Support Statement for Information Collection Requirements

ERDC

CERL

Assessing Human Response to Military Impulse Noise

Larry Pater, Ph.D., P.E.
Program/Project Manager, Noise R&D
US Army Engineer Research and Development Center (ERDC)
Construction Engineering Research Laboratory (CERL)

Edward T. Nykaza, M.S.
Acoustician
Construction Engineering Research Laboratory (CERL)

Robert Baumgartner, PhD.
Sociologist
PA Government Consulting

Kathleen K. Hodgdon M.S.
Psychoacoustician, Acoustician
Applied Research Laboratory, The Pennsylvania State University

George Luz PhD,
Psychologist
Luz and Associates

Justification

1. Need for the Information Collection

This proposed information collection is consistent with military policy regarding impacts of noise on sustainable mission capability as stated in a new U.S. Department of Defense (DoD) Instruction 4715.13 *DoD Noise Program* dated 15 November 2005; section 4.4 directs "Promote scientific research and use of sound scientific methods and validated noise data as a basis for and the establishment of noise program guidance." This proposal also addresses and supports several formal military requirements, including DoD Instruction 3030.3 *Joint Land Use Study (JLUS) Program* of 13 July 2004, Army Regulation 200-1 *Environmental Protection and Enhancement* (new version in preparation), Army Regulation 200-2 *Environmental Analysis of Army Actions***,** and Army Environmental Requirements and Technology Assessments (AERTA) Requirement 2.4.f "Training and Testing Range Noise Control**."**

Adequate methods are needed to assess and predict community reaction to high-energy impulsive military noise, to preserve sustainable military training and testing capability, maintain combat readiness, and minimize noise impacts on residents of installations and nearby communities in the interest of public welfare.

Military installations' noise management plans have, by regulation, been based on average noise levels. Noise management decisions are typically made based on noise complaints, damage claims, and legal actions. Noise complaints are received from geographic regions in which average noise levels meet acceptability criteria. Research to date has not established a reliable relationship between annoyance and noise complaints.

Noise impacts are almost universally assessed, for all types of noise, in terms of the response metric ***annoyance***, quantified as the percent of the population that is highly annoyed, as predicted by a ***long-term average*** noise level metric. This procedure has proven to be unsatisfactory for extremely variable impulsive military noise, such as weapons blast noise. It does not account for daily or weekly variations in noise level or community response. Individual event noise levels from military testing and training activities can be loud enough to elicit negative community response, yet when events are averaged over a year's time, the average level meets established acceptability criteria. This clearly does not provide adequate decision guidance.

The U.S. military has determined that current blast noise impact assessment procedures do not meet the DoD's and military installations' noise management needs. DoD stakeholders recently adopted a revised interim methodology that supplements "annoyance correlated to average noise level" with "complaint risk correlated with event noise level" to assess impulsive noise impact(AR 200-1 revised, 2005, in press). DoD stakeholders have endorsed this research proposal as the means to achieve improved assessment procedures.

2. Use of this Information

The information from this research effort will be used by the Department of Defense and the Strategic Environmental and Research Development Program (SERDP) to develop guidelines and guidance for use by military and civilian decision-makers responsible for

assessing noise impacts and mitigation and management plans for a variety of purposes, including managing day-to-day training and testing operations; planning ranges, aircraft routes, and training operations. Land developers will also use the guidelines and guidance from this research to choose and plan building sites that will mitigate future noise problems.

The information will also be used by the Department of Defense to manage encroachment impacts; purchases of buffer land and easements; and performing impact assessments mandated by the National Environmental Policy Act (NEPA). These complex requirements are becoming increasingly important as a significant portion of the military (perhaps up to a third of the Army) relocates because of Base Realignment and Closure (BRAC) decisions, is restructured into modular units, and is re-stationed from overseas to the United States.

The goal of this research is to provide improved methodologies to assess and predict human response and models of how high-energy impulsive military noise impacts individuals and communities in the vicinity of military installations. The research team will test and validate the models of noise impacts and work with SERDP and participating military installations and decision-makers to develop guidelines for sustainable noise management plans and guidance on how to interpret and respond to complaints and others forms of negative comments by members of the community.

These models will be published and promulgated by SERDP and the Department of Defense. The research will be funded by both SERDP and the Army Corps of Engineers Engineer Research and Development Center – Construction Engineering Research Laboratory. Both agencies will have access to the data developed in this research and will be responsible for storage and maintenance of the data and regulating access to the data after the study has been completed. Dr. John Hall, SERDP Sustainable Infrastructure Program Manager and Dr. Larry Pater, ERDC-CERL Principal Investigator will be responsible for managing and controlling access to the data for each agency.

The research protocols include:

(1) **Qualitative personal interviews** with residents who experience weapons blast noise to define the range of response descriptors,

(2) **In-situ studies** with residents who experience blast noise to measure near real-time in-home responses,

(3) **General community surveys** with community members who experience blast noise to measure community response and changes in community response over time, and

(4) **Noise complaint surveys** in areas where noise complaints are received to establish event level criteria to determine the relationship between complaints and annoyance.

Our intent is to start with individuals (personal interviews and in situ studies), compare findings across a several communities (general surveys and complaint surveys), and compare findings across installations. This will allow us to identify trends that can be generalized to exposure-response relationships on a national level.

Qualitative Personal Interview Research Protocol

Qualitative personal interviews with community residents will identify response metrics that have meaning to the population of interest and can provide a more complete understanding of community impact. A total of 10 to 20 qualitative personal interviews will be conducted at each of the three participating installations, with residents who live in areas that are typically exposed to high-energy impulsive noise. Detailed interviews will be transcribed verbatim and evaluated successively to code the input either manually or using an analysis software such as NVivo (QSR International).

The individual interviews will be analyzed to identify common observations, terminology, and types of complaints. A comprehensive analysis of these qualitative interviews will define a range of potential response descriptors to be considered for response metrics to be tested in our In-Situ and General Survey protocols. The process provides a more comprehensive and insightful assessment of the community impact.

It is common practice in survey research to first use personal interview protocols to allow the population of interest to identify, in everyday language, a range of appropriate response descriptors. Work done for the National Park Service and the USAF has identified insufficiencies in some of the traditional psychoacoustic response metrics such as “annoyance” (Baumgartner, 1999). Alternative response metrics were tested in a study of the Impact of Aircraft Overflights on park visitors for the National Park Service in the 1990’s. Respondents for a dose-response study reported higher levels of impact from aircraft overflights for the response measure “interference with the appreciation of natural quiet and the sounds of nature …” than the traditional annoyance response measures.

In-Situ Research Protocol

The In-Situ research protocol will examine how humans respond to individual blast events in near real-time as a part of their typical everyday experience. These data will enable us to determine which aspects of the noise correlate most strongly (and causally) with human response. Until this research is conducted, it will be impossible to determine exactly which aspects of the noise humans are reacting to. These data are necessary to determine which aspects and noise metrics should be measured and predicted by installations to guide their long and short term operations.

A randomly selected sample of residents who live near military installations and are typically exposed to blast noise will be selected and asked to participate in this research protocol. Microphones and accelerometers will be set up outside residents’ homes to document the stimulus (blast noise, vibration, rattle). The General Community Survey will also initially be administered to all volunteer participants in the In-situ research study. These data will enable us to evaluate how well the In-situ sample represents the members of the community and provide guidance on how to generalize the results of the In-situ dose-response models to the community. For each noise event that participants notice, they be asked to respond to a short series of 10 questions on a personal digital assistant (PDA) that is given to them by the research team for use in the study. Alternatively, participants can elect to provide a response each morning and evening covering all noise events during that day or indicate that no noise events were noticed on that day.

The response questionnaires will be programmed into the PDA's, so that all data collection will be conducted electronically, minimizing the burden on respondents. Respondents' data from their PDA will be downloaded by field staff periodically.

The in-situ research protocol will be conducted in the vicinity of two training installations that produce blast noise and that vary in population demographics and terrain. At each installation, the protocol will be conducted over a 12-month period, involving approximately 25 subjects who volunteer to participate at each site. The 12-month data collection period is required to capture a sufficient number and variety of noise events and to sample the variation in received waveform due to seasonal weather changes.

The strength of the In-Situ research protocol is detailed data regarding the variation of subject response to variable stimulus levels (dose-response functionality). This study will incorporate research procedures commonly used in diary studies in the transportation and recreation research fields to mitigate the extent to which the increased awareness and attention to blast events may skew their responses.

General Community Survey Research Protocol

The general community surveys in this research effort will be an improvement on previous community noise surveys because better measurements of the noise environment will be made and correlated to several measurements of response via social survey. Previous blast noise surveys correlated a single measurement of the average noise level for an entire year with a survey measure of annoyance. These prior community noise studies failed to account for the influence of individual noise event levels, and often used *predicted* (rather than actual) measures of yearly average noise level. These prior studies also implicitly assumed that community annoyance does not change as a function of time or as a function of short-term changes in noise environment, since annoyance was measured only at a single point in time during the entire study period.

The General Community Survey research protocol will use a questionnaire, administered several times during course of an 11-month study period at each installation to determine community response to the noise stimulus. *Actual* noise level history will be based on measurements made in the community (as part of the In-Situ Research Protocol described above). In any functional dose-response investigation, actual measurements are superior to predicted measurements because they eliminate the uncertainty inherent in predictions of highly variable noise events.

The General Community Survey will be administered by professional door-to-door personal interviewers, at randomly selected households in the study areas. The personal interview method was selected to achieve greater coverage (in comparison to telephone surveys, all households are eligible for selection in the sample, rather than only those with a listed number). The personal interview approach will also enable us to more accurately target only those households that are located in a precisely defined study area (the area that is covered by the noise monitoring equipment, so that the response burden is eliminated for those households who are located out of the study area. Further, professional personal interviewers will be able to gain a higher voluntary cooperation among the sampled households and produce a higher response rate.

For each of the three participating military installations, the General Community Survey will include two different samples of households:

- A cross-sectional representative sample to gauge the level of response among community residents at each point in time, and
- A panel sample of households (the same households surveyed each time) to enable analysis of the factors that influence change in household response over time.

The survey will be conducted three times during the 11-month study period (at approximately 4-month intervals) with a representative cross-sectional sample of households. For the panel sample, the survey will be conducted twice, with an 8-month interval. The table below shows the sample design for the General Survey for each of the three communities:

	Month 3	**Month 7**	**Month 11**
Panel Survey	175 households		175 households (as many of the original 175 as possible)
Cross-sectional Sample	175 households	175 households	175 households

After the initial survey wave (Month 3), one-half of the 350 responding households will be randomly selected and assigned to the panel sample. The panel sample of 175 households will be re-surveyed in Month 11. The panel sample will not be surveyed in Month 7 to avoid sensitizing respondents to noise impacts and to reduce the response burden on the panel households. The purpose of a panel survey (also frequently called a longitudinal survey) is to measure changes in awareness, attitudes, or reported impacts at the individual household level. Because data are collected from the same households at two different points in time, an analysis of the direction and magnitude of the changes can be conducted, and the influence of attitudes and social and demographic factors can be incorporated into the analysis.

The representative cross-sectional sample will include a different random sample of 175 households at each of the three survey waves. The cross-sectional sample will provide data on the levels of awareness, attitudes, and reported impacts at the community level. Three cross-sectional samples will be conducted in each community at 4-month intervals to provide a more frequent measure of the changes in community-level noise impacts.

The general survey and in-situ protocols will take place simultaneously and the noise monitors set up at each participant's house in the in-situ protocol can be used to describe the noise environment of a larger area or referred to as the study area in the proposal. The general survey will take place within the study area so a direct correlation between the stimulus (noise events) and response to survey questions can be made. Noise monitors at the participating military installations will typically be geographically

spread out and only measure peak noise level. These existing noise monitors cannot solely be relied upon for conducting the research outlined in our proposal. As a result, additional noise monitoring equipment will be set up in each community to conduct the research.

Complaint Survey Research Protocol

The complaint survey will only be conducted in one community – the area adjacent to the Aberdeen Proving Ground. The Complaint Survey research protocol will rely on measured noise levels from 44 noise monitors that will be set up in the area surrounding the Aberdeen Proving Ground (APG). Predictive models will be used to extrapolate and supplement noise monitor measurements to intermediate locations, which may be needed if complaints do not occur near one or more of the noise monitors. The effectiveness of the predictive models will be increased by the availability of daily atmospheric meteorological profiles at APG. The protocol for the complaint study is superior to previous studies, because each and every noise event will be measured.

The new Army noise regulation in AR 200-1 states that using complaint risk criteria to supplement annoyance correlated to average noise level is an interim procedure to be used until better guidance is available. It is inadequate because the relationship between complaint response and community annoyance is unknown. One of the objectives of this proposal is to answer this question.

Results of the Complaint Study research protocol will be crucial to illuminate the correlation between community response and complaints. It is unclear whether individual complainants are representative of the general community response to the stimulus. It is possible that unnecessary testing and training restrictions have been implemented because of the complaints of a few noise-sensitive complainants. A recent study conducted by one of the authors of this proposal (Nykaza et al, 2006) found that unnecessary and improper nighttime training restrictions were imposed at an installation. On the other hand, complaints may be a useful indicator of the general community response. The relationship between complaints and community response will be tested by surveying residents in the vicinity of recent noise complaints within a week of a complaint. A subset of the questions used in the General Community Survey will be adapted for the Complaint Survey.

The Complaint Survey will be administered by telephone. Noise complaints received by the Aberdeen Proving Ground will be logged. Once per month, a matched sample of households in the immediate vicinity or each complainant household will be identified and a telephone interview will be conducted. Data will be obtained from the complainant household, as well as the matched sample. The actual number of interviews conducted will depend upon the number of complaints received. Our analysis of historical data on noise complaints indicates that over the 11-month study period, we can expect a total of 50 noise complaints to be received at APG. A matched sample of 9-10 households in the immediate vicinity of each noise complaint will be surveyed. Based on this analysis, we anticipate that a total of 500 telephone interviews will be conducted with households in the community surrounding the APG during the 11-month time period for the Complaint Study.

The specific questions and the specific need for each question for the Qualitative Personal Interview, In-situ, General Community, and Noise Complaint Surveys are

provided below. It should be noted that the great majority of questions proposed for these information collections have been used in previous studies. In these studies, OMB approval was obtained for the survey and these individual questions.

Qualitative Personal Interviews

These questions are designed to explore respondents' perceptions of impulsive noise events, terminology they use to describe the events, and the factors that are associated with annoyance or impact.

- How do you like living in the area?
- What are the good things, if any, about living in this area?
- What are the negative things, if any, about living in this area?
- Is there anything you would change about this area?
- Do you ever hear noises in the area?
- What are the sources of the noise? Explore different noise sources.
- Ask R to describe the noise events in their own words.
- Ask R about what specific terms mean to them:
    - Annoyance
    - Loudness
    - Vibration
    - Rattle
    - Startle
    - Others

These questions will be used to refine the survey questions in the In-situ, General Community, and Complaint Surveys, by ensuring that the questions use terminology and descriptors that are meaningful to respondents. These questions will also provide data to assist in interpreting the results of the dose-response models from the other research protocols. For example, we anticipate these qualitative data will help to explain why some types of impulsive noise events are more annoying than others, even though the actual measured noise level appears to be similar.

In-situ Survey Questions

The in-situ survey will include only 7-10 questions, including the following types:

- Response (on a 10-point scale) for annoyance
- Response (on a 10-point scale) for intrusiveness
- Response (on a 10-point scale) for noise
- Response (on a 10-point scale) for vibration
- Response (on a 10-point scale) for rattle
- What activity R was engaged in when they heard the noise
- Whether the R was indoors or outdoors
- What time of day the noise event occurred

Each of the above questions will be used to measure the participants' response to each noise event they experience. These data will be time stamped for each questionnaire participants complete, providing the response measures for developing a dose-response model. The data from the noise monitoring equipment will be correlated with the appropriate response measures, using the time stamp for the response questionnaire, to

provide a series of ordered pairs of dose (measured noise) and response data for each noise event that participants' experience. A copy of the questionnaire forms for the in-situ survey are shown in Attachment 1. **[NOTE: The questions in the In-situ questionnaire have received OMB Approval for a prior study – OMB Approval No. 2700-0074]**

General Community Survey Questions

The General Community Survey contains questions regarding:

- Information about the household composition, the residence, and the individual respondent
- Open-ended evaluation of things they like and dislike about the neighborhood and general questions about all types of noise sources
- Questions about annoyance from military operations
- Attitudes and beliefs that are important mediators of noise annoyance
- Reports of the type of noise impacts experienced, such as rattle, task or sleep interference, startle, or irritation

Data from the General Community Survey will be used to develop dose-response models that estimate the percent of the population that will experience a high level of annoyance at different noise levels. This model will provide a tool for the DoD and individual military installations to manage the noise impacts from military operations and determine how to mitigate the impacts of military noise sources on residents of the surrounding communities. A copy of the General Community Survey questionnaire is shown in Attachment 2. The following is a discussion of how specific questions in the General Community Survey will be used.

<u>Topic 1: Household Composition, Characteristics of the Residence, and Characteristics of the Respondent</u>

- Questions 1-5 collect information about the composition of the household and will be used to determine if certain households are more likely to experience and express annoyance with noise sources and military blast noise in particular.

- Questions 15-20 collect information on what times of the day and days of the week the respondent is typically at home. These variables will be used to determine what specific noise events the respondent is likely to have experienced.

- Question 31 asks about the types of music and musical performers that respondents like to listen to. Perception of consonance and dissonance is reflected in musical listening preferences, and perception of dissonance has been shown to be directly related to annoyance.

- Questions 32-37 collect information on the characteristics of the residence. These variables will affect how respondents experience the impacts of noise.

[NOTE: The above questions, with the exception of Questions 30-31, have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

Topic 2: Open-ended evaluation of things they like and dislike about the neighborhood and general questions about all types of noise sources

The logic of the question flow for this topic is to tap positive and negative attitudes about the community to see if noise is mentioned, before focusing the respondent on general and more specific noise sources.

- Questions 6-8 ask about the general positive and negative aspects of the community. These variables will provide a higher-level view of their feelings about the community and determine if noise impacts are mentioned at this "top of mind" level.

- Questions 9-13 measure annoyance with non-noise impacts of different noise sources. These items come from prior land-use studies and noise complaint studies. They will be used to identify if there any aspects of noise impacts, not directly related to the noise level, that impact community residents.

- Question 14 measures the level of noise tolerance (or intolerance) of the respondent and experiences with noise impacts from a variety of sources.

[NOTE: The above questions have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

Topic 3: Questions about annoyance from military operations

For this group of questions, we ask about impacts of noise from military operations (or the installation) in general, then measure the impact of noise from explosions and heavy weapons, which is the specific focus of this study.

- Questions 21-25 ask about impacts of noise from the military installation, allowing respondents to indicate what types of noise and sources have the greatest impact.

- Questions 26-30 ask about impacts of noise from increasingly more specific military operations sources, with the final questions asking about explosions and heavy weapons blast noise.

[NOTE: The above questions, asking about the impact of sonic booms, rather than noise from blasts or explosions, have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

Topic 4: Questions that are specific to individual military installations

- Economic ties and beliefs about the importance of the noise source (Questions B1-B9 and B13-B15)

- Annoyance with noise from the military installation (Questions B10-B12c)

- Annoyance with non-noise impacts from military installations (such as rattle and vibration) which have been shown to affect annoyance (Questions B16-B18 and B20-B25)

- Question B26 measures whether the respondent has ever made a complaint to the military installation. This measure is required to evaluate the relationship between annoyance and complaints, one of the objectives of the study.

- Question B26 will contribute to the analysis of whether people who complain about noise annoyance differ in characteristics from those who live in the same area but do not register formal complaints about noise.

A copy of the questionnaire forms for the general survey are shown in Attachment 2. **[NOTE: The above questions have received OMB Approval for a prior study – OMB Approval No. 2700-0074]**

Complaint Survey Questions

The complaint survey measures a subset of the questions on the General Community Survey, as well as questions to determine whether respondents noticed the specific noise event that generated the complaint and, if so, how annoyed they were because of the noise event.

Topic 1: Household Composition, Characteristics of the Residence, and Characteristics of the Respondent

- Questions 1-3 collect information about the composition of the household and will be used to determine if households with certain demographic characteristics are more likely to experience annoyance and register complaints about noise sources and military blast noise, in particular.

- Questions 30-38 collect information on the characteristics of the residence. These variables will affect how respondents experience the impacts of noise.

[NOTE: The above questions, with the exception of Questions 30-31, have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

Topic 2: Open-ended evaluation of things they like and dislike about the neighborhood and general questions about all types of noise sources

The logic of the question flow for this topic is to tap positive and negative attitudes about the community to see if noise is mentioned, before focusing the respondent on general and more specific noise sources.

- Questions 4-6 ask about the general positive and negative aspects of the community. These variables will provide a higher-level view of their feelings about the community and determine if noise impacts are mentioned at this “top of mind” level.

- Questions 7-10 measure annoyance from a variety of different noise sources. These items come from prior land-use studies and noise complaint studies. They will be used to identify if there any aspects of noise impacts, not directly related to the military installation, that impact community residents.

[NOTE: The above questions have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

Topic 3: Questions about annoyance from military operations

For this group of questions, we ask about impacts of noise from military operations (or the installation) in general, then measure the impact of noise from explosions and heavy weapons, which is the specific focus of this study.

- Questions 11a and 11b ask about impacts of noise from the military installation, allowing respondents to indicate what types of noise and sources have the greatest impact.

- Questions 17-25 ask about the impacts of the specific noise event that triggered a complaint from someone in the neighborhood. This series of questions will only be asked of people who were home at the time and recall the noise event.

[NOTE: The above questions, asking about the impact of sonic booms, rather than noise from blasts or explosions, have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

Topic 4: Questions that are specific to individual military installations

- Questions 26-30 ask about economic ties to the military installation and beliefs about the importance of the noise source. These questions are hypothesized to affect the level of annoyance and likelihood of complaining about a specific noise event.

A copy of the questionnaire forms for the complaint survey are shown in Attachment 3.
[NOTE: The above questions have received OMB Approval for a prior study – OMB Approval No. 2700-0074]

3. Use of Information Technology

The in-situ study will utilize a PDA that will be supplied to participants to facilitate "real-time" data collection of response to noise events. The complaint study will be conducted by telephone. The telephone interview will utilize computer-assisted telephone interviewing (CATI) procedures, which enables the interviewers to be more efficient in using skip patterns and avoiding asking questions that are not applicable or redundant.

Use of electronic or technological data collection techniques will not be utilized for the personal interviews or the general community surveys. The personal interviews are qualitative in nature and involve more detailed responses and probing questions. The general community surveys will be conducted by door-to-door personal interviews because it is necessary to focus on specific geographic locations, relative to the noise monitoring equipment that will be employed at each study site.

4. Efforts to Identify Duplication

The acoustics literature and literature on military impulsive noise were studied extensively, through a literature search and through personal contacts with individuals who are active in this field.

Review of the literature reveals a major difference between research that supports the transportation assessment procedure and the high-energy impulsive noise assessment procedure. The transportation assessment procedure is built on a large number of social surveys and research studies (Schultz, 1978), while the high-energy impulsive noise assessment procedure is primarily based on five studies (CHABA, 1996).

Our review led to the following conclusions.

1. All previous studies looked for correlation between annual average noise level and a one-time measurement of community response. This cannot account for the possibility that response may change as a function of changing noise environment on a time scale shorter than the assessment period, which is recommended to be a year.
2. Predicted, rather than measured, noise levels were relied on in all of the previous blast assessment research. Further, they were made without meteorological information that would enable accurate predictions. In one study actual measurements were made, but were only measured for approximately 25 days at each of the study areas after the study was completed (Schomer, 1981). There is no assurance that the same types and amount of blast noise events occurred during those 25 days as did during the time before and during the social survey.
3. In another study actual noise measurements were made during the 6 months prior to the social survey, but were not used because the levels recorded did not show the correlation that was expected with the percent highly annoyed response metric (Schomer, 1985).
4. In all of the reviewed studies, percent highly annoyed was assumed to be the appropriate response metric. Work done for the National Park Service and the U.S. Air Force (USAF) has identified insufficiencies in traditional psychoacoustic response metrics such as “annoyance” (Baumgartner, 1999). The National Park Service has considered annoyance and interference metrics as criteria for managing the air space above national park visitor areas (Miller et al, 1999).
5. Review and consideration of blast noise and sonic boom studies suggested that the following acoustic and non-acoustic factors should be considered and evaluated during the proposed research:
    - Startle
    - Habituation
    - House vibration and rattle
    - Fear of damage from the source
    - Belief that one should complain about the source
    - Noise sensitivity
    - Belief that more can be done to reduce the noise impact
    - Interference with various activities

5. Burden on Small Business

Collection of this information does not have a significant impact on small businesses.

6. Consequences of Not Collecting the Information

This information is not scheduled to be collected by any other agency or program. If the information is not collected, the DoD will not be able to develop improved methodologies to assess and predict human response to high-energy impulsive military noise. Further, the DoD will not be able to develop methodologies to provide more reliable and practicable guidance for noise impact management decisions at military installations.

7. Special Circumstances

There are no special circumstance that require this collection to be conducted in a manner that is inconsistent with the guidelines in 5 CFR 1320.5(d)(2).

8. Consultation and Public Comments

The 60-day Federal Register notice published April 20, 2007 (72 FR 19886). No comments were received.

9. Payments to Respondents

The 30-50 individuals who volunteer to participate in the In-situ Survey will be offered an annual lump sum payment of $400 for their participation. This is a total of $12,000 - $20,000 across the 2 In-situ study sites. These payments to the In-situ participants are justified and based upon the tasks they will be asked to do over the course of the 12 months of their participation. First, noise monitoring equipment will be installed on their property outside their home. Second, they will complete the General Community Survey prior to their participation – an approximately 30-minute personal interview. Finally, participants will be given a pre-programmed PDA and asked to complete a short 6-question (2-3 minutes) questionnaire each time they experience a blast or impulsive noise event they think is from the military installation. There could be as many as 1,000 blast events during the 12-month period. Participants will be selected, in part, because they are frequently at home on weekdays and weekends. As a result, we anticipate that participants will experience a majority of the approximately 1,000 impulsive noise events that occur during the 12-month study period in their community.

No payments will be made to respondents for the Qualitative Personal Interview, General Community Survey, or the Complaint Survey. Based on our prior experience in conducting similar studies, we anticipate that sampled respondents in each of these surveys will be cooperative and willing to participate.

10. Assurance of Confidentiality

The survey will conform to the practices as approved by the Institutional Review Board at The Pennsylvania State University. In the cover letter accompanying each survey recruitment effort and interview appointment, respondents will be told that their responses are voluntary and will be kept strictly confidential. For all individual's who participate, they will be assigned a unique identification number for the forms recording the information they provide. Respondent's names or other identifying information will not be part of the data records. The staff administering the survey will maintain a master

log that associates each individual with their contact information. The master log will be kept stored in a secure and confidential location during the survey administration. Upon completion of the survey and the data processing, the master log and any other identifying information about respondents will be destroyed. The information that is provided to the sponsor and any other DoD stakeholders will not contain any information that can be used to identify respondents.

11. Sensitive Questions

There are no questions of a sensitive nature in any of the information collection protocols.

12. Respondent Burden Hours and Labor Costs

A. ANNUAL BURDEN HOURS:

Year 1 (2007): 37.5 hours
Year 2 (2008): 1,575 hours
Year 3 (2009): 700 hours
Year 4 (2010): 1,287.5 hours
Year 5 (2011): 412.5 hours
TOTAL BURDEN HOURS FOR 5 YEARS: 4,012.5hours

B. NUMBER OF RESPONDENTS:

Year 1 (2007): 75
Year 2 (2008): 1,575
Year 3 (2009): 575
Year 4 (2010): 725
Year 5 (2011): 25
TOTAL NUMBER OF RESPONDENTS FOR 5 YEARS: 2,975

C. RESPONSES PER RESPONDENT:

YEAR 1

- 1 response for 50 Qualitative Personal Interview respondents in three locations (30 minutes per interview equaling 25 hours)
- 1 response for 25 baseline interviews for the respondents participating in the In-situ study at location #1 (30 minutes per interview equaling 12.5 hours)

TOTAL RESPONSES FOR YEAR 1: 75

YEAR 2

- 16,750 (estimated) responses for 25 In-situ survey participants (670 responses per person) at location #1 (3 minutes per response equaling 837.5 hours)
- 1,225 responses for 1,050 General Community Survey (cross-sectional sample) respondents (30 minutes per survey equaling 612.5 hours)
    - 2 responses for 175 panel survey respondents at Site #1
    - 1 response for 525 cross-sectional survey respondents at Site #1
    - 1 response for 175 panel survey respondents at Site #2
    - 1 response for 175 cross-sectional survey respondents at Site #2
- 1 response for 500 complaint survey respondents (15 minutes per survey = 125 hours)

TOTAL RESPONSES FOR YEAR 2: 18,475

YEAR 3

- 8,250 (estimated) responses for 25 In-situ survey respondents (330 responses per person) at location #1 (3 minutes per response equaling 412.5 hours)
- 1 response for 25 post measurement interviews for In-situ study participants at location #1 (30 minutes per interview equaling 12.5 hours)
- 1 response for 25 baseline interviews for the respondents participating in the In-situ study at location #2 (30 minutes per interview equaling 12.5 hours)
- 1 response for 525 General Community Survey respondents at Site #2 (30 minutes per survey equaling 262.5 hours)
    - 1 response for 175 panel survey respondents
    - 1 response for 350 cross-sectional survey respondents

TOTAL RESPONSES FOR YEAR 3: 8,825

YEAR 4

- 16,750 (estimated) responses for 25 In-situ survey respondents (670 responses per person) at location #2 (3 minutes per response equaling 837.5 hours)
- 1 response for 25 post measurement interviews In-situ participants at location #2 (30 minutes per interview equaling 12.5 hours)
- 875 responses for General Community Survey at Site #3 (30 minutes per survey equaling 437.5 hours)
    - 2 responses for 175 panel survey respondents at Site #3
    - 1 response for 525 cross-sectional survey respondents at Site #3

TOTAL RESPONES FOR YEAR 4: 17,650

YEAR 5

8,250 (estimated) responses for 25 In-situ survey participants at Location #2 (330 responses per person) at location #2 (3 minutes per response equaling 412.5 hours)

TOTAL RESPONSES FOR YEAR 5: 8,250

TOTAL NUMBER OF RESPONSES FOR 5 YEARS: 53,275

D. AVERAGE BURDEN PER RESPONSE:

Qualitative Personal Interview	30 minutes
Baseline Interview	30 minutes
Post Measurement Interview	30 minutes
In-situ Survey	3 minutes
General Community Survey	30 minutes
Complaint Survey	15 minutes

E. FREQUENCY OF RESPONSES:

Qualitative Personal Interview	One time per installation
Baseline Interview	One time per installation
Post Measurement Interview	One time per installation
In-situ Survey	On occasion for 12 months
General Community Survey	
Panel Sample	Two times per installation
Cross-sectional sample	One time per installation
Complaint Survey	One time per installation

Labor Cost of Respondent Burden

To calculate the total annual labor cost of the respondent burden, we used an hourly rate of $17.16, which is the seasonally-adjusted average hourly labor rate for all private non-farm workers in the U.S. for February 2007 [United States Labor Department, Bureau of Labor Statistics, March 2007].

Using this average hourly labor rate, the annual labor cost of the respondent burden is:

Year 1	37.5 hours @ $17.16	$643.50
Year 2	1,575 hours @ $17.16	$27,027.00
Year 3	700 hours @ $17.16	$12,012.00
Year 4	1,287.5 hours @ $17.16	$22,093.50
Year 5	412.5 hours @ $17.16	$7,078.50
TOTAL LABOR COST FOR RESPONDENT BURDEN		$68,854.50

13. Estimates of Cost Burden to the Respondent for Collection of Information

No additional cost burden will be imposed on respondents aside from the labor cost of the burden hours shown above.

14. Cost to the Federal Government

Annual cost of the information collection to the Federal government ranges is shown below. Note that this cost includes salaries of U.S. Government employees, private contractors, and all expenses associated with measuring noise levels and collecting survey research data from community residents. Funding is being provided by the U.S. Army and the Department of Defense's Strategic Environmental Research and Development Program (SERDP).

Table 1. Total Project Funding

Year	SERDP Funds	US Army Funds	TOTAL Funds
1	$253,000	$31,000	$284,000
2	$518,000		$518,000
3	$374,000		$374,000
4	$435,000		$435,000
5	$303,000		$303,000
6	$105,000		$105,000
TOTAL	$1,988,000		$2,019,000

15. Changes in Burden

This is a new information collection, and thus is considered a program change. The reasons for the new information collection are discussed in Items 1 and 2.

16. Publication of Results

A comprehensive report to SERDP is planned for late 2011 or early 2012, documenting the procedures, analysis, results, and interpretation of the results and recommended guidelines for noise policies for U.S. military installations. This report will receive peer review by the SERDP Scientific Advisory Board. Annual progress reports will be prepared for the SERDP Program Office.

A planned list of publications from this study will include two target audiences -- acousticians and the managers/commanders of military installations.

For the acoustician audience, we are tentatively planning a series of articles, such as the following:

“A comparison of noise metrics: predicted vs. measured levels”
“An analysis of cross-community predictors of annoyance due to military training noise”
“Community differences in annoyance due to blast noise”
“Noise metrics and community impact: a comparison of prediction and response”
“Annoyance due to noise: prediction vs. perception”
“Comparison of five psychoacoustic models for integrating 24 hours of exposure to the noise of large guns into a prediction of subjective annoyance"

These articles will be published in professional refereed journals, such as: Noise and Health, Noise Control Engineering Journal, Canadian Acoustics, and the Journal of Low Frequency Noise Vibration and Active Control.
Journal of Sound and Vibration
Journal of Experimental Psychology
International Journal of Occupational Medicine and Environmental Health
Noise and Vibration Bulletin (National Research Council of Canada)
suggest "Comparison of Five Psychoacoustic Models for Integrating 24 hours of Exposure to the Noise of Large Guns into a Prediction of Subjective Annoyance"

For the managers/commanders of military installations, we plan to work with the National Defense University at Fort McNair, involving students and staff in preparing manuals and guidelines communicating the findings, implications, and recommendations from the study.

17. Approval Not to Display Expiration Date

Approval not to display an expiration date is not being sought.

18. Exceptions to the Certification Statement

No exceptions to the certification statement are being sought.

B. Collections of Information Employing Statistical Methods

1. Description of the Activity

The potential respondent universe is all households within an area of 64 square kilometers adjacent to each military installation. The study area is determined by the distance that can be covered by the noise monitoring equipment that will be installed at selected military installations where blast noise events are regularly experienced. A total of 3 military installations – the Aberdeen Proving Ground in Maryland plus two others – will be selected as study sites. The study team will select 25 locations to install noise monitoring equipment at each study site. Once the specific locations for the noise monitors have been determined, all residences within a specified distance from each noise monitor will be enumerated.

Three samples will be selected from these enumerated households:

- An In-situ sample of 25 households will be selected. A group of households will be randomly selected for recruitment and screening for this sample. Among the requirements for this sample are: (1) at least one adult member of the household is typically at home on weekday mornings and afternoons, (2) the person who is typically at home on weekdays does not suffer from a hearing defect, and (3) this person agrees to use a PDA (supplied by the researchers) to respond to a brief set of 5 questions whenever a noise event reaches a specified threshold.

- A General Community cross-sectional sample of 175 households will be randomly selected for a 30-minute personal interview. Representative samples of households within the enumeration area will be selected by a trained staff of door-to-door interviewers following specific instructions for sampling households. The cross-sectional samples will be selected at 3 points in time over an 11-month time period for each of the three communities that surround a participating military installation.

- A General Community panel sample of 175 households will be selected in the same manner as the cross-sectional sample at the time of the first survey administration in each community. Each household in the panel sample will be recontacted a second time, approximately 8 months after the first survey administration.

- At the Aberdeen Proving Ground installation, an additional sample of households will be selected for the Complaint Survey sample. Formal complaints filed at the Aberdeen Proving Ground will be monitored and on a monthly basis, a list of individual complainants will be compiled. For each complainant, a matched set of 10 households in the immediate vicinity of each complainant will be selected. A telephone survey will be conducted with the complainant and the matched sample of adjacent households. Over a 12-month study period at the Aberdeen Proving Ground, we anticipate compiling a list of 50 complaints. For each complaint, there will be a sample of 10 adjacent households that are selected for matched sample.

2. Procedures for the Collection of Information

a. Statistical methodologies for stratification and sample selection.

A random sample of households will be selected for recruitment for the In-situ sample, as well as for administration of the General Community survey – both the cross-sectional sample and for the panel sample. For each sample, a complete enumeration of households will be conducted within a predetermined distance from installed noise monitors in the community. For each community, no stratification procedures will be used. A systematic random sample will be selected by determining a random starting point on the enumerated list of households and using a sampling interval, based on the ratio of required respondents to the total number of available households.

b. Estimation Procedures

Survey data will be combined with acoustical measurement data to estimate dose-response models that estimate the level of response for a specific noise event. The primary estimation procedure for measuring community reaction to noise events is in terms of "annoyance" (the response metric) correlated to long-term-average noise (the stimulus metric). The annoyance/long-term average noise assessment method is based on assessment procedures that were established for transportation. Impact from transportation noise sources, such as aircraft and road traffic is assessed by virtually all analysts, including those working for the military, in terms of annoyance as predicted by long-term average noise. Schultz (1978) published a dose-response relationship for transportation noises based on data obtained by many researchers. This approach has been adopted internationally for virtually all types of noise, including high-energy impulsive noise, as described in ANSI 12.9Pt.4 and ISO 1996.

The response metric for this assessment method is the percentage of the population that is "highly annoyed," measured via a sample survey. The stimulus metric for this assessment method averages the sound exposure (SE), defined as the time integral of pressure squared, over the assessment period, which is typically one year. The method, applied to blast noise (CHABA, 1981) and later modified (CHABA, 1996), became the official Army policy as described in Chapter 7 of Army Regulation 200-1 version dated 1997. An average noise level of 62 dB C-weighted Day-Night Level (CDNL), which the model estimated would result in 13% of the population highly annoyed, was deemed acceptable for all land uses including schools, hospitals, and residences.

However, it is our contention that long-term-average noise level does not adequately guide land use. As an example, 100 events of 142 dB peak pressure level yield an annualized CDNL of 62 dB, which is supposedly suitable for all land uses. However, a peak level of 142 dB is so loud that it would almost certainly cause a strenuous negative public reaction. Average noise levels provide no indication of the loudness of individual events to which citizens are exposed.

Impact assessment results depend strongly on the selection of the time period over which the noise is averaged. The method ignores any effect of the timing of noise events; there is no difference between 10,000 noise events spread over a year or all occurring in 1 day. An underlying assumption behind this method is the "equal energy hypothesis," which states that the noise is accounted for by averaging the total SE over the assessment period, regardless of the magnitude of any individual noise event. This means, for example, that the effect of 1000 events of a given sound exposure level (SEL) is taken to be the same as that of 1 event containing 1000 times as much sound exposure (30 dB greater SEL).

For this study, we will advance the use of dose-response cause-and-effect functional relationships to estimate the impacts of military blast noise on residential communities. Our acoustic monitoring equipment will obtain data from which a range of stimulus metrics, including those that measure discrete noise events, can be developed. Our survey data will provide a range of response metrics, including the traditional long-term annoyance measure, as well as other response measures that are better able to capture the dynamic aspect of response to changing acoustic environment and to individual noise events.

Our predictor variables are based on measurements that are both quantitative (stimulus metrics) and qualitative (most response metrics). Factor analyses, e.g. principle component analysis (PCA), will be utilized to reduce the number of variables and identify relationships between variables. When the predictor variables to be compared are all quantitative, a multiple regression analysis may be conducted. If the predictors are all qualitative, an analysis of variance will be performed. If some predictors are quantitative and some qualitative, an analysis of covariance will be used. The multiple regression analysis may be used to assess relationships between data sets and the analysis of variance, or covariance may be used to assess the differences between the data set. For ordinal subjective data, a nonparametric test, such as the Spearman Rank Correlation Coefficient will be used to analyze relationships between stimulus and response metrics.

It is our intent to consider a wide range of acoustic factors that could elicit a subjective response and annoyance. The best metrics will then be run on a larger dataset and correlated with annoyance ratings. This effort does acknowledge and build on the research conducted during the 1970's (Shultz, 1978; CHABA 1996). That research was extensive and impressive, and is of great value to our efforts.

The acceptability criteria or threshold limit values identified from collectively examining results from each protocol will provide reliable and practicable guidance for noise impact management decisions, which will ultimately provide a means to sustain operational capability. The dose-response relations and acceptability criteria will be used to guide near-real-time and long-term noise management decisions by military commanders and range managers. That is, short-term risk assessments can be made to guide decisions to balance program delays against negative community response and long term planning decisions can be guided by statistical expectations of

variance in propagation conditions and thus of risk of adverse community reaction. Findings from this research can be applied with existing DoD tools such as Range Managers Toolkit (RMTK) and BNOISE2.

A second methodology to estimate the impact of noise events on community residents uses noise complaints risk (the response metric) correlated to single-event peak pressure (the stimulus metric). This second type of impulsive noise assessment method predicts complaint risk as a function of event noise level. At installations, noise impact is often managed, based on complaints. Complaints received from a variety of citizens and locations (as opposed to a small number of chronic complainers) are taken as an indication of a problem that can be expected to escalate into more aggressive attempts to curtail the noisy activity. A dose-response relationship was developed by the Navy (Pater, 1976) to guide decisions balancing risk of noise complaints against the cost of canceling training or testing activity. Similar noise complaint risk guidelines have been developed by Aberdeen Proving Ground, MD (USACHPPM, 1994), the United Kingdom (Geoff Kerry, pers. comm.), Germany (Karl Hirsch, pers. comm.), and for sonic booms (Micah Downing, pers. comm.).

An event level metric can be directly measured, is easy to explain to decision makers and the public, and facilitates guidelines for avoiding complaints. Impact assessment computational labor is reduced compared to average noise methods, and the results are less dependent on having accurate data regarding the number and timing of noise events. However, while it seems plausible that complaints might somehow be related to public attitude toward the noise, it has not been proven that noise complaints are an accurate measure of community response. At its present stage of development, the method provides no information regarding the effect of factors such as the number of noise events in a given time period, the elapsed time since the last bout of noisy events, or population demographics.

c. Degree of accuracy needed for the Purpose discussed in the justification

For each of the three General Community surveys, a total of 525 cross-sectional surveys will be obtained, as well as 350 panel sample survey responses. Our analysis plan will first examine individual community level responses, then combine the dose-response data across communities. This latter dataset should include 1,575 survey cross-sectional survey responses and 1,050 panel sample responses. Both of these datasets exceed the sample sizes that are reported in the professional journals for the development of dose-response models of noise impacts.

d. Unusual problems requiring specialized sampling procedures.

There are no unusual problems requiring specialized sampling procedures for this information collection.

e. Use of periodic or cyclical data collection to reduce respondent burden. All of information collection from individuals uses a periodic data collection cycle to minimize the total time burden on participating individuals.

3. Maximization of Response Rates, Non-response, and Reliability

A number of steps will be taken to maximize response rates and mitigate the potential for non-response bias in the information collection. These steps are described below.

- *Develop well-designed and "respondent-friendly" questionnaires.* The first step in achieving a high response rate is to develop questionnaires that take the respondent's point of view into account for designing questions, formats and layout, and interviewer and administration procedures. The current survey is based on recommendations from the Community Response to Noise Team (Team 6) of the International Commission on the Biological Effects of Noise (ICBEN) for socio-acoustic surveys. The questionnaires will also follow the commonly-accepted standards for the design sample surveys developed by Dillman (Dillman, Don A. Mail and Telephone Surveys: The Total Design Method. John Wiley & Sons, Inc., New York, 1978)

- *Use well-designed contact and implementation procedures.* The General Community Surveys will be conducted by professionally-trained interviewers. Each interviewer will be trained and certified in how to approach a residence, how to identify themselves and research sponsor, and how to introduce the survey and ask respondents who agree to participate for a convenient time to conduct the interview. For households where no one is home, a minimum of 3 "callbacks" will be attempted before replacing that sampled residence with a randomly selected alternate.

  For the Complaint Survey, to be administered by telephone, the interviewers will use a computer-assisted telephone interviewing (CATI) system. The CATI software records the time that call attempts were made to each sample record and automatically schedules callback attempts at different times of the day and different days of the week.

For the General Community Survey, to be administered by door-to-door personal interviewers, we anticipate the response rate will be 65 percent or higher. For the Complaint Survey, to be administered by telephone, we anticipate the response rate to be 55 percent or higher.

4. Tests of Procedures or Methods

No tests of procedures or methods will be undertaken for this information collection. The procedures and implementation methods for the information collection will follow the generally accepted social science research standards.

5. Statistical Consultation and Information Analysis

Standards and guidelines published by organizations, such as the Community Response to Noise Team (Team 6) of the International Commission on the Biological Effects of Noise (ICBEN) and the Ecological Noise Research Work Group 2000 have been consulted to develop for statistical analysis of noise impacts on individuals and communities.

In addition, our team contains several individuals with well-recognized expertise in noise analysis and/or in the statistical analysis of dose-response data on noise impacts. The team includes:

- Dr. Larry Pater, Program/Project manager, Noise research and development
- Dr. George Luz, Psychology
- Dr. Robert Baumgartner, PA Government Services, Sociological Research Methods and Statistics, analysis of response data
- Ms. Kathleen Hodgdon, Psychoacoustician, Acoustician, Applied Research Lab, Pennsylvania State University, analysis of response data
- Dr. Tom Gabrielson, Acoustician, Applied Research Lab, Pennsylvania State University.
- Mr. Edward Nykaza, Acoustician, ERDC/CERL.

Information collection for all surveys will be conducted under the direction of PA Government Services, Inc., led by Dr. Robert Baumgartner and Ms. Pamela Rathbun.