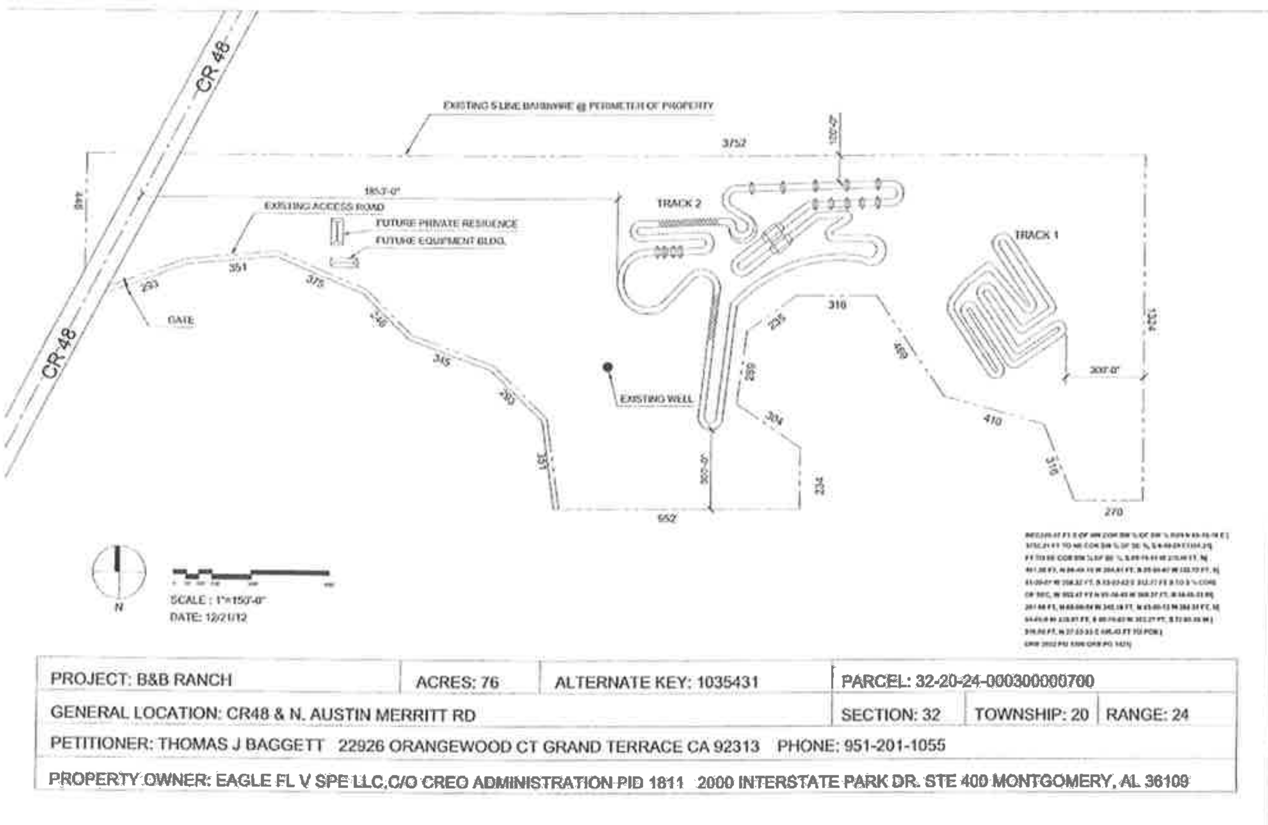


Figure 1. Proposed Motocross Training Facility

3.0 EXISTING AMBIENT SOUND MEASUREMENTS AND RESULTS

A sound pressure level survey was conducted to characterize the acoustical environment that currently exists in the vicinity of the proposed training area. The sound survey was performed Monday, January 7th through Tuesday January 8th 2013 and consisted of measuring the existing sound levels with two (2) A-weighted integrating and logging sound level monitors over a continuous nominal period of approximately one and a quarter days (spanning two typical training days). Measurement locations were selected as representative of the residential areas closest to the proposed expansion area. The data samples were taken over continuous 1 minute durations. Statistical sound levels and average (L_{eq}) A-weighted sound levels were obtained in accordance with ASTM E 1503 – 12[3] "*Standard Test Method for Conducting Outdoor Sound Measurements Using a Digital Statistical Sound Analysis System*". The weather conditions during the survey are defined in Appendix A.

3.1 Sound Measurement Instrumentation

The continuous sound level measurements were made using Integrating Sound Level Meters. Each meter was equipped with a half-inch pre-polarized condenser microphone and foam windscreen. The instrumentation meets ANSI Sl.4[4] and S1.43[5] Type 1 (precision) requirements for integrating acoustical measuring devices.

The measurement equipment was calibrated in the field before and after the survey with a calibrator meeting ANSI S1.40-1984[6] requirements. Prior to the measurements, the equipment was calibrated to 114.0 decibels (dB) at 1000 Hz. Calibrations were then rechecked after the survey. The posttest calibration was found to be within allowable tolerances. All measurement equipment conforms to standard practices for timely laboratory calibration. Certificates of calibration are available upon request.

Specific equipment used are shown in Table 2.

Table 2. Sound Measurement Equipment Model and Serial Numbers

Equipment	Model	Serial Number	Last Laboratory Calibration	Monitor Designation
Norsonic Field Calibration Source	1251	32841	June 25, 2012	Cal Source (all)
RION Type 1 Logging SLM	NL-31	00110049	June 26, 2012	Monitor A
RION Type 1 Logging SLM	NL-31	00410232	June 26, 2012	Monitor B
Norsonic Type 1 Sound Level Meter and Analyzer	NOR140	1404365	June 26, 2012	Motorcycle Measurements

3.2 Description of Data Obtained and Definition of Measurement Terms

Assessment of sound requires developing relationships between the physical properties of sound which can be measured by instruments, and correlated with people's reaction to sound through empirical means. The hearing threshold for a typical young person is 0 decibels (dB) under laboratory conditions, however, actual sounds are seldom distinguished if they are substantially below the existing ambient sound level. An increase in sound level of 3 dB is considered just perceptible while a 10 dB increase in sound level is generally perceived as a doubling in sound level. There are many ways that noise can be measured and quantified. Current acoustical standards use a logarithmic decibel (dB) scale, which compares the measured sound pressure to a reference pressure of 20 micropascals. A sound pressure of 20 micropascals then has a sound pressure level of zero (0) dB. Note decibels do not add arithmetically but sound pressures do add. Therefore, two sounds of equal magnitude will be 3 dB louder than a single sound source - i.e. 50 dB + 50 dB = 53 dB.

The A-weighted sound pressure level, dB(A), is the integrated total sound level of a full frequency sound spectrum as measured using the "A-weighted network" of a sound level meter. The A-weighted network was developed to simulate (electronically) the perceived response of the human ear. It deemphasizes very low frequencies and very high frequencies where humans hear the poorest. Generally, sounds between 250 Hz to 4000 Hz have the largest impact on A-weighted sound levels.

Sound statistics often used in evaluating environmental noise are L_{eq}, $L_{max,}$ and $L_{90.}$ These statistics correspond to the average or "equivalent" sound level, the maximum sound level and the sound exceeded 90% of the time respectively.

L_{90}, or the sound level exceeded 90 percent of the time, is commonly used to understand community sound levels since it tends to reduce the effect of short duration extraneous sounds not necessarily typical of the environment being measured. The L_{90} is the residual or broad area sound level in the community – basically the sound you hear when all the local traffic passes, no airplanes are overhead and localized human or mechanical noise are minimal. It's the brief moment of quiet when you hear only steady or distant sounds. Another way of thinking about L_{90} is that data taken over a measurement time of 1 minute would provide sound levels at or below the L_{90} for a total duration of only six (6) seconds. Fifty four (54) seconds of the one (1) minute data sample time, the sound level will exceed the L_{90} level.

The "*equivalent* sound level", L_{eq}, is a level of time-averaged fluctuating mean square sound pressure that would have the same equivalent sound level as a non-varying sound observed over that same period of time. It is simply described as a time averaged sound level.

The use of LA_{eq}, $LA_{max,}$ and LA_{90} implies the average or statistical sound level is A-weighted.

3.3 Sound Measurement Locations

The sound measurement locations were selected to be representative of the existing broad area ambient sound at the closest noise sensitive properties. Two sound level monitors were located as shown in Table 3. Monitor M-A is representative of existing sound near residences located near the property's southern boundary while Monitor M-B is representative of properties located adjacent to CR-48.

Table 3. Sound Monitor Measurement Locations

Direction	Representative Location	Sound Monitor
South	Closest residence along southern property line	Monitor M-A
Northwest	Closest residence(s) along CR-48	Monitor M-B

Microphone elevations were approximately 1.2 meters (±0.1 m) above ground. A representative map indicating the approximate sound measurement locations are presented in Figure 2.

Figure 2. Sound Survey Measurement Locations

3.4 Sound Survey Results

The sounds observed at locations adjacent to the site are mainly those generated by existing local traffic noise from County Road 48 and sounds of nature.

It should be noted that the ambient sound level measurements are representative of the sound in the mid-winter. Near CR-48, it is expected that the daytime sound would have minimal measureable seasonal differences. During the warmer summer months, seasonal fauna, such as cicada, would likely influence (increase) the sound levels at locations further away from County Road 48.

A summary of the measured existing ambient sound levels (residual (LA_{90}) and average (LA_{eq}) levels) are presented in Table 4 for times spanning 9:00 AM to 2:00 PM. The time corresponds to the typical motocross training times.

Table 4. Measured A-weighted Sound Level Summary

Measurement Location	Minimum* 9:00 AM - 2:00 PM 1 Minute LA_{90}	January 7th** LAeq Average 10:15 AM - 2:00 PM	January 8th LAeq Average 9:00 AM - 2:00 PM
Monitor M-A	26.7 dB(A)	43.0 dB(A)	39.8 dB(A)
Monitor M-B	28.3 dB(A)	61.3 dB(A)	58.5 dB(A)

* quietest 6 seconds of measurements observed over both days, **average taken after leaving site on January 7th.

The quietest 6 seconds of data ranged between 26.7 and 28.3 dB(A) depending on the monitor's location. The time averaged LA_{eq} A-weighted sound levels, over the 9:00 AM to 2:00 PM measurement periods, were found to be between 39.8 and 43.0 dB(A) at Monitor M-A (away from CR-48 traffic noise) and 58.5 to 61.3 dB(A) at Monitor M-B (near CR-48) . In general, sound levels were controlled by sound from CR-48 traffic and sounds of nature (i.e. wind, and fauna). Maximum A-weighted sound levels measured during any one minute period near CR-48 were found to exceed 80 dB(A) regularly due to loud vehicles traveling on the roadway while maximum A-weighted sound levels measured at Monitor M-B seldom exceeded 60 dB(A).

The resulting average, maximum and residual sound levels measured sound level time histories at locations M-A and M-B can be seen in Figures 3 and 4, respectively.

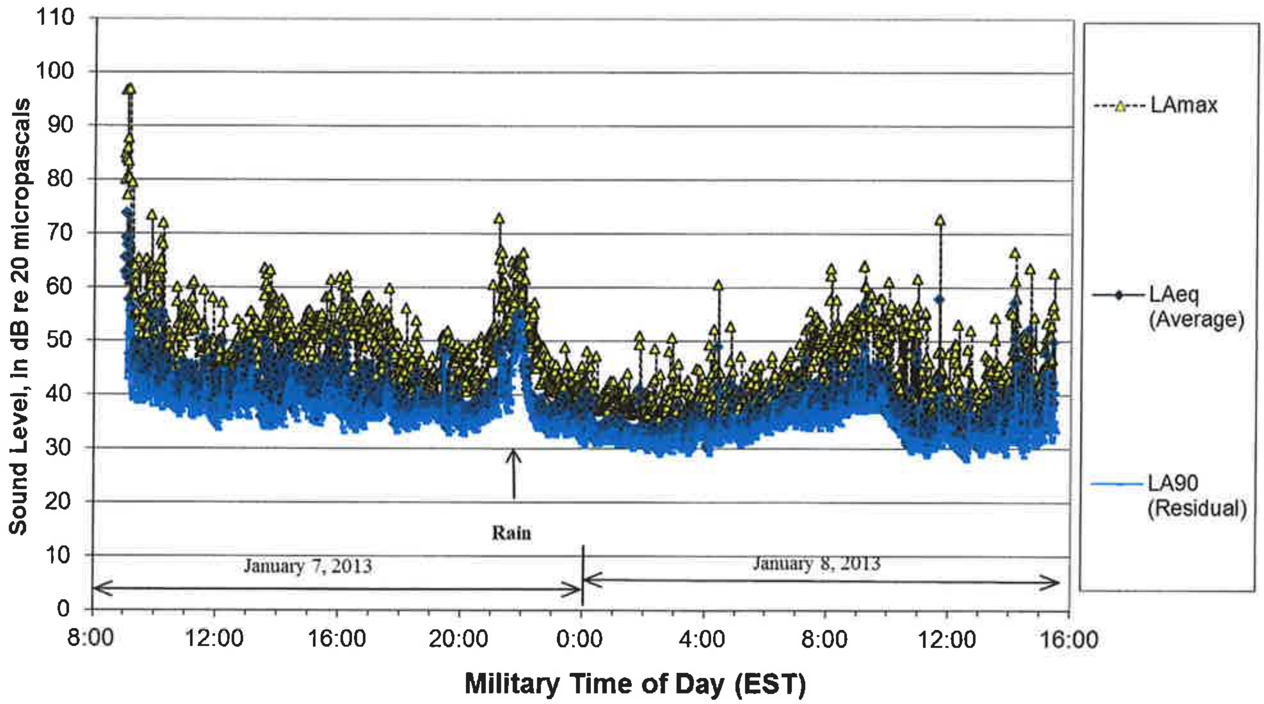


Figure 3. Measured Existing Ambient A-weighted Sound Levels (Location Monitor M-A)

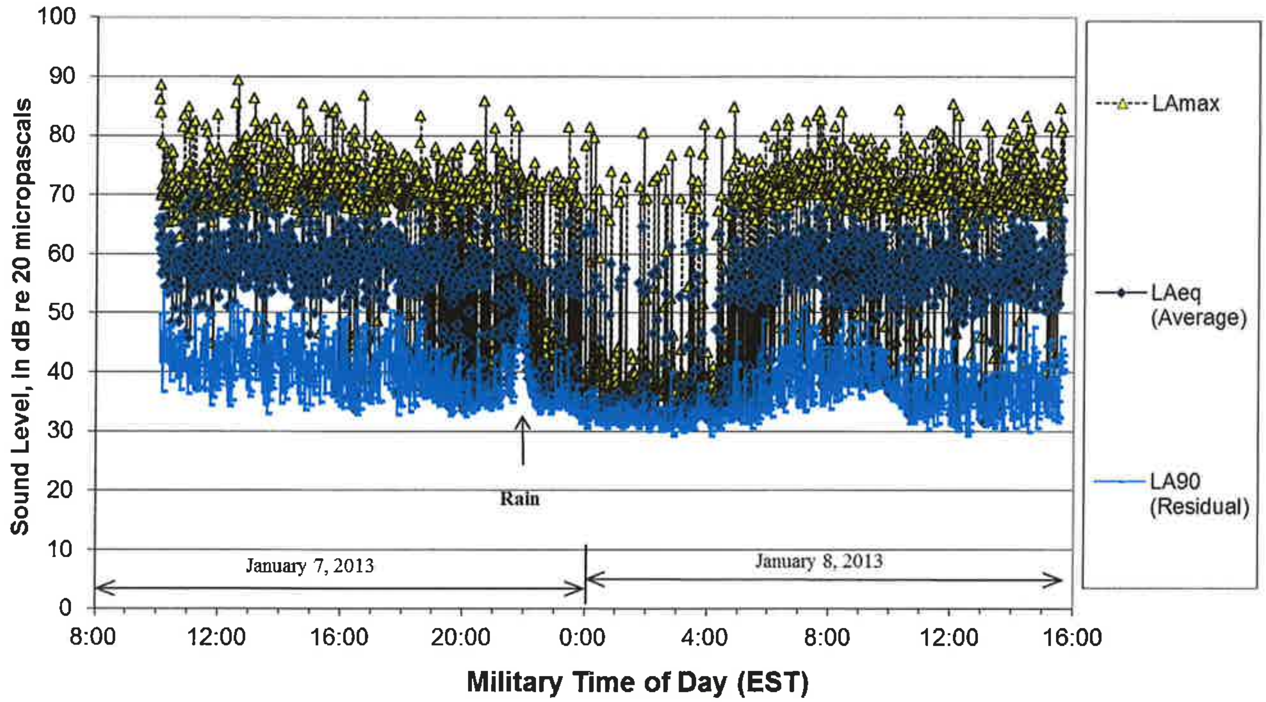


Figure 4. Measured Existing Ambient A-weighted Sound Levels (Location Monitor M-B)

4.0 NOISE STANDARDS

4.1 City of Leesburg Nuisance Standards (Local Noise Standards)

No numerically based community sound level limits are known to exist for the City of Leesburg. A nuisance based ordinance [2] is summarized below.

Sec. 12-19. - Regulation of public nuisances.
*On more than four (4) occasions within a six-month period as the subject of citizen complaints regarding excessive **noise**, including music or musical instruments producing sufficient volume to be heard inside any residential structure more than one hundred (100) feet away from the site, with the windows closed; and raucous outdoor gatherings such as crowds assembled in a public or private parking lot (excluding any music or outdoor gatherings for which a special events permit has been issued under this Code)*

With the absence of numerical or quantitative requirements, the motocross training facility will be compared to accepted American Standards such as US EPA guidelines [1] and ANSI 12.9 standards [8-12] and for estimating compatible with various land uses.

4.2 Recognized US Standards for Audible Sound

The US EPA has published a report to define applicable goals for community noise levels. The report, often referred to as "the levels document", defines acceptable sound levels in terms of day/night sound level, or DNL, for residential land uses. The US EPA report states DNL levels of up to 55 dB(A) are compatible for residential use properties.

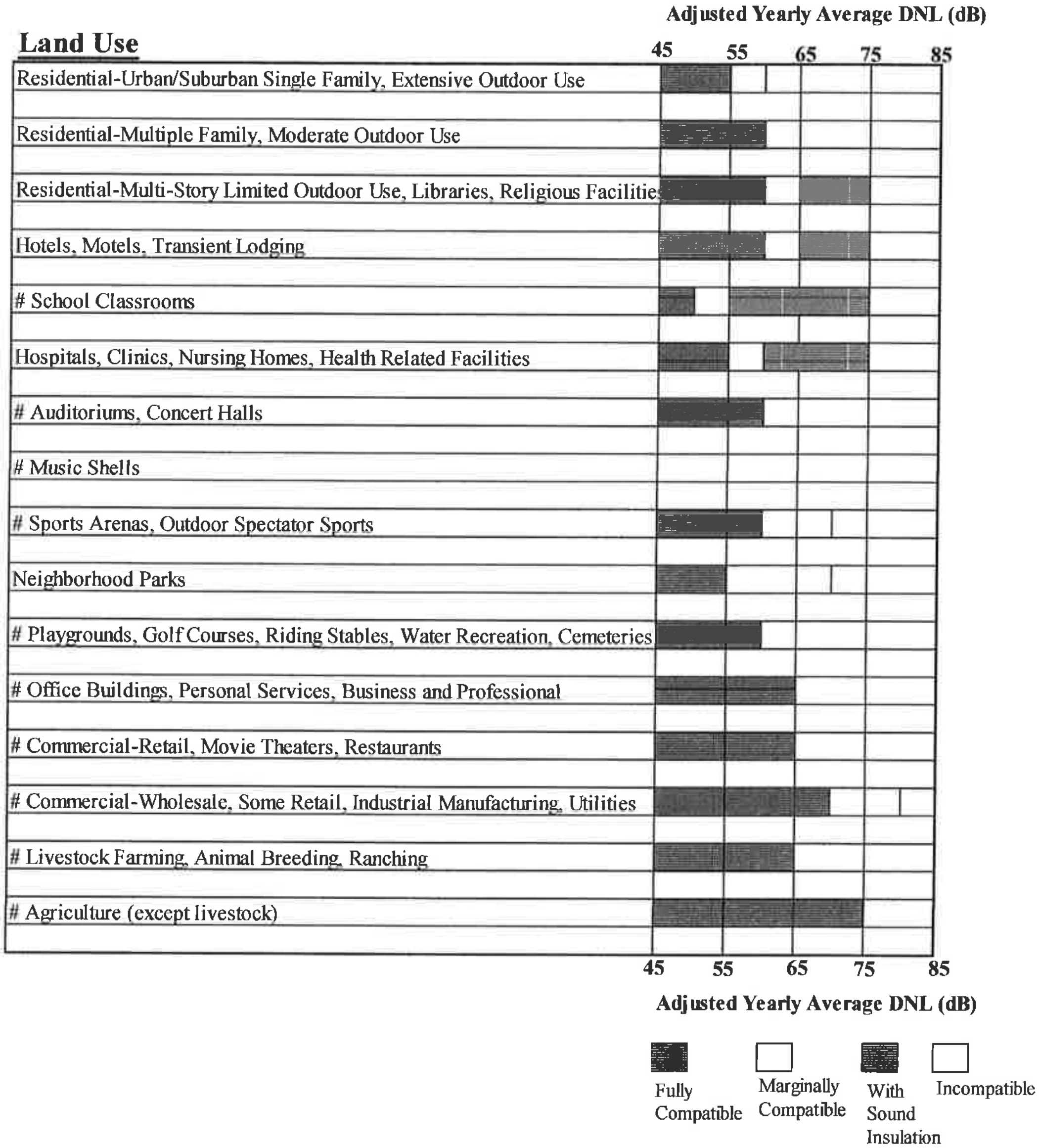
The American National Standard, ANSI S12.9-2012, "Quantities and Procedures for Description and Measurement of Environmental Sound - Part 5: Sound Level Descriptors for Determination of Compatible Land Use"[12], has adopted the EPA report levels as the basis of the standard and has expanded the allowable noise criteria for uses including many other land uses such as agricultural and livestock farming.

The day/night average sound level, DNL, is a 24 hour measure of averaged A-weighted sound levels with a mathematical weighting or penalty of 10 dB applied to sound levels generated at nighttime between the hours of 10 PM and 7 AM.

Since the motocross training occurs only between the hours of 9:00 AM and 2:00 PM, no nighttime penalties apply.

The American National Standard ANSI 12.9-Part 5 suggests yearly adjusted DNL, as shown in Table 5, for a variety of land uses.

Table 5. ANSI S12.9-2012/Part 5 Compatible Land Use Chart



Extracted from ANSI S12.9-2007(R2012)/Part 5. -- Land use compatibility with yearly average total adjusted day-night sound exposure (DNSE) or yearly average adjusted day-night average sound level (DNL) at a site for buildings as commonly constructed. At specific receiver locations, it may be appropriate to use sound exposure and sound exposure level without inclusion of the special adjustments from Part 4 of ANSI S12.9. A "#" sign is placed in front of the description of such land uses.

The standard indicates that the adjusted DNL is found to be fully compatible with single family residential Urban/Suburban properties when below 55 decibels. However, it states some rural residences, not located near a major roadway, often have expectations of a quieter environment [11]. However, with the limited daytime hours of training use, it is less likely that the training facility would be perceived as a community noise nuisance.

5.0 PREDICTION METHOD/ANALYSIS AND CONDITIONS MODELED

The environmental noise modeling was performed with Power Acoustics, Inc. sound propagation model SPM9613™. The SPM9613™ computer model is based on the International Standard ISO 9613 part 2[7]. The world-wide accepted standard specifies methods for calculating noise attenuation of outdoor noise sources from a large variety of equipment under favorable downwind noise propagation conditions. Using a method that assumes conditions favorable to sound propagation assures the calculated sound levels are likely to be conservative.

The sound propagation model accounts for the following attenuation and reinforcement of sound; spherical divergence, atmospheric absorption, ground absorption, sound screening and barriers, screening from foliage, and reflections from hard surfaces.

Each sound source is characterized by a frequency dependent (octave band) sound power level of the equipment and its spatial coordinates.

Each observer/receptor is characterized spatially by defining the height above the ground plane and position relative to the sound producing equipment. Objects between the sound source and observer are accounted for at each of the observer locations.

5.1 Ground Conditions Modeled

Ground composition between the traack area and off-site locations is considered "mixed" or typical of a mixture of surfaces including roads and vegetative ground covering. Absorption coefficients range from 0.0 for hard surfaces, like asphalt, to 1.0 for soft surfaces, like a freshly plowed farm field. The mixed ground has been modeled with absorption coefficients of (0.75) since it the ground surface is primarily vegetative cover.

5.2 Motorcycle Noise Source Modeled

The motorcycle noise was based on sound measurements made of a 2012 Kawasaki KX250F off-road motorcycle, with FMF Factory 4.1 Carbon Fiber Exhaust (decibel reducing) muffler/silencer. The measurements were made on January 7th at the proposed Leesburg site. The motorcycle tested is U.S. Forestry Approved, American Motorcycle Association Approved, and F.I.M Europe Approved.

The sound pressure levels were taken on a 100 feet sideline from the motorcycle using the sound analyzer's fast response time (0.125 second). The sound data used represents the maximum sound levels developed by the motorcycle during our testing with open throttle.

The typical maximum sound pressure level spectrum measured at 100 feet from the motorcycle is presented in Table 6. These measurements represent the basis of the sound modeling.

Table 6. Maximum Sound Pressure Level Spectrum 100 Feet from Motorcycle

Octave Band Center Frequency, Hertz										
16	31.5	63	125	250	500	1000	2000	4000	8000	dB(A)
65	65.7	84.7	92.9	92.8	84.5	81.2	89	86.3	77.2	93.4

Motocross training will produce instantaneous sound levels that change over time. To account for the variability, a time averaged and A-weighted equivalent hourly sound level, or (LA_{eq}), is predicted and presented herein. We have conservatively assumed the motorcycle would operate at full throttle for approximately 40% of the time.

6.0 OPERATIONAL SOUND LEVEL ESTIMATES

The acoustical models were developed to address training activity on the proposed training Tracks 1 and 2.

Hourly average sound levels are estimated as shown in Table 7 at nearby residential use properties. The estimated A-weighted sound level of the motocross training operations are presented in Figures 5 and 6 as sound level contours superimposed on an aerial photo for training on Tracks 1 and 2 respectively.

Table 7. Sound Level Estimates for Motocross Training

Direction	Representative Location	Existing Ambient LAeq	Sound from Motorcycle (only) Training on Track 1 LAeq	Sound from Motorcycle (only) Training on Track 2 LAeq
Northwest	County Road 48 residence(s)	58.5 to 61.3 dB(A)	50 dB(A)	55 dB(A)
South	Southern residence	39.8 to 43.0 dB(A)	55 dB(A)	54 dB(A)

Based on the estimated sound levels as shown in Table 7, we would anticipate there will be a low probability of negative reaction from residences located within about two hundred feet of CR-48.

At residences closer to the motocross training tracks and further away from CR-48, the A-weighted sound level due to the motocross training is estimated to be more than 10 dB(A) above the existing (very quiet) average ambient sound levels. While the sound of the motorcycle training will be clearly audible at existing residences closer to the training facility, we estimate that sound levels will be within the EPA guidelines for compatibility with residential use and within ANSI S12.9 guidelines for agricultural uses. However, since the motocross training will be audible above the very quiet existing ambient sound, it is impossible to determine if there will be any negative reactions from the sparsely dispersed residences in the area.

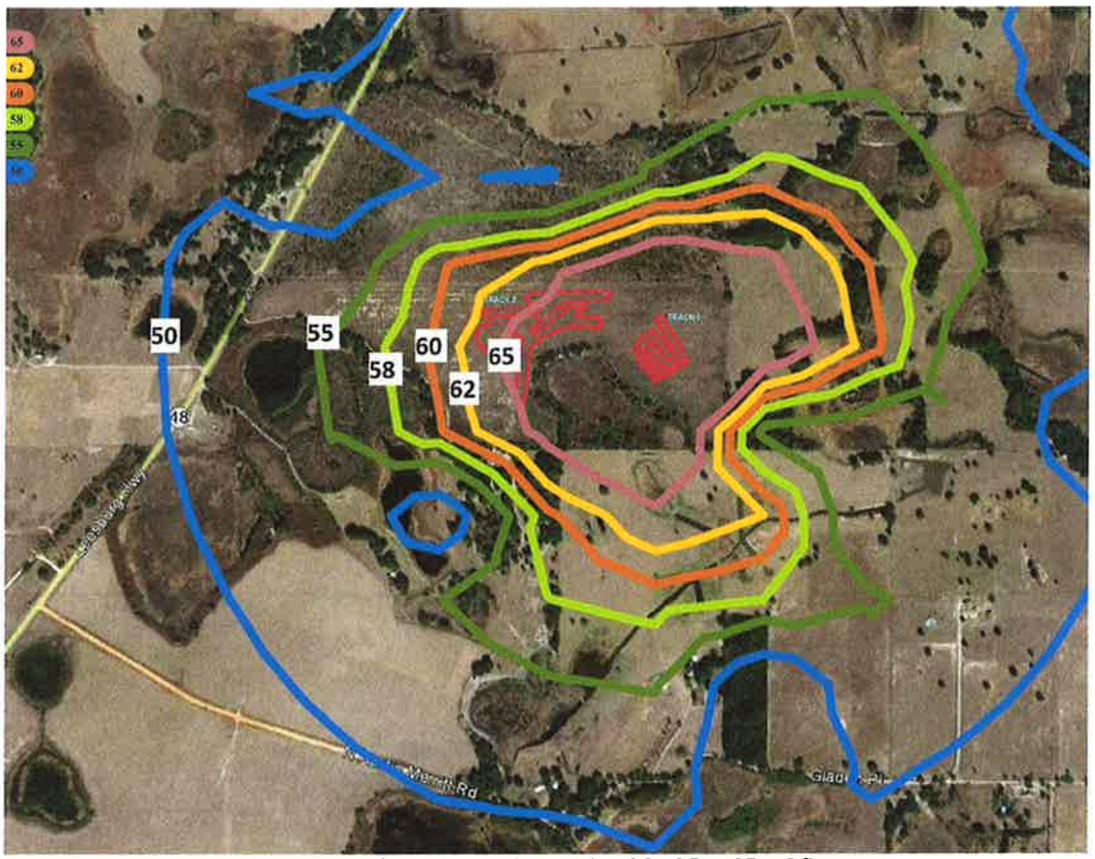


Figure 5. Estimated Hourly Average A-weighted Sound Level Contours
(Track 1 in Use)

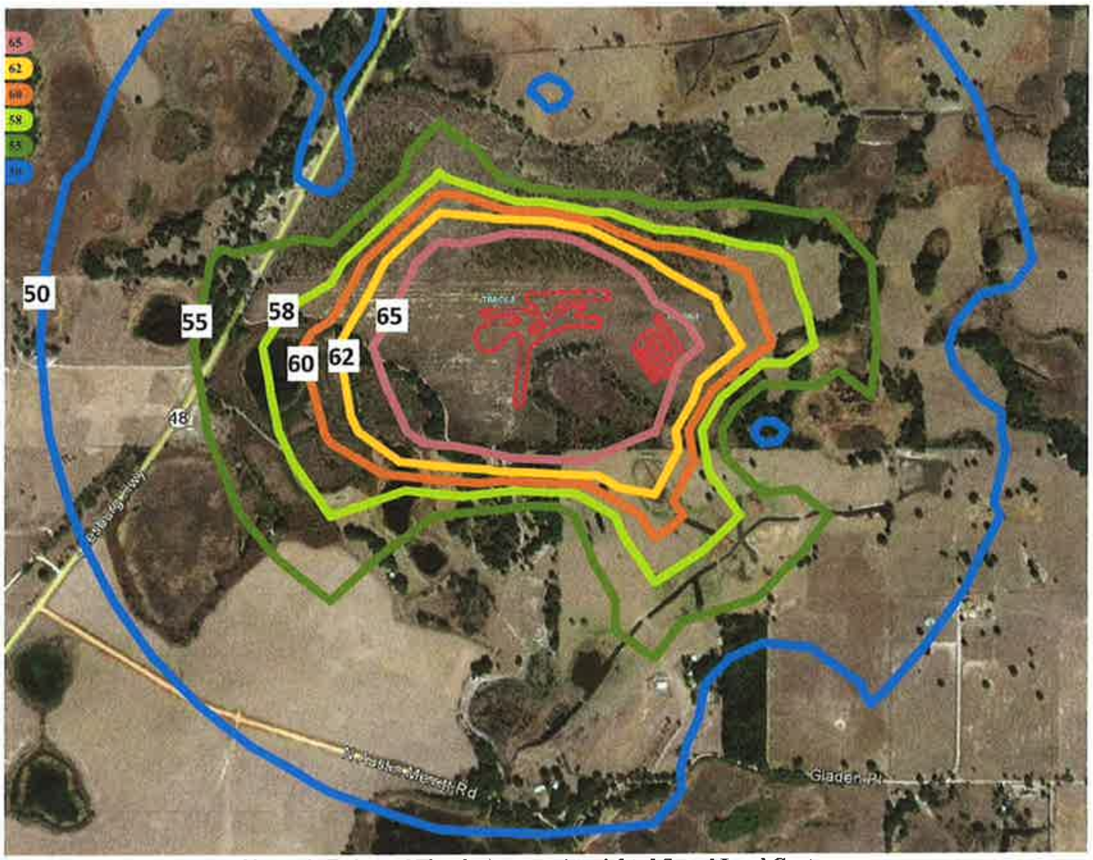


Figure 6. Estimated Hourly Average A-weighted Sound Level Contours (Track 2 in Use)

6.1 Comparing Motocross Training Sound to Other Common Sound Sources

For reference, sound levels of common sources are provided in Figure 7 to help readers assess the sound emitted by the motocross activity.

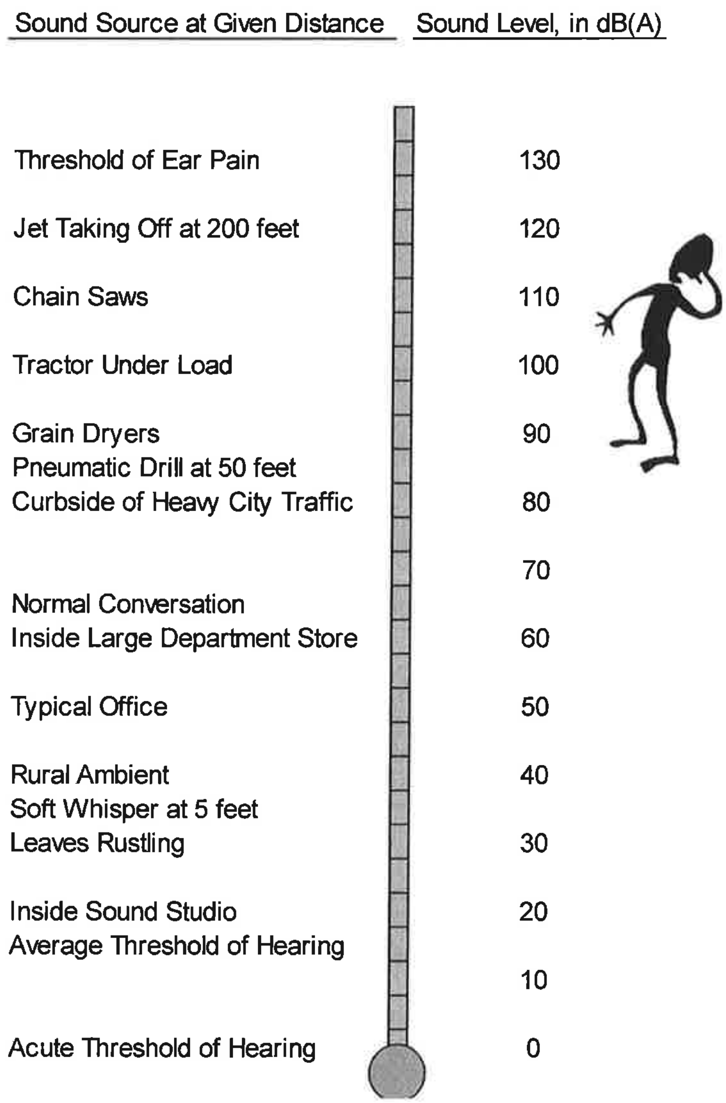


Figure 7. Sound Levels of Common Sources

7.0 CONCLUSIONS AND RECOMMENDATIONS

The sound modeling study shows the estimated sound generated by the proposed motocross facility to be within guidelines specified by credible US standards such as US EPA and ANSI S12.9 part 5 for compatibility with residential and agricultural uses.

To further minimize the possibility of noise complaints of neighbors from the motocross training we recommend that ultra low noise silencers/mufflers are installed and maintained on all practice motorcycles. In the event that there are complaints of noise, earth berms can be designed and installed close to, but at a safe distance from, the motocross tracks. A well designed and placed earth berm can help reduce the average sound levels by 5 dB(A) or more provided it adequately blocks the line of sight to the noise source.

8.0 REFERENCES

1. US Environmental Protection Agency Report, EPA 550/9-74-004, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with Adequate Margin of Safety", 1974.

2. CODE OF ORDINANCES OF CITY OF LEESBURG, FLORIDA, ARTICLE II. – NUISANCES, Sec. 12-19. - Regulation of public nuisances.

3. ASTM E 1503 – 12, "Standard Test Method for Conducting Outdoor Sound Measurements Using a Digital Statistical Sound Analysis System".

4. ANSI S1.4-1983, "AMERICAN NATIONAL STANDARD, Specification for Sound Level Meters".

5. ANSI S1.43-1997, "AMERICAN NATIONAL STANDARD, Specification for Integrating-Averaging Sound Level Meters "

6. ANSI S1.40-1984, "AMERICAN NATIONAL STANDARD, Specification for Acoustical Calibrators"

7. Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, International Standard ISO 9613-2: 1996 (International Organization for Standardization, Switzerland, 1996

8. ANSI S12.9-1988, Part 1, "AMERICAN NATIONAL STANDARD, Quantities and Procedures for the Description and Measurement of Environmental Sound"

9. ANSI S12.9-1992, Part 2 "AMERICAN NATIONAL STANDARD, Quantities and Procedures for the Description and Measurement of Environmental Sound. Part 2: Long Term Wide-Area Sound"

10. ANSI S12.9-1993, Part 3 "AMERICAN NATIONAL STANDARD, Quantities and Procedures for the Description and Measurement of Environmental Sound. Part 3: Short-term measurements with an observer present."

11. ANSI S12.9-2005, Part 4 "AMERICAN NATIONAL STANDARD, Quantities and Procedures for the Description and Measurement of Environmental Sound. Part 4: Noise Assessment and Prediction of Long-term Community Response."

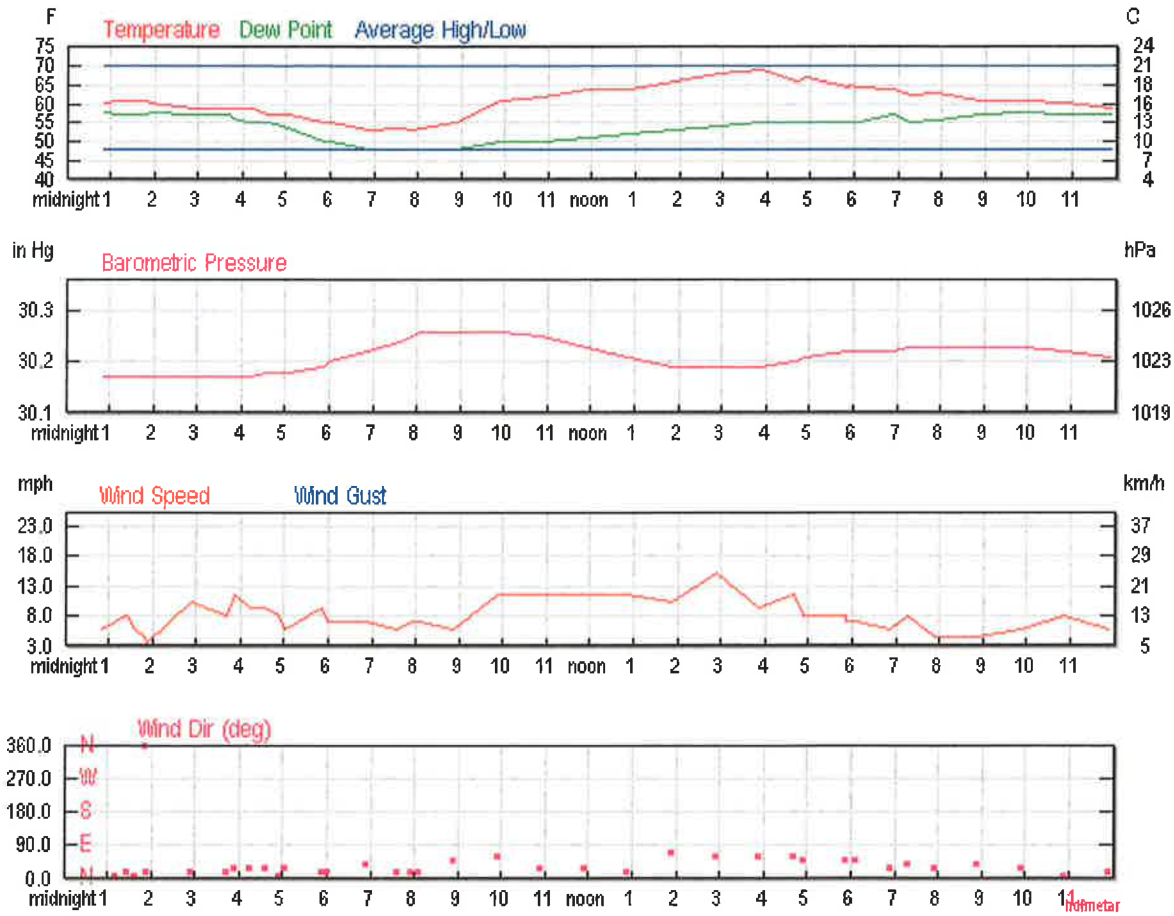
12. ANSI S12.9-2007(R2012), Part 5 "AMERICAN NATIONAL STANDARD, Quantities and Procedures for the Description and Measurement of Environmental Sound. Part 5: Sound Descriptors for Determination of Compatible Land Use."

APPENDIX A

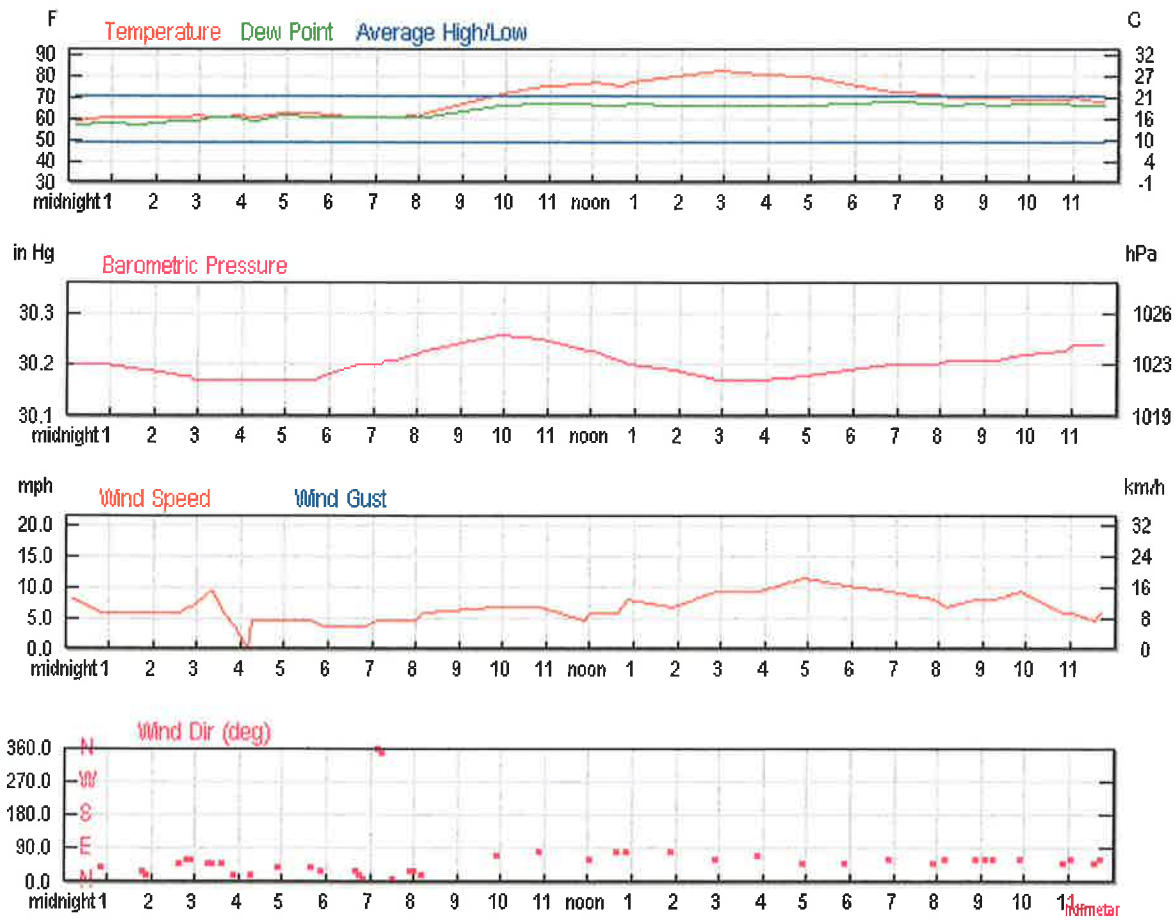
Weather Conditions During Sound Survey

As reported by Leesburg International Airport (KLEE)

January 7th 2013



January 8th 2013



APPENDIX B

Reporting Consultant's Résumé

Technical Résumé of

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EXPERIENCE

March 1998 to present

Dave Parzych has 30 years of experience in acoustical engineering and noise control design and is the principal and founder of Power Acoustics, Inc. Since 1998, he has provided a full range of acoustical consulting services for several hundred projects including; sound measurements, analytical modeling studies and working as an expert witness in industrial, commercial, transportation and residential applications. Mr. Parzych has also developed a commercial software package, SPM9613, used worldwide in community noise modeling.

He is known as an expert in outdoor sound propagation and modeling, power plant noise and gas turbine silencing. He has developed suitable community noise criteria, designed noise controls for and/or verified facility acoustical compliance through specialized sound tests for several dozen multibillion dollar power plants situated throughout the world. He has also designed noise abatement for many industrial, commercial and residential buildings.

Dave has been an invited speaker and author in conference sessions sponsored by the Acoustical Society of America and the Institute of Noise Control Engineering on noise modeling and measurements of power plants, industrial facilities and modeling the performance of sound barrier walls.

October 1992 to February 1998

Mr. Parzych was a Senior Noise Control Engineer and Technical Group Leader of Acoustics in the Environmental Engineering group at Westinghouse Power Generation. From 1992 through February of 1998 he led the development of noise control and state-of-the-art research in modeling and diagnostics techniques. Mr. Parzych was responsible for the acoustical silencing and design of combustion turbines, aerodynamic source modeling of turbo-machinery noise, overall acoustical design of combustion turbine, steam turbine and cogeneration projects and environmental modeling to determine community impacts and worker noise exposure.

October 1983 to October 1992

From 1983 to 1992, Mr. Parzych gained experience in aircraft noise through an intensive effort to develop a quiet counter-rotating Prop-Fan aircraft engine as an Analytical Acoustical Engineer at United Technologies Corp., Hamilton Standard Division. Mr. Parzych has been an investigator on several NASA funded research projects involving acoustics and unsteady aerodynamics of propellers, Prop-Fans and wind turbines.

<u>May 1982 to October 1983</u>

Dave began his professional career as an acoustical engineer in 1982 with General Dynamics, Electric Boat Division in Groton, Connecticut working in airborne and structureborne silencing for the on-board nuclear power plants used in the US NAVY submarine fleet.

EDUCATION

Bachelor of Science in Engineering, Acoustics, University of Hartford 1982
Continuing education in acoustics and noise control including aero-acoustics offered at the Catholic University in Washington D.C. and many seminars and conferences on acoustics and noise control.

CERTIFICATION AND PROFESSIONAL ACTIVITIES

- Board Certified Member of the Institute of Noise Control Engineering
- Licensed Professional Engineer, State of Oregon, with specialty in Acoustical Engineering (PE18940)
- Full Member Acoustical Society of America
- Firm Member National Council of Acoustical Consultants
- Full Member ASME
- Full Member ASTM
- Chairman of ANSI B133.8, subcommittee 7, Gas Turbine Installation Sound Emissions (1997-2000)
- Member of ANSI B133.8, subcommittee 7, Gas Turbine Installation Sound Emissions (2000-2012)
- Member ASTM E33 Committee on Environmental Noise (current)
- Chairman ASME Codes and Standards Committee PTC-36 "Measurement of Industrial Sound" (current)

PATENTS

Patent Number 5,709,529, January 20, 1998, "Optimization of Turbomachinery Harmonics"

TECHNICAL PAPERS

INTERNOISE 2012 Proceedings, Combustion turbine silencer design, selection and applications, 2012. (*Invited Paper*)

INTERNOISE 2009 Proceedings, Challenges of unanticipated power plant startup noise, 2009. (*Invited Paper*)

NOISE CON 2007 Proceedings, Methods to Eliminate Continuous and Variable Background Noise Sources, October 2007. (*Invited Paper*)

INTER-NOISE 2006 Proceedings, Modeling the reduced insertion loss of a sound barrier in a downward refracting atmosphere for a petrochemical plant, December 2006. (Co-authored)

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NOISE CON'2004 Proceedings, Handling of Barriers in ISO 9613-2, July 2004. (*Invited Paper*)

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DGLR/AIAA-92-02-049, Near Field Noise Theory for Propellers with Angular Inflow, 1992, (Co-authored)

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AIAA-3979, Modal Evaluation of Noise Generated by the Front Rotor of a Counter-Rotating Prop-Fan, 1990.

AIAA-90-3978, Vortex Structure of Wakes Behind an Advanced Propeller at Take-off Load Conditions, 1990, (Co-authored)

AIAA-89-1094, Interaction Noise Mechanisms for Advanced Propellers, Analytical Evaluation, 1989.

SAE 871839, Prop-Fan/Turboprop Acoustic Terminology, 1987.

AIAA-86-1895, Noise of the Fairey Gannett Counter Rotating Propeller, 1986.